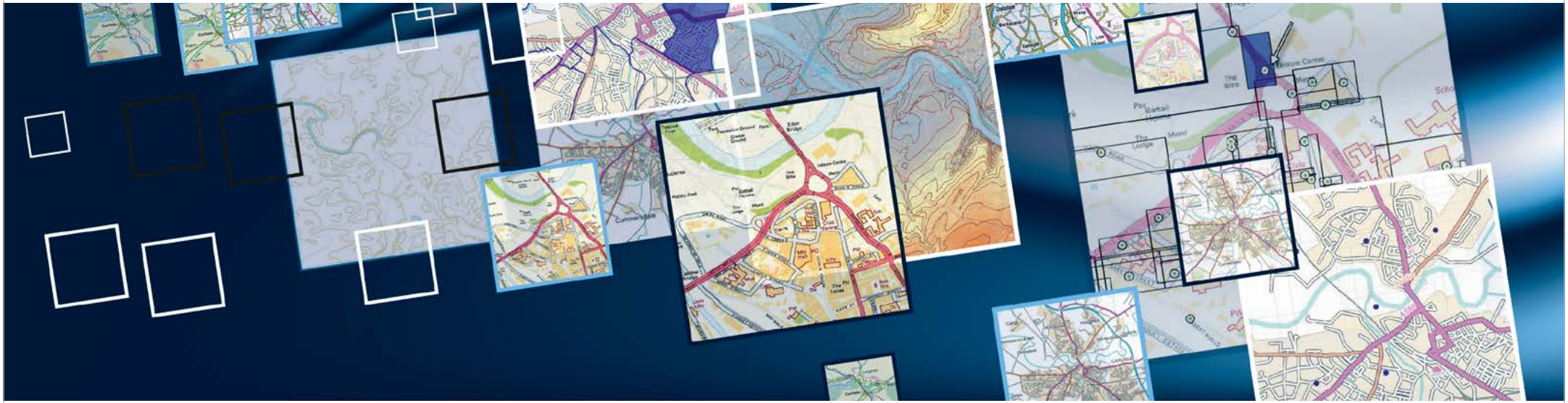
Ordnance Survey®

OS **OpenData** Masterclass



OS **OpenData**™ Masterclass

Introduction

This course is aimed at anyone with no previous knowledge of geographical information systems (GIS). It is intended as an introduction to OS OpenData™ products, and how to use them in an open-source GIS.

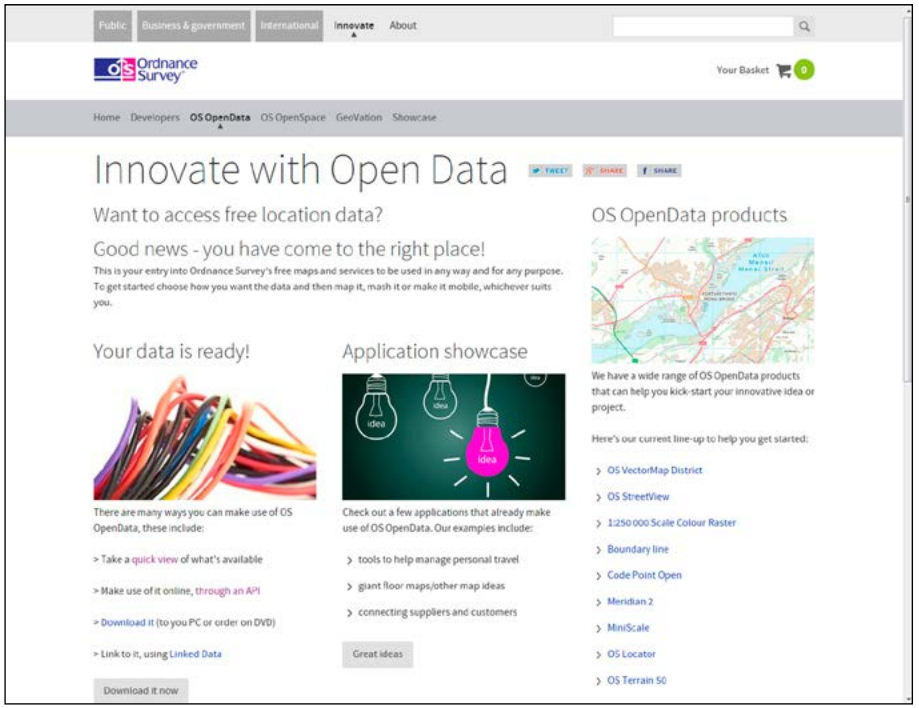
A GIS is a computer system capable of capturing, storing, checking, integrating, manipulating, analysing and displaying geographic information (GI). They can be small desktop software packages running on a single machine or very large network-based systems comprising many software components across a whole organisation.

Throughout the following four exercises, you will use Quantum GIS (QGIS). This is one of many open-source GIS products, which can be downloaded free of charge.

Exercise 1 Downloading OS OpenData

In this exercise, we will run through the process of downloading the OS OpenData products.

1 Firstly, you will need to download the OpenData products from Ordnance Survey's website. Visit **http://www.ordnancesurvey.co.uk/innovate/innovate-with-open-data.html** or follow the pathway **http://www.ordnancesurvey.co.uk** →Innovate → OS OpenData



Please note: *Ordnance Survey OpenData consists of 11 continuously maintained products, providing information from postcodes and boundaries to digital backdrop maps. The 12th product, Land-Form PANORAMA, is a legacy product and is not updated.*

2 This will open a web page where all the OpenData products are available, as either a DVD delivery or download, or both.

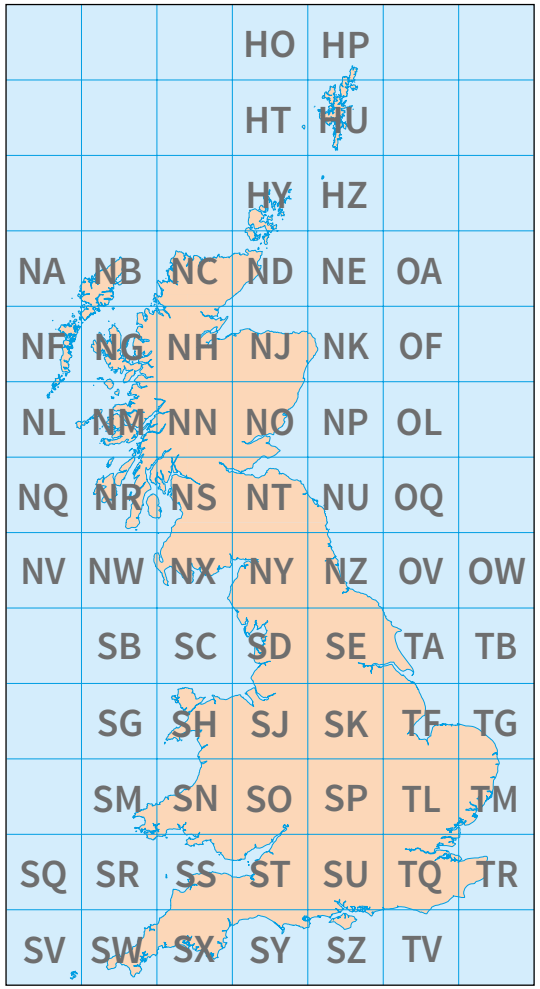
While most of the 12 products available are downloadable at Great Britain coverage, three products (**OS VectorMap District® Raster and Vector** and **OS Street View®**) must be downloaded according to their 2-letter grid reference. To choose which grid references you will need to download, there are a number of useful resources available:

3 Open a new tab in your web browser and visit the Ordnance Survey '**OS getamap™**' web page: **http://www.getamap.ordnancesurveyleisure.co.uk/** . The Get-a-Map service provides Ordnance Survey Leisure maps online, with numerous interactive options such as creating and sharing cycling and walking routes, loading to a GPS device, access to the *Good Pub Guide*, *Country Walking* and *Trail Magazine* information. The home page can also be used to work out the grid reference of a particular place.

4 Our study area will be the Isle of Wight. Search for '**Cowes**' in the search bar on the left-hand side of the screen. The six-figure grid reference for the centre of the screen will then be shown (see below). The first two letters are **SZ**, therefore this is the 100 km grid-square we will need to download to view Cowes within the GIS.

5 This is put into context when you see the national grid in its entirety (see right). This is also available as the **national_grid.bmp** image within the folders OSOS_QGIS_2013 →ALL_DATA. This is an image of the national grid referencing system, which is used for all Ordnance Survey maps. For the following four exercises, we will be looking at the **SZ** 100 km square only.

Further information can be accessed here:
http://www.ordnancesurvey.co.uk/resources/maps-and-geographic-resources/the-national-grid.html



The GIS data are available in different formats depending on the information they contain. When we open the products in QGIS, this will become important. OS OpenData products are supplied in three main formats:

- Raster – a pixelated image; as you zoom in the pixels will become bigger, creating a blurry image. It is difficult to change the styling of raster products.
- Vector – a series of points, lines and polygons. Points are single dots, lines connect these points, and polygons are shapes. Upon zooming in, the map retains its clarity. It is much easier to change the styling of vector format maps.
- Point – point data is a table of information that can be added to a map using a geographical reference.

For example, OS Terrain 50® is a grid and vector product, supplied in ESRI® Shape (contours), GML (contours) and ASCII Grid and GML (grid) formats, available at a Great Britain coverage as a download only (see below):

The OS OpenData products we will be using in this exercise are:

- **OS VectorMap District® vector** – a mid-scale district map in vector format .
- **OS VectorMap District raster** – a mid-scale district map in raster format.
- **OS Terrain 50®** – this is a height/topography product which displays 10 m contours in vector format.

6 Select the 'download' option for these three products, ensuring you have selected the correct National Grid reference square for **OS VectorMap District®** (SZ), and select 'next'. Fill in your personal details and select 'Continue'. Enter an email address which you will have access to during the workshop. Once the request has been submitted, it will take a few minutes to two hours for the links to arrive in your inbox.

7 When you receive the email, the files are in a 'zipped' format, which greatly reduces the file size, and allows it to be sent via email. Right-click on the download link and save the file to a location of your choice. Once downloaded, you will need to unzip the files to read them in their useable formats. Once all contents have been unzipped, the original zipped file can be deleted.

Please note: *These products have been pre-downloaded to use in the following workshops and are accessible within the folder: OSOS_GQIS_2013 → ALL_DATA. Please use this data for this workshop.*

Exercise 2 Opening the OS OpenData products in QGIS

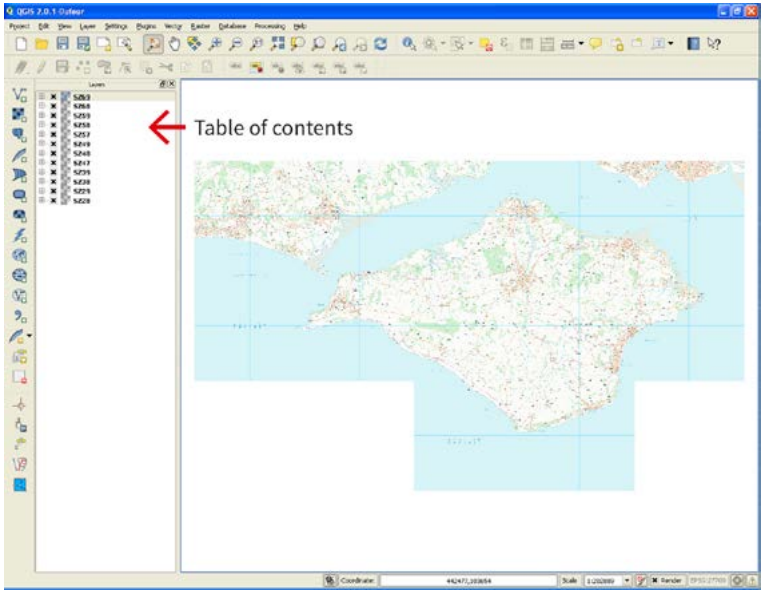
Throughout this exercise, we will run through how to open the OS OpenData products in QGIS (the open-source GIS). The products we will be using consist of a background map for context (**OS VectorMap District: raster format**), a map we can manipulate and style to see basic infrastructure (**OS VectorMap District: vector format**), and a product that shows topography (**OS Terrain 50**). This exercise will therefore guide you through opening both raster and vector files within QGIS.

1 Open QGIS 2.0.1 from Start → Programs → QQIS Dufour → QGIS Desktop 2.0.1.

2 Firstly, we will open **OS VectorMap District: raster format**. Select 'Add Raster Layer' in the left-hand toolbar (see right).

3 Click 'Browse' and navigate to OSOD_QGIS_2013 →ALL_DATA → VectorMap_District_Raster → data. Select all the .tif files. Click 'Open'.

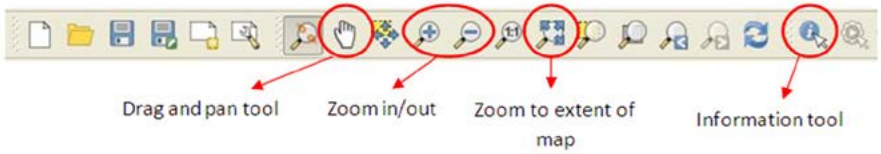
4 A map, similar to the one below, will appear:



Please note: I*n future, when opening a large number of individual raster files, it may be more efficient to input them into QGIS using the 'Build Virtual Raster' option (click on the 'Raster' tab, then 'Miscellaneous', then 'Build Virtual Raster (Catalog)'). Here, you are able to input numerous raster files, and output one .vrt file, enabling all raster files to be opened in QGIS as a single file.*

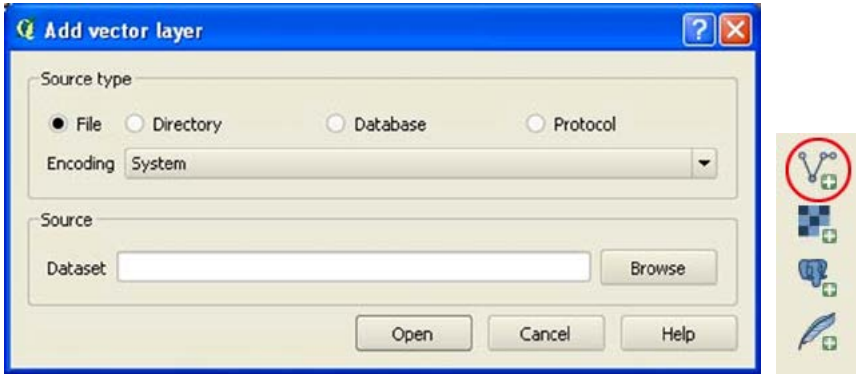
Please note: *the table of contents on the left-hand side of the screen is where the 'layers' are displayed. Here, each 10km raster square is displayed as a separate layer.*

5 Use the toolbar to zoom in/out and drag the map.



6 Now is a good time to save the workspace. Select 'Project'→ 'Save As' → "OSOpenData_QGIS_Workshop" (or similar), click 'Save'. Remember to save your work regularly.

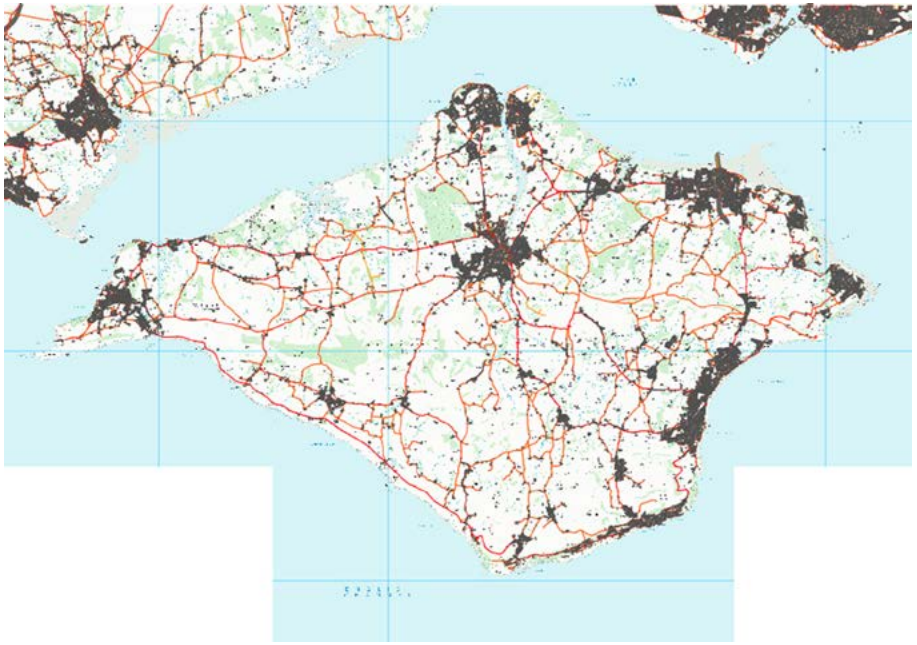
7 Now we will open **OS VectorMap District: vector format**. Select 'Add Vector Layer' in the left-hand toolbar (see below).



8 Click 'Browse' and select OSOD_QGIS_2013 →ALL_DATA → VectorMap_District_Vector→ data. Change the File type to 'ESRI Shapefiles (.shp)', now select and open the following three files:

i. SZ_Building.shp
ii. SZ_RailwayTrack.shp
iii. SZ_Road.shp

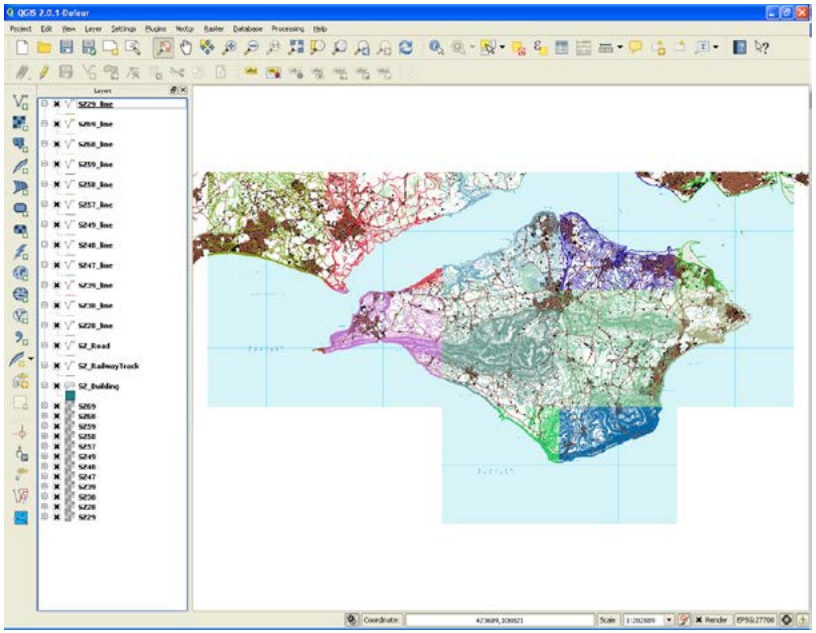
We are only looking at the basic transport network and buildings in order to get a general depiction of the land use and infrastructure; therefore we have only selected these three features to display. Click 'Open'. This will bring up a map image similar to the one below, where the vector layers are overlaid on the raster layers:



9 Finally, we will open **OS Terrain 50®**, which is also a vector product. Click on 'Add Vector Layer' (see below right); click 'Browse', and select OSOD_QGIS_2013 → ALL_DATA → Terrain_50 → line. Change the file type to 'ESRI Shapefiles (.shp)', select all and click 'Open'.

Please note: *In future, when opening a large number of individual vector files, it may be more efficient to input them into QGIS using the 'Merge shapefiles to one' option (click on the 'Vector' tab, then 'Data Management tools', then 'Merge shapefiles to one'). Here, you can input numerous polygons, lines or points, and output one, new, shapefile. This makes it easier to edit the layers as one.*

You will see a screen similar to the one below:

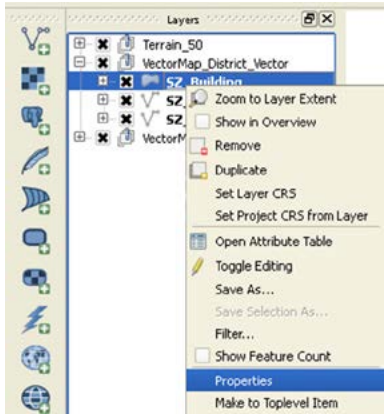


10 To organise the table of contents and group each collection of layers, select all the raster layers (click on the top layer, press shift, and click on the last layer), right click and select 'Group Selected'. Rename the group '**VectorMap_District_Raster**'. Do the same for the '**VectorMap_District_Vector**' and '**Terrain_50**' layers.

Please note: *The position of the layers in the table of contents determines their visibility on the map. For example, the top layer will be visible until it is dragged to sit beneath the layer below. You can experiment with this by changing the order of the layers in the table of contents (drag and drop). Layers can also be turned on and off (visible and invisible) by ticking and unticking the boxes beside them.*

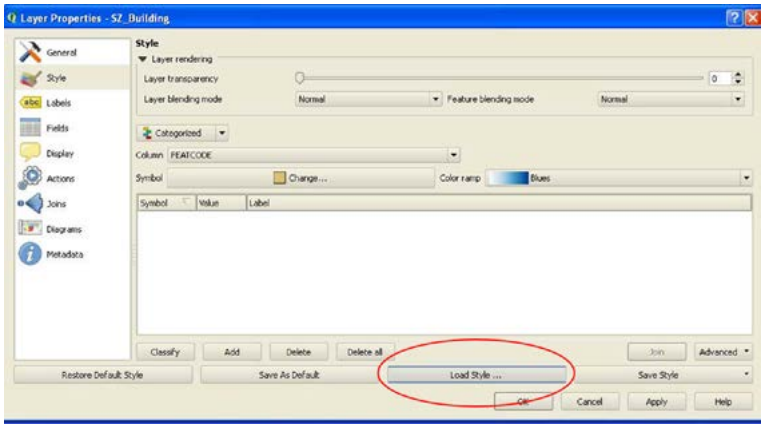
11 QGIS randomly assigns a colour to each new layer feature when it is opened. To change the style of these features, you can create your own style, or use pre-designed 'Styled Layer Descriptor' (SLD) files, which are available to download free of charge from the Ordnance Survey website:
http://www.ordnancesurvey.co.uk/business-and-government/help-and-support/products/styled-layer-descriptors.html
Some custom-made styles for use within this workshop are available within the folder OSOD_QGIS_2013 → ALL_DATA.

12 In QGIS, right-click on '**SZ_Buildings**' within the 'VectorMap_District_Vector' group and select 'Properties'.

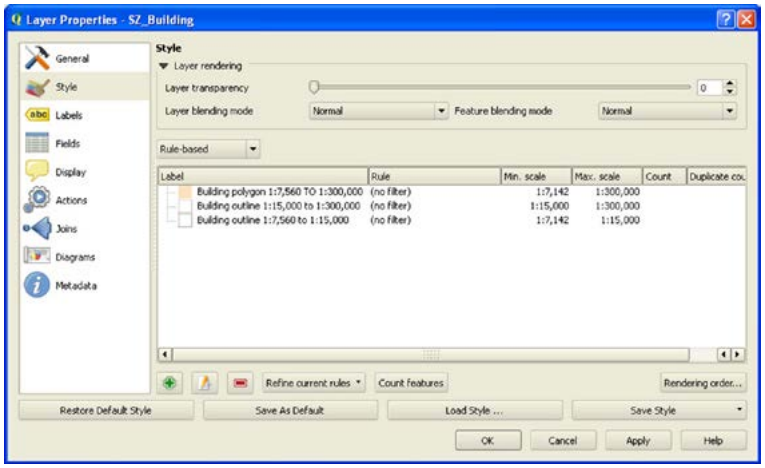


13 Ensure the 'Style' tab on the left is active, and change the 'Single Symbol' selection to 'Categorised'.

14 Select 'Load style'; change the file type to SLD file (.sld), and open OSOD_QGIS_2013 → ALL_DATA. Highlight the **Building_Fullcolour.sld** file and open.



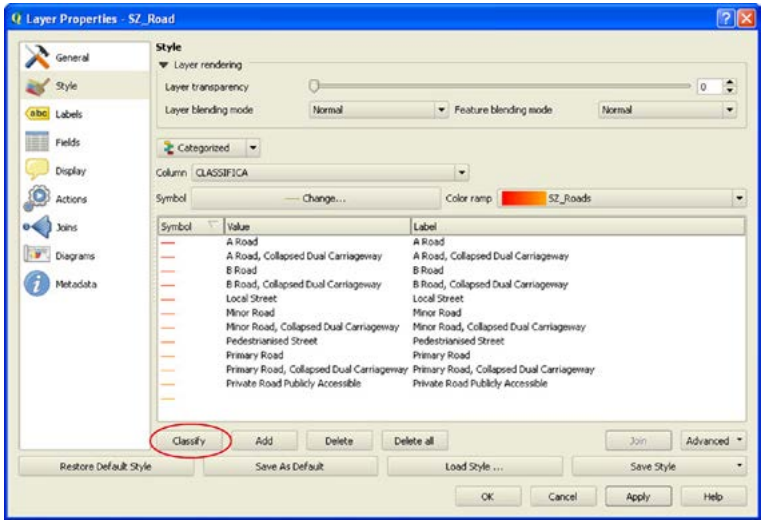
15 You will notice that the building polygon and outline labels have a minimum and maximum scale applied to each label. Double-click on the maximum scale of each of the three labels and change to match the selections below, also change the 'label' to match. Now when we zoom out to the extent of the Isle of Wight, the building polygons and outlines will be visible. Click OK.



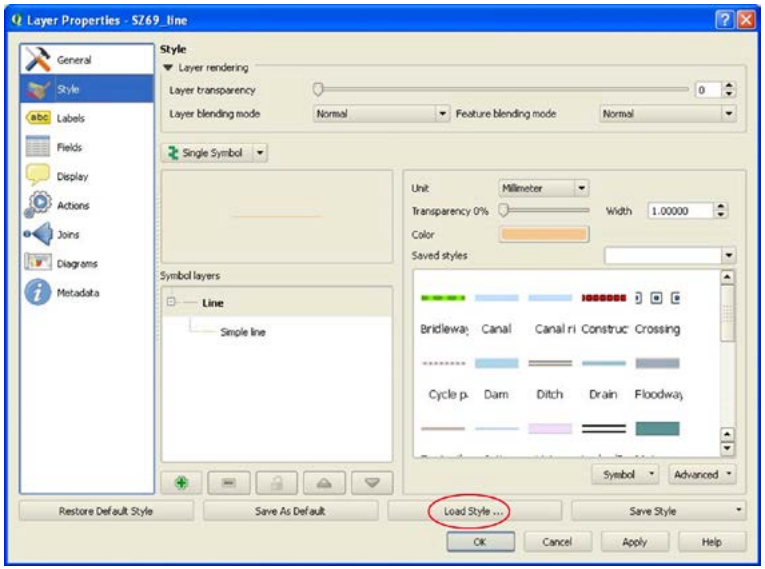
16 For both the **SZ_Road** and the **SZ_RailwayTrack** layers, repeat steps 12 and 13. You will have selected 'Categorised' in the 'Layer Properties' screen; now select the column as 'CLASSIFICA'. Nothing will appear immediately. You now need to select the overall 'Colour Ramp' of the roads/railway tracks.

17 Either click on the 'Colour Ramp' tab and select a colour gradient of your choice and click 'Classify' (see below), or select 'load style'. Change the file type to 'SLD File' (.sld), select '**VMD_SZ_Road_Style.sld**' (see below) and '**Railway Track_ FullColour.sld**' for the appropriate feature, and click 'Open'. Once happy with your selections, click 'OK'.

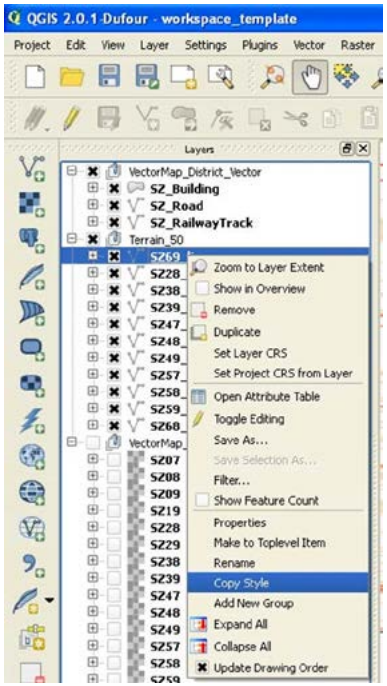
Please note: *You must first 'delete' any selections within the layer properties screen before editing and re-classifying.*



18 Now, in the table of contents, select the top **OS Terrain 50** layer within the **Terrain_50** group (for example, SZ29_line), right-click and select 'Properties' and then click on the 'Load Style' button. Change the 'file type' to SLD file (.sld), and navigate to OSOD_QGIS_2013 → ALL_DATA and select **Terrain_50_style.sld**. Click 'OK'. This will have changed the colour of the contours of one 10 by 10 km grid.

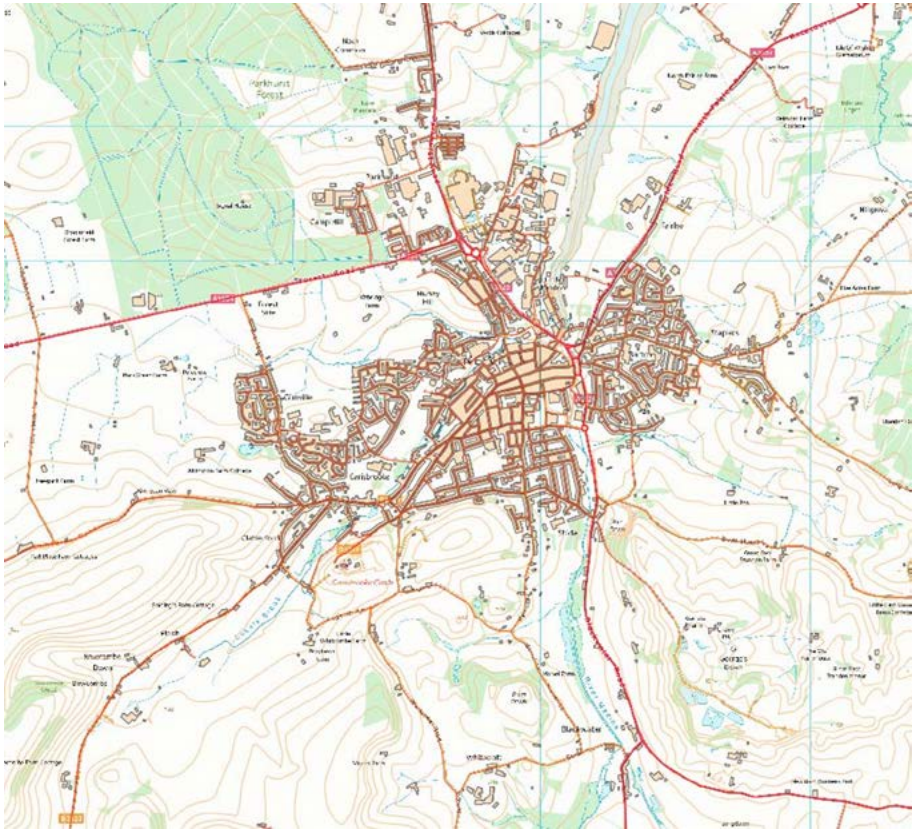


19 Right-click on the newly styled top layer, select 'Copy Style' (see right). Now right-click on each of the remaining Terrain_50 layers and 'Paste Style'. Continue with this method until all contours are a consistent style. You should now be viewing a screen similar to the one below:



Here **OS VectorMap District raster** is providing the colourful backdrop, **OS VectorMap District vector** is the styled layer showing the clusters of buildings, roads and railway networks and the distance between **OS Terrain 50** contours give an indication of land height.

Upon zooming in, individual houses and road network features become more clear:



Now progress to the next exercise (exercise 3) to input the additional data.

Exercise 3 Opening the ONS data in QGIS

We have opened and styled the OS OpenData products within QGIS. Now, we will open additional datasets within QGIS, and assign them a geographical reference to attach the data to the map. Many OS OpenData datasets can be found at: **data.gov.uk**, including data from ONS (Office for National Statistics). A page on Ordnance Survey's website outlines many other open data sources: **http://www.ordnancesurvey.co.uk/innovate/geovation/data-sources.html**

We will be looking at three open source datasets:
- Distance to GP surgeries (in kilometres)
- Percentage ageing population (% over 60s)
- GP surgery locations (exercise 4 only)

This information can be downloaded free of charge directly from ONS. For these exercises, it is available within the 'ONS_Access_data' folder.

The first task is to assign this data a geographic location, so we can display it on the map. Firstly, we will look at the 'Distance to GP' data. As this data is in .csv (comma separate values) format, this exercise will guide you through opening delimited text data in QGIS.

**Remember to save your work regularly.*

1 This exercise will follow on from Exercise 2. Keep the QGIS workspace from Exercise 2 open.

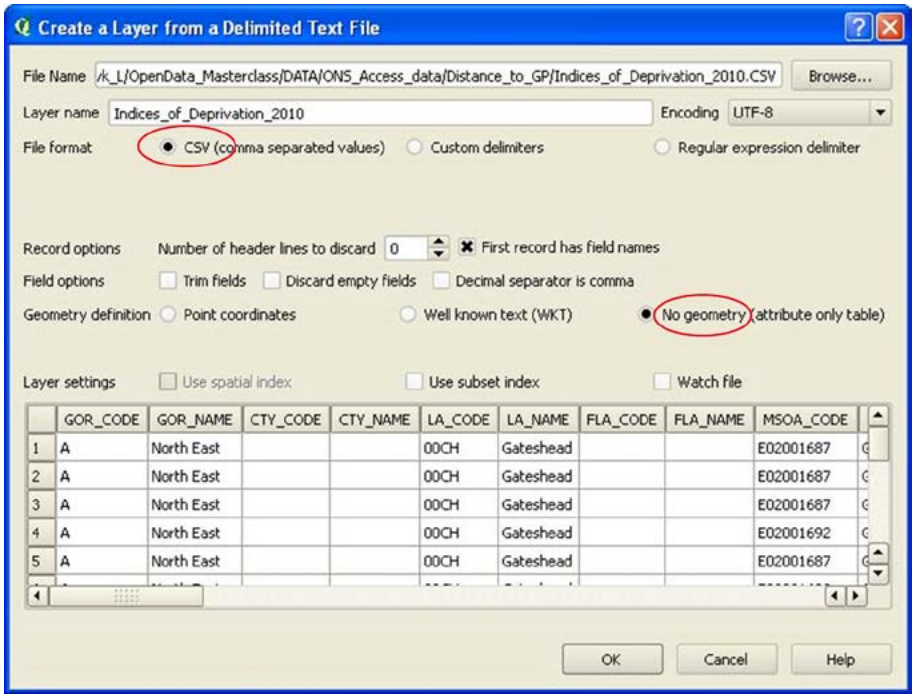
2 Open up the **Indices_of_Deprivation_2010.csv** file in excel, OpenOffice Calc, or similar (OSOD_QGIS_2013 → ALL_DATA → ONS_Access_Data → Distance_to_GP → Indices_of_Deprivation_2010.csv). Browse to familiarise yourself with the data. Here we are mainly interested in the 'LSOA_CODE' column, and the 'DIST_TO_GP' column.

Please note: *The LSOA code refers to the 'Lower Layer Super Output Area', which is a measure of small area statistics used by ONS. LSOAs are used where ward boundaries are too large to store useful population data (see diagram below).*

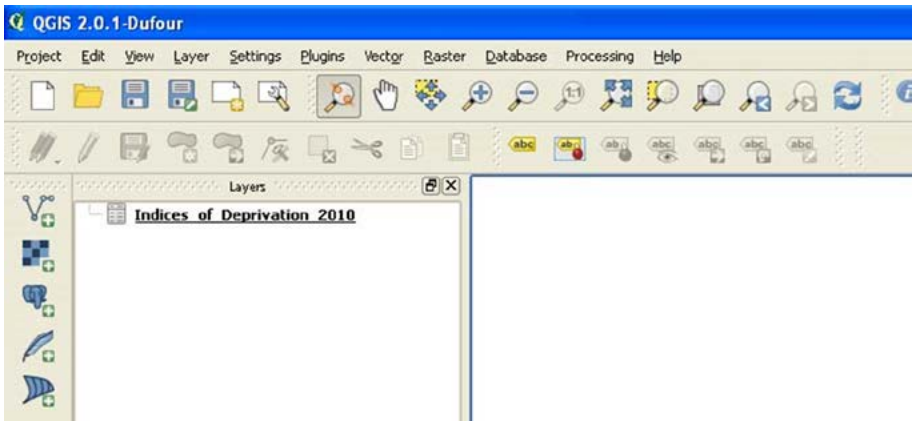
Taken from: **http://www.neighbourhood.statistics.gov.uk/HTMLDocs/images/GeographyPolicy_tcm97-51009.pdf**

3 The **Indices_of_Deprivation_2010** data is stored as a .csv file ('comma separated values'). To input this into QGIS, click on the 'Add Delimited Text Layer' button (see right).

4 Click on 'Browse' and select the **Indices_of_Deprivation_2010.csv** file to open. Ensure the CSV button is selected, as well as the 'No geometry (attribute only table)' button, as this dataset does not have point coordinates within it. Click 'OK'.

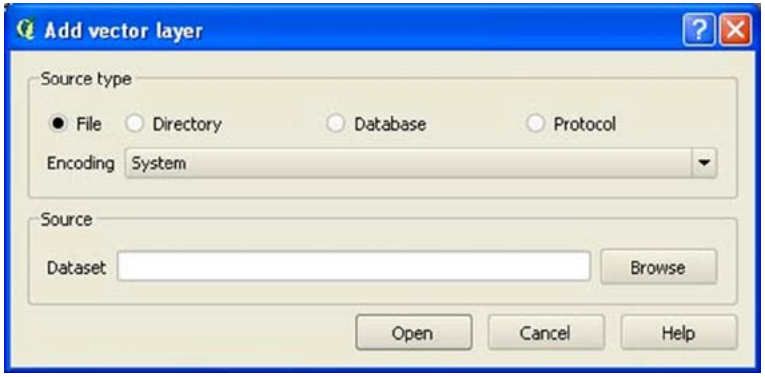


This will insert an attribute-only layer into the layer column in QGIS (see below).



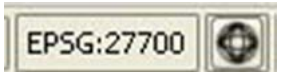
5 Right-click on the '**Indices_of_Deprivation_2010**' layer and select 'Open Attribute Table'. Browse for reference. You will see that the table of data is the same as in excel. Close the table.

6 Now, you must assign this dataset a geographical location. To do this, we will use a publicly available super output area dataset in vector format. Select the 'Add Vector Layer' button (see right and below).



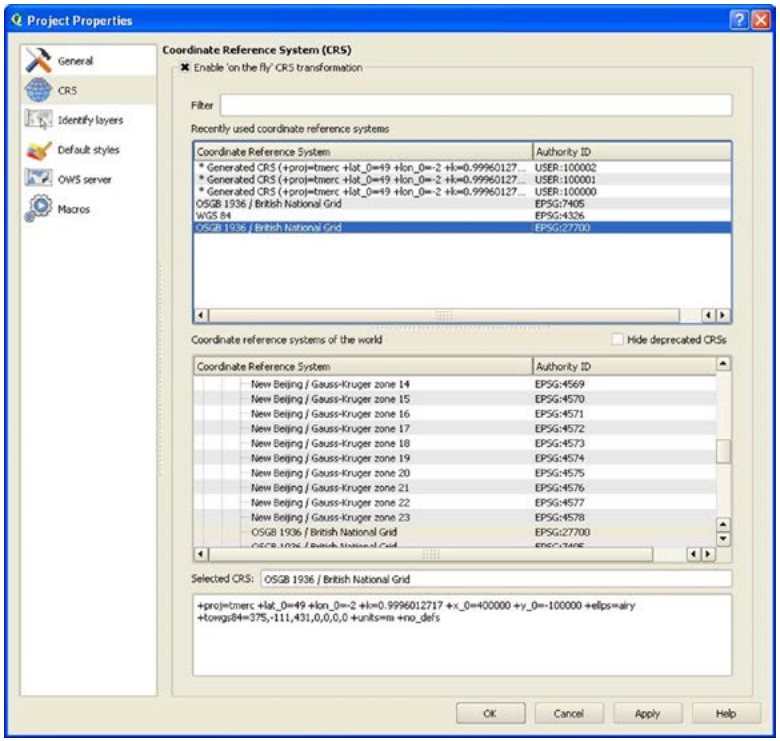
7 Click on 'Browse' and select the LSOA_regions_Feb04.shp file from within OSOD_QGIS_2013→ ALL_DATA → ONS_Access_Data → Clipped_LSOAs and Open.

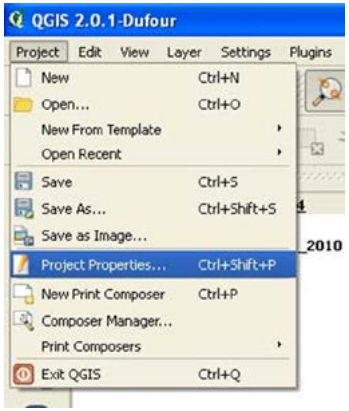
8 This will bring up the LSOA regions for Great Britain. We now need to make sure the Coordinate Reference System is correct; otherwise the map will be distorted. In the bottom right hand corner of your QGIS screen, it states the coordinate reference system that is currently being applied. It should read:



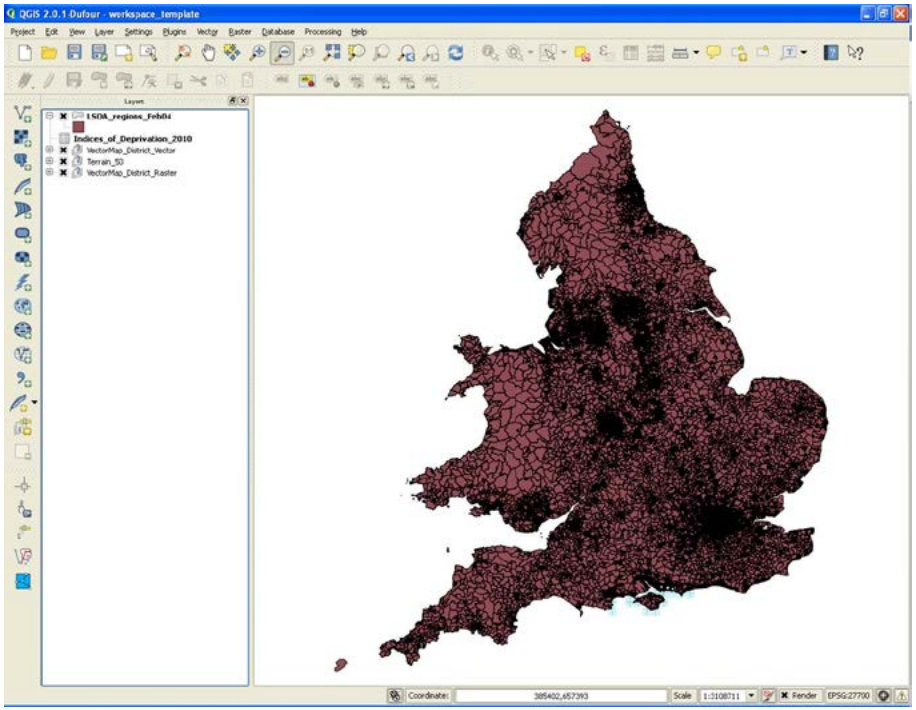
9 If this is correct, proceed to number 10. If not, select 'Project', then 'Project Properties'. Select 'CRS' from the left-hand column, then 'OSGB 1936 / British National Grid ESPG:27700', as below (If this is not within the 'Recently used coordinate reference systems', select from 'Coordinate reference systems of the world' → 'Projected coordinate systems' → 'Transverse Mercator', or use the 'Filter' at the top of the dialog box).

Click 'OK'.

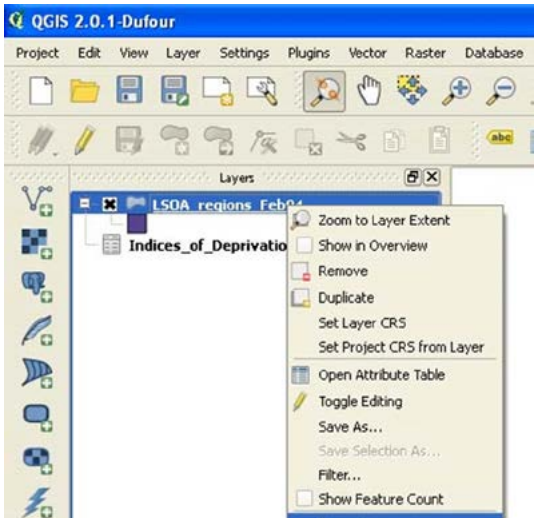




You should now see a screen similar to the one below:



10 You now need to join the **Indices_of_Deprivation_2010** dataset to the **LSOA_regions_Feb04**, in order to plot the **Indices_of_Deprivation_2010** data on the map. To do this, we join the tables together. Right-click on the **LSOA_regions_Feb04** layer title, and select 'Properties'.



11 From the 'Layer Properties' screen that opens, select the 'Joins' tab in the left-hand column, select the 'Add Vector Join' button. Fill in the 'Add Vector Join' screen that appears as below, selecting the following values from the drop-down lists:

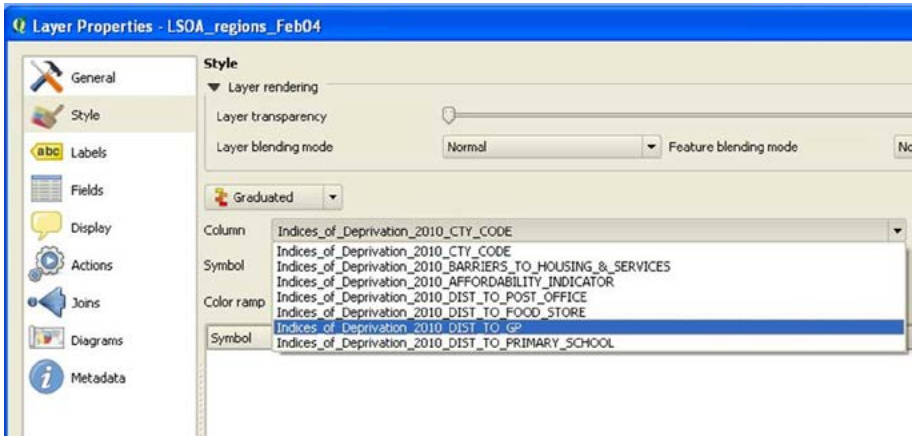
12 Here, you are creating a geographical relationship between the **LSOA_CODEs** within the **Indices_of_Deprivation_2010** dataset and the **LSOA_CODEs** within the **LSOA_regions-Feb04 dataset**. Click 'OK'.

13 Now you are able to exit the window, although the map will not have changed. This is because the map is styled to only show a single colour (and therefore is not showing any attribute data). Our aim now is to create a thematic map of LSOAs according to the distance to a GP surgery.

Thematic Maps: *GI systems have many ways by which to analyse imported information. One of the most powerful is the ability to create thematic maps. Thematic maps often appear in atlases and geography text books in which the different properties of the objects are symbolised in some way. For example, a map of parliamentary constituencies can be coloured with a different colour to represent the political party holding that seat.*

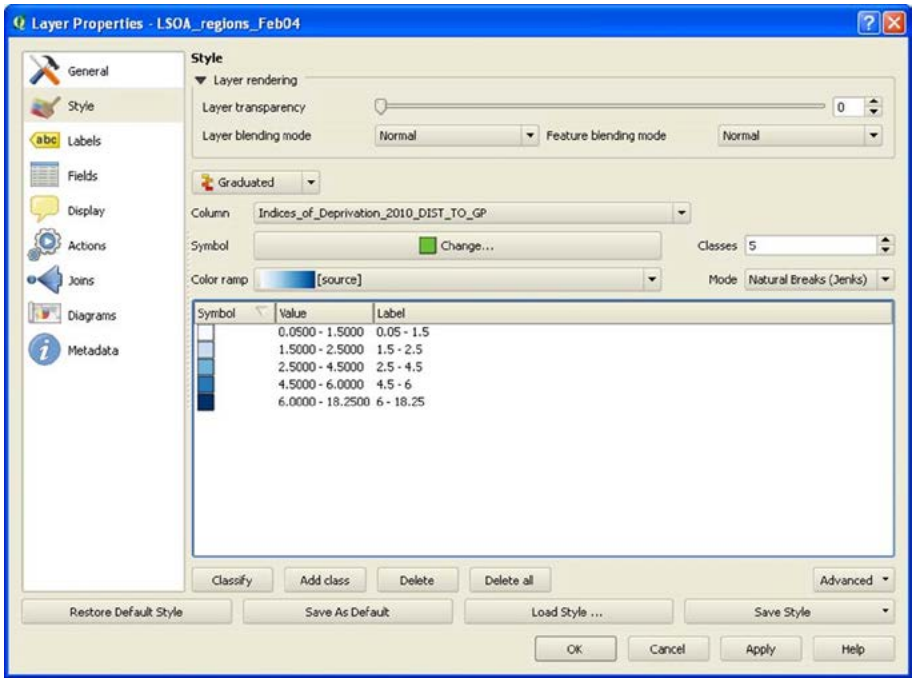
14 With the **LSOA_Regions_Feb04** 'Properties' table open, click on the 'Style' tab from the left-hand menu and select the 'Graduated' option from the drop-down menu (see below).

15 From the 'Column' drop-down selection that has now appeared, select '**Indices_of_Deprivation_2010_DIST_TO_GP**'.



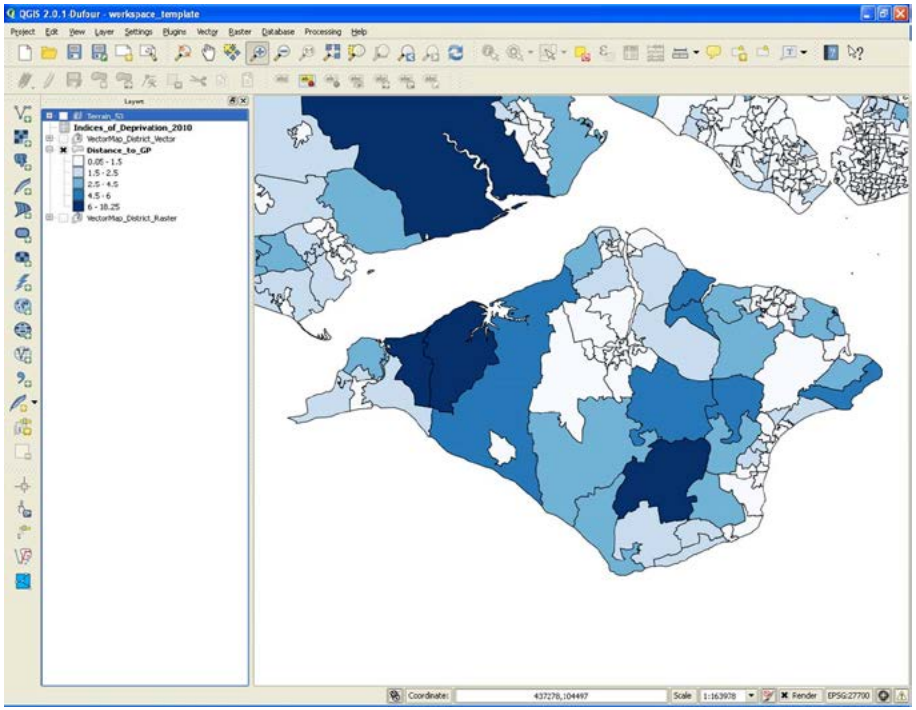
16 Experiment with changing the 'Colour ramp', number of 'Classes' and the 'Mode' by which the values are categorised. In this example, although the 'Mode' selected is 'Natural Breaks (Jenks)', we want to create personalised bands by which the data is categorised.

17 By double-clicking on any of the 'Value's, they become editable. Fill in the values to match those in the image below. Now fill in the same numbers in the 'Labels' column. Click 'OK'.



18 Finally, right-click on the **LSOA_regions_Feb04** layer in the table of contents, click 'Rename' and type '**Distance_to_GP**' or similar.

You have now created a thematic map illustrating the distances people have to travel to visit their GPs within LSOA boundaries:

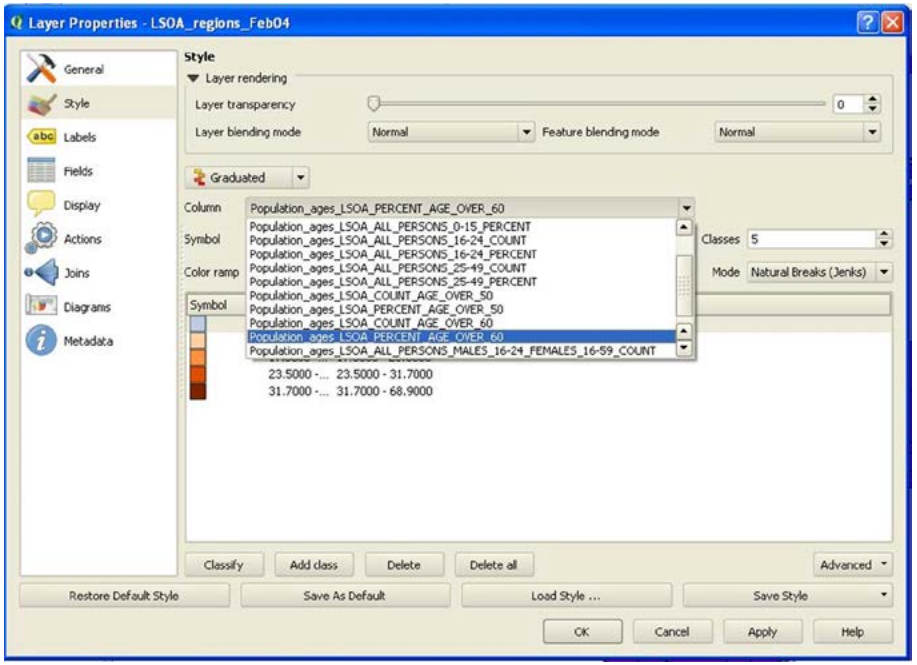


19 Ensure only the '**Terrain_50**', '**VectorMap_District_Vector**' and '**Distance_to_GP**' layers are turned on (shown by the cross), with the '**Distance_to_GP**' thematic map as the bottom layer. Which areas tend to have less distance to travel to their GP? Which areas tend to have more?

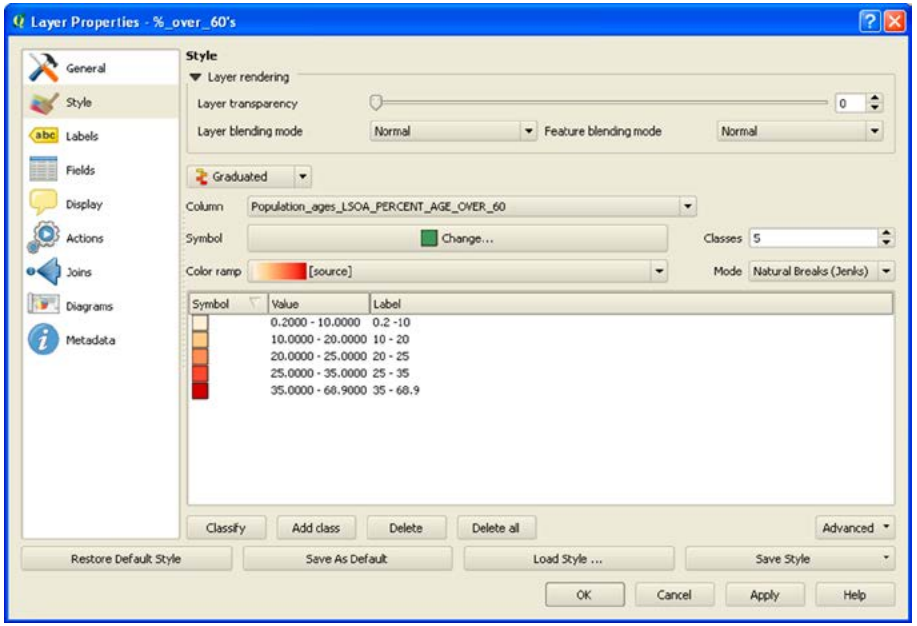
20 Now, we will follow the same process to create a thematic map illustrating the percentage of people aged over 60. Repeat steps 3-9, opening the file '**Population_ages_LSOA**' LSOA' (within OSOD_QGIS_2013→ ALL_DATA → ONS_Access_Data →Population_Data) rather than '**Indices_of_Deprivation_2010**'.

21 Right-click on the '**LSOA_regions_Feb04**' layer in the table of contents, and select 'Properties'. Ensure the 'Joins' tab is active, and select the 'Add Vector Join' button (see right). Fill in the 'Add Vector Join' screen that appears, selecting the right values from the drop-down lists, as below:

22 Click onto the 'Style' tab in the left-hand column of the 'Layer Properties' screen. Select 'Graduated' from the drop-down menu, and choose the '**Population_ages_LSOA_PERCENT_AGE_OVER_60**' column to create the thematic map (see below).



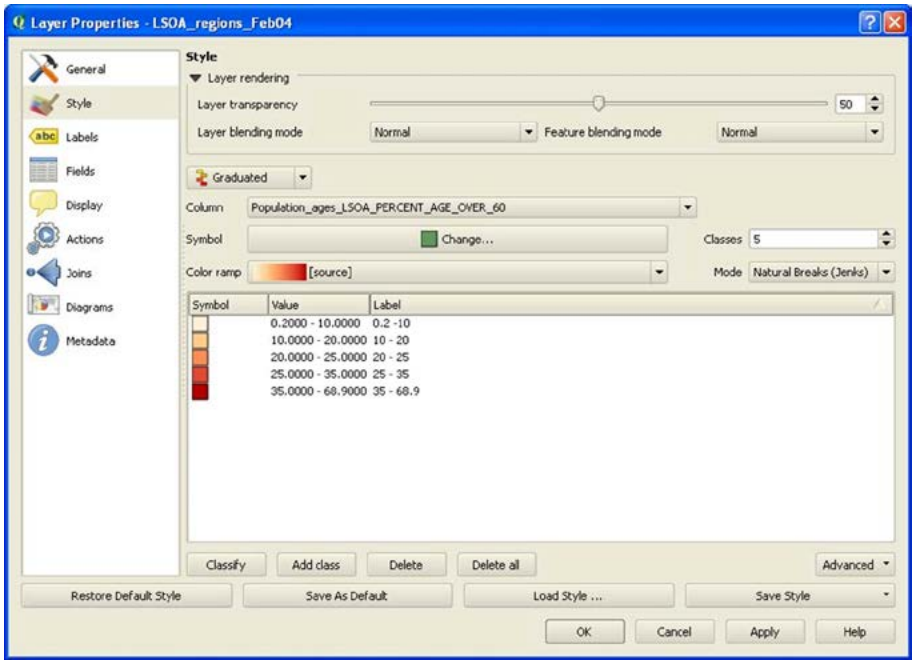
23 Change the 'Colour ramp' to a red gradient, and input new categorisation values as below and click 'OK' (Ensure you have chosen the colour ramp before clicking 'Classify' and inputting the new value boundaries, otherwise the values will be recalculated).



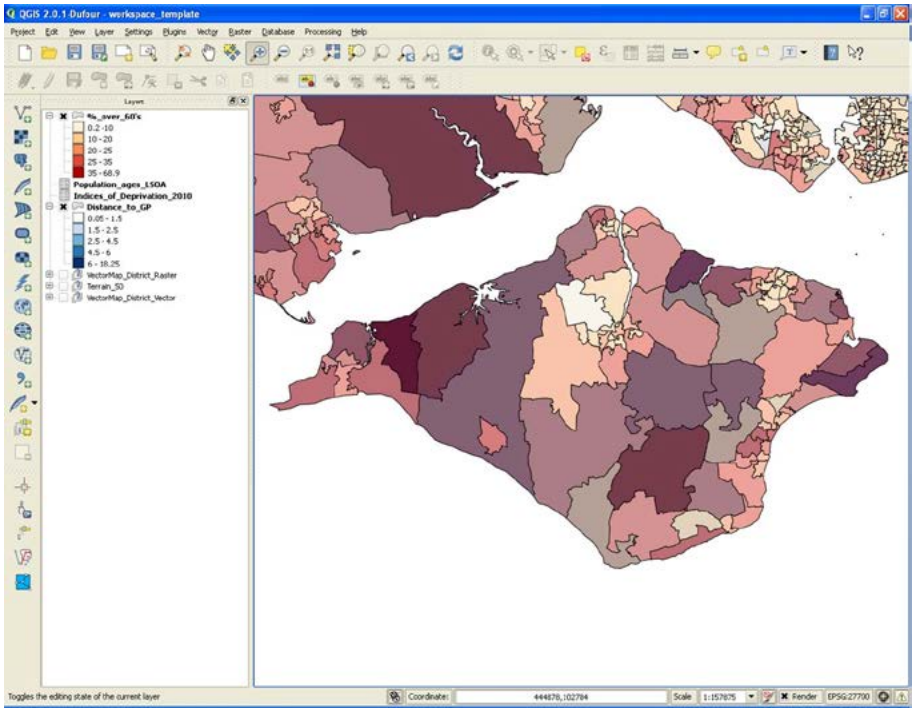
24 Finally, rename the '**LSOA_Regions_Feb_04**' layer as '**%_over_60s**' or similar.

25 Ensure only the '**Terrain_50**', '**VectorMap_District_Vector**' and '**%_over_60s**' layers are selected, with the '**%_over_60s**' thematic map as the bottom layer. Explore the map; what conclusions can you draw based on what you see? Do the areas with a higher percentage of people aged over 60 also have access to a good transport network?

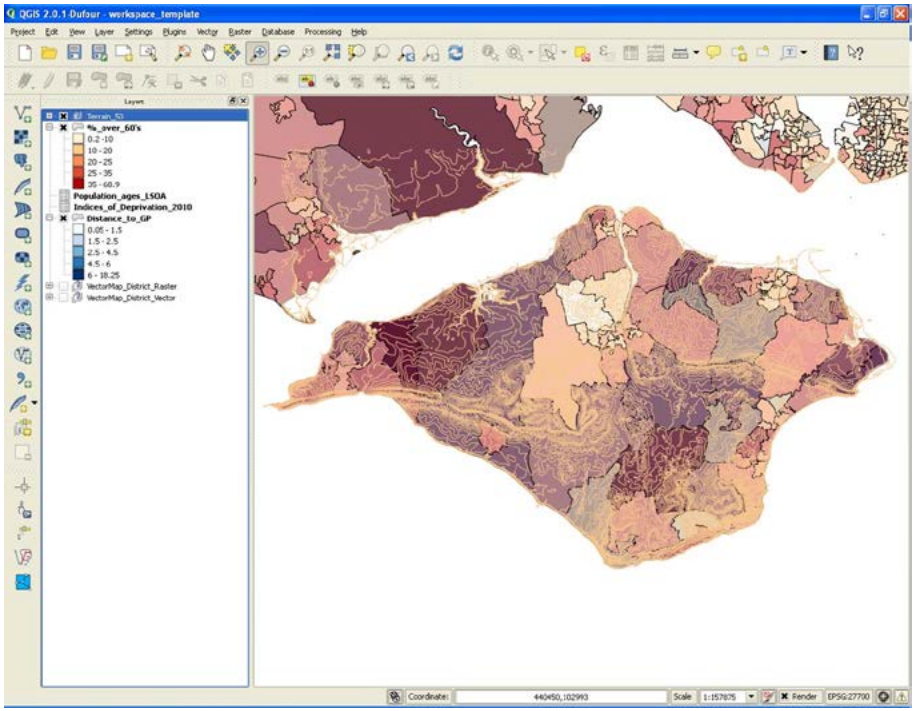
26 Now we will combine the two thematic maps to provide an overall analysis of the LSOA regions based on distance to a GP surgery, and percentage ageing population. Right-click on the '**%_over_60s**' layer and select 'Properties'. Move the 'Layer transparency' indicator to '50' (see below) and click OK.



27 Ensure **only** the '**%_over_60s**' and '**Distance_to_GP**' layers are both selected. The darker LSOA regions on the map are the ones with a higher percentage of people aged over 60 and a further distance to travel to reach a GP:



28 Now, overlay the Terrain_50 layer. What interpretations can you make based on what you can see?



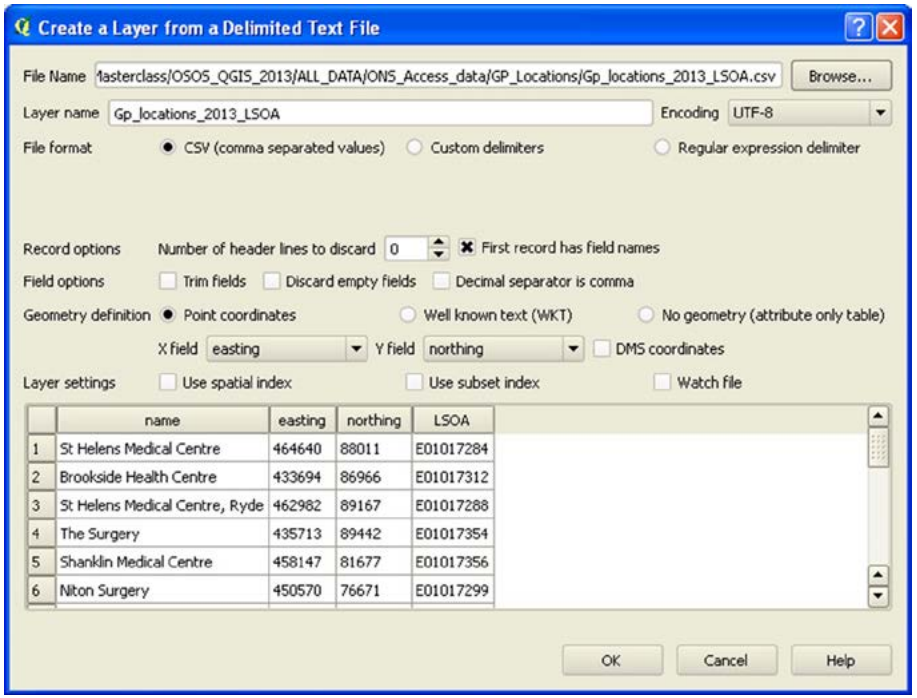
Exercise 4 Carrying out a spatial query in QGIS

In this exercise, we will plot GP surgeries on the map. This will allow us to build up a more detailed picture of GP location data. For example, the GP surgeries located within LSOA boundaries are not necessarily in the centre. People within the LSOA may still have difficulty accessing GP facilities. Using this data, we will then identify the LSOAs which contain a GP surgery, by performing a spatial query.

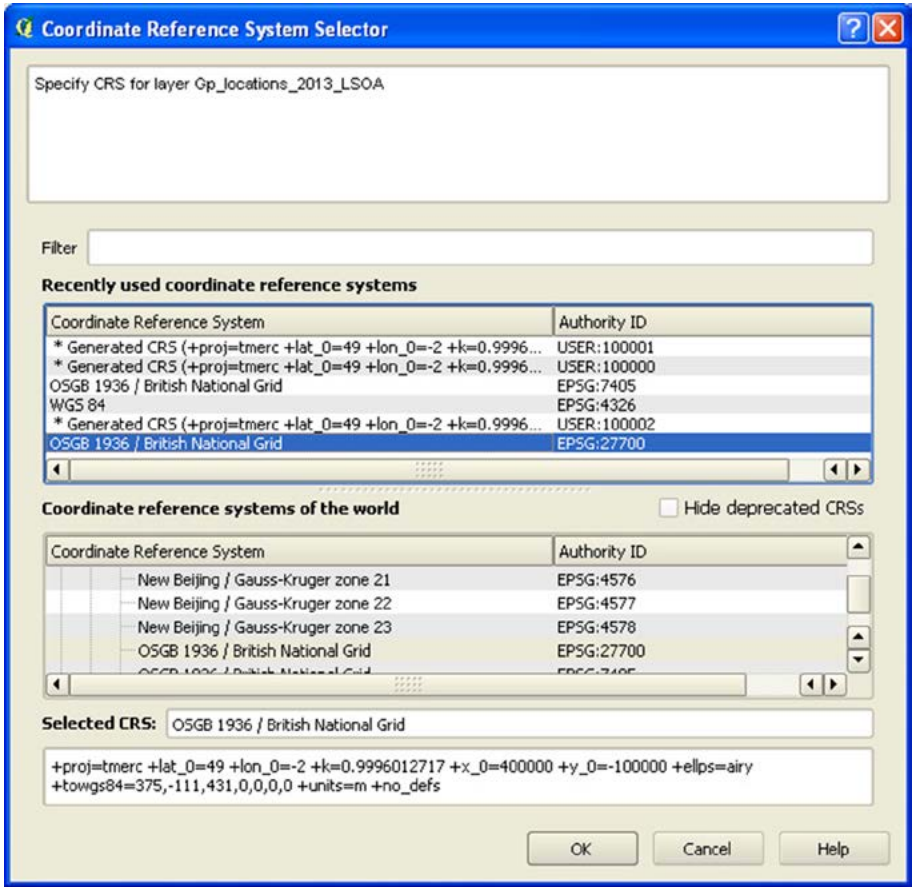
1 Open the saved workspace from exercise 3 in QGIS.

2 Click on the 'Add Delimited Text File' button.

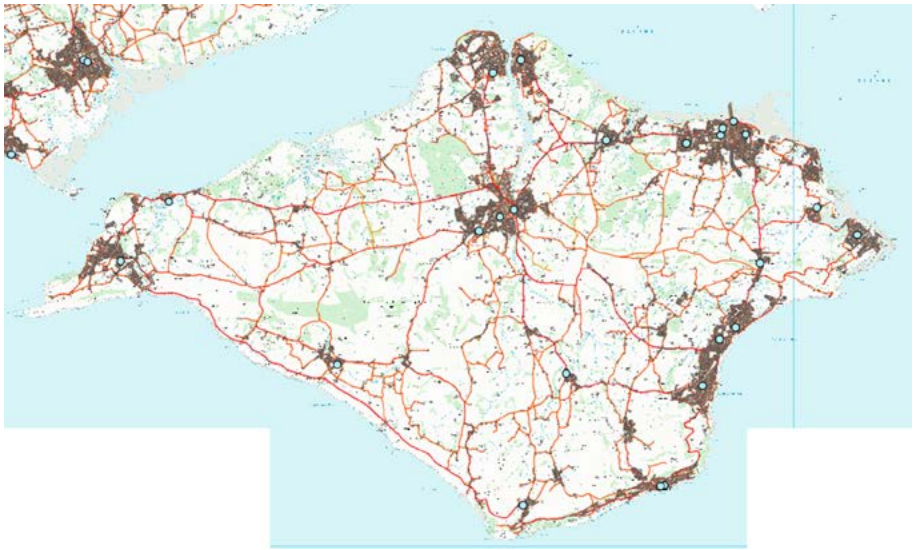
3 Click 'Browse', and select the 'GP_Locations_2013_LSOA' file within OSOD_QGIS_2013 → ALL_DATA →ONS_Access_data → GP_Locations. This file contains geographical information, in the form of northing and easting point coordinates. Ensure the screen looks like the one below, and click 'OK'.



4 Select the 'OSGB 1936 / British National Grid ESPG:27700' Coordinate Reference System (If this is not within the 'Recently used coordinate reference systems', select from 'Coordinate reference systems of the world' → 'Projected coordinate systems' → 'Transverse Mercator', or use the 'Filter' at the top of the dialog box). Click 'OK'.



This will bring up the GP surgeries onto the map as a separate layer, as below:

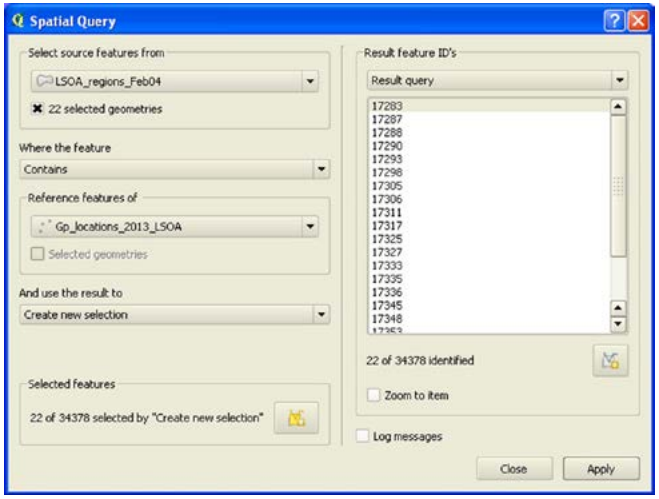


5 Now, we will determine which LSOAs contain a GP surgery, and which do not. To do this, we perform a spatial query. Firstly, we must open up the LSOA boundary vector dataset. Click 'Add Vector Layer', and select the '**LSOA_regions_Feb04**' shapefile. Click 'Open'.

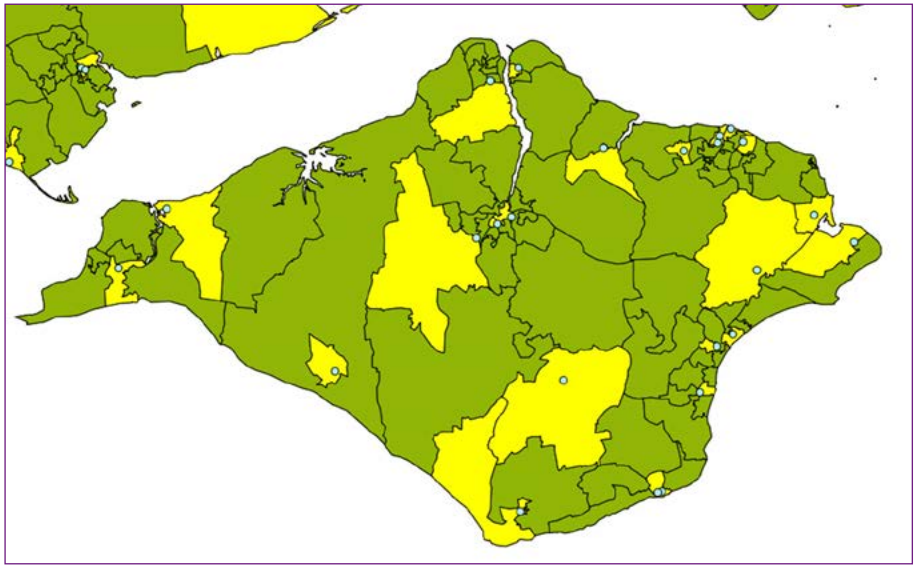
6 Now, click on the 'Vector' tab, then 'Spatial Query' as below. You may need to install the plugin, if it is not shown in the Vector tab. To do this, go to 'Plugins', select 'Manage and Install Plugins...', and select 'Spatial Query Plugin' (x).

7 Fill in the screen, as below, and click 'Apply':

8 This will bring up another screen summarising the query and showing how many selections have been made (that is, how many LSOAs contain a GP surgery, see below). Click 'Close'.



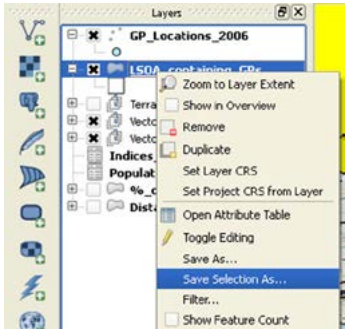
You will see a screen similar to the one below:



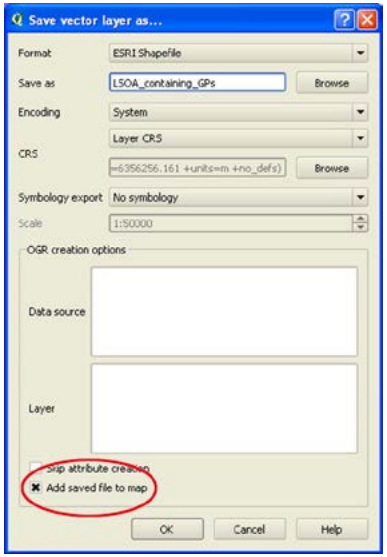
Here the yellow areas represent those LSOAs which contain a GP surgery.

We now need to save the selection to remove those LSOAs which do not contain a GP surgery (the green areas) in order to interpret the map more effectively.

9 Right-click on the '**LSOA_regions_Feb04**' layer within the table of contents; select 'Save Selection As' (see below).

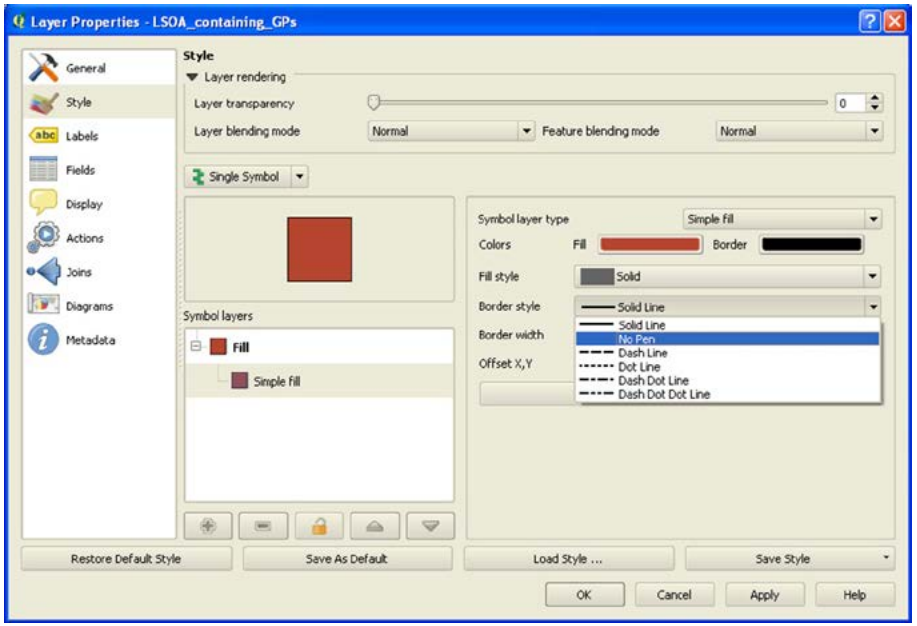


10 Click on 'Browse' and select a location you can easily access, for example within the OSOD_ QGIS_LSOA_2013 folder. Name the vector layer '**LSOA_containing_GPs**' or similar. Check the box 'Add saved file to map', as below. Click 'OK'.

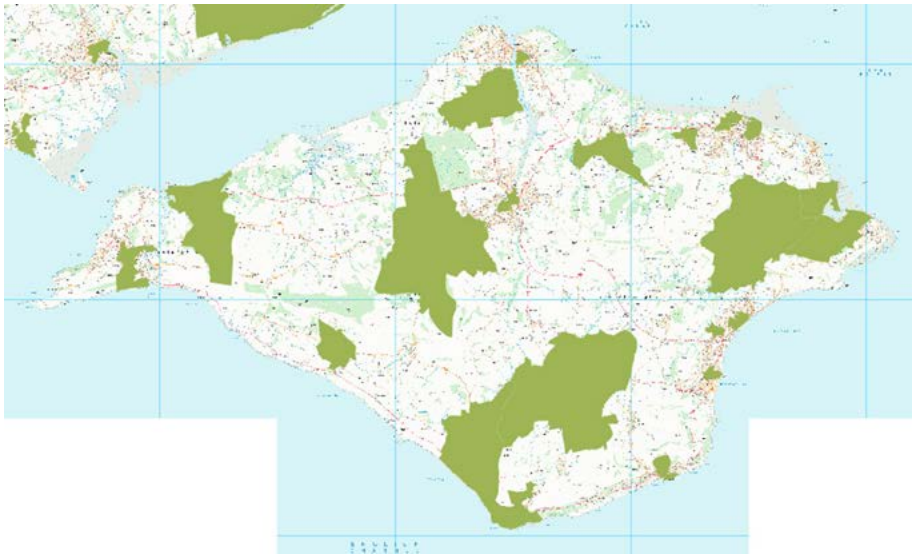


11 You can now delete the **LSOA_regions_Feb04** layer. Right-click on the layer in the table of contents and select 'Remove'.

12 Right-click on the new '**LSOA_containing_GPs**' layer, click 'Properties', and change the 'Border style' to 'No Pen', as below. Change the fill colour if you wish.



The resulting map should look similar to the one below:



How does the addition of this new layer affect the way you view the case study? Open up all the layers together. Are there any unusual results? (Clue: does the 'Distance to GP' and 'GP location' data agree?) What conclusions can you draw from this?

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