

# Methodology to produce a Transportation System (Accessibility and Capillarity) and Water map using GIS desktop

By PhD student:

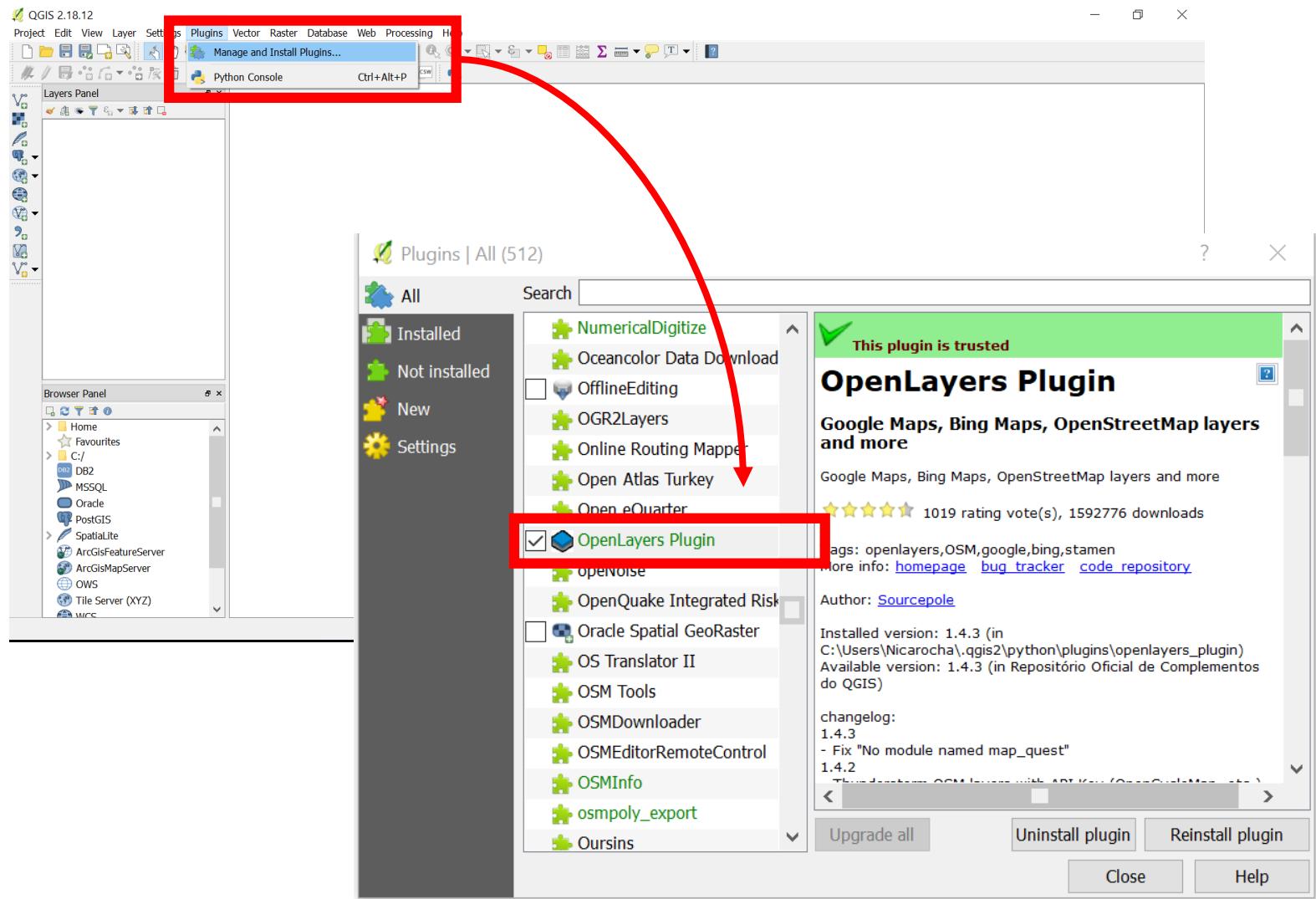
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- Head Teacher: Ana Clara Mourão Moura

# Introduction

- To produce the transportation system, we divided this work in three steps:
  - Get the data using OpenStreetMap by Qgis
  - Treat the data using ArcMap to prepare the Transport system using capillarity and Accessibility map based on highways (roads and type of roads)
  - Arbitrate value to propose the Transport system (Capillarity and Accessibility )
- The Waterway map is subproduct the Transport system

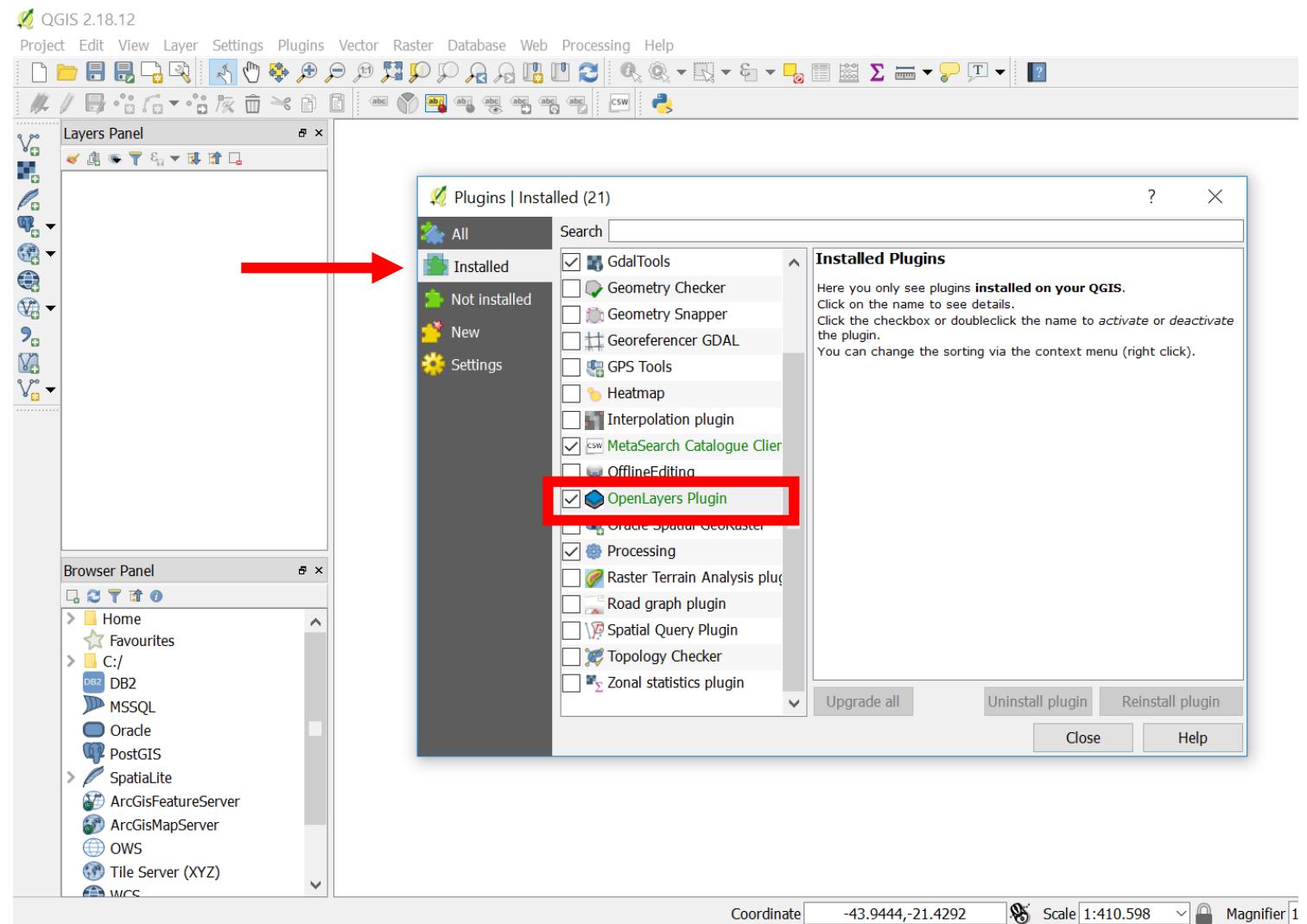
# OpenLayers plugin

- Click in “Plugins”,
- In “manage and install plugins” command, add OpenLayers Plugin



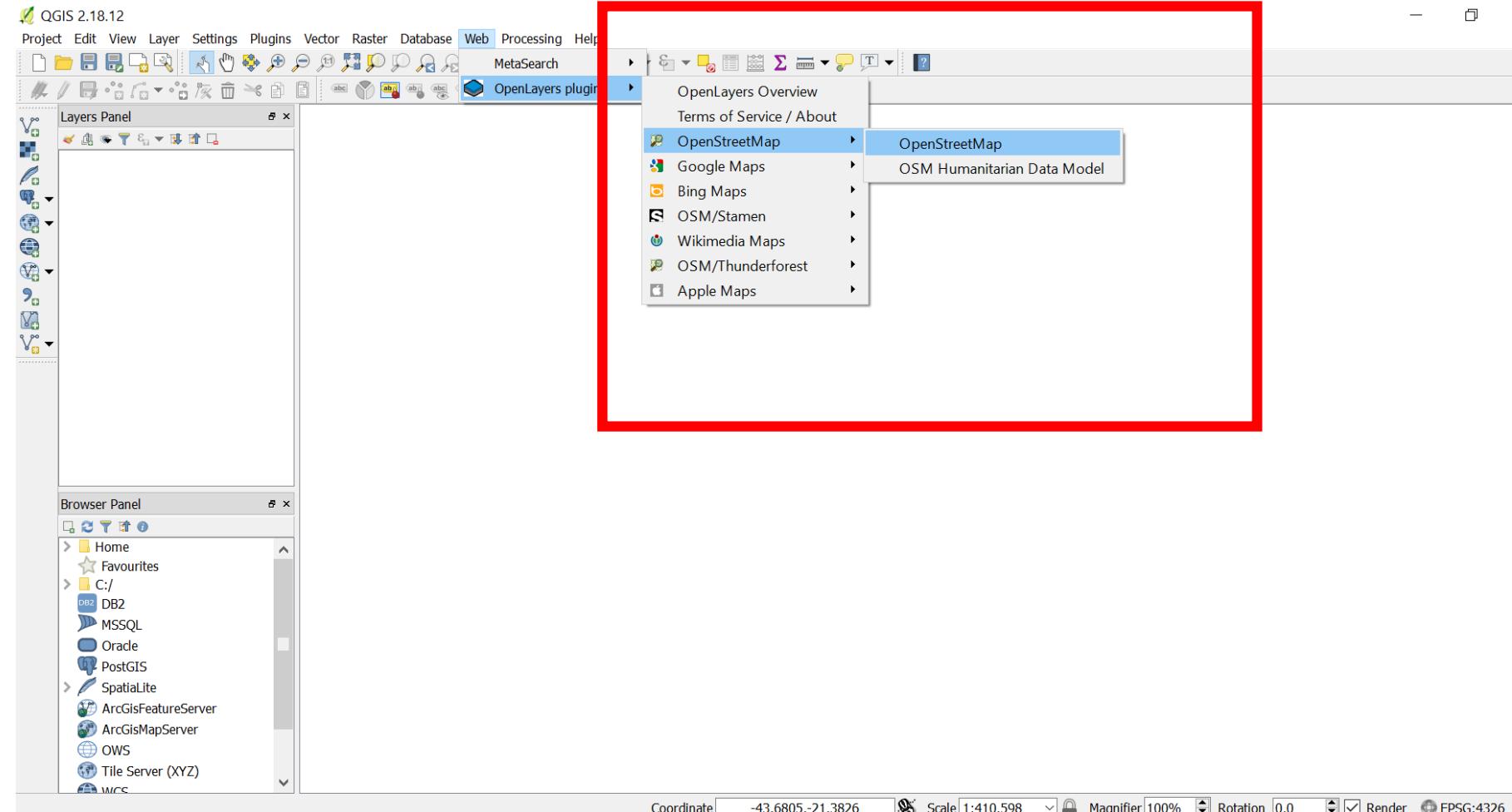
# OpenLayers plugin

- In installed command, verify if the plugin is marked.



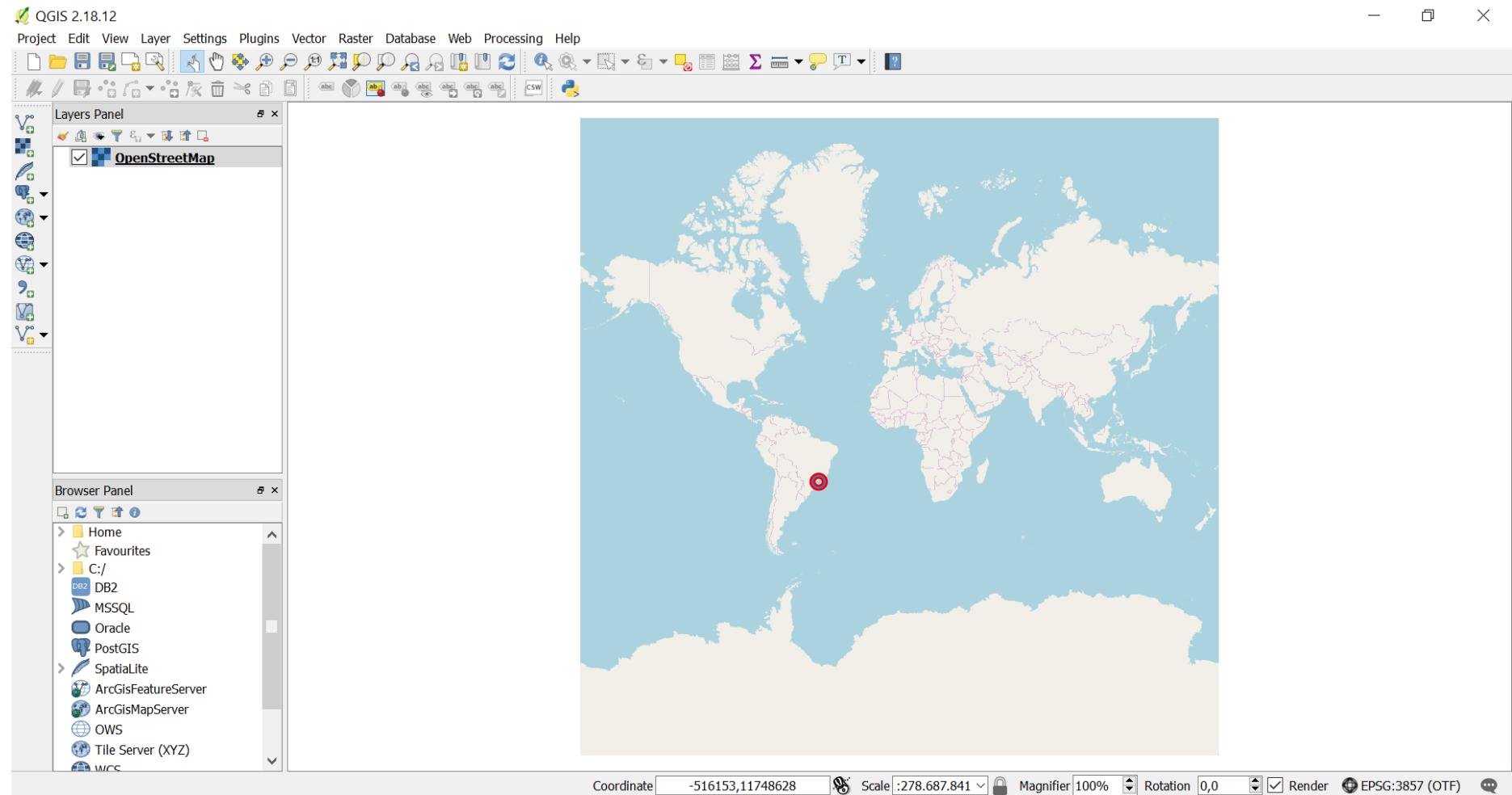
# Using openstreet map

- In web command, select the openlayer plugin
- After, open the “OpenStreet Map” command



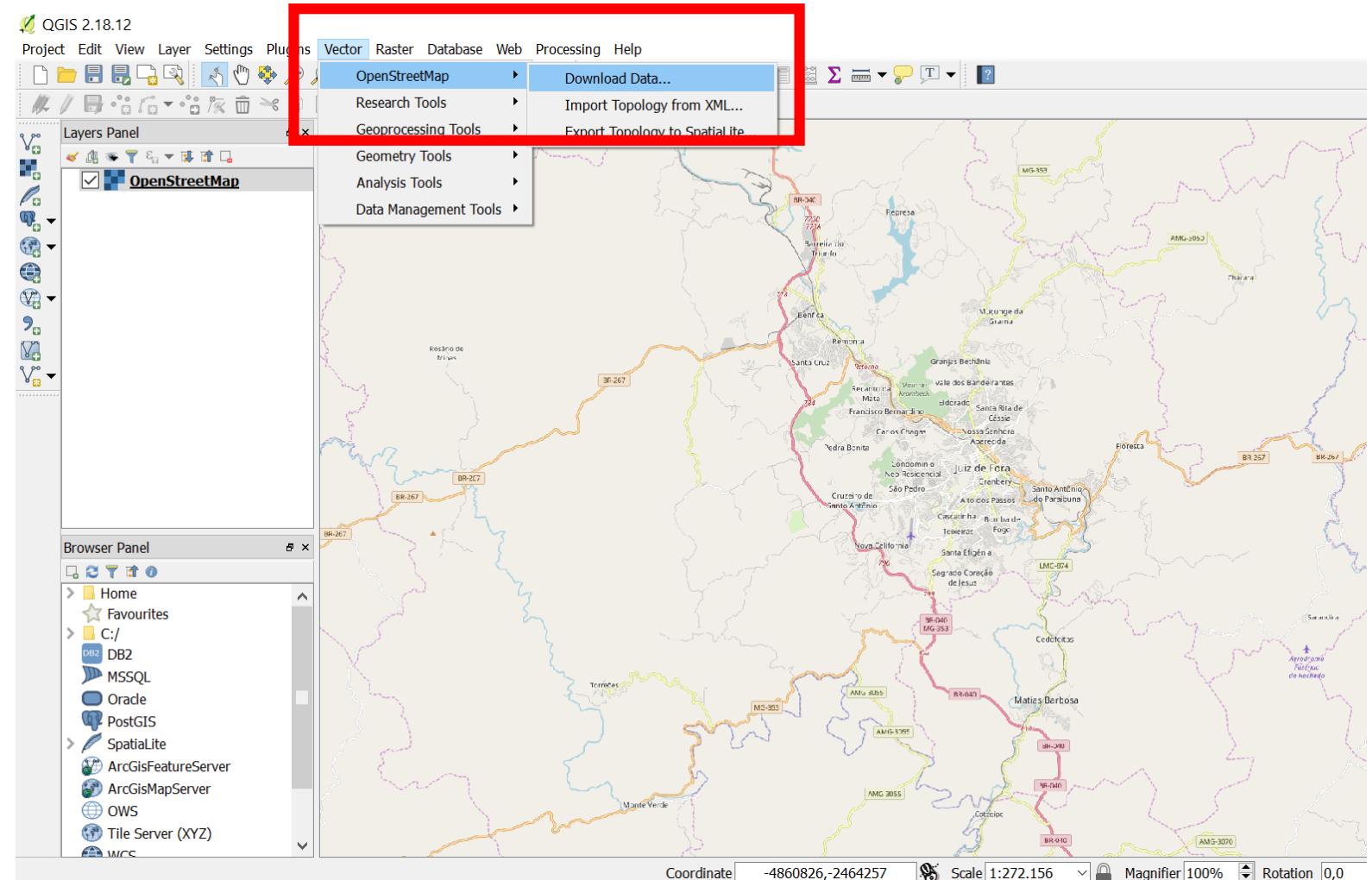
# Using openstreet map

- To get the data, you must search the city in the map.
- To case study, we will select Juiz de Fora city.



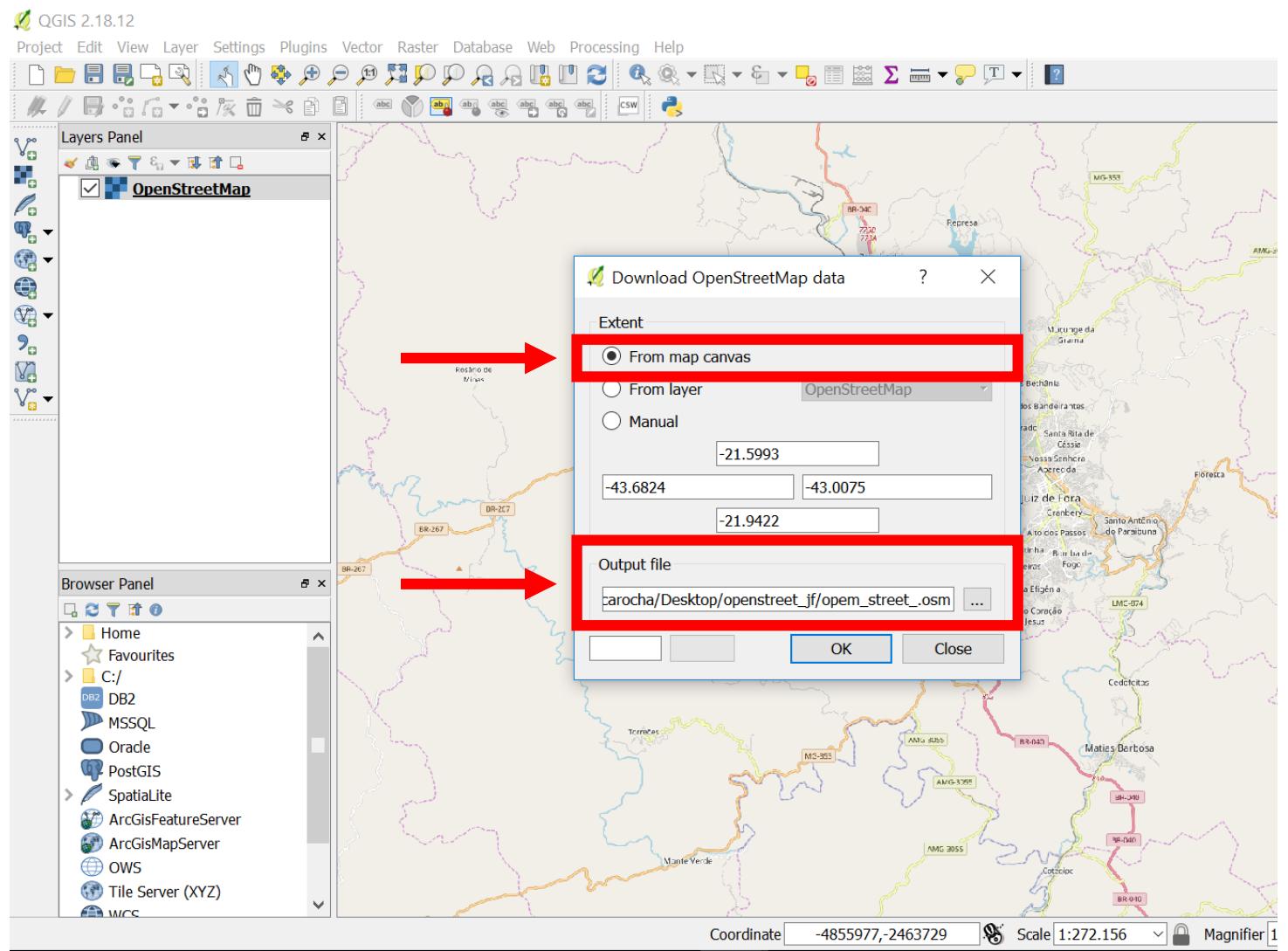
# Using openstreet map

- After, to select the city, go to “Vector” command, select OpenStreetMap, “download data”



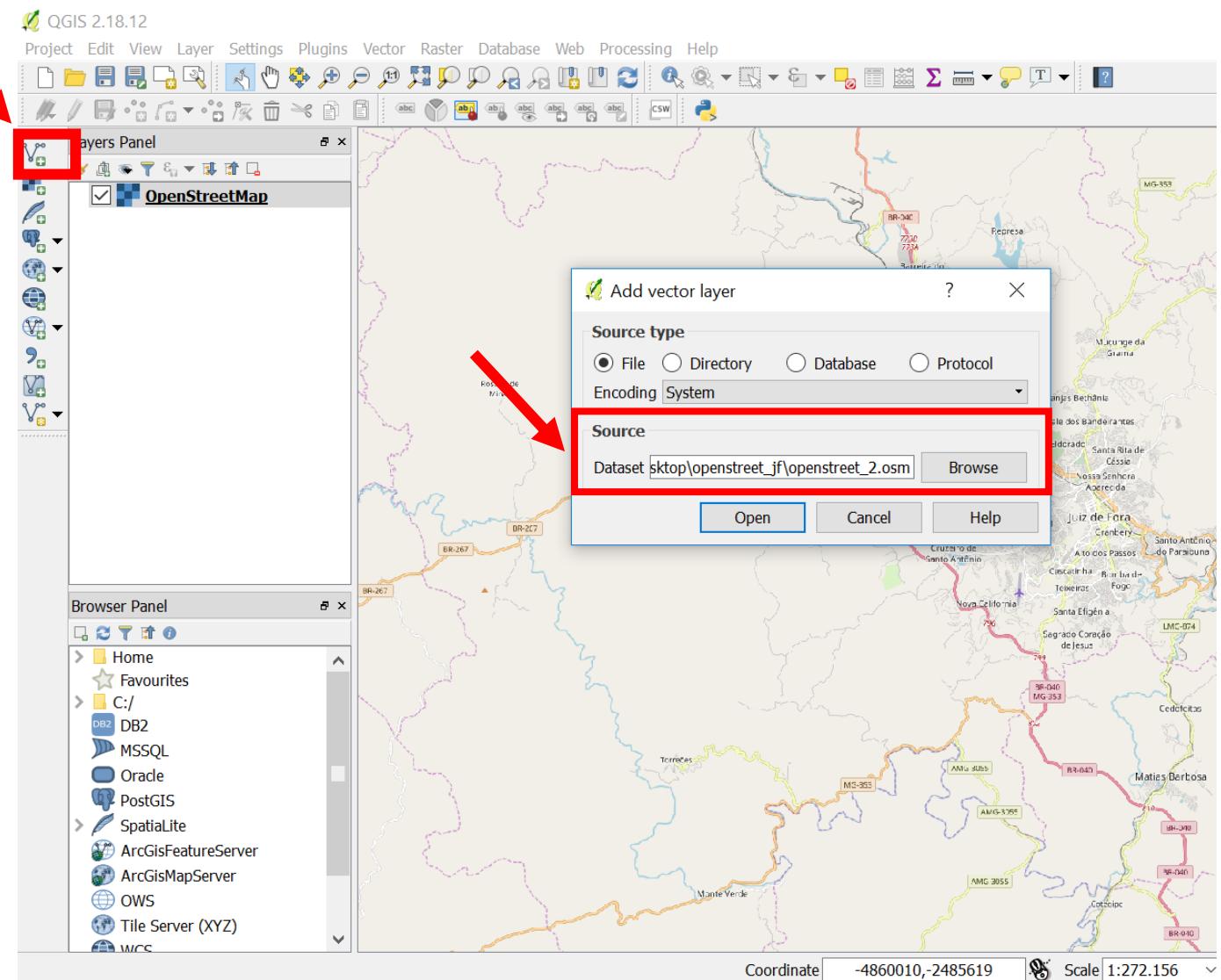
# Download the data

- Select the option “from map canvas”
- OpenLayers define that you want the download from the window area.
  - Tip: Take one area bigger than you want.
- Select where you will archive the file in “output file”. The file will archive in OSM.



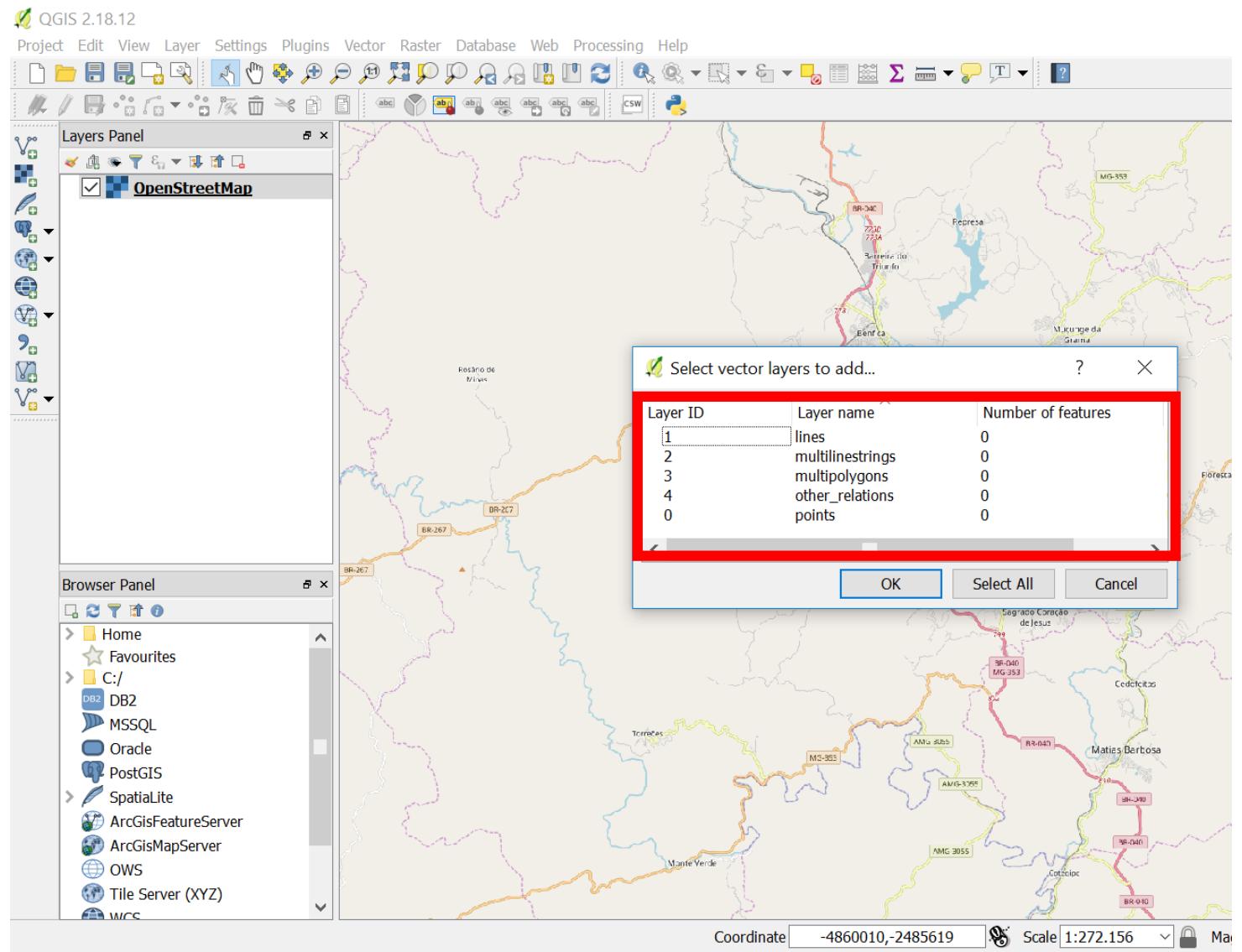
# Treating the data

- From “add vectorial layer” in the sidebar
- In the window, search the download file “osm.” archived and open.



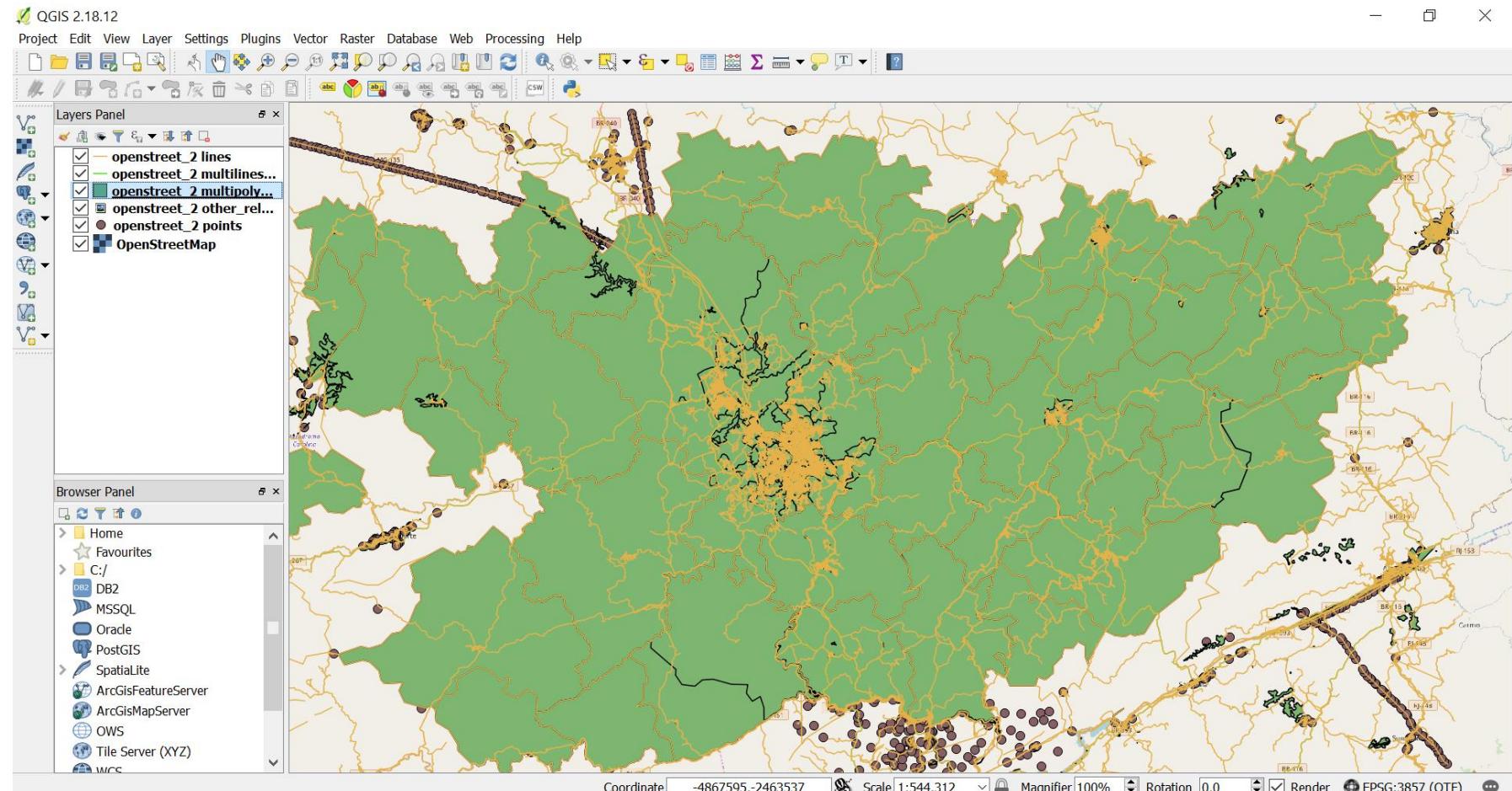
# Treating the data

- Select all layers



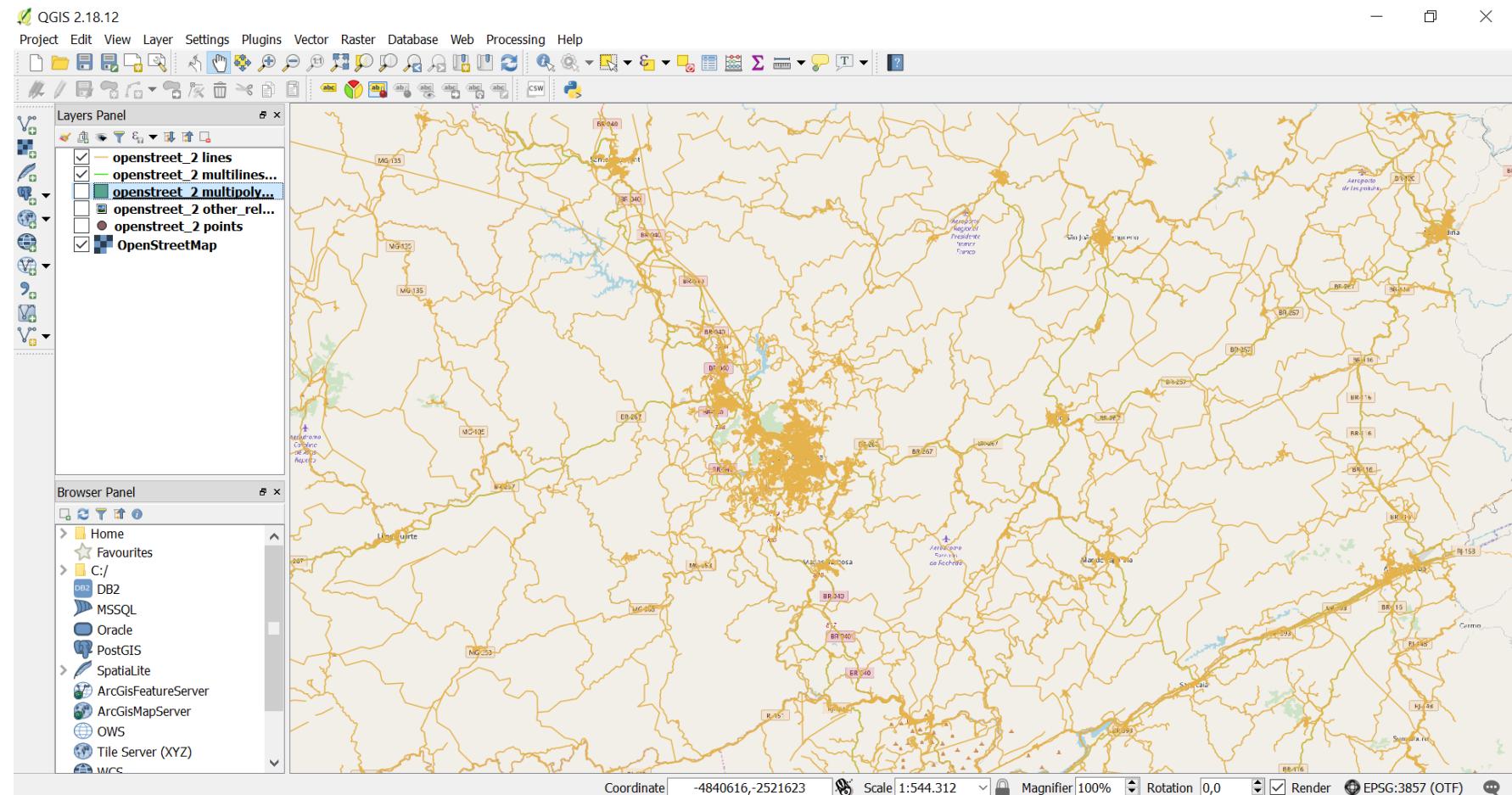
# Treating the data

- You get lines, multilinestrings, multipolygons, points, and all information openlayers have to the area.



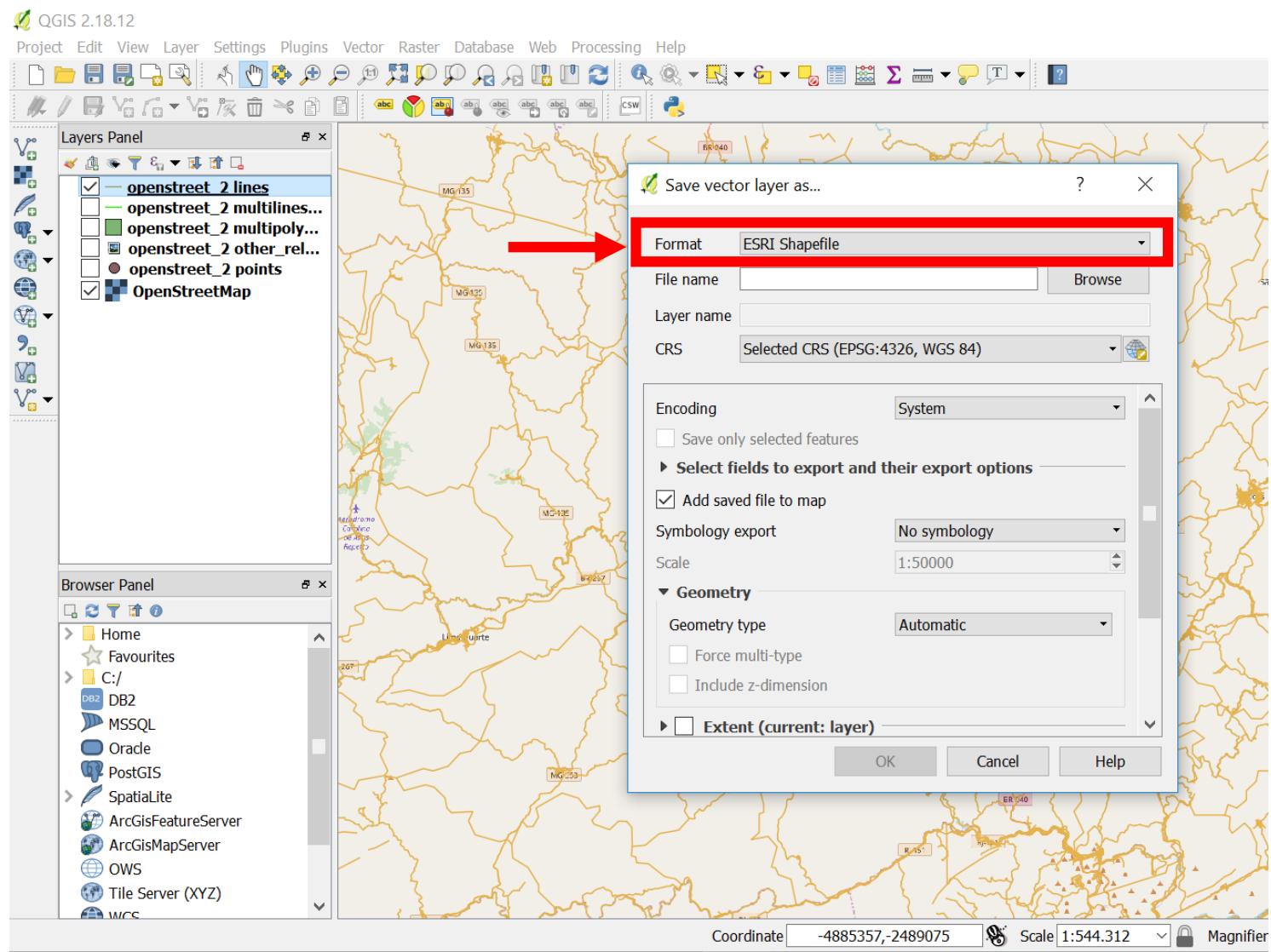
# The treatment of data

- In the example, you are seeing the “lines”.
- Observe that these lines can be roads, rivers, and all linear elements.



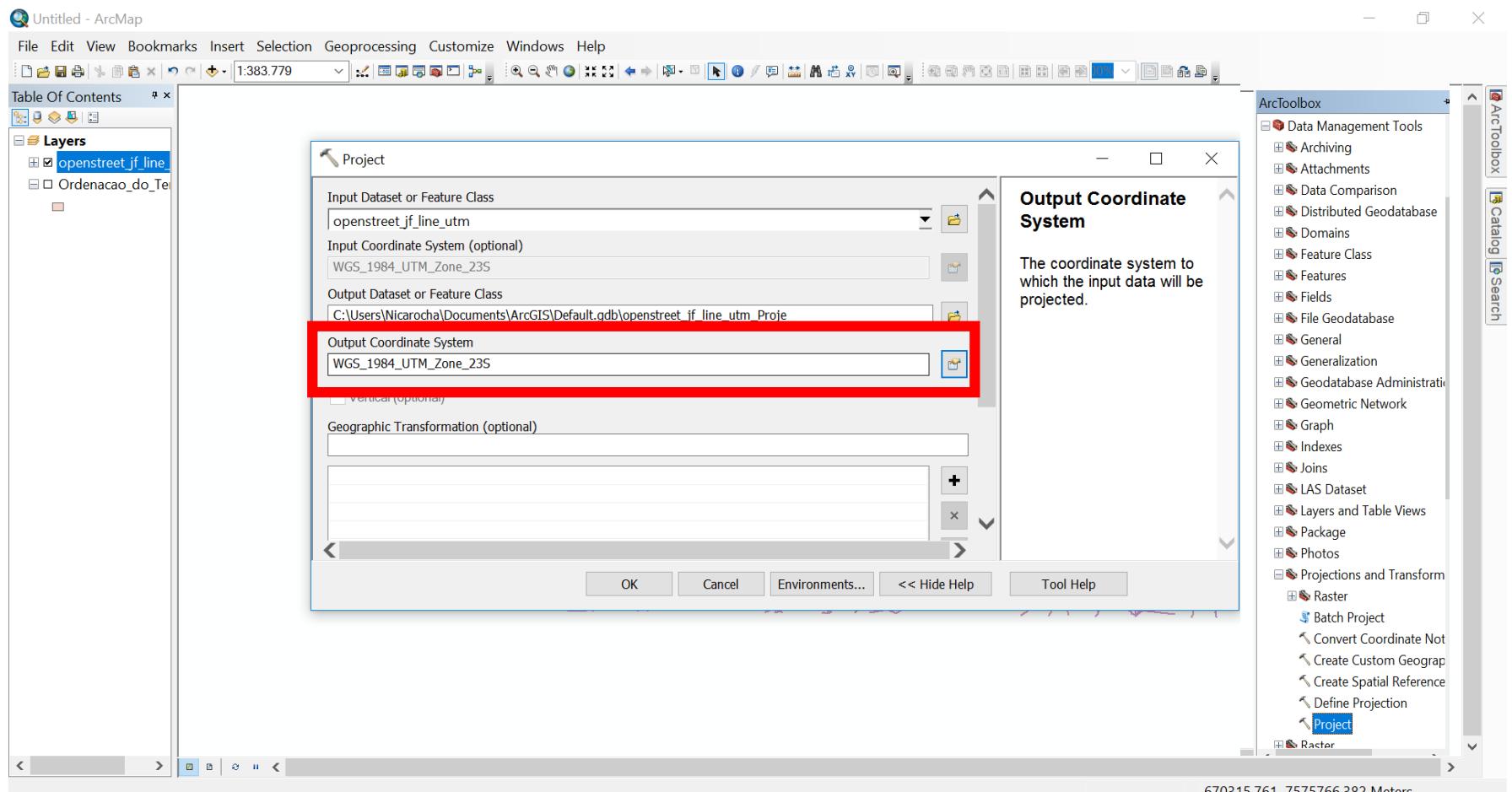
# OSM to Shapefile

- The osm (openstreetmap) “lines” layer was saved as shapefile



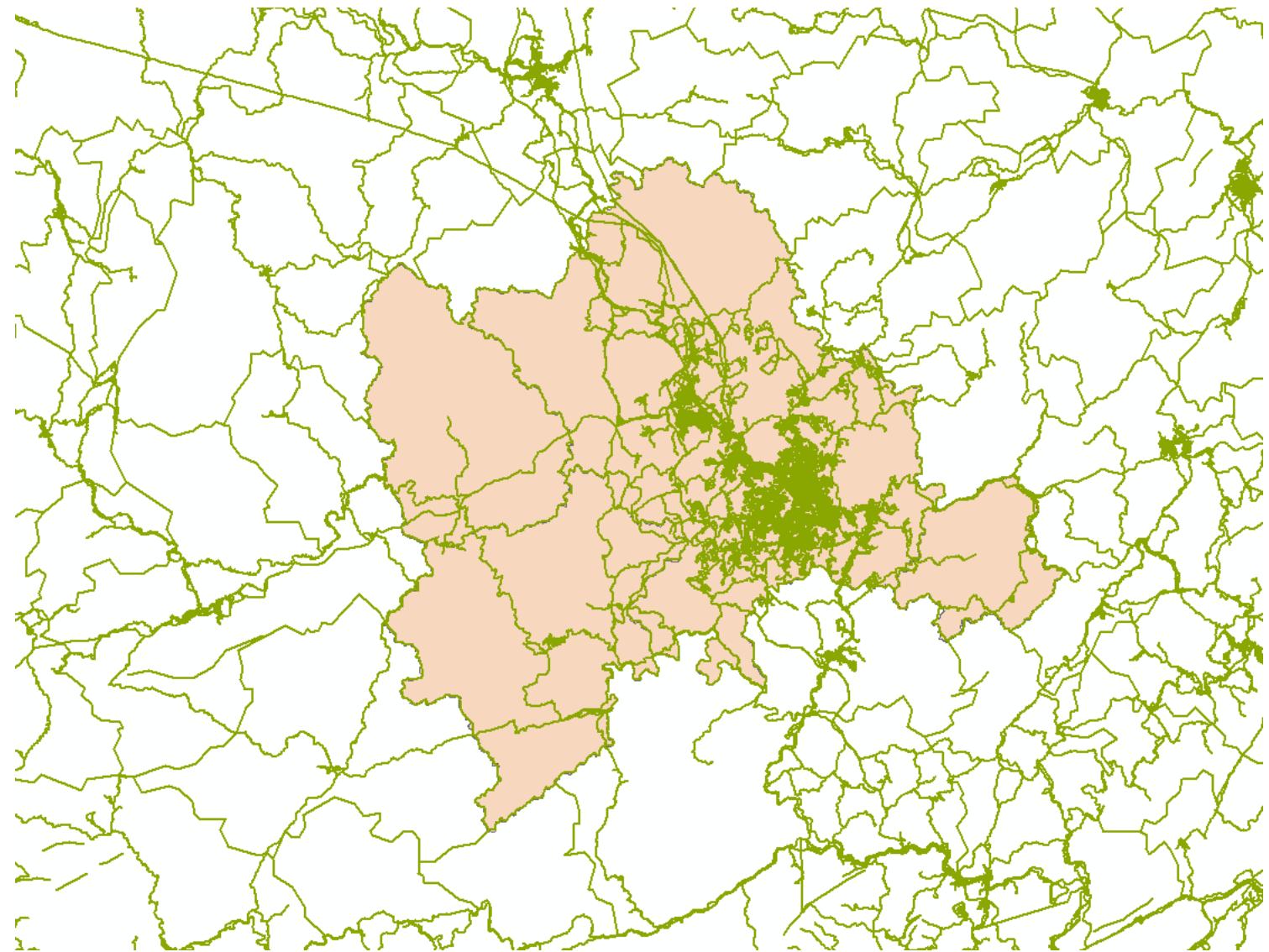
# Working the data using ArcMap

- Add the layer in ArcMap
- The layer was in WGS84, Geographic (Lat/Long)
- Convert the layer to WGS84, UTM Projected coordinate system

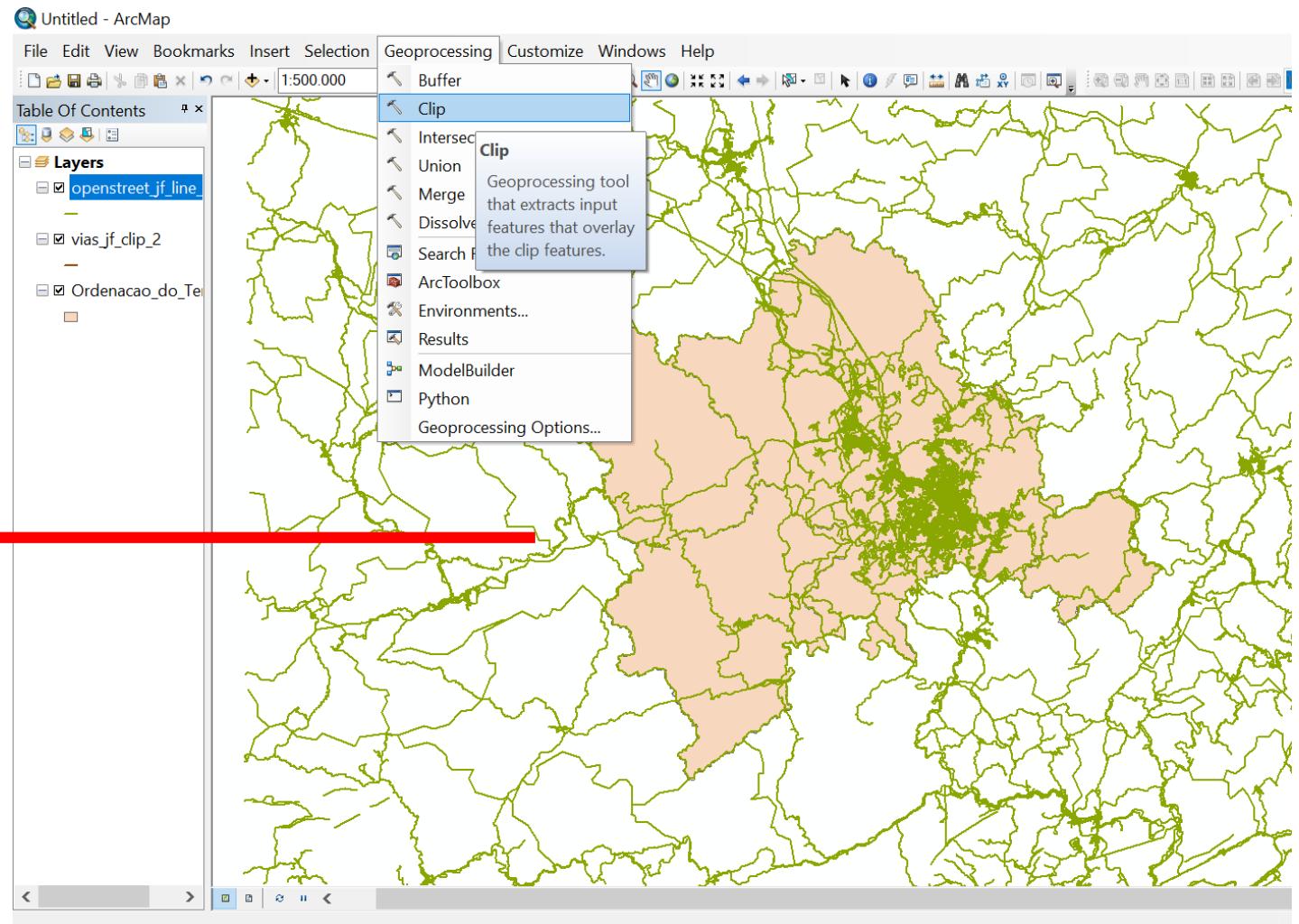
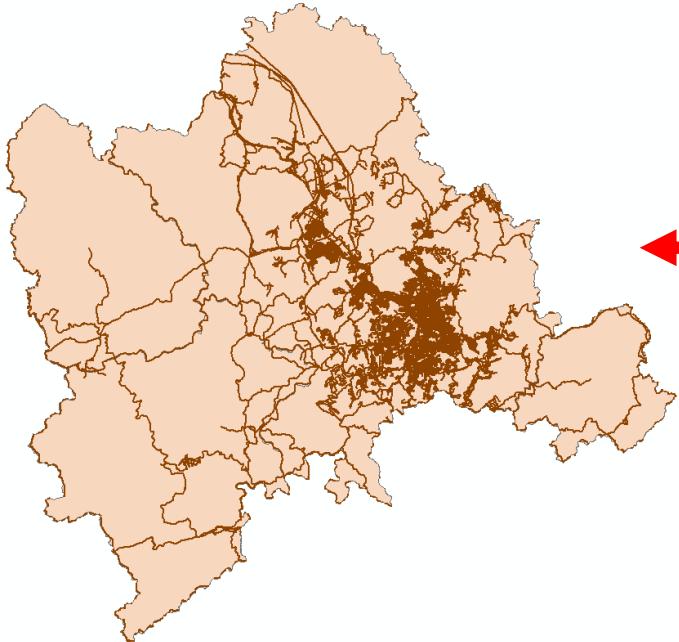


# Working the data using ArcMap

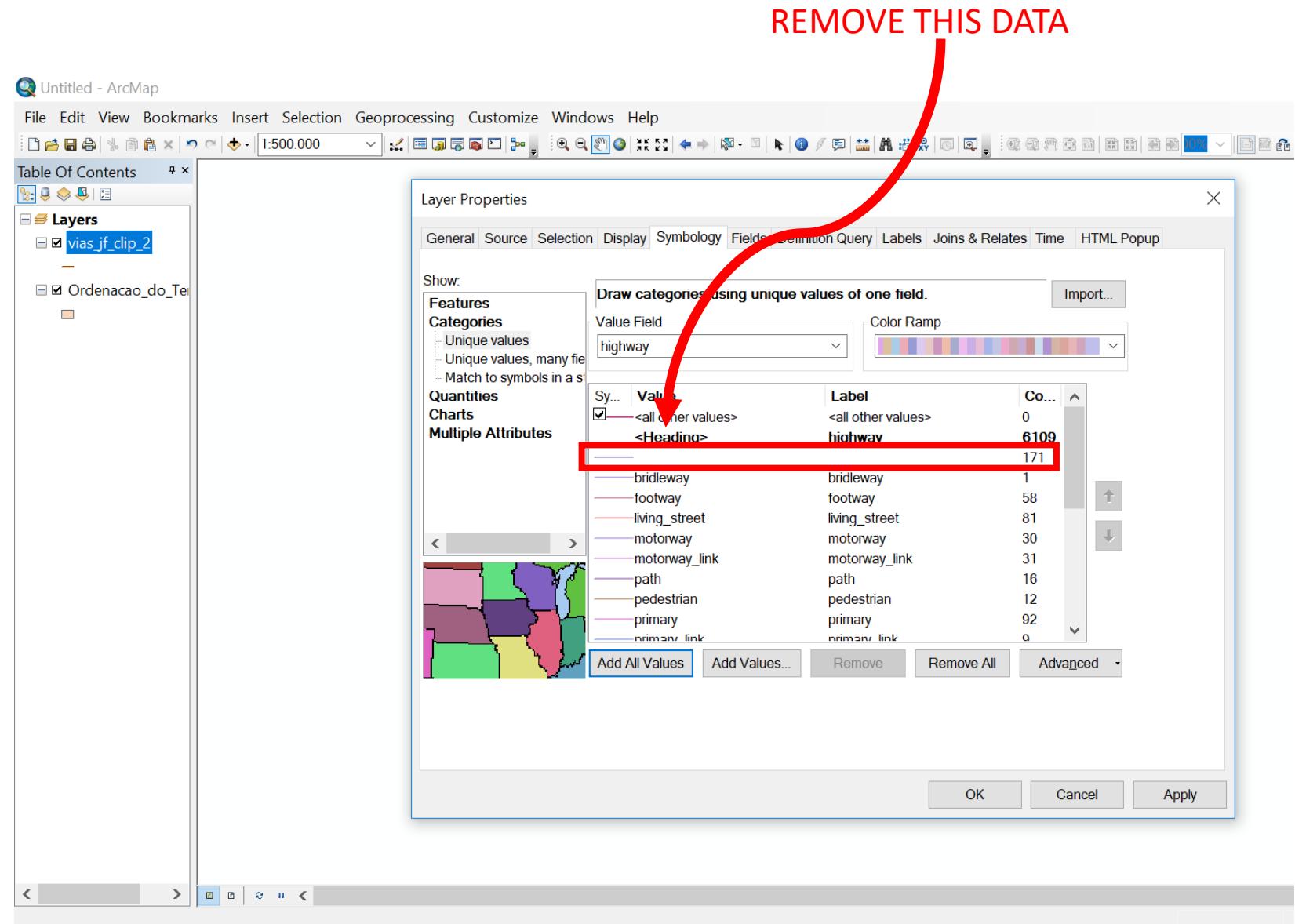
- We need a boundary to define the area of the case study (we used the municipality of Juiz de Fora - Brazil).



- Cut the layers, using clip command

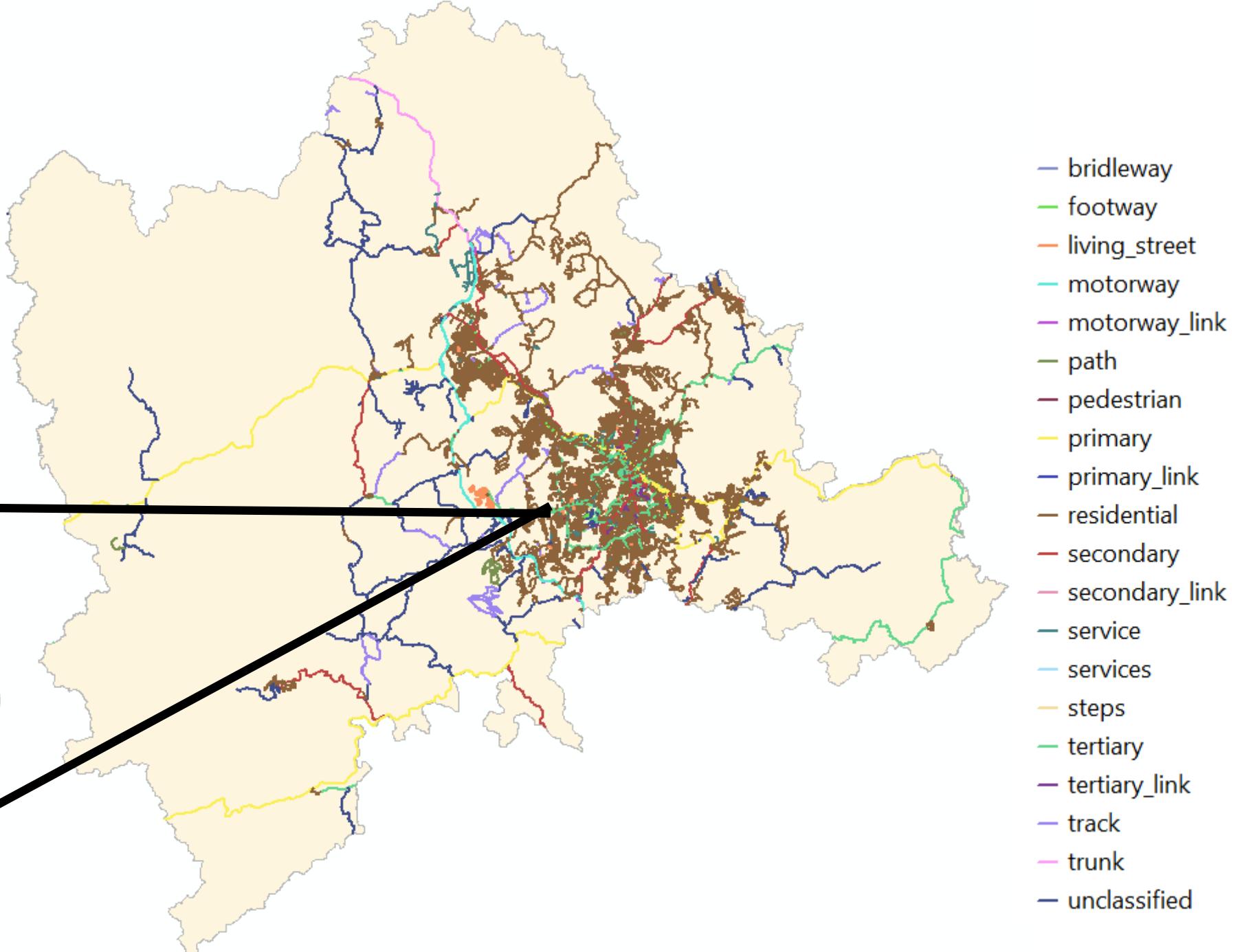
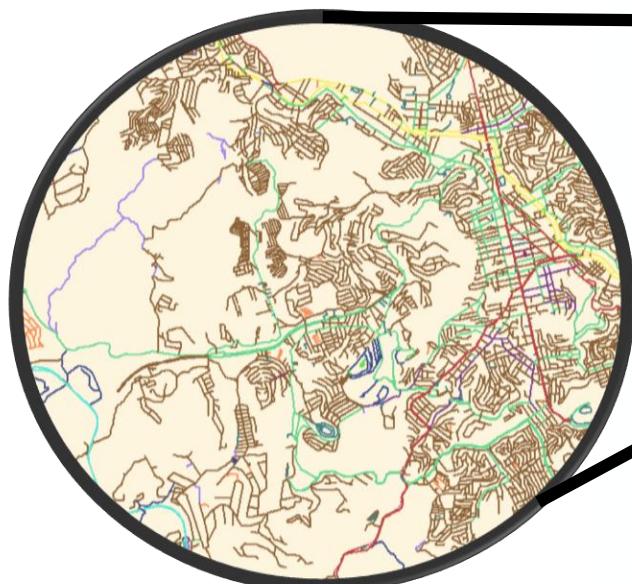


- The lines layer have some attributes. One of the fields of attributes is “highway”.
- When classified, this attribute presents a group without information, as “no data”, and that means those elements are not “highways”, are not roads or streets.
- In our case study, we kept only the lines the had information about “highway”



# Highway map

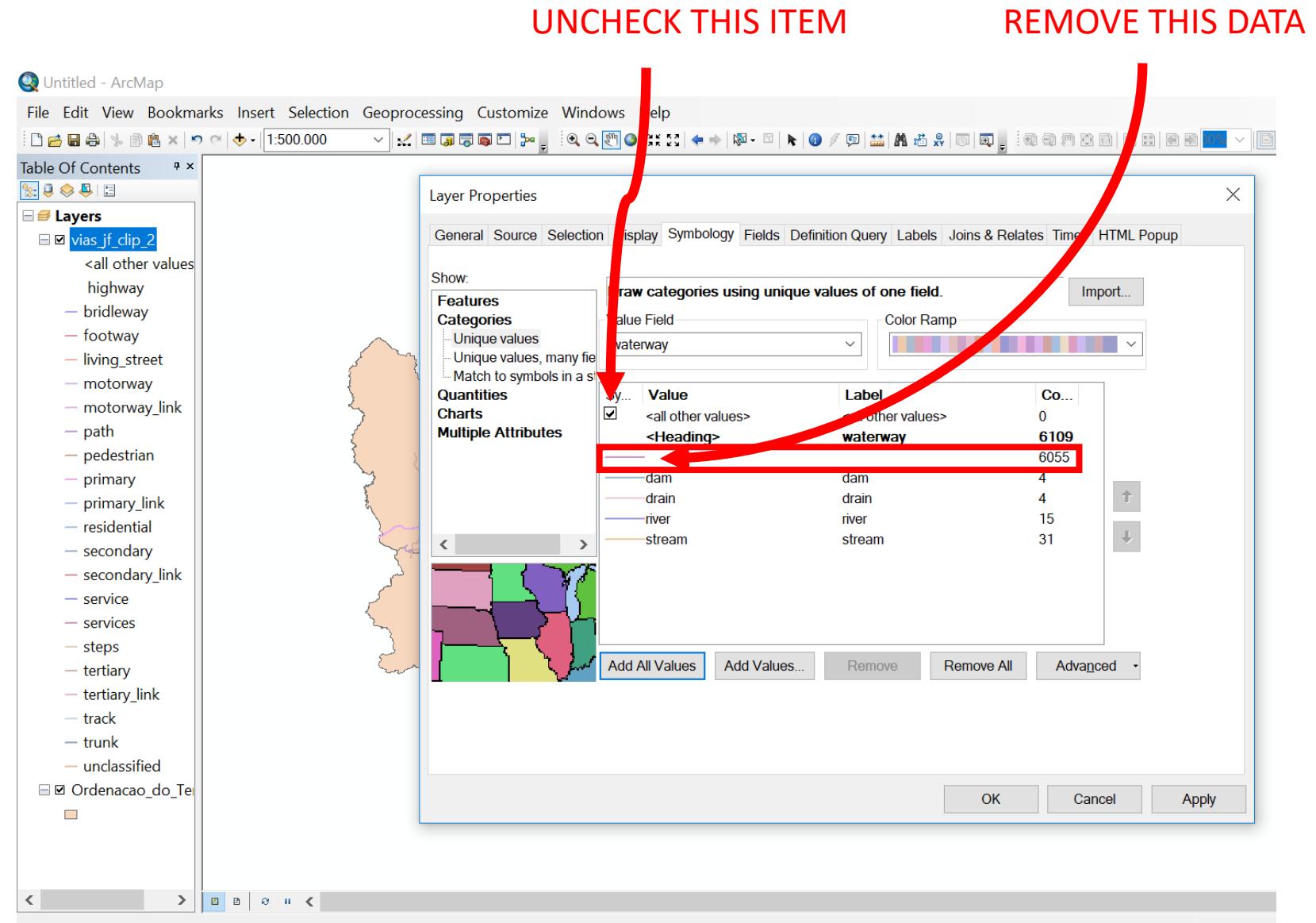
- Types of roads



bridleway
footway
living_street
motorway
motorway_link
path
pedestrian
primary
primary_link
residential
secondary
secondary_link
service
services
steps
tertiary
tertiary_link
track
trunk
unclassified

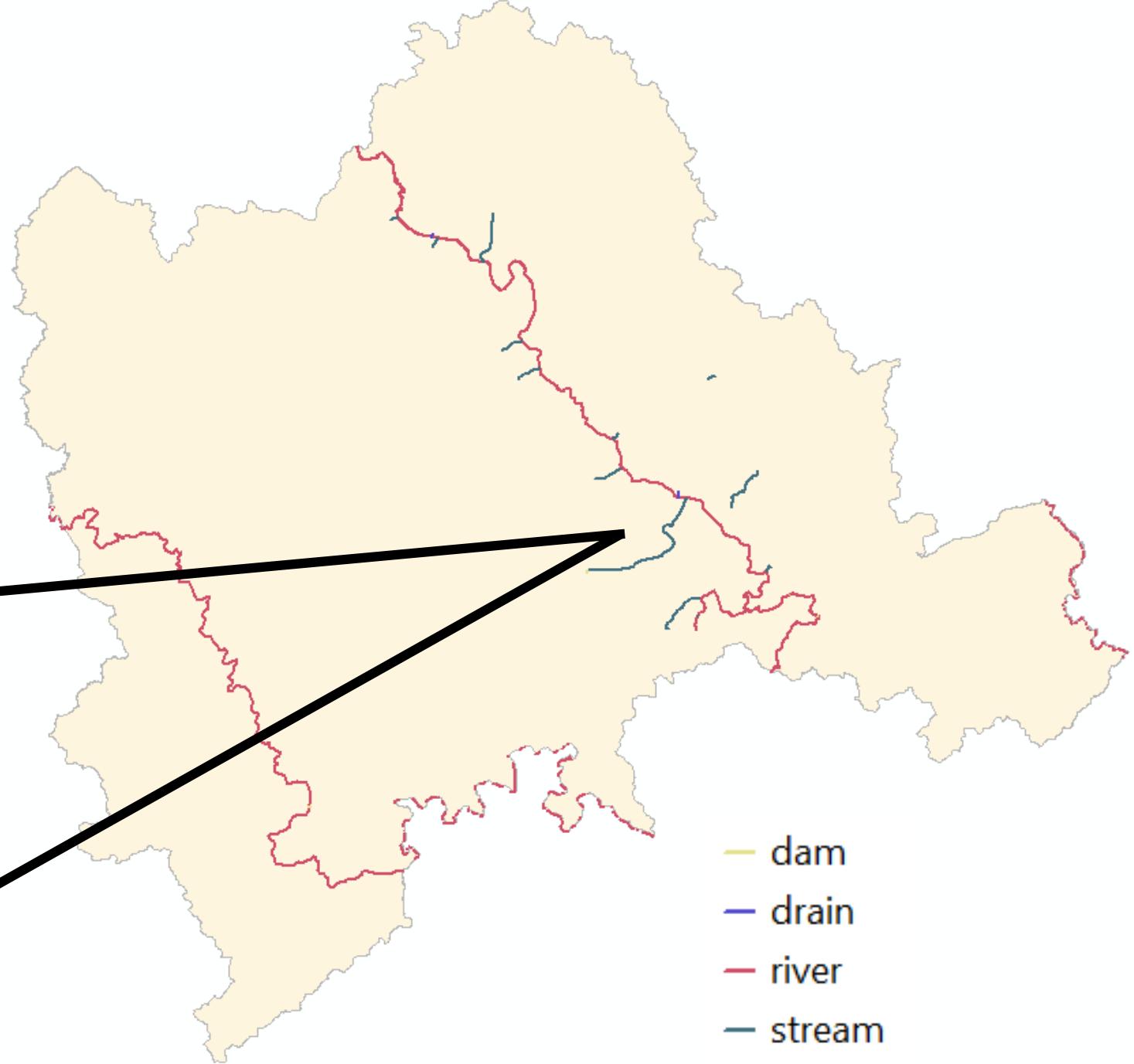
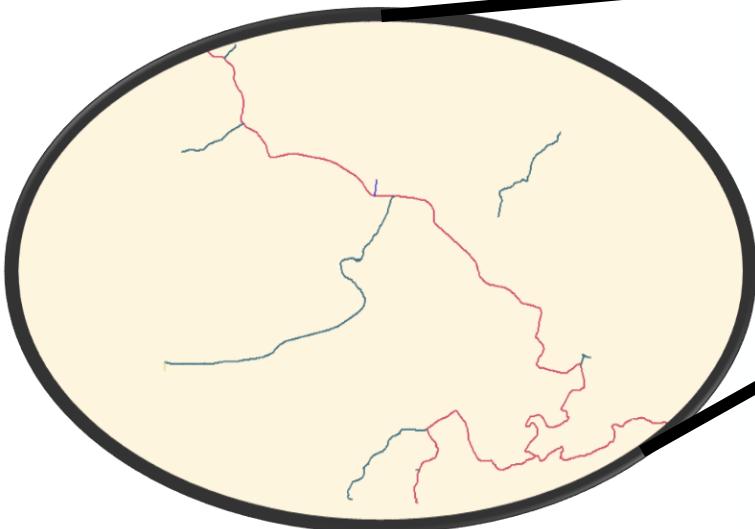
# Waterway map

- Observe that if you symbolize by the field “waterway”, for example, that the same collection of lines will have some with data (dam, drain, river, stream), but there are many lines without information, as “no data” because they are not waterway.
- Due to that, it’s important to separate the layer in more layers, deleting those lines that are not of interest to you.



# Waterway map

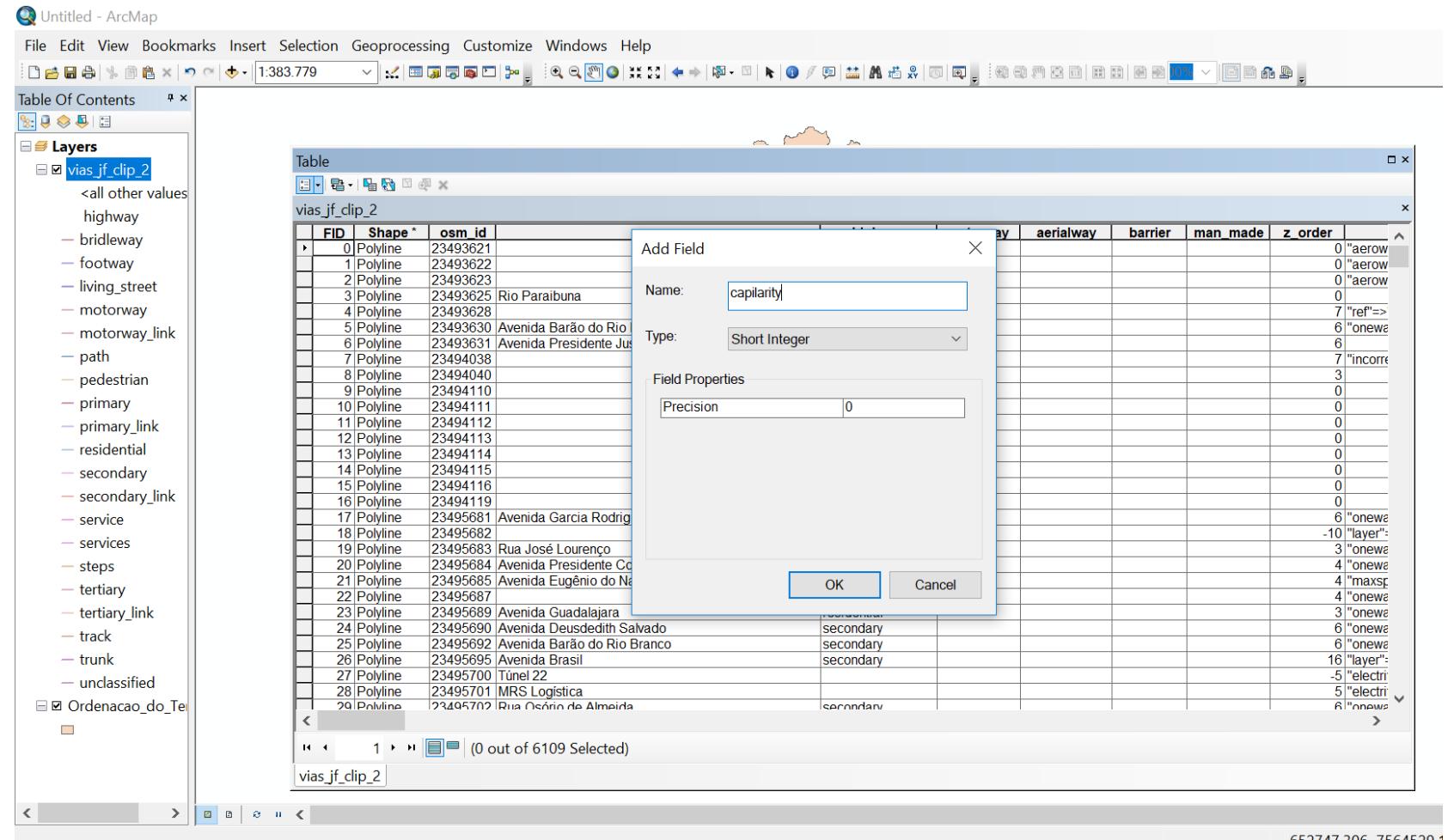
- Selecting by symbology command – “waterway”



Transportation map (Capilarity and  
acessibility)

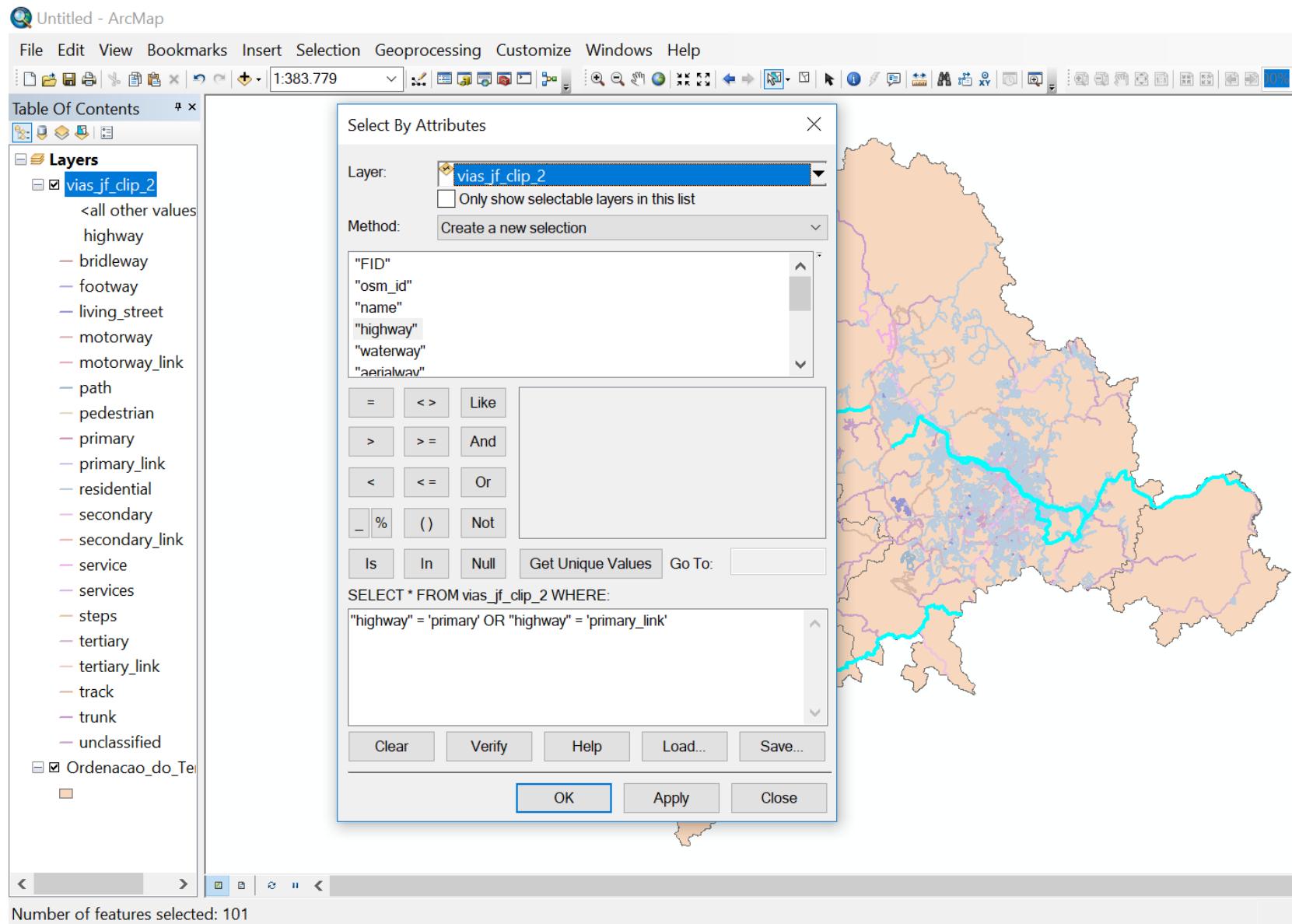
# Creating the Capillarity map

- We created a new attribute, a field called “Capillarity” to define the importance of the line according to the typology of the streets/road.



# Classifying the types of roads

- We must classify the types of roads according to capillarity and accessibility.
- The field “capillarity” receives values according to this classification.
- Using “select by attributes”, the types of roads are selected, and the field “capillarity” is filled with a numerical value.



# Classifying the types of roads

- Very high importance to capillarity and accessibility: roads that are: 'primary' or 'primary\_link'
- Very important to capillarity and accessibility: roads that are 'secondary' or 'secondary\_link'
- Important to capillarity and accessibility: 'tertiary' or 'tertiary\_link'
- Medium importance to capillarity and accessibility: 'motorway' or 'motorway\_link'
- Medium to low importance to capillarity and accessibility: 'living\_street' or 'residential'
- Low importance to capillarity and accessibility: 'track' or 'unclassified'
- Very low importance to capillarity and accessibility: 'bridleway' or 'footway' or 'path' or 'pedestrian' or 'steps'
- Without importance to capillarity and accessibility: 'service' or 'services'
- According to this classification, the field "Capillarity received numerical values, using "select by attribute":

# Classifying the types of roads

- to value 100 -> "highway" = 'primary' OR "highway" = 'primary\_link'
- to value 70 -> "highway" = 'secondary' OR "highway" = 'secondary\_link'
- to value 50 -> "highway" = 'tertiary' OR "highway" = 'tertiary\_link'
- to value 25 -> "highway" = 'motorway' OR "highway" = 'motorway\_link'
- to value 10 -> "highway" = 'living\_street' OR "highway" = 'residential'
- to value 5 -> "highway" = 'track' OR "highway" = 'unclassified'
- to value 3 -> "highway" = 'bridleway' OR "highway" = 'footway' OR "highway" = 'path' OR "highway" = 'pedestrian' OR "highway" = 'steps'
- to value 1 -> "highway" = 'service' OR "highway" = 'services'

# Classifying the types of roads

Screenshot of ArcMap showing the process of classifying road types based on OSM attributes.

The "Select by Attributes" dialog box is open, displaying a WHERE clause:

```
SELECT * FROM vias_jf_clip_2 WHERE:  
"highway" = 'primary' OR "highway" = 'primary_link'
```

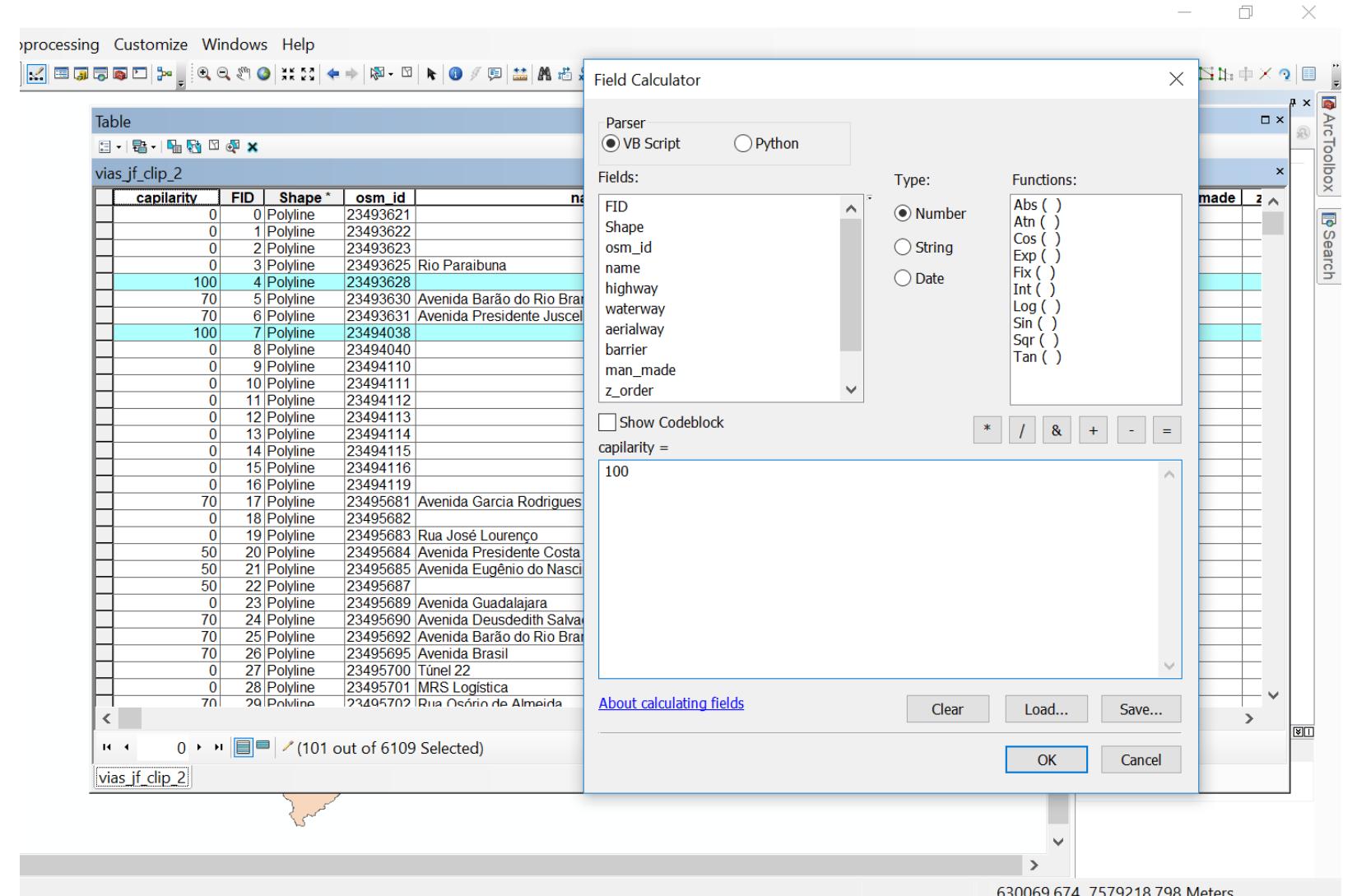
The "vias\_jf\_clip\_2" table is displayed in the main window, showing the following columns and data:

id	FID	Shape *	osm_id	name	highway	waterway	aerialway	barrier	man_made	z
0	0	Polyline	23493621							
0	1	Polyline	23493622							
0	2	Polyline	23493623							
0	3	Polyline	23493625	Rio Paraibuna		river				
100	4	Polyline	23493628		primary					
70	5	Polyline	23493630	Avenida Barão do Rio Branco	secondary					
70	6	Polyline	23493631	Avenida Presidente Juscelino Kubitschek	secondary					
100	7	Polyline	23494038		primary					
0	8	Polyline	23494040		unclassified					
0	9	Polyline	23494110		service					
0	10	Polyline	23494111		service					
0	11	Polyline	23494112		service					
0	12	Polyline	23494113		service					
0	13	Polyline	23494114		service					
0	14	Polyline	23494115		service					
0	15	Polyline	23494116		service					
0	16	Polyline	23494119		service					
70	17	Polyline	23495681	Avenida Garcia Rodrigues Paes	secondary					
0	18	Polyline	23495682		stream					
0	19	Polyline	23495683	Rua José Lourenço	residential					
50	20	Polyline	23495684	Avenida Presidente Costa e Silva	tertiary					
50	21	Polyline	23495685	Avenida Eugênio do Nascimento	tertiary					
50	22	Polyline	23495687		tertiary					
0	23	Polyline	23495689	Avenida Guadalajara	residential					
70	24	Polyline	23495690	Avenida Deusdedit Salvado	secondary					
70	25	Polyline	23495692	Avenida Barão do Rio Branco	secondary					
70	26	Polyline	23495695	Avenida Brasil	secondary					
0	27	Polyline	23495700	Túnel 22						
0	28	Polyline	23495701	MRS Logística						
70	29	Polyline	23495702	Rua Osório de Almeida	secondary					

Number of features selected: 101

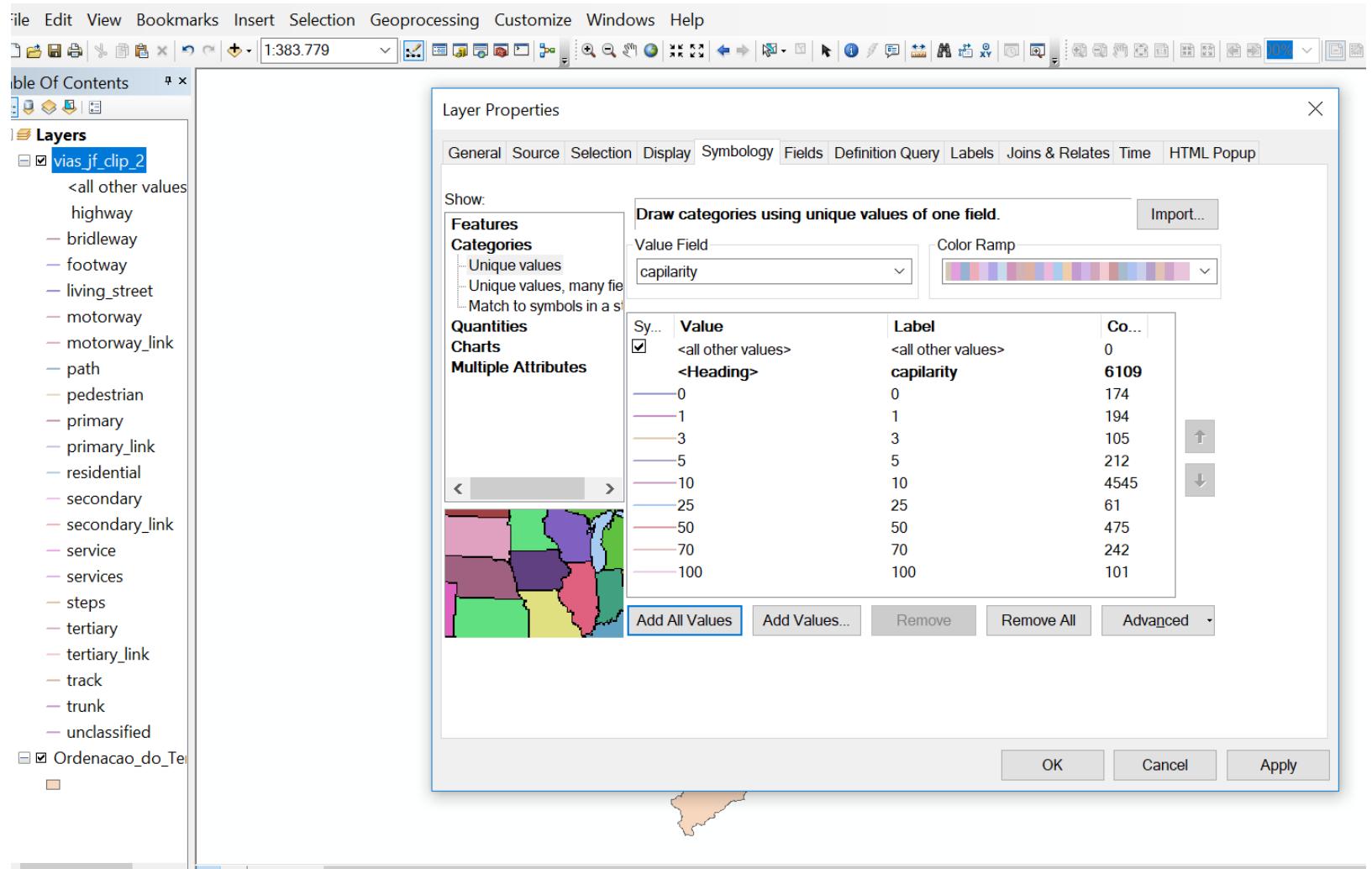
# Classifying the types of roads

- To put the values, you need “start the edition”
- In field calculator select the types and put the values



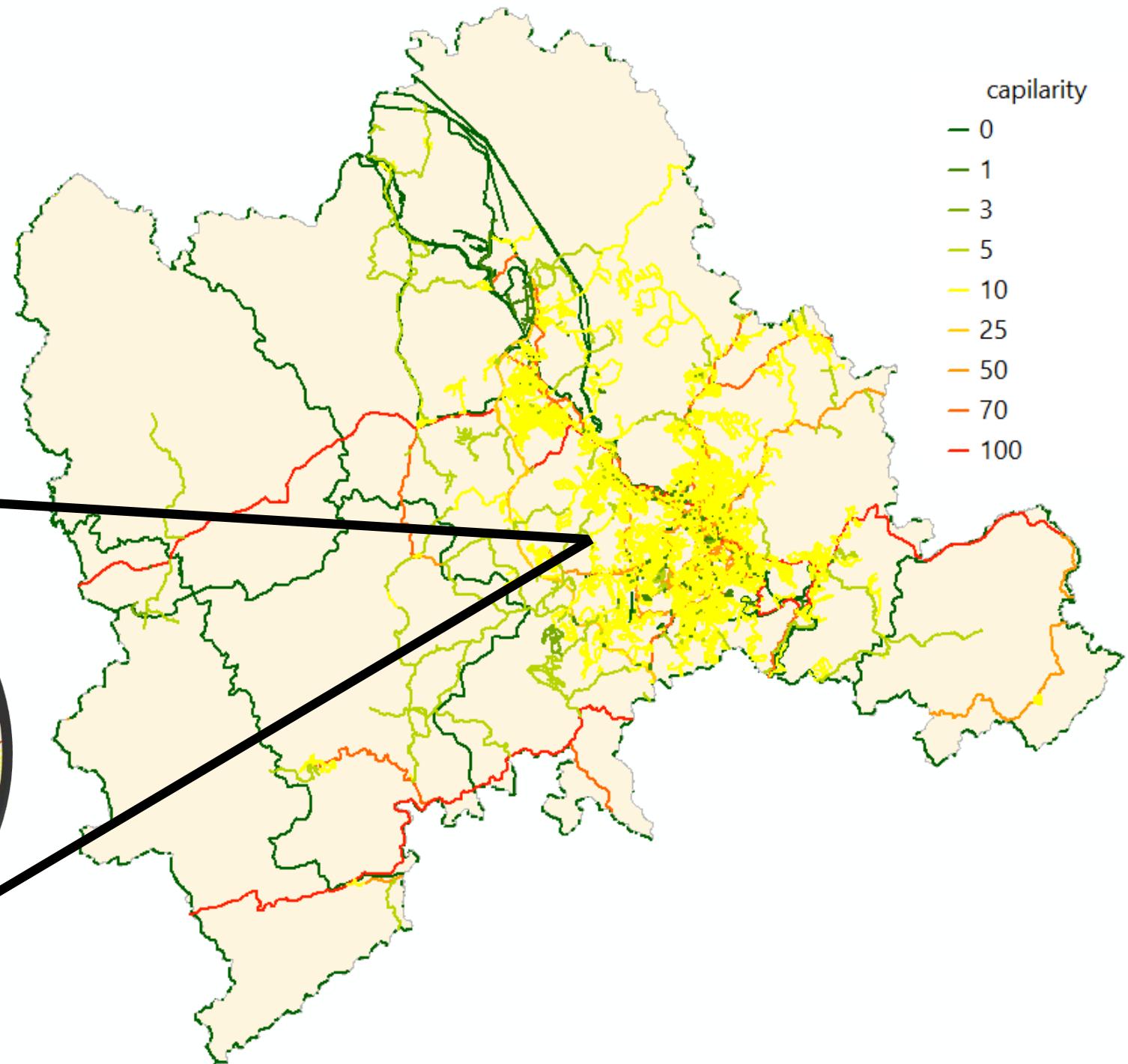
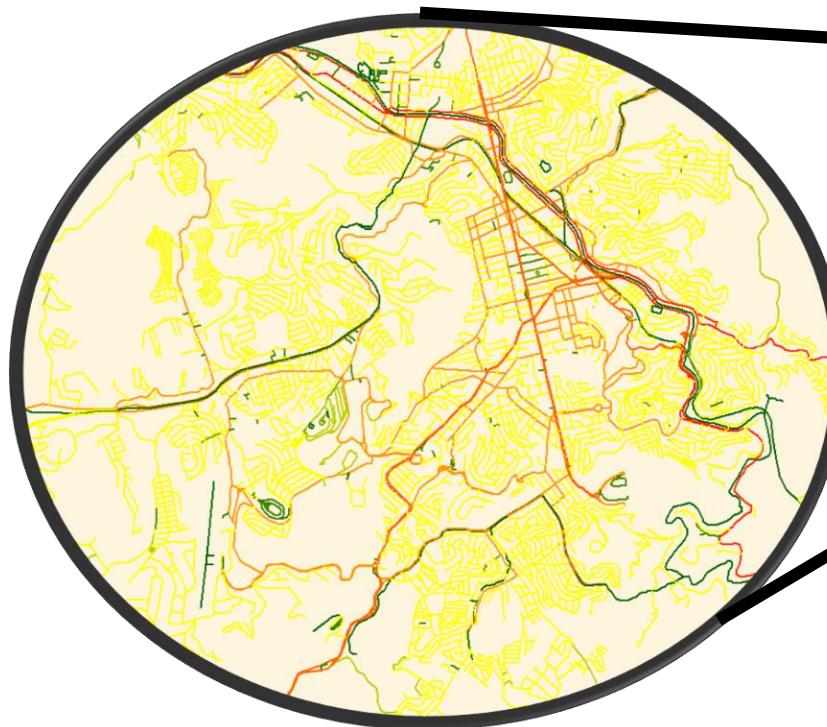
# To visualize the new data

- Select by “capilarity” in field “value field”

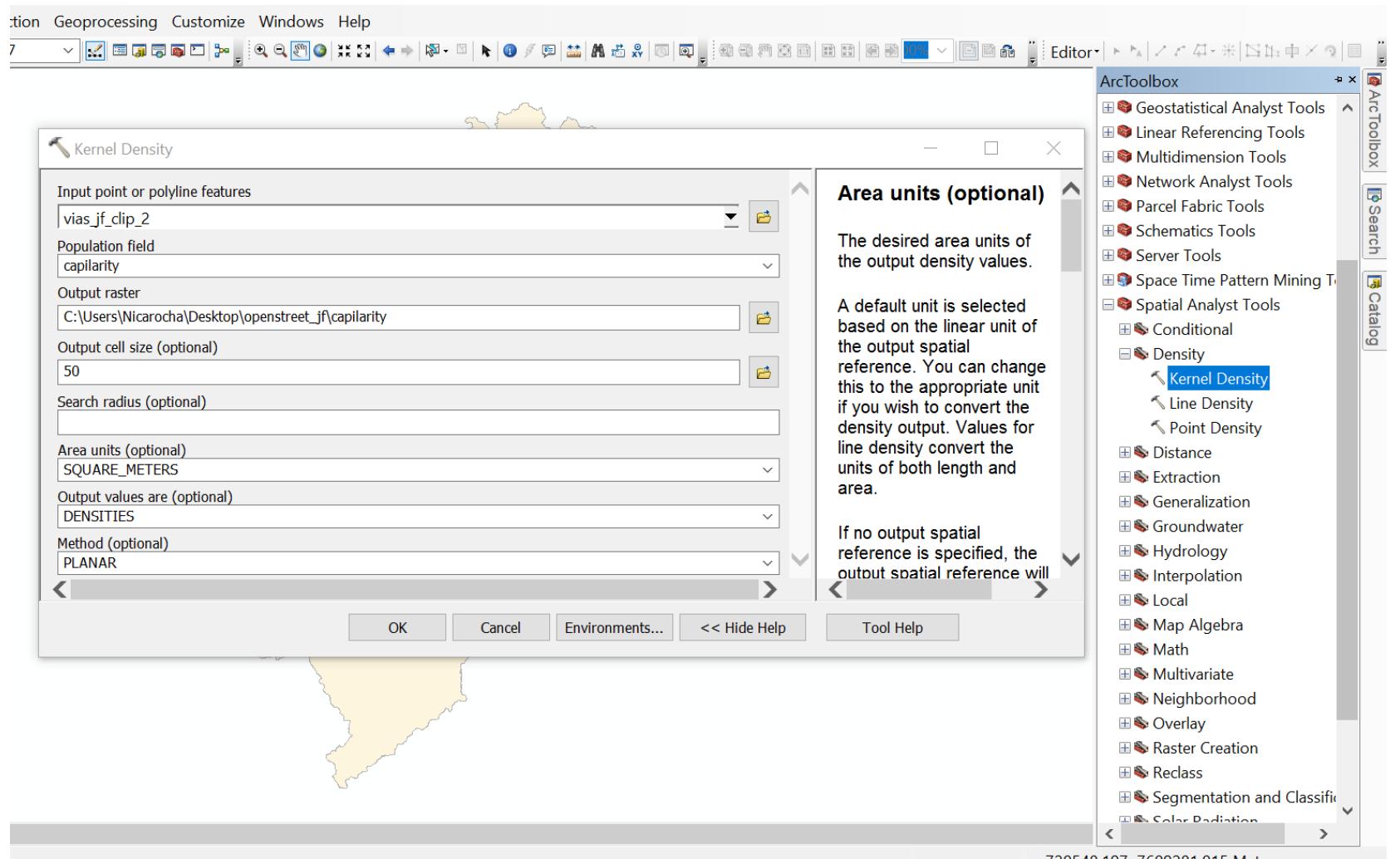


# Types of roads

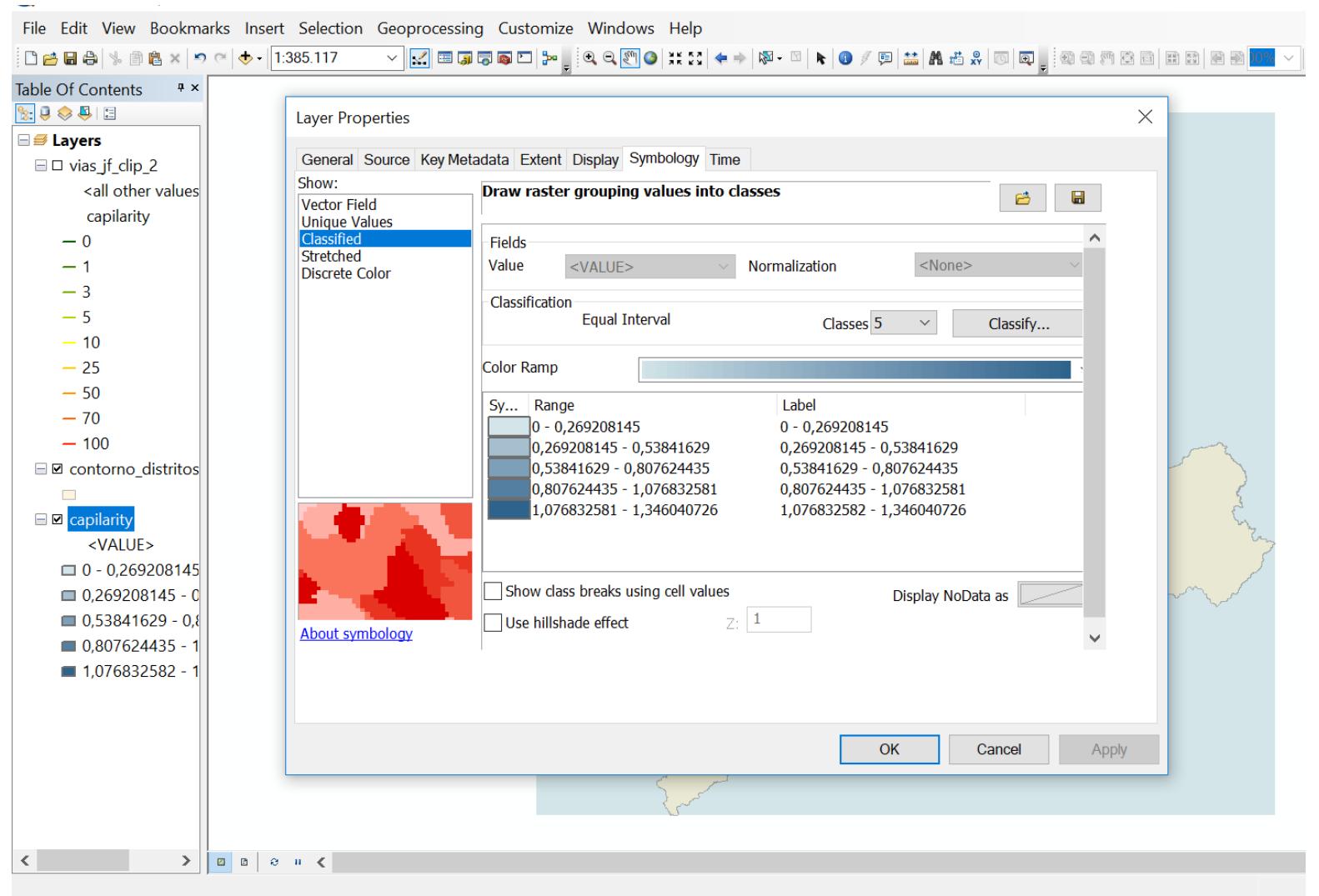
- The result of the numeric values in the field "capillarity"



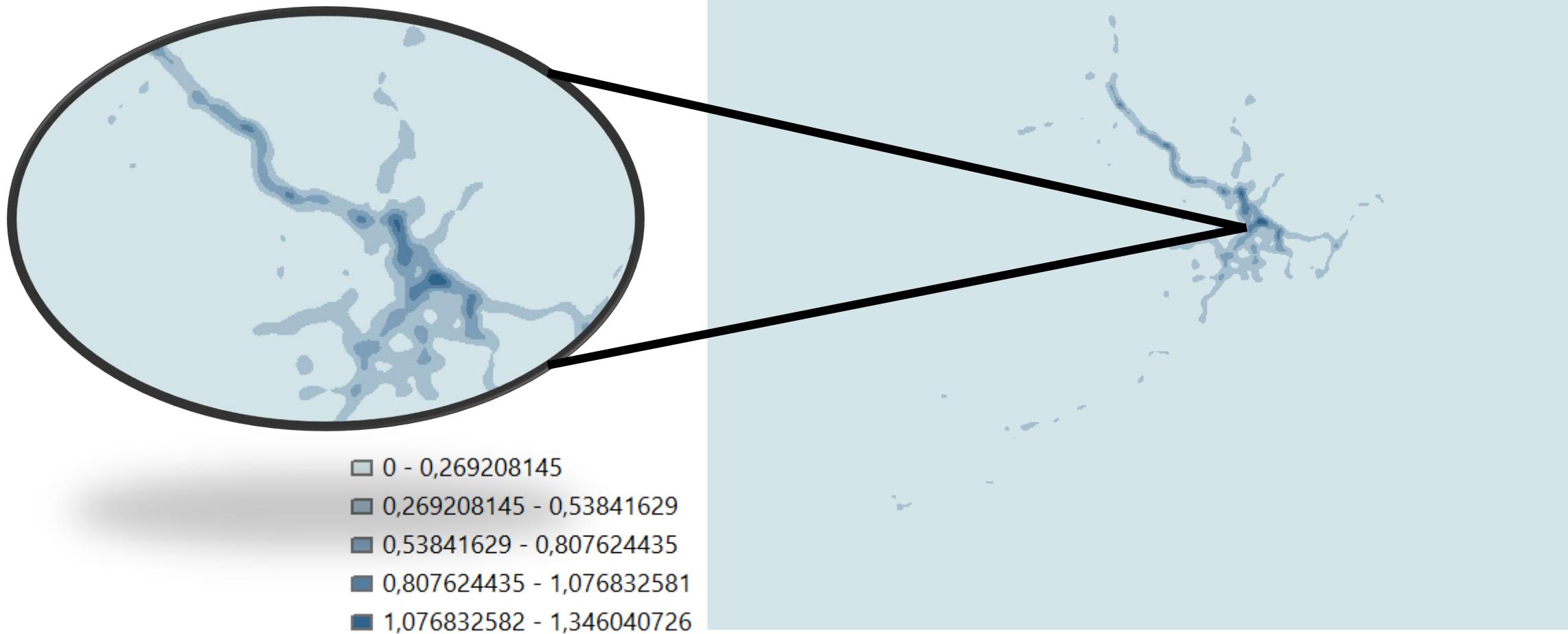
- Use Kernel Density to calculate capillarity.
- Construct it weighted according to the value in the field “capillarity”.
- In this case, we decided for the resolution of 50 meters in the output, and we didn't define the radius of capture, allowing the software to indicate the adequate aggregation distance.



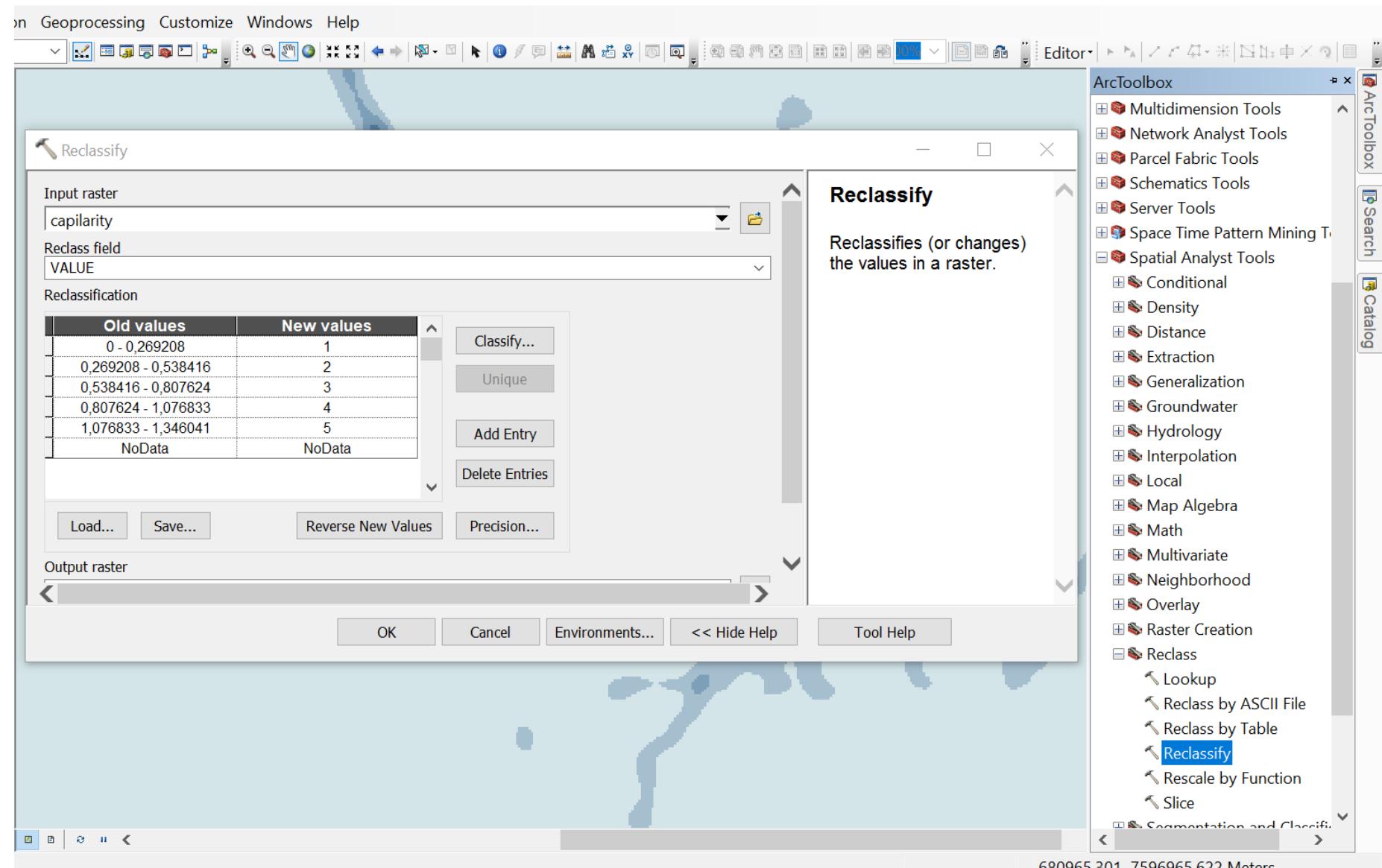
- The result of Kernel Density is sliced into 5 ranges, using “natural break” distribution.



# Result Kernel

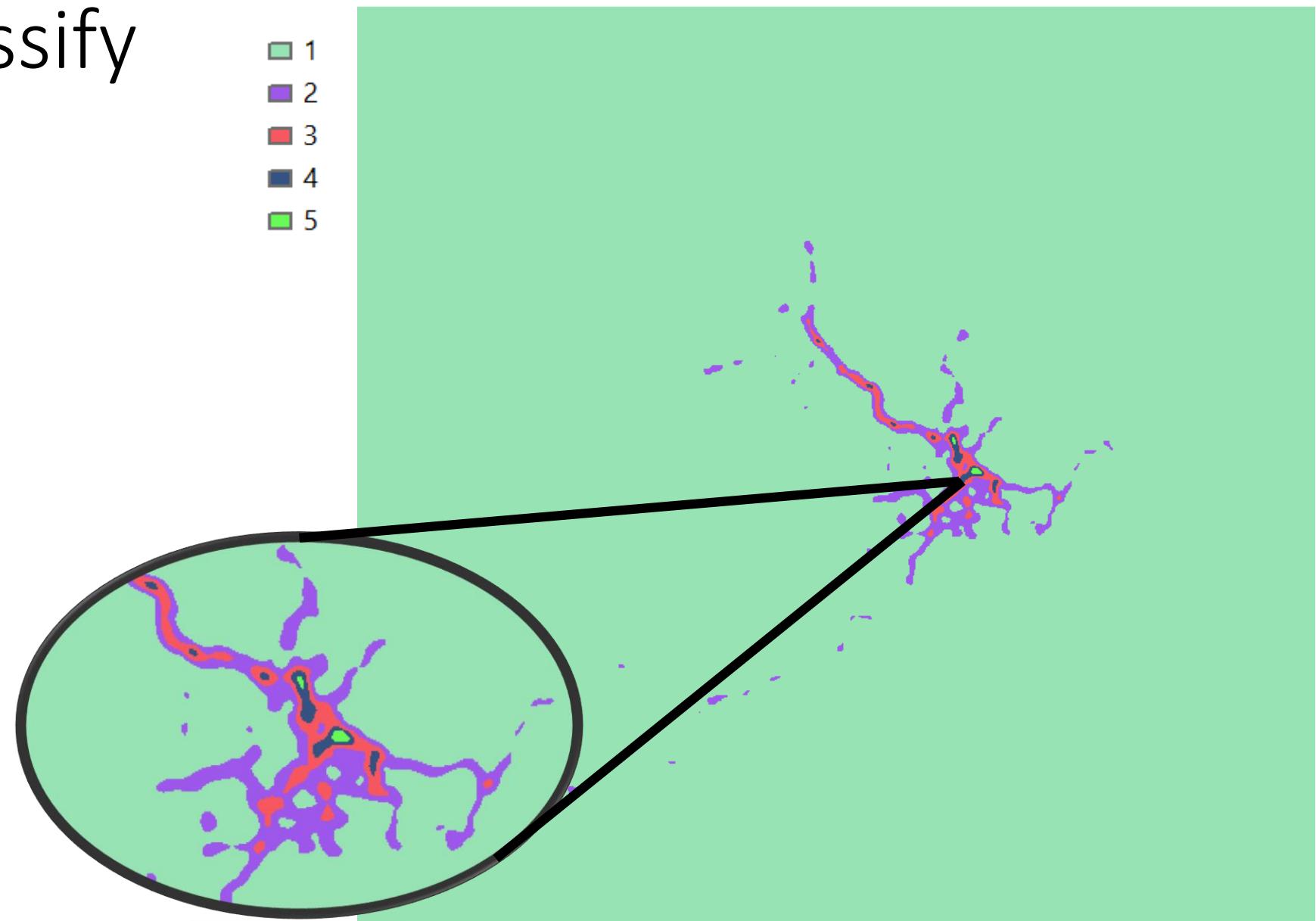


- To keep this distribution in 5 classes, the .tif of Kernel Density is reclassified into 5 pieces



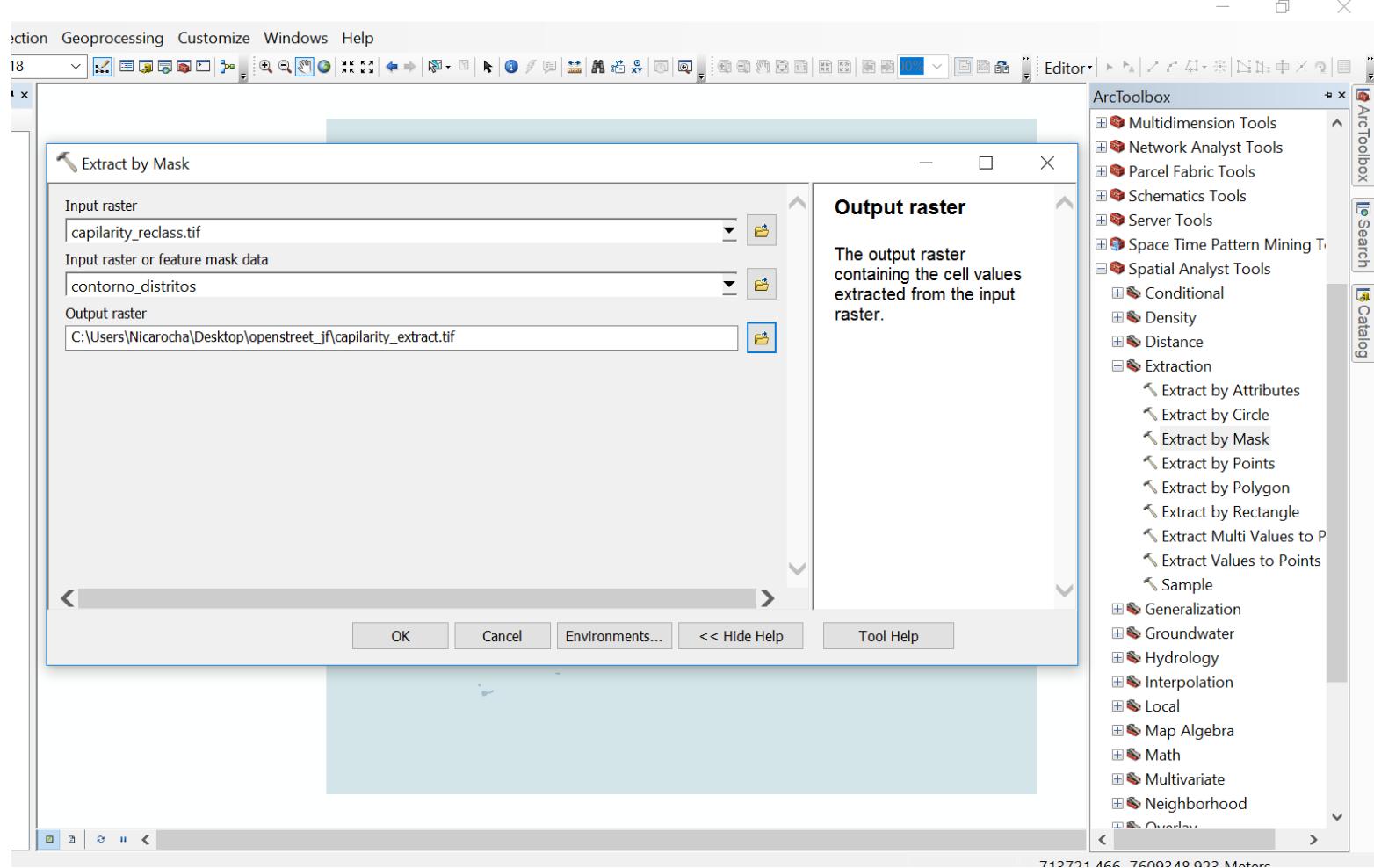
# Result reclassify

- The result reclassify in 5 levels
- Representing the level of capillarity and accessibility.
- It is in raster, but can be converted to vector, and also simplify the resolution.



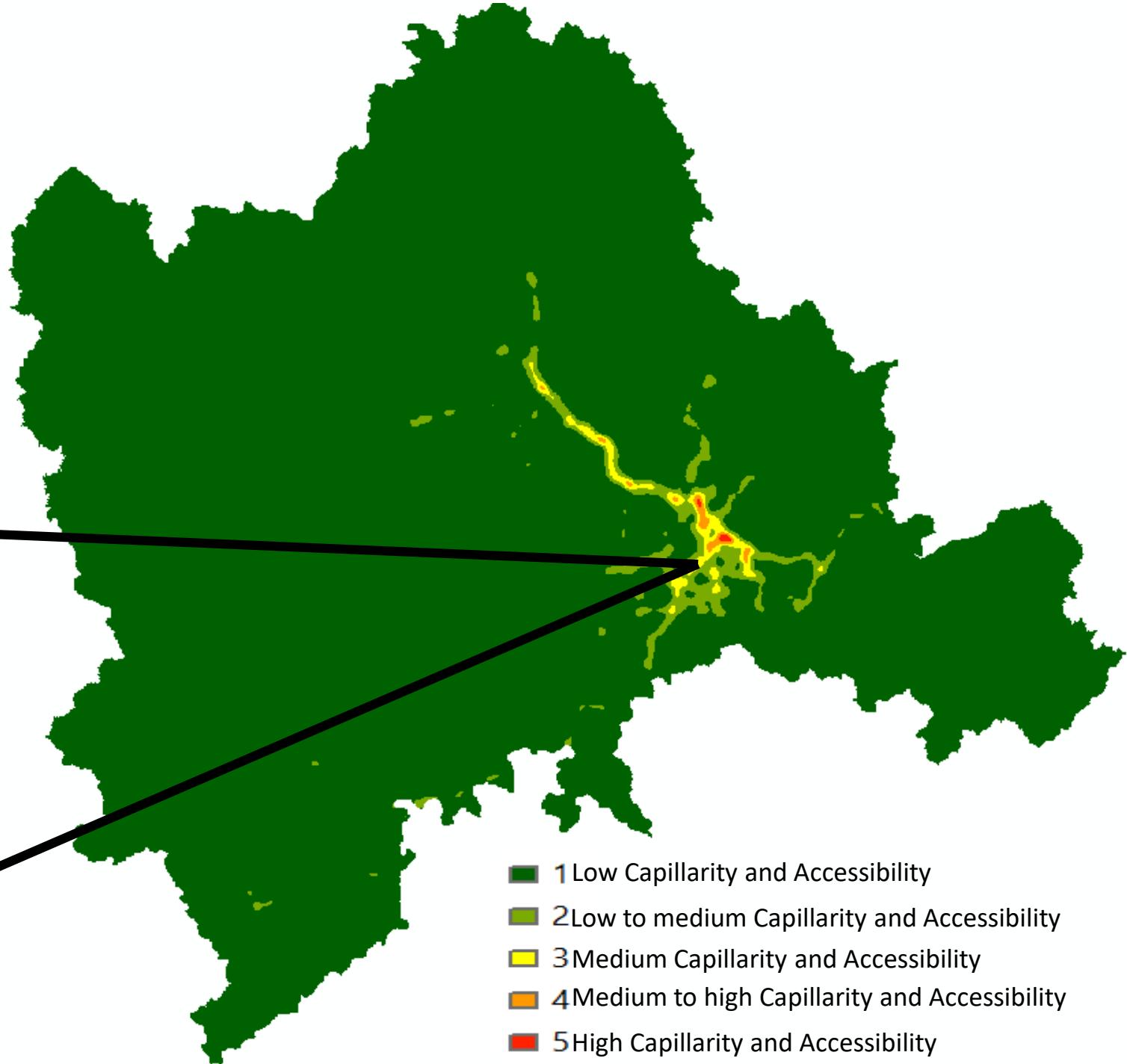
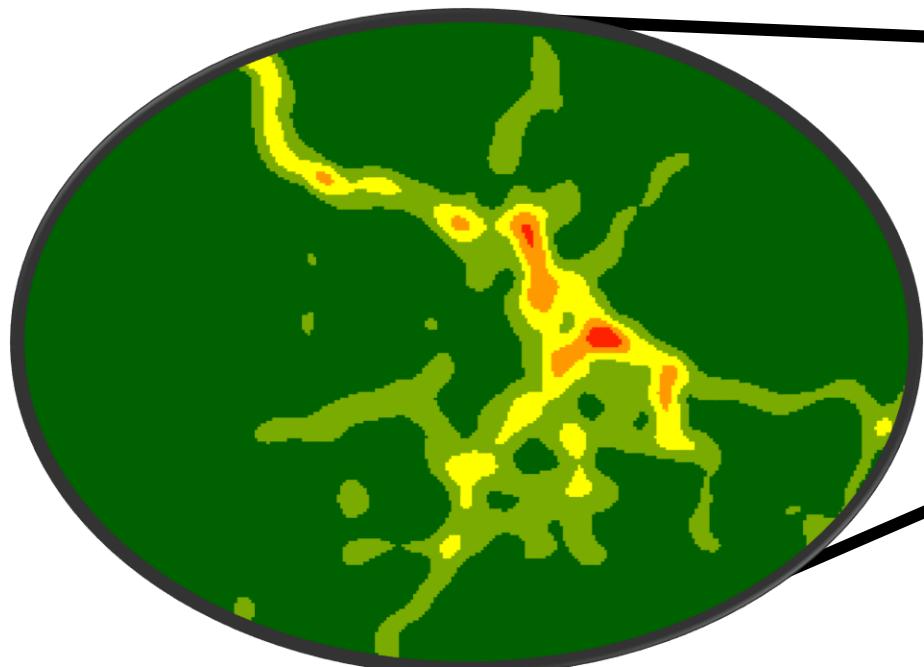
# Cut the Kernel result

- To have the boundaries you need use extract by mask



# Transportation map

- Capillarity and Accessibility map



- 1 Low Capillarity and Accessibility
- 2 Low to medium Capillarity and Accessibility
- 3 Medium Capillarity and Accessibility
- 4 Medium to high Capillarity and Accessibility
- 5 High Capillarity and Accessibility