

Hands-on Exercise 1: Your First Date with QGIS

This hands-on exercise introduces you to QGIS (formally known as Quantum GIS), a full-features open source GIS software. It consists of two sections. First, it shows you how to download and install QGIS in your working computer. The second section of this exercise shares with you the basic operations of a GIS software in general and the graphic user interfaces (GUIs) of QGIS specifically.

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Download and Install QGIS

This section provides you with step-by-step guide on how to download and install QGIS in your window-based computer (i.e. desktop or laptop).

Download QGIS installer

- Launch the web browser.
- In the address bar at the top of the window, enter <http://qgis.org/> and press **Enter**.

The website should look something like this:

The screenshot shows the QGIS website homepage. At the top, there's a navigation bar with links for 'DISCOVER QGIS', 'FOR USERS', 'GET INVOLVED', and 'DOCUMENTATION'. On the far right, there's a language selection dropdown set to 'English'. Below the navigation, the QGIS logo is displayed with the text '3.20.1' and '3.16.9 LTR'. A banner at the top of the main content area announces 'QGIS 3.20 Odense has been released!' with a small orange QGIS icon. The background of the banner features a historical map of a city. Below the banner, there's a section with the text 'Create, edit, visualise, analyse and publish geospatial information on Windows, Mac, Linux, BSD and mobile devices' and 'For your desktop, server, in your web browser and as developer libraries'. At the bottom of the page, there's a footer with links for 'INSTALLATION DOWNLOADS', 'ALL RELEASES', and 'SOURCES'.

- Click on **Download Now** button.

Your screen should look similar to the figure below.

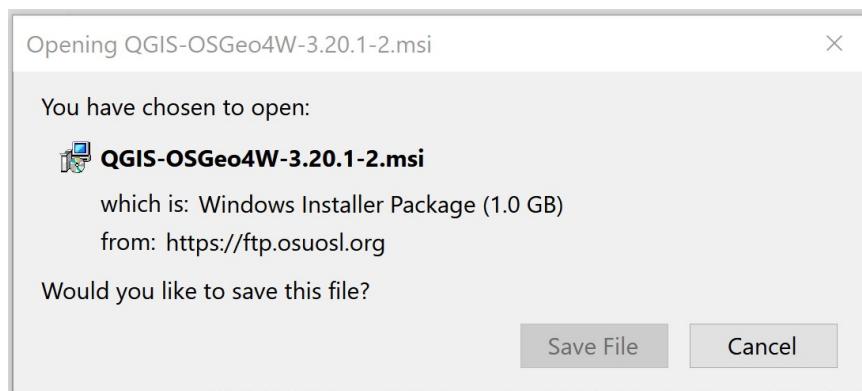
The screenshot shows the 'Download QGIS for your platform' page. The top navigation bar is identical to the previous screenshot. The main content area has a heading 'Download QGIS for your platform'. Below it, there's a paragraph about binary packages (installers) and the current version (QGIS 3.20.1 'Odense'). It also mentions long-term repositories offering QGIS 3.16.9 'Hannover'. A navigation bar at the bottom includes 'INSTALLATION DOWNLOADS' (which is highlighted), 'ALL RELEASES', and 'SOURCES'. Below this, a specific section for 'Download for Windows' is shown, featuring a link to the 'OSGeo4W Network Installer'.

- Click on **QGIS Standalone Installer Version 3.20**.

The screenshot shows the 'QGIS Standalone Installer Version 3.20' download page. It features the QGIS logo and the text 'QGIS Standalone Installer Version 3.20'. Below this, there's a link for 'sha256'.

After a few seconds (depend on your network speed), a pop-up window appears

After a few seconds (depends on your network speed), a pop up window appears.



- Click on the **Save File** button.

When the file is downloaded, you are going to install QGIS into your computer.

Install QGIS

In this section, you will learn how to install QGIS into your computer.

- Find the QGIS installer on your computer, right-click and select **Run as administrator** from the context menu to launch the setup.
- Click on the **Yes** button when Windows prompt you with the dialog "Do you want to allow this app to make change to your device?"

After a few second, the Setup Wizard dialog window appears.

- Click on the **Next** button.

The next setup dialog window appears.

- Click on the **I Agree** button.

The Setup dialog window appears.

- Ensure that the Destination Folder is at **C:Files**.
- Click on the **Next** button.

The Setup dialog window should look similar to the figure below.

- Click on the check box in front of the extra datasets that you would like to install.
- Click on the **Install** button.

QGIS will begin to install. It may take a few minutes to install so be patient.

When the QGIS Setup Winzard appears

- Click on **Finish** button.

- Click on **FINISH** button.

Congratulations! You have installed QGIS successfully!

Hello QGIS

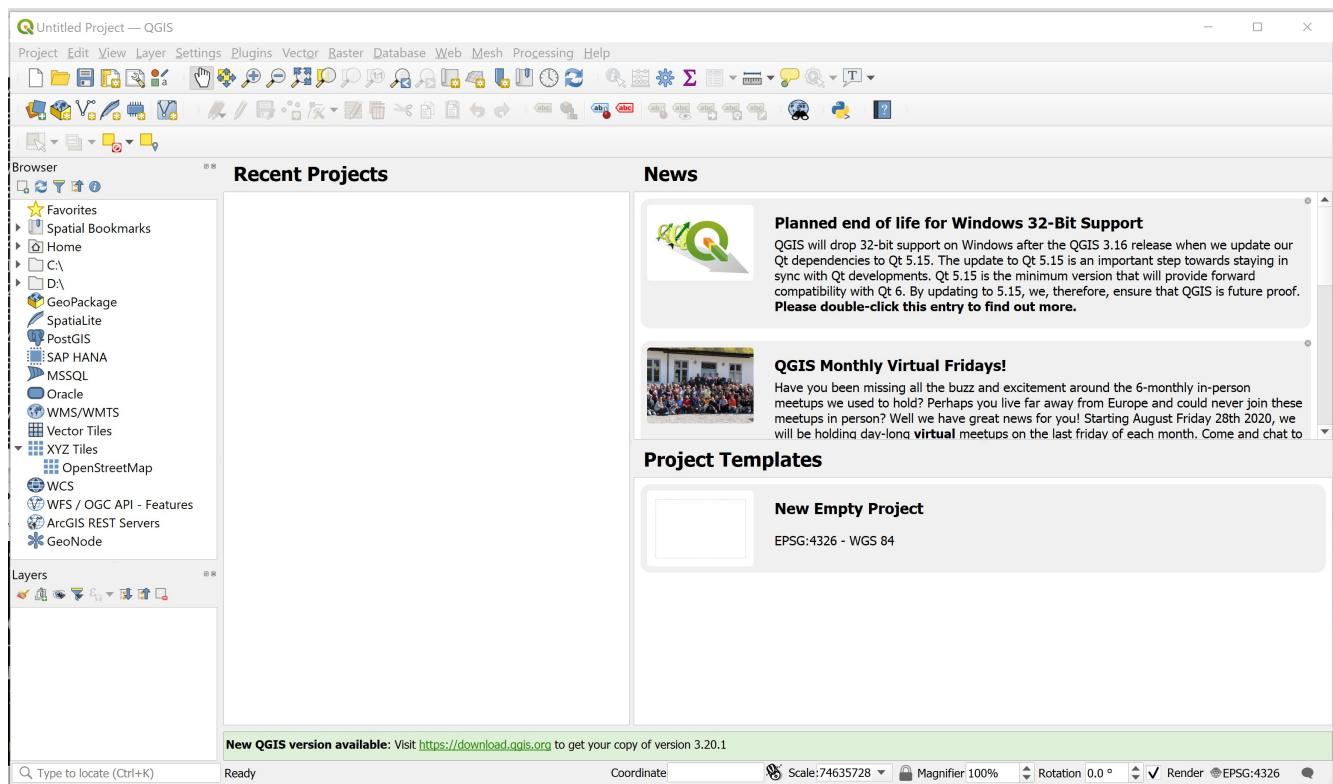
Now, you are ready to launch QGIS.

- At your window, double-click on **QGIS Desktop3.20** icon.

After a few seconds, QGIS window appears.

- On the *QGIS Tips! Dialog* window, click on the **OK** button.

Your screen should look similar to the figure below.



Getting to know a GIS project file

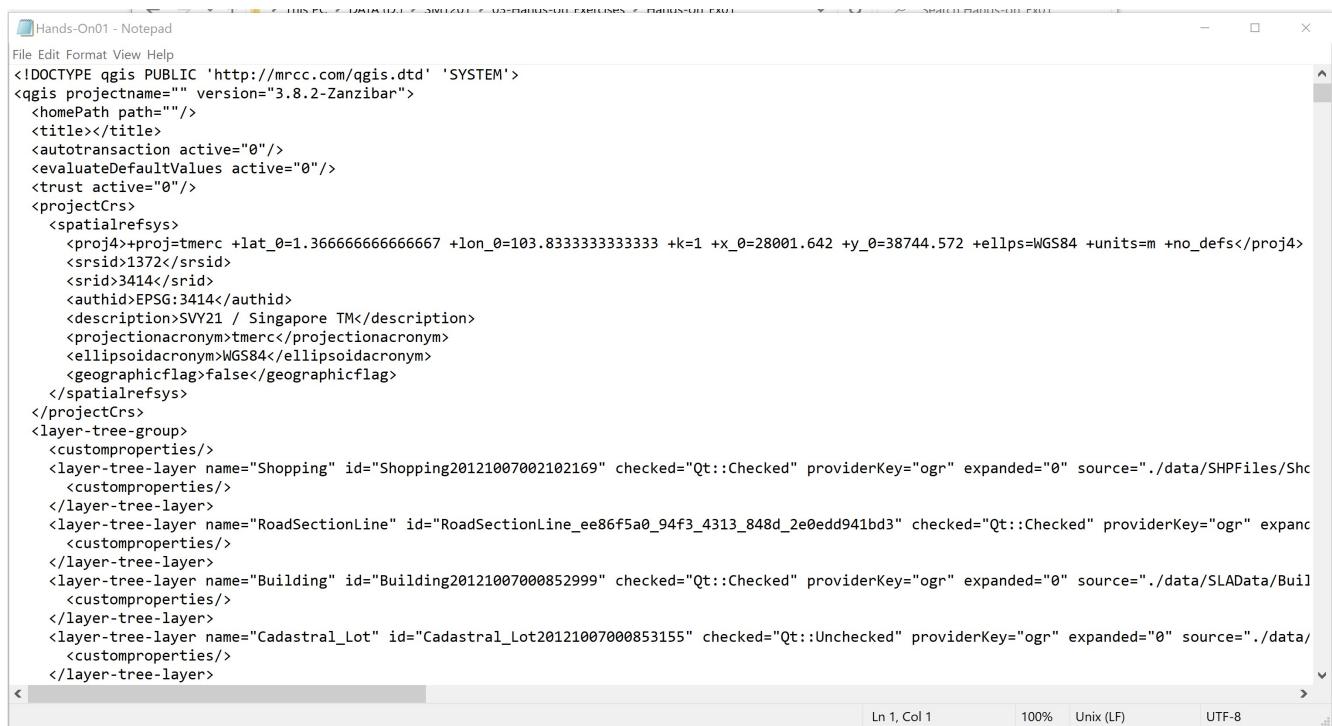
A GIS project file provides a link between the GIS software and the geospatial datasets instead of stored data. It also contains GIS operation configurations such as symbolisation used, data classification, map projection, the paths of each data and map design. In this section, you will explore an existing QGIS's project file called Hands-on01.qgs.

- Start Window Explorer.
- Navigate to \SMT201\Hands-on_Ex01\ sub-folder.

You will find a file called `Hands-on01.qgs` in the sub-folder

- Right-click on Hands-On01.qgs.
- Select **Open** with from the context menu.
- Use the **Notepad** to open the file.

The Notepad window should look similar to the figure below.



```
<!DOCTYPE qgis PUBLIC 'http://mrcc.com/qgis.dtd' 'SYSTEM'>
<qgis projectname="" version="3.8.2-Zanzibar">
  <homePath path="/" />
  <title></title>
  <autotransaction active="0"/>
  <evaluateDefaultValues active="0"/>
  <trust active="0"/>
  <projectCrs>
    <spatialrefsys>
      <proj4+proj=tmerc +lat_0=1.36666666666667 +lon_0=103.833333333333 +k=1 +x_0=28001.642 +y_0=38744.572 +ellps=WGS84 +units=m +no_defs</proj4>
      <srsid>1372</srsid>
      <srid>3414</srid>
      <authid>EPSG:3414</authid>
      <description>SVY21 / Singapore TM</description>
      <projectionacronym>tmerc</projectionacronym>
      <ellipsoidacronym>WGS84</ellipsoidacronym>
      <geographicflag>false</geographicflag>
    </spatialrefsys>
  </projectCrs>
</layer-tree-group>
<customproperties/>
<layer-tree-layer name="Shopping" id="Shopping20121007002102169" checked="Qt::Checked" providerKey="ogr" expanded="0" source=".//data/SHPFiles/Shc">
  <customproperties/>
</layer-tree-layer>
<layer-tree-layer name="RoadSectionLine" id="RoadSectionLine_ee86f5a0_94f3_4313_848d_2e0edd941bd3" checked="Qt::Checked" providerKey="ogr" expanded="0" source=".//data/SLAData/Road">
  <customproperties/>
</layer-tree-layer>
<layer-tree-layer name="Building" id="Building20121007000852999" checked="Qt::Checked" providerKey="ogr" expanded="0" source=".//data/SLAData/Build">
  <customproperties/>
</layer-tree-layer>
<layer-tree-layer name="Cadastral_Lot" id="Cadastral_Lot20121007000853155" checked="Qt::Unchecked" providerKey="ogr" expanded="0" source=".//data/SLAData/Cada">
  <customproperties/>
</layer-tree-layer>
</layer-tree-group>
```

Notice that the QGIS project file is actually in XML format.

- Close Notepad.

Open an existing project file

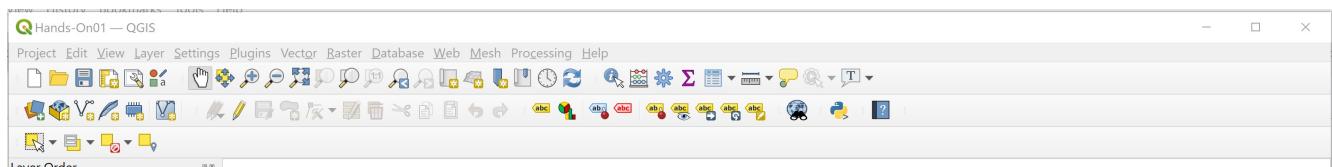
In this section, you will learn how to open an existing QGIS project file.

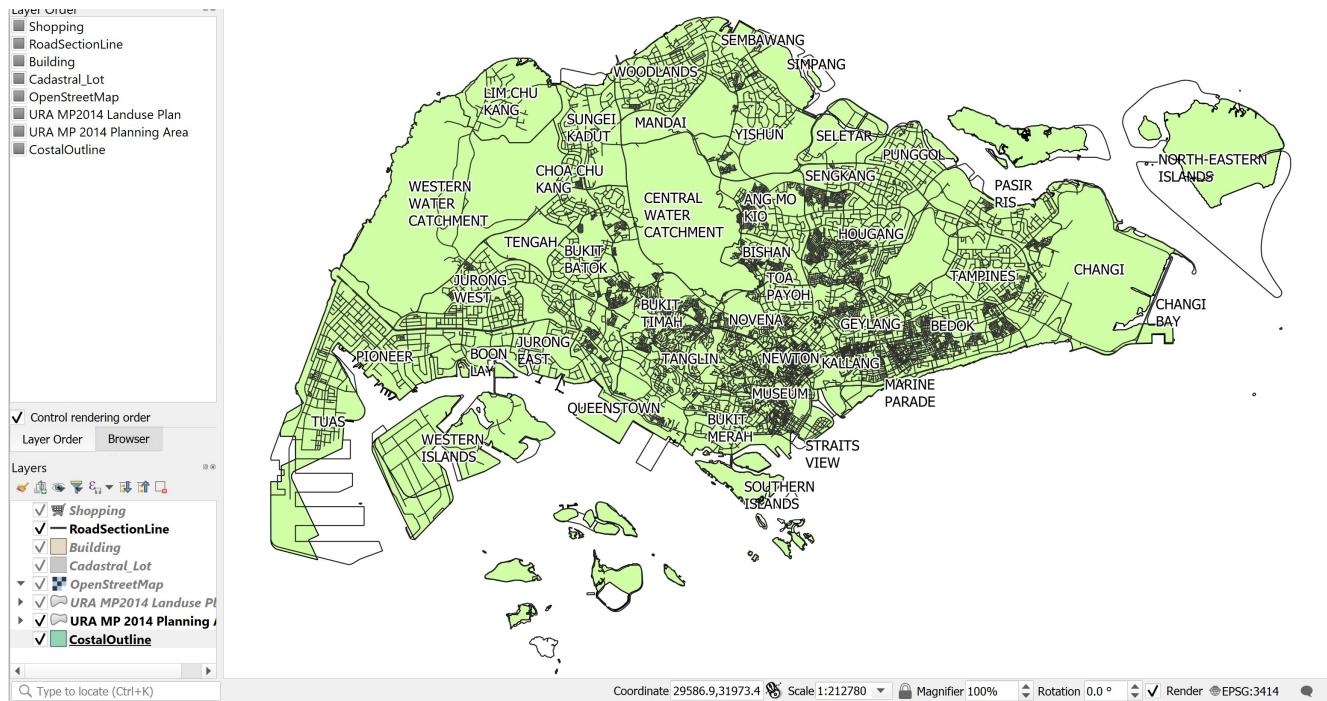
- From QGIS main menu, click on **Project -> Open**.

The Choose a QGIS project file to open dialog window appears.

- Navigate to \SMT201\Hands-on_Ex01\ sub-folder.
- Double-click on Hans-On01.qgs file.

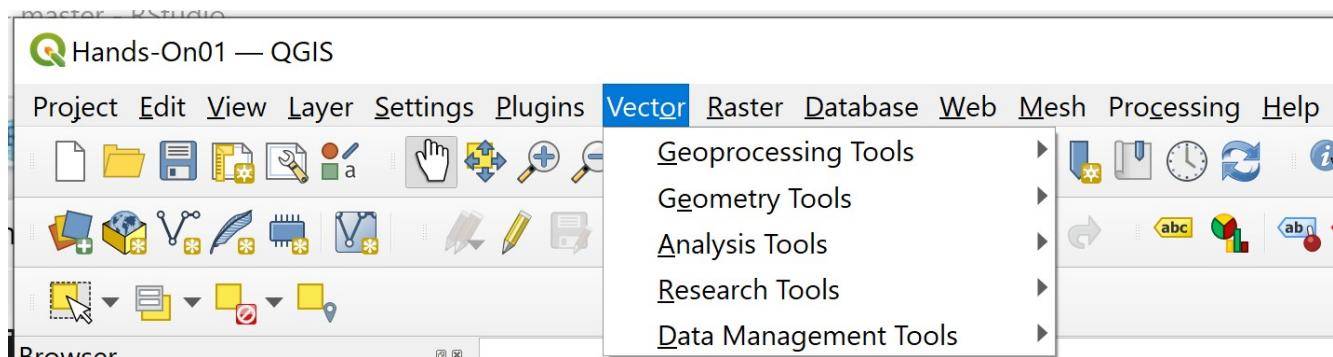
Your screen should look similar to the figure below.



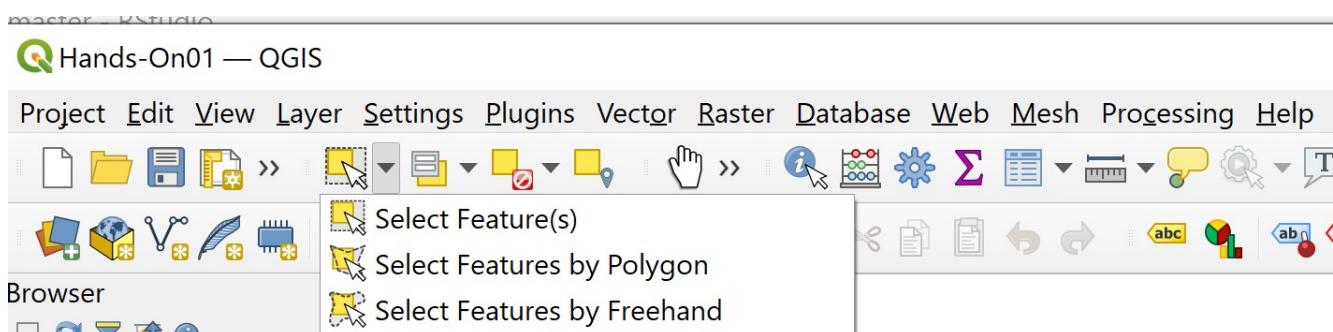


Exploring QGIS interfaces

The QGIS interface comprises six major components. They are: menu bar, toolbar, map legend, browser, status bar and map view. The **Menu Bar** provides access to various features and functions of QGIS using hierarchical menu. The location of the menu and menu items is fixed, although if you activate certain plugins, they may add an additional menu to the bar.

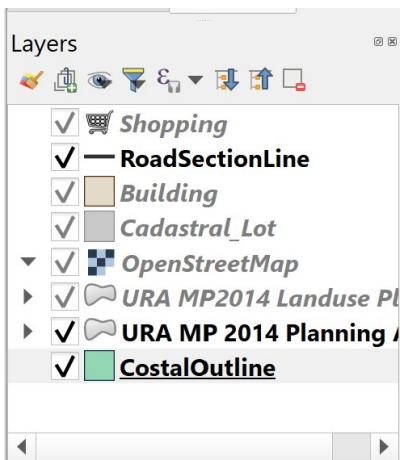


The **Toolbar** replicates many of the features and functions in the Menu Bar, providing access to common features in a single click. The location of the toolbar is not fixed; if you hover over the edge of the toolbar and hold down the left mouse button you can drag the toolbar wherever you like.





The **Map Legend** lists data layers that are linked with the current project.



You can turn each of the data layer on and off by clicking on the checkbox in front of each data layer.

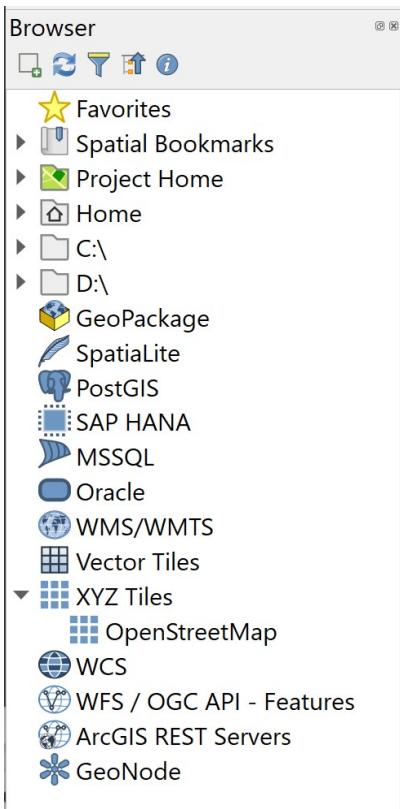
- From the Map Legend, click on the checkbox in front of CoastalOutline.

Notice that the Singapore boundary map on the Map View window disappears.

- Click on the checkbox in front of CoastalOutline again.

Notice that the Singapore boundary map on the Map View window reappears.

The **Browser**, a new feature in QGIS 2.0, allows users to see their file system and all of the GIS data files and databases. It also allows users to drag files from the file system into QGIS project.



The **Status Bar** shows the current scale of the map view, the coordinates of the current position of the cursor and the coordinate system used by the project. When a computation operation such as buffering is used, the progress meters will appear here to show the progress of the operations.



Last but not least, the **Map View** window displays all the active layers in the project.

Navigating the Map View

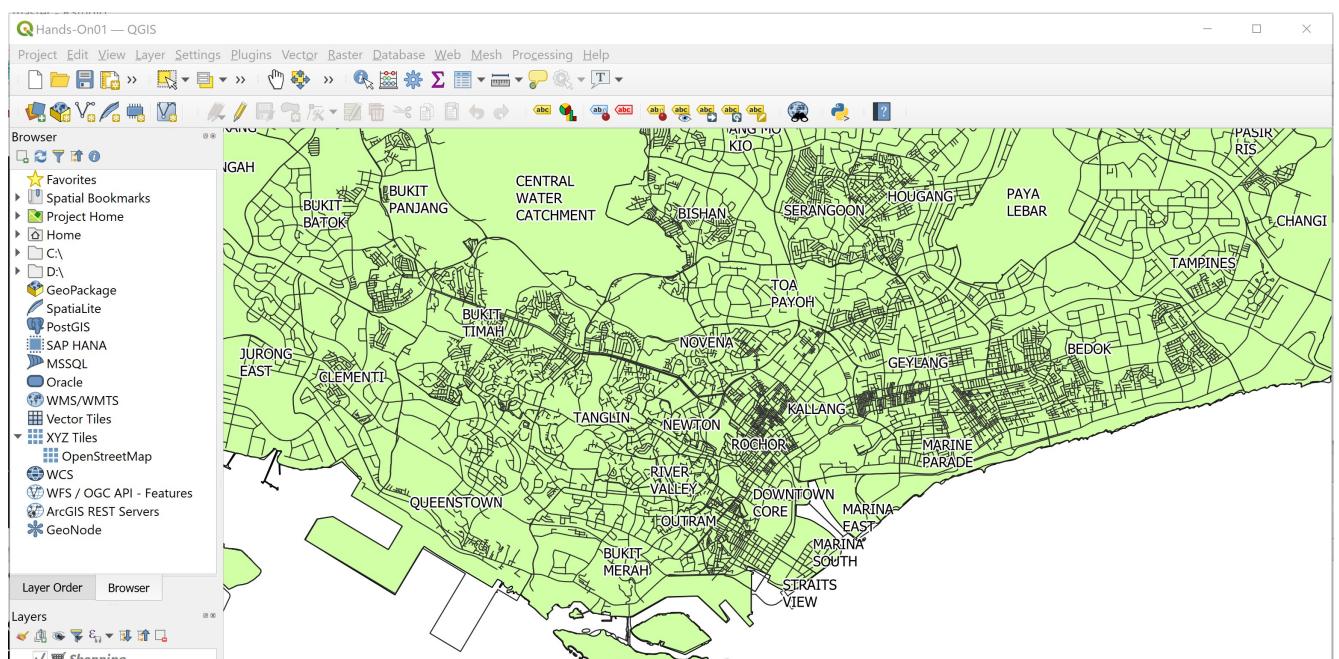
Navigating around a GIS view

In this section, you will learn how to navigate around the Map View. First, you will work with the navigation tools.



- From the **Toolbar**, click on the **Zoom In** tool.
- Hover the mouse to the centre of Singapore, click once.

Your screen should look similar to the figure below.





Notice that the map layer zooms into a new extent.

Now, you want to return to the previous extent.

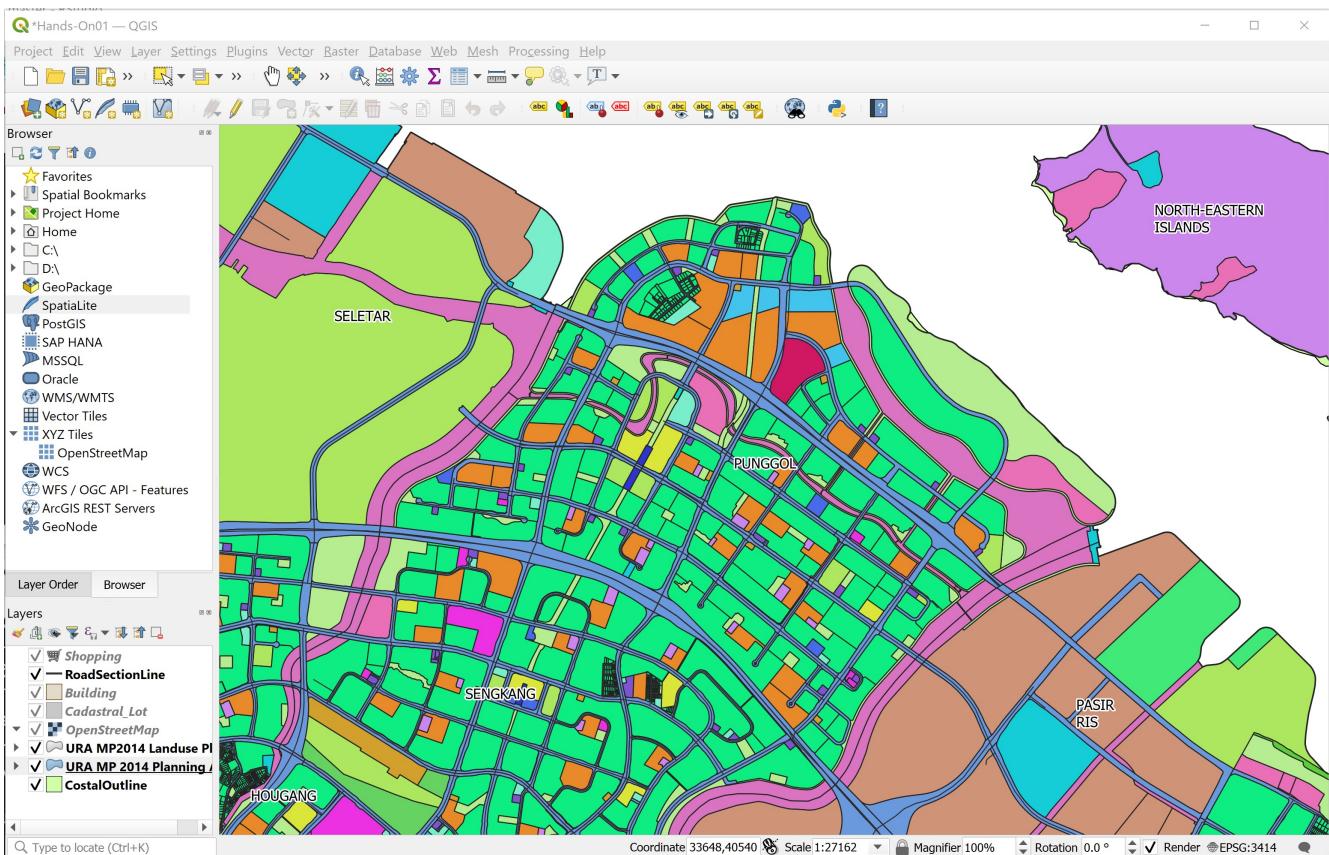
- From **Map Navigation Toolbar**, click on the **Zoom Last** tool.

Notice that the map view returns to the initial extant now.

Next, you will learn how to zoom into a specific location using the Zoom In tool. For example, we would like to zoom into the mark area as shown in the figure below.

- From **Map Navigation Toolbar**, click on the **Zoom In** tool.
- Hover the mouse over Punggol Planning Area.
- Press on the left button of the mouse, drag to form a rectangle around Puggol Planning Area.
- Release the left button.

Your screen should look similar to the figure below. Notice that the URA MP2014 Landuse Plan layer appears now.



Next, you will return to the previous extent using alternative zooming tool.

- From **Map Navigation Toolbar**, click on the **Zoom to Layer** tool.

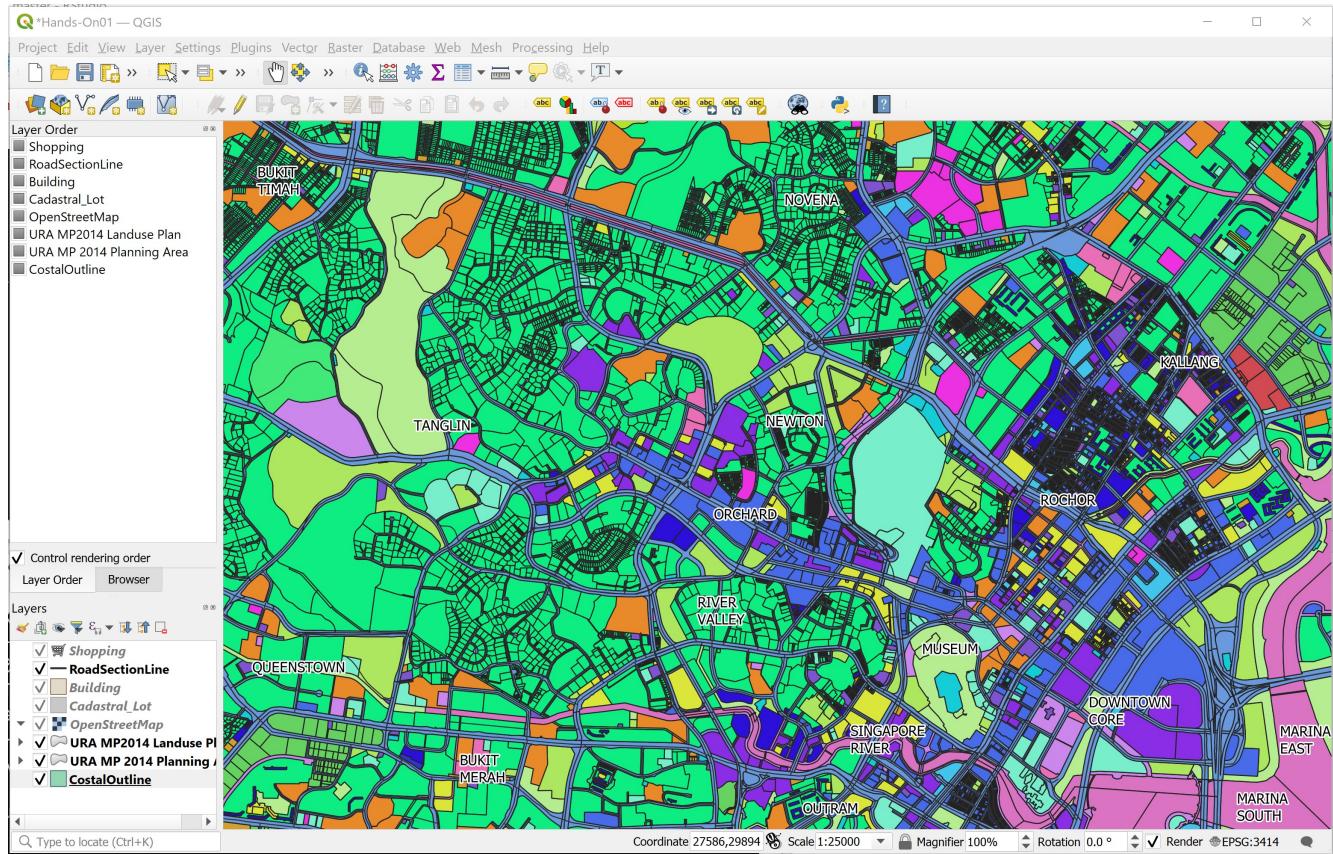
Notice that the map view returns to the previous state and *URA MP2014 Landuse Plan* layers are turned off again.

*DIY: Try out the remaining navigation tools in **Map Navigation Toolbar**.*

Map Navigation by changing the map scale

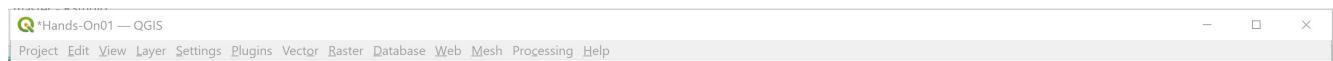
In this section, you will learn how to change the map view by changing the map scale.

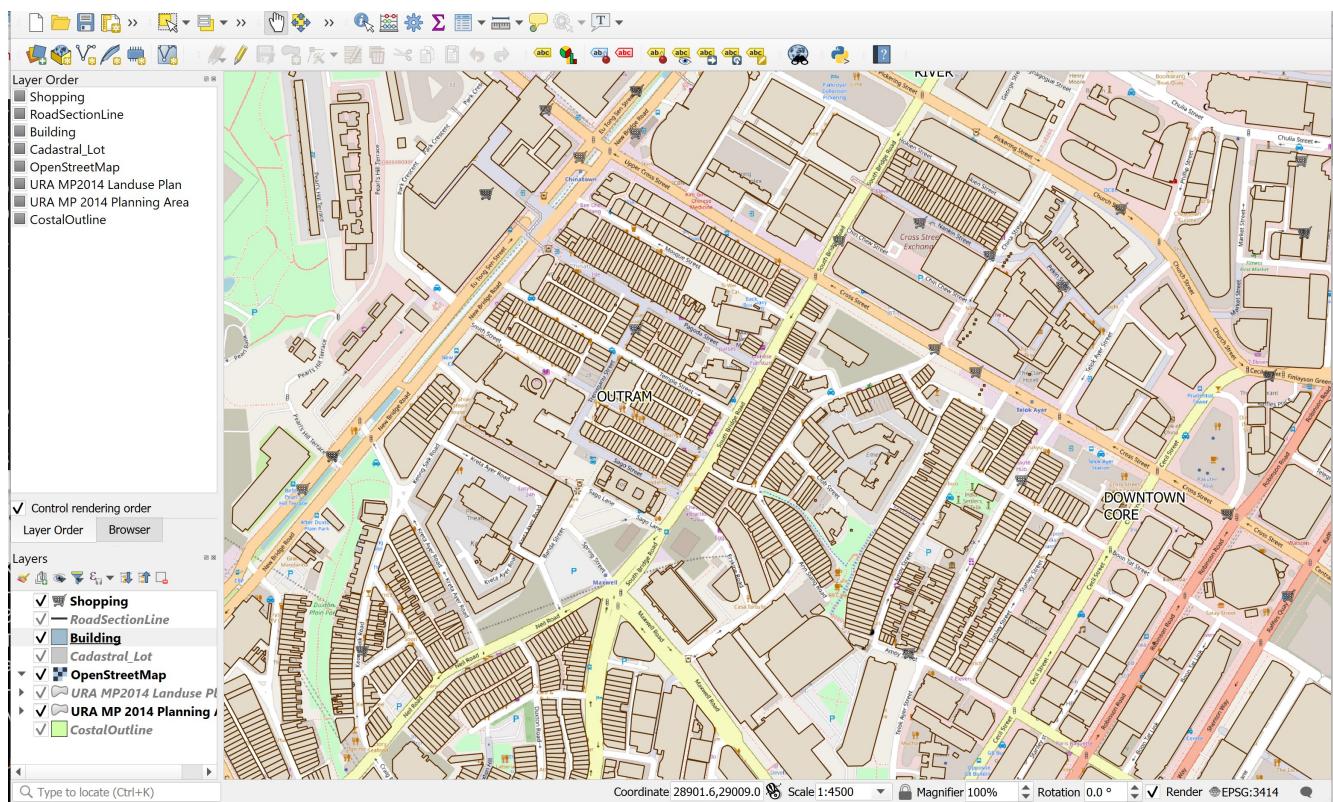
- From the **Status bar** (located below Map View), click on the drop-down list of **Scale**.
- Select **1:25,000**.
- Use the **Pan tool** to move the map area so that it looks similar to the figure below.



- From the **Scale** of at the **Status bar**, click on the drop-down list again.
- Select **1:4500**.

Your screen should look similar to the figure below. Notice that more detail appears when the map scale increases.





Exploring GIS data

In this section, you will learn how to interact with the features that appear in the Map View and retrieve their corresponding attribute information.

Exploring GIS Layer

In this sub-section, you will learn how to explore the information of individual GIS layer.

- From the **Map Legend** window, right-click on **Building** layer.
- Select **Properties** from the context menu.

The Layer Properties of Building layer appears. It provides the full metadata of Building layer, its symbolization configuration and the data fields.

Layer Properties — Building — Information

Information

Information from provider

Name	Building
Path	D:\SMT201\03-Hands-on_Exercises\Hands-on_Ex01\data\SLAData\Building.shp
Storage	ESRI Shapefile
Comment	
Encoding	UTF-8
Geometry	Polygon (MultiPolygon)
Extent	24295.278600008927658,26430.4446999998035608 : 32243.2765918396180496,31857.4965000005759066
Feature count	6,427

The screenshot shows the QGIS Layer Properties dialog for a 'Building' layer. The left sidebar lists various tabs: Diagrams, Fields, Attributes Form, Joins, Auxiliary Storage, Actions, Display, Rendering, Temporal, Variables, Metadata, Dependencies, and Legend. The 'CRS' tab is currently selected.

Coordinate Reference System (CRS)

Name: Custom CRS: PROJCRS["unknown",BASEGEOGCRS["unknown",DATUM["World Geodetic System 1984",ELLIPSOID["WGS 84",6378137,298.257223563,LENGTHUNIT["metre",1]],ID["EPSG",6326]],PRIMEM["Greenwich",0,ANGLEUNIT["degree",0.0174532925199433],ID["EPSG",8901]],CONVERSION["unknown",METHOD["Transverse Mercator",ID["EPSG",9807]],PARAMETER["Latitude of natural origin",1.366666666666667,ANGLEUNIT["degree",0.0174532925199433],ID["EPSG",8801]],PARAMETER["Longitude of natural origin",103.833333333333,ANGLEUNIT["degree",0.0174532925199433],ID["EPSG",8802]],PARAMETER["Scale factor at natural origin",1,SCALEUNIT["unity",1],ID["EPSG",8805]],PARAMETER["False easting",28001.642,LENGTHUNIT["metre",1],ID["EPSG",8806]],PARAMETER["False northing",38744.572,LENGTHUNIT["metre",1],ID["EPSG",8807]]],CS[Cartesian,2],AXIS["(E)",east,ORDER[1],LENGTHUNIT["metre",1],ID["EPSG",9001]],AXIS["(N)",north,ORDER[2],LENGTHUNIT["metre",1],ID["EPSG",9001]]]

Units: meters

Method: Transverse Mercator

Celestial body: Earth

Accuracy: Based on a dynamic CRS, but no coordinate epoch is set. Coordinates are ambiguous and of limited accuracy.

Reference: Dynamic (relies on a datum which is not plate-fixed)

Identification

OK Cancel Apply Help

By default, QGIS will display the general information of the selected layer. You can retrieve other information or configurations of the layer by clicking on the appropriate tab.

The key information available are as follows:

- Source shows the path of Building layer.
- Storage reveals the file type, i.e. ESRI Shapefile format.
- Geometry indicate the spatial object used to represent the real world feature.
- CRS shows the georeferencing information of the active layer (i.e. SVY21/Singapore TM).
- Unit is the unit measurement of the active layer.

Let us examine other tab.

- Click on **Rendering** tab.

Your screen should look similar to the figure below.

The screenshot shows the QGIS Layer Properties dialog for a 'Building' layer. The left sidebar lists various tabs: Information, Source, Symbology, Labels, Masks, 3D View, Diagrams, Fields, and Attributes Form. The 'Rendering' tab is currently selected.

Scale Dependent Visibility

Minimum (exclusive): 1:5000

Maximum (inclusive): 0

Simplify Geometry

Note: Feature simplification may speed up rendering but can result in rendering inconsistencies

Simplification threshold (higher values result in more simplification): 1.00 pixels

Simplification algorithm: Distance

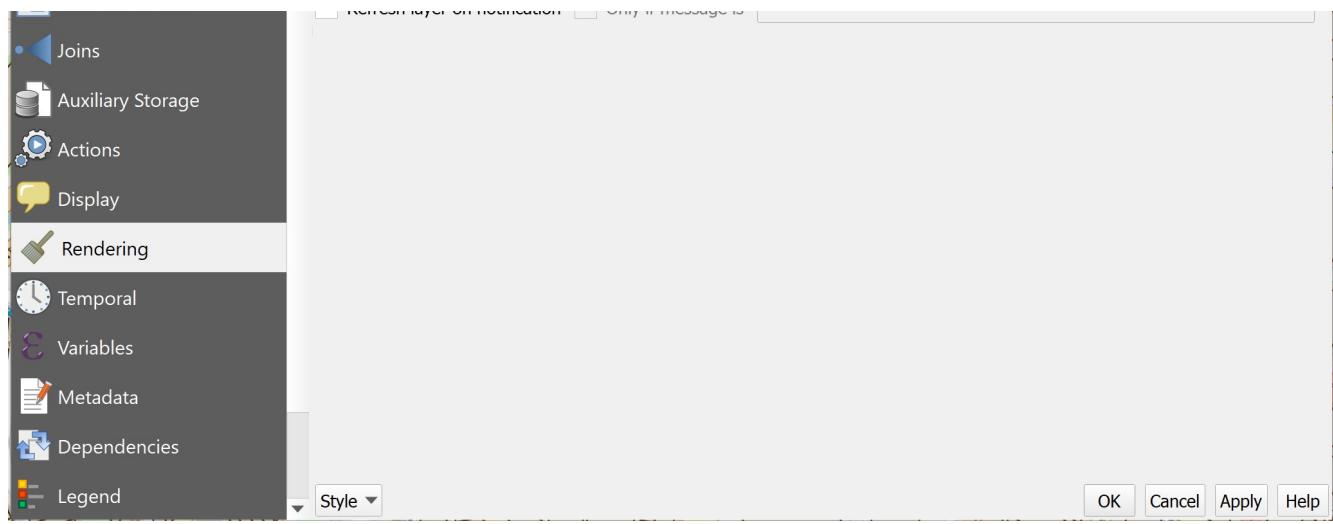
Simplify on provider side if possible (Not supported)

Maximum scale at which the layer should be simplified (1:1 always simplifies): 1:1

Force layer to render as a raster (may result in smaller export file sizes)

Refresh layer at interval (seconds): 0.00

Refresh layer on notification Only if message is



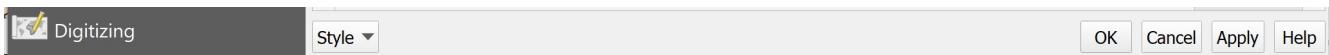
Note that the minimum map scale is 5000. That explains why the building layer only appears when the map scale of Map View is less than or equal to 1:5000.

Next, you will explore the data fields of Building layer.

- Click on the **Field** tab.

Your screen should look similar to the figure below.

ID	Name	Alias	Type	Type name	Length	Precision	Comment	Configuration
123 0	OBJECTID		int	Integer	9	0		
1.2 1	FEA_ID		double	Real	18	11		
abc 2	BUILDING_N		QString	String	66	0		
abc 3	BLDG_NAME_		QString	String	1	0		
abc 4	HOUSE_BLK_		QString	String	10	0		
abc 5	ROAD_NAME		QString	String	65	0		
abc 6	POSTAL_COD		QString	String	6	0		
abc 7	ADDRESS_TY		QString	String	2	0		
1.2 8	X_ADDR		double	Real	18	11		
1.2 9	Y_ADDR		double	Real	18	11		
1.2 10	Shape_Leng		double	Real	18	11		
1.2 11	Shape_Area		double	Real	18	11		



Notice that there are 12 fields in the corresponding attribute table of Building layer. The Layer Properties window also shows the data type, length and precision of each field.

You will explore the other tabs in the next hands-on.

- At the **Layer Properties** window, click on the cross button located at the upper right hand corner to close the window.

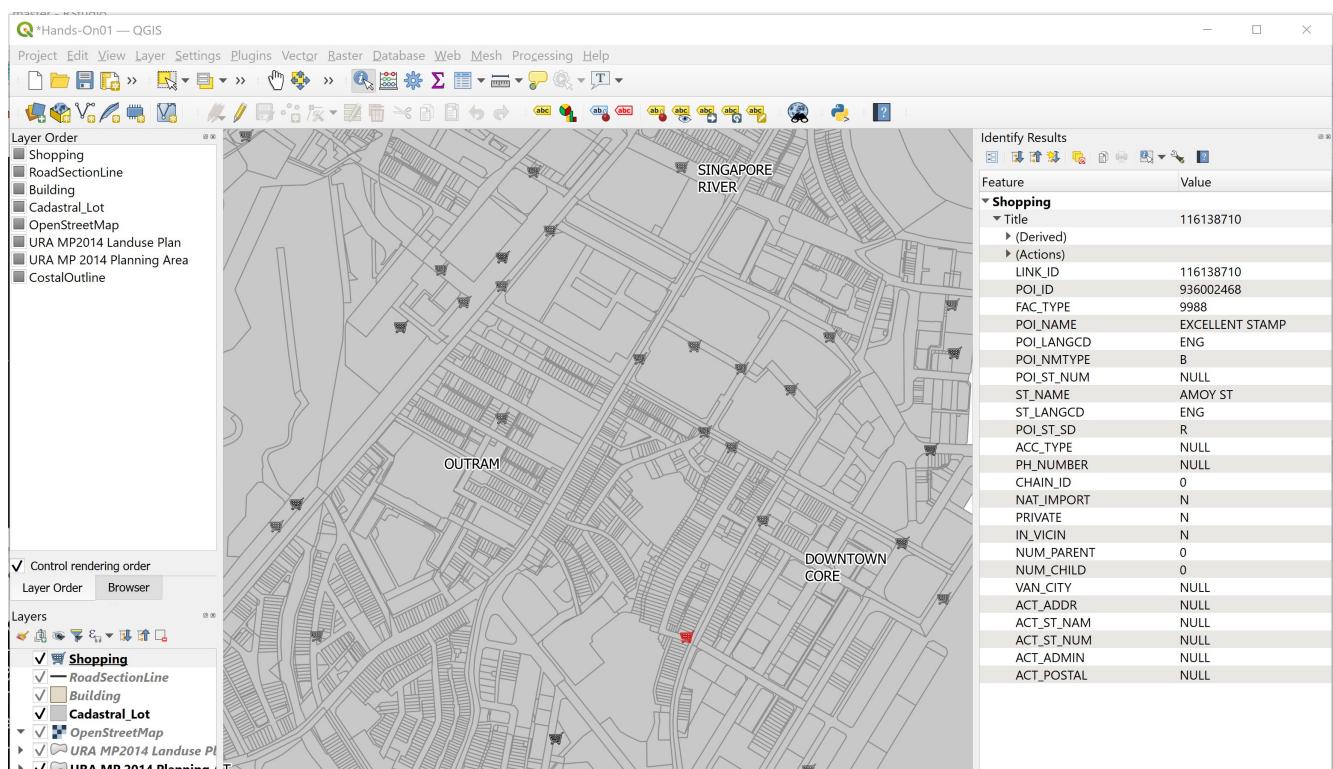
Working with Identify Features tool

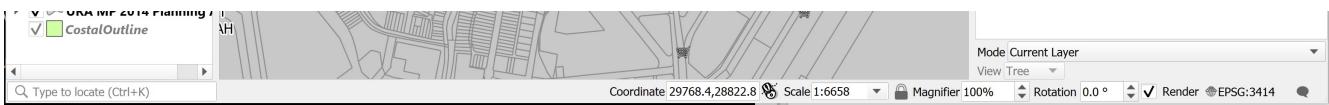
Using **Identify Features** tool to interact with a geographical feature and retrieve its corresponding attribute information is a two steps process. First, you need to make the layer of the feature active. Then, you will use the Identify Features tool to query the information.

In this section, you will learn how to query information of a selected Shopping feature (marks by a circle in the figure above).

- At the **Map Legend** window, click on Shopping layer to make it active.
- Click on the **Identify Features** tool.
- At the **Map View** window, hovers the mouse over the shopping feature you are interested to query (the one marked in the figure above).
- Click on an shopping feature.

Your screen should look similar to the figure below.





Notice that the selected shopping feature was highlighted (i.e. in red) and the Identify Results window appears.

DIY: Using the steps you had learned from this section, query a building feature, a road network feature and a URA planning area feature.

Query Attribute Table

The ability to interactively select a geographic feature and query its associated attribute information is a very powerful feature of a GIS. However, there are times that you would like to see the attributes of all the features in a GIS layer. In this section, you will learn how to use QGIS's Open Attribute Table function to display the attribute table of a GIS layer.

- At the **Map Legend** window, right-click on Building layer.
- Select **Open Attribute Table** from the context menu.

The **Attribute table** window appears.

Identify Results													
	OBJECTID	FEA_ID	BUILDING_N	BLDG_NAME_	HOUSE_BLK_	ROAD_NAME	POSTAL_COD	ADDRESS_TY	X_ADDR	Y_ADDR	Shape_Leng	Shape_Area	
1		72	96220.00000000...	KIM LIN PARK	1	53	JALAN KELAWAR	249282	R	27258.22543340...	31440.57936000...	61.46964405620	201.27461860300
2		111	181573.00000000...	SUPREME COUR...	4	1	SUPREME COUR...	178879	S	29939.91939340...	30311.95074830...	364.01626076500	7227.415990060...
3		112	93776.00000000...	MASONIC HALL	1	23A	COLEMAN STREET	179806	S	29718.30448100...	30538.49507430...	38.94401655170	71.67002244670
4		181	13949.00000000...	NULL	3	123	DEVONSHIRE R...	239883	S	28338.42272870...	31346.15357220...	63.62348996960	128.00315287800
5		221	134723.00000000...	NULL	3	96	DEPOT ROAD	109668	S	25917.31271140...	29300.44101220...	5.51993779678	2.11217333389
6		231	108591.00000000...	BOAT QUAY CO...	1	78	BOAT QUAY	049866	U	29764.67951170...	30078.64915540...	65.17508638430	142.91673881200
7		239	32148.00000000...	HONG LEONG B...	1	16	RAFFLES QUAY	048581	K	29958.79157210...	29312.13831670...	245.92411508800	4111.213410980...
8		250	99425.00000000...	NULL	NULL	1A	EVERTON PARK	083001	H	28772.27525990...	28850.76474240...	56.78621749040	192.38127170900
9		270	84448.00000000...	NULL	3	717	HAVELOCK ROAD	169643	U	27403.75187120...	30175.67069530...	63.44003681010	149.33745925400
10		298	48745.00000000...	NULL	3	14	BUKIT TERESA C...	099786	S	27187.33236730...	28793.69445910...	45.66329901900	112.03212328300
11		312	85588.00000000...	BOAT QUAY CO...	1	8	LORONG TELOK	049021	U	29695.19284740...	29927.52356440...	59.01840001780	128.90241858400
12		345	28963.00000000...	TANJONG PAGA...	1	161	NEIL ROAD	088885	S	28437.04514220...	28843.09453260...	77.42513786000	196.59680513900
13		348	55641.00000000...	MND BUILDING ...	2	7	MAXWELL ROAD	069111	K	29478.87861560...	29075.00437330...	305.06211243900	3953.937082510...
14		371	8227.00000000...	TIONG BAHRU E...	1	71	SENG POH ROAD	160071	H	27909.45756890...	29630.65914530...	154.33878200000	1275.613209680...
15		446	101226.00000000...	NULL	3	25	KRETA AYER RO...	088993	U	28991.73224670...	29219.45829530...	64.73914826100	150.49312199900
16		458	104540.00000000...	MASONIC HALL	1	23A	COLEMAN STREET	179806	S	29742.62190010...	30523.59211800...	144.42839468600	637.71142230000
17		493	49146.00000000...	BESTWAY BUILD...	1	12	PRINCE EDWAR...	079212	K	29590.40181890...	28505.23467200...	127.16239630900	894.43274927500
18		501	78187.00000000...	NULL	3	9	SMITH STREET	058923	U	29249.64270920...	29375.53690890...	47.22732439360	99.28594685100

The table provide detail information of each geographical feature (i.e. building) such as building name, postal code, road name, block number, just to name a few of them.

DIY: Using the steps you had learned from this section, review the attribute table of Shopping and URA MP2014 Planning Area layers.

Whew! That was a lot to take in! Take a deep breath and relax. By now you should have a good understanding of the basic operations of QGIS. You can start playing with it and practice the techniques that you have learned.