

# **Hands-on Exercise 2: Working with GIS Data**

In this hands-on exercise, you will learn how to import and handling geospatial and aspatial data from different sources and data types by using QGIS

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## **1.0 Introduction**

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A GIS is specially designed to manage geospatial data. This hands-on exercise consists of five sections. First, you will learn how to import geospatial data from different sources and file format into QGIS. At the same time, you will also learn how to check their feature type, coordinate system and other related information. You will also learn how to create a GIS data from an aspatial data by using QGIS. Next, you will learn how to transform this newly created GIS layer into Singapore National projected coordinates systems (i.e. SVY21). Lastly, you will also learn how to use the geocoding function of QGIS to create geospatially referenced data from a non-spatial data.

### **1.1 Learning Outcome**

By the end of this session, you will be able to:

- work with geospatial data from data.gov.sg
- create geospatially-enabled data
- create GIS Layer from a text data with georeference information
- transform a GIS data onto a different projection system
- work with raster GIS data • work with internet geospatial services • work with geospatial database

## 2.0 Working with Geospatial Data from data.gov.sg

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In this section, you will learn how to download geospatial data from data.gov.sg and import them into QGIS.

### 2.1 Downloading geospatial data from data.gov.sg

First, you are required to download the following geospatial and aspatial data from [data.gov.sg](http://data.gov.sg):

- Master Plan 2014 Subzone Boundary (No Sea),
- Child Care Services,
- Street and Places, and
- School Directory and Information

### 2.2 Managing the imported data

For any GIS project, it is important for us to practice good document management. Assuming that the root directory of this project is called `Hands-on_Ex02`,

- created a sub-folder call `data.gov`.
- inside `data.gov`, create two new sub-folders. Call them `geospatial` and `aspatial` respectively.
- place the downloaded Master Plan 2014 Subzone Boundary (No Sea), Child Care Services and Street and Places into the `geospatial` folder.
  - unzipped their respective zipped files,
  - extract the unzipped files, and
  - place them in `geospatial` folder.

- place the downloaded School Directory and information zipped file into aspatial sub-folder.
  - unzipped the file,
  - copy and paste general-information-of-schools.csv into aspatial sub-folder.

The geospatial folder should look similar to the screenshot below.

Name	Date modified	Type	Size
child-care-services-geojson	29/8/2020 8:03 am	GEOJSON File	2,066 KB
child-care-services-kml	29/8/2020 8:02 am	KML File	2,897 KB
metadata-child-care-services	29/8/2020 8:02 am	Text Document	2 KB
metadata-master-plan-2014-subzone-boundary-no-sea	6/2/2017 3:15 pm	Text Document	2 KB
metadata-street-and-places	6/6/2017 11:56 am	Text Document	2 KB
MP14_SUBZONE_NO_SEA_PL.dbf	2/6/2016 12:46 pm	DBF File	80 KB
MP14_SUBZONE_NO_SEA_PL		KML File	2,782 KB
MP14_SUBZONE_NO_SEA_PL	2/6/2016 12:46 pm	PRJ File	1 KB
MP14_SUBZONE_NO_SEA_PL.sbn	2/6/2016 12:46 pm	SBN File	4 KB
MP14_SUBZONE_NO_SEA_PL.sbx	2/6/2016 12:46 pm	SBX File	1 KB
MP14_SUBZONE_NO_SEA_PL.shp	2/6/2016 12:46 pm	SHP File	890 KB
MP14_SUBZONE_NO_SEA_PL.shp	2/6/2016 12:46 pm	XML Document	12 KB
MP14_SUBZONE_NO_SEA_PL.shx	2/6/2016 12:46 pm	SHX File	3 KB
StreetsandPlaces.dbf	5/6/2017 2:57 pm	DBF File	930 KB
StreetsandPlaces		KML File	959 KB
StreetsandPlaces	5/6/2017 2:57 pm	PRJ File	1 KB
StreetsandPlaces.sbn	5/6/2017 2:57 pm	SBN File	4 KB
StreetsandPlaces.sbx	5/6/2017 2:57 pm	SBX File	1 KB
StreetsandPlaces.shp	5/6/2017 2:57 pm	SHP File	11 KB
StreetsandPlaces.shp	5/6/2017 2:57 pm	XML Document	13 KB
StreetsandPlaces.shx	5/6/2017 2:57 pm	SHX File	3 KB

Notice that besides the geospatial data files, I also include the metadata of the data into the folder. This is because the metadata provide useful information of the data and it is important for us to keep them for future references.

## 2.3 Examining the geospatial data

Before you add the GIS data into QGIS, you should spend some time to examine the files in geospatial folder.

Notice that the shapefile version of MP14\_SUBZONE\_NO\_SEA\_PL and StreetsandPlaces data sets are actually made up of multiples files that have the same names but with different extensions.

Table below details the meaning of each file.

Mandatory files :

- .shp — shape format; the feature geometry itself
- .shx — shape index format; a positional index of the feature geometry to allow seeking forwards and backwards quickly
- .dbf — attribute format; columnar attributes for each shape, in dBase IV format

Optional files :

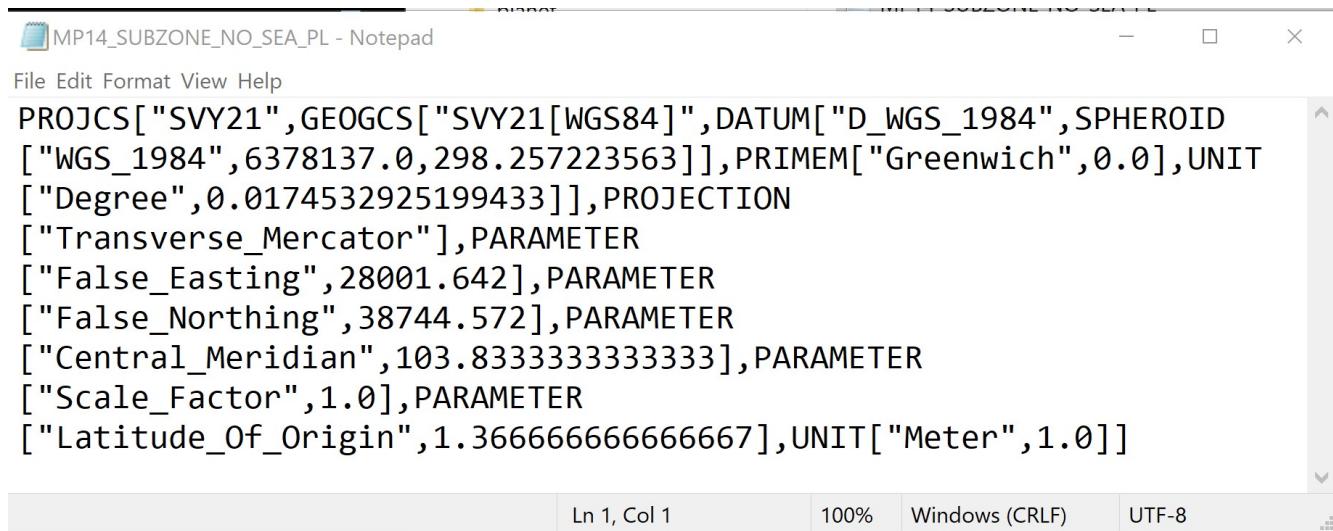
- .prj — projection format; the coordinate system and projection information, a plain text file describing the projection using well-known text format
- .sbn and .sbx — a spatial index of the features
- .fbn and .fbx — a spatial index of the features for shapefiles that are read-only
- .ain and .aih — an attribute index of the active fields in a table or a theme's attribute table
- .ixs — a geocoding index for read-write shapefiles
- .mxs — a geocoding index for read-write shapefiles (ODB format)
- .atx — an attribute index for the .dbf file in the form of *shapefile.columnname.atx* (ArcGIS 8 and later)
- .shp.xml — geospatial metadata in XML format, such as ISO 19115 or other schemas
- .cpg — used to specify the code page (only for .dbf) for identifying the character encoding to be used

Source: <https://en.wikipedia.org/wiki/Shapefile>

Next, you should also check the projection of the shapefile.

- Right-click on the PRJ file of MP14\_SUBZONE\_NO\_SEA\_PL
- Select *Open with -> NotePad*.

Your NotePad should look similar to the figure below.



```
MP14_SUBZONE_NO_SEA_PL - Notepad
File Edit Format View Help
PROJCS["SVY21",GEOGCS["SVY21[WGS84]",DATUM["D_WGS_1984",SPHEROID
["WGS_1984",6378137.0,298.257223563]],PRIMEM["Greenwich",0.0],UNIT
["Degree",0.0174532925199433]],PROJECTION
["Transverse_Mercator"],PARAMETER
["False_Easting",28001.642],PARAMETER
["False_Northing",38744.572],PARAMETER
["Central_Meridian",103.833333333333],PARAMETER
["Scale_Factor",1.0],PARAMETER
["Latitude_Of_Origin",1.3666666666666667],UNIT["Meter",1.0]]
```

Ln 1, Col 1      100%      Windows (CRLF)      UTF-8

From the screenshot, it is clear that MP14\_SUBZONE\_NO\_SEA\_PL is in svy21 projected coordinate system.

- Close the NotePad.

Different from shapefile, the geojson and kml files are editing in xml format. You can examine the content of these two files by using either Notepad or WordPad.

## 2.4 Adding geospatial data from data.gov into QGIS

Now, we are ready to bring the geospatial data downloaded from data.gov into QGIS.

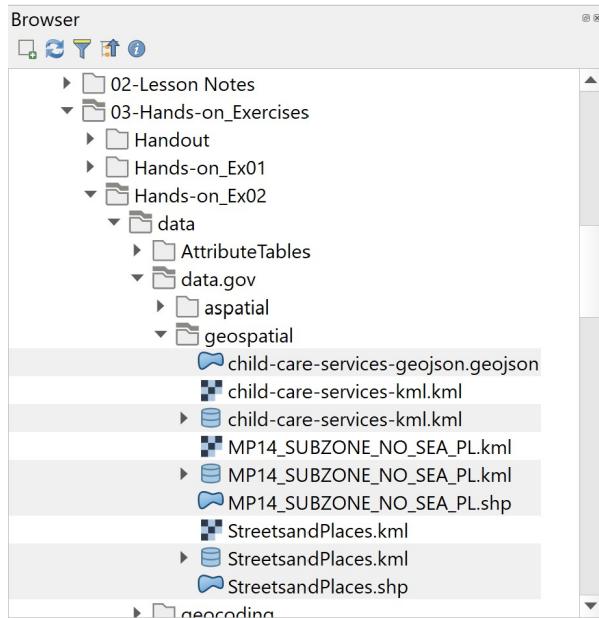
- From Window Desktop, launch QGIS.

You will start a new QGIS project.

- From the menu bar, select **Project -> New**.

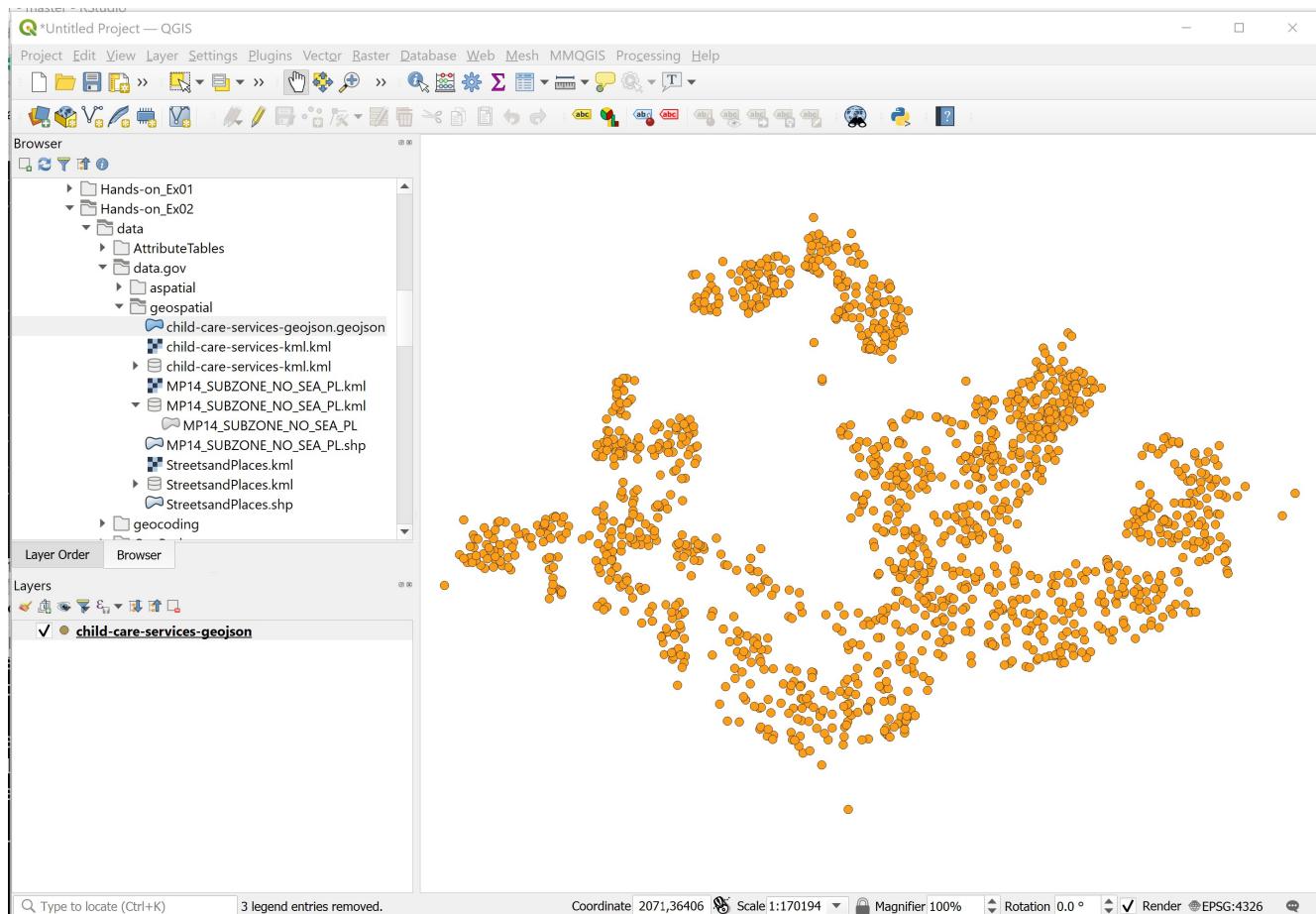
Next, you are going to learn how to bring geospatial data sets into QGIS via the **Browser** panel.

- From the Browser panel, navigate to the path of Hands-on\_Ex02.govas shown in the screenshot below.



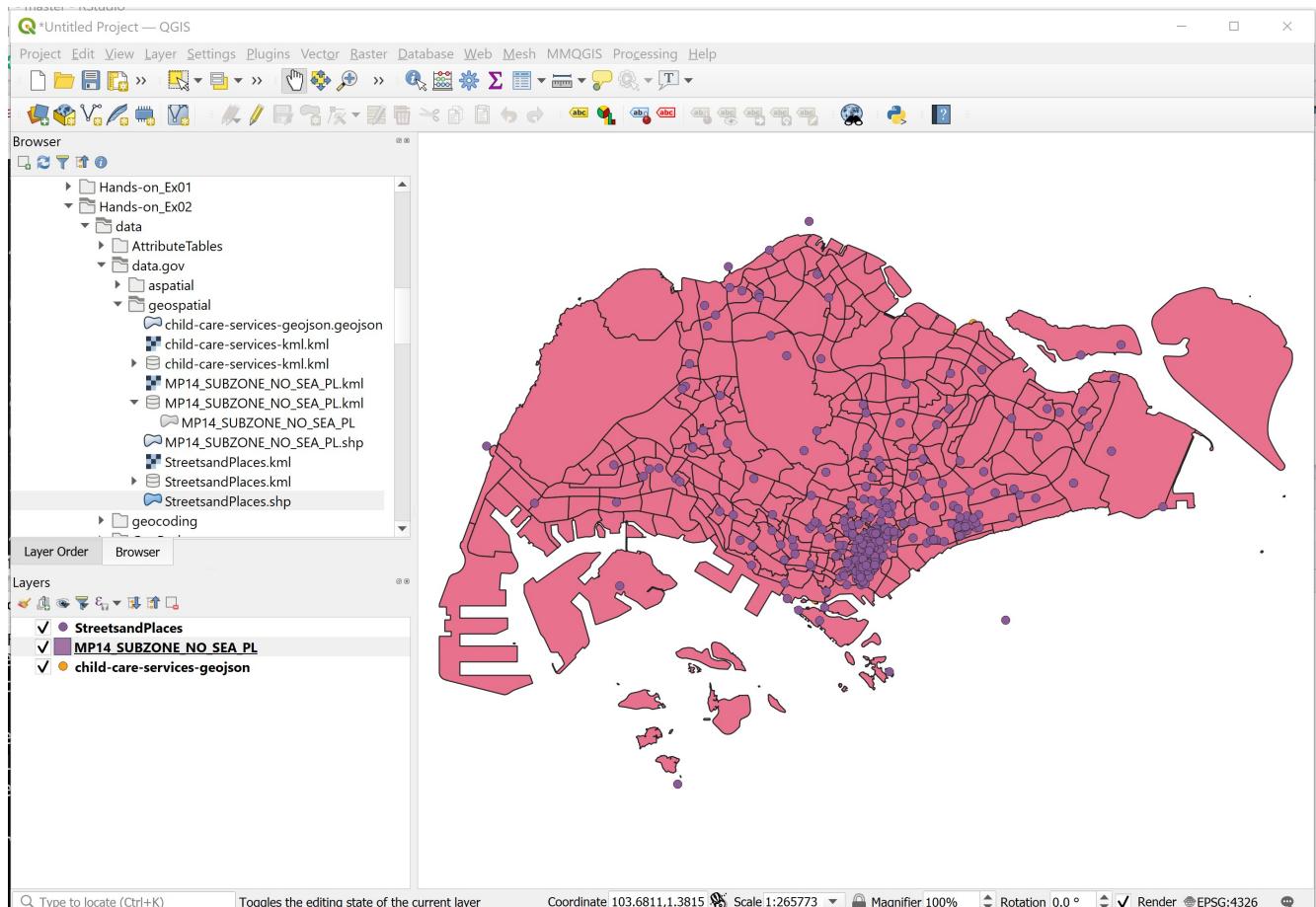
- Double-click on `child-care-services-geojson.geojson`.

Notice that `child-care-services-geojson.geojson` is added in the **Layer** panel and display on the View window as shown below.



*DIY: Using the steps you had learned, bring in MP14\_SUBZONE\_NO\_SEA\_PL.shp and StreetsandPlaces.shp into QGIS.*

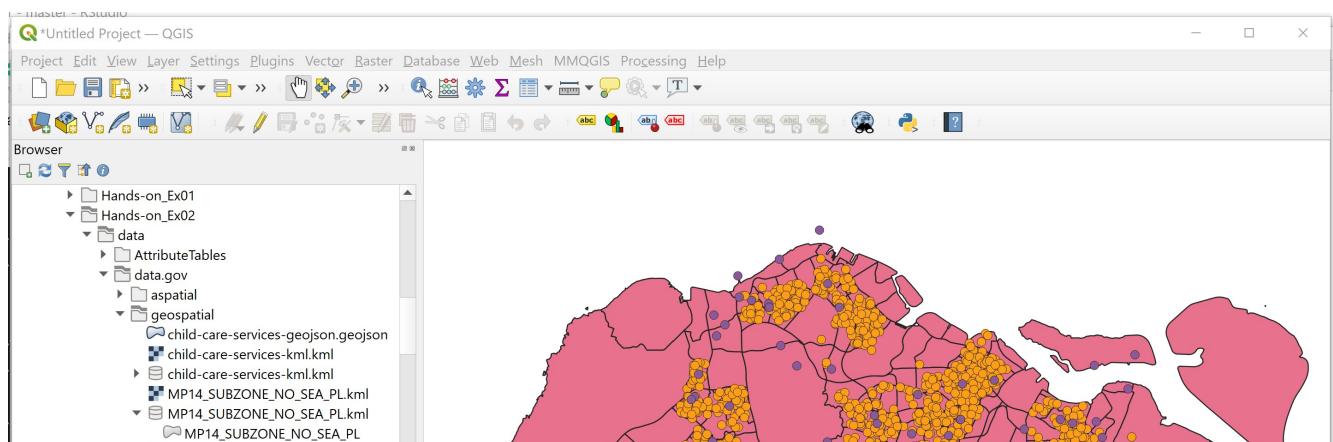
Your screen should look similar to the figure below.

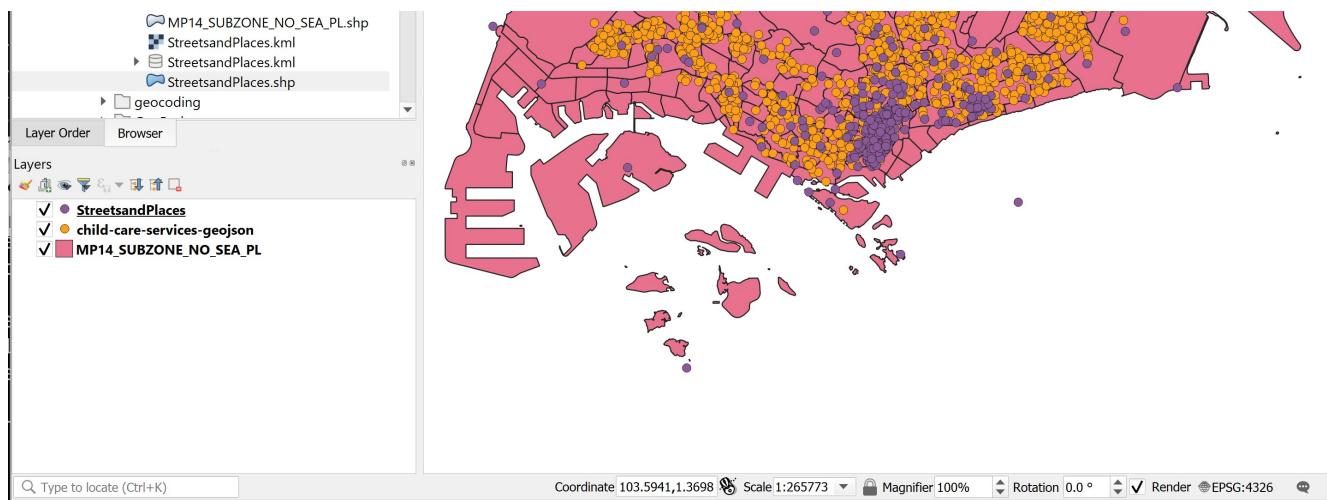


Notice that `child-care-services-geojson` layer does not appear on Map View. This is because it is covered by `MP14_SUBZONE_NO_SEA_PL` layer.

- From the **Layer** panel, click on `MP14_SUBZONE_NO_SEA_PL` layer.
- Hold down the left mouse button, drag and place it below `child-care-services-geojson`.

Now you should see all the active layers appear on the View window as shown below.



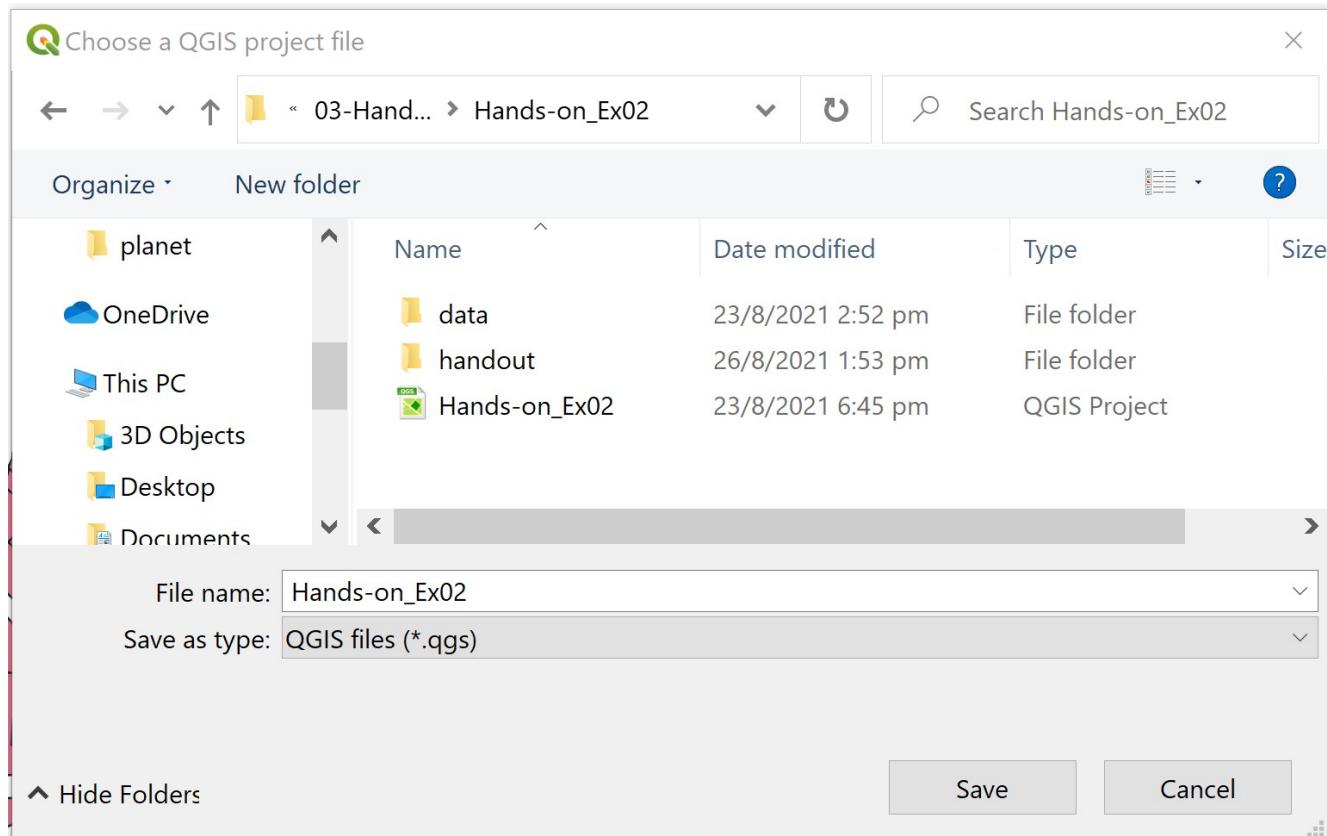


**QGIS Tip:** In order to avoid point and line feature layers being blocked away by polygon feature layer, it is always advisable to place the polygon feature layer at the bottom of the layer order.

It is time to save the project.

- From the menu bar, click **Project** -> **Save** (Alternatively, from the icon bar, click on **Save Project** icon).
- At the **Choose a QGIS project file** dialog window, navigate to the root project folder, then provide a proper project name such as `Hands-on_Ex02`, remember to select **QGIS files (\*.qgs)\*** from the **Save as type:** dropdown list.

Your screen should look similar to the figure below.



- Click on **Save** button.

Notice that the upper left corner of the top banner is labelled `Hands-on_Ex02` instead of `untitled` now.

## 3.0 Working with Projection

In this section, you will learn how to:

- assign appropriate coordinate system to the QGIS project.
- how to transform a GIS data set from one coordinate system to another coordinate system.

### 3.1 Assigning project coordinate system

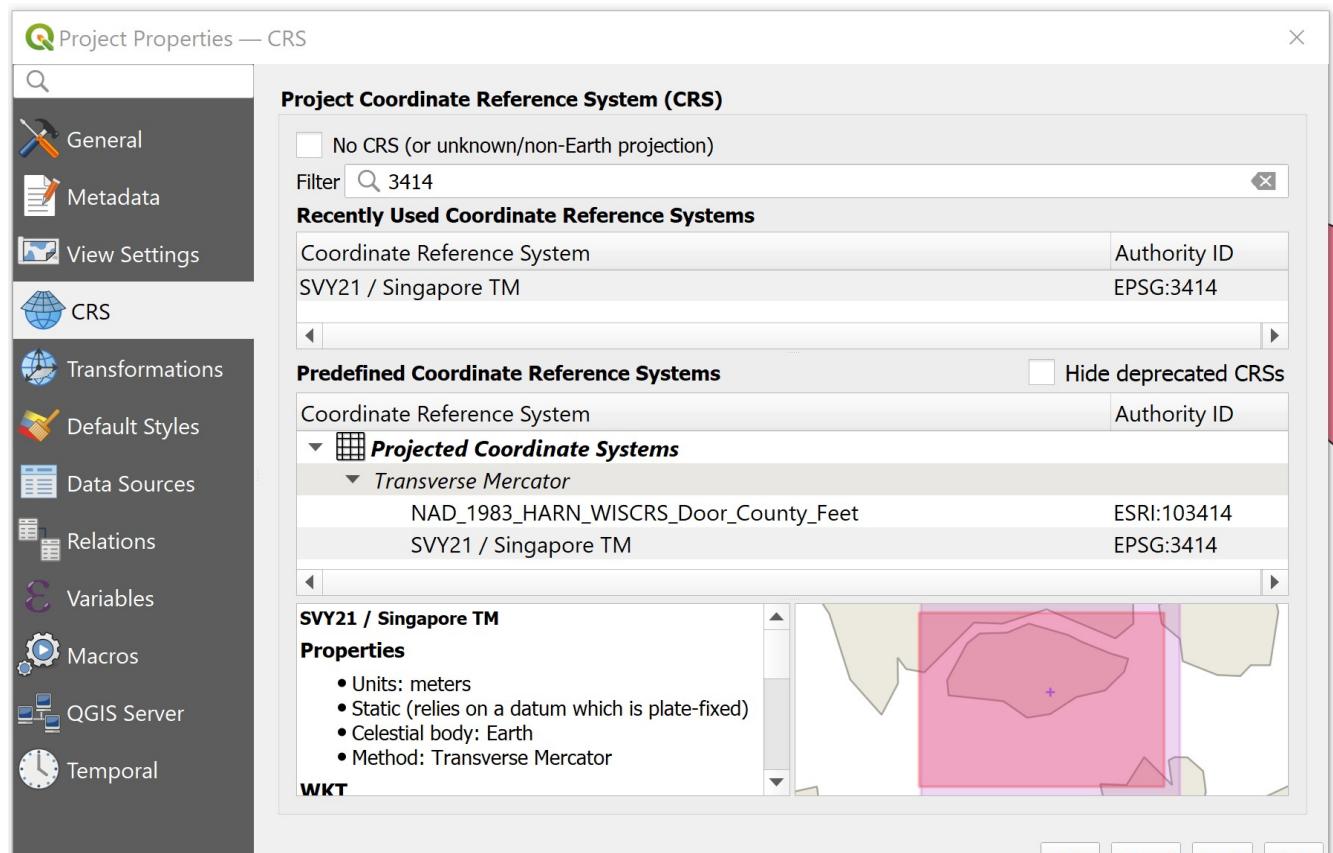
If you refer to the lower left corner of the active QGIS project window, there is a high chance that the EPSG is not in **3414** which is the EPSG code of **svy21**.

If there is the case, you can use the step below to assign the correct projection system for your QGIS project.



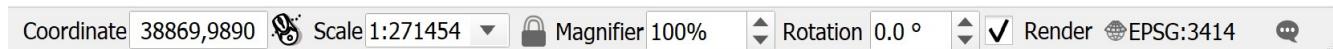
- At the lower right corner of QGIS project banner, click on the list of **Render**.

Project Properties dialog window appears.



- From **Predefined Coordinate Reference Systems**, click on **EPSG:3414** from the list.
- Click on **Apply** button to make the change.
- Click on **OK** button to close the window.

Notice that the projection has been updated to EPSG:3414 now.



Option:

If this is the first time you use the **Projection Properties**, there is a high chance that the **Predefined Coordinate Reference Systems** is empty.

In this case,

- at **Filter**, type **3414**. This will help to narrow down the search.

Before you move on to the next section, you should save the latest changes on the project file.

- From the icon bar, click on the **Save Project** icon.

## 3.2 Transforming coordinate system

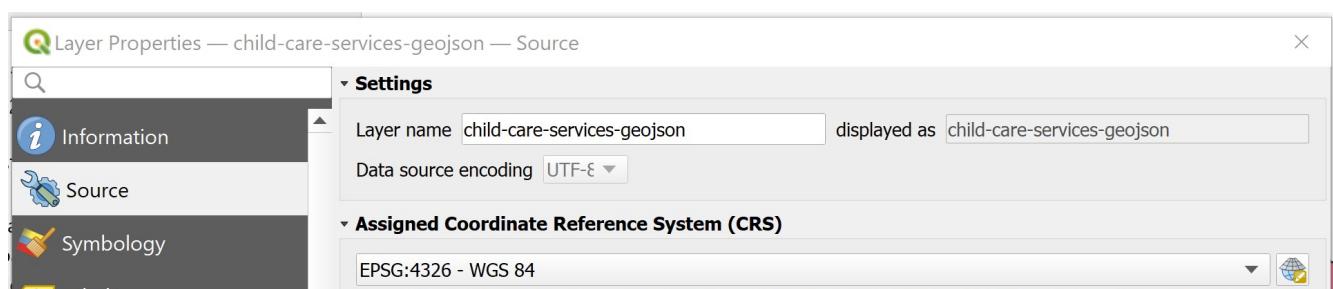
In a GIS project, it is always a good practice to keep the geospatial data set(s) in a same projected coordinate system, using the national projected coordinate system such as svy21 of Singapore.

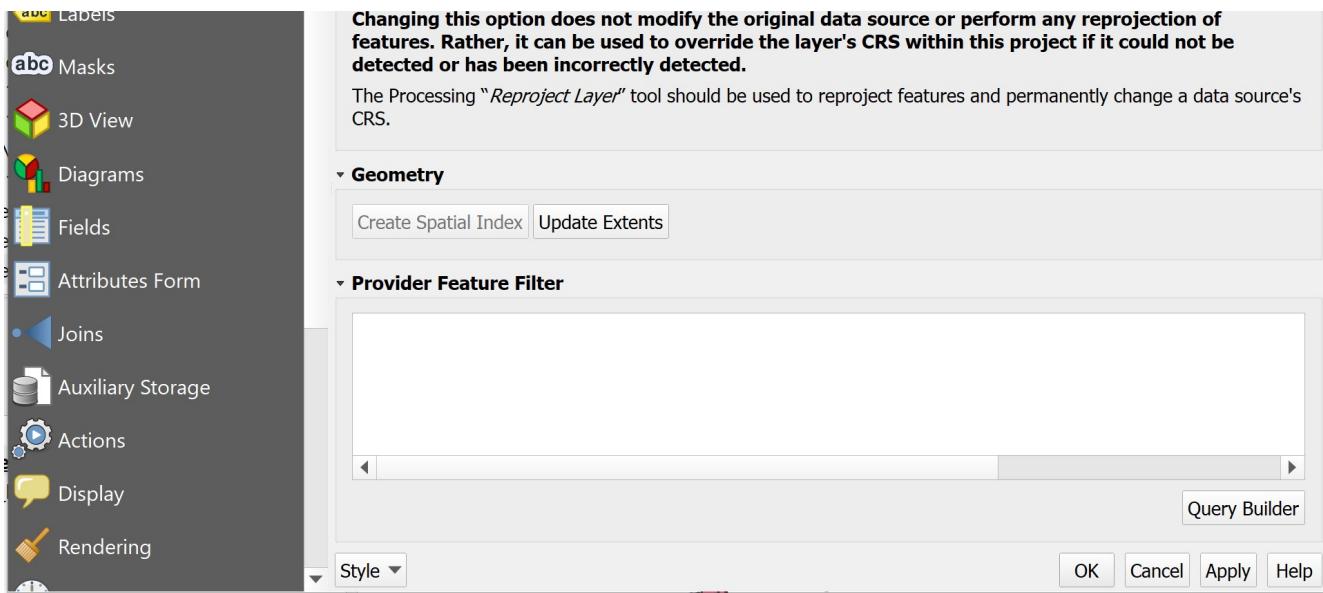
In this section, you will learn how to transform a geospatial data set from WGS84 Geographic Coordinate System to SVY21 Projected Coordinates System. You will also learn how to save the output into a new shapefile for permanent storage purpose. For the purpose of this exercise, child-care-services-geojson layer will be used.

First, let us verify if an appropriate projection system was used.

- From the **Layers** panel, right-click on `child-care-services-geojson` layer.
- Select **Properties**.

The Layer Properties dialog window of `child-care-services-geojson` layer appears.





- Click on **Source**.

Notice that `child-care-services-geojson` layer is in WGS geographic coordinates system and not in SVY21 projected coordinates system.

- Click on **OK** button to close the dialog window.

Next, we are going export the `child-care-services-geojson` layer into a new shapefile and at the same time transform the newly created shapefile into svy21 projected coordinates systems.

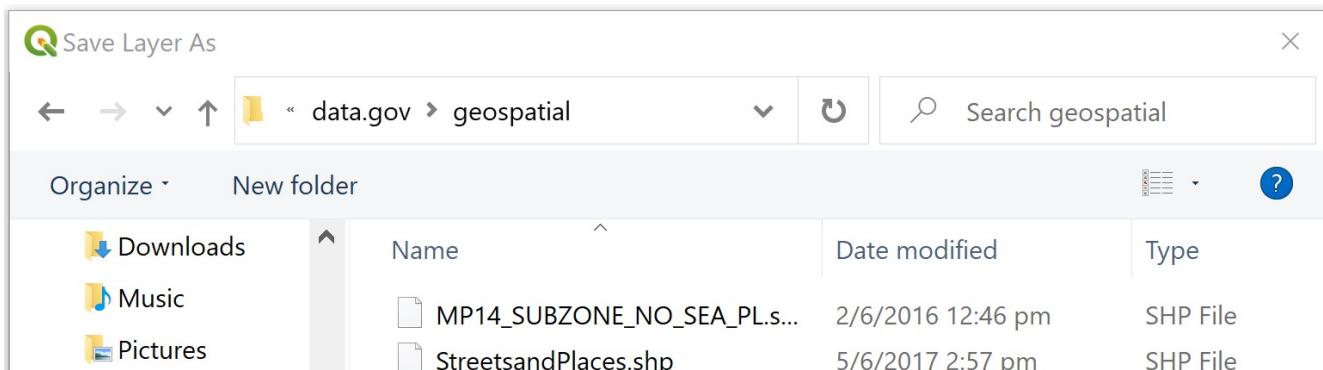
- From the **Layers** panel, right-click on `child-care-services-geojson` layer.
- Select **Export -> Save Features As** from the context menu.

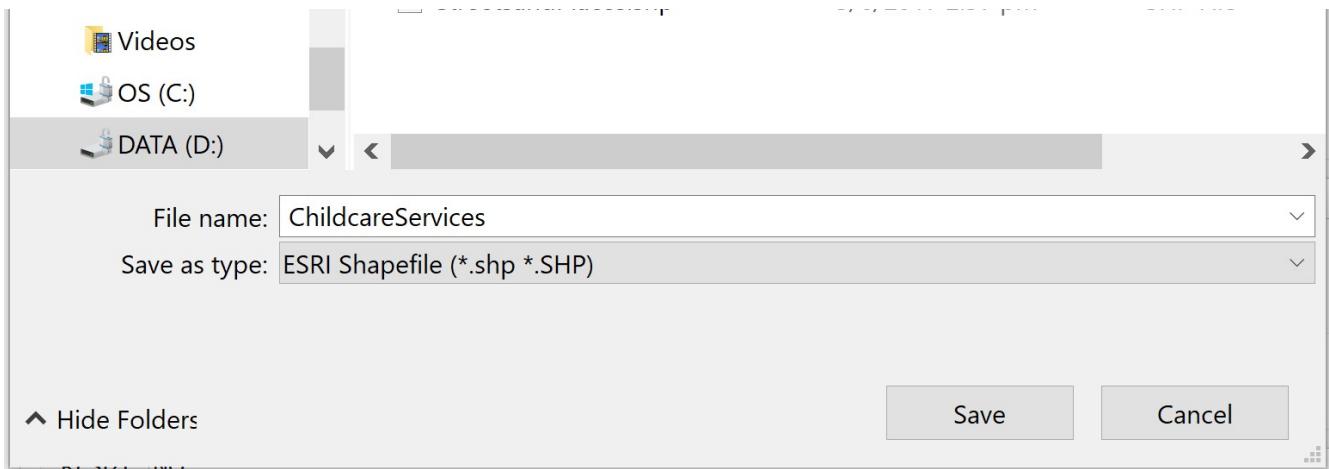
The **Save Vector Layer** dialog window appears.

- For **Format:**, select ESRI Shapefile from the drop-down list.
- For **Save as**, click on the *Browse* button.

The **Save Layer As** dialog window appear.

- Navigate to `\SMT201\Hands-On02\data\data.gov\geospatial` sub-folder.
- For File Name, type `ChildcareServices`.





- Click on the **Save** button.

You will return to **Save Vector Layer as** dialog window.

Now, you are going to select the appropriate projected coordinate system.

- For **CRS**, click on the **Browse** button.

The Coordinate Reference System Selector dialog window appears.

- Click on SVY21/Singapore TM.
- Click on OK to update the selection.



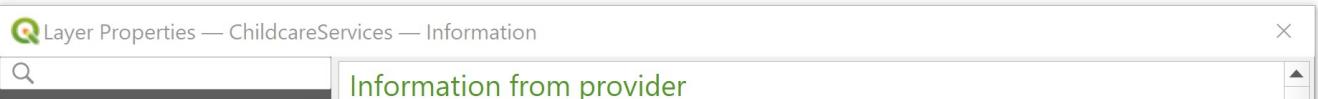
Notice that the **CRS** is **EPSG:3414 - SVY21 / SINGAPORE TM** now.

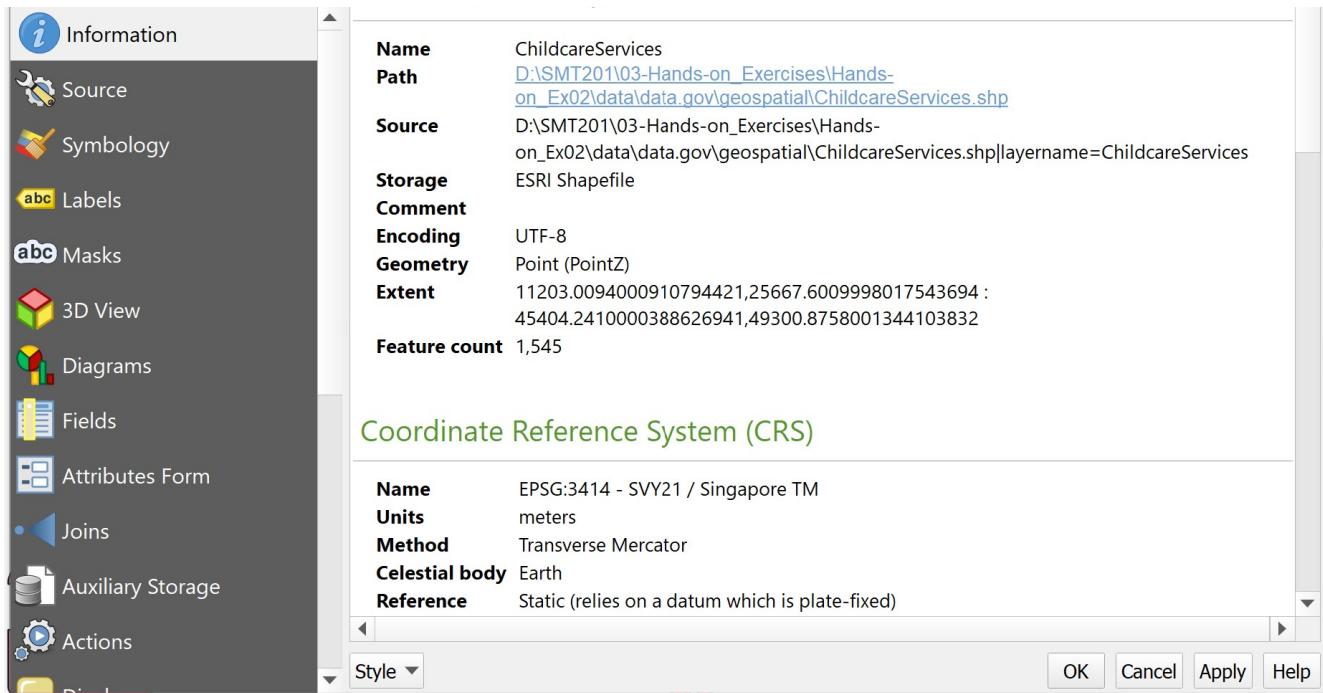
Keep the rest of the default option check and you are ready to convert the geospatial data set into ESRI shapefile format and at the same time transform it into SVY21 projected coordinate system.

- Click on the **OK** button.

Notice that a new geospatial layer called `ChildcareServices` has been added on `Layers` panel and was plotted on the `View` window.

*DIY: Using the steps you had learned in earlier section, check the properties of this newly created `ChildcareServices`*





Your screen should look similar to the screenshot above.

Notice that `ChildcareServices` layer is in ESRI Shapefile format and its Coordinate Reference System in SVY21 / SINGAPORE TM.

- Click on OK button to close the dialog window.

*DIY: You can also remove `child-care-services-geojson` layer from Layers dialog window.*

## 4.0 Creating Geospatially-Enabled Data

By and large, business data such as polyclinics, schools and business establishments do not capture geospatial information such as x- and y- coordinates explicitly. However, it is possible to create geospatially-enabled data from them by using the geocoding technique.

Geocoding is the process of finding associated geographic coordinates (often expressed as latitude and longitude) from other geographic data, such as street addresses, zip codes or postal codes (<http://en.wikipedia.org/wiki/Geocoding>).

### 4.1 Data Preparation

In this section, you will learn how to create geospatially enable data by using `general-information-of-schools.csv` you downloaded from `data.gov.sg`.

Note: In this section, we assume that `general-information-of-schools.csv` is stored in `\Hands-on_Ex02\data\data.gov\aspatial\` sub-folder and you have Microsoft Excel installed in your computer.

Let us review the content of general-information-of-schools.csv file.

- At File Explorer, navigate to the sub-folder where general-information-of-schools.csv is stored.
- Right-click on general-information-of-schools.csv file.
- From the context menu, select **Open with -> Excel**.

Your screen should look similar to the figure below.

A	B	C	D	E	F	G	H	I	J
1 school_name	url_address	address	postal_code	telephone_no	telephone_fax_no	fax_no_2	email_address	mrt_d	
2 ADMIRALTY PR1	https://admiral11	WOODLANDS CIRCLE	738907	63620598	na	63627512	na	ADMIRALT	Admiral
3 ADMIRALTY SEC	http://www.e31	WOODLANDS CRESCENT	737916	63651733	63654596	63652774	na	Admiralty_	ADM
4 AHMAD IBRAHII	http://www.e10	YISHUN STREET 11	768643	67592906	na	67592927	na	aips@moe	Yishun
5 AHMAD IBRAHII	http://www.e751	YISHUN AVENUE 7	768928	67585384	na	67557778	na	aiss@moe	CANB
6 AI TONG SCHOC	http://www.e100	Bright Hill Drive	579646	64547672	na	64532726	na	AITONG_S	Bishan
7 ALEXANDRA PRI	http://alexan	2A Prince Charles Crescent	159016	62485400	na	62485409	na	alexandra_	Redhill
8 ANCHOR GREEN	http://www.e31	Anchorvale Drive	544969	68861356	na	63159825	na	anchorgree	MRT :
9 ANDERSON PRIM	http://www.e19	ANG MO KIO AVE 9	569785	64560340	na	65522310	na	anderson_	Yio Ch
10 ANDERSON SEC	http://www.e10	ANG MO KIO STREET 53	569206	64598303	na	64586104	na	anderson_	ANG N

Notice that general-information-of-schools.csv file consists of 31 fields. However, we only need to retain school\_name, address and postal\_code field.

- Use appropriate Excel function to delete the unwanted fields.

Next, we will create two new fields. They are: country and city.

- Use appropriate Excel function to create two new fields. Call them country and city.
- Fill in the cell below country and city fields with Singapore.

The final general-information-of-schools.csv should look similar to the screenshot below.

A	B	C	D	E	F	G	H	I	J
1 school_name	url_address	address	SG	Singapore	Singapore	Singapore	Singapore	Singapore	
2 ADMIRALTY PR1	https://admiral11	WOODLANDS CIRCLE	SG	Singapore	Singapore	Singapore	Singapore	Singapore	
3 ADMIRALTY SEC	http://www.e31	WOODLANDS CRESCENT	SG	Singapore	Singapore	Singapore	Singapore	Singapore	
4 AHMAD IBRAHII	http://www.e10	YISHUN STREET 11	SG	Singapore	Singapore	Singapore	Singapore	Singapore	
5 AHMAD IBRAHII	http://www.e751	YISHUN AVENUE 7	SG	Singapore	Singapore	Singapore	Singapore	Singapore	
6 AI TONG SCHOC	http://www.e100	Bright Hill Drive	SG	Singapore	Singapore	Singapore	Singapore	Singapore	
7 ALEXANDRA PRI	http://alexan	2A Prince Charles Crescent	SG	Singapore	Singapore	Singapore	Singapore	Singapore	
8 ANCHOR GREEN	http://www.e31	Anchorvale Drive	SG	Singapore	Singapore	Singapore	Singapore	Singapore	
9 ANDERSON PRIM	http://www.e19	ANG MO KIO AVE 9	SG	Singapore	Singapore	Singapore	Singapore	Singapore	
10 ANDERSON SEC	http://www.e10	ANG MO KIO STREET 53	SG	Singapore	Singapore	Singapore	Singapore	Singapore	

	A	B	C	D	E	F	G	H
1	school_name	address	postal_code	country	city			
2	ADMIRALTY PRIMARY SCHOOL	11 WOODLANDS CIRCLE	738907	Singapore	Singapore			
3	ADMIRALTY SECONDARY SCHOOL	31 WOODLANDS CRESCENT	737916	Singapore	Singapore			
4	AHMAD IBRAHIM PRIMARY SCHOOL	10 YISHUN STREET 11	768643	Singapore	Singapore			
5	AHMAD IBRAHIM SECONDARY SCHOOL	751 YISHUN AVENUE 7	768928	Singapore	Singapore			
6	AI TONG SCHOOL	100 Bright Hill Drive	579646	Singapore	Singapore			
7	ALEXANDRA PRIMARY SCHOOL	2A Prince Charles Crescent	159016	Singapore	Singapore			
8	ANCHOR GREEN PRIMARY SCHOOL	31 Anchorvale Drive	544969	Singapore	Singapore			
9	ANDERSON PRIMARY SCHOOL	19 ANG MO KIO AVE 9	569785	Singapore	Singapore			
10	ANDERSON SECONDARY SCHOOL	10 ANG MO KIO STREET 53	569206	Singapore	Singapore			

- Use the **Save as** function of Excel to save the tidied csv file into Hands-on\_Ex02.govsub-folder. Name the output file `schools.csv`.

*Note: It is important to ensure that the output file is in csv file format.*

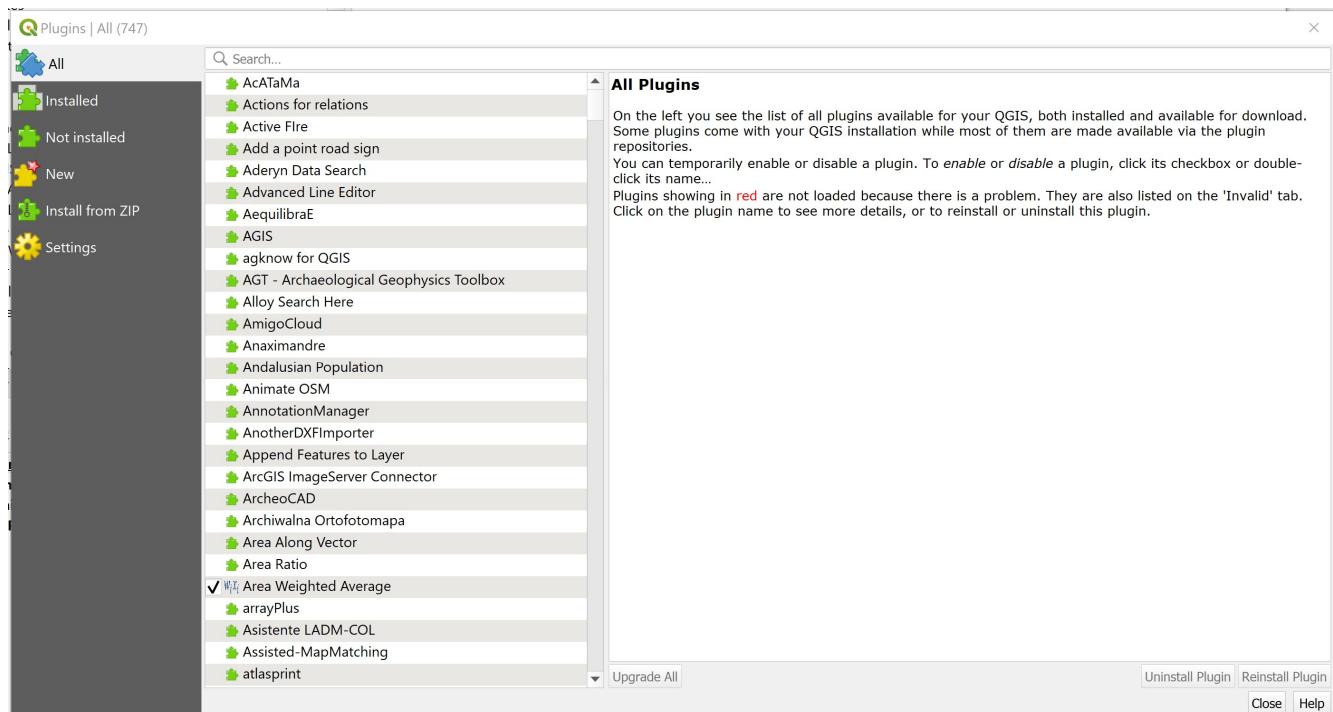
## 4.2 Install the MMQGIS Plugin

Instead of using the geocoding API of SLA OneMap, in this section you will use the *Geocode Tools* of **MMQGIS** plugin developed by Michael Minn.

To install the **MMQGIS** plugin, you will need to load the QGIS plugin repository by following the steps below.

- From the menu bar, select **Plugins → Manage and Install Plugins**.

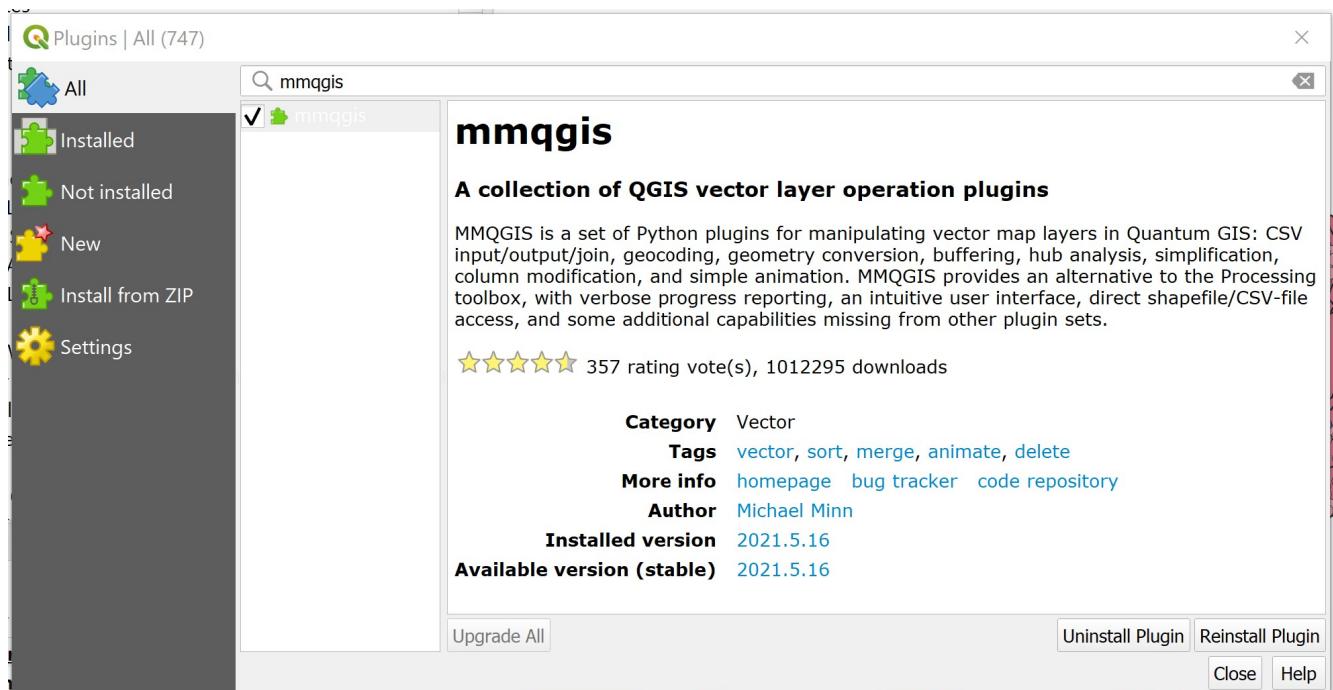
Plugins dialog window appears as shown below.



Notice that there is a long list of plugins available. We can use the Search function to locate mmqgis plugin easily.

- At Search, type *mmqgis*.

Your screen should look similar to the figure below.



**Friendly Advice:** It is a good practice to read the documentation of the plugin (i.e. More info: homepage) thoroughly before download or/and using any QGIS plugin.

- Click on **Install Plugin** button to run the installer.

After installing mmqgis plugin, remember to close the Plugin dialog window.

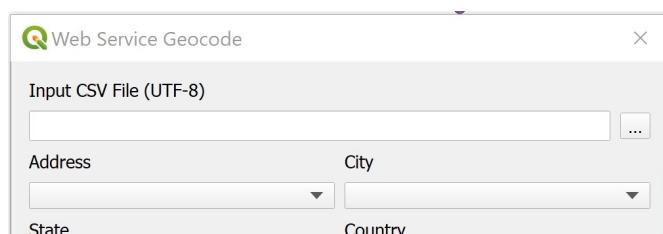
- Click on **Close** button.

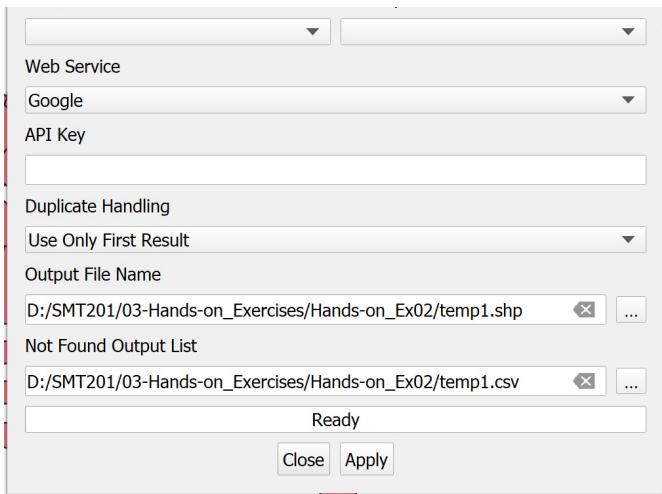
## 4.3 Geocoding using MMQGIS Plugin

Now, you are ready to geocode schools dataset.

- From the menu bar, select **MMQGIS -> Geocode -> Geocode CSV with Web Service**.

Web Service Geocode dialog window appears.





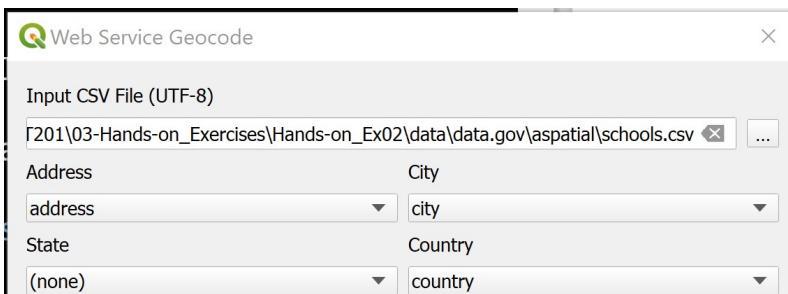
Geocode Tools of MMQGIS plugin imports addresses from a CSV file. The input CSV file should be encoded in the UTF-8 character set. Although other 8-bit encodings (like Windoze ISO-8859-x) will work if only ASCII characters are present, non-ASCII characters may cause unpredictable behavior.

- From **Input CSV File (UTF-8)**, click on **Browse** button.

**Select a file** dialog window appears.

- Navigate to the path where schools.csv reside.
- Click on schools.csv.
- Click on **Open** button.

Your screen should similar to the screenshot below.



Notice that the **Address**, **City** and **Country** drop-down lists have been mapped to the corresponding field names in schools.csv. This explains why the data preparation performed in previous step was important and necessary.

**MMQGIS Geocode Tool** supports five geocoding services. They are: Google, OpenStreetMap/Nomination, US Census Bureau, ESRI Server and NetToolKit. Except OpenStreetMap/Nomination, the rest of the geocoding services required you to have an API key.

In this exercise, OpenStreetmap/Nominatim geocoding service will be used.

*Warning: To complete this section, you will need internet access to run the geocoding process.*

- For **Web Service**, select **OpenStreetMap/Nominatim** from the drop-down list.

Geocode Tool will generate two output files. They are a point feature GIS data set along with a *NotFound* CSV file containing all rows that could not be geocoded (for whatever reason). We need to tell Geocode Tool where to keep these two output files.

- Use File Explorer to create a new sub-folder called geocoding in -on\_Ex02 directory.
- For **Output File Name**, click on **Browse** button.

**Create or select a file** dialog window appears.

- Navigate to the newly create *geocoding* sub-folder.
- For **File name**, type `geocoded_sch.shp`.
- Click on **Save** button.

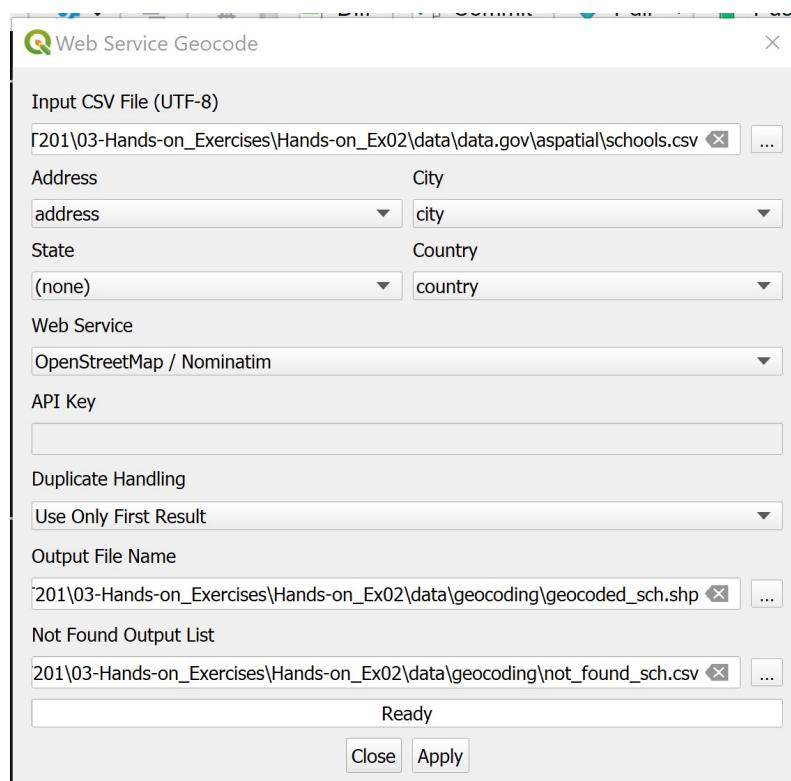
You also need to provide the **Not Found List Output list** a place holder.

- For **Not Found Output list**, click on **Browse** button.

**Create or select a file** dialog window appears.

- Navigate to the newly create *geocoding* sub-folder.
- For **File name**, type `not_found_sch.csv`.
- Click on **Save** button.

The completed dialog window should look similar to the screenshot below.



Now, you are ready to perform the geocoding function.

- At the **Web Service Geocode** dialog window, click on **Apply** button.

When the geocoding function is completed, notice that a new shapefile layer will be added on QGIS map window. At the same time, the progress bar will indicate numbers of records that have been geocoded successfully as shown below.



The output report shows that out of the 346 schools data records, 325 of them have been geocoded successfully.

- click on **Close** button to closed the dialog window.

Let us examine the layer properties of the newly created `geocoded_sch` layer.

- Hover your mouse over `geocoded_sch` layer, right-click and select **Open Attribute Table** from the context menu.

The **Attribute table** of `geocoded_sch` appears.

A screenshot of the QGIS Attribute Table for the "geocoded\_sch" layer. The table has 11 columns: school\_nam, address, postal\_cod, city, country, result\_num, osm\_id, display\_na, category, type, and latlong. The table contains 10 rows of data, each representing a school. The "display\_na" column shows the full name of the school, and the "category" and "type" columns indicate they are schools. The "latlong" column shows coordinates for each school.

	school_nam	address	postal_cod	city	country	result_num	osm_id	display_na	category	type	latlong
1	ADMIRALTY PRI...	11 WOODLAN...	738907	Singapore	Singapore	0	154157142	Admiralty Primary School, 11, Wo...	amenity	school	1.4429414,103.8...
2	ADMIRALTY SEC...	31 WOODLAN...	737916	Singapore	Singapore	0	146745903	Admiralty Secondary School, 31, ...	amenity	school	1.445911849999...
3	AHMAD IBRAHI...	10 YISHUN STR...	768643	Singapore	Singapore	0	172125698	Ahmad Ibrahim Primary School, 1...	amenity	school	1.4338487,103.8...
4	AI TONG SCHOOL	100 Bright Hill ...	579646	Singapore	Singapore	0	157675859	Ai Tong School, 100, Bright Hill Dri...	amenity	school	1.360712550000...
5	ALEXANDRA PRI...	2A Prince Charl...	159016	Singapore	Singapore	0	292420395	Alexandra Primary School, 2A, Pri...	amenity	school	1.291283700000...
6	ANCHOR GREE...	31 Anchorvale ...	544969	Singapore	Singapore	0	32695945	Anchor Green Primary School, 31, ...	amenity	school	1.390379799999...
7	ANDERSON PRI...	19 ANG MO KI...	569785	Singapore	Singapore	0	692703779	Ang Mo Kio Avenue 9, Ang Mo Ki...	highway	secondary	1.38312,103.840...
8	ANDERSON SEC...	10 ANG MO KI...	569206	Singapore	Singapore	0	153582552	Anderson Secondary School, 10, ...	amenity	school	1.37541705,103....
9	ANDERSON SER...	4500 ANG MO K...	569843	Singapore	Singapore	0	32396132	Anderson Serangoon Junior Colle...	amenity	college	1.379151499999...
10	ANG MO KIO PR...	20 ANG MO KI...	569920	Singapore	Singapore	0	292420397	Ang Mo Kio Primary School, 20, A...	amenity	school	1.3691002,103.8...

Notice that all columns from the input CSV file are added as attributes in the output shapefile. Six additional fields are added to in the shapefile. The **category** and **type** fields are internal from OpenStreetMap. They provide useful data classification for the schools data sets.

*DIY: Using the steps you had learned in previous section, examine and transform the coordinate system of `geocoded_sch` data set into SVY21 projected coordinate system.*

## 5.0 Working with Raster GIS data

Raster data such as those collected by remote sensing satellite or airplanes are one of the important data sources of a GIS project. Beyond layers, these data are stored in image file formats such as TIFF, GeoTIFF, JPEG

sources of a GIS project. By and large, these data are stored in image file format such as TIF, GeoTIF, JPG and GeoJPG. In this section, you will learn how to bring a raster data in GeoTIF file format into QGIS. The raster data is called Chinatown.tif. It is available in -on\_Ex02sub-folder.

- Start **File Explorer**.
- Navigate to -on\_Ex02sub-folder.

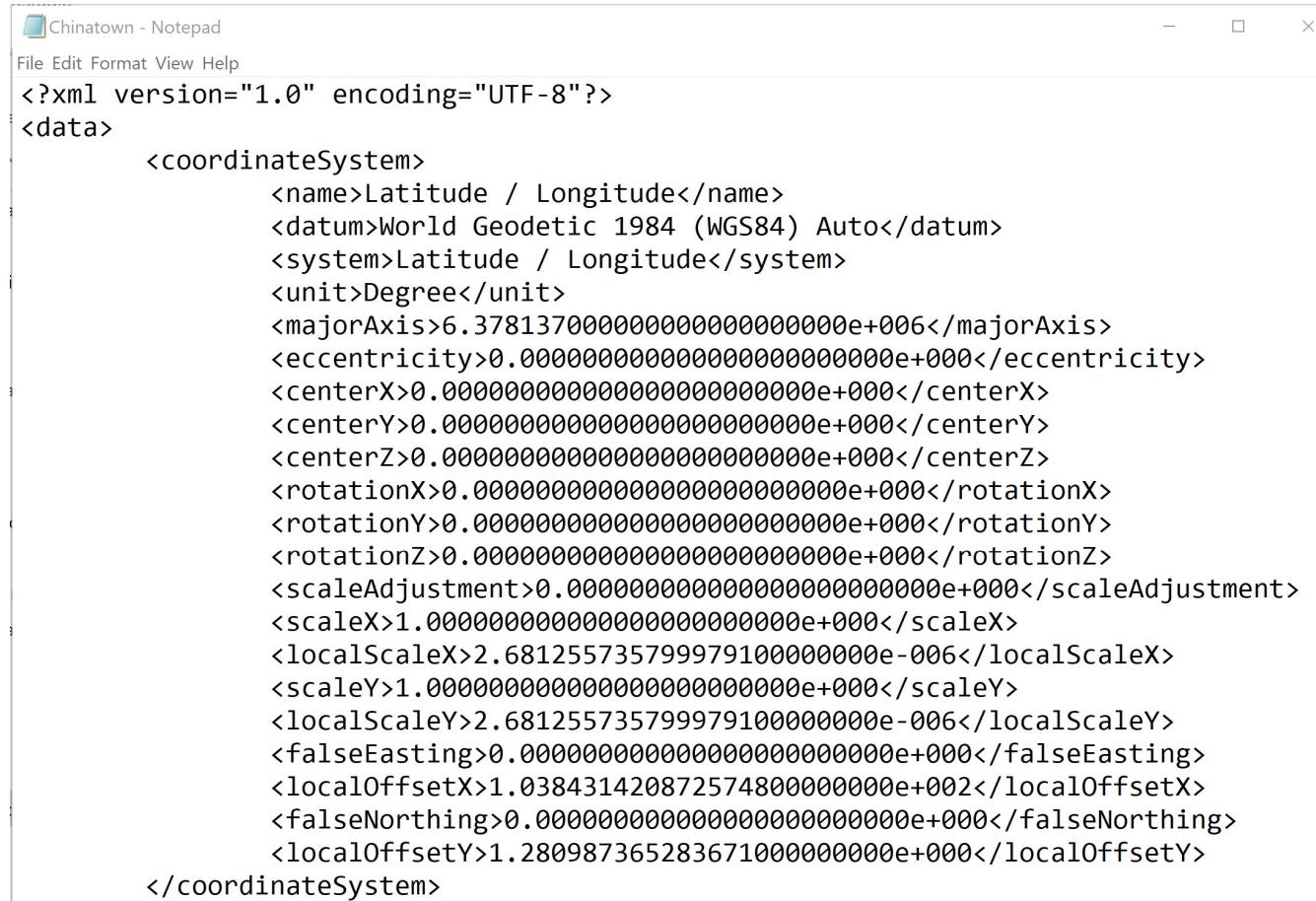
You should see the following files in the sub-folders.

Name	Date modified	Type	Size
Chinatown	24/10/2019 3:17 pm	RMF File	1 KB
Chinatown.tfw	24/10/2019 3:17 pm	TFW File	1 KB
Chinatown	24/10/2019 3:17 pm	TIF File	23,439 KB
Chinatown.tif.aux	24/10/2019 3:17 pm	XML Document	1 KB
Chinatown	24/10/2019 3:17 pm	XML Document	2 KB

This is an example of images file in GeoTIF format. The geographical information of the image file (i.e. Chinatown.TIF) is actually contained in the Chinatown.XML file.

- Open Chinatown.XML using **Notepad**.

It should look similar to the figure below.



```
<?xml version="1.0" encoding="UTF-8"?>
<data>
    <coordinateSystem>
        <name>Latitude / Longitude</name>
        <datum>World Geodetic 1984 (WGS84) Auto</datum>
        <system>Latitude / Longitude</system>
        <unit>Degree</unit>
        <majorAxis>6.37813700000000000000000e+006</majorAxis>
        <eccentricity>0.00000000000000000000000e+000</eccentricity>
        <centerX>0.00000000000000000000000e+000</centerX>
        <centerY>0.00000000000000000000000e+000</centerY>
        <centerZ>0.00000000000000000000000e+000</centerZ>
        <rotationX>0.00000000000000000000000e+000</rotationX>
        <rotationY>0.00000000000000000000000e+000</rotationY>
        <rotationZ>0.00000000000000000000000e+000</rotationZ>
        <scaleAdjustment>0.00000000000000000000000e+000</scaleAdjustment>
        <scaleX>1.00000000000000000000000e+000</scaleX>
        <localScaleX>2.68125573579997910000000e-006</localScaleX>
        <scaleY>1.00000000000000000000000e+000</scaleY>
        <localScaleY>2.68125573579997910000000e-006</localScaleY>
        <>falseEasting>0.00000000000000000000000e+000</falseEasting>
        <localOffsetX>1.03843142087257480000000e+002</localOffsetX>
        <falseNorthing>0.00000000000000000000000e+000</falseNorthing>
        <localOffsetY>1.28098736528367100000000e+000</localOffsetY>
    </coordinateSystem>
```

```

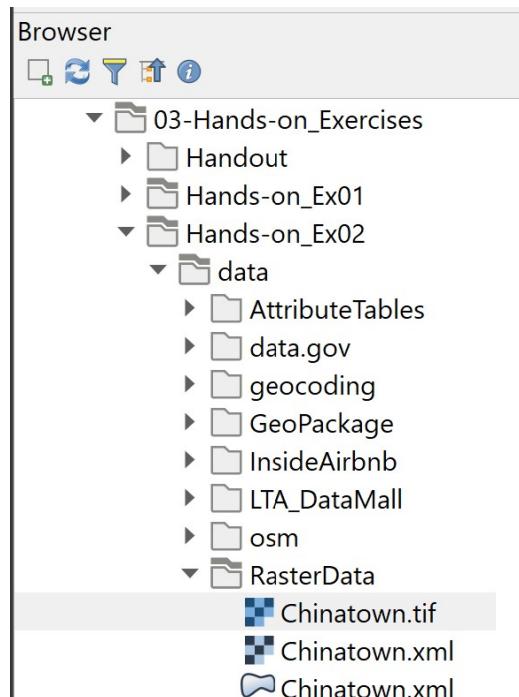
<image>
    <channels>4</channels>
    <cx>2571</cx>
    <cy>2332</cy>
</image>
</data>

```

It provides details information of the image file including georeference system used, the geographical extent of the data, spectral resolution of the dataset and spatial resolution of the dataset.

Next, you will import Chinatown raster data into QGIS.

- From **Browser** panel, navigate to sub-folder as shown in the screenshot below.



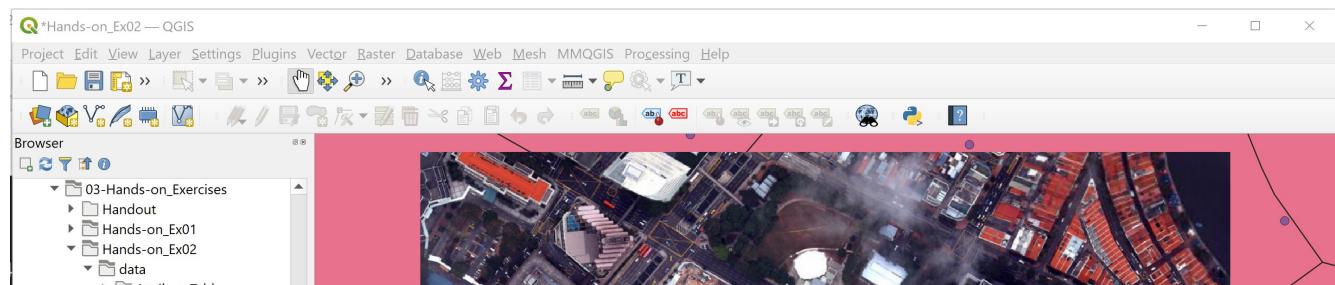
- Double-click on `Chinatown.tif`.

Notice that a new raster layer called Chinatown has been added on the **Layers** panel. However, it is not visible on the View window. This is because it is block by the massive point features.

In order to view the newly added Chinatown layer, we need to zoom into the extend of Chinatown layer.

*DIY: Using the steps you had learned in Hands-on Exercise 1, zoom to the extend of Chinatown layer.*

Your screen should look similar to the screenshot below.





*DIY: Using the steps you had learn in the earlier sections of this hands-on exercise, examine the properties of Chinatown data layer.*

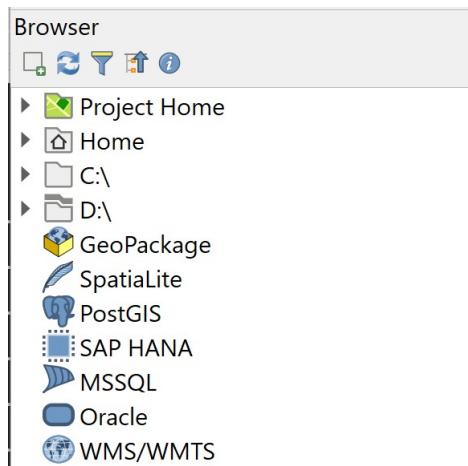
## 6.0 Working with Internet Geospatial Services

One of the unique feathers of a modern GIS is its capability of consuming GIS data shared over the internet. These data can be in the form of WMS, WMS or proprietary format such as Google map, Bing map and OpenStreetMap format. In this section, you will learn how to consume an OpenStreetMap (OSM) data using QGIS.

**DIY:** Before we can use OSM service, let us display the map view by using the full extent of MP14\_SUBZONE\_NO\_SEA\_PL layer. This is because we will use the extend of MP14\_SUBZONE\_NO\_SEA\_PL as the reference to map OSM service in QGIS.

- From **Browser** panel, click on the triangle in front of **XYZ Tiles**.

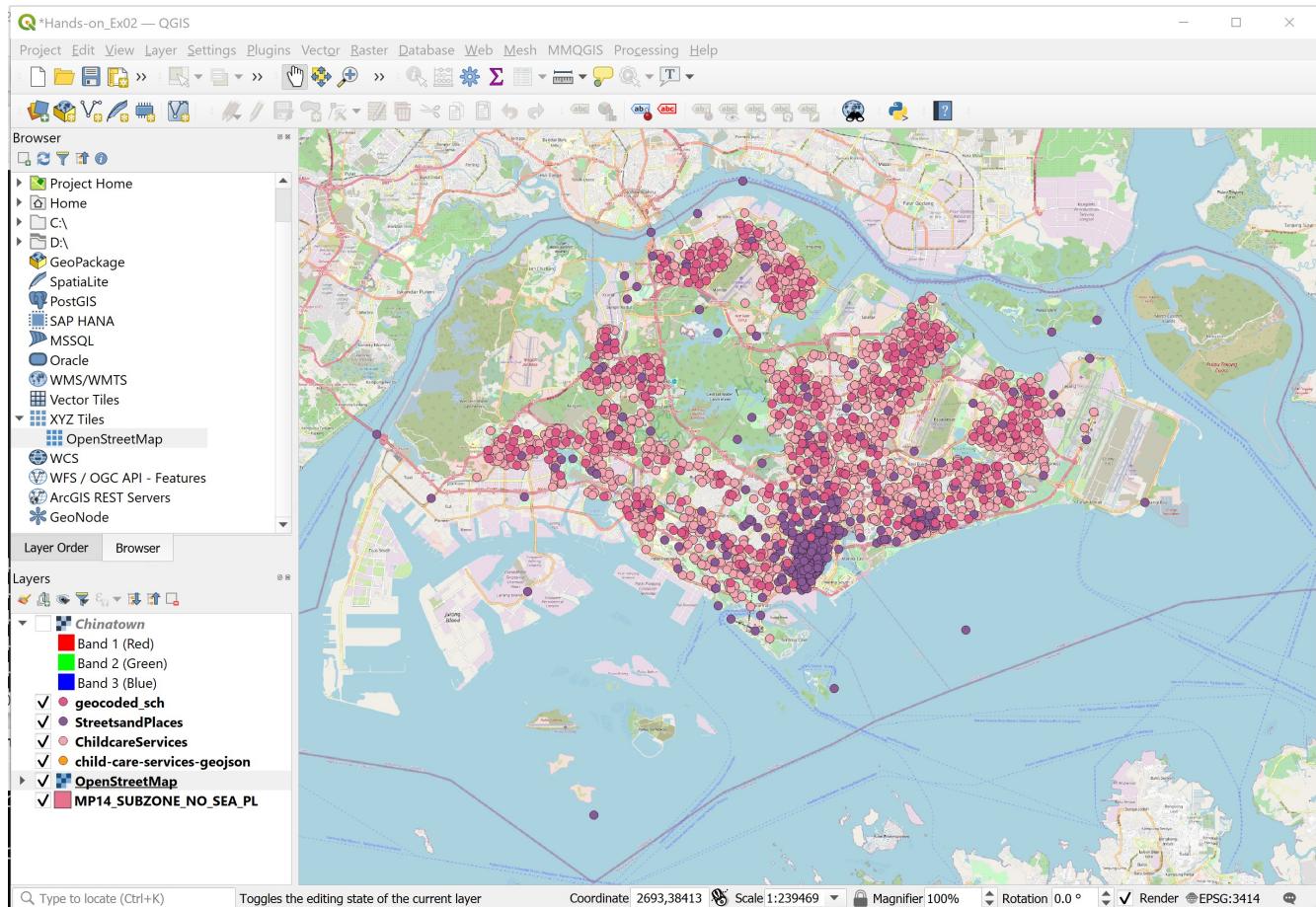
OpenStreetMap icon appears as shown in the screenshot below.





- Double-click on **OpenStreetMap** icon.

Your screen should look similar to the figure below.



*DIY: Use the skills you had learned from previous sections, 1. Re-organise the GIS layers so that you can see the polyclinics, and childcare centres are plotted on top of OpenStreetMap layer. 2. Navigate around the map areas and look for details.*