Trajectories 2024 – Mapping the Census of Canada

This workshop has been prepared by MacOdrum Library GIS Services (gis@carleton.ca).

Mapping the Census of Canada can be a great way to visualize and analyze census data. However, navigating the Stats Canada website can be tricky and data tables often require cleaning, merging, and a lot of digging around. Thankfully, while you are an active Carleton member (student, staff, or faculty) you have access to an amazing tool called the Canadian Census Analyser. We have some excellent help guides that will walk you through using this tool.

Before we begin, open your P:drive and create a new folder called **MappingCensusCanada.** This will be your project folder where you will save your data and your project.

We will attempt to answer the following question: *What City of Ottawa census tracts have the highest public transit ridership for commute to work?*

Part 1. Getting the data

1. Go to GIS Help: Mapping the Census of Canada | MacOdrum Library (carleton.ca). Click on What are census geographies to get an idea of the type of geography you want to map. For this exercise, we will choose one of the smallest census geographies – census tracts.
   a. Click on Census of Canada: Downloading Canadian Census Analyser Data | MacOdrum Library (carleton.ca) | Click on Canadian Census Analyser website, hosted by the University of Toronto link| you will be prompted to sign in using your **MyCarletonOne credentials**
   b. On the Canadian Census Analyser page, click on **2021** under "**by Census Year**."
   c. On the next page, click on **Profile of Census Tract**

2. On the Canadian Census Analyser 2021 Census Profile page, you will go through a series of Steps to choose the geography and variables you want to map.

   a. **Step1: Specify Census Geography for retrieval** | click on the **by Province** tab | check **Ontario**| click on the **by Name** tab and check the letter **"O"** | you will see 2 items found, check **Ottawa – Gatineau (Ont.)**

Step1: Specify Census Geography for retrieval

Census Geography: (1 selected)

◉ Locate census geography (CMAs/CAs with CTs) in the

| by Name | by Province |

-check all- | -uncheck all-

☐A ☐B ☐C ☐D ☐E ☐F ☐G
☐H ☐K ☐L ☐M ☐N ☑O ☐P
☐Q ☐R ☐S ☐T ☐V ☐W

-check all- | -uncheck all-

2 items found:
☐ Oshawa (Ont.)
☑ Ottawa - Gatineau (Ont.)

-remove all- | -order-

Selected items:
☑ Ottawa - Gatineau (Ont.)

b. **Step2: Specify Census Profile variables for retrieval** | let's look at some of the variable options | We are interested in population and commute to work

    i. first click on the Population and dwellings tab and check the following:

        1. Population, 2021

        2. Population, 2016

        3. Population percentage change, 2016 to 2021

        4. Population density per square kilometre

| Population and dwellings | Age & sex | Dwelling | F.H.M. |
| Mobility | Minority Official Language | | |

Population and dwelling counts *(vertical tab label)*

-check all- | -uncheck all-

Population and dwelling counts
☑ Population, 2021 (v1)
☑ Population, 2016 (v2)
☑ Population percentage change, 2016 to 2021 (v3)
☐ Total private dwellings (v4)
☐ Private dwellings occupied by usual residents (v5)
☑ Population density per square kilometre (v6)
☐ Land area in square kilometres (v7)

    ii. Next, click on the **Journey to Work** tab and check the following:

        1. Car, truck or van ; Both sexes (v7338)

        2. Car, truck or van - as a driver ; Both sexes (v7339)

        3. Car, truck or van - as a passenger ; Both sexes (v7340)

        4. Public transit ; Both sexes (v7341)

        5. Walked ; Both sexes (v7342)

        6. Bicycle ; Both sexes (v7343)

c. **Step3: Specify the output details and submit query**
    i. check all the options as it's always helpful to have a little more information in our table…and we will need some of this information!

    ii. Skip to Select **output format** and choose **to Download to a file** as a **CSV** file. *Note this is important! Census tract names are a code with leading and trailing zeros. When outputting to a CSV those leading and trailing zeros can disappear – especially when adding the CSV to a GIS software. We will do some work to make sure our leading and trailing zeros remain in tact.*
    iii. Click on Submit Query

3. After you submit your query you will be redirected to the Data Request Summary page. There will be two links: **Data file** and **Header file**. You will need both.
    a. Click on the Data file to download the data
    b. Right click on the Header file to **Save link as** the file as a .txt file in your project folder.
    c. Copy the Data file from your downloads into your project folder
    d. Rename the CSV to something meaningful like OttawaCommuteData
    e. Make a second copy of the Data file and call it OttawaCommuteDataraw (you will not work with this data! It's just a back up copy in case things go wrong – good GIS practice!)

4. Downloading Census Tract Boundaries from Stats Canada
    a. Go to the Stats Canada website homepage - [Statistics Canada: Canada's national statistical agency (statcan.gc.ca)](https://statcan.gc.ca)
    b. Click on the **Geography** tab in the top ribbon
    c. Click on the drop down menu for **Spatial information products** and click on **Boundary files**
    d. Click on the **2021 Census year**

e. Scroll down on the next page to the **Boundary files** options and choose the following options using the radio buttons:
   i. Language – **English**
   ii. Type – **Cartographic Boundary Files**
   iii. Format – **Shapefile (.shp)**
   iv. Statistical boundaries – **Census tracts**
   v. Click **Continue**
f. The next page there will be a download link to your zipped boundary shapefile. Click on the link to begin the download

Alternative format – ZIP document

The following document is available for downloading or viewing:

- lct_000b21a_e.zip (ZIP version, 13,089.0 kb)

g. Copy the downloaded zipped folder into your project folder and unzip/extract the folder – right-click on the folder and choose Extract All and Extract. Rename the unzipped folder **CensusTracts**

5. Go to Open Ottawa and type in Ward in the search box. Select **Wards 2022-2026**. Click download. Hopefully, you will see choices for download such as CSV, Shapefile, etc. Download the Shapefile (if the website is not loading properly, we have made all the data available for download here). Copy the Wards_2022-2026 shapefile from your downloads into your project folder. Make sure to unzip/extract the folder.

Part 2: Prepping data and adding it to QGIS

Note, this is where the majority of our time will be spent – data prep!

6. Open the CSV and make sure our COL5 that contains our Census Tracts is in tact. When you open the CSV excel may ask you if you want to convert COL5 to numeric, choose **do not convert**! Click on the F column to highlight the entire column. Right-click on the F and choose **Format cells** from the menu. Change the **Category** from General to **Text**. **Save** your CSV.
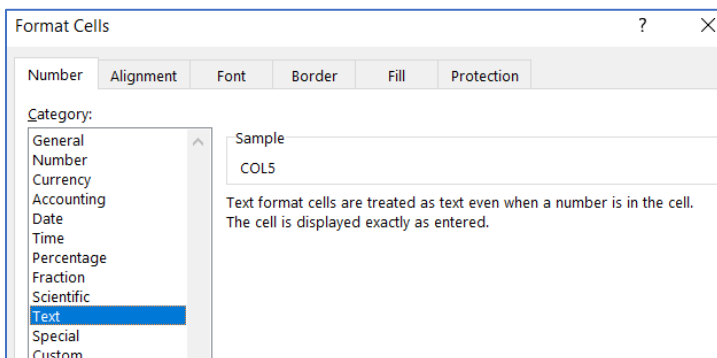
7. We can change the field headings in the CSV using our Header file as reference. Open your header text file. Use the headers to create very short, meaningful field headings in your CSV. QGIS only allows a certain number of characters for field headings. Use the following example to change your field headers. When you are finished, save the CSV.
COL0 = GEOUID
COL1 = PROV_NUM
COL2 = PROV
COL3 = CMA_NUM
COL4 = CMA
COL5 = CT
COL6 = POP_2021
COL7 = POP_2016
COL8 = POP%CHANGE
COL9 = POP_DENS
COL10 = VEH_DRIVE
COL11 = VEH_PASS
COL12 = TRANSIT
COL13 = WALK
COL14 = BIKE
COL15 = OTHER

8. Note the first row has very large numbers. This is not a single census tract. Instead, it represents all of the Ottawa CMA. For this exercise we do not require this row. Right click on row 2 and delete it to shift the rows up.

|	A	B	C	D	E	F	G	H
1	GEOUID	PROV_NU	PROV	CMA_NUM	CMA	CT	POP_2021	POP_2016 P
2	5050000	35	Ontario		505 Ottawa - C	0000.00	1488307	1371576
3	5050001.04	35	Ontario		505 Ottawa - C	0001.04	2865	2718

9. Scroll to the bottom of the CT column and note that there are 5 values that are not configured the same as the others. We need to add decimal places to these CT values. Click on each one and edit them to **add .00** at the end of the values. 1000 should be 1000.00, 1001 should be 1001.00...etc. The decimal place values should stick since we changed our column to Text.

   Save and close the CSV. Now we are ready to add the CSV to QGIS!

10. Search for QGIS in the lab computer start menu. Launch QGIS 3.4. Where it says Project Templates, double-click on **New Empty Project** to start a new project.

11. There are a couple of ways to bring in data to a QGIS project.
    a. In the top ribbon, click on the Layer tab, hover over Add layer, and choose **Add Delimited Text Layer...**
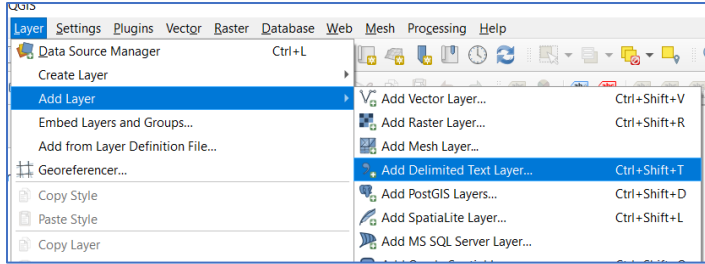
12. You can browse to your project folder and locate the CSV using the **three-dot browse** menu – beside File name.
    a. **File format** is **CSV**.
    b. **Record and Fields**, only **check First record has field names**.
    c. Leave **Detect field names unchecked**!
    d. **Geometry Definition** – choose **No geometry**.
    e. Preview your table to ensure the CT column is still text (string). All columns should, currently, be Text (string). We want certain columns to be **numeric or integer**. Side scroll to **POP_2021** column and change the field type to **integer (32 bit)**. Do this for all the number columns to the right of POP_2021 *except for* **POP%CHANGE and POP_DENS –** these two columns should be **Decimal (double)** as they have decimal places.
    f. Once everything looks correct (image below), click **Add** at the bottom of the box. Then, click **Close** to close the Data Source Manager box.
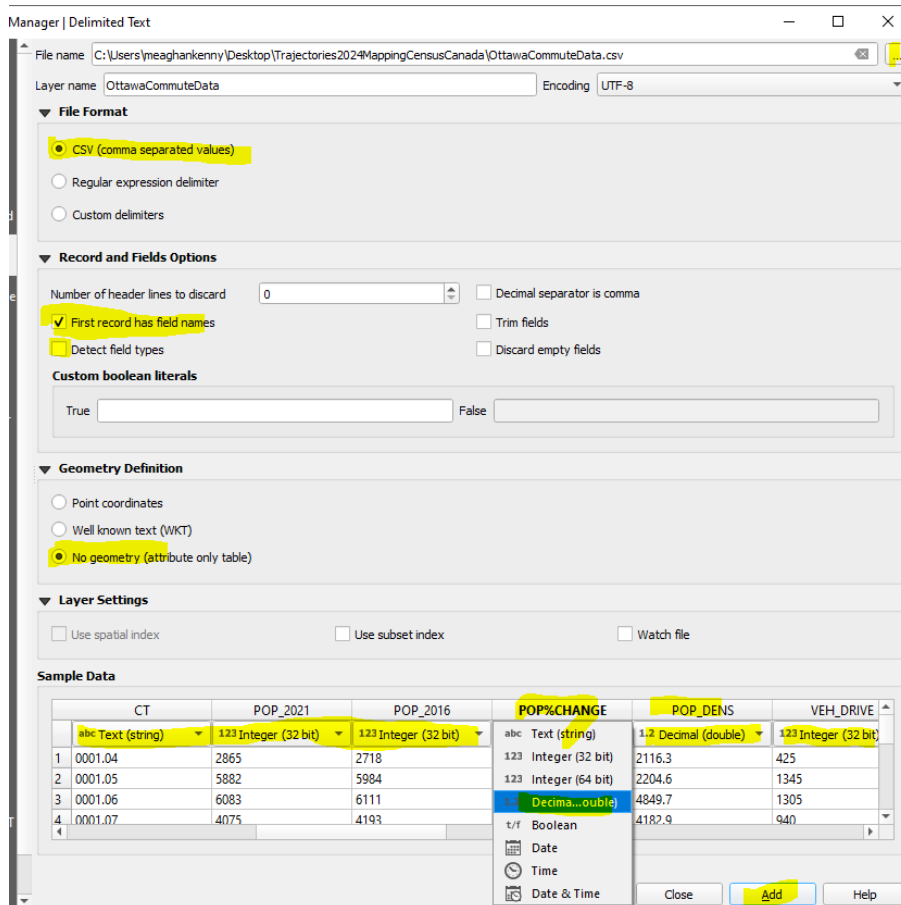
13. Right-click on the newly added OttawaCommuteData file and click on Open Attribute Table from the drop down menu. Always check your data to make sure everything was added correctly.

14. Now we can add our Census Tracts (these will be for all of Canada). This time we will drag and drop the file into our map viewer. Navigate to the location of your CensusTracts folder and locate your census tract shapefile. The shapefile will be named something like lct_000b21a_e.shp. Click on the lct_000b21a_e.shp

Drag the shapefile into your map viewer to display the census tracts.
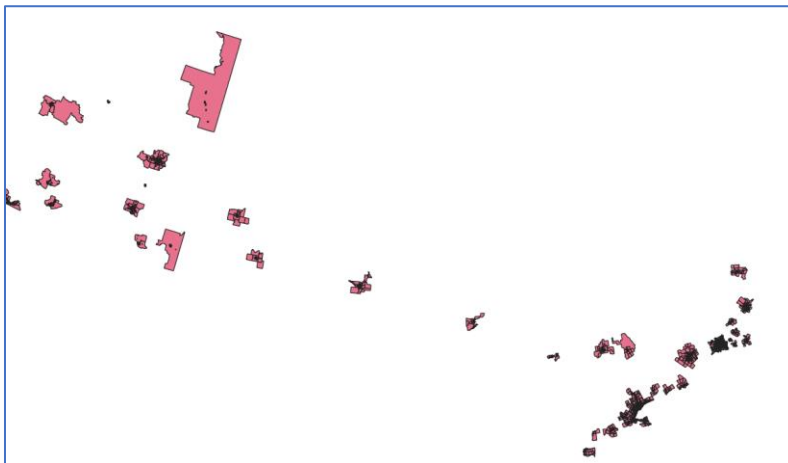
15. Add a basemap as a reference layer so we can see that our census tracts are showing up in the right place. In the Browser panel, on the left hand side, Scroll to the **XYZ Tiles** and drop down the menu. Select **OpenStreetMap** by double clicking on the item. It should load into your map viewer. If your census tracts disappear, it may be due to the Open street map layer being on top. You can change the hierarchy of layers in your **Layers panel** on the left hand side.
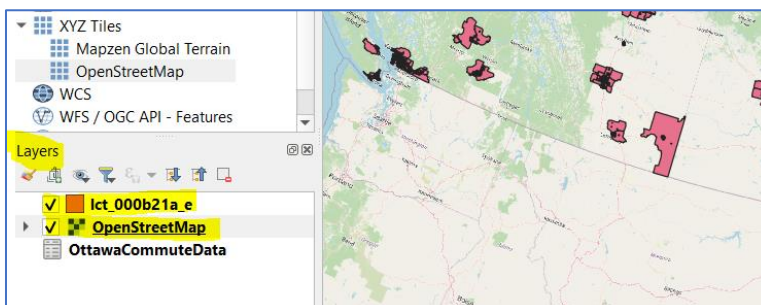
16. Open the attribute table for the shapefile to inspect the data. **Right-click on the lct_000b21a_e** layer and **Open Attribute Table**. Note that the CTNAME field has the census tracts with the leading and trailing zeros. Later we will use this column to perform a join to the matching CT column in our OttawaCommuteData table.

17. The census tract shapefile is for all of Canada and we only want census tracts for the Ottawa-Gatineau CMA. The CTUID is combination of the CMA code and the CT code to create a unique identifier code. Right click on the **OttawaCommuteData** table and **open the attribute table** to see the **CMA code** for Ottawa (hint – it's 505!). We now know that Ottawa CTUID's will start with 505. We will perform a **select by expression** to select only CT's for Ottawa-Gatineau CMA from our shapefile table. Close the OttawaCommutedata table.

    a. In the lct_000b21a_e layer attribute table click on the tiny **select by expression** icon.
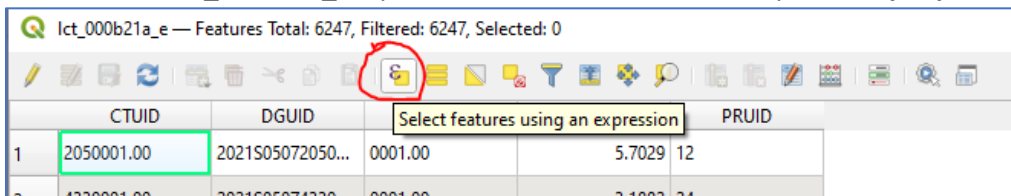
    b. In the **Select by Expression** box, in the middle panel, click on **Fields and Values.** Double click on the **CTUID field** – this will add it to the expression panel on the left-hand side. In the right-hand panel, in the **Values** search box type **505** and click on **All Unique.** A list of unique CTUID's starting with 505 should list in the section below All Unique. **Double click on one of the values** to add it to the expression panel. To ensure we are only selecting CTUID's that start with 505, we will change our expression to read: **"CTUID" Like '505%'**. The percent sign acts as a wild card so we will get CTUID's that start with 505 and have unique endings. Click on **Select Features** in the bottom right corner.
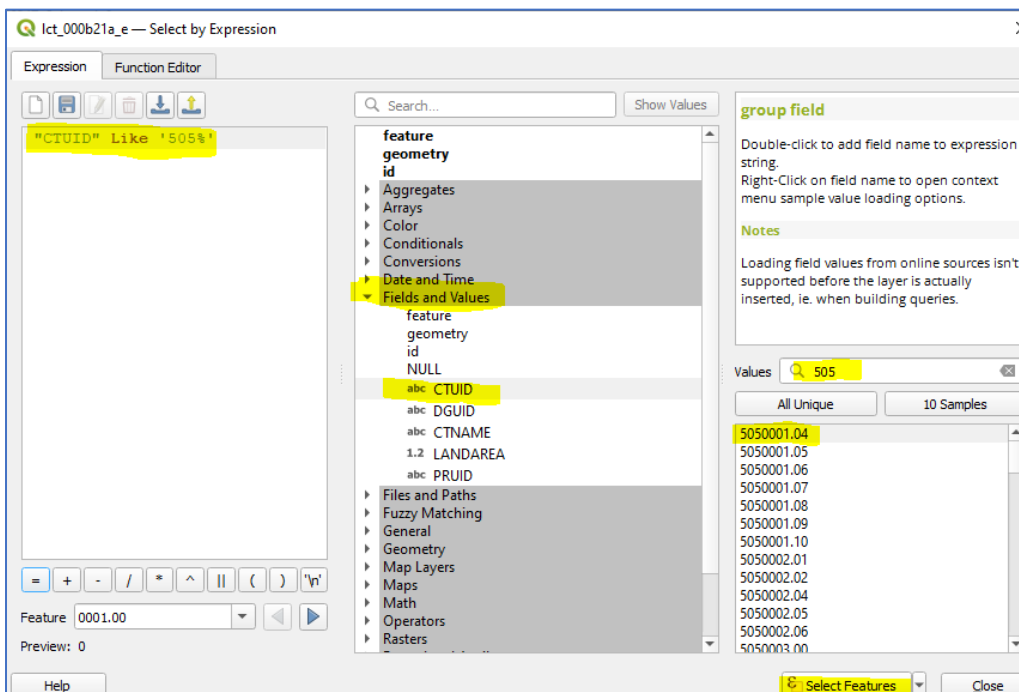
c. Your shapefile attribute table should show 315 features have been selected. That's the same number of CT's in our OttawaCommuteData table. **Great! Close** the Select by Expression box.

d. In the attribute table you can show **only the selection** by clicking on **Show Selected Features** in the bottom left corner of the table. Additionally, you can see at the top of the attribute table that there are 315 selected features. Perfect!
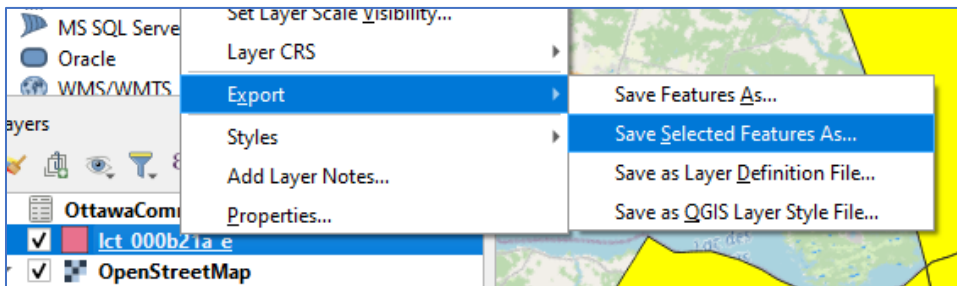

e. Close the table.

18. In the layers panel, right click on the lct_000b21a_e shapefile, click on **Export**, click on **Save Selected Features As...**

19. In the **Save Vector Layer as...** choose the following:
   a. **ESRI Shapefile** for the **Format**,
   b. For **File name**, use the **three-dot menu to browse** to your project folder to save your new shapefile and name it **OttawaGat_CT,** leave the rest of the default settings (see image below).
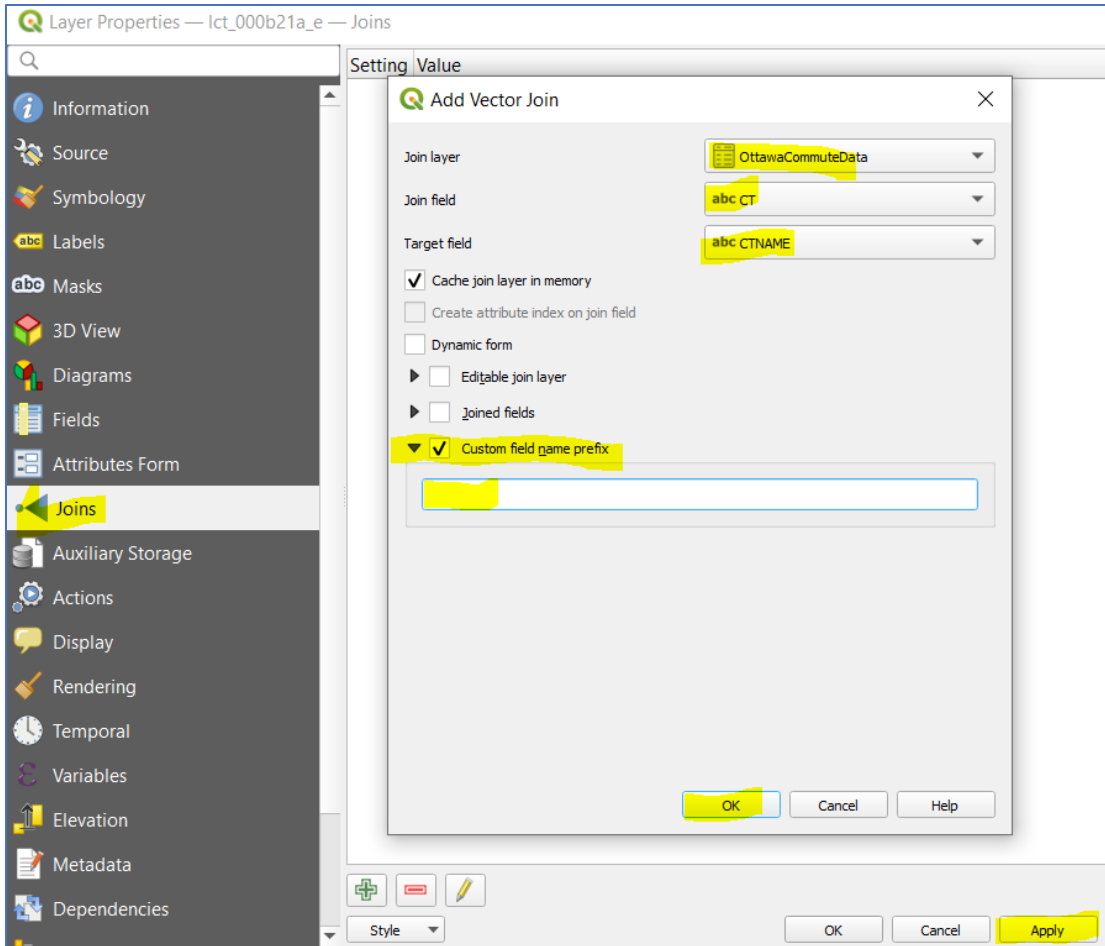   c. Click **OK.**
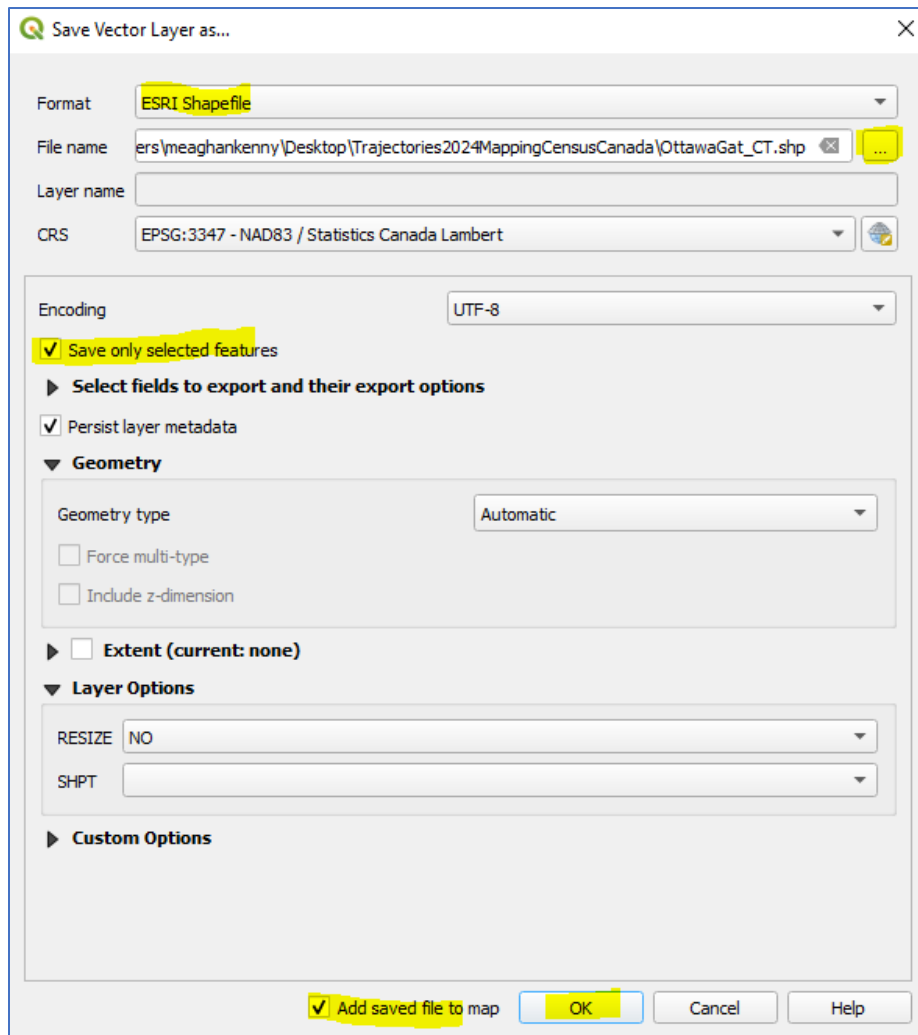
We can now remove the lct_000b21a_e file from our layer panel. The OttawaGat_CT should be the only shapefile. Right click on the layer and click on **Remove layer**.

**Part 3: Preparing and Performing a Join – Joining the data table to the cartographic boundaries**

20. Right-click on OttawaGat_CT layer and click on **Properties.** In the **Layer Properties panel** click on **Attributes Form** to see more details about the attributes. We can see the **CTNAME column is text.** This is good as it will be our join column.
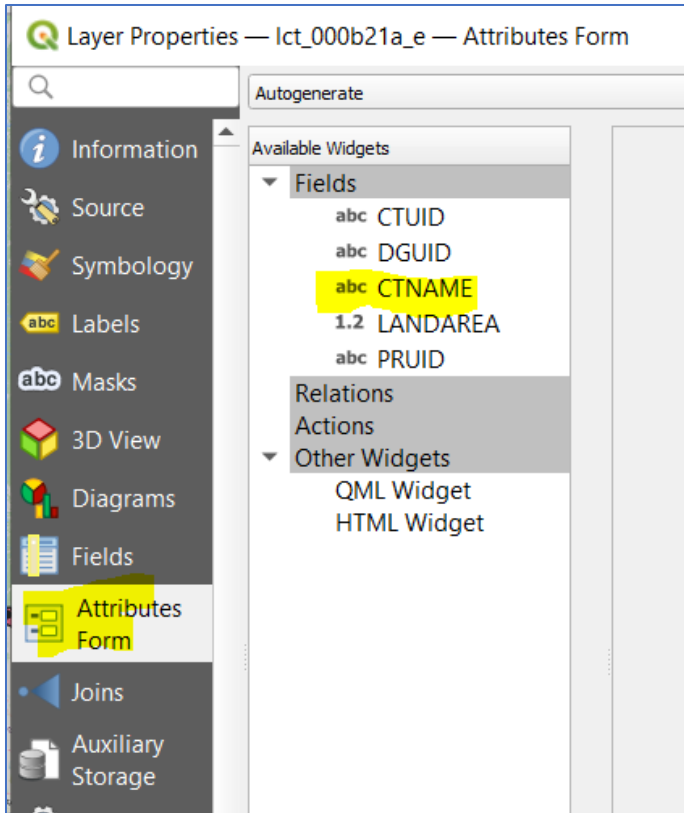
21. We can also perform our join from the Layer Properties panel.
    a. Click on **Joins**.
    b. Click on the little green plus sign at the bottom of the right hand panel.
    c. **Join layer** will be your **OttawaCommuteData** table.
    d. **Join field** will be **CT**
    e. **Target field** will be **CTNAME**. Note that they are both text (abc).
    f. Check **Custom field name prefix** and **remove the text** from the box. Click **OK**.
    g. Click **Apply** on the bottom right. It will look like nothing happened! Click **OK** and close the Layer Properties box.

22. Right-click on the OttawaGat_CT layer and open the attribute table. Inspect the data table to see that all the data table values have joined successfully.

23. When inspecting our map we can see that the CMA for Ottawa-Gatineau covers more area than we actually want for our area of interest. We only want data for the City of Ottawa. Almonte, Arnprior, Russel and the Quebec side of the CMA are not required for this exercise. We will use our Ottawa Ward_2022-2026 boundary file to perform two geoprocessing actions: **dissolve** and **clip.**

24. Add the Wards 2022-2026 shapefile to your QGIS project, choose one of the methods we previously used – **drag and drop** or **Layer, Add Vector Layer**

25. In the top ribbon click on **Vector**. Hover over **Geoprocessing Tools**. Click on **Dissolve**
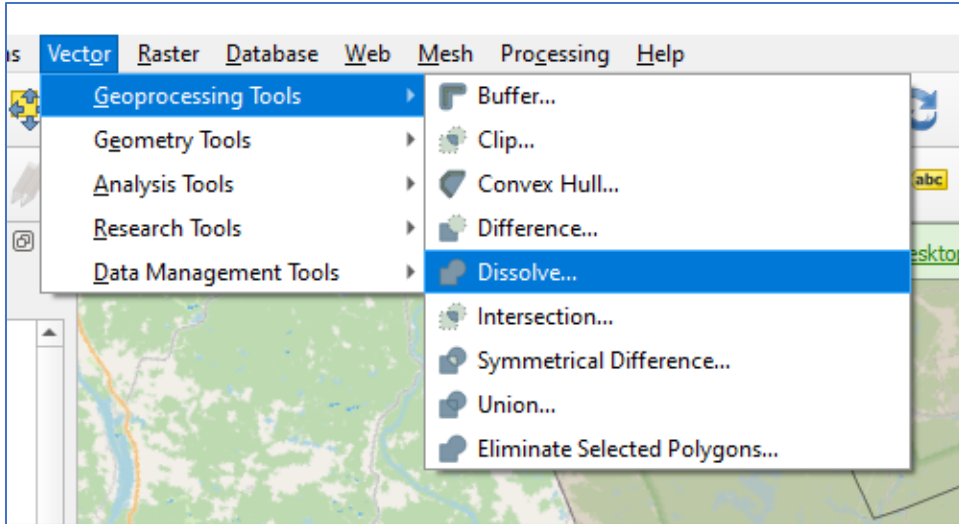
26. We just want the outline or boundary of the City of Ottawa so we will dissolve the ward boundaries.
    a. **Input layer** is **Wards_2022-2026**.
    b. Click on the **three-dot menu** and choose **Save to File**.
    c. Save your dissolved file in your project folder as **Ottawa_Dissolved.**
   d. Click on **Run.**
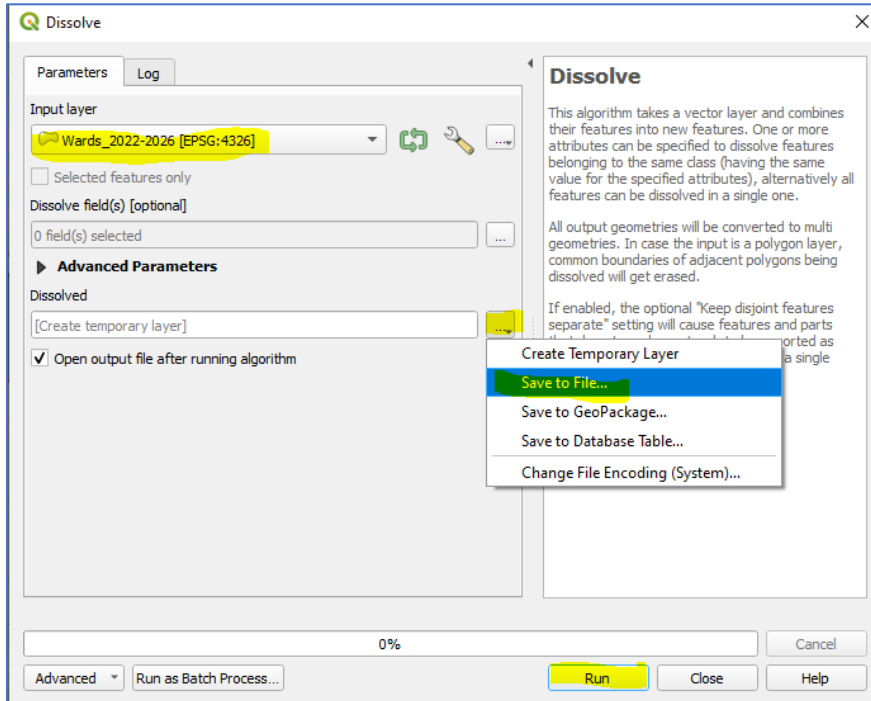
The result should be added to the map and should have no ward boundary lines. **Remove the Wards_2022-2026 layer** from your Layers panel.

27. Click on **Vector** in the top ribbon. Hover over **Geoprocessing Tools.** Click on **Clip**.
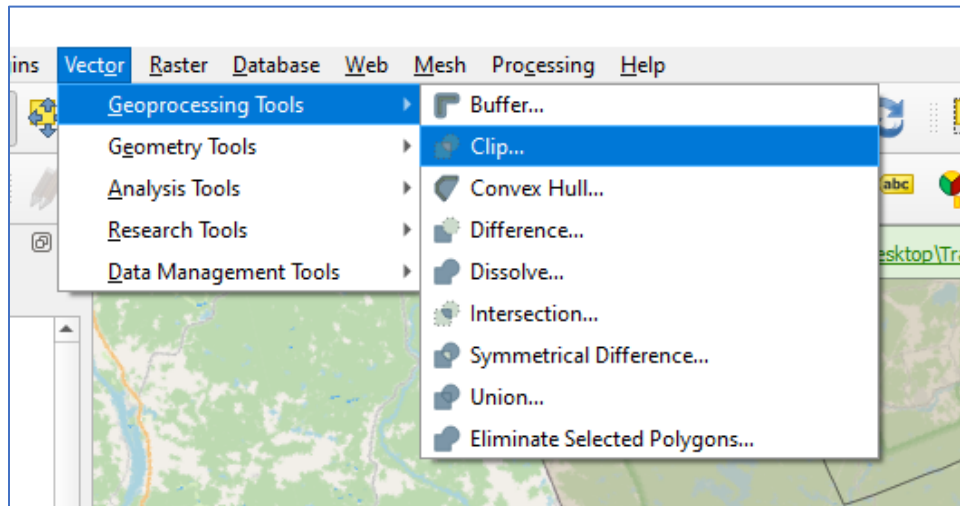
28. In the Clip box enter the following:
    a. **OttawaGat_CT** for the **Input layer.**
    b. Enter **OttawaDissolved** for the **Overlay layer**.
    c. For **Clipped**, Click on the **three-dot menu** to **Save to file** and save the file to your project folder and call it **CityofOttawaCT_Commute.** Make sure the file type is **shapefile.**
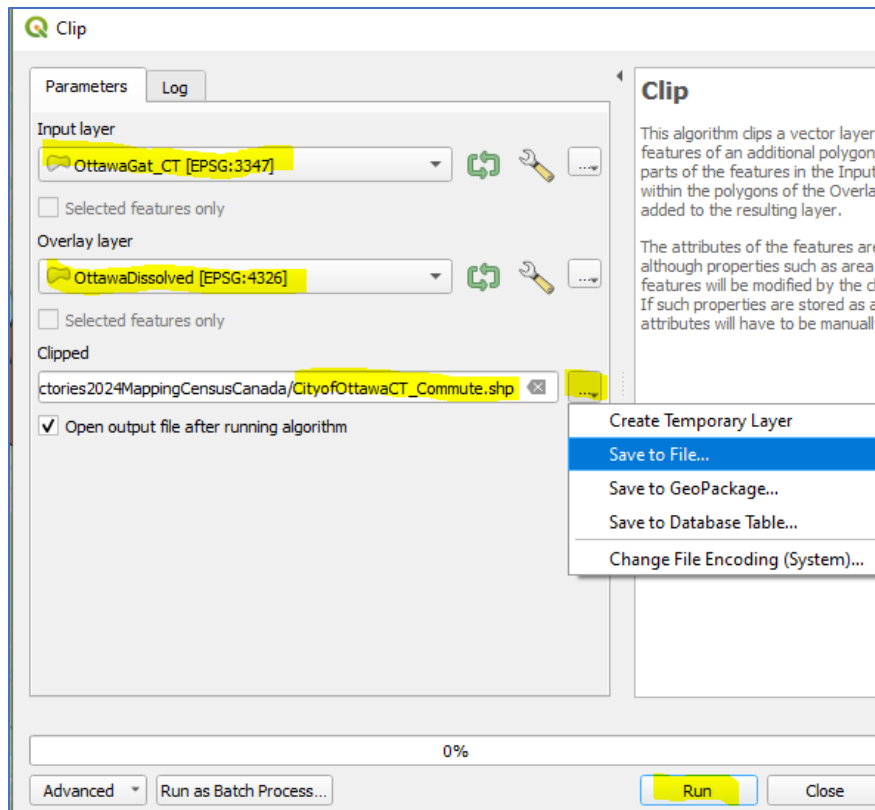
There should now be a CityofOttawaCT_Commute layer in your layer panel and in the map viewer. You should see all the census tracts for the City of Ottawa. **Remove the OttawaDissolved** from your layers panel.

Part 4: Symbology!

Now, we are ready to apply symbology to visually represent an analysis. With the variables we have chosen there are many questions we can answer by applying symbology, such as:

- CT's with high or low population change since the last census
- CT's with high or low population density
- CT's with high or low numbers of people that rely on cycling to work

For this exercise, we will apply symbology to look at CT's with high number of public transit commutes to work.

29. Right click on the **CityofOttawaCT_Commute** layer and click on Properties to open the Layer Properties box. Click on **Symbology**

30. In the **top drop down menu**, change the symbology from Single Symbol to **Graduated**. For **Value**, choose **TRANSIT**. For **Color ramp**, change the color scheme to one of your choosing. I'm choosing greens. For **mode**, choose **Natural Breaks (jenks).**
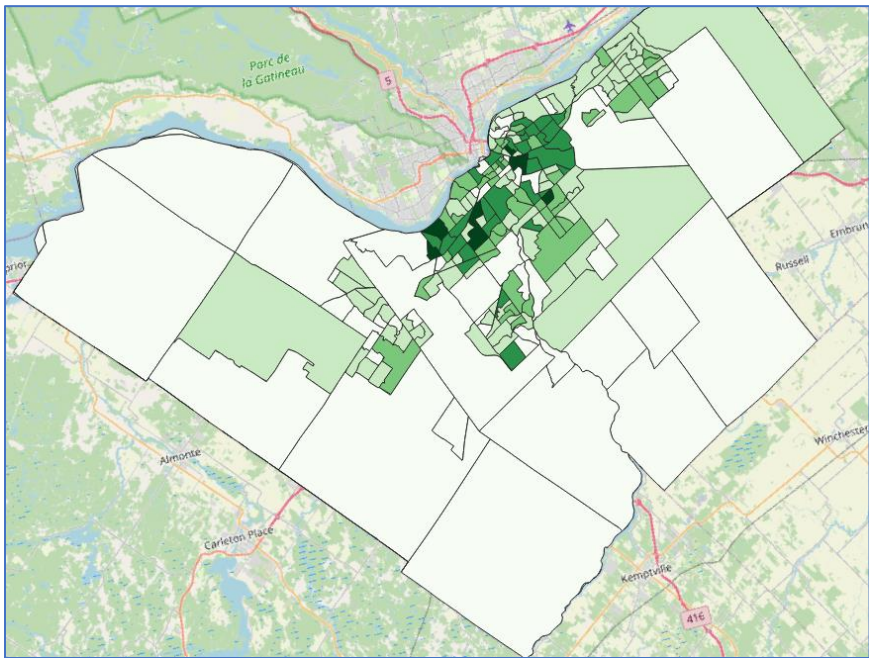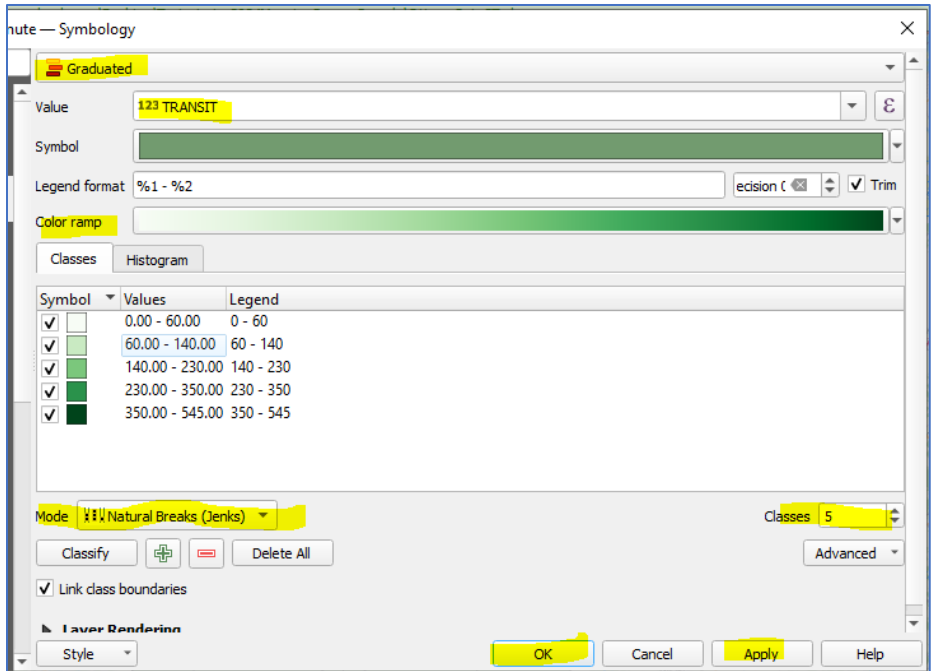
31. Inspect the map. What can you see?
    a. A big hole in the centre? Why?
        i. Inspect the data in the attribute table. Are there any Null values?
        ii. Does anyone live in this area of the greenbelt?
   iii. How would you adjust the data table to "fill in" the hole?

b. To fix the hole, we need to replace the Null values with 0's. Open the attribute table for the **CityofOttawaCT_Commute** layer. In the top left corner, click on the little pencil to toggle editing on.
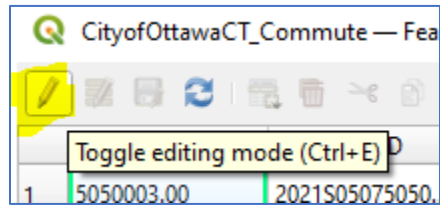
Scroll to the Null values and click on the cell to replace the Null with 0.

When you are finished replacing the Null values, Save your edits and toggle editing off using the icons in the top left corner of the attribute table
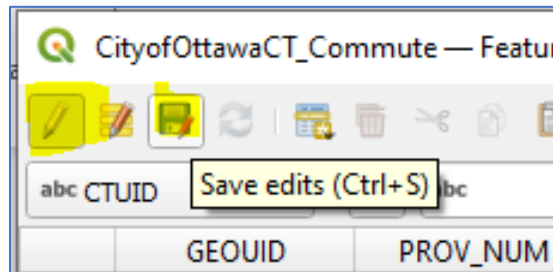
c. Seemingly low public transit ridership for commute to work in 2021? Why?
    i. Run the exercise again with data from 2016 to see if there was a big change
    ii. Is it due to work from home protocols or decrease in transit quality?

Part 5: Bonus material! Adding Labels and Creating a Layout

Label Your Map

To better visualize our census data, we'll use different colours and labels for our map. Before doing so, we'll adjust how our column headers look, since the column names aren't clearly labelled.

Create Field Alias

1. Right click on the **CityofOttawaCT_Commute** layer and select **Properties**…

2. Click on the *Attributes Form* tab

3. You will see a list of all the fields. Click on the TRANSIT field and input text in the *Alias* field to something helpful for your audience. For example, "Public transit ridership for journey to work". Click on the *CTNAME field* and make the Alias field "*Census Tract*." Click **Ok** when done.
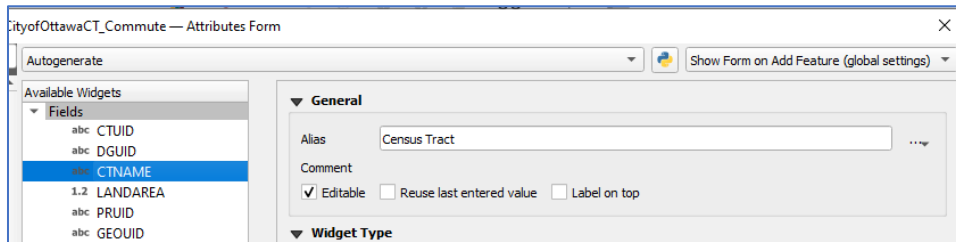
4. Now let's label each Census Tract with the number of the TRANSIT field.
   a) In Layer Properties box, select the Labels tab.
   b) Select Single Labels for this layer and set the Value to **Public transit ridership for journey to work** the value will show up as **TRANSIT.**
   c) Choose your **label font**. In the example it's Arial, size 12, bold, black. I like to apply a **Buffer** as well to make the text pop.
   d) Click Apply and OK to close the Layer Properties box.
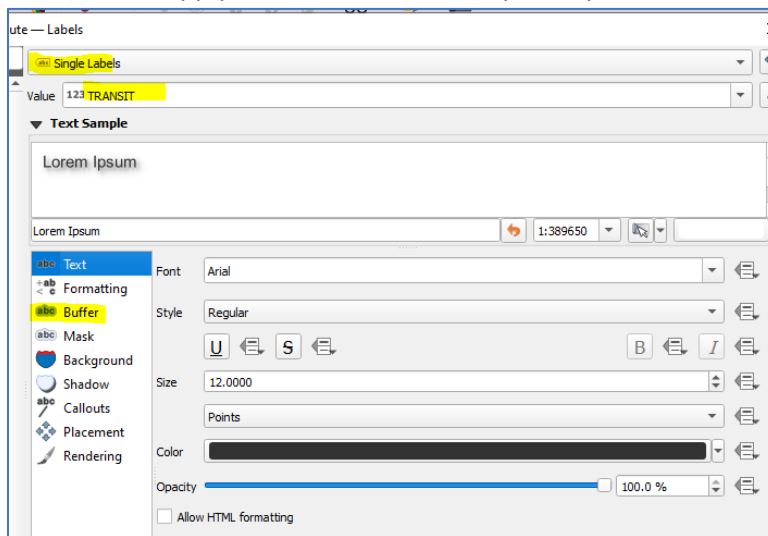
Creating a Map Layout

1. Start off by right-clicking the layer you want to create a layout for, and select **Zoom to layer**.
2. In the top ribbon, click on the **Project tab** and click on **New Print Layout**.
3. In the Layout title dialog box, give your new composition a name. Ottawa Public Transit Ridership for Journey to Work 2021 by Census Tract. Click **OK**.
   4. A new Layout window will appear. To add your map of Ottawa, click **Add Item** from the top ribbon menu and click on **Add Map**, then draw a box that is just inside the perimeter of the page.

Adding Other Map Elements

Adding a Legend

1. In the menu, select *Add Item* > *Add Legend*.
2. Draw a box where you would like your legend to appear.
3. By default, all the layers on the map will appear as legend items in the legend.
4. To remove a legend item, select the legend, and the **Item Properties** panel should appear on the right hand side of the page. **Uncheck the Auto update checkbox.** You should then be able manually remove the layers you don't want in your legend using the **red minus button**. When you are finished with your changes, click on **Update All**.
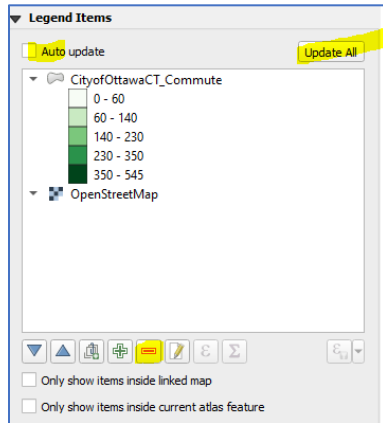

Adding a North Arrow

1. In the menu, select *Add Item* > *Add North Arrow*.
2. Draw a box where you would like to see your north arrow.
3. In the **Item properties** panel on the right, click on the **SVG browser** submenu, and click on **Arrows**.
4. Select an arrow that meets your needs. You could always design your own if you feel creative, or just go for a Star Trek vibe (never a bad idea):
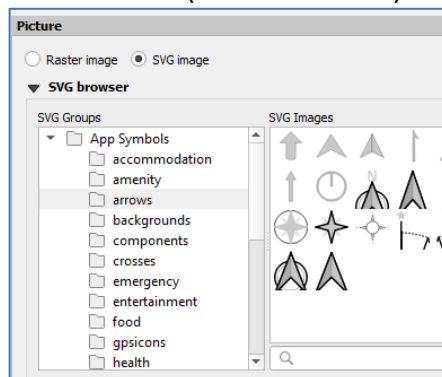
Adding a Scale Bar

1. In the menu, select *Add Item* > *Add Scale Bar*.
2. Draw a box where you would like to see the scale bar.
3. In the Item properties tab, you can select one of six styles under the **Style** dropdown.
4. Choose the units for the scale bar under **Units**.
5. Adjust the segments in the **Segments** area.

       a.   E.g.: left 0 and right 4 on a Line Ticks Up style will look something like this:
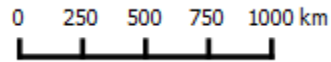
6. Click and drag the scale bar into place on your map.

Adding a Title to a Map

1. In the menu, select *Add Item* > *Add Label*.
2. Draw a box where you'd like your title to be (you can move it later).
3. Type your title into the **Main properties** text box.

Export the Map

1. When your ready to export your map, click on **Layout** > **Export as Image** or **Export as PDF**.
2. Select the name for your output map and click **ok.**
3. Your map should now be saved as an **Image** or a **PDF**.