Brock University Map, Data & GIS Library
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INTRO TO QGIS

MARTIN CHANDLER
GEOSPATIAL/GIS SERVICES LIBRARIAN

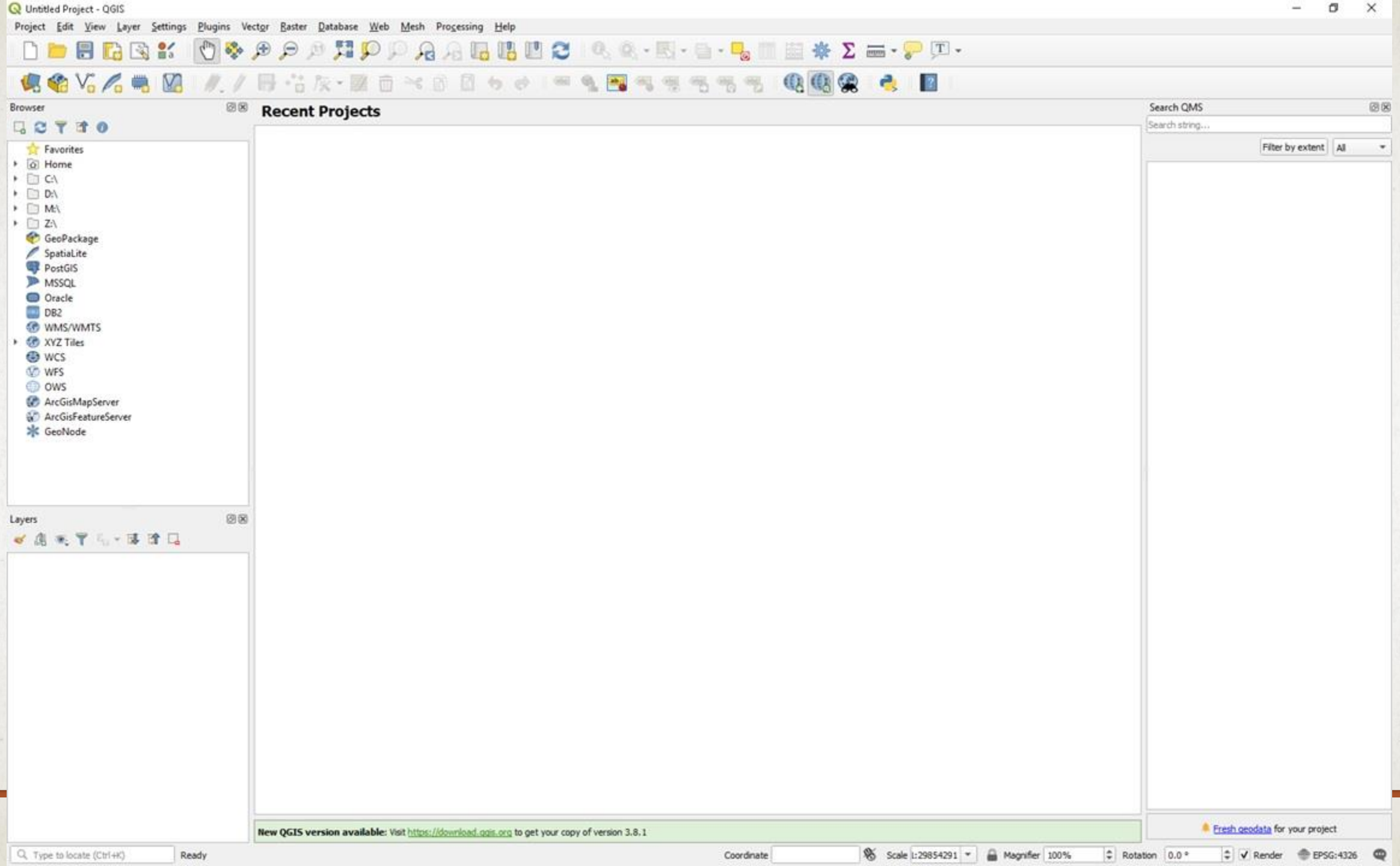
AGENDA

- What is QGIS?
- The interface
- Where to find data for use
- How to add data to QGIS
- How to work with data in QGIS
- How to create and export a map

ABOUT QGIS

- “Quantum Geographic Information System”
- Free and open source software
- Runs on Linux, Apple, Windows, and Android (currently in beta)
- Has both community and commercial support
- Has nifty logo -----> 

THE INTERFACE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New QGIS version available: Visit https://download.qgis.org to get your copy of version 3.8.1
Fresh geodata for your project
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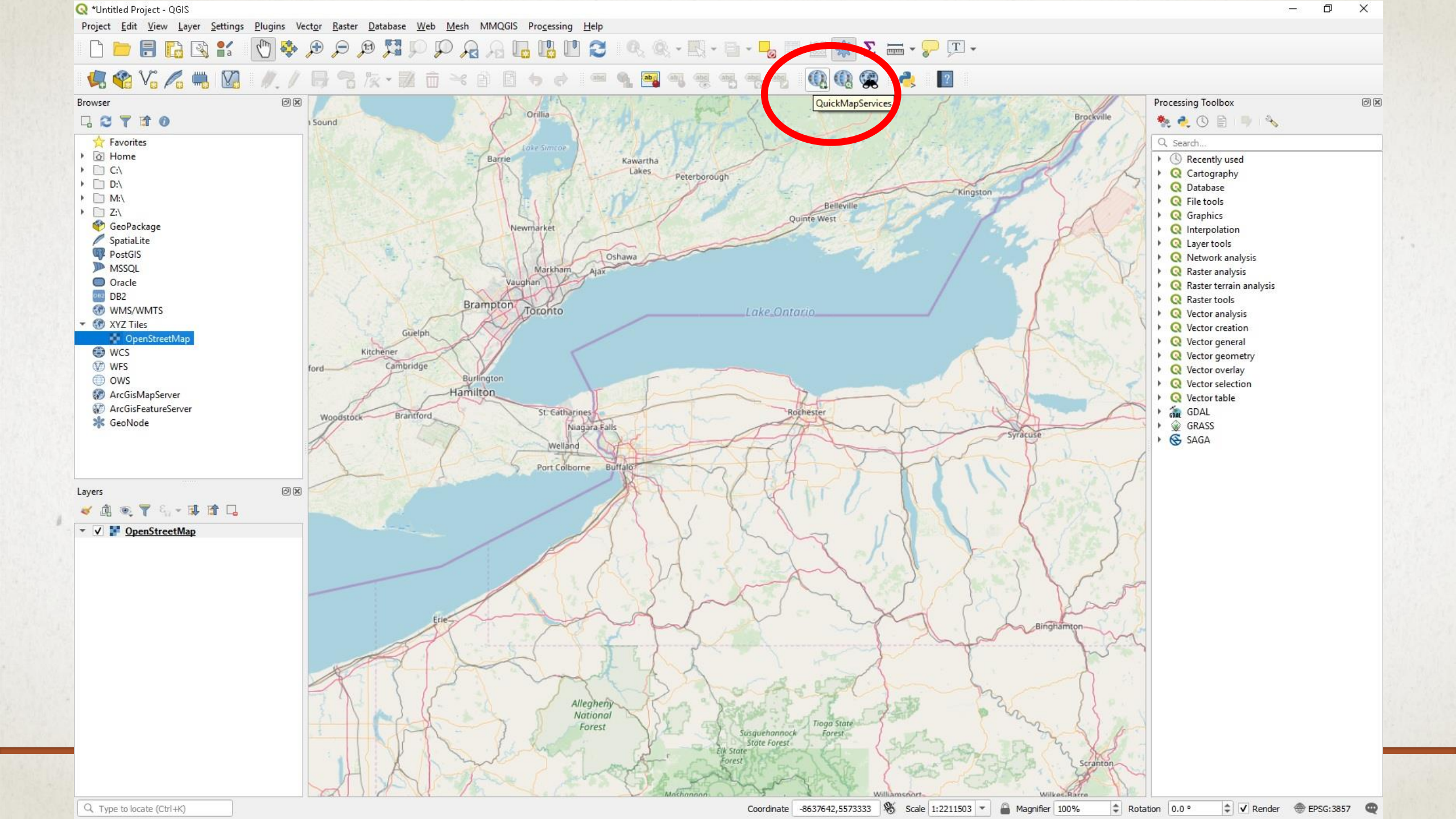
BASEMAP

- Right now, we just have a blank canvas
- Let's get started by adding a basemap!
- The easy way: on the left "Browser" bar, click "XYZ Tiles", then double click (or click and drag) "OpenStreetMap".

PLUGINS FOR QGIS

- QGIS has an active development community, who have been creating plugins to add functions that weren't previously in the program, or where under-served
- An alternate – and more robust – method for adding a basemap is using a plugin
- Click "Plugins", then "Manage and Install Plugins"
- Choose "QuickMapServices" and click "Install Plugin"
- A new icon will appear in the ribbon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Layer tools
Network analysis
Raster analysis
Raster terrain analysis
Raster tools
Vector analysis
Vector creation
Vector general
Vector geometry
Vector overlay
Vector selection
Vector table
GDAL
GRASS
SAGA
Lake Ontario
Toronto
Brampton
Hamilton
Buffalo
Rochester
Syracuse
Binghamton
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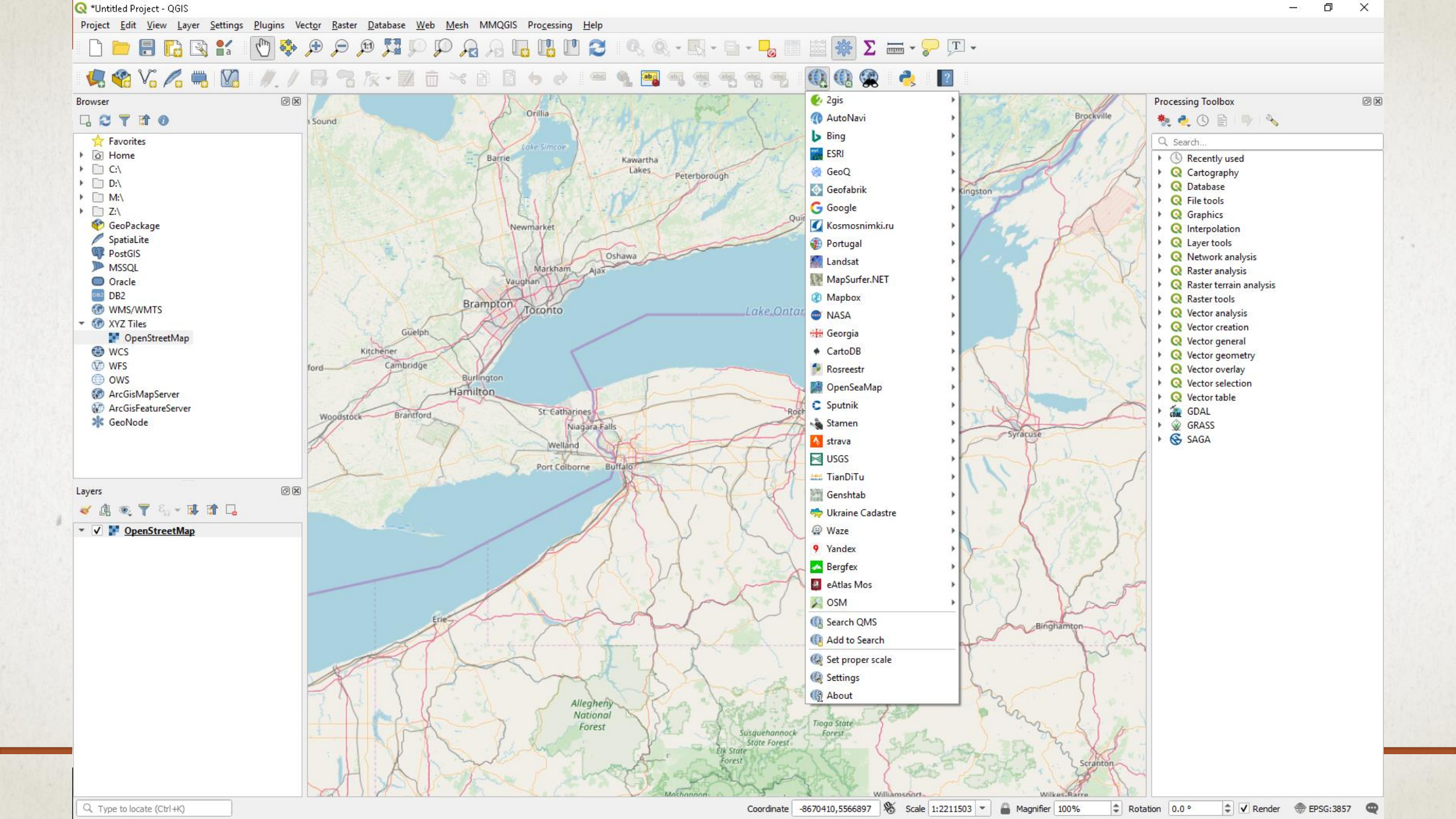
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Landsat
MapSurfer.NET
Mapbox
NASA
Georgia
CartoDB
Rosreestr
OpenSeaMap
Sputnik
Stamen
strava
USGS
TianDiTu
Genshtab
Ukraine Cadastre
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Markham
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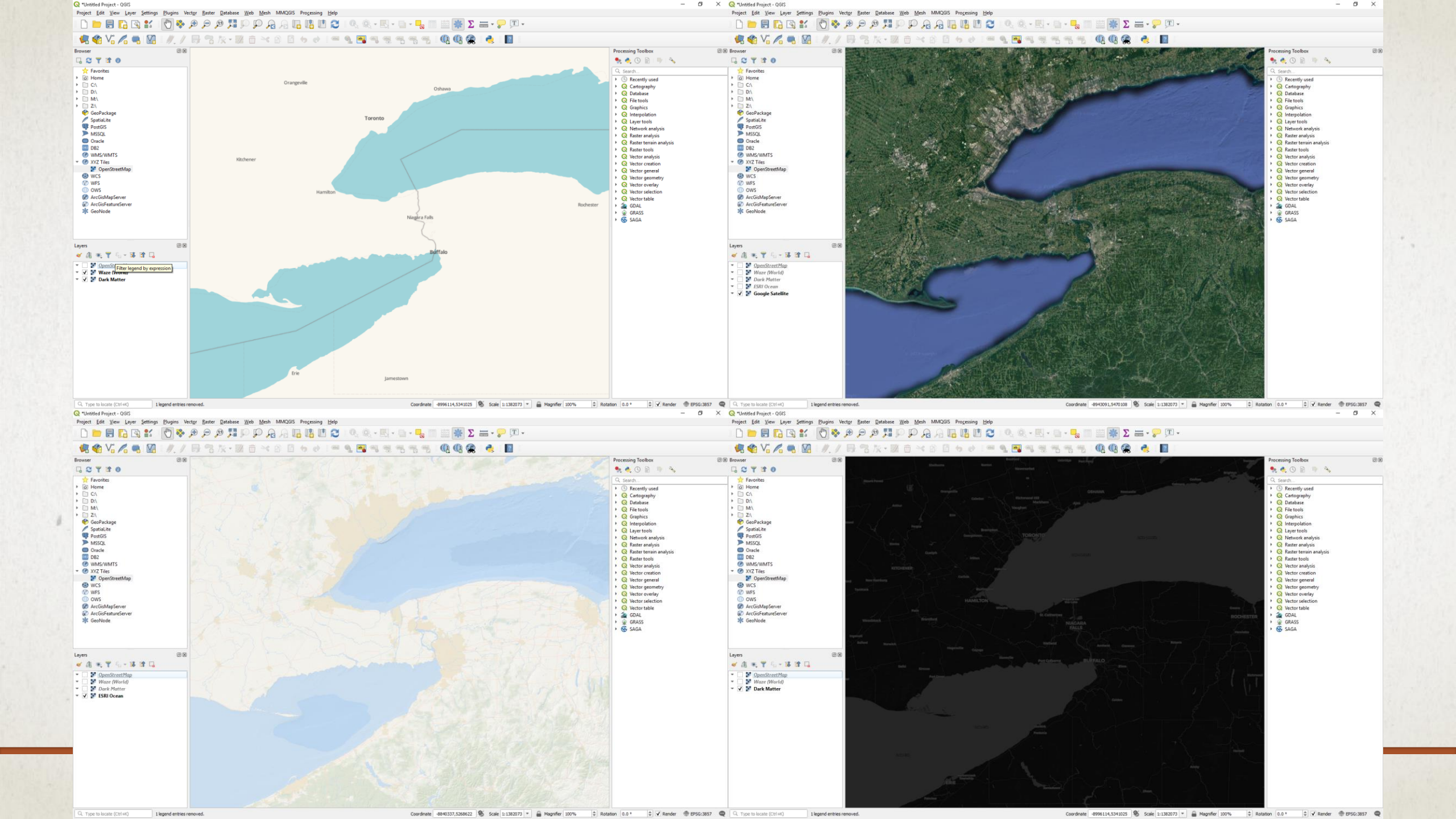
Vaughan
Brampton
Toronto
Guelph
Kitchener
Cambridge
Burlington
Hamilton
Woodstock
Brantford
St. Catharines
Niagara Falls
Welland
Port Colborne
Buffalo
Erie
Brockville
Kingston
Syracuse
Binghamton
Scranton
Allegheny National Forest
Susquehannock State Forest
Tioga State Forest
Elk State Forest
Type to locate (Ctrl+K)
Coordinate -8670410,5566897
Scale 1:2211503
Magnifier 100%
Rotation 0.0 °
Render
EPSG:3857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ArcGisFeatureServer
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1 legend entries removed.
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WHERE TO FIND DATA

- GeoData listing: https://brocku.ca/library/collections/mdg/maps-geodata/
- Data & Statistics LibGuide: https://researchguides.library.brocku.ca/c.php?g=99761&p=646435
- Scholars GeoPortal: http://geo2.scholarsportal.info/

ADDING DATA TO QGIS

LEARNING SCENARIO:

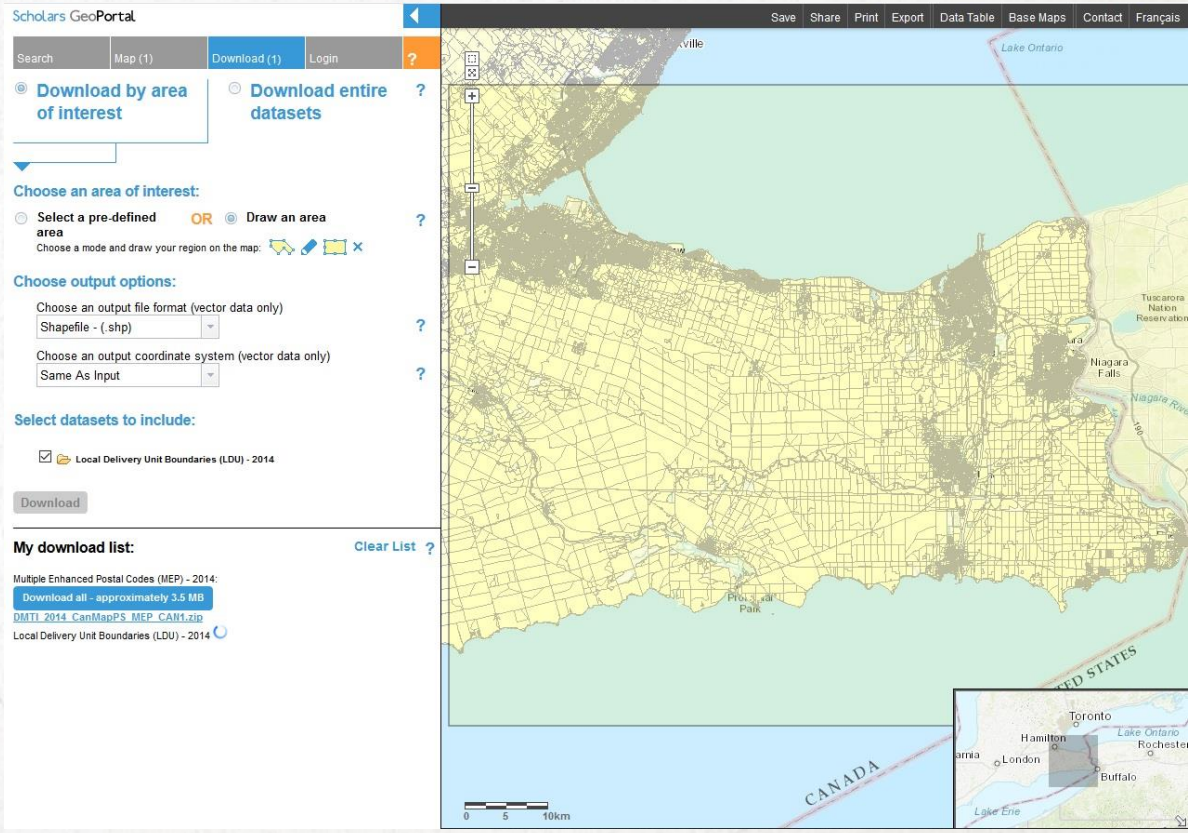
- To demonstrate some of the features of QGIS, and how to use it generally, we're going to use a fictional scenario:
- A research has collected data on the Niagara region displaying the number of dogs, and the relative derpiness of those dogs.
- We're going to map that data to see which areas are more or less derpy.

DATA

- We currently have a dataset, as a .csv, that shows the number of dogs by postal code, and the “average derp factor” of the dogs in that area. (see:)
- We need: data that shows postal codes on a map
- We’re only looking at Niagara, so we’ll want to cut away the excess stuff (GIS lets you do that!)

DATA (CONTINUED)

- First, go to Scholars GeoPortal: http://geo2.scholarsportal.info
- Search “Postal Codes”, and choose “Local Delivery Unit Boundaries” and add it (the most recent).
- Zoom in to the Niagara region, then click the “Download” tab, then “Download by area of interest”, and we’ll draw an area.
- Draw a box that encompasses a little more than the Niagara region. For output file, choose “Shapefile”.
- Click the link to download (not “Download all”), and extract the files.

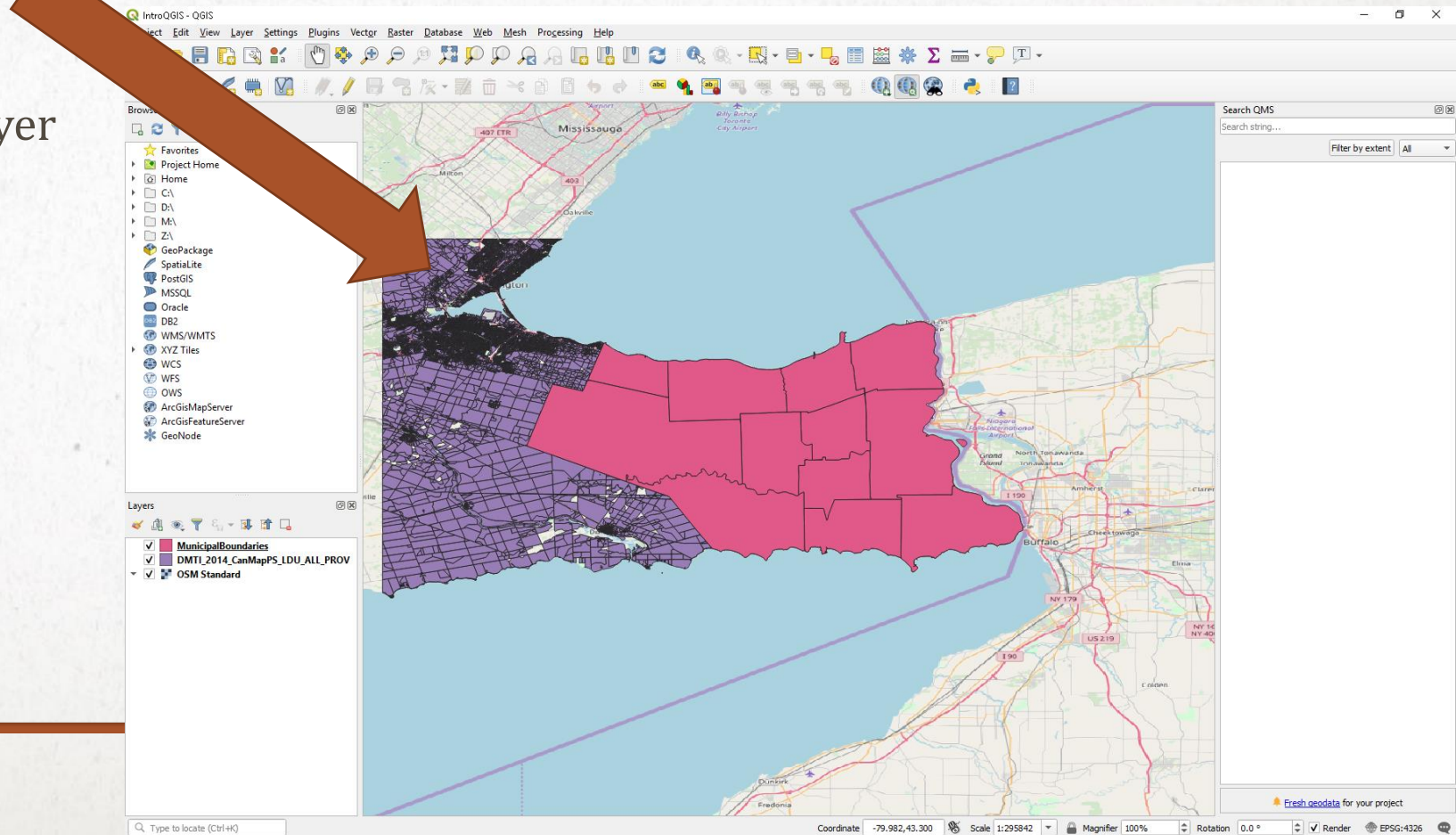


DATA (CONTINUED AGAIN)

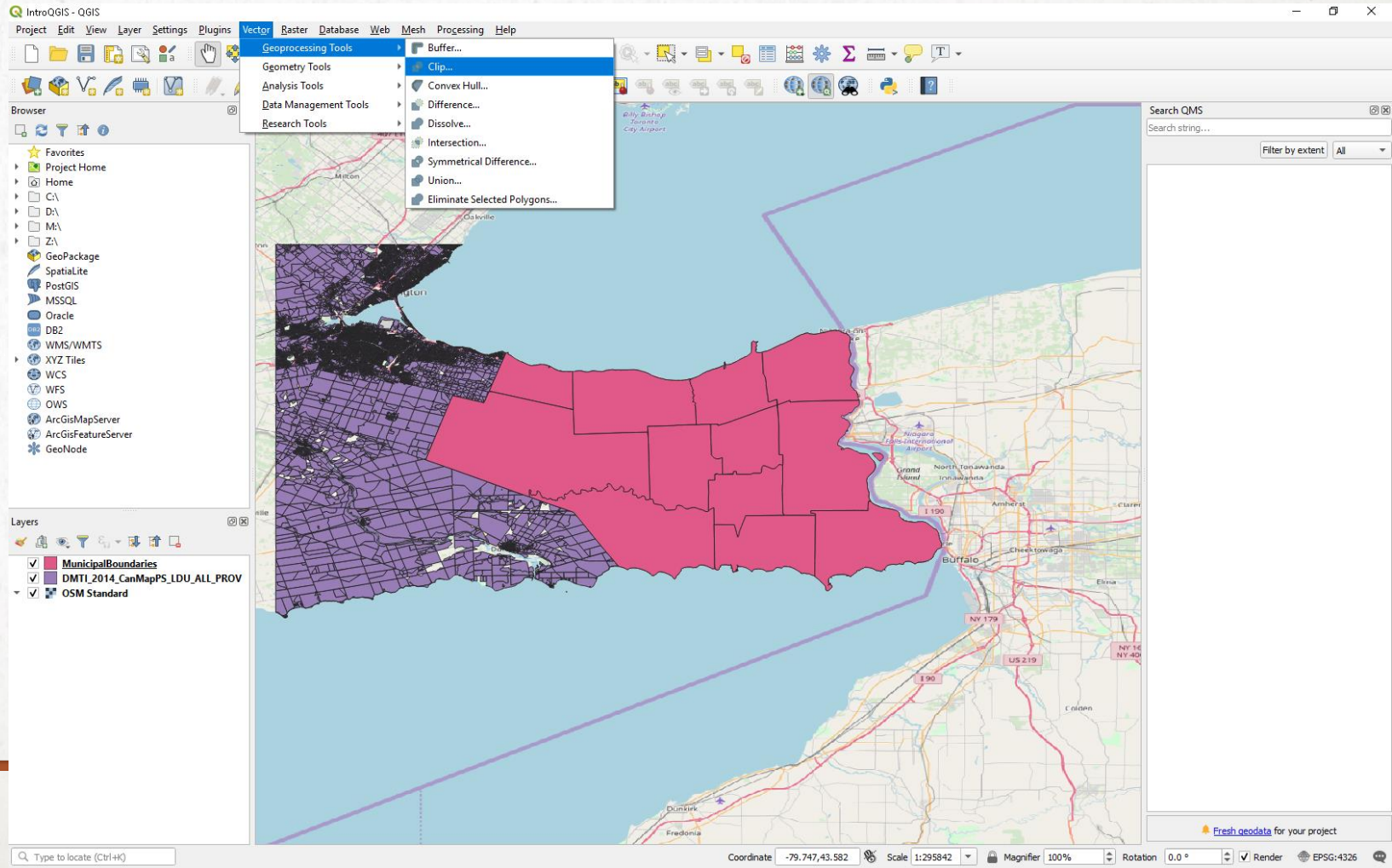
- Go to https://niagaraopendata.ca/
- Search “municipal boundaries”
- Choose the option for the whole Niagara region
- Select the shp file, click “Explore”, and choose “Go to resource”
- Download and extract the file, then add it to your map

DATA (CONTINUED, AGAIN, AGAIN)

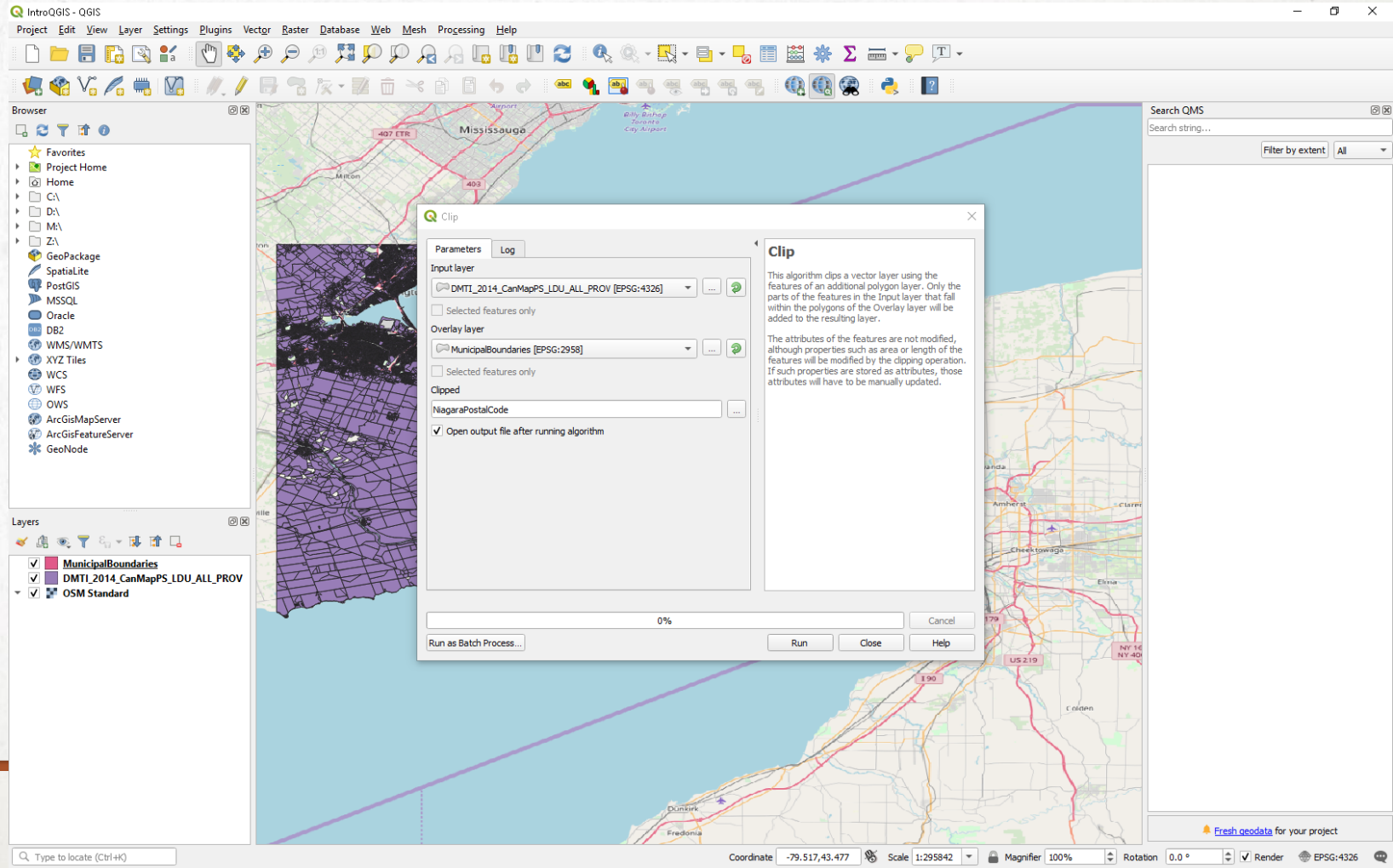
- We still have more data than we need – we're only looking at the Niagara region, but we have all of this stuff
- We're going to clip one layer to the other



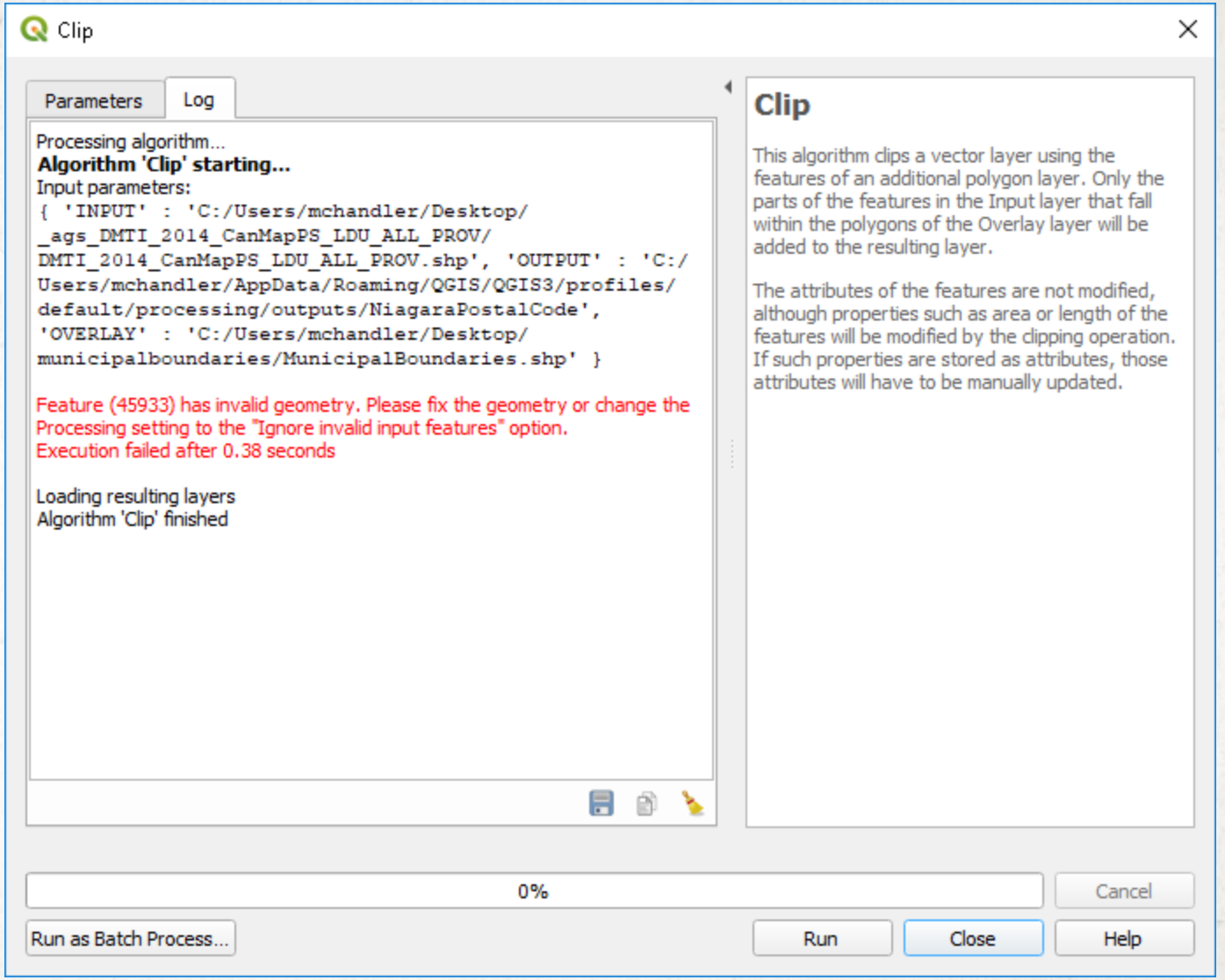
- Under “Vector”, select “Geoprocessing Tools”, then select “Clip”.



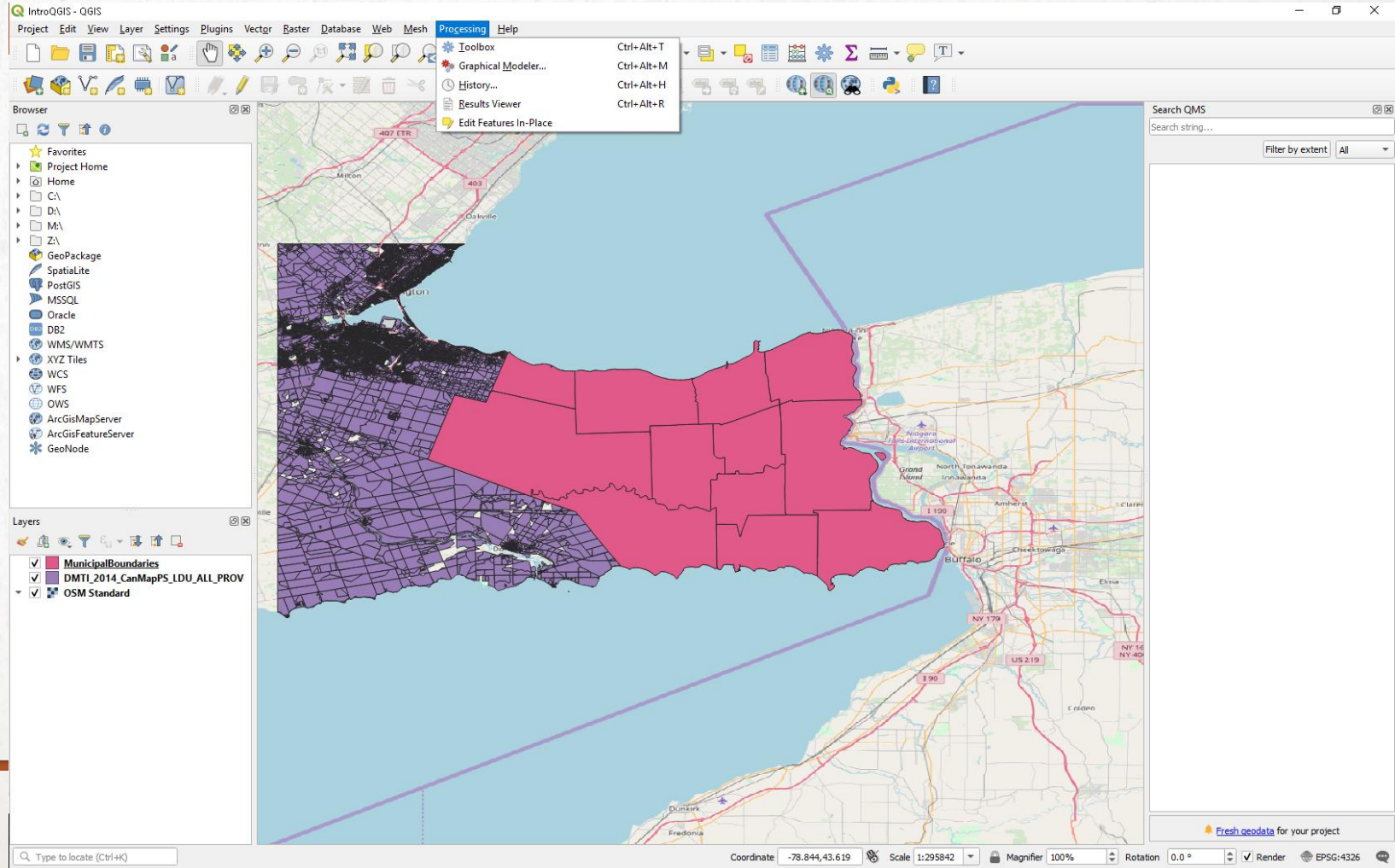
- For “Input layer”, choose DMTI_2014_CanMapPS_LDU_ALL_PROV
- For “Overlay layer”, choose MunicipalBoundaries
- Name the new layer (eg “NiagaraPostalCode”)



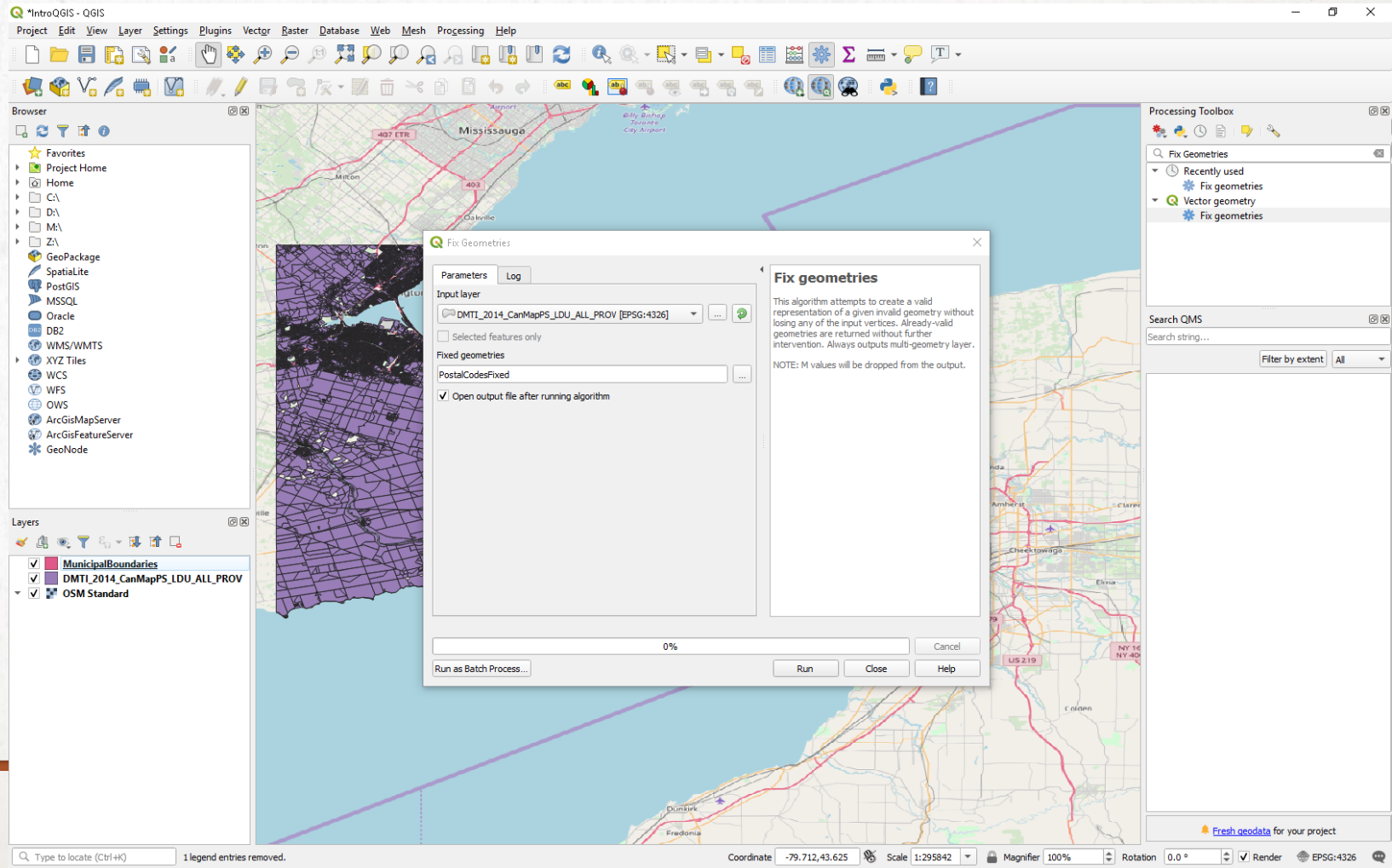
- You'll likely get this error:



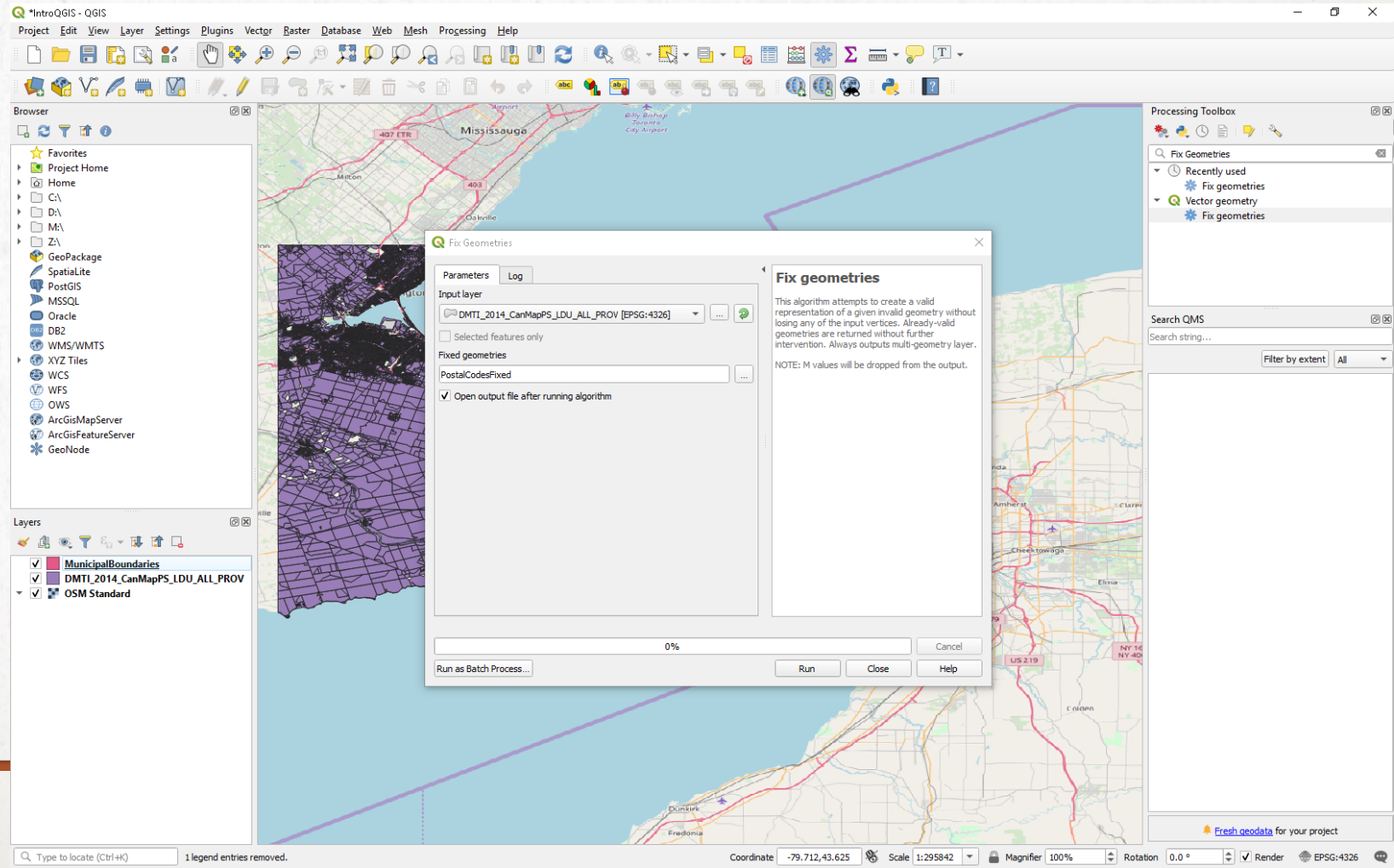
- Go to “Processing”, then “Toolbox”



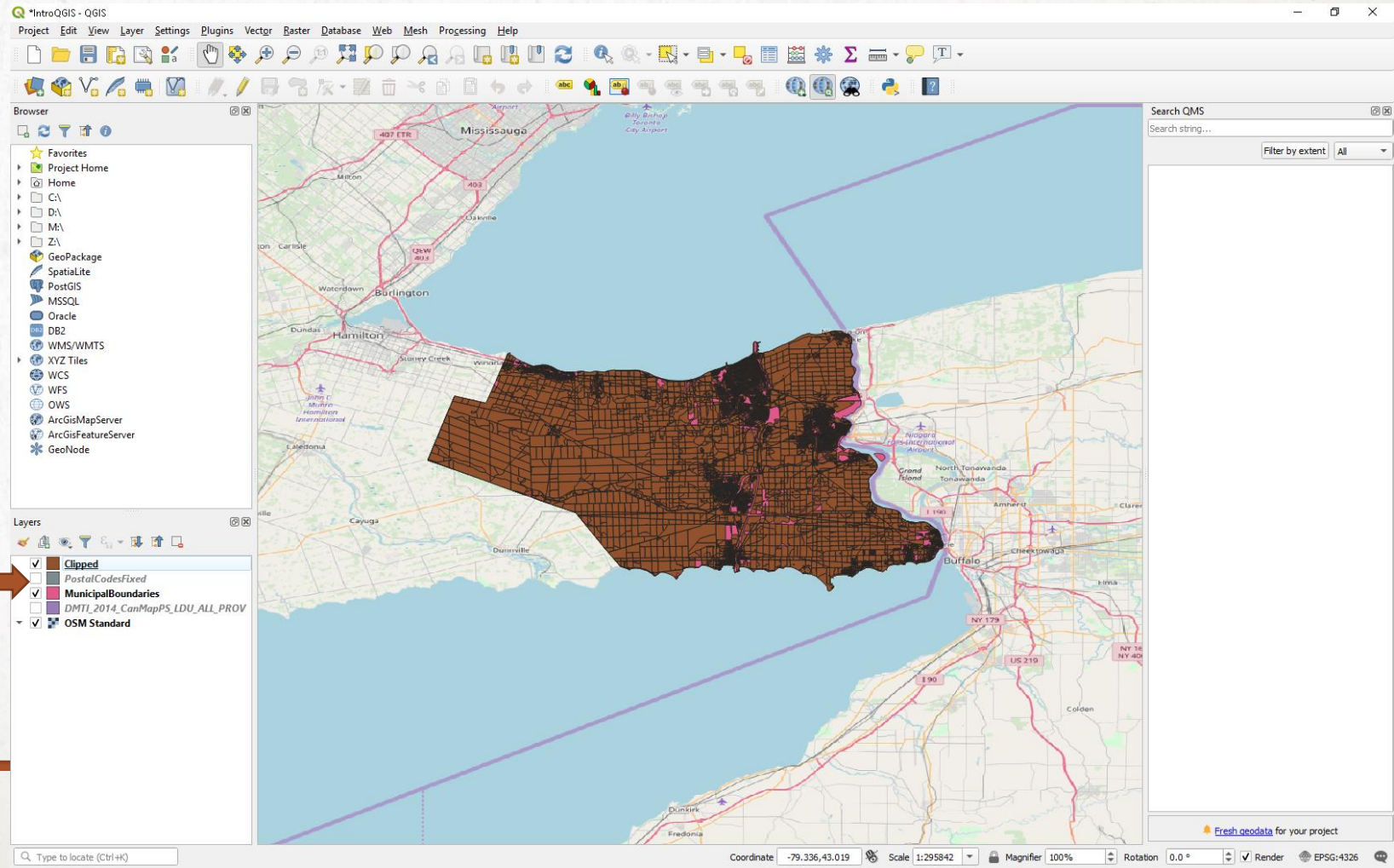
- In the Processing Toolbox search, type “Fix Geometries” or “Valid”, and under “Vector Geometry”, choose “Fix Geometries”
- For Input layer, select DMTI_2014_CanMapPS_LDU_ALL_PROV [EPSG:4326]
- Name the new layer
- Click “Run”



- Now run the Clip tool again, this time using your fixed layer as the Input layer, and MunicipalBoundaries as the Overlay layer. Remember to name the new layer you're creating.

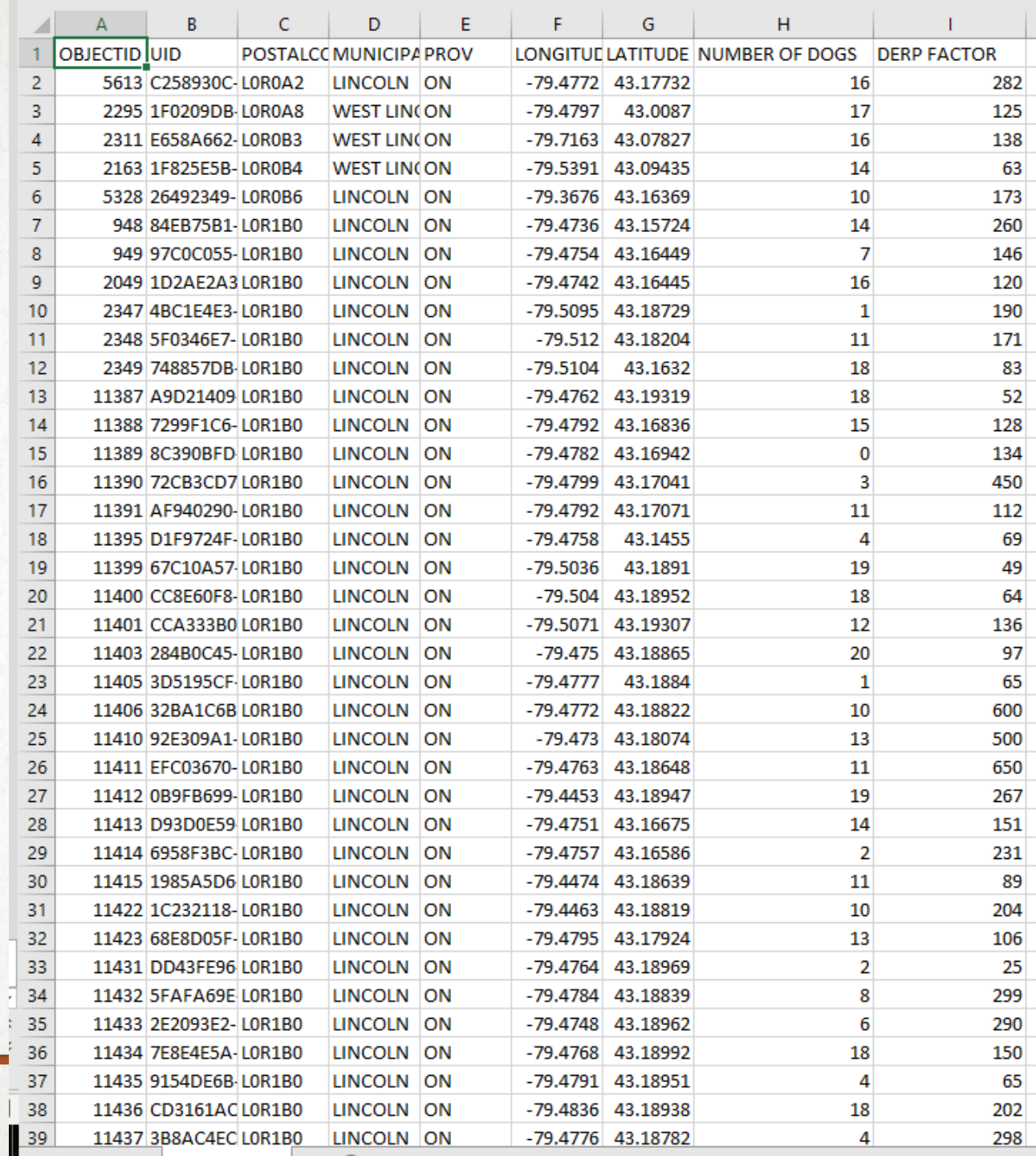


- As you can see, we have cut it down to what the boundaries of the Niagara region.
- Turn off the other layers by clicking the check boxes.



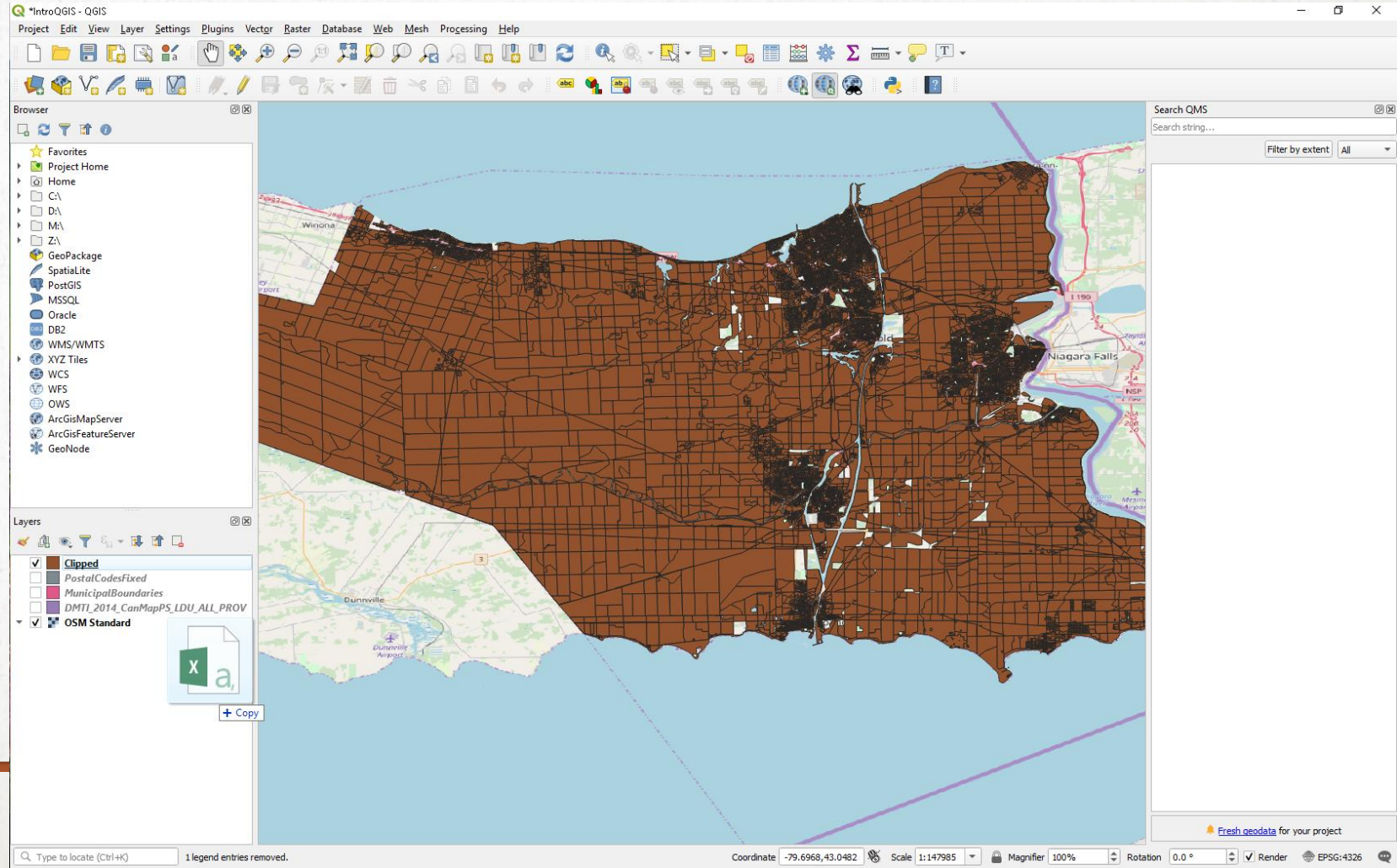
LAST PIECE OF DATA

- Open the “DerpFactor” csv.
- It has numerous pieces of data, including postal code, the number of dogs, and the “derp factor” of each dog.
- We’re going to join this to the clipped data we just created, and map the derp factor of each postal code.



	A	B	C	D	E	F	G	H	I
1	OBJECTID	UID	POSTALCC	MUNICIPA	PROV	LONGITUI	LATITUDE	NUMBER OF DOGS	DERP FACTOR
2	5613	C258930C-	L0R0A2	LINCOLN	ON	-79.4772	43.17732	16	282
3	2295	1F0209DB-	L0R0A8	WEST LIN(	ON	-79.4797	43.0087	17	125
4	2311	E658A662-	L0R0B3	WEST LIN(	ON	-79.7163	43.07827	16	138
5	2163	1F825E5B-	L0R0B4	WEST LIN(	ON	-79.5391	43.09435	14	63
6	5328	26492349-	L0R0B6	LINCOLN	ON	-79.3676	43.16369	10	173
7	948	84EB75B1-	L0R1B0	LINCOLN	ON	-79.4736	43.15724	14	260
8	949	97C0C055-	L0R1B0	LINCOLN	ON	-79.4754	43.16449	7	146
9	2049	1D2AE2A3	L0R1B0	LINCOLN	ON	-79.4742	43.16445	16	120
10	2347	4BC1E4E3-	L0R1B0	LINCOLN	ON	-79.5095	43.18729	1	190
11	2348	5F0346E7-	L0R1B0	LINCOLN	ON	-79.512	43.18204	11	171
12	2349	748857DB-	L0R1B0	LINCOLN	ON	-79.5104	43.1632	18	83
13	11387	A9D21409	L0R1B0	LINCOLN	ON	-79.4762	43.19319	18	52
14	11388	7299F1C6-	L0R1B0	LINCOLN	ON	-79.4792	43.16836	15	128
15	11389	8C390BFD	L0R1B0	LINCOLN	ON	-79.4782	43.16942	0	134
16	11390	72CB3CD7	L0R1B0	LINCOLN	ON	-79.4799	43.17041	3	450
17	11391	AF940290-	L0R1B0	LINCOLN	ON	-79.4792	43.17071	11	112
18	11395	D1F9724F-	L0R1B0	LINCOLN	ON	-79.4758	43.1455	4	69
19	11399	67C10A57	L0R1B0	LINCOLN	ON	-79.5036	43.1891	19	49
20	11400	CC8E60F8-	L0R1B0	LINCOLN	ON	-79.504	43.18952	18	64
21	11401	CCA333B0	L0R1B0	LINCOLN	ON	-79.5071	43.19307	12	136
22	11403	284B0C45-	L0R1B0	LINCOLN	ON	-79.475	43.18865	20	97
23	11405	3D5195CF-	L0R1B0	LINCOLN	ON	-79.4777	43.1884	1	65
24	11406	32BA1C6B	L0R1B0	LINCOLN	ON	-79.4772	43.18822	10	600
25	11410	92E309A1-	L0R1B0	LINCOLN	ON	-79.473	43.18074	13	500
26	11411	EFC03670-	L0R1B0	LINCOLN	ON	-79.4763	43.18648	11	650
27	11412	0B9FB699-	L0R1B0	LINCOLN	ON	-79.4453	43.18947	19	267
28	11413	D93D0E59	L0R1B0	LINCOLN	ON	-79.4751	43.16675	14	151
29	11414	6958F3BC-	L0R1B0	LINCOLN	ON	-79.4757	43.16586	2	231
30	11415	1985A5D6	L0R1B0	LINCOLN	ON	-79.4474	43.18639	11	89
31	11422	1C232118-	L0R1B0	LINCOLN	ON	-79.4463	43.18819	10	204
32	11423	68E8D05F-	L0R1B0	LINCOLN	ON	-79.4795	43.17924	13	106
33	11431	DD43FE96	L0R1B0	LINCOLN	ON	-79.4764	43.18969	2	25
34	11432	5FAFA69E	L0R1B0	LINCOLN	ON	-79.4784	43.18839	8	299
35	11433	2E2093E2-	L0R1B0	LINCOLN	ON	-79.4748	43.18962	6	290
36	11434	7E8E4E5A-	L0R1B0	LINCOLN	ON	-79.4768	43.18992	18	150
37	11435	9154DE6B-	L0R1B0	LINCOLN	ON	-79.4791	43.18951	4	65
38	11436	CD3161AC	L0R1B0	LINCOLN	ON	-79.4836	43.18938	18	202
39	11437	3B8AC4EC	L0R1B0	LINCOLN	ON	-79.4776	43.18782	4	298

- Drag and drop the csv into the layers box

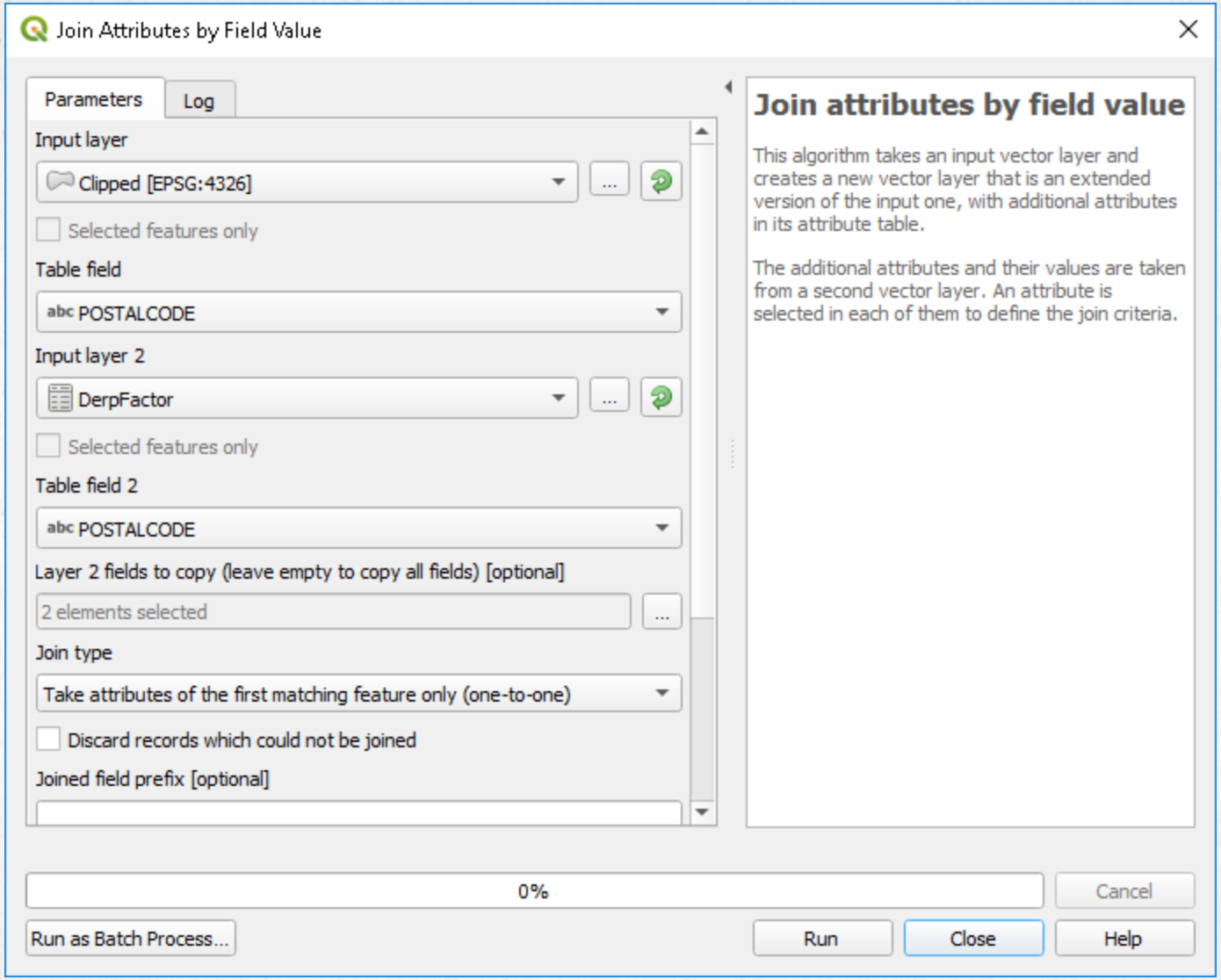


JOINING DATA

- You can do the join with QGIS as is:
  - Double click the “Clipped” layer, then click the “Joins” tab
  - Click the  at the bottom
  - For “Join layer”, choose the “DerpFactor” csv
  - For “Join field” and “Target field” choose “POSTALCODE”
  - Right click the “Clipped” layer, then choose “Open Attribute Table”. If you scroll to the right, you should now see the attributes from the “DerpFactor” csv added to the “Clipped” attribute table.

ALTERNATIVE

- You can access the various tools in the Toolbox
- Click on “Processing”, then choose “Toolbox”
- Search for a tool using the search function – in this case, search “join”, and choose “Join attributes by field value” under “Vector general”
- For “Input layer” choose the clipped layer created
- For “Input layer 2”, select the csv file.
- In both cases, select “POSTALCODE” in the “Table field” drop downs – this will match the information using the postal codes
- “Layer 2 fields to copy” lets you choose the specific fields to copy over and work with – let’s do that. Choose “Number of dogs” and “Derp factor”
- Under “Joined layer” you can give the layer a name.


Join Attributes by Field Value
Parameters
Log
Input layer
Clipped [EPSG:4326]
Selected features only
Table field
POSTALCODE
Input layer 2
DerpFactor
Selected features only
Table field 2
POSTALCODE
Layer 2 fields to copy (leave empty to copy all fields) [optional]
2 elements selected
Join type
Take attributes of the first matching feature only (one-to-one)
Discard records which could not be joined
Joined field prefix [optional]
Join attributes by field value
This algorithm takes an input vector layer and creates a new vector layer that is an extended version of the input one, with additional attributes in its attribute table.
The additional attributes and their values are taken from a second vector layer. An attribute is selected in each of them to define the join criteria.
0%
Cancel
Run as Batch Process...
Run
Close
Help

- Right click on the new layer, and select “Open Attribute Table”
- On the far right, you’ll see the two new fields, of “Number of Dogs” and “Derp Factor”
- Now right click on the layer again, and choose properties
- Click the “Source fields” tab 
- Notice that “Number of Dogs” and “Derp Factor” were created as String types; the software understands them as strings of text, not real numbers. We need to change them to “real”
- Close the Properties box, and go to the Toolbox. Type “Refactor”, and open “Refactor fields”
- Expand the box, and under “Type” for “Number of Dogs”, change “String” to “Double”. Do the same for “Derp Factor”. Click “Run”, and a new layer will be created.

Refactor Fields

Parameters | Log

Input layer

Joined layer [EPSG:4326]

Selected features only

Fields mapping

	Source expression		Field name	Type	Length	Precision
0	123 fid	ε	fid	Integer64	0	0
1	1.2 PCA_ID	ε	PCA_ID	Double	0	0
2	abc POSTALCODE	ε	POSTALCODE	String	6	0
3	abc PROV	ε	PROV	String	2	0
4	1.2 MAF_ID	ε	MAF_ID	Double	0	0
5	1.2 PREC_CODE	ε	PREC_CODE	Double	0	0
6	1.2 PCA_COUNT	ε	PCA_COUNT	Double	0	0
7	1.2 DOM_PCA	ε	DOM_PCA	Double	0	0
8	1.2 MULTI_PC	ε	MULTI_PC	Double	0	0
9	abc DEL_M_ID	ε	DEL_M_ID	String	6	0
10	1.2 LONGITUDE	ε	LONGITUDE	Double	0	0
11	1.2 LATITUDE	ε	LATITUDE	Double	0	0
12	1.2 Shape_Leng	ε	Shape_Leng	Double	0	0
13	1.2 Shape_Area	ε	Shape_Area	Double	0	0
14	abc NUMBER OF DOGS	ε	NUMBER OF DOGS	Double	255	0
15	abc DERP FACTOR	ε	DERP FACTOR	Double	255	0

Load fields from layer: Clipped — Load Fields

Refactored

[Create temporary layer]

Open output file after running algorithm

Refactor fields

This algorithm allows editing the structure of the attributes table of a vector layer. Fields can be modified in their type and name, using a fields mapping.

The original layer is not modified. A new layer is generated, which contains a modified attribute table, according to the provided fields mapping.

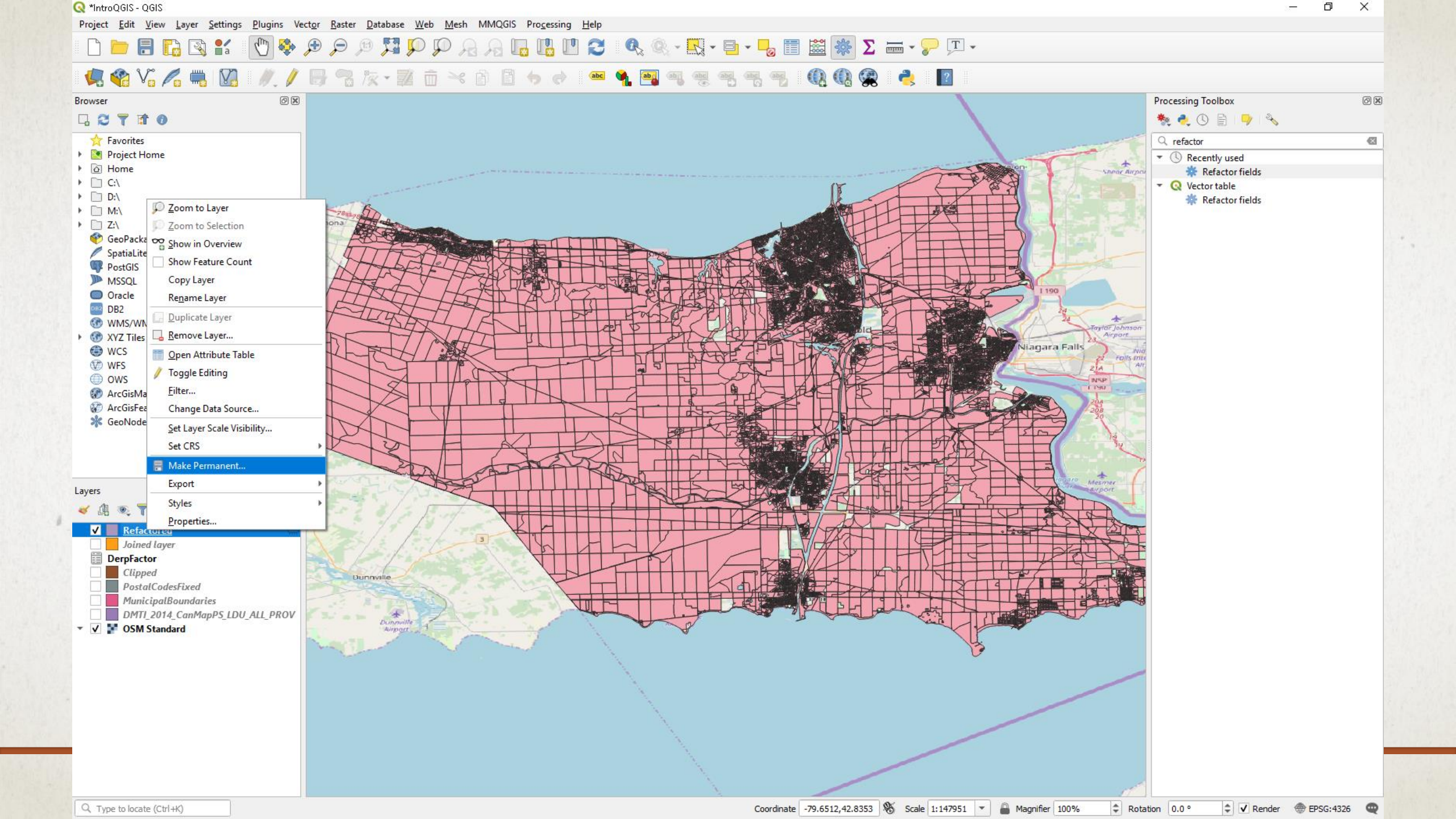
0%

Cancel

Run as Batch Process...

Run | Close | Help

- The “Refactor” function only creates a temporary layer
- Right click the new “Refactored” layer, and choose “Make Permanent”. This will create a new GeoPackage to work with
- (You can also choose “Export” to do effectively the same thing)
- Name the new layer, and click OK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PostGIS
MSSQL
Oracle
DB2
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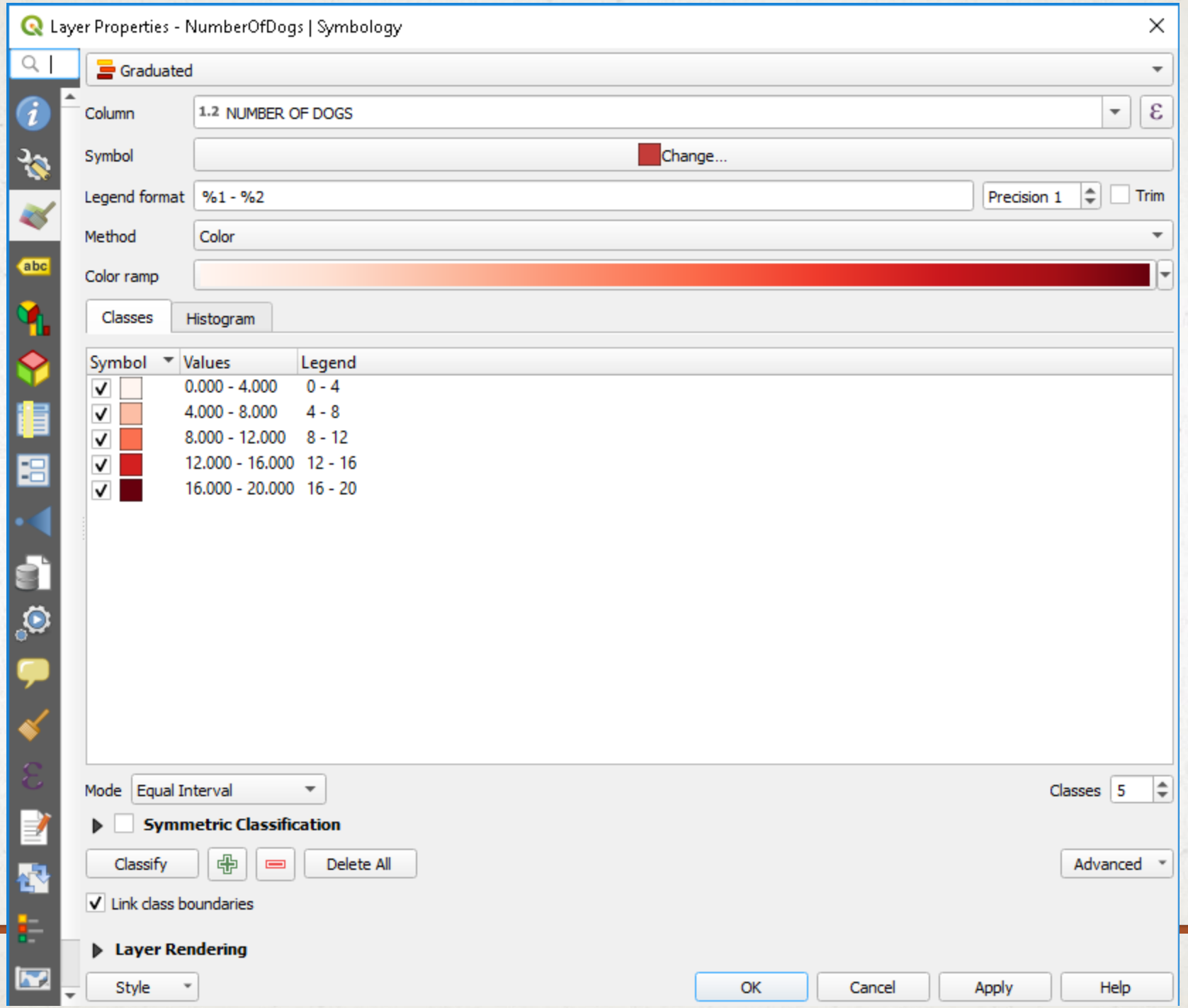
XYZ Tiles
WCS
WFS
OWS
ArcGisMa
ArcGisFea
GeoNode
Zoom to Layer
Zoom to Selection
Show in Overview
Show Feature Count
Copy Layer
Rename Layer
Duplicate Layer
Remove Layer...
Open Attribute Table
Toggle Editing
Filter...
Change Data Source...
Set Layer Scale Visibility...
Set CRS
Make Permanent...
Export
Styles
Properties...
Layers
Refactored
Joined layer
DerpFactor
Clipped
PostalCodesFixed
MunicipalBoundaries
DMTI_2014_CanMapPS_LDU_ALL_PROV
OSM Standard
Processing Toolbox
refactor
Recently used
Refactor fields
Vector table
Refactor fields
Niagara Falls
Dunnville
Type to locate (Ctrl+K)
Coordinate -79.6512,42.8353
Scale 1:147951
Magnifier 100%
Rotation 0.0 °
Render
EPSG:4326

ANALYSIS

- We're now going to display the differences in dog populations of each postal code, as well as the "Derp factor" of each postal code
- Right click on the new layer, and choose "Rename layer" to change the name
- Right click again, and open the Properties. Click the "Symbology" tab 
- Under "Column" choose "Number of Dogs"
- Where it says "Single symbol", click the drop down and change it to "Graduated"
- Choose your preferred Colour ramp. Leave everything else the same for now, and click "Classify", then click "OK".


Layer Properties - NumberOfDogs | Symbology
Graduated
Column
1.2 NUMBER OF DOGS
Symbol
Change...
Legend format
%1 - %2
Precision 1
Trim
Method
Color
Color ramp
Classes
Histogram
Symbol
Values
Legend
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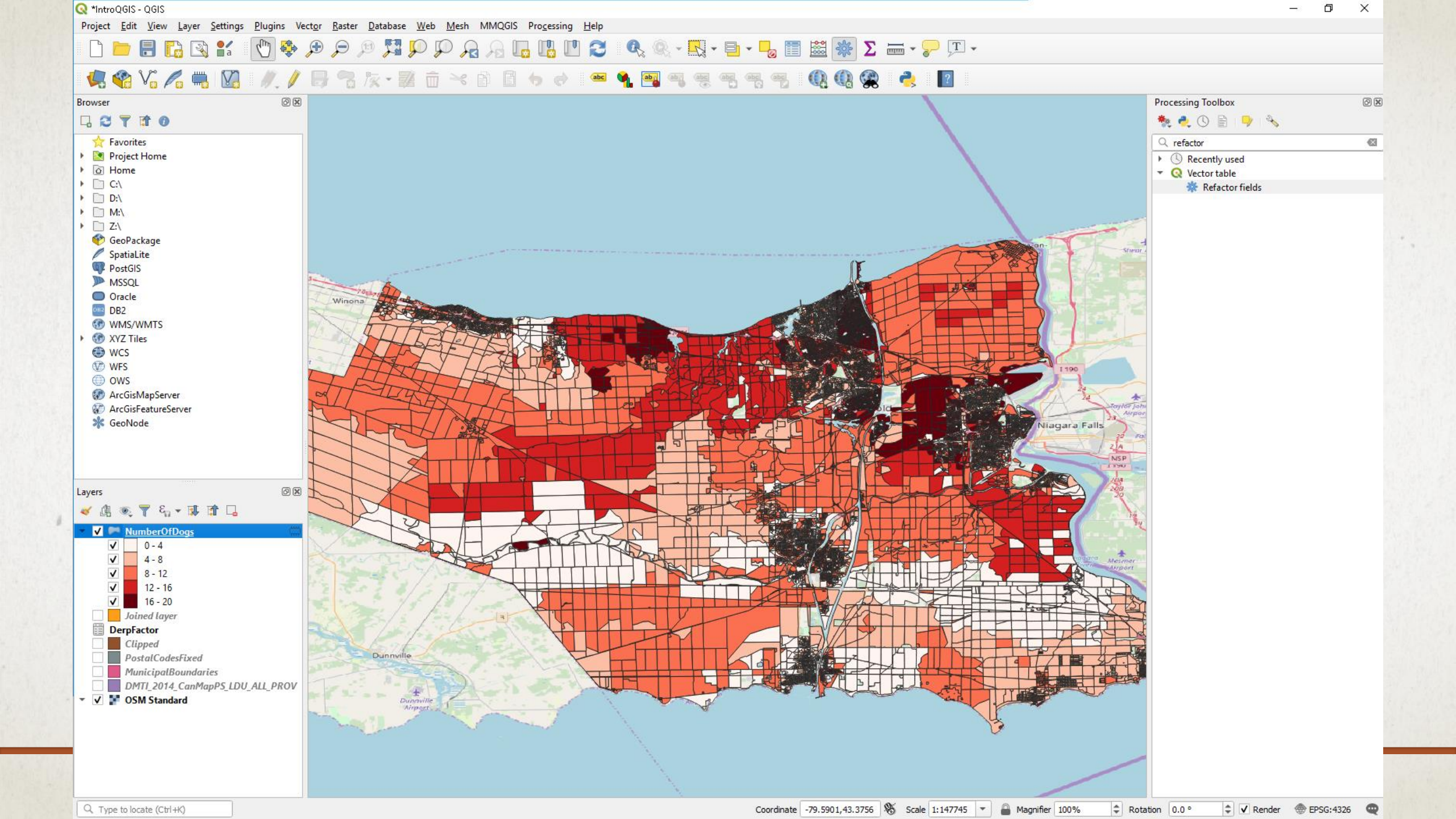
0 - 4
4.000 - 8.000
4 - 8
8.000 - 12.000
8 - 12
12.000 - 16.000
12 - 16
16.000 - 20.000
16 - 20
Mode
Equal Interval
Classes
5
Symmetric Classification
Classify
Delete All
Advanced
Link class boundaries
Layer Rendering
Style
OK
Cancel
Apply
Help


*IntroQGIS - QGIS
Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh MMQGIS Processing Help
Browser
Favorites
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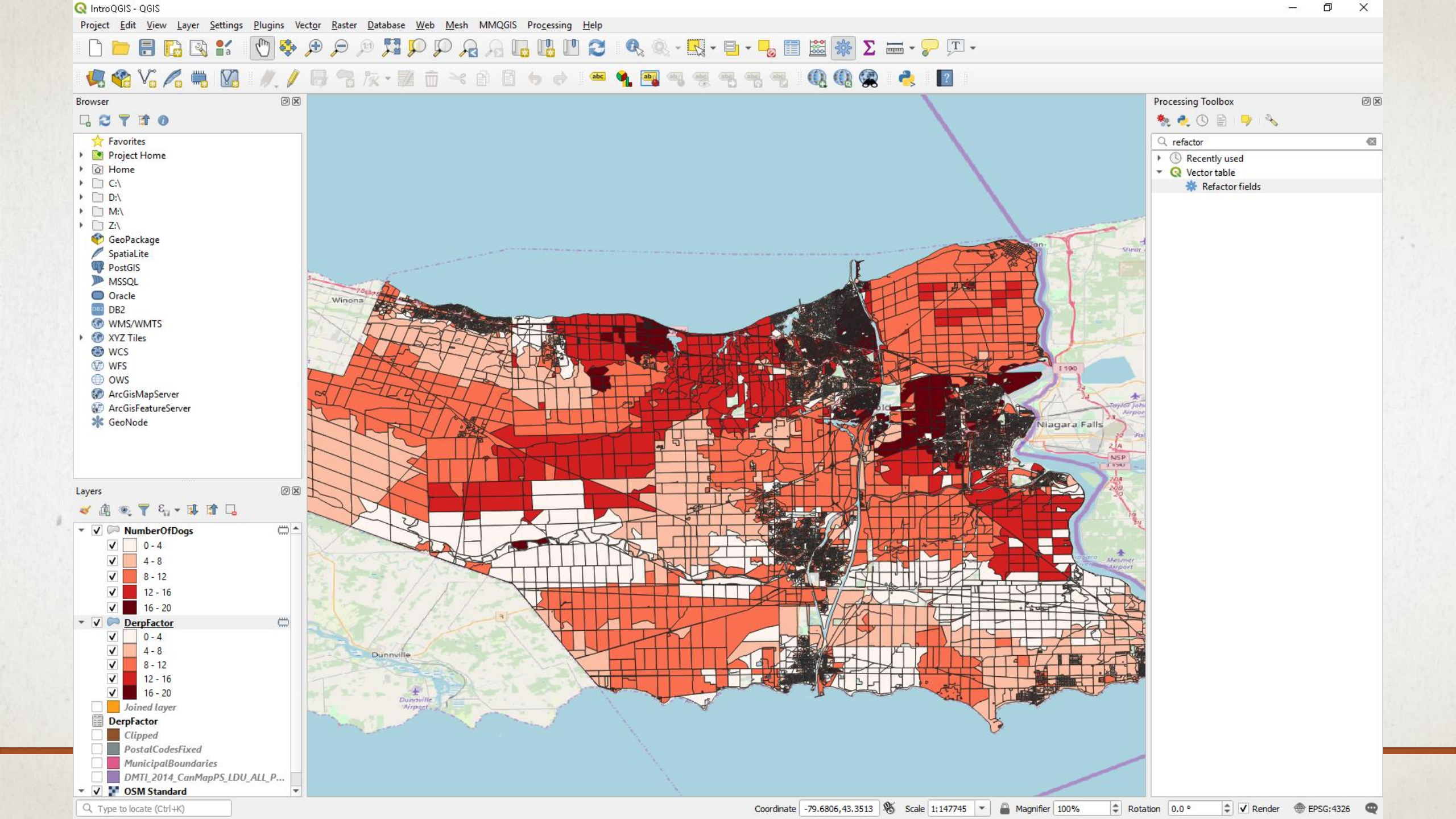
ArcGisMapServer
ArcGisFeatureServer
GeoNode
Layers
NumberOfDogs
0 - 4
4 - 8
8 - 12
12 - 16
16 - 20
Joined layer
DerpFactor
Clipped
PostalCodesFixed
MunicipalBoundaries
DMTI_2014_CanMapPS_LDU_ALL_PROV
OSM Standard
Processing Toolbox
refactor
Recently used
Vector table
Refactor fields
Winona
Niagara Falls
Dunnville
Type to locate (Ctrl+K)
Coordinate -79.5901,43.3756
Scale 1:147745
Magnifier 100%
Rotation 0.0 °
Render
EPSG:4326

ANALYSIS (CONTINUED)

- We have visualized the relative number of dogs in each area – now let's find out which areas are the "Derpiest".
- Right click on the layer you just worked with, and choose "Duplicate Layer"
- Rename the new layer


IntroQGIS - QGIS
Project Edit View Layer Settings Plugins Vector Raster Database Web Mesh MMQGIS Processing Help
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ArcGisFeatureServer
GeoNode
Layers
NumberOfDogs
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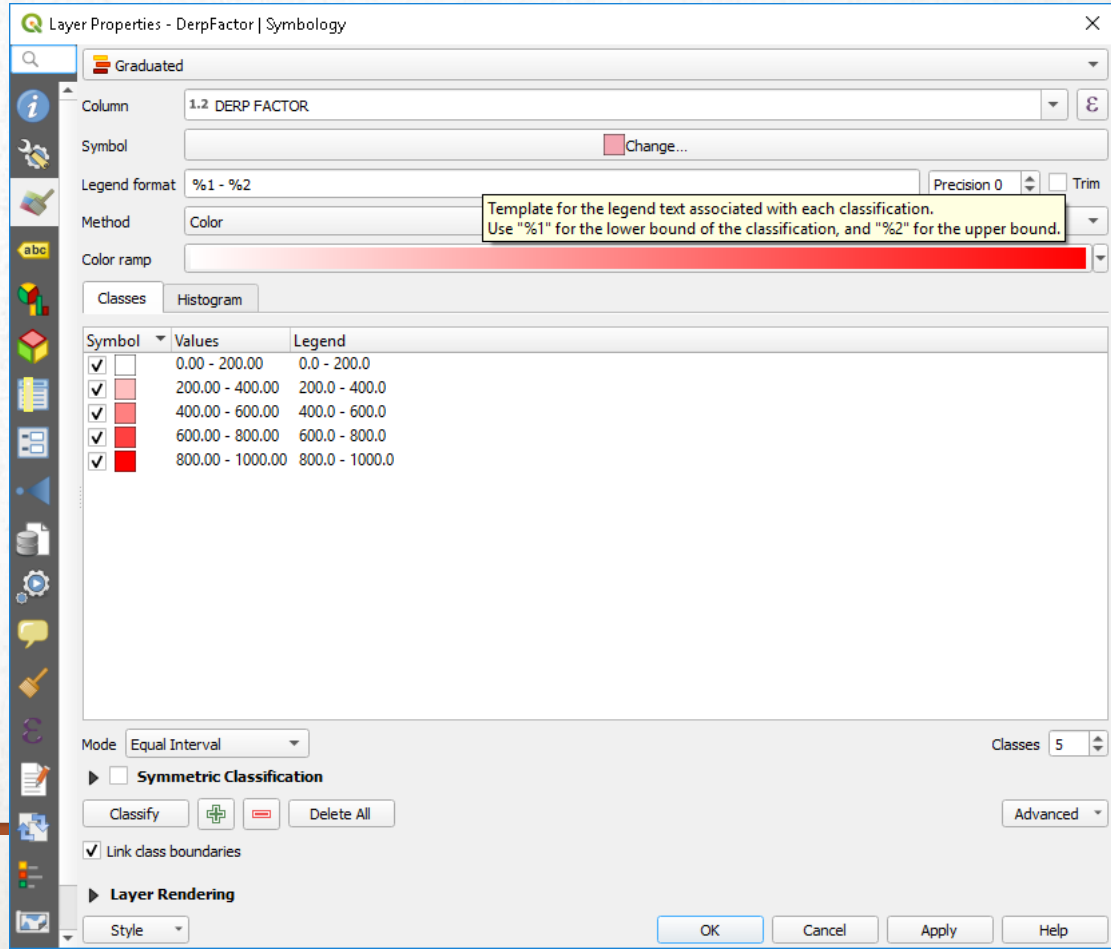
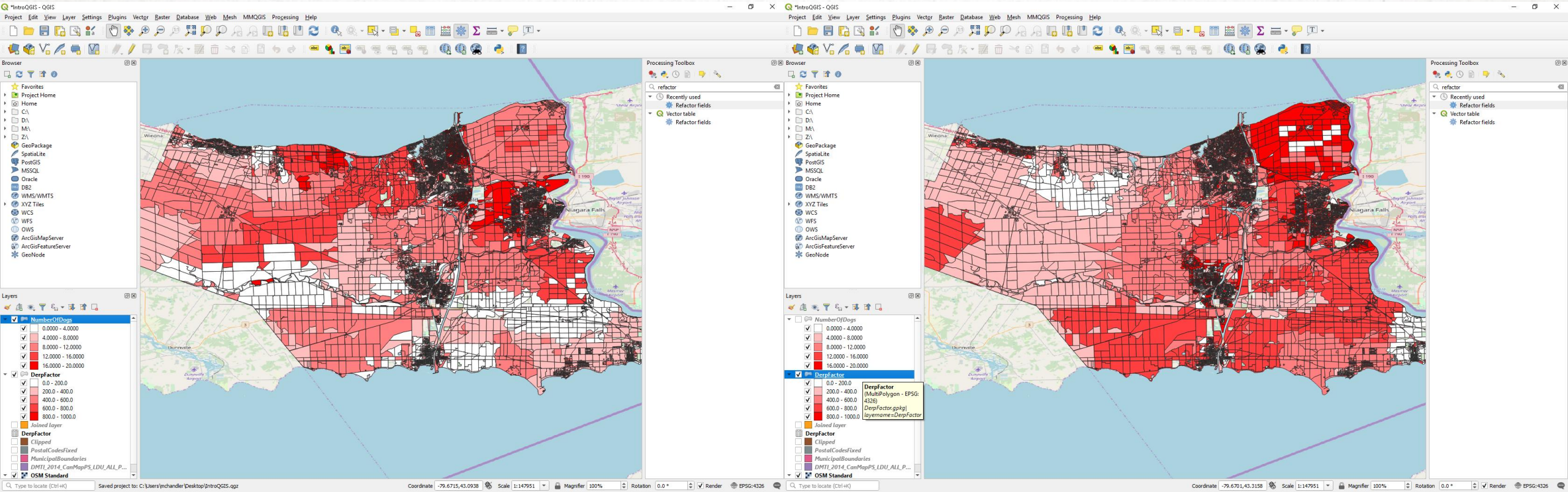
8 - 12
12 - 16
16 - 20
DerpFactor
0 - 4
4 - 8
8 - 12
12 - 16
16 - 20
Joined layer
DerpFactor
Clipped
PostalCodesFixed
MunicipalBoundaries
DMTI_2014_CanMapPS_LDU_ALL_P...
OSM Standard
Winona
Niagara Falls
Dunnville
Processing Toolbox
refactor
Recently used
Vector table
Refactor fields
Type to locate (Ctrl+K)
Coordinate -79.6806,43.3513
Scale 1:147745
Magnifier 100%
Rotation 0.0 °
Render
EPSG:4326

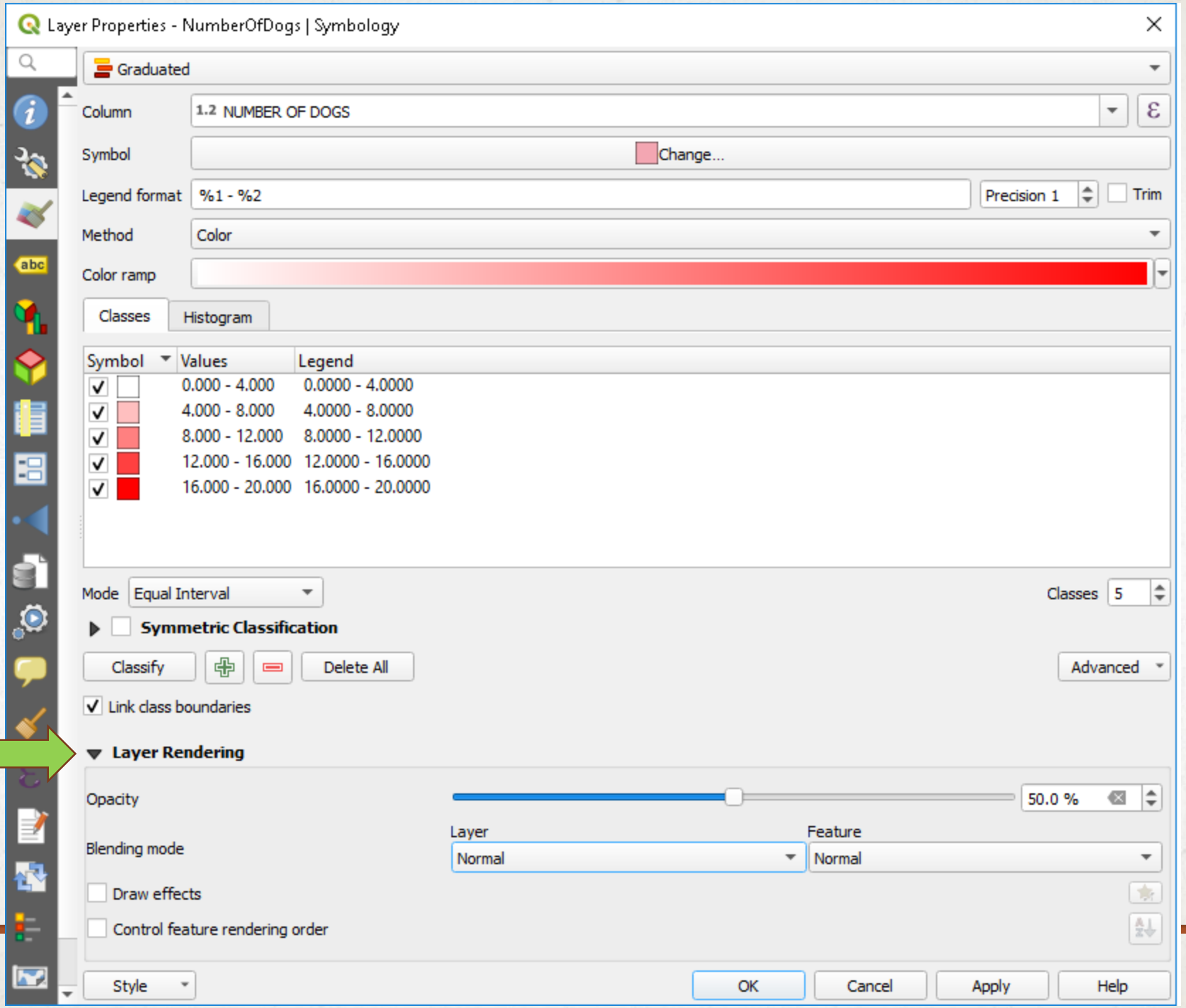
- Now, do the same graduated symbology that we did with the Number of Dogs, but this time use the “Derp Factor” column



- You can visually compare the number of dogs and their relative derpiness by clicking the checkmark beside the layer



- You can also change the colour ramp of one of the layers (eg DerpFactor), then make the layer on top partially transparent
- To make the layer partially transparent, in the Properties box, under the Symbology tab, click the arrow next to “Layer Rendering”, then change the Opacity


Layer Properties - NumberOfDogs | Symbology
Graduated
Column
1.2 NUMBER OF DOGS
Symbol
Change...
Legend format
%1 - %2
Precision 1
Trim
Method
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Color ramp
Classes
Histogram
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Mode
Equal Interval
Classes
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Symmetric Classification
Classify
Delete All
Advanced
Link class boundaries
Layer Rendering
Opacity
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Blending mode
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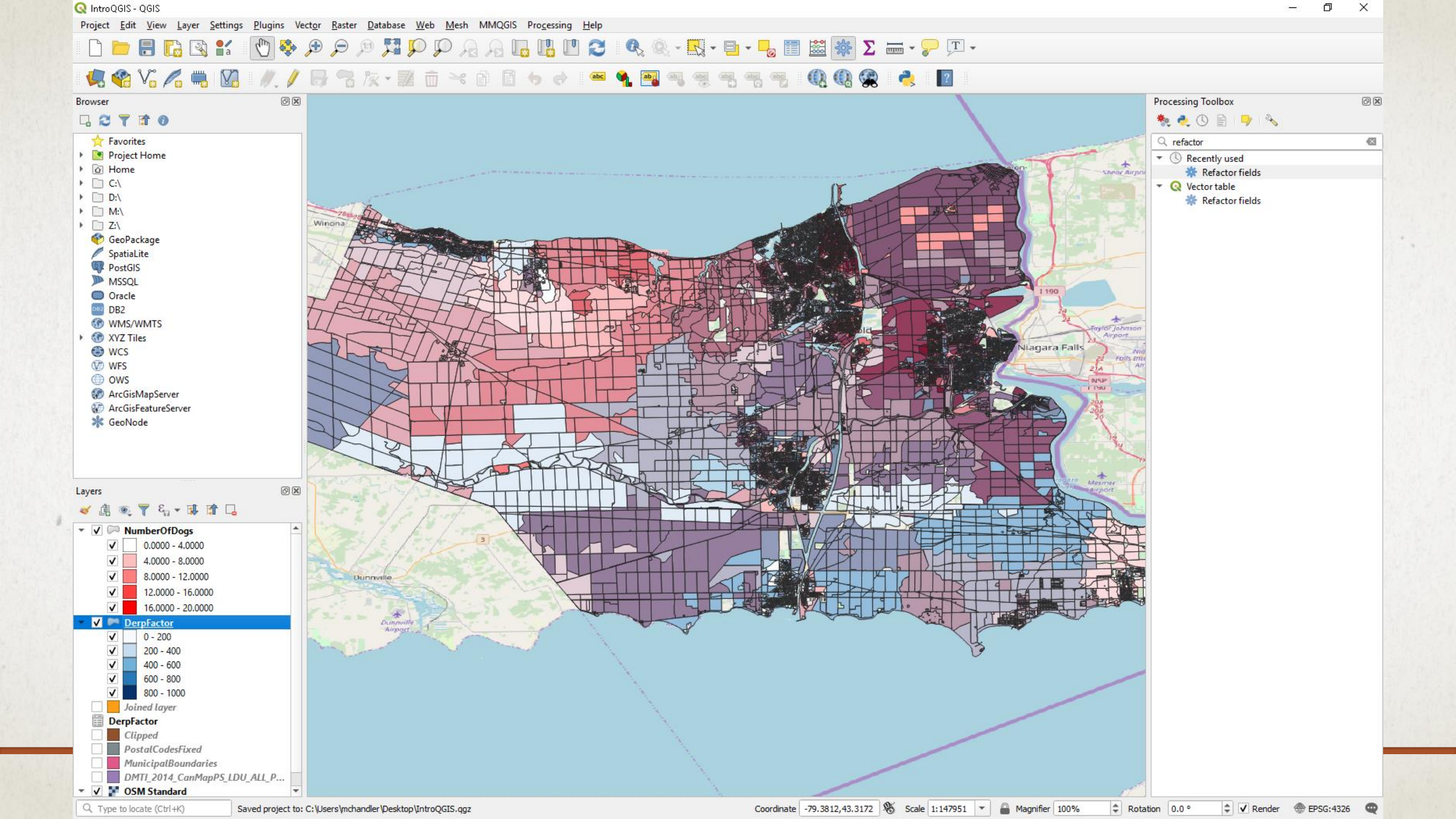
Normal
Draw effects
Control feature rendering order
Style
OK
Cancel
Apply
Help


IntroQGIS - QGIS
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ArcGisMapServer
ArcGisFeatureServer
GeoNode
Layers
NumberOfDogs
0.0000 - 4.0000
4.0000 - 8.0000
8.0000 - 12.0000
12.0000 - 16.0000
16.0000 - 20.0000
DerpFactor
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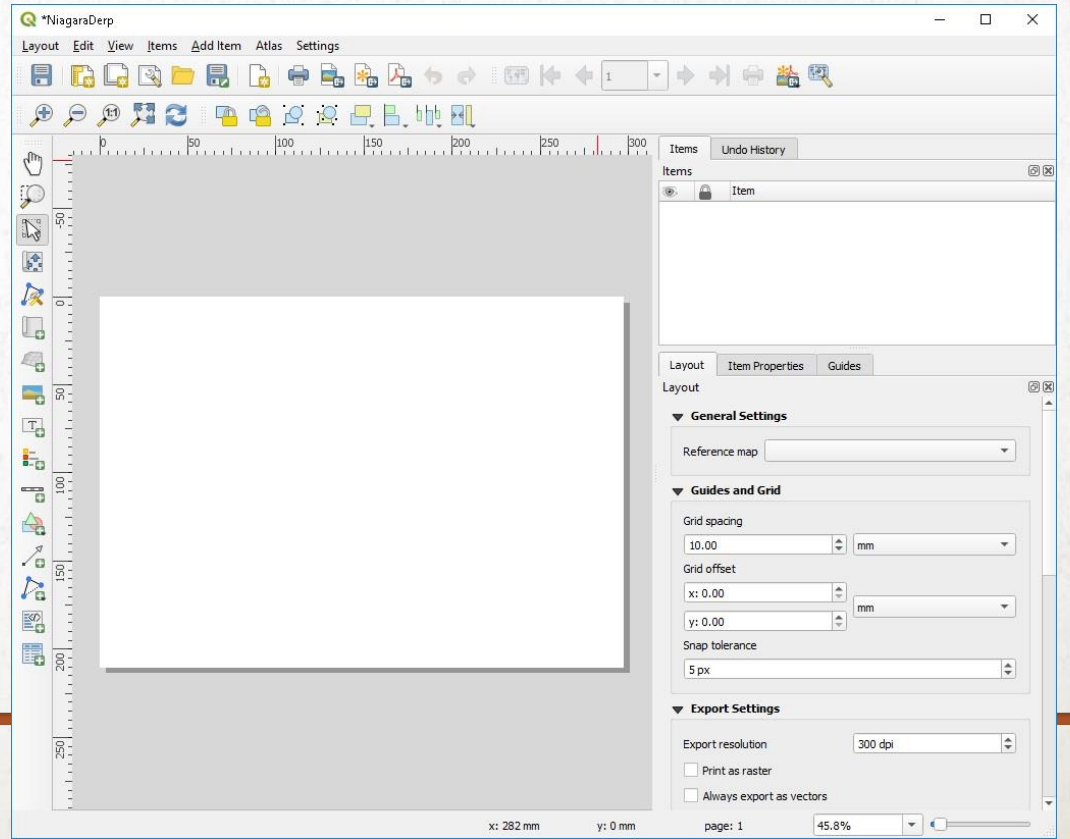
200 - 400
400 - 600
600 - 800
800 - 1000
Joined layer
DerpFactor
Clipped
PostalCodesFixed
MunicipalBoundaries
DMTI_2014_CanMapPS_LDU_ALL_P...
OSM Standard
Winona
Niagara Falls
Dunnville
Processing Toolbox
refactor
Recently used
Refactor fields
Vector table
Refactor fields
Type to locate (Ctrl+K)
Saved project to: C:\Users\mchandler\Desktop\IntroQGIS.qgz
Coordinate -79.3812,43.3172
Scale 1:147951
Magnifier 100%
Rotation 0.0 °
Render
EPSG:4326

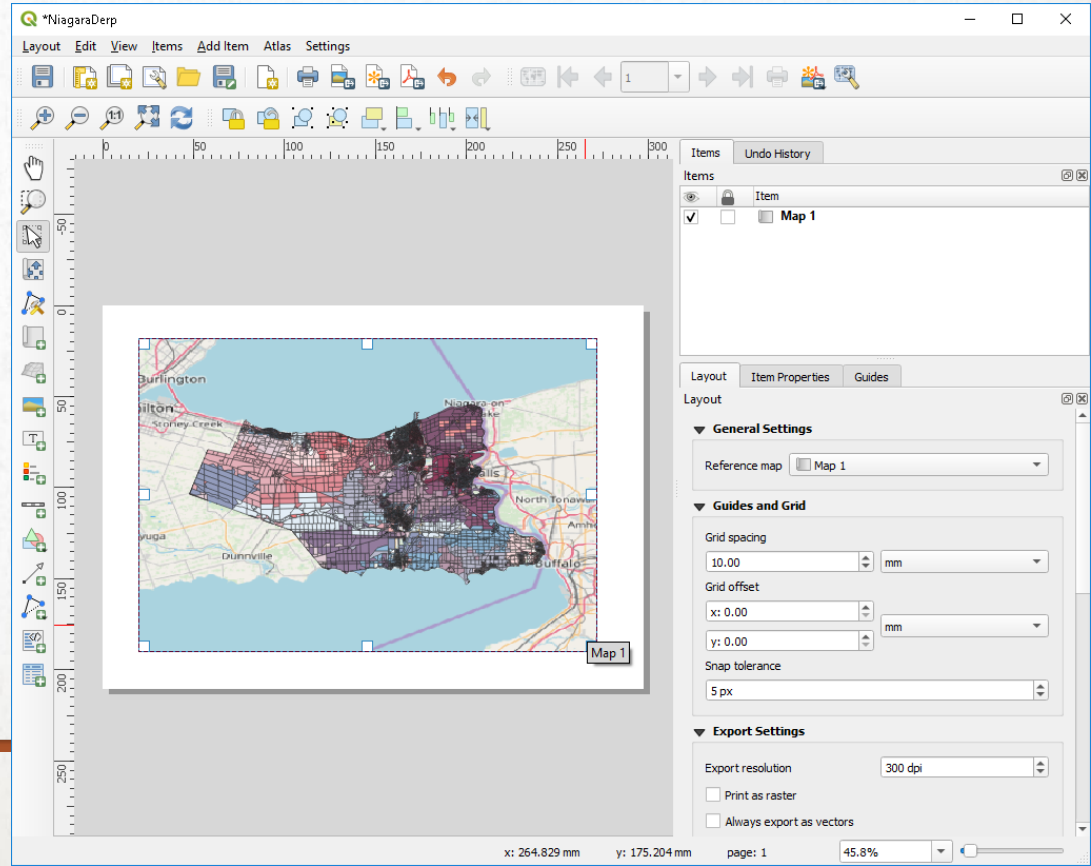
CREATING A MAP LAYOUT

- Under “Project”, select “New Print Layout”
- Give your new map a name in the dialog box, and click “OK”
- A new window will appear:



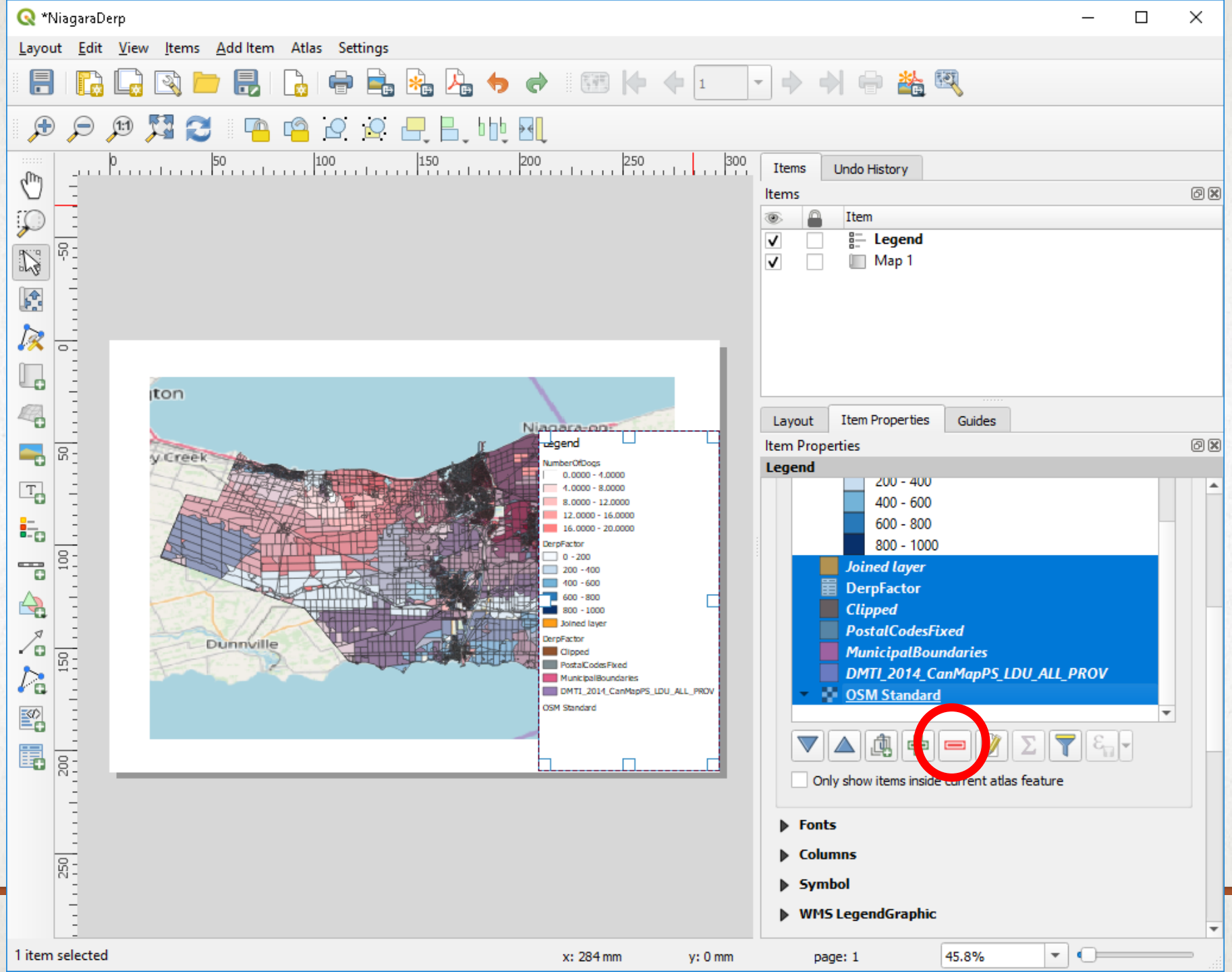
CREATING A MAP LAYOUT (CONTINUED)

- Under “Add Item”, click “Add map”
- Move your cursor to the page – it will now be a +
- Draw a box – this is where your map will appear
- You can move the map by clicking and dragging
- You can resize the map by clicking and dragging the edges of the box



CREATING A MAP LAYOUT (CONTINUED AGAIN)

- You can change the map scale under “Item Properties”, to show a larger or smaller area (a larger number will show more area, but particular features appear smaller – a smaller scale)
- To add a legend: Under “Add Item”, choose “Add Legend”, then draw a box where you would like your legend. You can move this around and resize as needed
- To remove items from the legend, click on Item Properties (this time, it’s referring to the legend, rather than the map), and under “Legend Items” uncheck “Auto update”. You can then highlight any items you done want/need in the legend, and click the  sign to remove them.
- You can also give the legend a title, such as “Legend”, by typing it in to the box “Title” in the Item Properties.


*NiagaraDerp
Layout
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Add Item
Atlas
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Items
Undo History
Item
Legend
Map 1
Layout
Item Properties
Guides
Item Properties
Legend
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600 - 800
800 - 1000
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DerpFactor
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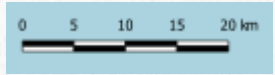
PostalCodesFixed
MunicipalBoundaries
DMTI_2014_CanMapPS_LDU_ALL_PROV
OSM Standard
Only show items inside current atlas feature
Fonts
Columns
Symbol
WMS LegendGraphic
Dunnville
1 item selected
x: 284 mm
y: 0 mm
page: 1
45.8%

CREATING A MAP LAYOUT (STILL CONTINUED)

- You can change the name of an item in the legend by clicking on the legend item, then clicking the edit button (next to the minus button).

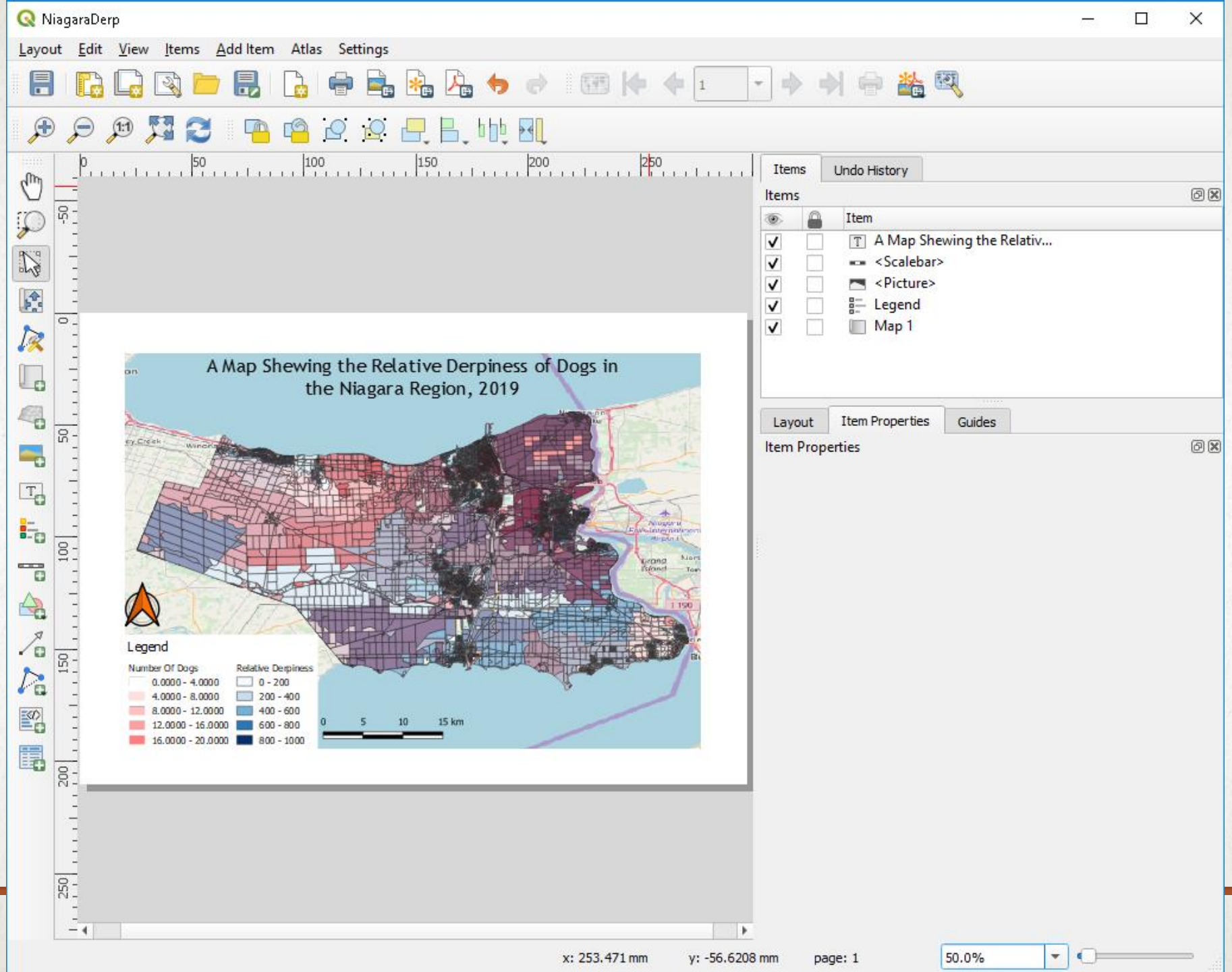
- To add a north arrow, click on “Add Item” and select “Add picture”. Draw a box on the canvas, then in the Item Properties panel on the right, expand the “Search Directories” section. Choose an arrow from here, or design your own

- To add a scale bar, click “Add Item” and select “Add Scale Bar”. Draw a box on the canvas, then edit the appearance, units, and number of segments in the Item Properties panel



- To give your map a title, click “Add Item” and select “Add Label”. Draw a box where you’d like your map title, then replace the “Lorem Ipsum” in the Item Properties box with your map title

- Adjust the items in your map until they look good – a good map is both informative and enjoyable to look at!


NiagaraDerp
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A Map Shewing the Relative Derpiness of Dogs in the Niagara Region, 2019
Legend
Number Of Dogs
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12.0000 - 16.0000
16.0000 - 20.0000
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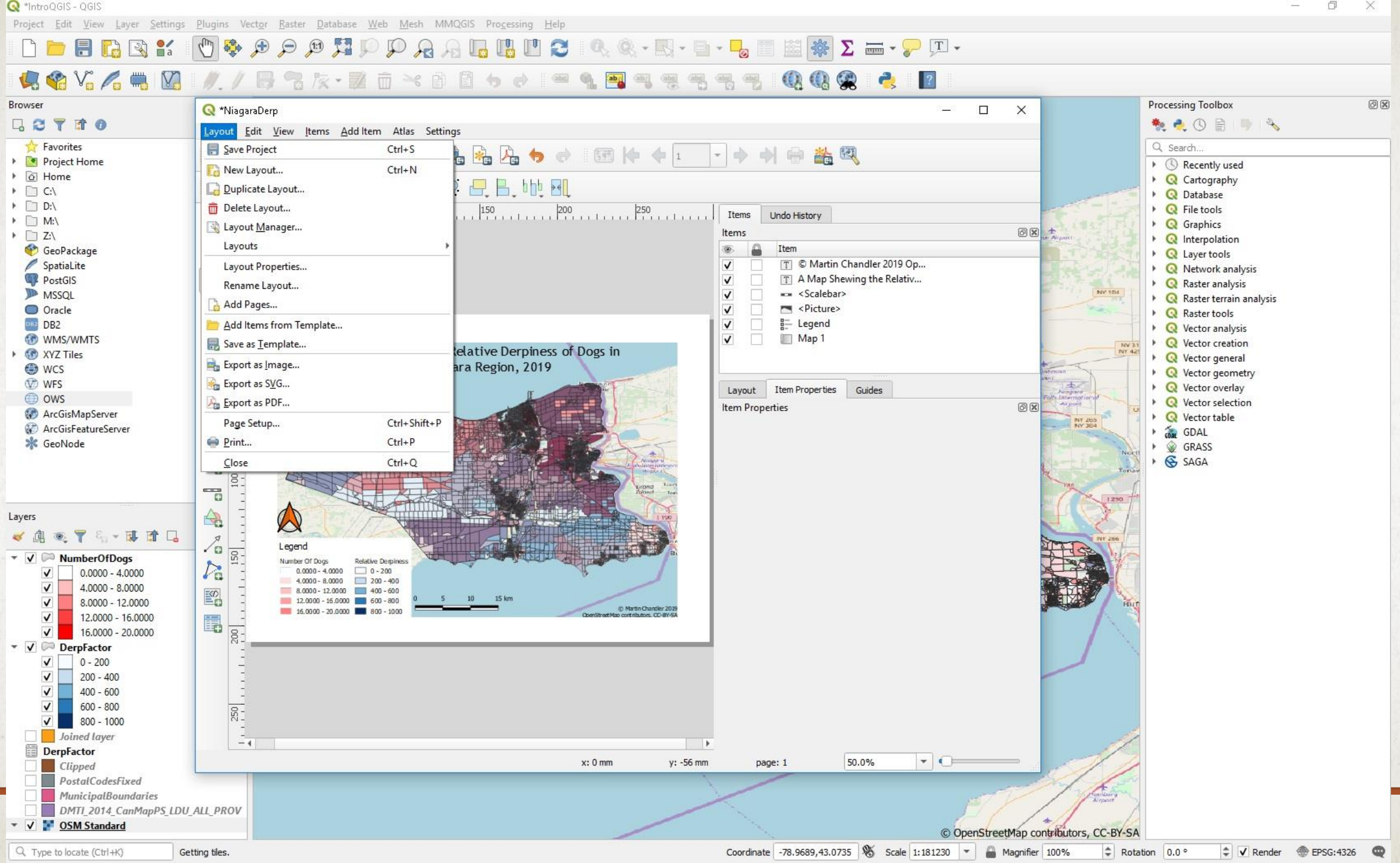
CREATING A MAP LAYOUT (FINAL)

- Remember to add a attribution information to your map – ie your name, the year of creation, and any affiliation you have related to the map, as well as data you used (in this case, OpenStreetMap). To do this, use the “Add Label” that we used for the title, but make it smaller, usually in a lower corner of the map
- QGIS doesn’t have as many design elements readily available as commercial software, but you can import things like fonts, images, etc. to work with. The trade-off that comes with free software is that it takes a bit more work to get the same result
- Once your map looks how you’d like it to, remember to save it
- You can then print your map, or export it as an image or pdf, using the Layout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© Martin Chandler 2019
OpenStreetMap contributors, CC-BY-SA
Items
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Layout
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Guides
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File tools
Graphics
Interpolation
Layer tools
Network analysis
Raster analysis
Raster terrain analysis
Raster tools
Vector analysis
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Vector general
Vector geometry
Vector overlay
Vector selection
Vector table
GDAL
GRASS
SAGA
© OpenStreetMap contributors, CC-BY-SA
Type to locate (Ctrl+K)
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Coordinate -78.9689,43.0735
Scale 1:181230
Magnifier 100%
Rotation 0.0 °
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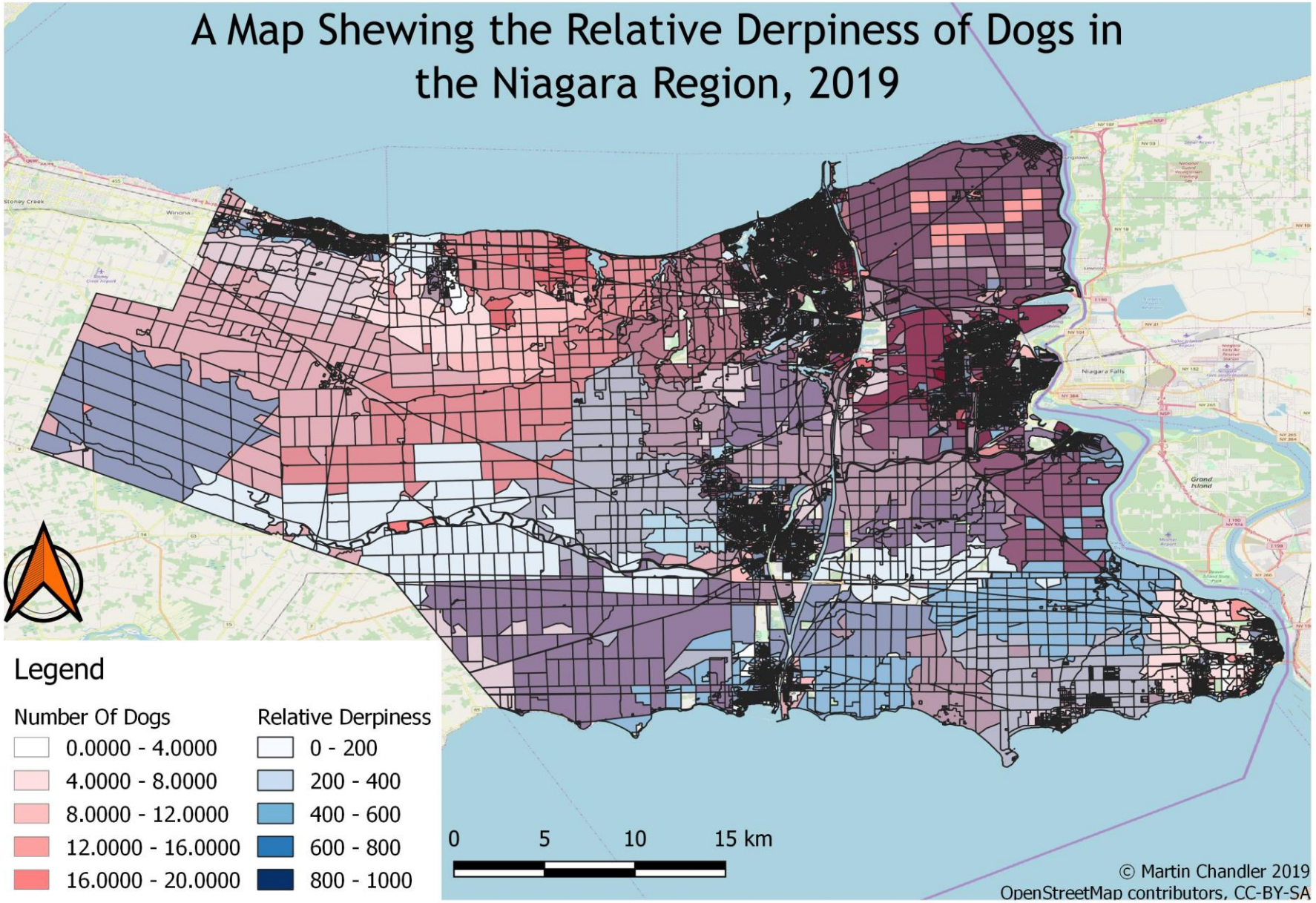
EPSG:4326


A Map Shewing the Relative Derpiness of Dogs in the Niagara Region, 2019
Legend
Number Of Dogs
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Relative Derpiness
0 - 200
200 - 400
400 - 600
600 - 800
800 - 1000
0
5
10
15 km
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QUESTIONS?

Contact the Map, Data & GIS Library: maplib@brocku.ca