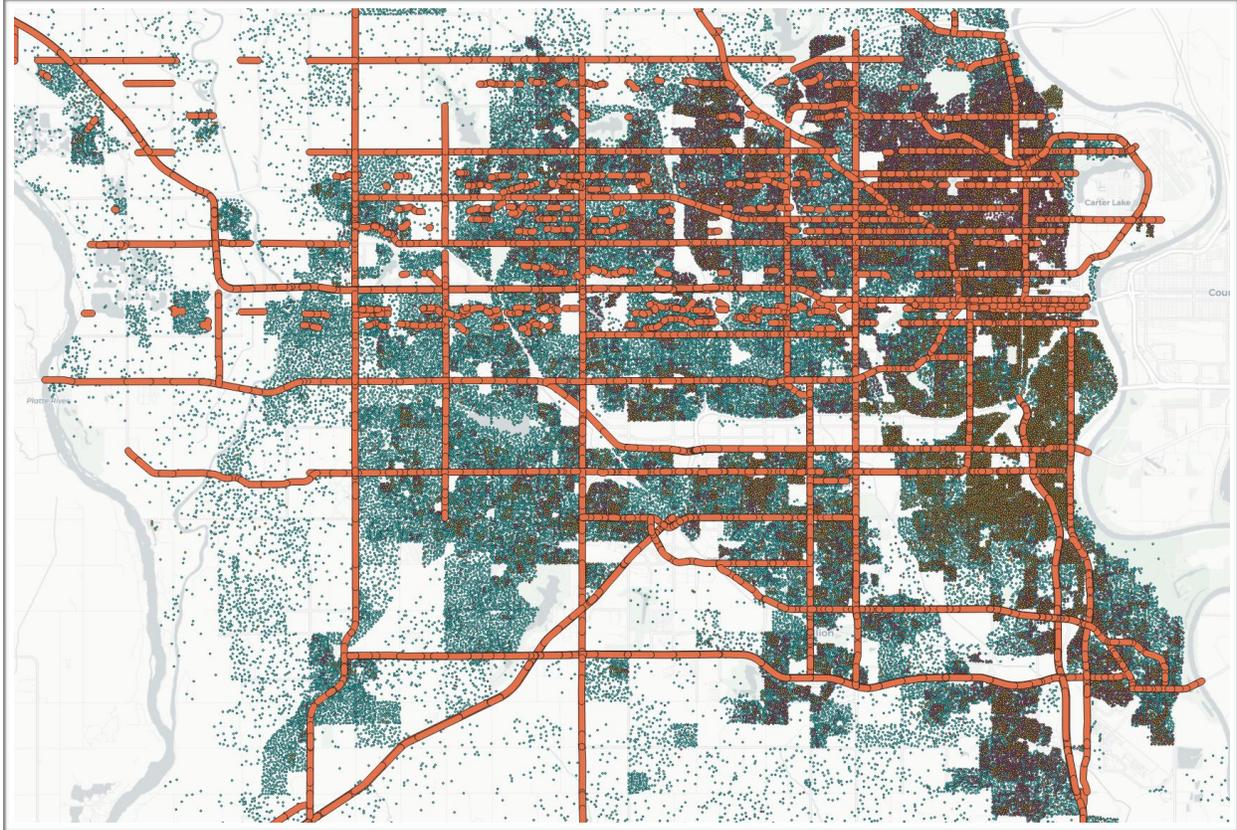


# Introduction to GIS I

## *Vector Layers & Buffers*

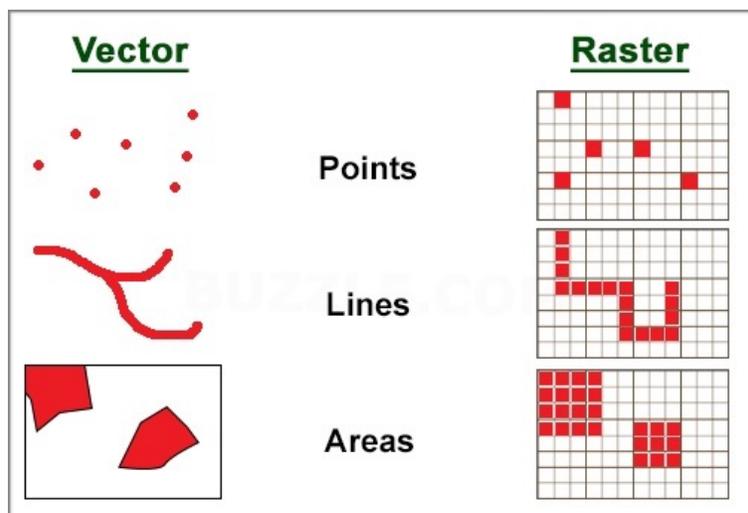


Introduction: Vector layers are one of the primary building blocks of any GIS. They visualize spatial information using three formats: *points*, *lines*, and *polygons*. Learning how to build, edit, and interpret vector 'shapefiles' will help you organize and visualize geographic information in your final project. Shapefiles facilitate powerful spatial analysis techniques, including buffer analysis and just as importantly, assign geographic form and location to the data you wish to associate with those locations (called attribute data). This exercise will introduce you to the core methods of creating, editing, and interpreting point shapefiles.

## *Definition:*

Vector: “A coordinate-based data model that represents geographic features as points, lines, and polygons. Each point feature is represented as a single coordinate pair, while line and polygon features are represented as ordered lists of vertices. Attributes are associated with each vector feature, as opposed to a raster data model, which associates attributes with grid cells.” ESRI GIS dictionary

- translation - Whereas “raster” data is visualized as cells (think of pixels on your computer screen) and do not inherently store location data, vector data are tied to coordinates on a projection and contain additional information (called attributes) tied to those same coordinates. Vector layers can be displayed as point data (i.e. one discrete place on the earth/one coordinate pair), line data, or polygon data.



## *Instructions:*

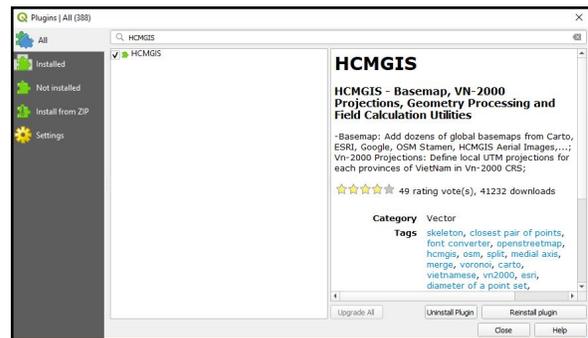
### Part I - Importing a shapefile point layer

1. First, we're going to add shapefiles that have already been created to a map. Open QGIS on your personal computer.
2. Create a new directory on your hard drive dedicated to this class. You can do this by adding a folder inside 'My Documents' or equivalent. For instance, Documents\HIS483\ All of the files you create in this exercise should be stored here.

- Next download the files from the Google Drive to your hard drive and add them to your new folder. Download each folder separately. You can access them with the (below) url.
- [https://drive.google.com/drive/folders/1DotQzIm0CAHNaosG1-vP0EBu\\_aCAXYvO?usp=sharing](https://drive.google.com/drive/folders/1DotQzIm0CAHNaosG1-vP0EBu_aCAXYvO?usp=sharing)
- Make sure to download all of the files. They will be downloaded as a zip file. Double click the file to unzip them and copy them to your new folder.
- The files within the 'Omaha2010' are census files that visualizes households by race in Omaha.
- Go back to QGIS. Before we add this data, we need a basemap to orient us.

Basemaps are not part of the preloaded functions of QGIS, but there are dozens of plugins you can add. We're going to add one called 'HCMGIS'.

Under the main menu, click 'plugins', then 'manage and install plugins'. On the following screen, type 'HCMGIS' in the search bar, then click 'install plugin.' You should now see HCMGIS on the top bar.



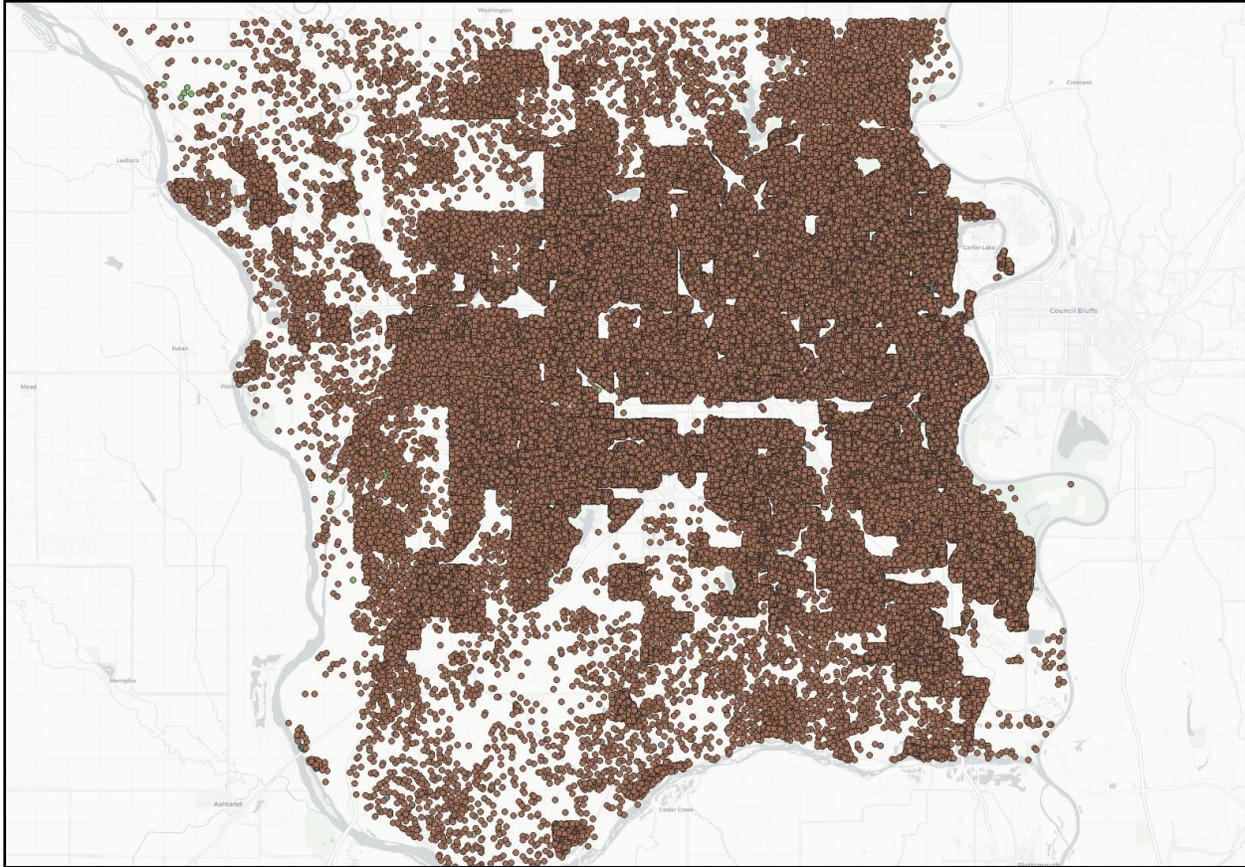
- Click HCMGIS, 'base map,' then select a base map that you like. Zoom into Omaha using the leftmost magnifying lens. The other three from left to right 'zoom out', 'zoom to native resolution (ignore this one), and 'zoom to maximum extent.'



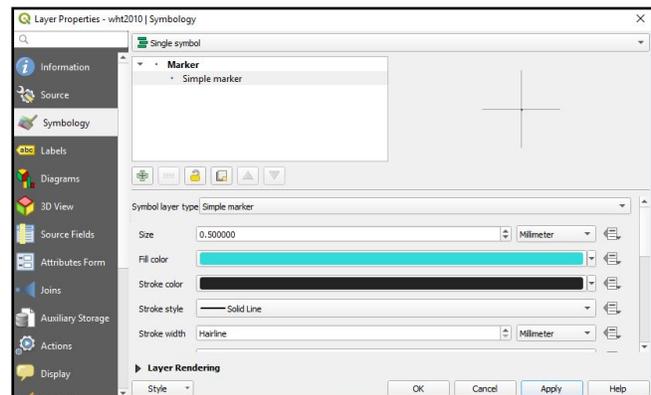
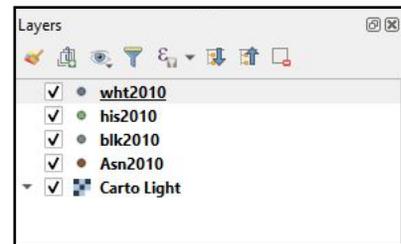
- We're now ready to add our shapefile. On the top bar of the screen, click 'Layer', 'add layer,' 'add vector layer.' Add vector layer should have and icon next to it that looks like this.



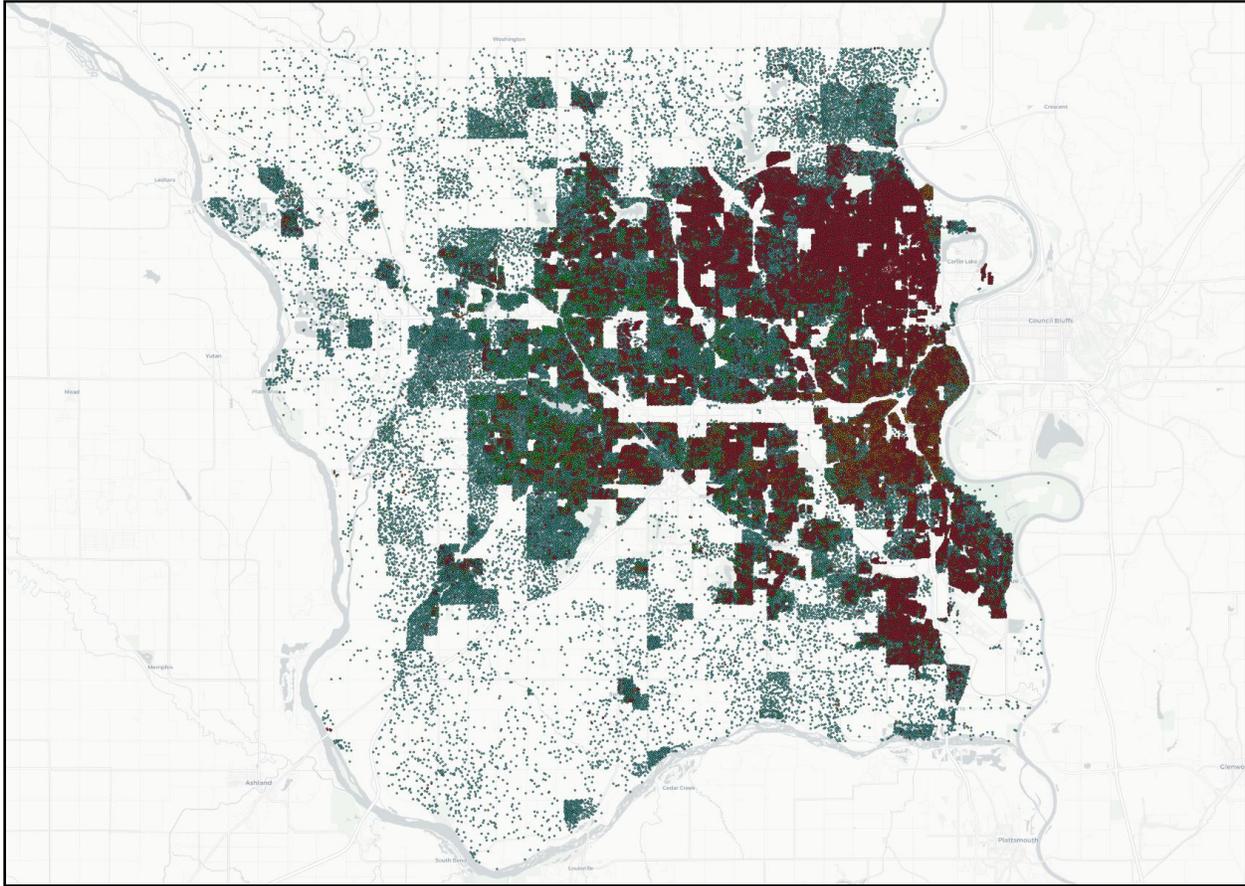
- On the popup screen, click the ellipses (...) beneath 'source' and select Asn2010.shp. Then click 'open.' Do the same for blk2010.shp, his2010.shp, and wht2010.shp. **Make sure to select the files that end with .shp.** Your map should now look like this (below).
- Save your project to the same directory as the files you downloaded by clicking 'project', 'save as.' Make sure to save after every step.



12. This doesn't tell us much, but we know there's data. Let's change the size and the color of the points so that we can see each clearly.
13. On the lower left of your screen, you should see a 'Layers' panel with the files you just added. Right click the first file and select 'properties.' On the resulting popup panel, on the left side, click 'symbology.'
14. On the main panel, click 'simple marker.' Change the 'fill color' to light blue and the size to .7 mm.
15. Now do the same for your other files, keeping the same size (.7 mm), but choosing different colors. Avoid darker colors.
16. Change 'stroke style' to 'no pen.'
17. Your map should look something



like this (below).



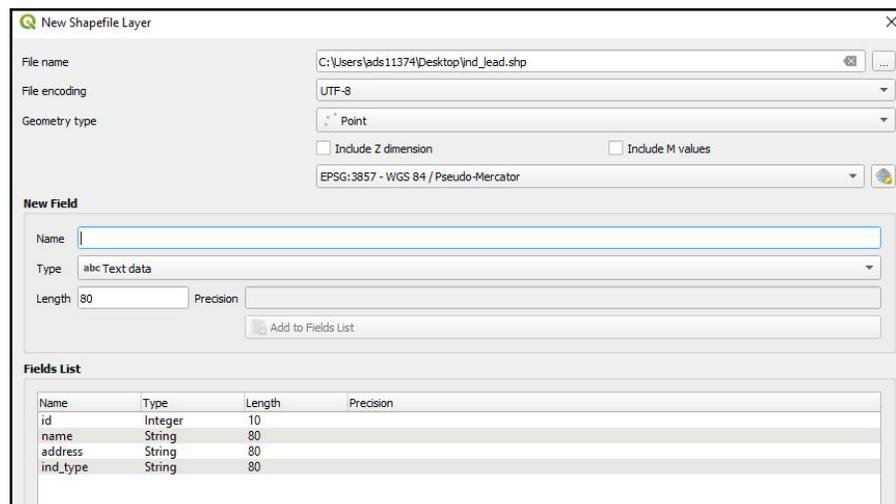
18. You've now made a racial dot map of Omaha. *Based on this information, how segregated is Omaha? What spatial patterns can you observe? If you'd like to compare Omaha to other cities, visit this website: <https://demographics.virginia.edu/DotMap/index.html>*

## Part II - Creating a shapefile point layer

19. This is a good start, but most datasets do not come ready-made online. For your final project, you will need to FIND historical data (oftentimes physical documents) and created your own shapefiles. The next part of this tutorial will show you how.
20. Let's look at a different file from the Google Drive. This file is a pdf from a NE "Directory of Manufacturers in 1996-1997." Directories are great resources for

GIS because they are organized by industry, year and they have addresses. I've scanned one page that includes two businesses that were involved with lead in Omaha: ASARCO and Aaron Ferer and Sons. We're going to make a shapefile that includes both sites and add it to our map.

21. Go back to QGIS. On the top bar, click 'Layer' again, then 'create layer,' and 'new shapefile layer.' Click the ellipses to the right of 'file name' and navigate to the directory you created for this tutorial. Once you're there, give this file a name. Call it 'ind\_lead.'" Click 'save.' This brings you back to the previous popup. Make sure that the 'Geometry type' is 'Point'.
22. Before we exit the 'New Shapefile Layer' screen, we want to add two new fields (also called 'attribute types') to our shapefile. We want our file to contain spatial information, but also text information about the industries we're digitizing. The name, address, and industrial type are what's included in the "Directory of Manufacturers," so that's what we'll add. We want them to appear in the 'Fields List' at the bottom of this window.
23. Below 'New Field', in the 'Name' field, type 'name'. This says that whenever we create a new point on our map indicating an industrial site, the GIS will prompt us to record its name. We want it to be recorded as text (as opposed to a number) so make sure 'Type' is 'Text data'. 'Length' should be 80 (this means you have 80 characters to write the name). Then click 'Add to fields list'. This new field should now appear in our list! Now repeat steps 22 and 23 to add an 'address' field and an 'ind\_type' (so we can record what type of industry we're recording). It should look like this. Click OK.
24. Nothing appears to have changed except now you have a new layer in your map. There aren't any points associated with this layer



yet. Let's add them. Using the 'Directory of Manufacturers' PDF in the google drive and google maps, find the location of ASARCO. *What is there now?*

25. Now go back to your map. Right click your 'ind\_lead' layer again and, this time, click 'toggle editing.' This allows us to edit the shapefile you just created - giving it coordinate on our map plane. Lets add points. On the second bar from the top, a new icon should now be available called 'add point feature.' The icon looks like this. Click it.



26. Now click the spot on your map where ASARCO used to be located. A new window should pop up that includes the 'attribute fields' you created (name, address, ind\_type). Ignore id.

27. Add ASARCO as the 'name', type in the 'address', and use the Directory of Manufacturers to add type descriptors. Click OK. Now do the same for Aaron Ferer & Sons. When you're done, right click your 'ind\_lead' layer again and 'toggle editing.' Save your changes. You've now created a layer that includes two historic industrial sites for lead. They have coordinates and they have text 'attributes'.

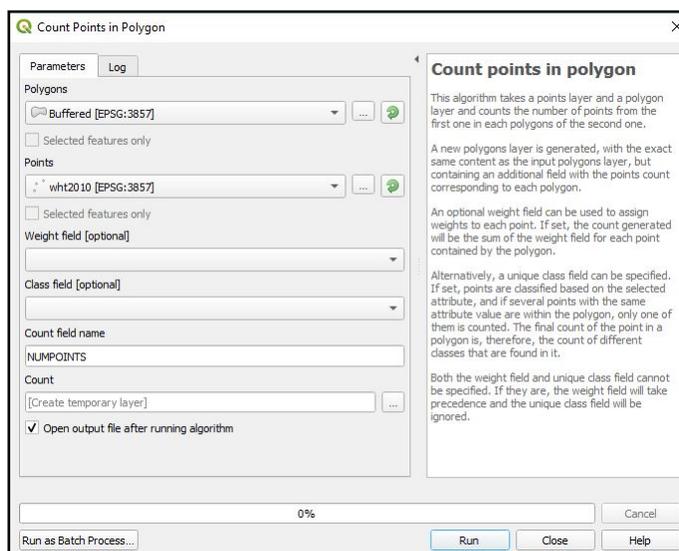
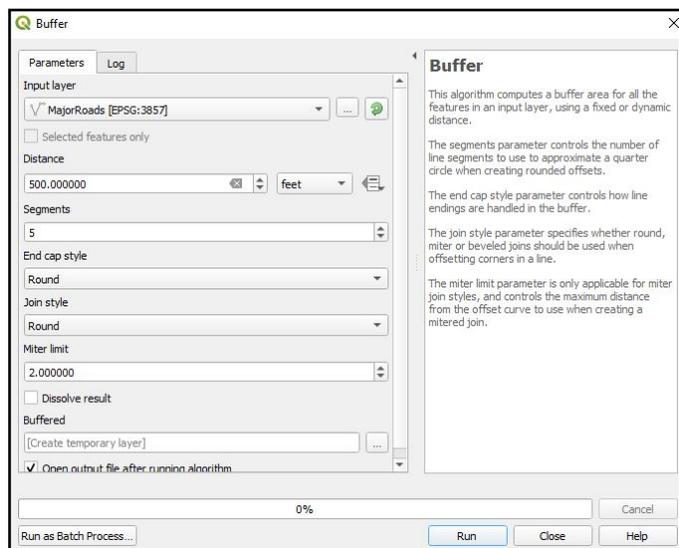
ind_lead - Feature Attributes	
Actions	
id	NULL
name	ASARCO
address	500 Douglas Street
ind_type	Refined lead, bismuth, antimony oxide

28. Let's look at what you did more closely. Right click your new layer 'ind\_lead' and click 'open attribute table. It's pretty simple, but you've now 'geocoded' the Nebraska Manufacturers Directory and created a map from it. This shapefile include geospatial information (including latitude and longitude) as well as text-based descriptors pinned to that location. Now imagine you have hundreds of these locations! What spatial patterns might emerge?

## Part III - Lines & Buffer Analysis

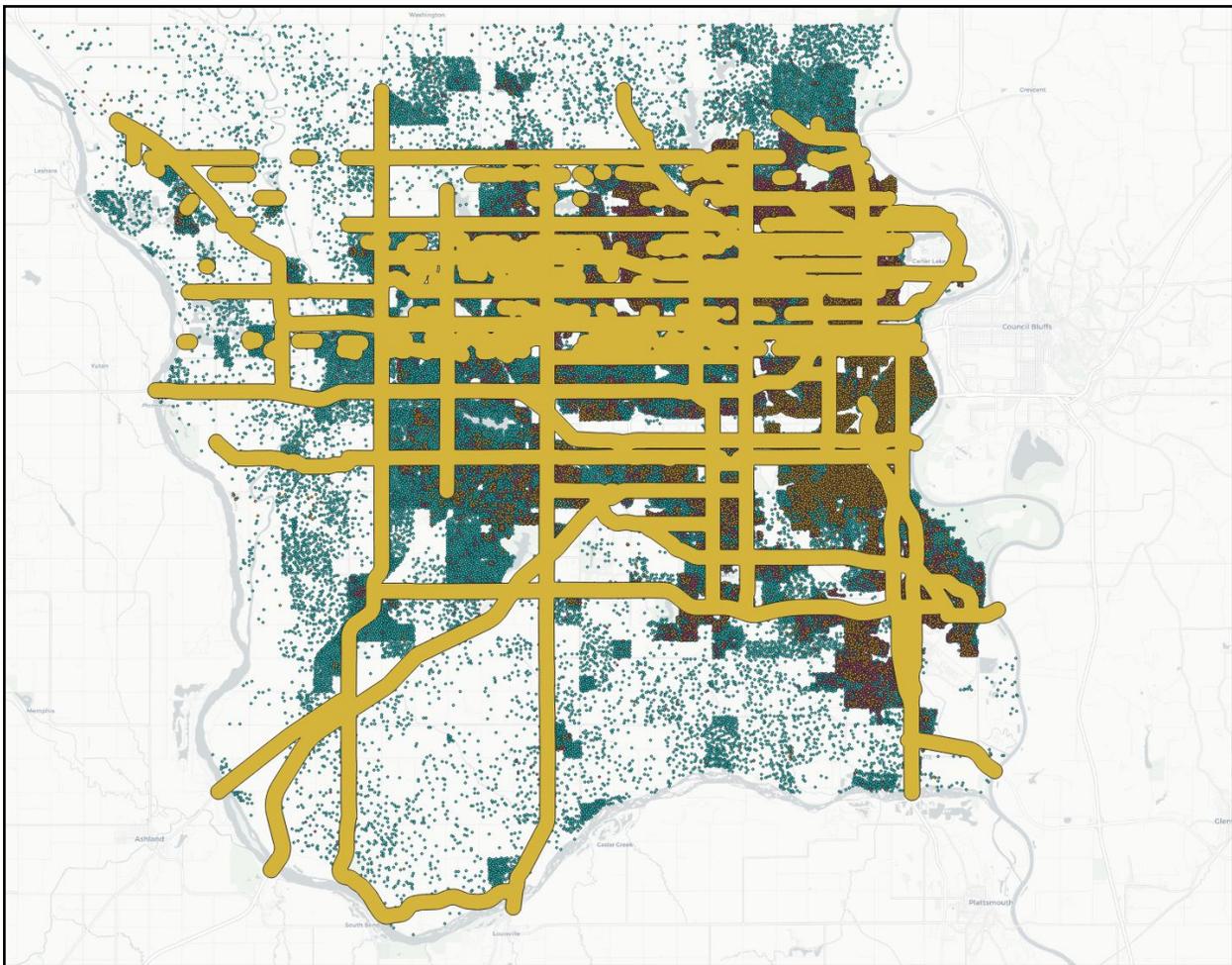
29. We've been working with ONE type of vector data so far, points. Now, let's use another type of vector data, lines.
30. Go back to Google Drive one more time. Download the 'major\_roads' file.
31. Add the new layer to your map using the same steps you used to add your point layer. (no.s 9-10)

32. Your map should now look like this.
33. If we were curious how many households were located with 500 ft of the roads (in case tailpipe emissions affected them, for instance) one spatial analysis tool we have at our disposal is the 'buffer analysis.' This is what we will be creating.
34. Click 'vector' in the top toolbar, then 'geoprocessing tools', then 'buffer.' In the popup screen, select 'MajorRoads' from the dropdown menu. Make sure the distance is '500' and 'feet'. Below that, check the 'dissolve result' box. Click 'run.'
35. We've now created a new shapefile *polygon* layer that extends 500 ft away from our roads. It also *overlays* the households we want to count that are within 500 ft of that road.
36. This buffer layer allows us to count the number of households, by race, within 500 ft of the roads. To do this, click 'vector' , 'analysis tools,' 'count points in polygon.'
37. In the popup, under select 'buffered' from the polygons



dropdown. This is the buffer layer you just created. Select one of your census points layers. It can be any of them. Note that it says the 'count field name' will be 'numpoints.' What analysis does it create a new column in your attribute table that counts the points that are overlaid by the buffer. Click 'run'.

38. You now have a NEW polygon layer called 'Count'. Open its attribute table by right clicking it. You added a new column to this layer called 'numpoints.' Its at the far right. Just ignore the other columns, because we 'dissolved' the buffer surrounding our roads, this data is now jumbled. All we're concerned about is the final number. Write it in the table below.



39. Now perform the same analysis for your other point files.



