LESSON 3: INTRODUCTION TO QGIS

Objective:

- Explain what QGIS is
- Navigate QGIS interface
- Install plugins
- Understand Coordinate Reference System (CRS)
- Create a QGIS project.

A. GIS SOFTWARE

There are several GIS Mapping software for analyzing geospatial data. During this course, we will use QGIS, an open-source cross platform

B. What is QGIS?

Quantum GIS (QGIS) is open-source geographical information software that runs on different platforms such as Mac, Windows or Linux. This project was first developed by Gary Sherman in 2002. The original goal was to create an open data viewer. QGIS is maintained by volunteers that update and improve the software constantly. QGIS as a Project is currently organized as an association legally based in Switzerland. QGIS is subject to the GNU General Public License.

C. Installation

Since QGIS runs in Mac, Windows, and Linux, there are some differences across operating systems. In general, the interface and capabilities are the same. However, if there are small differences, consider the platform and the QGIS version. In this lesson, the QGIS 3.10 Mac version is used.

To install QGIS go to https://qgis.org/en/site/ and download the latest **LTR (Long Term Release**). If you encounter a problem, follow the video that match your operating system:

- **Mac** https://www.youtube.com/watch?v=kE0WBEcBKtI
- **Windows** https://www.youtube.com/watch?v=ngaeJ_1SDpA
- **Linux** https://www.youtube.com/watch?v=YVE_gXPaMsU

D. Interface

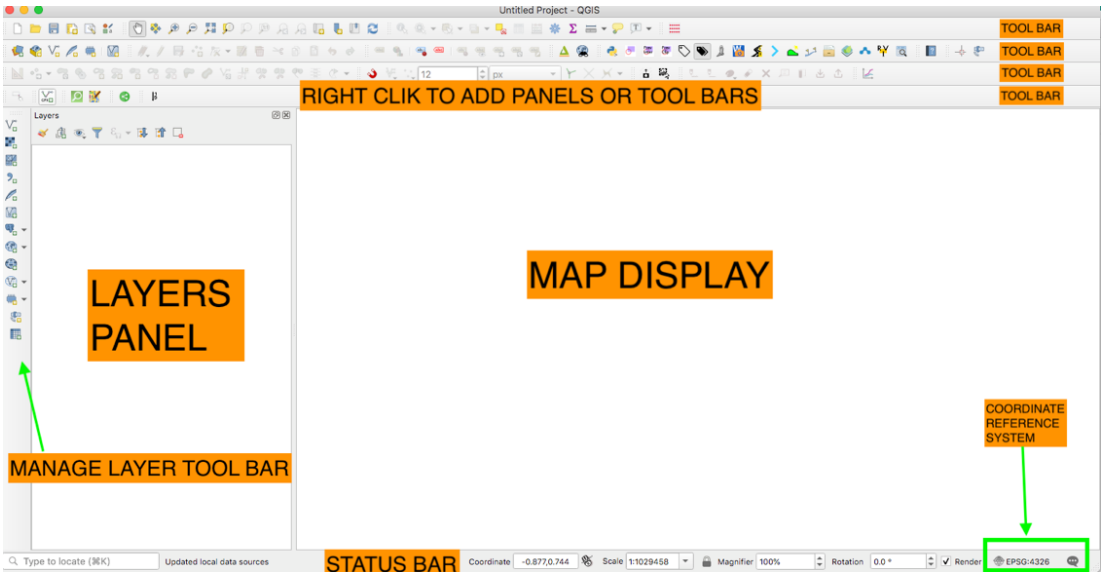

Figure 1 QGIS Interface

1. In your computer, open QGIS by double clicking on the icon. It may take a long time to open QGIS the first time you own it.
2. Once QGIS opens, look at the interface in Figure 1. QGIS interface is mainly composed of:
    i. Map Display
    ii. Main Menu (not show on Figure 1)
    iii. Tool Bars (More tool bars can be added)
    Add **the Manage tool bar** by right clicking in any toolbar and check it.
    iv. Layer Panel (More panels can be added)
    v. Status Bar
    CRS (Coordinate Reference System)
3. Additionally, is important to take the following buttons into account:

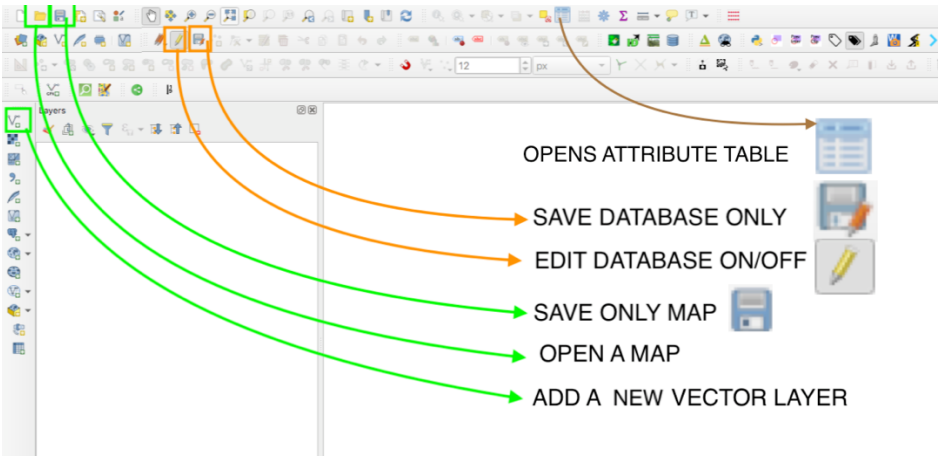

Figure 2 Important buttons to understand

- QGIS has **two save buttons** which happen to look similar, but they have different purposes. The **save map** button saves the way a map looks including colors, themes, fonts. On the other hand, **save database** (layer edit) button saves the values on the database itself. In other words, it saves the values on the table of data.
- The edit database on/off (**Toggle editing**) is like a switch that allows to modify the database. Think of this as switch that opens a door for the database.
- The **Open** button opens the maps.
- The **Add new vector layer** append new vector layers to the main map.
- Once a layer is loaded the **opens attribute table button** becomes available to display de table attributes of the database.

4. Add new plugins (Figure 4)
    a. Go to the main **menu** an clicking on **Manage and Install Plugins.**
    b. In the new window plugins go to **setting** and check **show also experimental plugins** and click on All to go back.
    c. Search for the plugins listed below and install them one by one:
        - **ImportPhoto** Lets you import images with longitude and latitude metadata.
        - **Spreadsheet Layers** lest you import excel files.
        - **Openlayers** Plugins lest you add an open street map background.
        - **QuickOSM** Lest you download attributes from opens street map

d. Once installed you will be able to see icons like in figure 4.

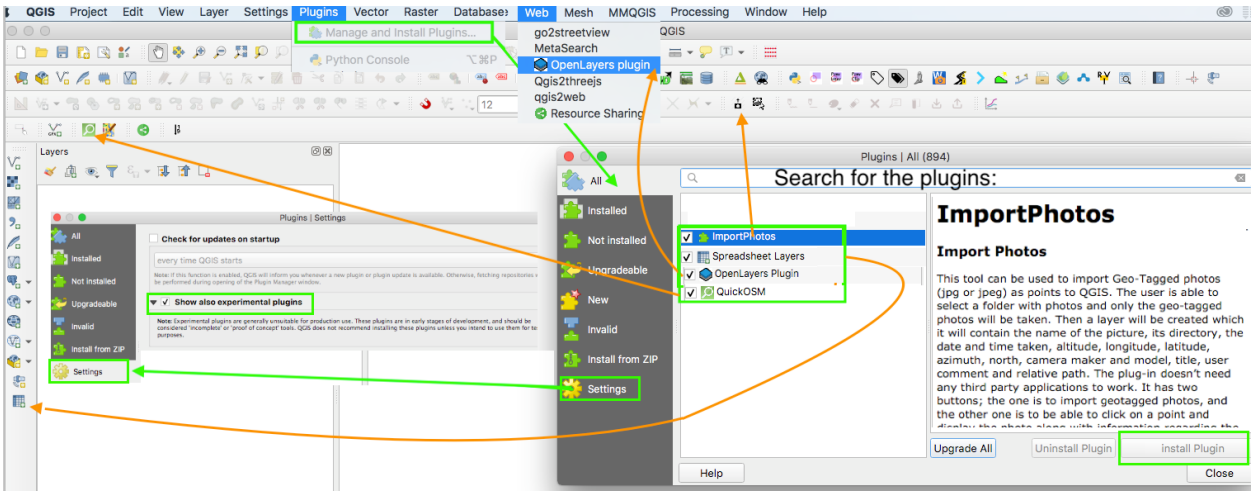

Figure 3 Searching and Installing Plugins

E. Coordinate Reference System (CRS)

QGIS can display data from different coordinates systems. These coordinates systems are easily identified by an EPSG (Geodetic Parameter Dataset) code number. During this tutorial the EPSG should be set to 4326 (EPSG:4326).

CRS are usually either geographical (measuring degrees) or projected (meters, feet). Depending on the type of work needed to achieve and the location the CRS will vary to minimize distortion.

As we all know the earth can be simplified as 3D spheroid or ellipsoid. This 3D has a Geoid (shape of earth based on sea level water under influence of gravity) and/or Datum that gets closer to the fit of shape of the earth.

Up until this point coordinates can be measured in degrees, but the need of two-dimensional maps requires 3D shapes to be projected. This can be achieved throw a cylinder, cone or azimuthal like is shown in Figure 5.

These 2D projections generate maps in meters or feet but depending on their location distortion can be expected. In order to minimize these distortions users must identify the correct projection for the location and type of work in process.

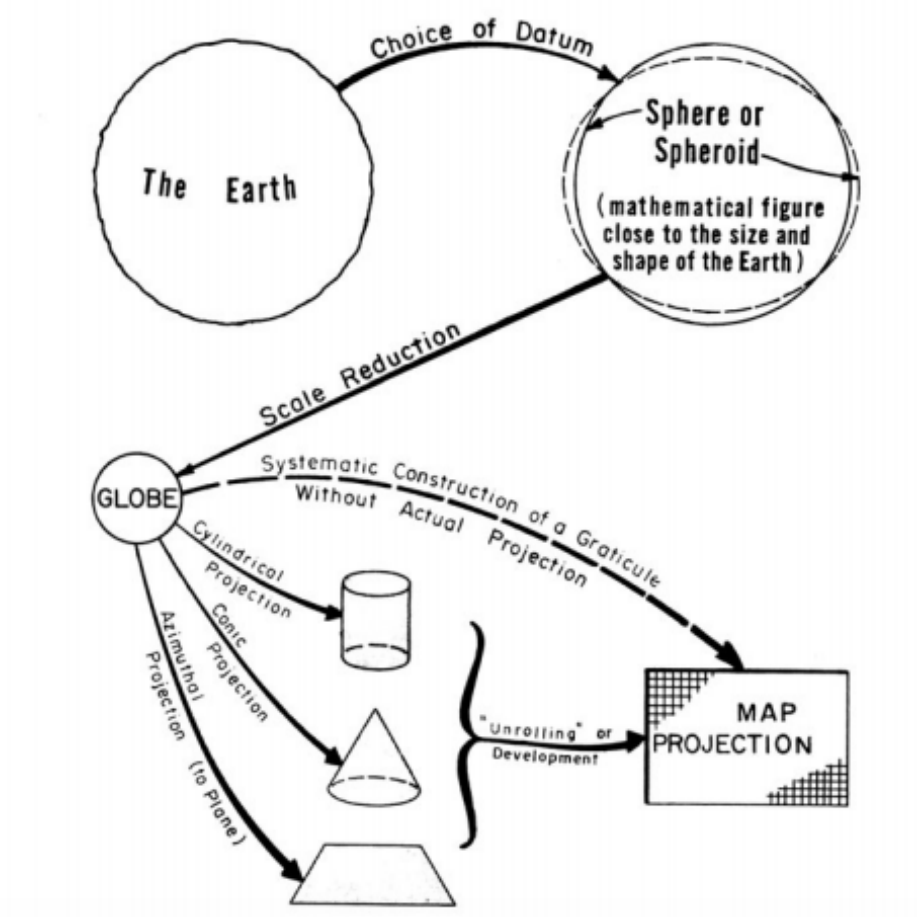

Figure 5 Introduction to map projections (McDonnell P.W., 1987)

The coordinate system reference EPSG:4326 is a geographical coordinate system Datum/Geoid WSG84 (Spheroid) that measures locations in longitude and latitude. This is one of the most popular CRS used for our GPS and cellphones.

F. TUTORIAL

1. Create folder and subfolders for this tutorial similar to Figure 6.

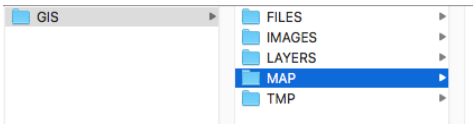

Figure 6 Folders and subfolder for this tutorial.

2. Open QGIS by double clicking on the icon. Click **new empty project**. Make sure the CRS is **EPSG:4326**.
3. Go to the main **menu** and click on **SAVE AS**. Search for the folder MAP we created in step 1 and save the MAP as **MYFIRSTTUTORIAL.qgz**
4. Go to the **main menu** and click **Web/OpenLayer plugin/OpenStreetMap/Openstreetmap** (Figure 7). A World map will show**. Zoom to Atlanta Georgia** by using the mouse wheel to zoon in/put and mouse wheel click hold to move up/down/left/right.

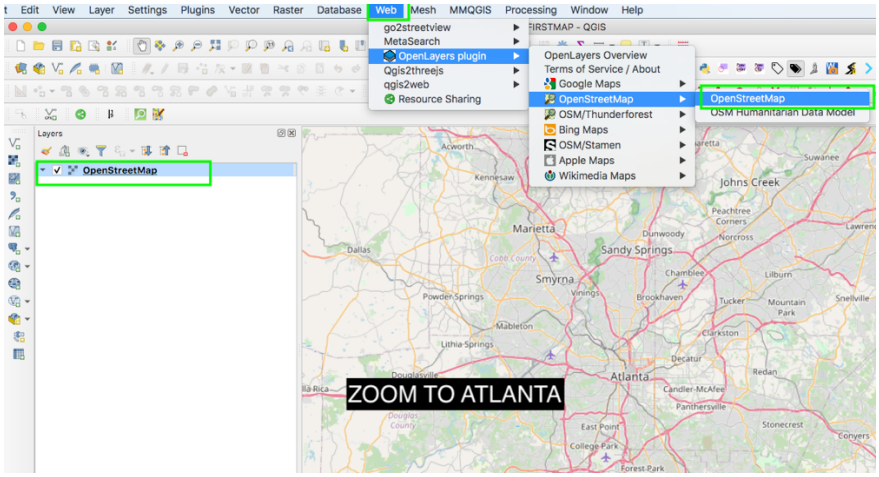

Figure 7 Add Open Street Map

5. If you examine the layer panel, there is a new layer named OpenStreetMap. This layer is only an image and does not have attribute values that can extracted, and is only a background base map. (This OSM map will not work offline).
6. Go to the main menu and click on Vector/QuickOSM/QuickOSM.. and a window like in Figure 8 will appear.

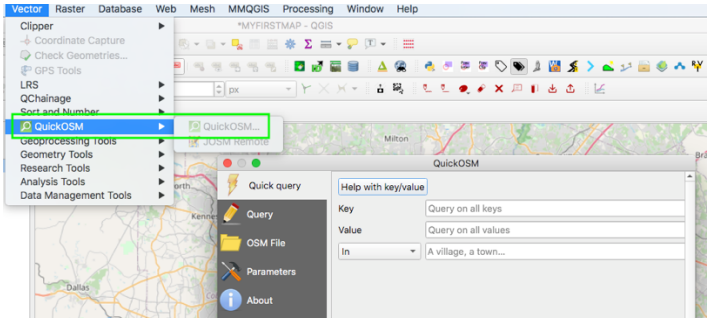

Figure 8 QuickOSM plugin

7. Open a web browser window and go to the website https://wiki.openstreetmap.org/wiki/Map_features. In this website the values and key for OSM database is explained. Look for **Fast Food** and search for **Key** amenity **value** fast_food (Figure 9).

Key	Value	Element	Comment	carto-Rendering	Photo
			Sustenance		
amenity	bar		**Bar** is a purpose-built commercial establishment that sells alcoholic drinks to be consumed on the premises. They are characterised by a noisy and vibrant atmosphere, similar to a party and usually don't sell food. See also the description of the tags `amenity=pub;bar;restaurant` for a distinction between these.		
amenity	biergarten		**Biergarten** or **beer garden** is an open-air area where alcoholic beverages along with food is prepared and served. See also the description of the tags `amenity=pub;bar;restaurant`. A biergarten can commonly be found attached to a beer hall, pub, bar, or restaurant. In this case, you can use `biergarten=yes` additional to `amenity=pub;bar;restaurant`.		
amenity	cafe		**Cafe** is generally an informal place that offers casual meals and beverages; typically, the focus is on coffee or tea. Also known as a **coffeehouse/shop**, **bistro** or **sidewalk cafe**. The kind of food served may be mapped with the tags `cuisine=*` and `diet=*`. See also the tags `amenity=restaurant;bar;fast_food`.		
amenity	fast_food		Fast food restaurant (see also `amenity=restaurant`). The kind of food served can be tagged with `cuisine=*` and `diet=*`.		

Figure 9 OSM Map features - amenity fast_food

8. Return to the main QGIS interface and do the following
    - In the QuickOSM window populate **amenity** and **fast_food** for the key and value respectively like is shown in figure 9.
    - Next, select from the pull-down **Canvas Extent.**
    - Click on the button **Run Query**
    - After a couple seconds you should see two new temporal layers added to the layer panel. (Temporal Layers can be identified by this icon to the right of the name  .
    - Right click over the layer named amenity_fast_food that shows a **square** symbol and click remove layer.
    - Right click over the layer named amenity_fasf_food that shows a **point** symbol and click rename layer and type FastFood.

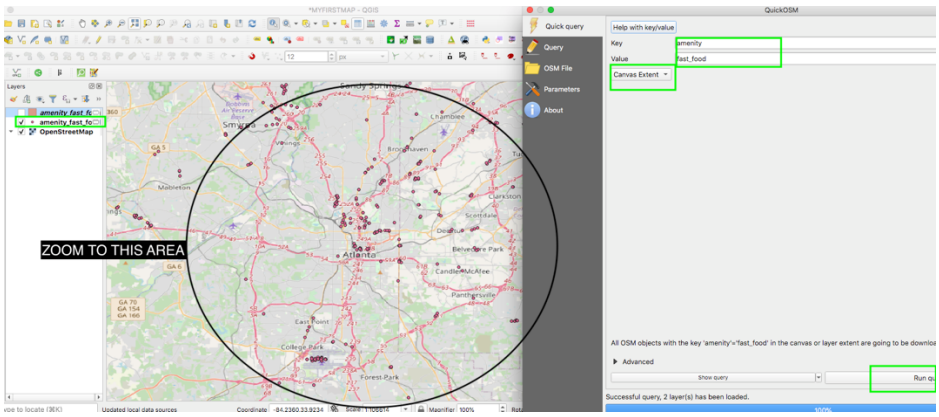

Figure 10 Quick OSM searching for fast food

9. Right click on the layer FastFood and click **make permanent** a new window will pop up. Do the following:
    - Select in format ESRI Shape.
    - In file name click on the … and look for the folder defined in this tutorial in bullet 1 and save this file with the name FastFood.
    - Then click save then **ok**
    - The temporary icon  will disappear and this layer is saved in our hard drive.

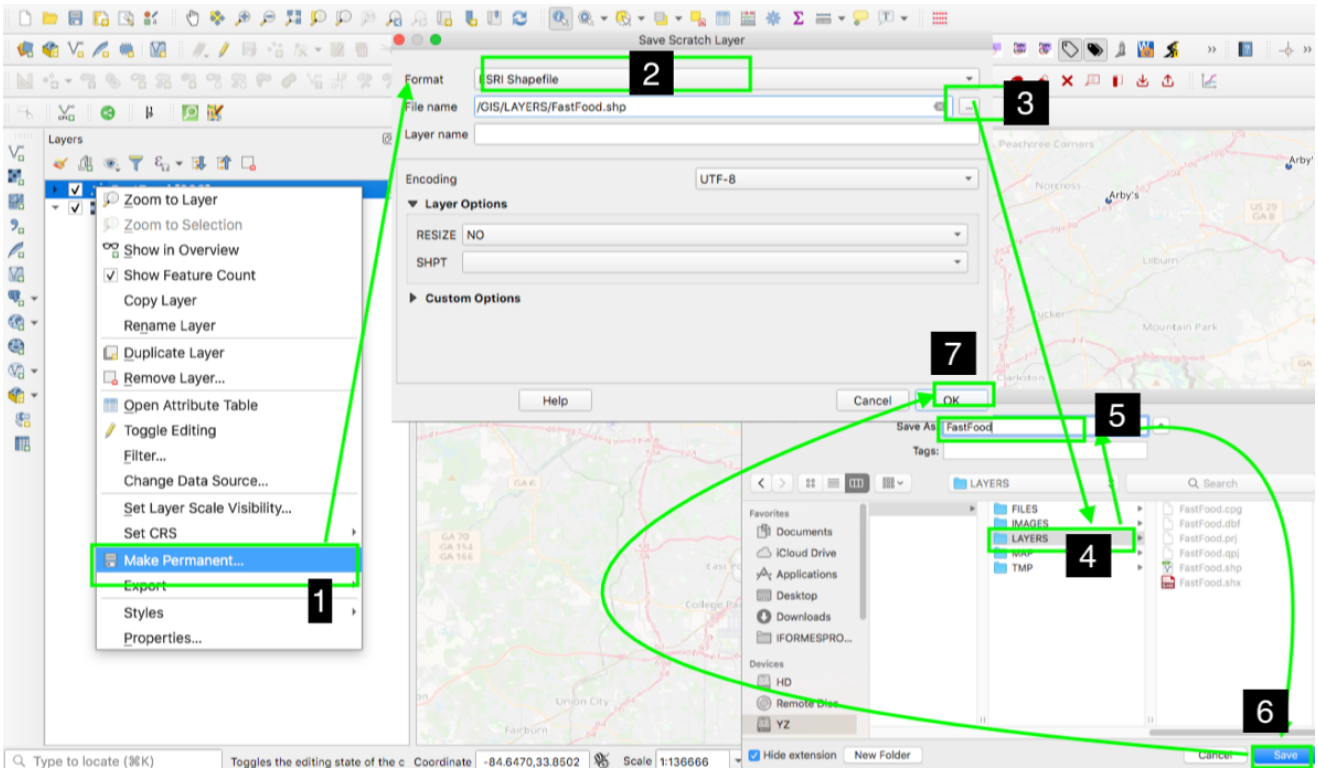

Figure 4 Make a temporal layer permanent

10. Double click on the layer FastFood and the **layer properties** will appear
    - Click on **Symbology**
    - Select in the first pull-down menu and choose **categorized**
    - Select in the **Value** pull-down menu **name**
    - Like shown in figure 10 click **classify** and click **ok**
    - You should see in the map layer a new pull-down arrow that shows all the classification (Figure 11)

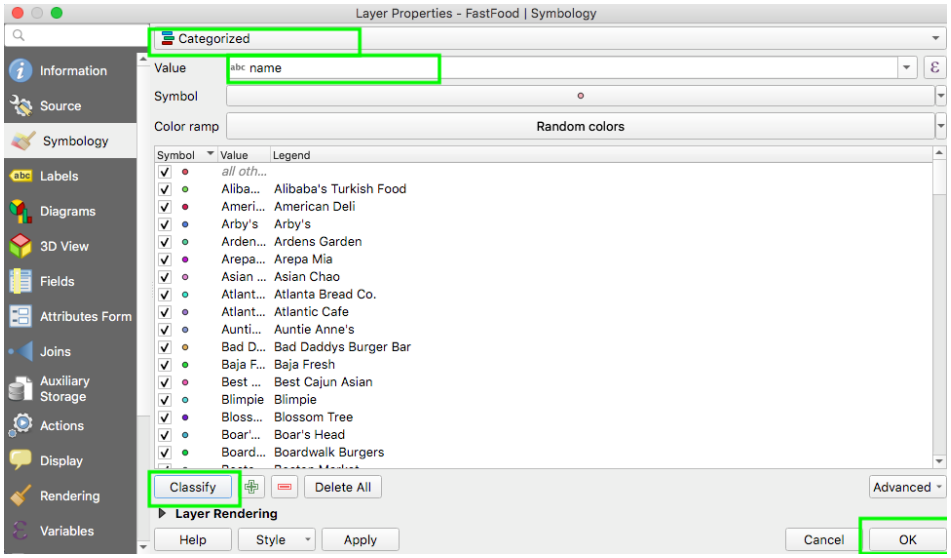

Figure 12 Layer Properties-Symbology

11. Right click over FastFood Layer and check **show feature count**. Now you can appreciate that each fast food has been color coded and that we can see the **count** for each category in the layer panel.

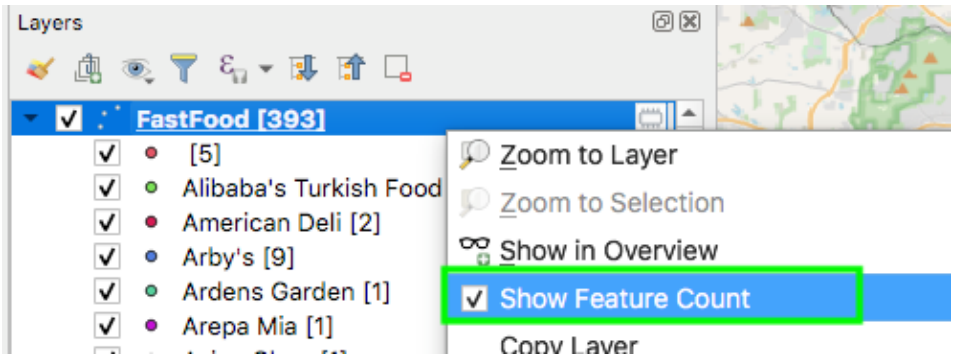

Figure 13 shows feature count

12. Double click again in FastFood layer and the **properties layer** shows up. Do the following:
    - Select **Label** in the left column.
    - In the first pull-down menu select **single labels.**
    - Select in Value **name.**
    - In the second column menu select **buffer.**
    - Check on **Draw text buffer.**
    - Click **ok.**
    - If you zoom in and out, the map shows the name label of the fast food places.
    - Do not forget to save the map or go to main menu **Project/save.**

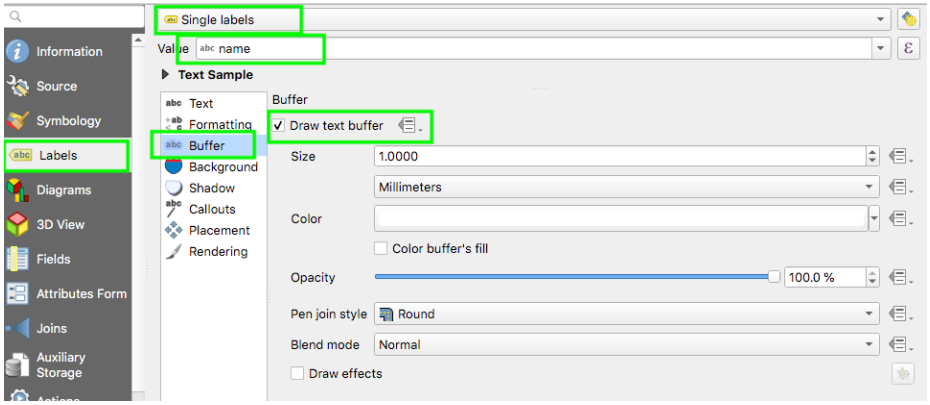

Figure 14 Add a label from layer properties

13. **Let's assume my favorite restaurant is Arby´s**
    - Let's right click on Arby´s and click **hide all items** (Figure 15). This way all the fast food points disappear from the map display.

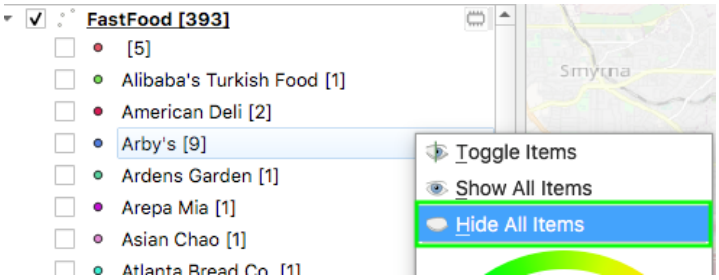

Figure 15 Hide Elements

- Now, check back on only Arby´s symbol. Now you can see only the Arby´s on the map.

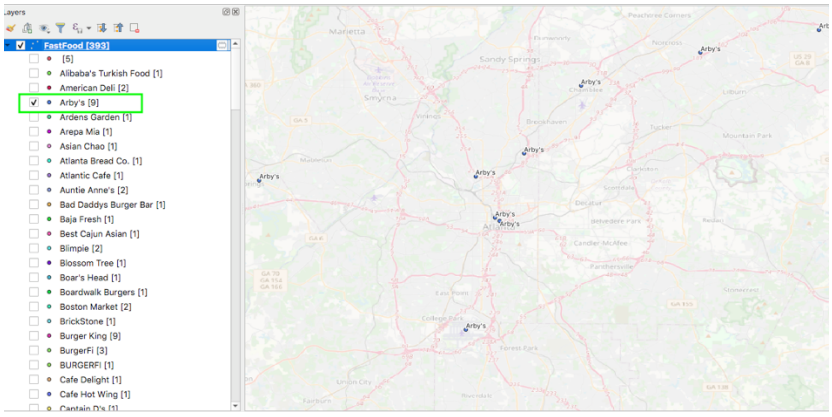

Figure 5 Final Result showing only Arby's

14. Look at the database by right click on FastFood layer on the layer panels and select **Open Attribute Table**. Look around a become familiar with the database and variables (top label of each column).

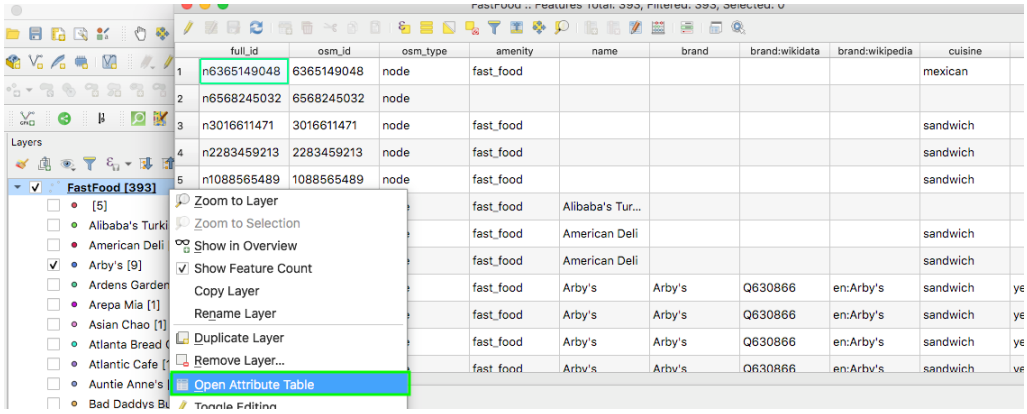

Figure 17 Attribute Table of FastFood

15. If your background map OpenStreetMap layer is too strong, you can give transparency so it will not be too invasive to the final map. You can accomplish this by double clicking in layer OpenStreetMap and in the layer properties and select **transparency** and type **40 %** then ok.

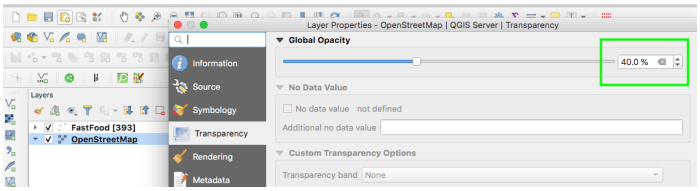

Figure 18 Transparency for OSM

16. **Save** the map and **quit** QGIS

After Class

Create a map similar using QGIS to the one created in the tutorial above. This time instead of fast food, find all the **Charing Stations** for electric cars in Atlanta. Take a screen shoot of the map with the total number of stations and the search for the closest charging station to Morehouse College and take another screenshot of it. This information must be computer generated. Do not forget to save your project as **YOURNAMEMAP1**

References

McDonnell P.W. (1987) Map Projections. In: Brinker R.C., Minnick R. (eds) *The Surveying Handbook.* Springer, Boston, MA. https://doi.org/10.1007/978-1-4757-1188-2_16

QGIS.org. (2021). *QGIS 3.16. Geographic Information System User Guide. QGIS Association.* Electronic document: https://docs.qgis.org/3.16/en/docs/user_manual/index.html