INTRODUCTION TO QGIS

PRACTICAL EXERCISE 1A

The purpose of this exercise is to introduce first time/beginner level users to the QIS Interface. This session will provide an overview of the QGIS interface by focusing on:

1) Setting up the interface for first-time use

2) Introducing some of the important features of the interface and where they are located

3) Practical examples of loading data, removing data and simple manipulation of data layers

4) Observing details about data through the **{Properties}** menu (i.e. coordinate system, meta-data, styling details etc.)

The following assumptions have been made in relation to delivery of this practical workshop session:

➢ Workshop participants have had little or no experience with QGIS or other GIS applications

➢ QGIS version 2.8.3 (Wien) has been pre-installed on participants' Windows or Mac computers and will be used to perform the exercises.

➢ Participants have acquired the necessary data for use in practical exercises

Instructors

• **Mr. Grahame Niles** - Remote Sensing/GIS Specialist, CIMH, Barbados

• **Ms. Elena Flórez** - Junior scientist, Agencia Estatal de Meteorología, Spain

• **Mr. Courtney Forde** - Intern, CIMH, Barbados

• **Ms. Soumaya Ben Rached** - Ingénieur des travaux, Institut National de la Météorologie, Tunisia

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1 PREPARING YOUR QGIS INTERFACE

Follow the instructions provided in this section to customize the QGIS interface so that it is simpler and more easily grasped. Please note that if this is the first time using QGIS, your instance of the application may look quite similar to the image below when it is launched. However, if other users of your machine have previously customized the existing QGIS installation, then it may possibly look quite different from this image. The next steps ensure that all tutorial participants are working with the same basic interface.
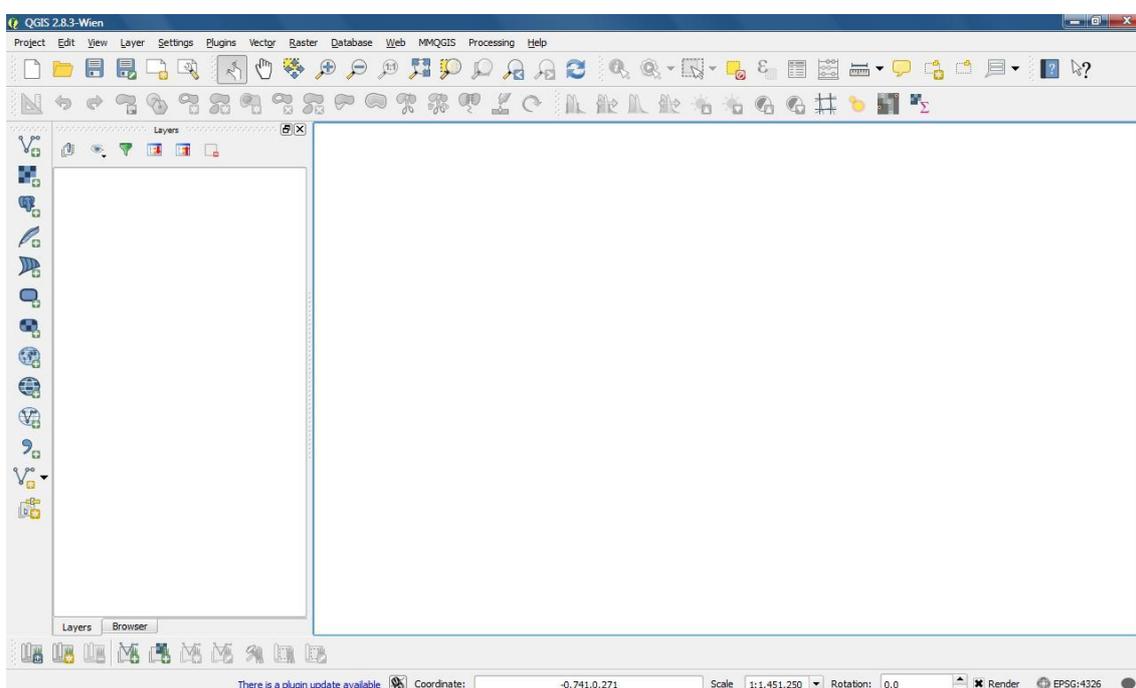
1. Launch QGIS:

   a. For Windows users, QGIS may be launched from the Desktop icon or via the Start Menu.

   b. Mac users can locate the QGIS application in the Applications directory under **"Finder"**.

2. Locate the **[View]** menu and scroll to **{Toolbars}** as shown in the following image.
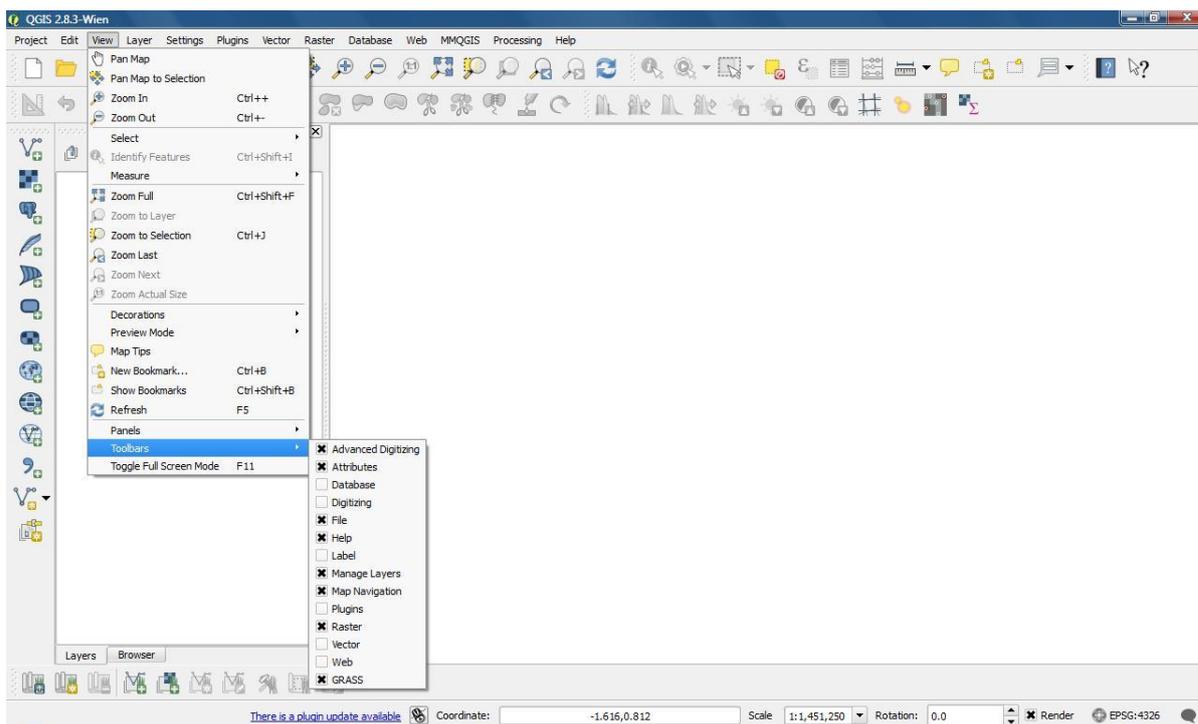
Note: This action reveals a drop-list of toolbar options which may be enabled or disabled. Enabled toolbars are marked with an 'x' and disabled toolbars have blank check-boxes.

3. Disable all options from the **{Toolbars}** menu except **{Attributes}**, **{File}** and **{Map Navigation}.**
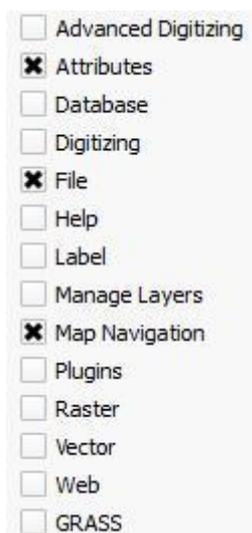
Note: The {Attributes}, {File} and {Map Navigation} toolbars are illustrated below. These toolbars are commonly used to perform most of the basic operations related to handling data in QGIS. There are other toolbars in the list which are very convenient and effective. However, we have removed them in order to keep the appearance of the interface simple. Additional toolbars may be added at any time from the menu if you should so desire.

{Attributes}

{File}

{Map Navigation}

4. Browse to the **[View]** menu and scroll to **{Panels}** as shown.
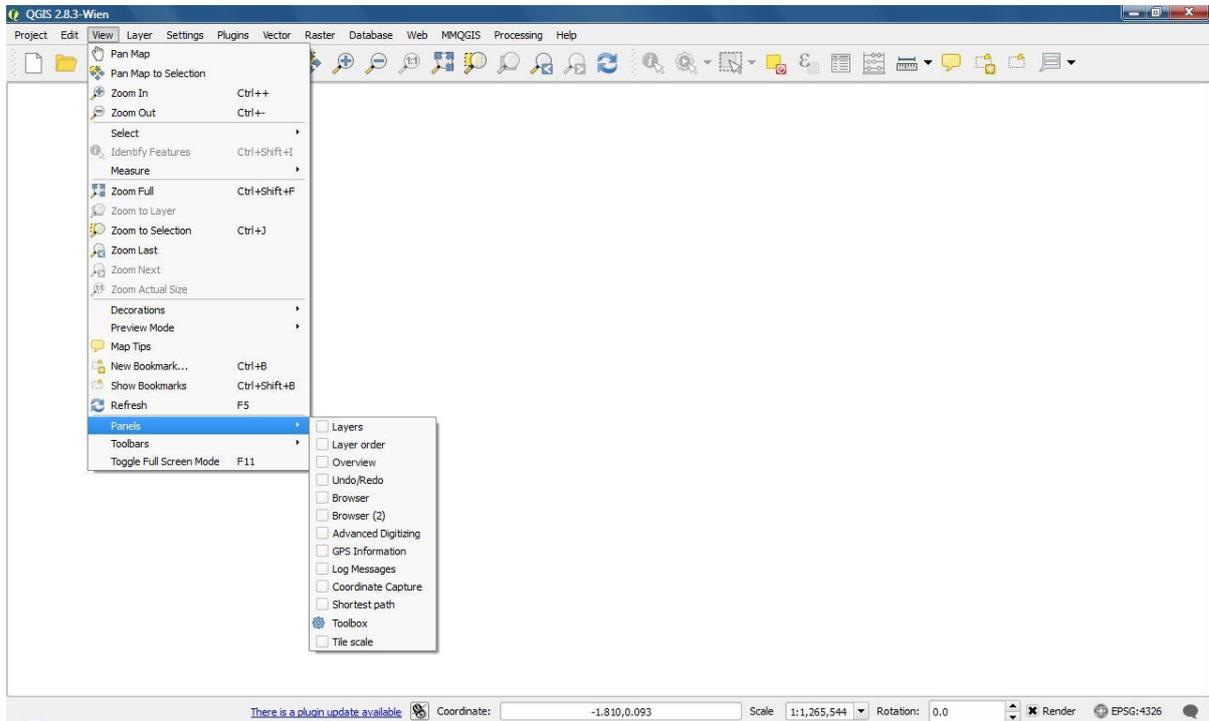
Note: This reveals another drop-list of options which may also be enabled or disabled.

5. Enable the **{Layers}** and **{Browser}** options and disable all others.
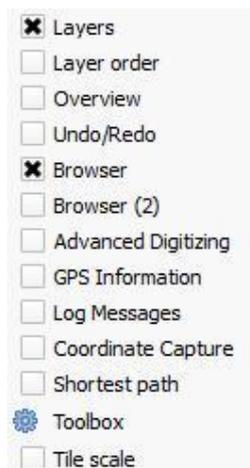
Note: The {Layers} and {Browser} options are very useful. They will be amongst the most heavily utilised part of the interface during the exercises.

Your QGIS interface should now resemble the following image.

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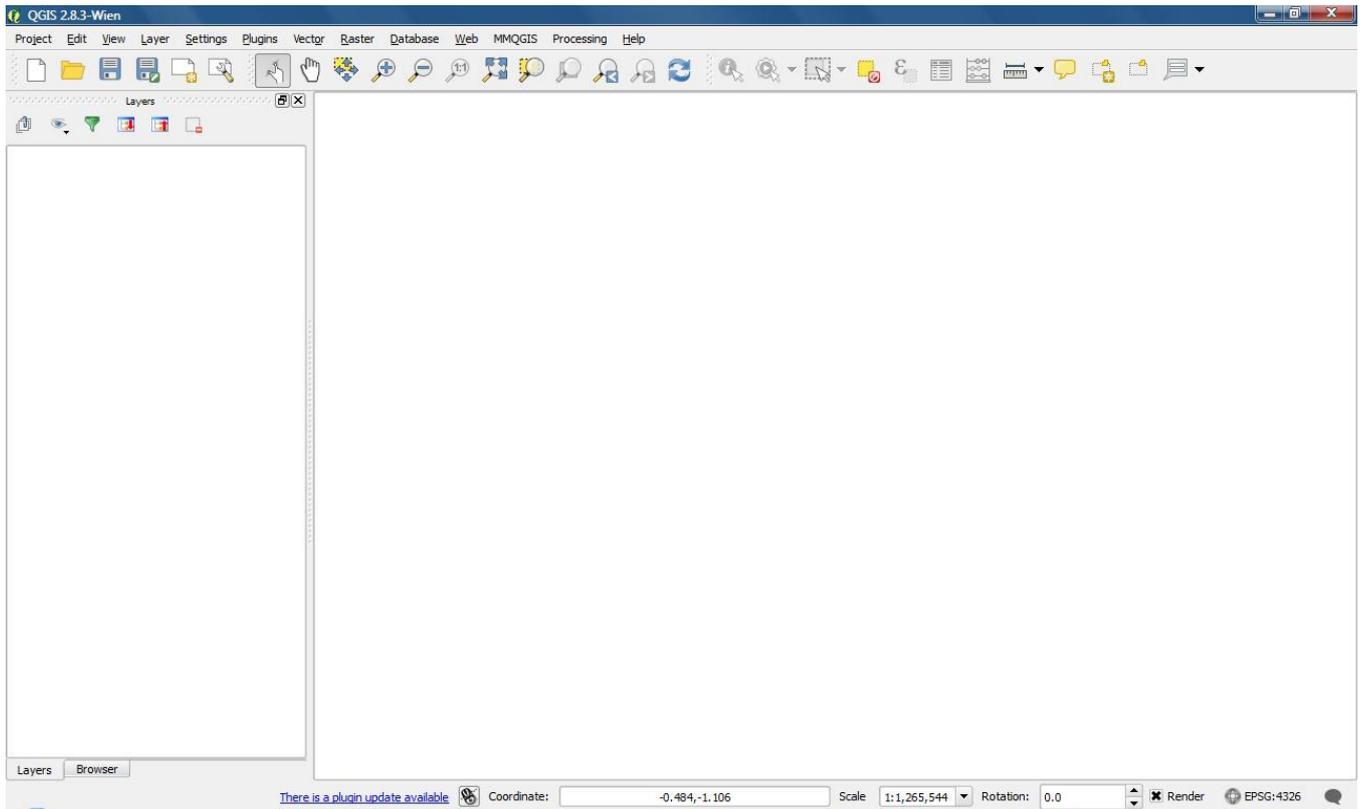
2   INTRODUCING THE QGIS INTERFACE

Now that QGIS has been customized for simplicity, a formal introduction may proceed.

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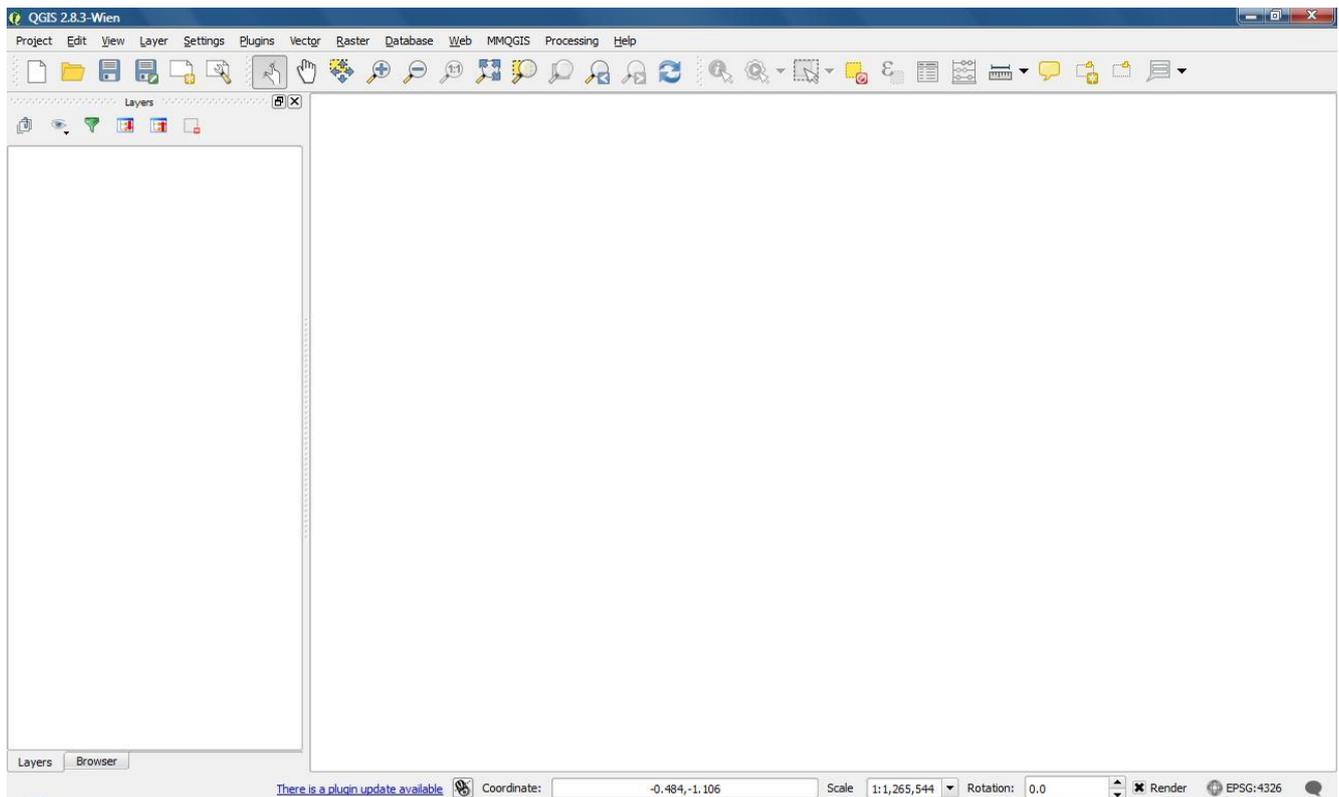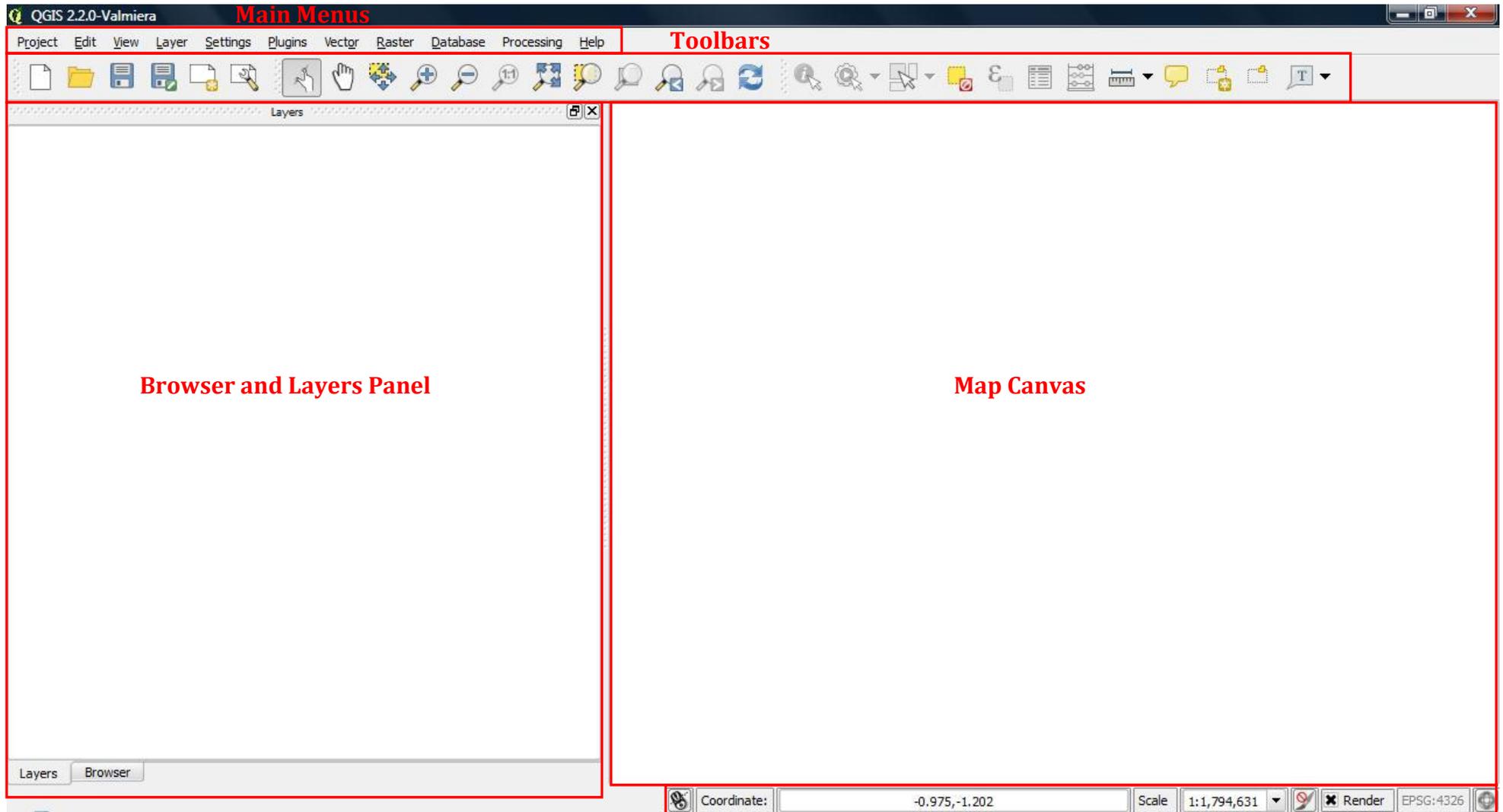
The previous image illustrates 5 important regions of the QGIS interface. These are briefly explained below.

i. The Main Menus

Project | Edit | View | Layer | Settings | Plugins | Vector | Raster | Database | Web | MMQGIS | Processing | Help

They provide access to virtually all functionality within the QGIS platform through the **[Project], [Edit], [View], [Layer], [Settings], [Plugins], [Vector], [Raster], [Database], [Processing]** and [**Help**] menus. A few of these menus are briefly described below.

➤ **[Project]** menu – This contains sub-menu operations such as **{New}**, **{Open}, {Save} and {Save As...}** that are typical of most Windows application **[File]** menus. From **[Project],** you may also export the QGIS project you are developing as an image via the **{Save as Image...}** operation.

➤ **[Edit]** menu – Use this menu to access a series of advanced operations that allow you to modify features of your project data in special ways. Some of these useful operations will be explored in successive exercises.

➤ **[View]** contains standard map visualisation operations which allow one to accomplish tasks such as dynamically changing the scale of maps and data by zooming (in and out), selecting/highlighting and identifying and measuring data features of interest. As previously demonstrated, the **[View]** menu also provides customisation capabilities for the QGIS interface, via the **{Panels}** and **{Toolbars}** sub-menus.

➤ GIS data can exist in a variety of formats. The **[Layer]** menu provides a number of useful resources for managing the data layers in an existing project. Different types of spatial data can be imported, copied, extracted and exported to different formats and even queried from this menu.

➤ The **[Vector], [Raster] and [Processing]** menus contain key data manipulation, geoprocessing and spatial data analysis functions that are cornerstone to GIS. Some of these will be explored during the workshop.

ii. The Toolbars

This row of tools highlighted on the interface is a set of iconic shortcuts to many of the commonly used functions/operations that may be accessed via the main menus. For convenience, additional toolbars may be added to this

section and other areas of the interface via the **{Toolbars}** sub-menu within the main **[View]** menu.

iii.   Layers/Browser Panel
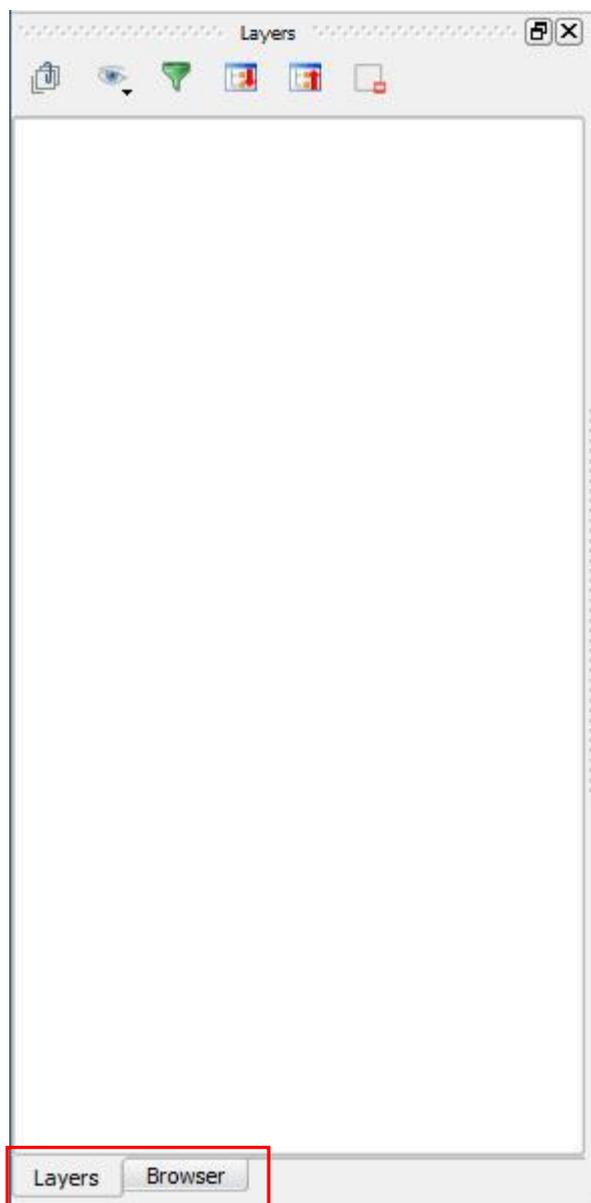
Users may toggle between the **Browser** and **Layers** panels (see highlighted tabs at the base of the panel). The **Browser** panel provides a directory listing for all the files on the system which QGIS is installed on. From here, you can browse through system directories to locate spatial data and import them into QGIS as data layers. The **Layers Panel** lists all data layers that have been imported into QGIS. You can directly interact with layers in this list by clicking on them.

iv.   The Map Canvas (See page 7)

The **Map Canvas** is where data are graphically displayed. Any changes to data made through the **Main Menus**, the **Toolbars** or the **Layers** panel are made visible here.

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v. Status Bar

The status bar provides basic dashboard functionality. It dynamically reveals spatial details about the contents of the **Map Canvas**. From here, you can retrieve basic information such as map coordinates relative to a cursor position, the coordinate system being utilised by the data in view and the present scale at which the data are rendered.

Note: Spend about five to ten minutes doing the following:

➢ *Try adding and removing different toolbars and panels get comfortable with customizing your interface.*

➢ *Try shifting around/repositioning the toolbars to change the appearance of your interface. To shift a toolbar around, simply left-click on the left end of the toolbar; hold and then drag it to a new location on the interface.*

➢ *Try hovering your mouse over the toolbar icons to learn the names of the tools*

➢ *Explore the different function menus on the interface*

Be sure to raise any questions you may have with the instructors.

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3 BASIC DATA OPERATIONS IN QGIS

The following sections utilize GIS data which was made available prior to the workshop in a zipped format. Before conducting the exercises, you must unzip the data directory to your desktop. The unzipped folder is named, **"GIS_Workspace"**. From this point onward, any mention of the term **"workspace"** should be regarded as a reference to this directory. Your workspace shall serve as a repository for all the data supplied for the workshop and any output generated from the exercises that follow. Be sure to save your QGIS project to the workspace under the name, **"Practical Exercise 1A"**. The save functions may be accessed from the **[Project]** menu in QGIS at any time.

3.1 Adding Data to QGIS

The first step to working with data in any GIS platform is to import it. Your workspace should contain a set of GIS files which you will be importing into QGIS using the methods illustrated.

3.1.1 Using the Browser Panel to Add Data

1. Activate the **Browser Panel** and navigate the filing system to locate your workspace folder on the Desktop.
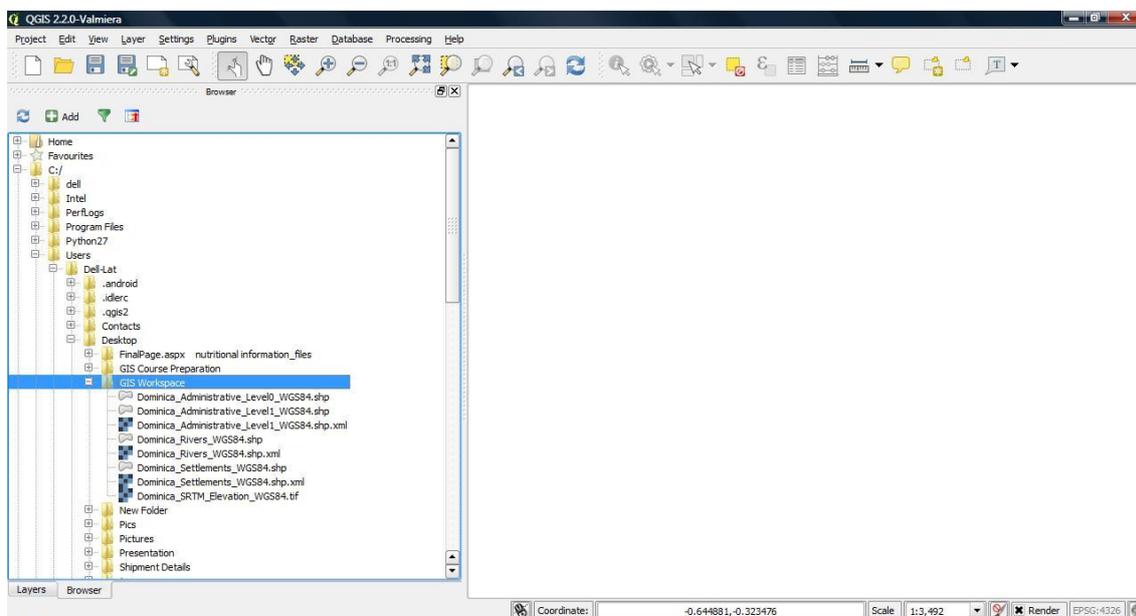
Note: You will see a list of files positioned in the hierarchy under your GIS_Workspace directory on the Desktop. The file you will be loading is called,

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"Global_Countries_WGS84.shp". It is a Vector data file that graphically represents the physical extent and configuration of space consumed by all countries in the world.

2. Import **"Global_Countries_WGS84.shp"** into QGIS by double-clicking the file with the mouse.

   Note: A polygon, vector object showing all countries in the world should now be visible in the Map Canvas – see image below. Greater details on vector GIS data will be explored in latter exercises.
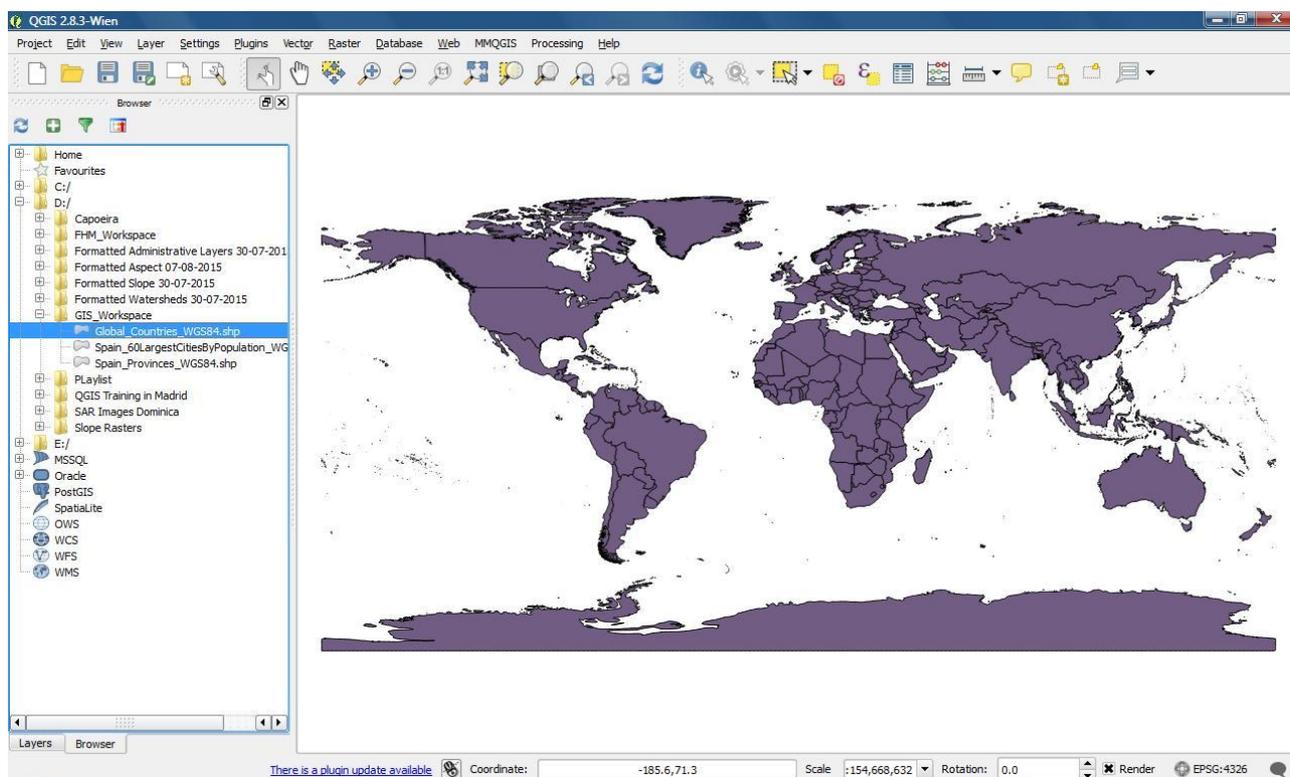
3. Activate the **Layers Panel**

   Note: This reveals a list of all the layers presently imported to QGIS. So far you've only added one data layer, so you should see only one entry – (see the following image)

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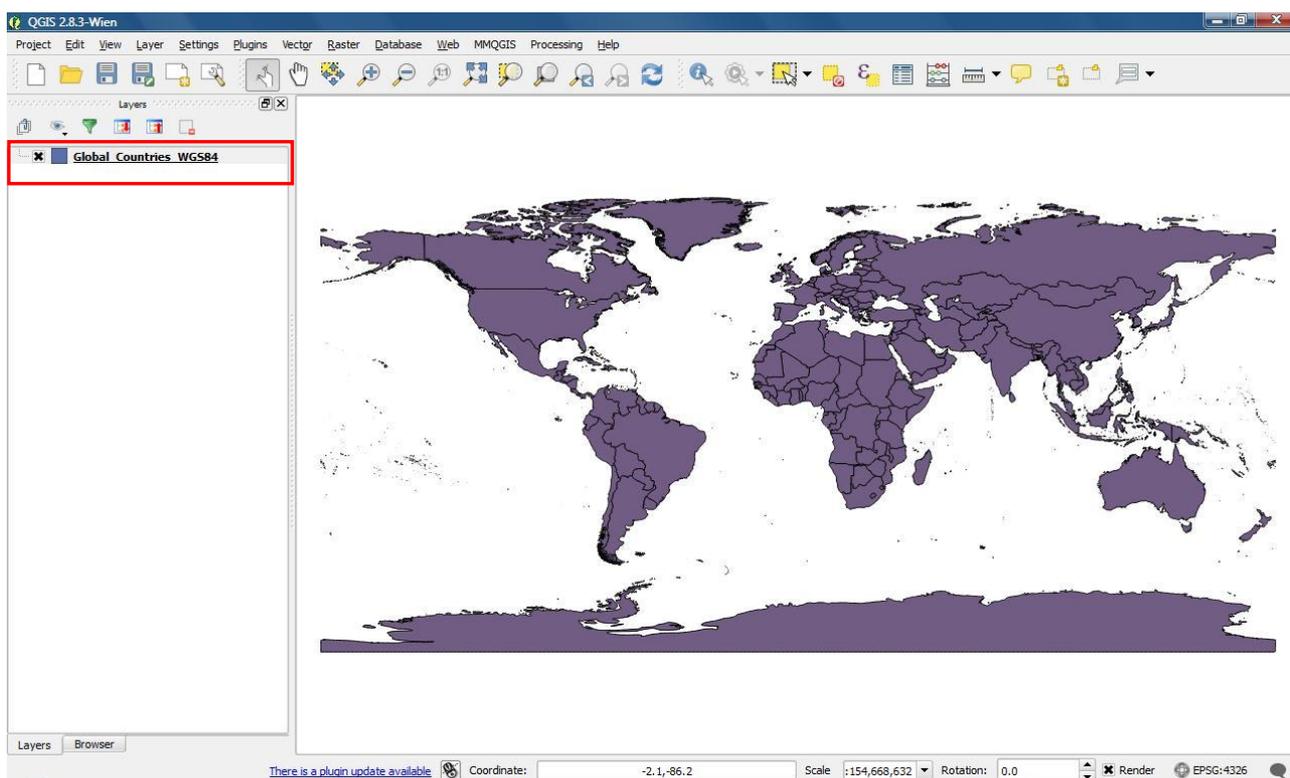
4. Position your mouse over the data layer in the **Layers Panel**; right-click; select **{Remove}** from the menu that appears. Select **{OK}** from pop-up box that appears.

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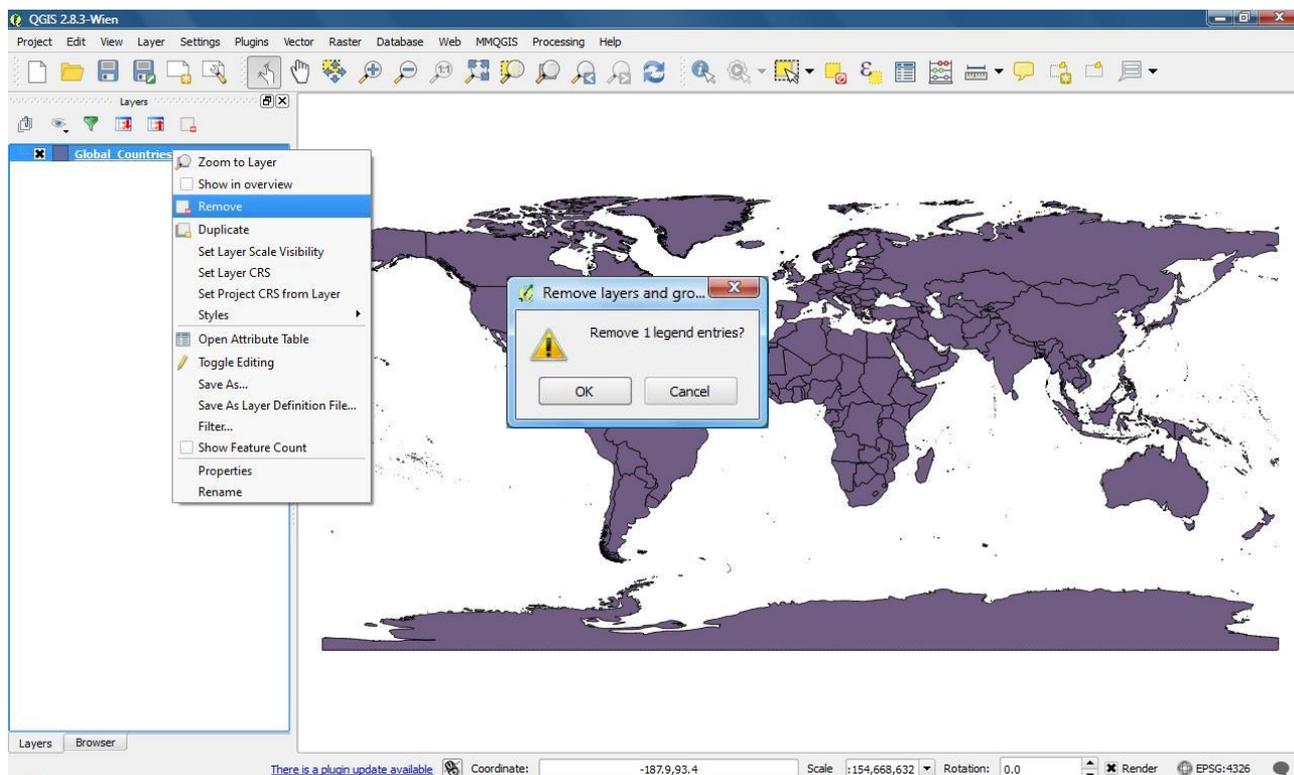
Note: These actions, remove data from QGIS. Once completed, the data layer previously added will neither be visible in the Layers Panel nor the Map Canvas. The next step examines a second method for importing data.

5. Return to the **Browser Panel** and locate the same data layer previously added (**"Global_Countries_WGS84.shp"**).

6. Using your mouse – highlight the layer by applying a single left-click.

7. Hit the **{Add}** button at the top of the **Browser Panel** to import the data file to QGIS.
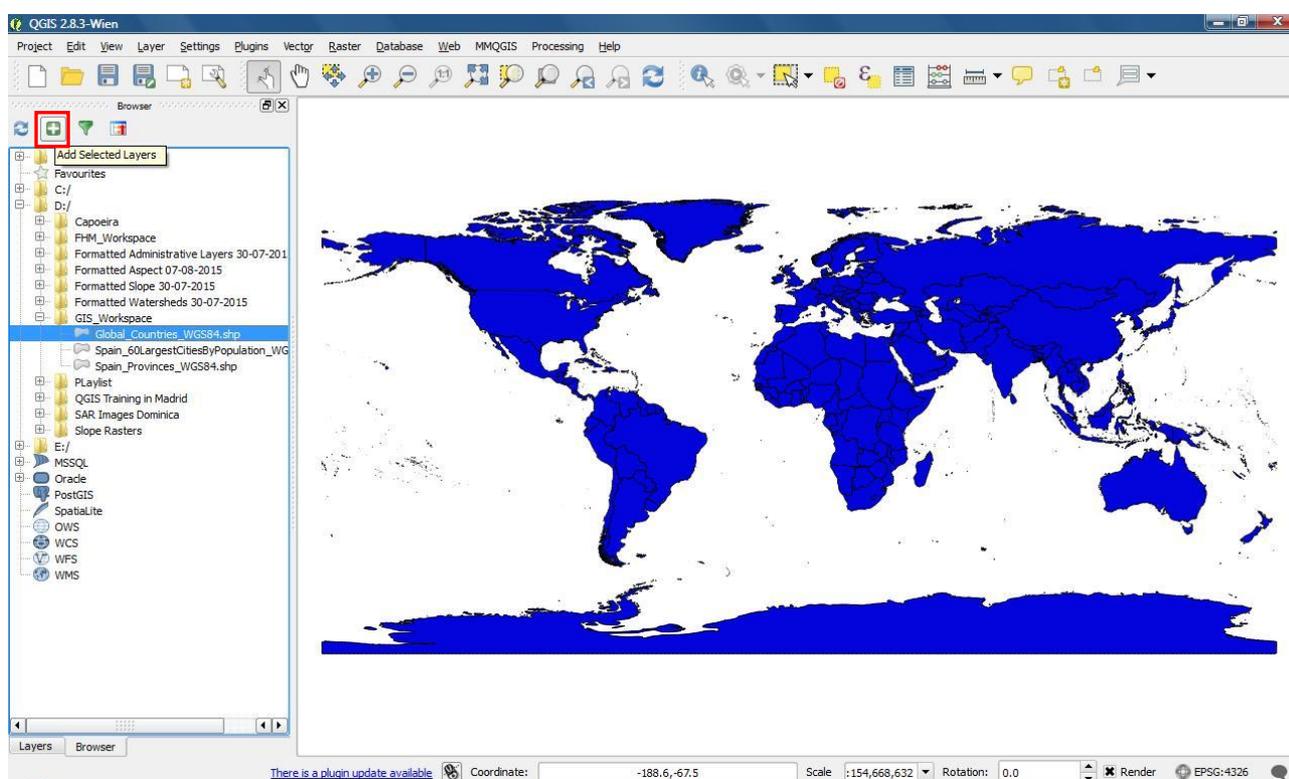
Note: Once again, the data layer ("Global_Countries_WGS84.shp") has been added to QGIS and is visible in the Layers Panel and the Map Canvas.

In the next step you will experiment with importing more than one data layer at the same time. Remove the present layer before proceeding.

8. From the **Browser Panel** – Locate and select/highlight the following layers

> ➢ **"Spain_Provinces_WGS84.shp"**

> ➢ **"Spain_60LargestCitiesByPopulation_WGS84.shp"**

Note: To select/highlight more than one data layer from the Browser Panel, press and hold the Ctrl key on your keyboard while left-clicking each layer you wish to add. To deselect a layer previously highlighted, hold the Ctrl key and left-click the layer.

9. Right-click any of the highlighted files and choose **{Add Selected Layers}** from the drop-menu.
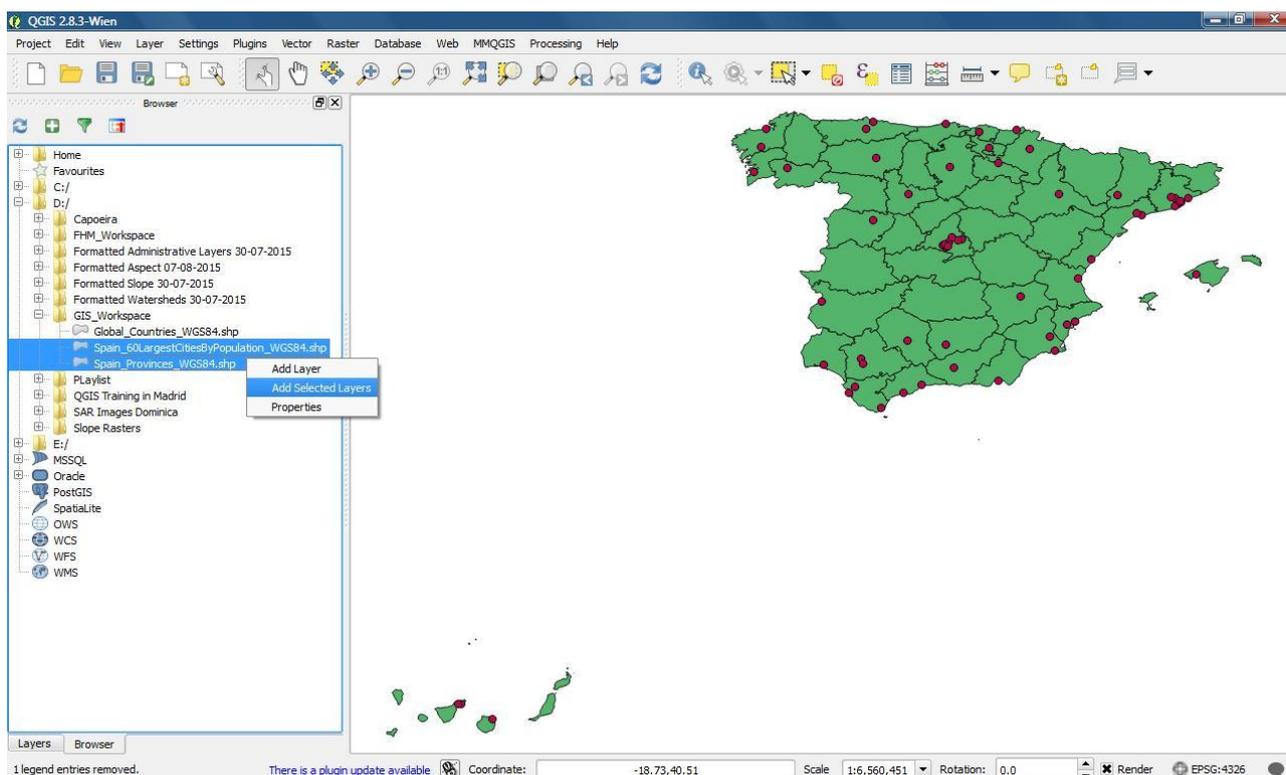
Note: This adds two new vector layers to the Layers Panel which are visible in the Map Canvas. "Spain_Provinces_WGS84.shp" is a polygon vector layer that illustrates the geographical extent and distribution of provinces across the country of Spain. "Spain_60LargestCitiesByPopulation_WGS84.shp" is a point vector layer that represents the approximate point locations of 60 cities in Spain, ranked by population size (Source: www.tageo.com).

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10. Activate the **Layers Panel** to see the list of layers present in **QGIS**. *Your Layers Panel should now have two data layers and your Map Canvas should show an overlay of these layers with the city points plotted on top of the provinces of Spain.*
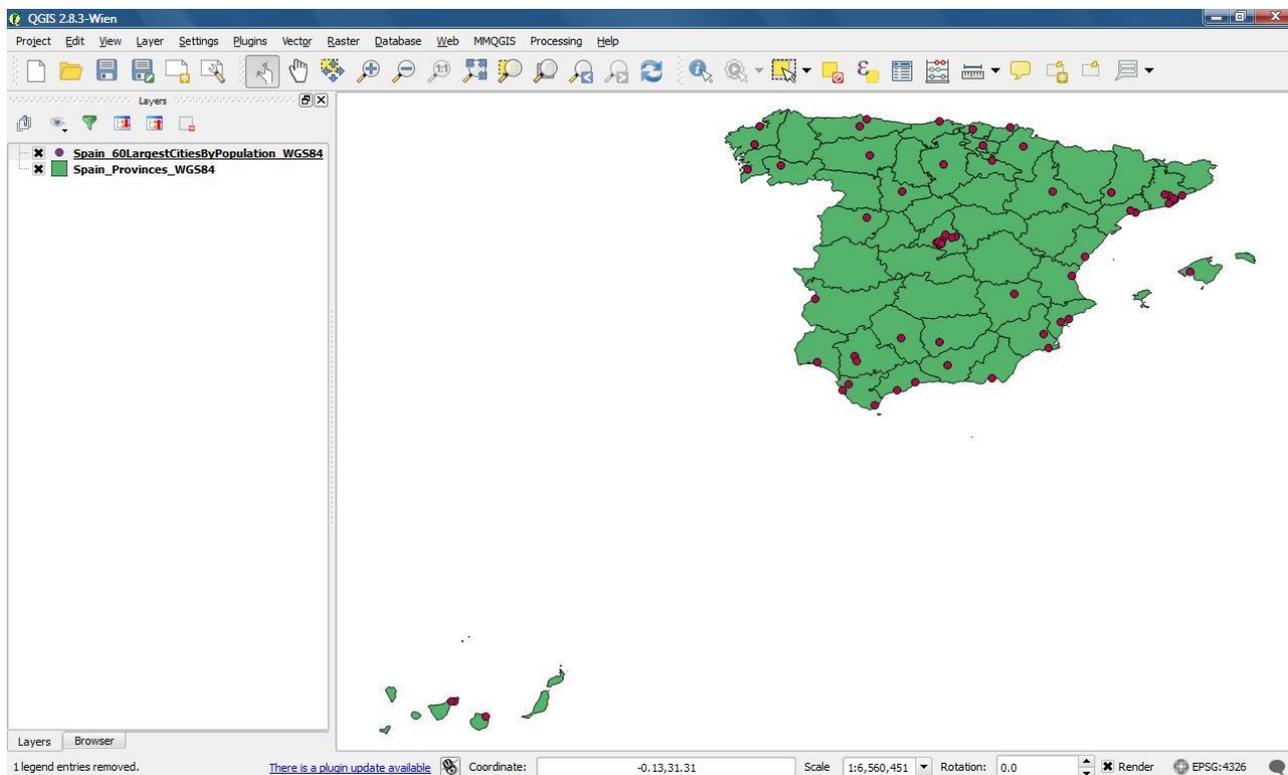
Tip: More than one layer may also be removed at the same time. You can do this by pressing and holding the Ctrl key and clicking on each layer in the Layers Panel to select them. Once selected, right-click on any highlighted layer in the list and select {Remove}.

Tip: Vector layers may also be added from the [Layer] main menu. Navigate to [Layer] → {Add Layer} → {Add Vector Layer}; use the Browse system menu to locate and open the file; then hit the {Open} button to add the layer. The same layer may be imported to QGIS multiple times. Hence, try adding another copy of the provinces layer via this method – see next image.

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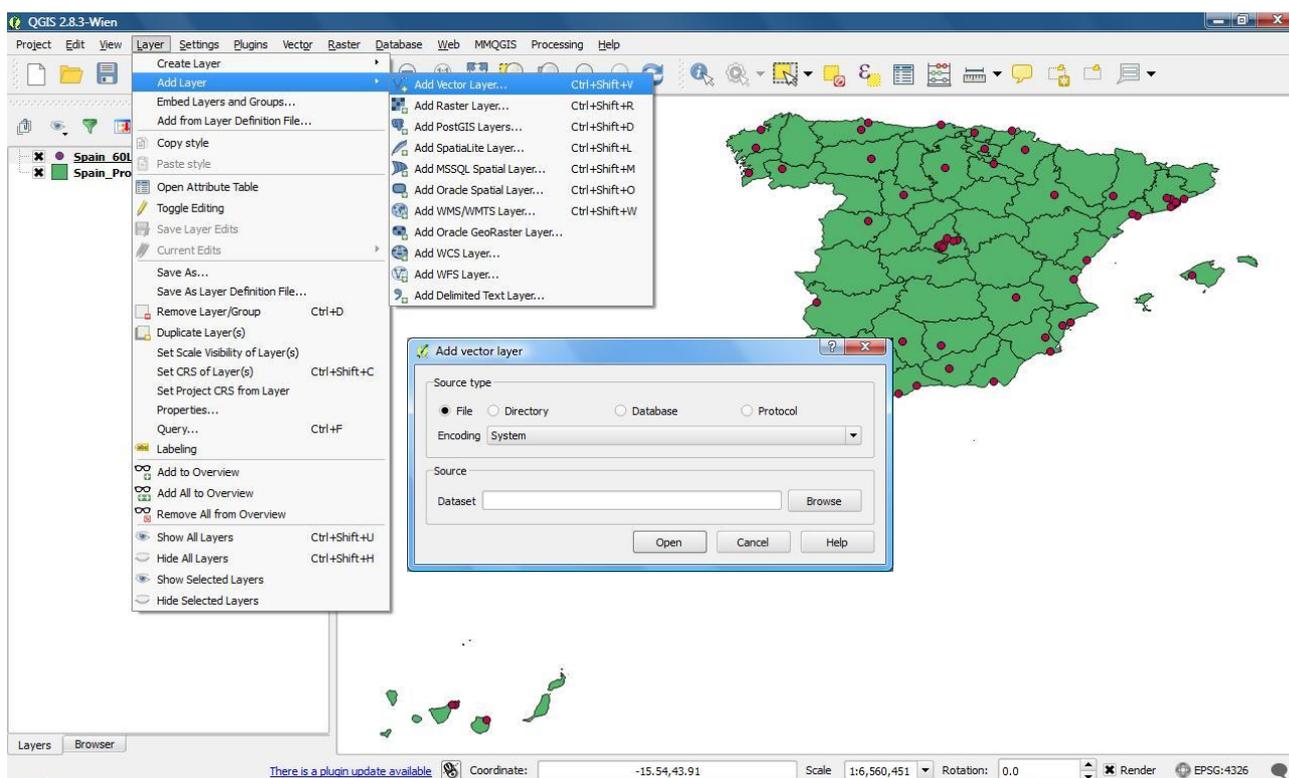
3.2   Manipulating Map Objects in QGIS

Now that you've successfully added and removed data from QGIS, you should get to know the basic map functions and the parts of the interface where they can be accessed. Follow the next set of instructions to get up to speed.

Before proceeding, make sure that you have only one instance of the provinces and of the cities layers present in the **Layers Panel**. If you've removed layers from the previous steps or added extra copies of the provinces and cities layers to the map, then make the necessary imports to/removals from the **Layers Panel**.

3.2.1 Enabling and Disabling Data Layers

1. From the **Layers Panel** – click on the 'x' in the checkbox next to the cities layer (**"Spain_60LargestCitiesByPopulation_WGS84.shp"**) in the list.

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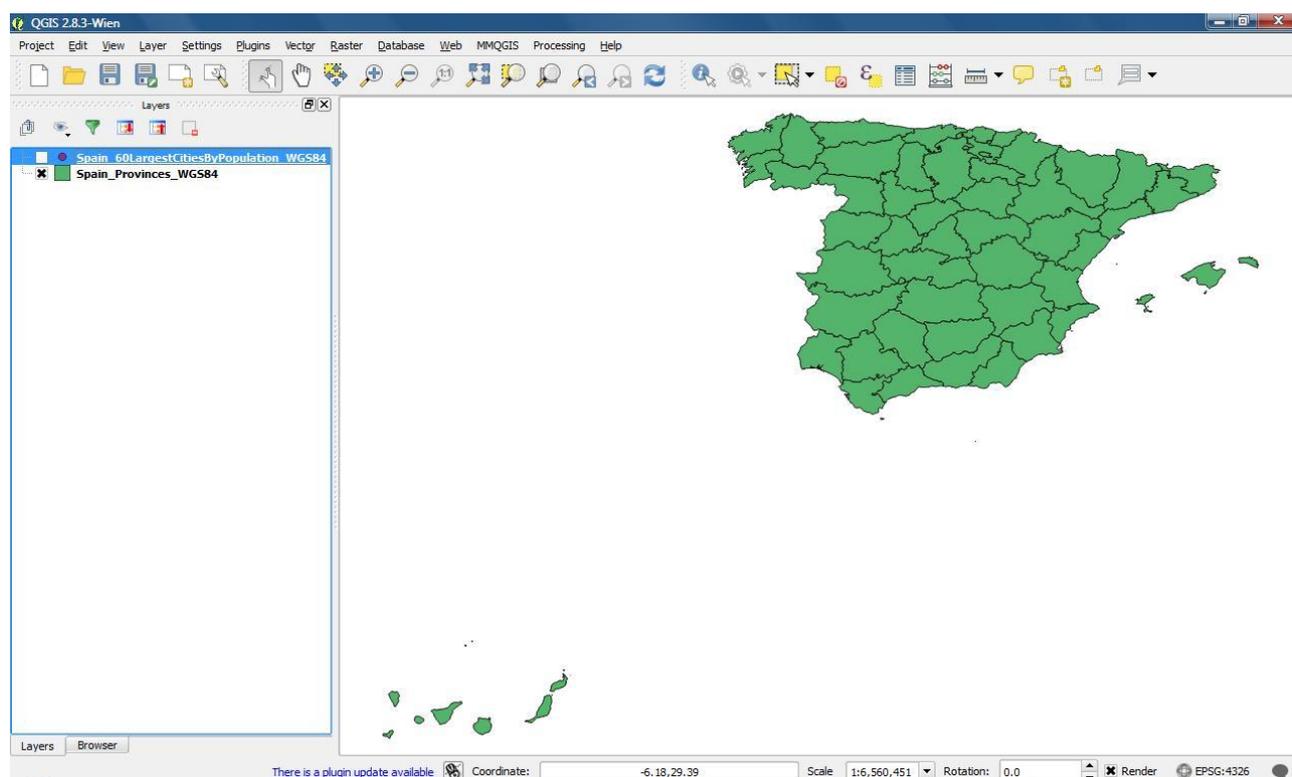
Note: This disables the layer so that the vector points representing the cities can no longer be seen in the Map Canvas.

2. Enable the points (cities) layer again by clicking inside the checkbox area.

    Note: Checking the box again makes the 'x' and also the vector points in the Map Canvas reappear.

3. Experiment with enabling and disabling the provinces layer.

3.2.2 Shifting Layer Positions

The ordering of layers in the **Layers Panel** sometimes impacts how data are graphically represented in the **Map Canvas**. For example, your current **Map Canvas** shows points (cities) that are drawn on top of the polygon shapes of provinces within Spain. These objects appear this way because in the **Layers Panel**, points (cities) are listed above the polygon (Spanish provinces). Next, you'll try changing the order of objects in the **Layers Panel** and then observing the results in the **Map Canvas.**

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1. Use your mouse to select/highlight and drag the polygon layer (**"Spain_Provinces_WGS84"**) to the top of the list.

The action results in a change in the appearance of map objects. Before, the point (cities) symbols were positioned on top of the polygon features (Provinces). Now, the point symbols are hidden from view.
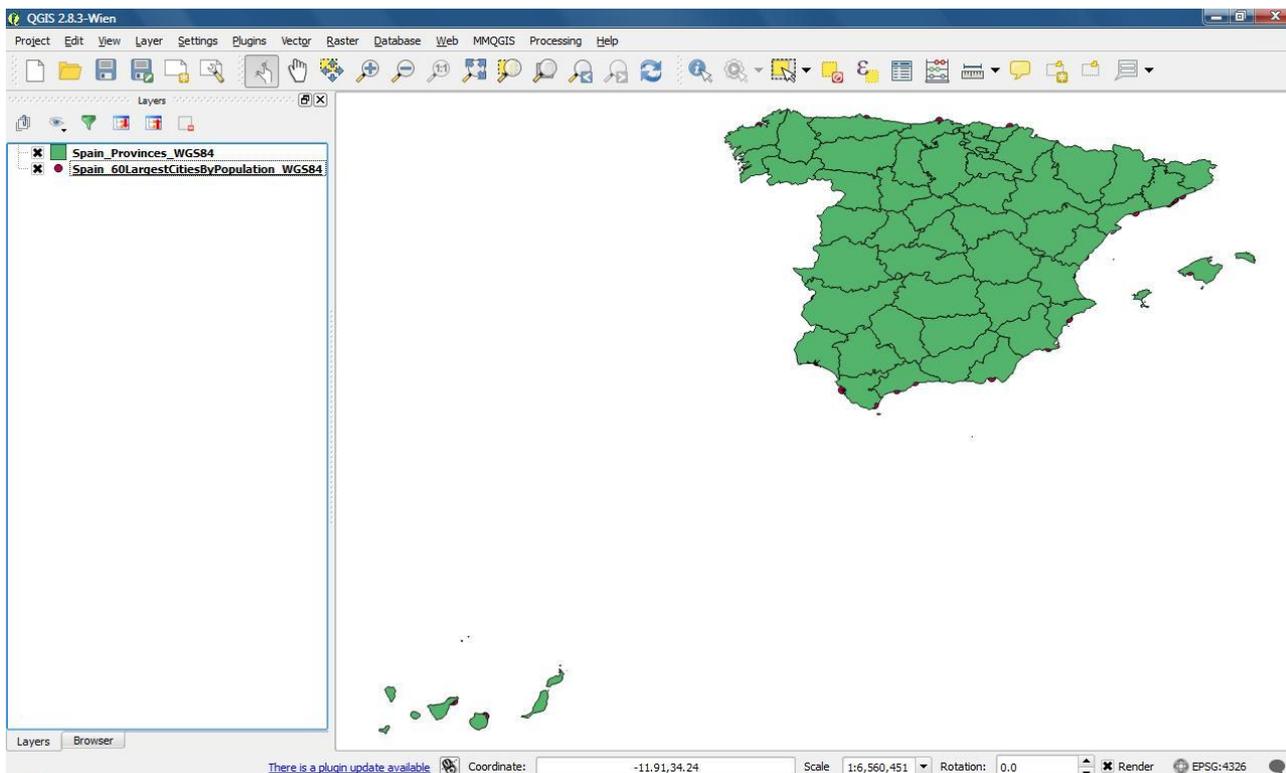
Note: Placing the polygon shape at the top of the Layers Panel has instructed QGIS to draw the polygon (provinces layer) on top of the points (cities). This hides the cities from view because the solid polygon shape (which has a larger extent) overlaps the point objects. It must be stressed that the point features are still present in the Map Canvas but just blocked from view. For example, if you were to apply a degree of transparency to the polygon shape, the cities would be visible underneath.

2. Return the polygon shape to its original position before proceeding.

3.2.3 Pan, Zoom and Identify Map Functions

When working with map layers, it is often necessary to manipulate objects by moving them around the **Map Canvas** and/or changing the extent of view by zooming in and out. You may also need to identify or obtain details about

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specific map features. The next steps demonstrate how these actions may be performed.

1. Select/Enable the **Pan** tool from the **Toolbar** list.

2. Point your mouse over the objects in the **Map Canvas**. Now click and hold your mouse down, while moving it in any direction you choose (left, right, up, down, etc.).

   Note: This allows you to move the objects across the Map Canvas in the same direction as your mouse. Return the map objects to a central position before proceeding. Feel free to use the Pan tool (highlighted above) at any point during this exercise to centre the objects in the Map Canvas for better viewing.

3. Select/Enable the **Zoom In** tool from the **Toolbar** list.

4. Left-click, hold and drag your mouse over a small area surrounding the point features (cities) in the north; then release the mouse.

   Tip: Pick any area with points in the north; start at a position that is northwest of any cluster of cities; click, hold and drag to the east and then to the south. This will create an area (highlighted by a transparent square) around the cities. When you release the mouse, QGIS will zoom into this area

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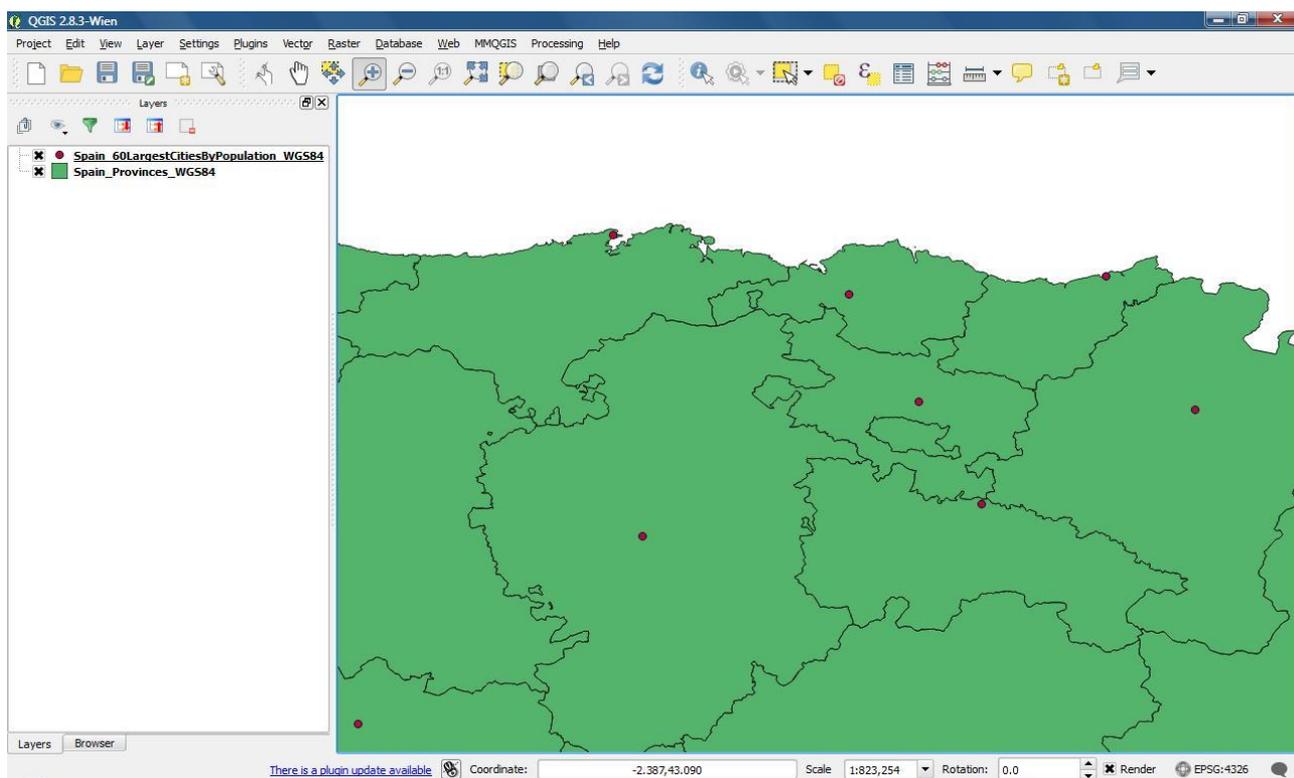
These actions provide a closer view of the northern section of the map.

5. Click on the **Zoom Last** tool.

Note: The Map Canvas should have returned to its original extent.

6. Click on the **Zoom Next** tool to revisit the zoomed in view of the northern part of Spain

Note: This returns your Map Canvas to the extent seen after step 4.

7. Pick different areas to Zoom in to and then try toggling between the **Zoom Last** and **Zoom Next** tools.

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Note: This switches the Map Canvas back and forth between the original extent and the zoomed in version. As you experiment with this, observe the activity in the Status Bar as the map scale changes.

8. Return the **Map Canvas** to its zoomed-in extent of the north.

9. Select/Enable the **Zoom Out** tool from the **Toolbar**.

10. Place your mouse over the map and left-click repeatedly until the data is fully in view.
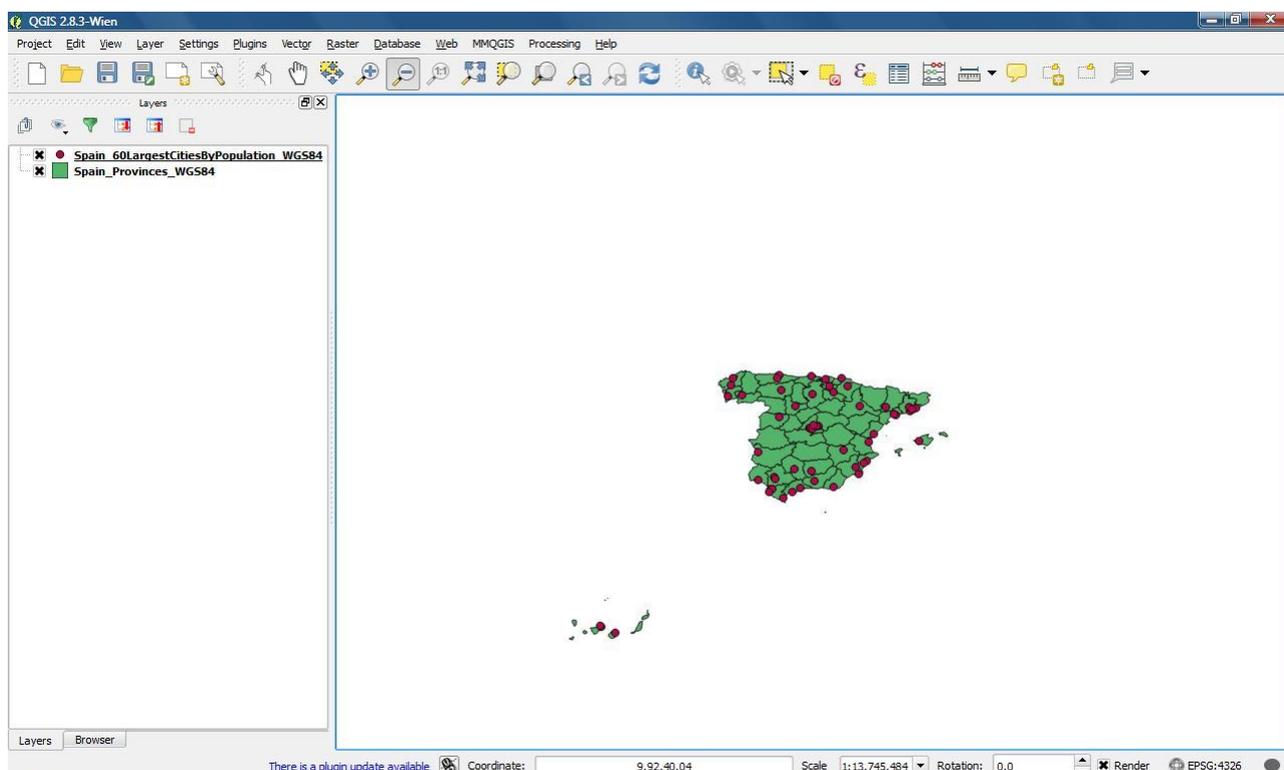
Tip: If you have zoomed out too far, you may reverse your action by using the Zoom Last tool or the Zoom In tool. Remember to use the Pan tool to centre your map for better viewing if required.

11. Zooming may also be accomplished with a mouse wheel. If your mouse has a wheel then position the pointer over the objects in the **Map Canvas;** scroll up and down and see what happens.

    Note: Using the mouse wheel will zoom to or away from map objects. When experimenting with the mouse wheel and zooming, the Pan, Zoom Last and Zoom Next tools may be used to control the positioning and extent of map objects.

12. Hit the **Zoom Full** tool button to return the map to its original and full extent.

    Note: This tool (Zoom Full) changes the view so that the entire map is fully visible, centred and zoomed to its full extent.

    Now that you've learnt about the pan and zoom map functions, you will learn about a very important tool known as the Identify tool.

13. Disable the cities layer.

14. Select/Highlight the polygon layer (**"Spain_Provinces_WGS84"**) in the **Layers Panel** and then select/enable the **Identify** tool from the **Toolbar** list.

15. Position your mouse over any of the provinces in the layer and left-click.
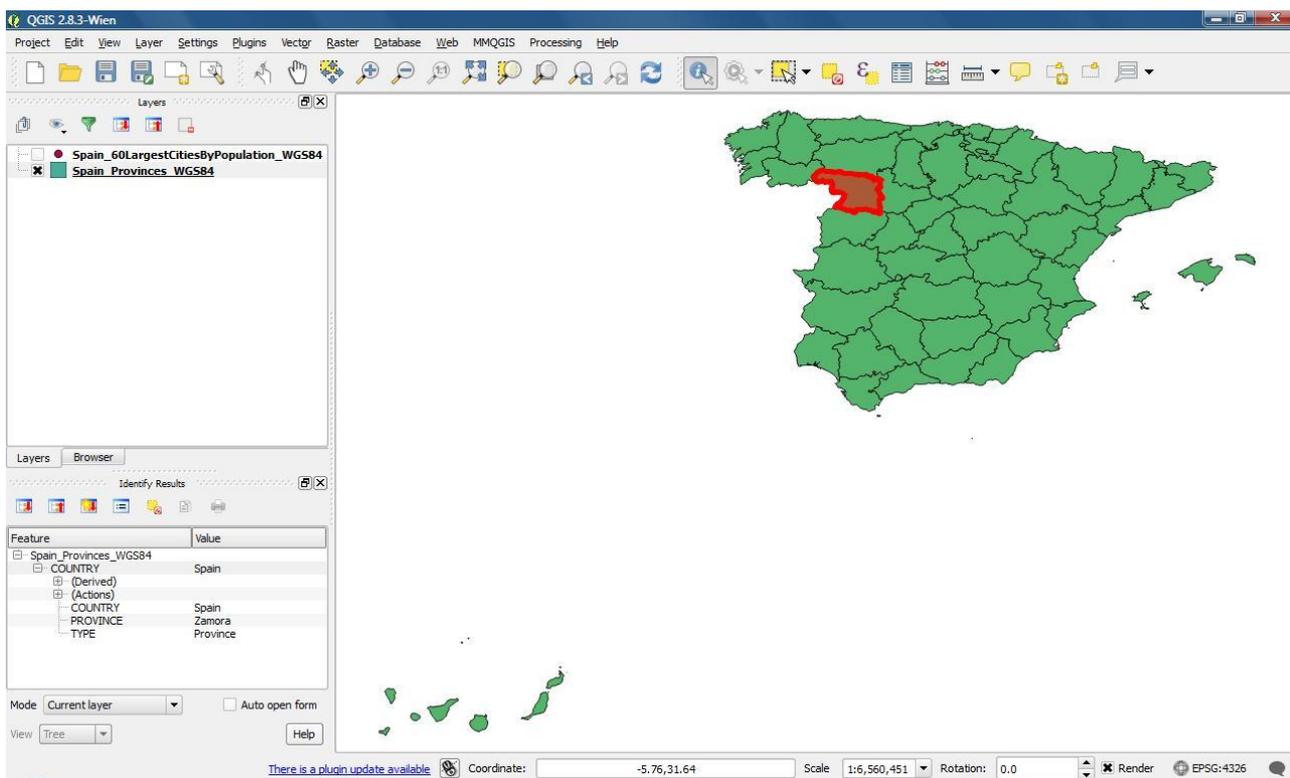
A new window should appear on your interface like that which is shown below.
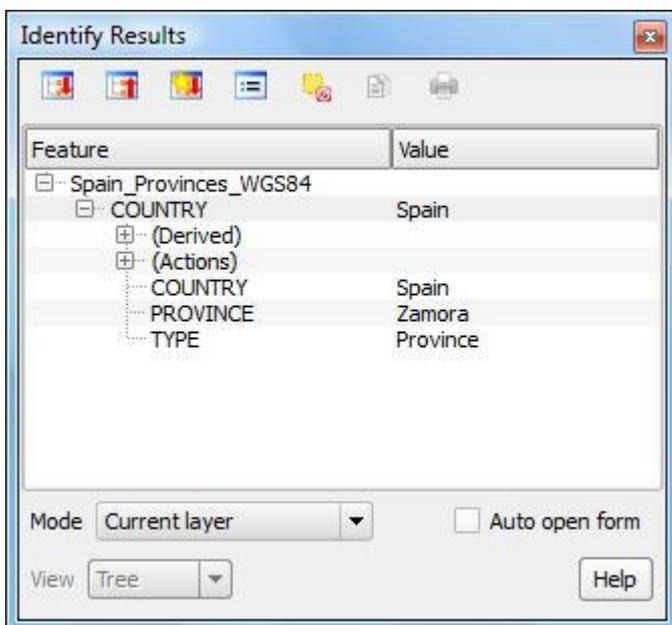
This is the Identify Results table. Once activated, it will most likely be docked underneath the section with the Browser and Layers panels. To get a better view of this tool, it is best to undock it and resize the window. Do the following:

16. Undock the **Identify Results** table by double clicking in the area highlighted in the image below.

Double –click here
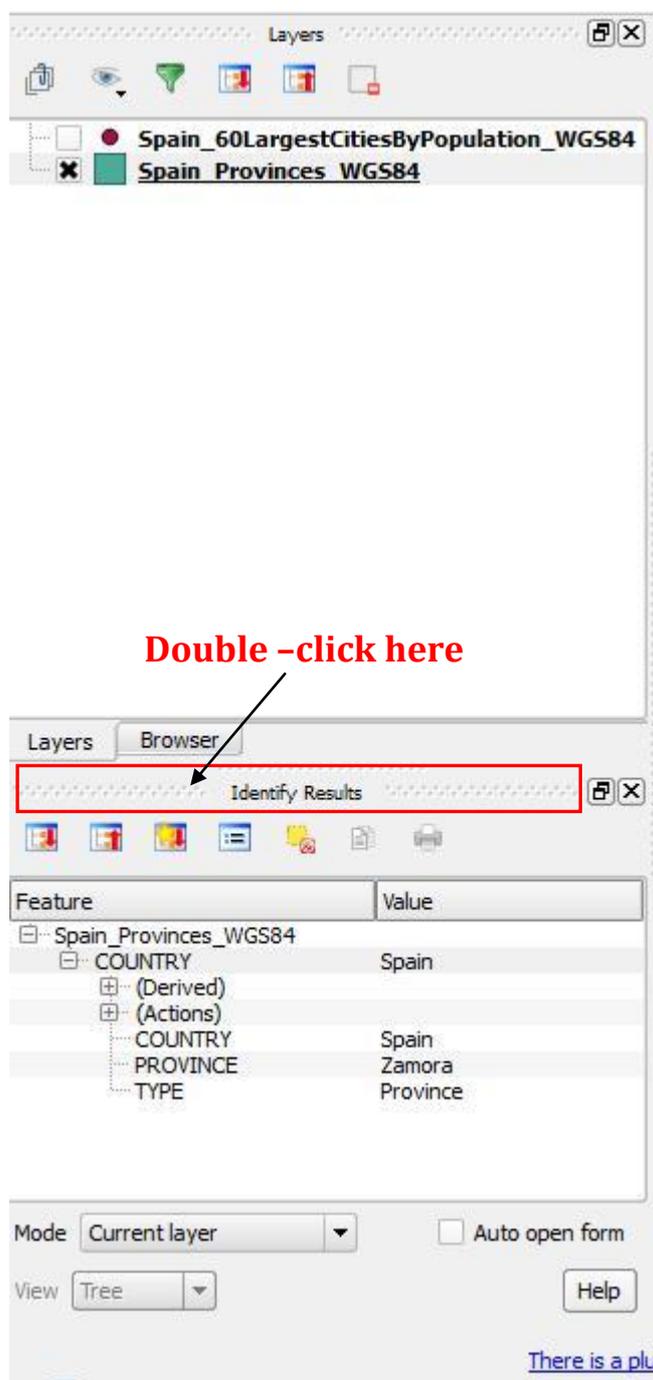
17. If necessary, resize the window so that all of its contents are visible.
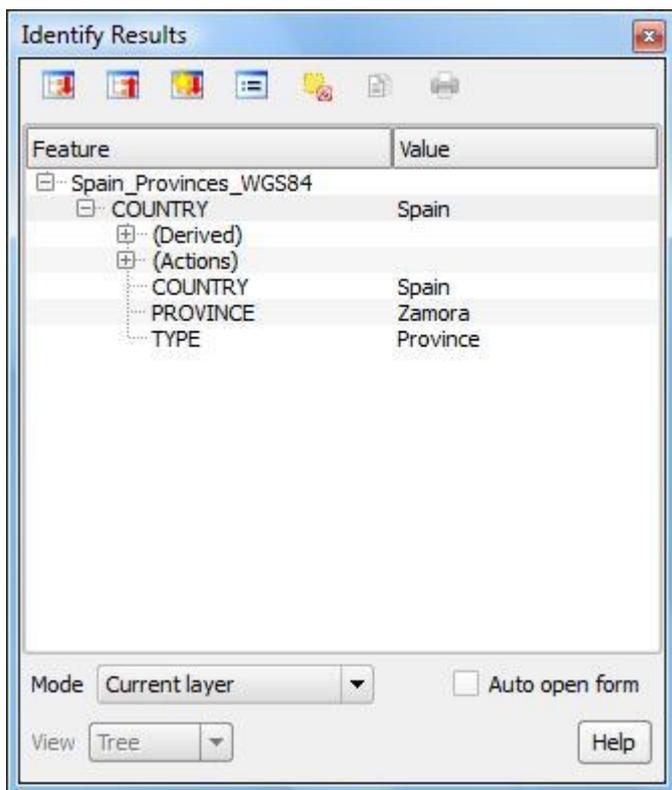
Note: The Identify Results table provides details on the feature you clicked on with the Identify Tool. Under the Feature column, the table currently lists names of 3 fields of information (i.e. COUNTRY, PROVINCE and TYPE.). The "COUNTRY" field lists the name of the country of each province. The "PROVINCE" field lists the names of the provinces and the "Type" field indicates the category of administrative division within the country. These fields are known as data attributes and the corresponding data shown in the Value column may be used to aid analysis. The illustrated example shows attribute data for the Province of Zamora.

Information in the Identify Results table may also be viewed in another way. Locate and click the "View Feature Form" icon at the top of the Identify Results table.

This will launch a separate table that presents the data attributes in a more user-friendly manner, via the use of a form. Refer to the image on the right.

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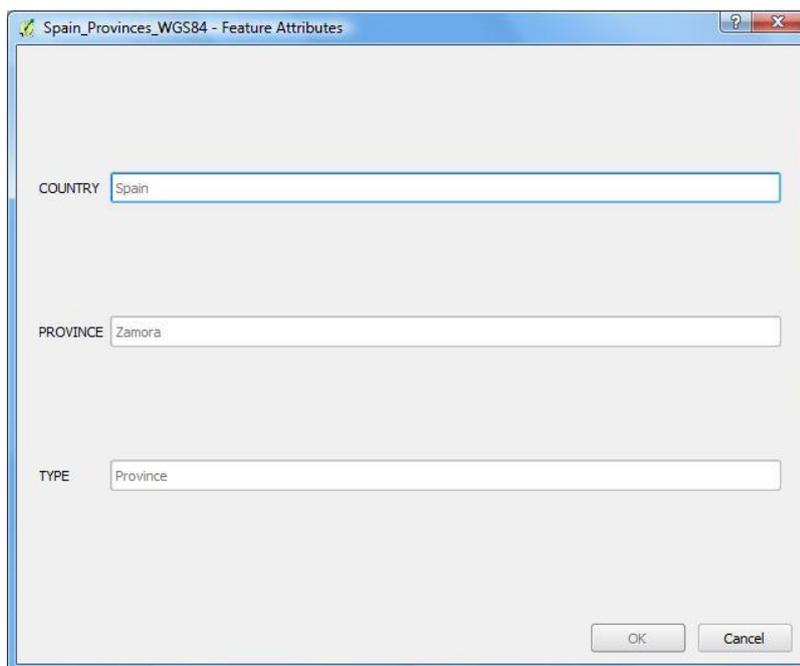
18. After reviewing the data attributes of the Provinces layer, close the form window.

19. Return the **Identify Results** table to its original dock location by double clicking in the same area used to undock it.

Tip: You can set the Identify Tool to automatically open a feature form when used. Do this by selecting the Auto open form option as shown below. If this option is selected, the next time the tool is used, a form will automatically pop up displaying attribute information for the feature you have clicked on.
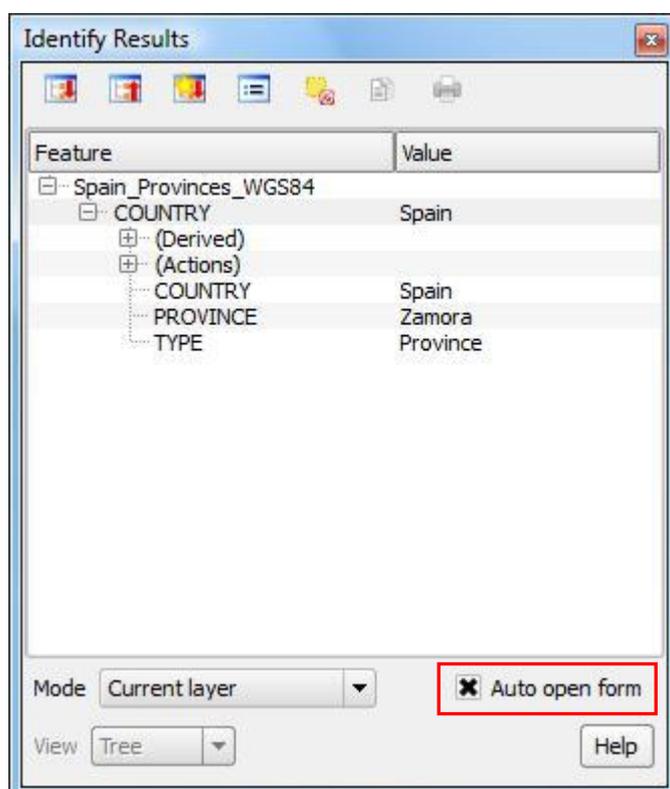
Close the Identify Results table to remove it from the interface.

20. Practise using the Identify Tool to obtain attribute information for other provinces in Spain and also for various points in the cities layer.

Tip: For use of the Identify Tool with cities, recall that this layer was previously disabled. You will therefore need to first re-enable it before proceeding. You are also reminded that the Identify Tool only works on layers that have been highlighted in the Layers Panel. Finally, you are advised to zoom in before attempting to click on city points with the Identify Tool. This is because it is sometimes harder to accurately select points with the Tool at larger map scales.

Tip: You may use the Zoom Full tool to return all map objects to the full extent of view after zooming in.

21. Close the **Identify Results** table and all associated forms that were opened and return all map layers to the full extent.

4   THE DATA PROPERTIES MENU

There are ten categories of data properties that may be explored for any data layer loaded in the **Layers Panel**. Many of these properties may be changed in different ways to enhance visualization of data or support more effective analysis. In other instances, these properties may be accessed simply to obtain information about the dataset. In this section, the data properties menu for the cities layer will be explored. Some of the categories under the properties menu will be illustrated and briefly explained.

1. Right-click on the cities layer in the **Layers Panel** and select **{Properties}** from the menu.

    Note: The {Properties} menu should appear as shown below.
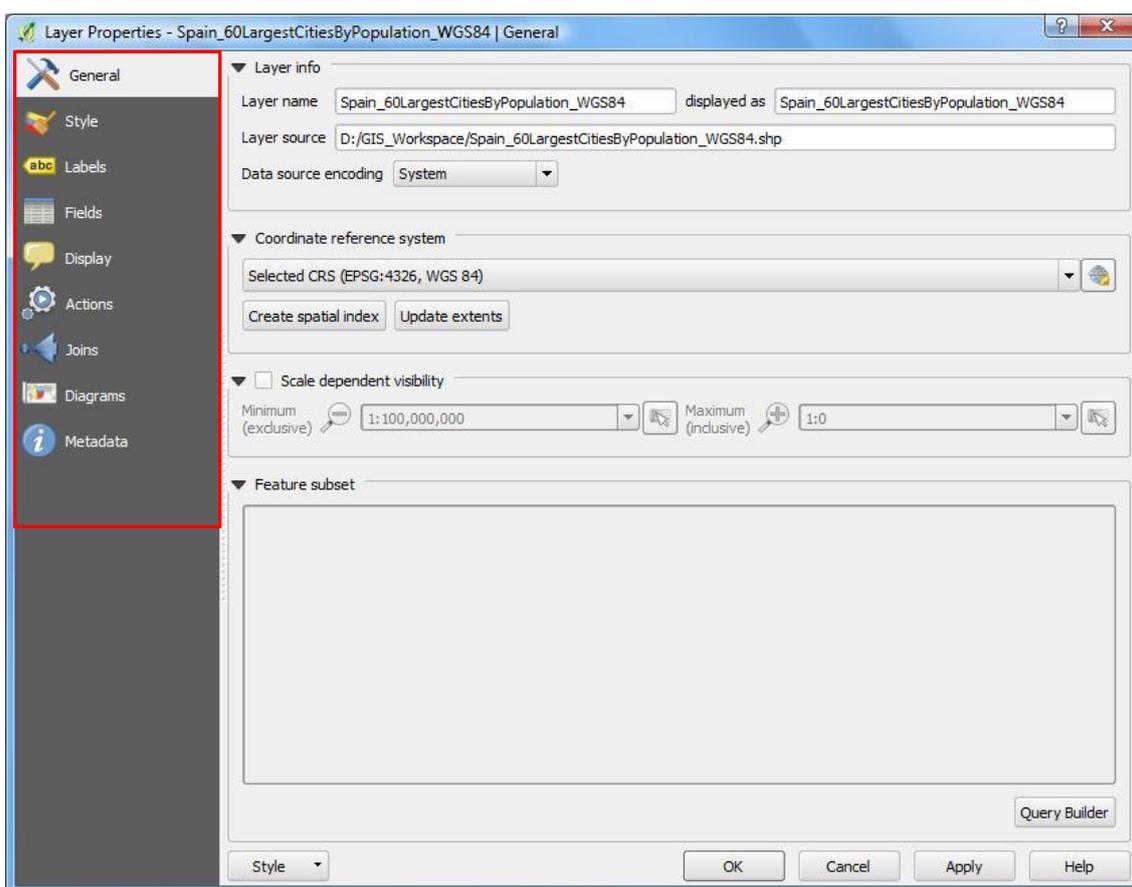
Tip: The {Properties} menu may also be accessed by first highlighting a layer in the Layers Panel and then browsing to {Properties} within the main [Layer] menu.

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As seen in the previous image, the ten data property categories are listed vertically on the left of the menu. These are as follows:

- ➤ **General**
- ➤ **Style**
- ➤ **Labels**
- ➤ **Fields**
- ➤ **Rendering**
- ➤ **Display**
- ➤ **Actions**
- ➤ **Joins**
- ➤ **Diagrams**
- ➤ **Metadata**

Clicking on any of the categories on the left opens up menu options on the right which may be accessed to obtain information about the data layer or to change the layer's characteristics for the purposes of visualization and/or analysis. Four of these category tabs which will be accessed in further workshop exercises are briefly explained below.

4.1   The General Properties-Tab

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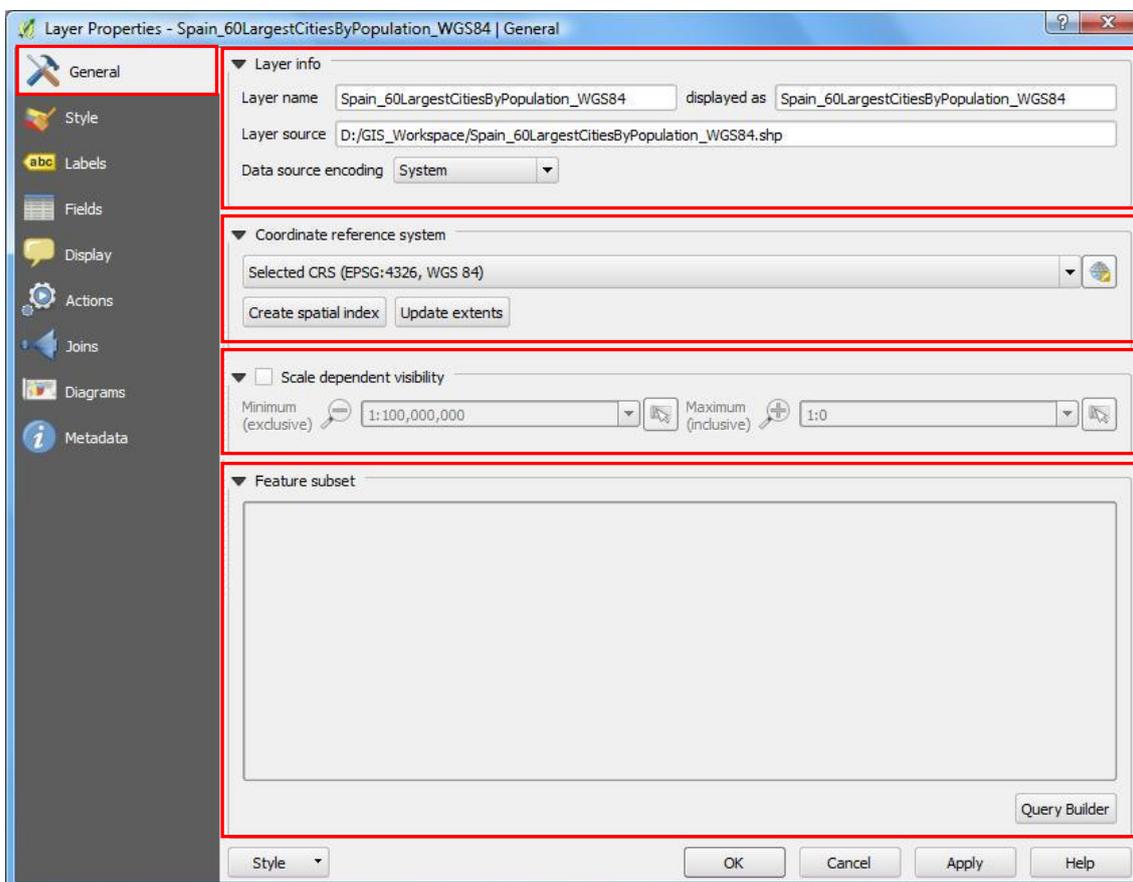
Sections of the General properties-menu are described below:

- **Layer Info** – This section of the menu may be accessed to:

  - Change the layer name as it is displayed in the Layers Panel

  - See the file path to the data layer as stored on the system - This is particularly useful when dealing with multiple datasets stored in different locations. Knowing where your data is located is very important when conducting geoprocesses.

- **Coordinate Reference System** – This section provides information about the Coordinate System the layer is registered in. Understanding the coordinate systems applied to all datasets in the **Layers Panel** is important. The type of coordinate system associated with a data layer can have implications for processes that may need to be carried out on the layer. Also, because of the need for compatibility between layers used in analysis or for mapping purposes, it is always important to know what coordinate system your layer uses.

- **Scale Dependent Visibility –** This part of the menu is used to control the range of scales for which features in your data layer are visible. For example, at larger scales, it may be difficult to absorb high levels of detail in some features. Therefore, this setting may be used to render these complex features invisible until one zooms to a smaller map scale where the features can be better assimilated.

- **Feature Subset –** Features within a data layer may be hidden from view by entering an expression into this field with the **Query Builder**. Some exposure to query building will be provided in further exercises.

4.2 The Style Properties-Tab
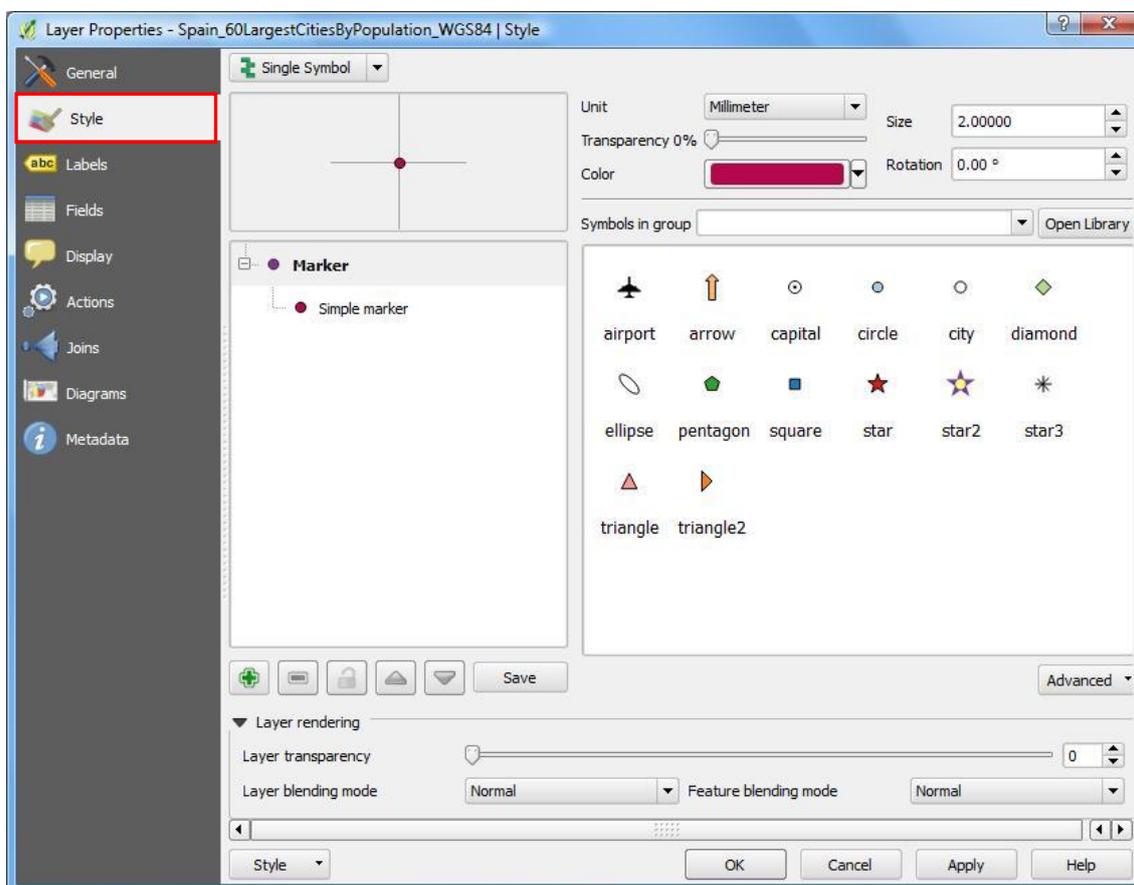
This menu is used to change the way layers are rendered in QGIS. Changes made here will impact the way a layer appears in the **Map Canvas**. Examples of changes that can be made are as follows:

> Colours used to render vector and raster files may be changed using a wide array of options.

> Symbols used to represent vectors can be changed, also using a wide variety of options

> The presentation of data layers may be changed to reflect categorization using attribute information for visualization and analytical purposes.

> Other visualization characteristics can also be applied. For example, layers can be made transparent to a specified degree.

More in-depth exploration of the **Style** properties will be conducted in Practical Exercise 1B.

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4.3 The Labels Properties-Tab
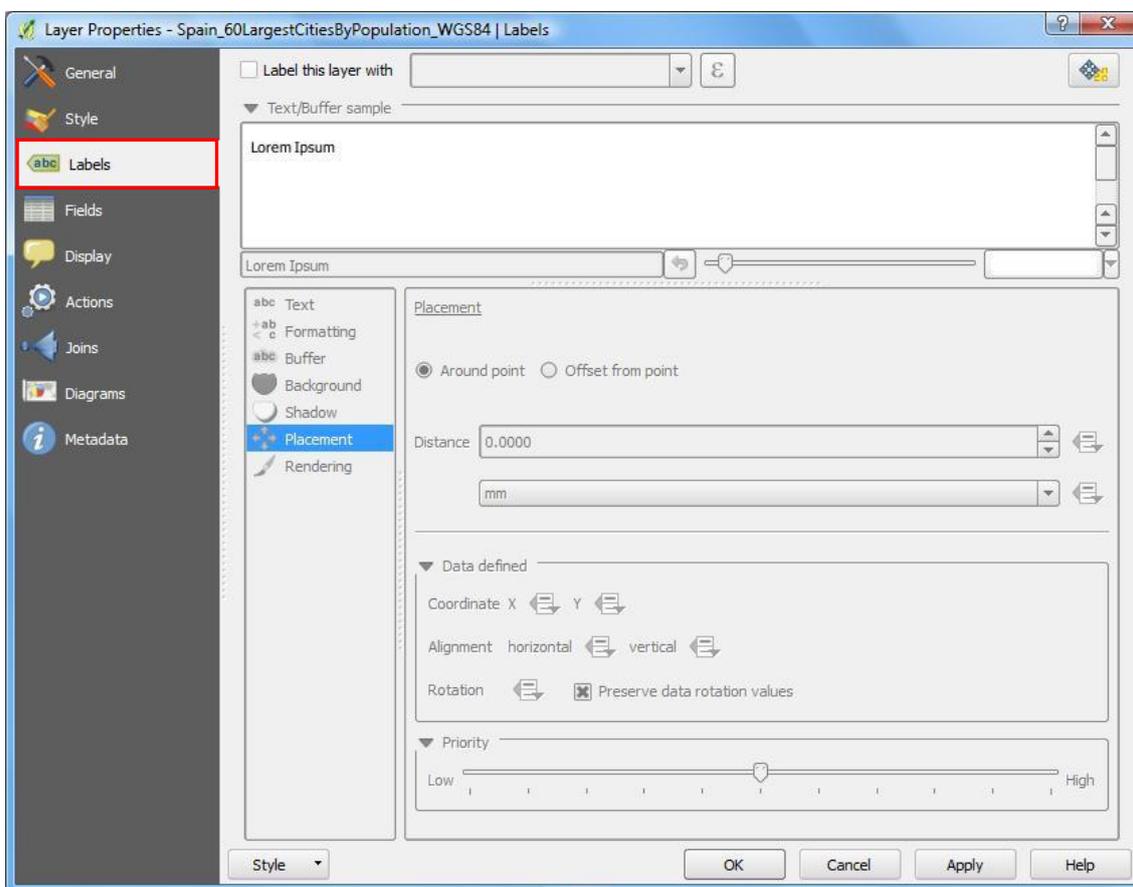
Labelling of features in layers is often a requirement for mapping and visual analysis. The ability to use a layer's attribute information for labelling is provided by this menu. There are also a set of controls within this menu that help to place labels appropriately on a map so that they can be properly seen and/or so that they do not obstruct the view of other important information being portrayed. Use of this menu will be demonstrated in **Practical Exercise 1B**.

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4.4 The Metadata Properties-Tab
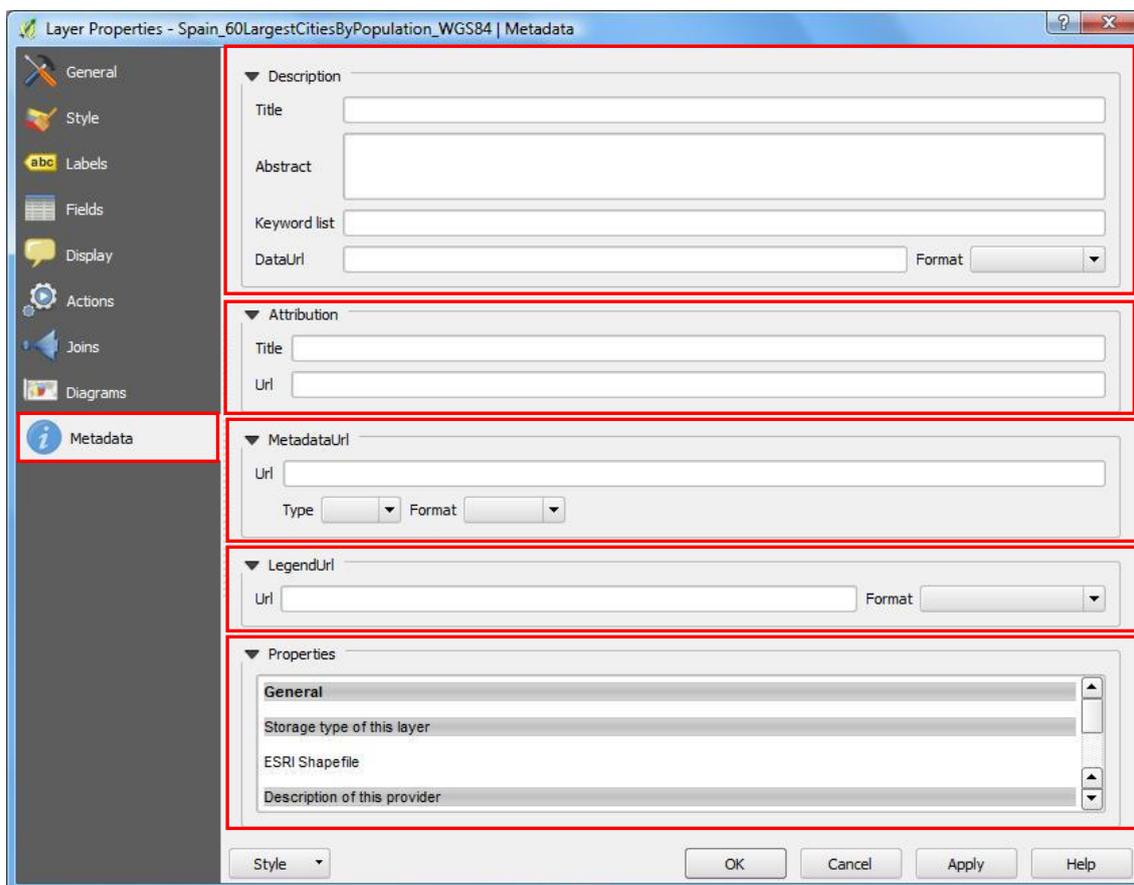
Metadata is often an overlooked part of data management in GIS. However, if metadata has been assigned to layers you are working on, it can be accessed here. You may also use this tab to add metadata to your layers as follows:

> The **Description** section – You can use this section to add information which describes the dataset. For example under the **Abstract** field, you may choose to write a brief summary of what the data illustrates, when it was prepared, the purpose of its creation and any other relevant piece of information about the data which other users may find useful.

> The **Attribution** section – Use this section to provide a link to an external site which informs users of the source of the data or those who may be responsible for its creation.

> **MetadataUrl** section – Sometimes metadata is available via an external online source in html or text-based format. If such a metadata source exists for the layer in question. You may add the address for it here.

> **LegendUrl**– Add a link to an external legend here

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➢ **The Properties** section provides basic information about most vector and raster layers. Examples of information obtained in this section of the menu include:

- o The file format (ESRI Shapefile, Geotiff etc.)

- o The file source (i.e. the location of file on the system)

- o The nature of the file (e.g. whether a vector polygon, point or line or a raster etc.)

- o Geographical extent of the layer (i.e. the bounding coordinates)

- o The spatial reference system applied to the layer

This concludes **Practical Exercise 1A**. Hopefully you now have an appreciation for some of the key features of the interface and are ready to explore **Practical Exercise 1B** which addresses some of the basic workflow operations involving vector and raster data in QGIS**.**