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Faculdade
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move ▸ green

Sustainable Mobility

Information

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Turnos

Turno	Semanas	Data	Sala	Turma(s)
PL21	1 - 7, 9 - 14	Qui, 09:00 — 12:00	3.1.10	1MEEA

Mobility space usage

a Definition
Proportion of land use, taken by all city transport modes, including direct and indirect uses.

b Parameter
Square meters of direct and indirect mobility space usage per capita.

c Methodology description
➔ M4: Spatial analysis
The efficiency of mobility space usage is calculated by the ratio of the area covered by all city transport modes, including direct and indirect uses, to the total population of the city. The space usage is preferably measured by using spatial data and GIS, calculating the overlap of the shape file area for city transport and the one of the total area. An alternative is using existing data.

d Formula & Calculation method
Efficiency of land use, taken by all city transport modes, including direct and indirect uses

$$LUM = \frac{\sum_i (LD_i + LI_i)}{Cap}$$

LUM = Land use for mobility applications [m²]
LD_i = Direct Land use for mobility mode i [m²]
LI_i = Indirect Land use for mobility mode i [m²]
i = Mobility mode[#]
Cap = Capita or number of inhabitants in the city [#]

Efficiency refers indirectly to mobility output by referencing total population.
Direct land use by city transport refers to the area covered by transport infrastructure such as roads and streets and squares used to move people and for vehicles (public areas excluding parks, playgrounds and sport terrains). Airports and sea ports are excluded, inland ports included.

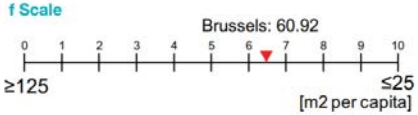
Indirect land use by city transport refers to indirect uses such as off-street parking areas, security areas, service areas, stations, inland port hubs, storage areas and distributions centers for city freight transport.
Some suggestions of land use for the calculation:

DIRECT
Fast transit roads
Other roads
Railways
Inland ports and water ways
INDIRECT
Open parking
Private parking
Service area and petrol stations
Storage and logistic centres
Stations

e Source
Methodology
The described methodology is based on information from the Victoria Transport Policy Institute (VPTI, "Evaluating Transportation Land Use Impacts", (2012), p. 11-16)

Data sources:
- Direct and indirect land use for mobility can be extracted from GIS maps (for parking this net land use has to be multiplied with the number of levels).

f Scale



➔ 0: ≥ 125 (m²/capita)
➔ 10: ≤25 (m²/capita)

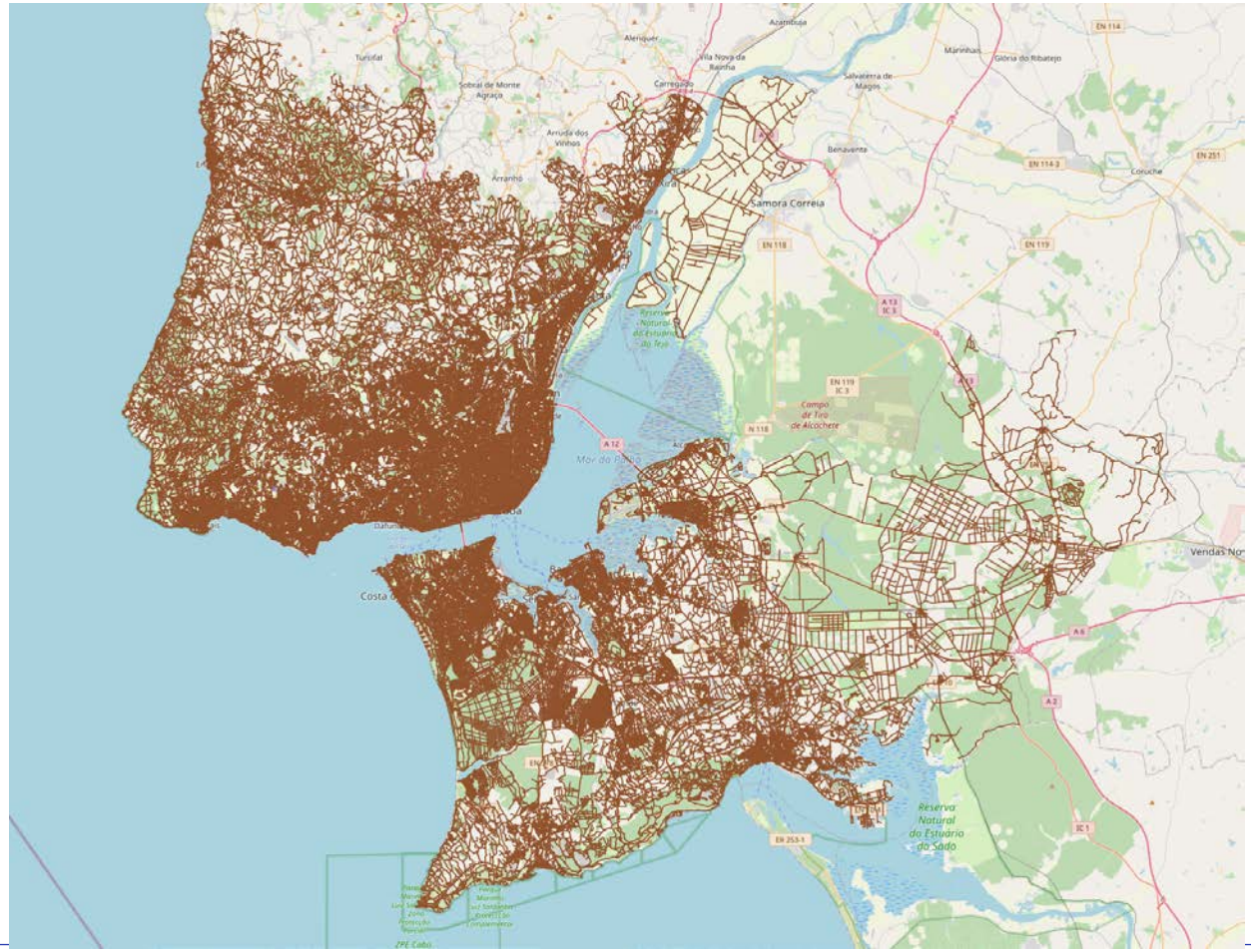
Land use for car traffic is almost the same amount as for housing (US; source: Litman). A minimum score of 125 m² is chosen.

g Notes

- Direct land use can also be calculated as a product of the total length of the infrastructure category (e.g. secondary roads) multiplied by a standard width per category.
- Indirect land use can also be based on the average unit surfaces for parking and service areas.

To calculate this indicator, we will use the power of QuickOSM (Quick OpenStreetMap) tool in Qgis.

I will probably make this file available to you as this requires quite some computing power to download and load in qgis (raw data with millions of datapoints.) – If you are following this at home skip to slide 9.



You can try to use the QuickOSM tool yourself, or even download the already available OSM packages for AML and AMP on the internet. We will talk a little bit about it in class.

Still, since this requires quite some computational power, we will not use it for the final data, but we can tinker with it for smaller regions so you can learn.

Links that might be useful:
https://learnosm.org/en/osm-data/osm-in-qgis/
https://gis.stackexchange.com/questions/301221/downloading-road-map-of-specific-country-from-planet-osm-and-using-it-in-arcgis
https://www.interline.io/osm/extracts/

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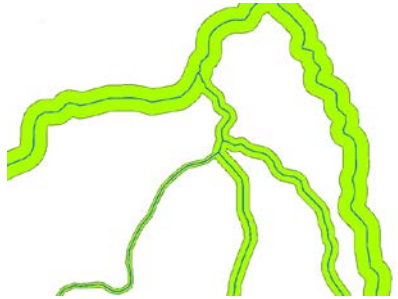
At this stage, we should have our OSM roads loaded and ready for the next steps.

Next steps: Let us focus on calculating how much space roads occupy. For this, we must know the span of a residential, primary, and tertiary road, etc.

OSM_Roads_Final_AML — Features Total: 260045, Filtered: 260045, Selected: 0

	fid	full_id	osm_id	osm_type	highway	junction	lanes	oneway
1	1	w2954258	2954258	way	residential	NULL	NULL	no
2	2	w3979151	3979151	way	residential	NULL	NULL	no
3	3	w3979152	3979152	way	primary	NULL	1	no
4	4	w3979153	3979153	way	residential	NULL	NULL	no
5	5	w3979154	3979154	way	residential	NULL	NULL	no
6	6	w3979155	3979155	way	steps	NULL	NULL	NULL
7	7	w3979156	3979156	way	residential	NULL	NULL	no
8	8	w3979157	3979157	way	residential	NULL	NULL	no
9	9	w3979159	3979159	way	residential	NULL	NULL	no
10	10	w3979160	3979160	way	primary	roundabout	NULL	NULL
11	11	w3979161	3979161	way	residential	NULL	NULL	no
12	12	w3979162	3979162	way	primary	NULL	1	yes
13	13	w3979163	3979163	way	primary	NULL	2	no
14	14	w3979164	3979164	way	residential	NULL	NULL	no

After we have an attribute which states how wide a road is (guesstimate based on the available data).



We can use that attribute to create a “buffer” which highlights the area it occupies.

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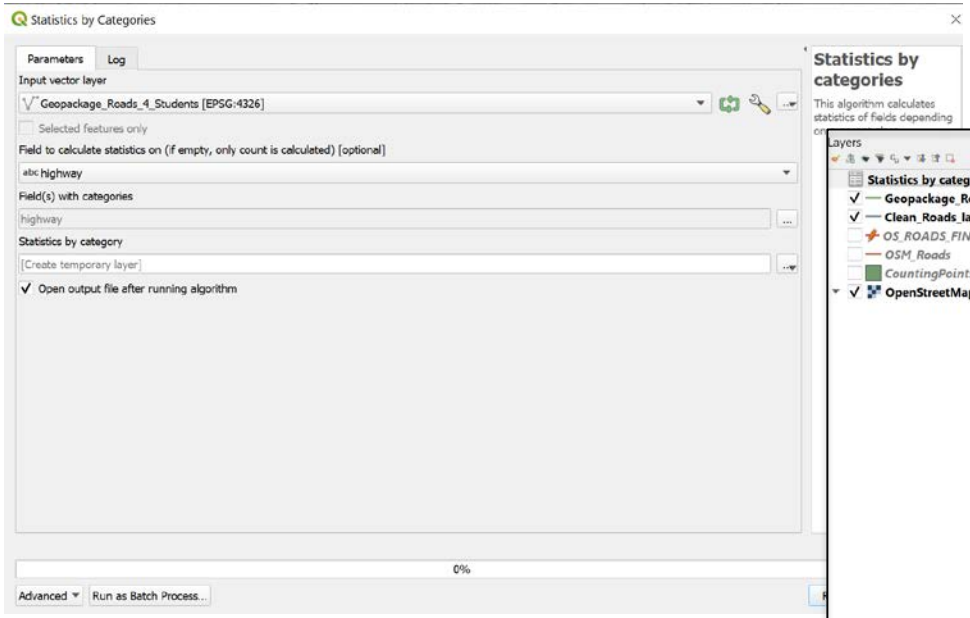
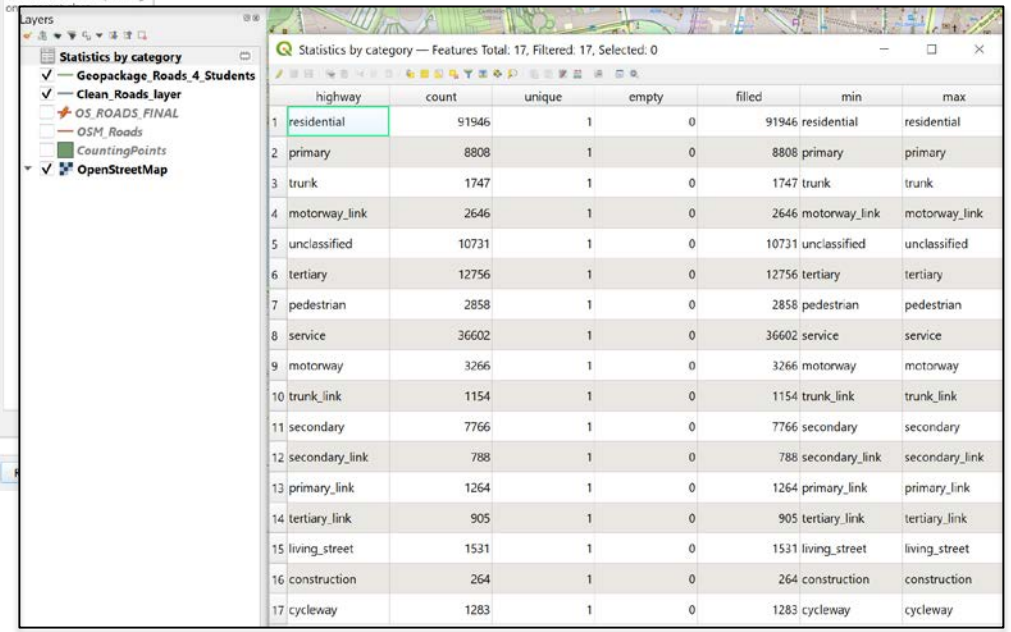
Running the Tool “Statistics by categories” we can see every unique road trait we have. Since we only care about road infrastructure for transport mobility and so forth, we use another Tool “Select by expression” to remove unwanted data.





	highway	count	unique	empty	filled	min	max
1	residential	91946	1	0	91946	residential	residential
2	primary	8808	1	0	8808	primary	primary
3	trunk	1747	1	0	1747	trunk	trunk
4	motorway_link	2646	1	0	2646	motorway_link	motorway_link
5	unclassified	10731	1	0	10731	unclassified	unclassified
6	tertiary	12756	1	0	12756	tertiary	tertiary
7	pedestrian	2858	1	0	2858	pedestrian	pedestrian
8	service	36602	1	0	36602	service	service
9	motorway	3266	1	0	3266	motorway	motorway
10	trunk_link	1154	1	0	1154	trunk_link	trunk_link
11	secondary	7766	1	0	7766	secondary	secondary
12	secondary_link	788	1	0	788	secondary_link	secondary_link
13	primary_link	1264	1	0	1264	primary_link	primary_link
14	tertiary_link	905	1	0	905	tertiary_link	tertiary_link
15	living_street	1531	1	0	1531	living_street	living_street
16	construction	264	1	0	264	construction	construction
17	cycleway	1283	1	0	1283	cycleway	cycleway

Our job is now to attribute “weight”, meaning, a width, to each of these highway categories

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Considering the following table:

Nível		1º Nível	2º Nível	3º Nível	4º Nível	5º Nível
Designação		Rede estruturante	Rede de Distribuição Principal	Rede de Distribuição Secundária	Rede de Proximidade	Rede de Acesso Local
Objectivos		Suporte a percursos de longa distância	Distribuição inter e intra setores	Distribuição de proximidade	Distribuição no bairro	Proteção e incentivo do modo pedonal e ciclável
Características Físicas	Número de sentidos	2	2	1 ou 2	1 ou 2	1 ou 2
	Número mínimo de vias com 1 sentido de circulação	-	-	2	1	1
	Número mínimo de vias com 2 sentidos de circulação	3 + 3	2 + 2	1 + 1	1 + 1	1 + 1
	Separação física dos sentidos de circulação	Obrigatória	Desejável	Facultativa	A evitar	Proibida
	Largura mínima das vias (m)	3,25	3,00	3,00	3,00	3,00
	Largura mínima das bermas lado direito (m)	2,50 (em vias novas)	-	-	-	-
	Largura mínima das bermas lado esquerdo (m)	0,50	-	-	-	-
	Largura mínima dos passeios em arruamentos existentes (m)	-	1,50	1,50	1,20	1,20
	Largura mínima dos passeios em novos arruamentos (m)	-	3,00	3,00	3,00	3,00

Figure 1. Taken from CML Public Space Manual

And our clean data (This file is available In Fenix "Clean_roads_4 students"):

Statistics by category — Features Total: 17, Filtered: 17, Selected: 0

	highway	count	unique	empty	filled	min	max
1	residential	91946	1	0	91946	residential	residential
2	service	36602	1	0	36602	service	service
3	tertiary	12756	1	0	12756	tertiary	tertiary
4	unclassified	10731	1	0	10731	unclassified	unclassified
5	primary	8808	1	0	8808	primary	primary
6	secondary	7766	1	0	7766	secondary	secondary
7	motorway	3266	1	0	3266	motorway	motorway
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16	secondary_link	788	1	0	788	secondary_link	secondary_link
17	construction	264	1	0	264	construction	construction

We must devise a way to attribute appropriate widths to all these different roads.

OSM nomenclature partially helps solve our problems:

https://wiki.openstreetmap.org/wiki/Key:highway

The CML guide helps us complement this information:

https://www.lisboa.pt/fileadmin/cidade_temas/urbanismo/espaco_publico/Manual_espaco_publico.pdf
(It is in “Espaços de Circulação rodoviária”.

Nível		1º Nível	2º Nível	3º Nível	4º Nível	5º Nível
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	Largura mínima das bermas lado esquerdo (m)	0,50	-	-	-	-
	Largura mínima dos passeios em arruamentos existentes (m)	-	1,50	1,50	1,20	1,20
	Largura mínima dos passeios em novos arruamentos (m)	-	3,00	3,00	3,00	3,00

Cheats and assumptions for the class:
Motorways and motorway links can be interpreted as 3.25m for each lane + 0.5 kerb width. The rest of the roads we will assume 3m for each lane with no kerb width.

Thus, during the class we did the following:

We separated the motorway and motorway_link from the rest of the roads with select or extract by expression and then, through the attribute field calculator we created a new column called “new_width” using the code:

```
CASE
	WHEN "width" IS NOT null THEN width
	WHEN "lanes" IS NOT null THEN lanes*3.25+0.5
	WHEN "oneway" IS null THEN 3.25*2+1
	WHEN "oneway" IS 'yes' THEN 3.25+0.5
	WHEN "oneway" IS 'no' THEN 3.25*2+1
END
```

This type of rough approximation can result in some motorways being accurately represented just as it can result in gross misrepresentations of the real width. Tinker with these values and justify your approach.

The code for the new_width column for the rest of the roads differs in the following way:

```
CASE
        WHEN "width" IS NOT null THEN width
        WHEN "lanes" IS NOT null THEN lanes*3
        WHEN "oneway" IS null THEN 3*2
        WHEN "oneway" IS 'yes' THEN 3
        WHEN "oneway" IS 'no' THEN 3*2
END
```

The interpretation is the following: When we have a value in the column width, we use that value. If we do not, we then attempt to use the lanes column to devise a width value by multiplying it by the CML “reference” for the lane width. When we do not have such values, we the attempt to at least characterize the street as being one-way or two-way and assume that if it is two-way, then we multiply by 2 (two-lanes of traffic). If we do not have any value, we assume it is a two-way street.

All these assumptions can be tinkered with. We will leave you to justify your approach in the presentation. It is incentivized to try different things.

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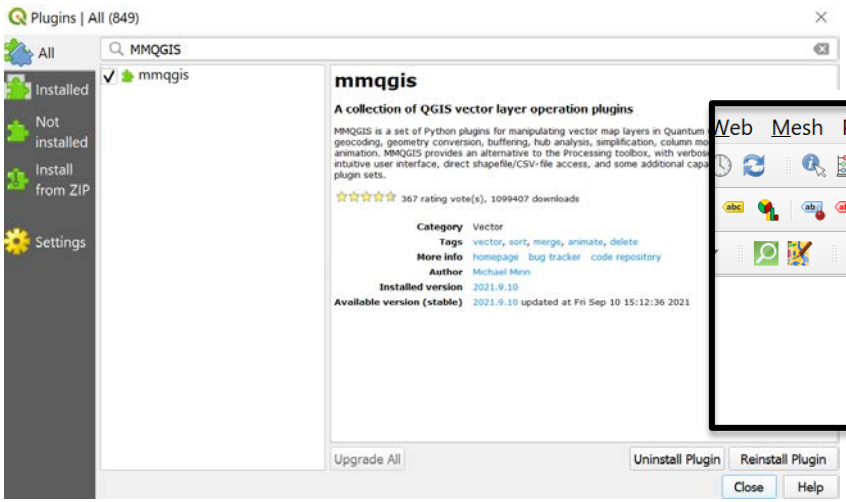
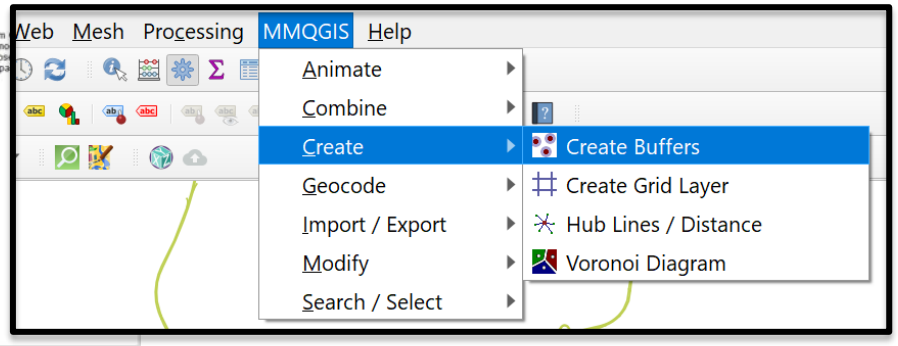
Make sure you are using ETRS89 / PORTUGAL TM06 before running the mmqgis buffer

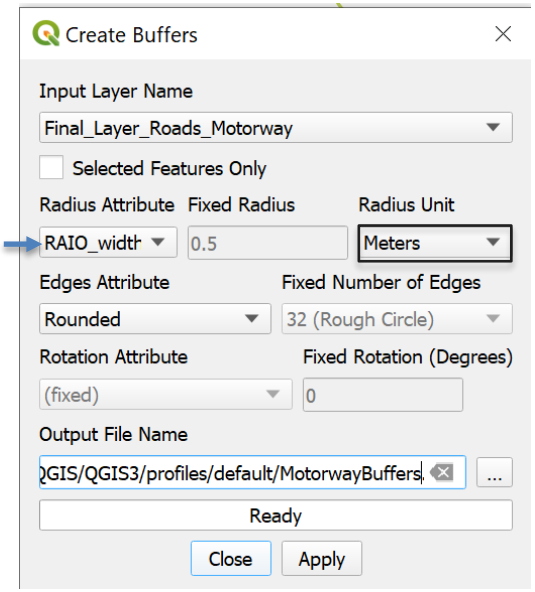
Click here and search for it

Instead of using the standard buffer we will use an older tool less prone to errors: install mmqgis plugin and use it.



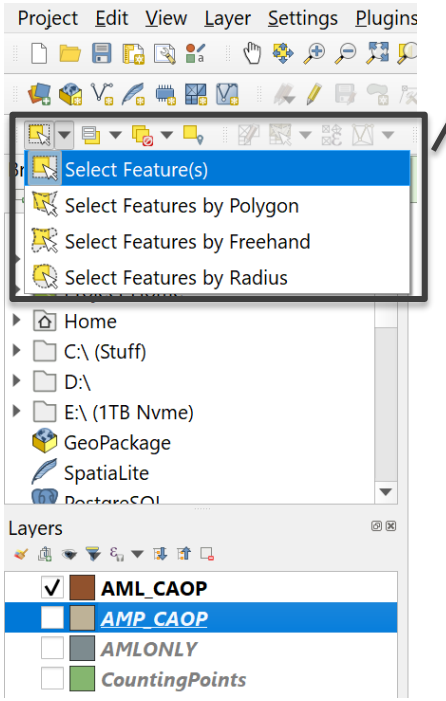


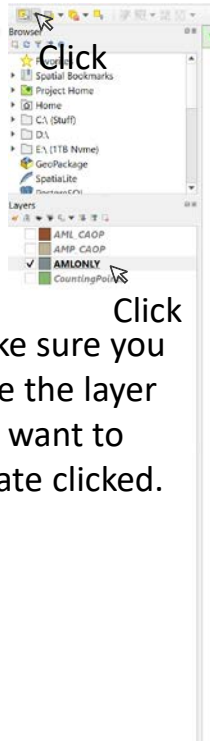
Your width column created with the CASES code



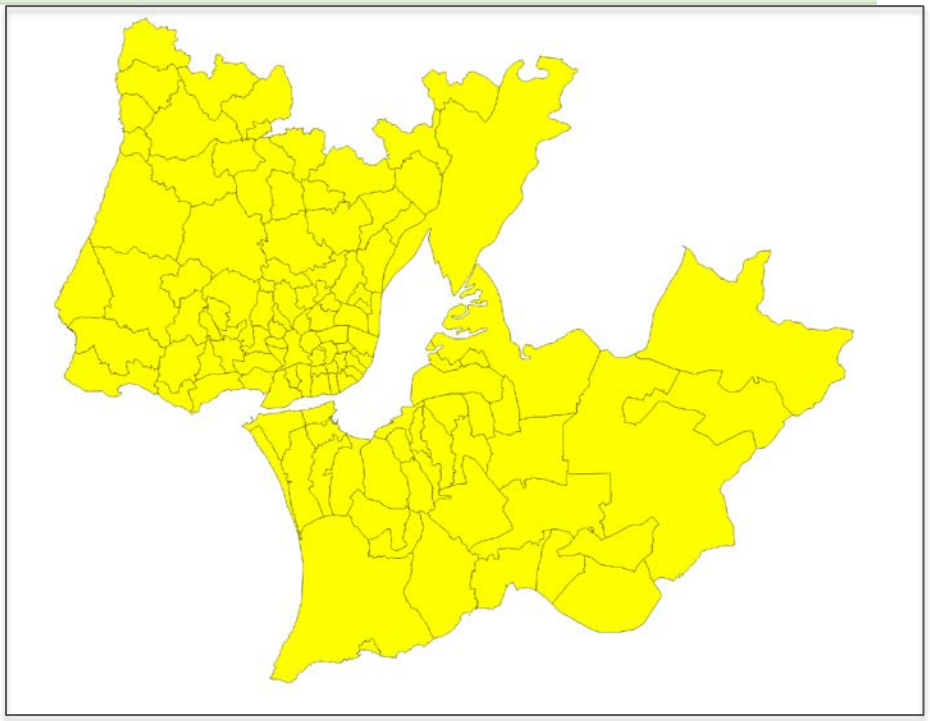
After creating our buffers for both motorways and non-motorways layers, we need to merge them and separate them by AML and AMP. There are several ways to do it, here we propose:

Use your original unaltered CAOP_fix (Fenix), which contains both AMP and AML and let us separate them so we can do the indicator for both AML and AMP.





Make sure you have the layer you want to isolate clicked.



Encompass the whole AML

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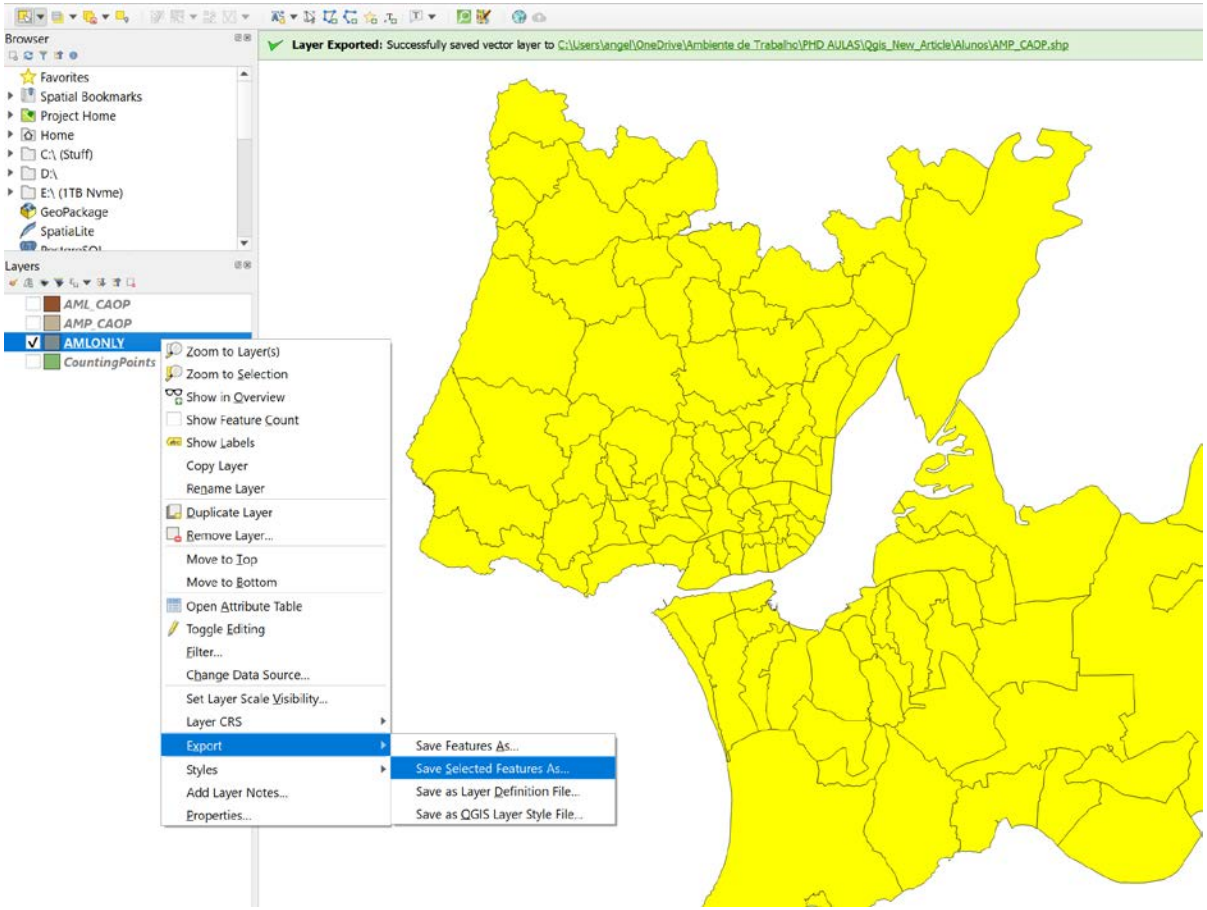
Save the selected polygons from this layer to a new layer by saving selected features as. You have isolated AML into a single layer.

Do the same for AMP.



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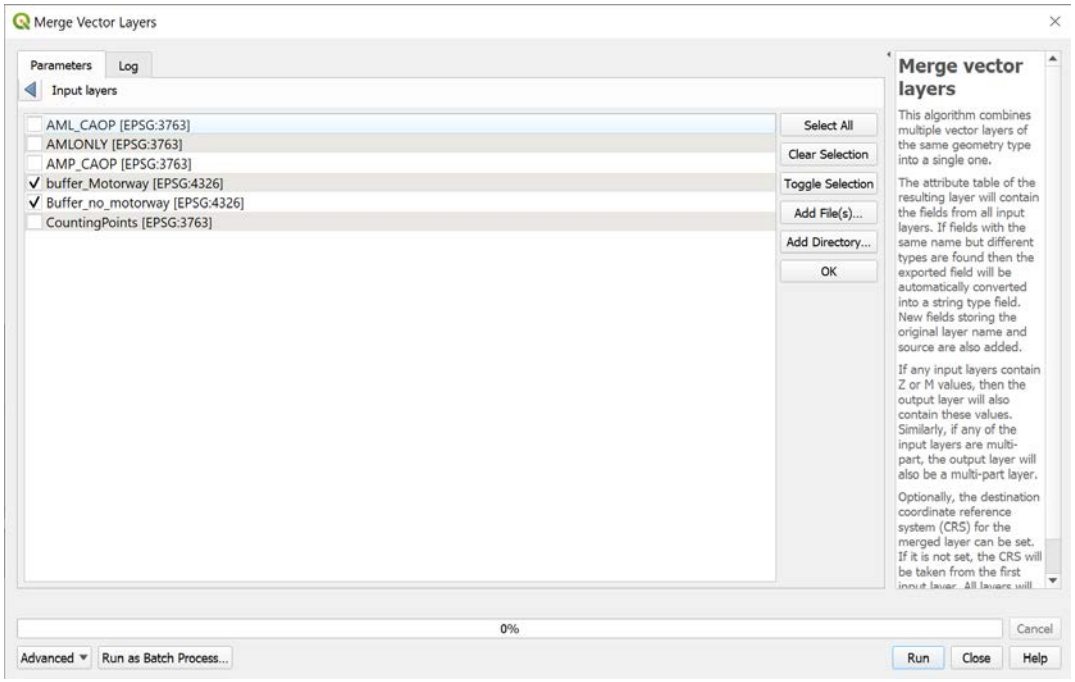
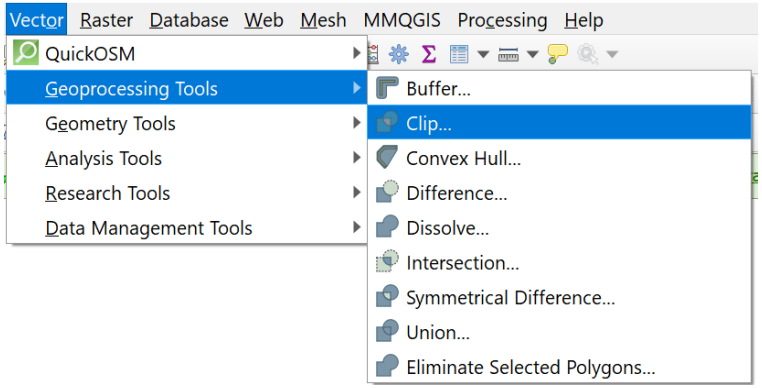
Next, merge your buffers to simplify the process of clipping.

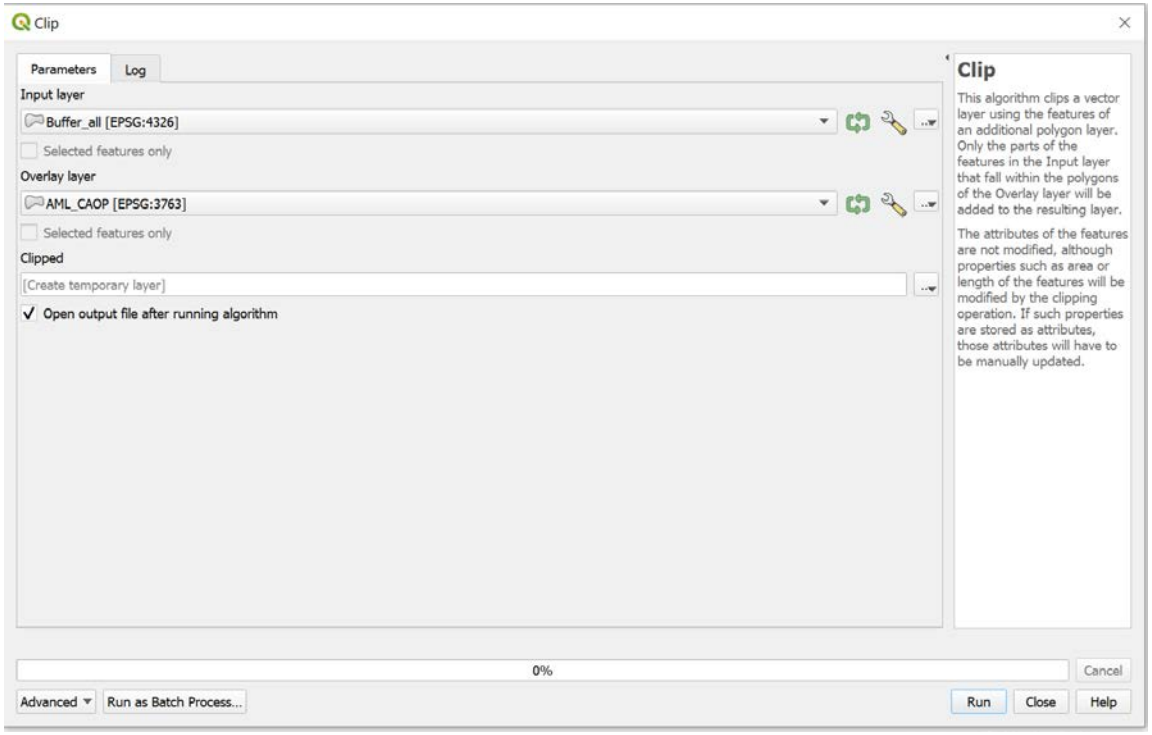


Clipping:



We only want AML for now (repeat for AMP, same steps).

This means:
We want all the buffer points which are contained in the AML_CAOP layer only.



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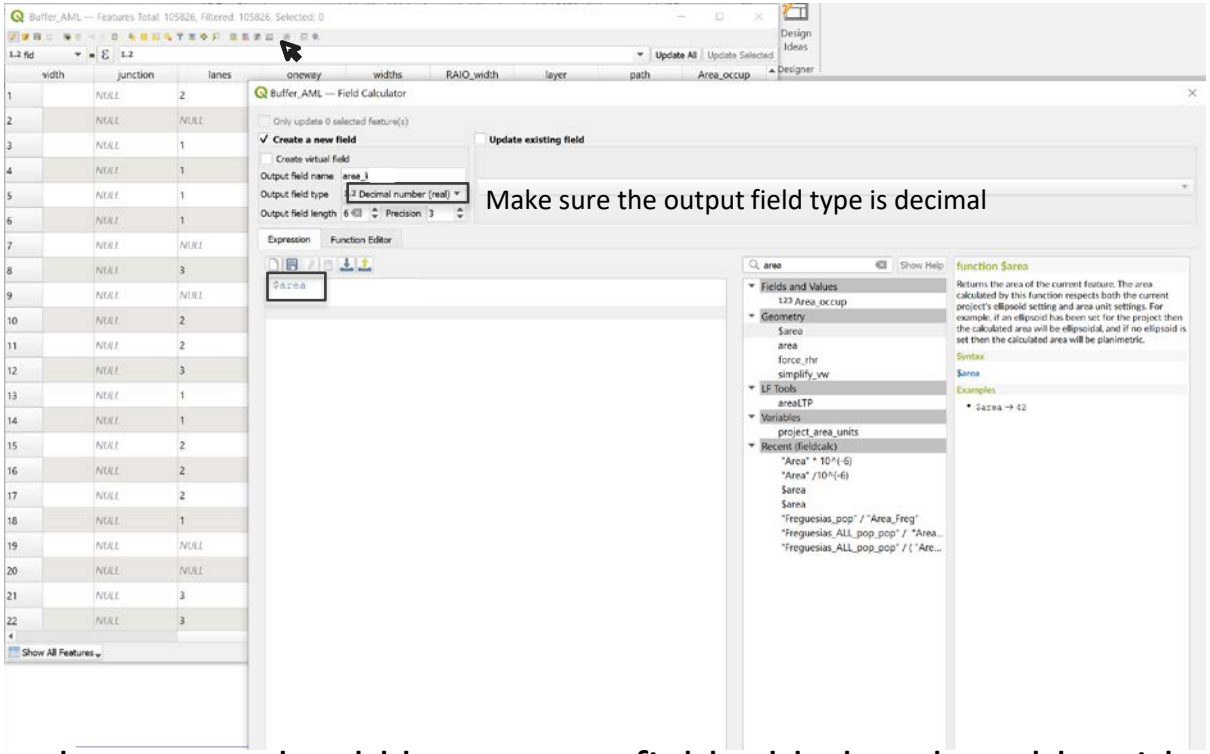
Now that we have AML and AMP only, we will calculate the areas of the buffer in these districts.

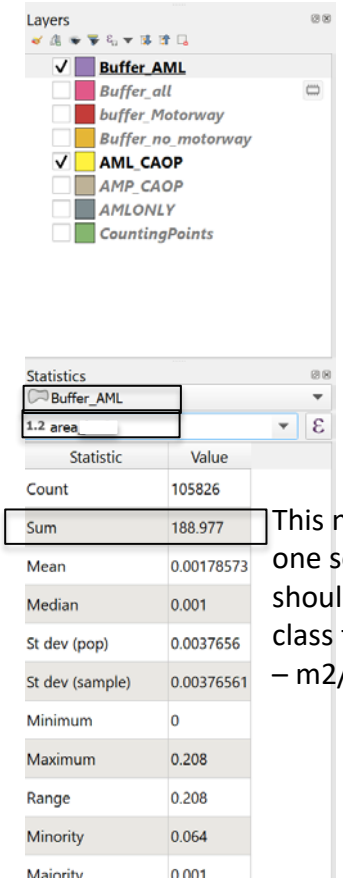
To calculate the buffer areas, we use our trusted field calculator in the attribute fields (we did not do this step in class, I would advise to do so just in case and then confirm the value with the next slide.):



Run and now you should have a new field added to the table with the area that the AML buffer occupies. (Do the same for AMP obviously.)

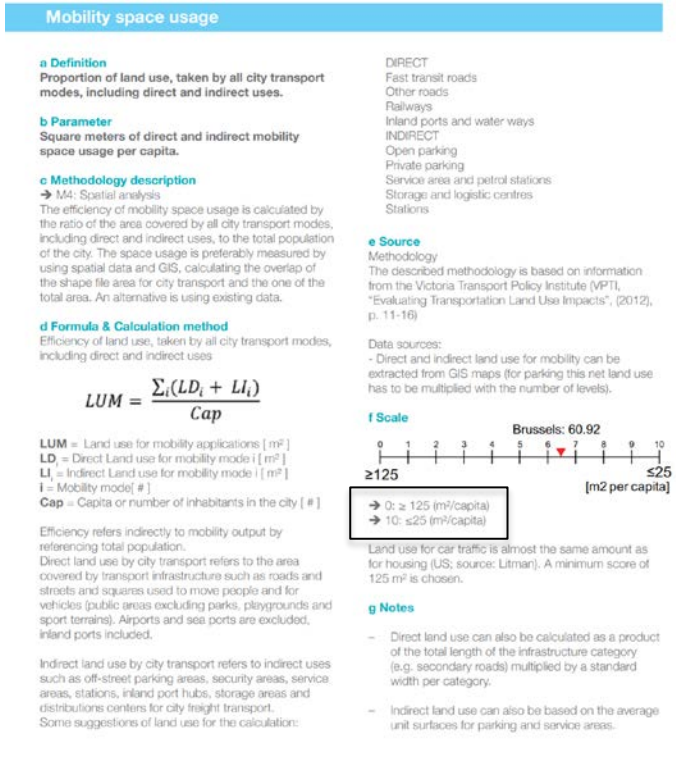
1. Use the field calculator to sum these areas.

View > Statistical summary



This number should be bigger than the one seen here (which is in km2). You should keep it in m2 like you did in class for the indicator Landusage/capita – m2/capita.

2. Lastly, using the scale highlighted below, convert the sum of both motorway+ motorway_links + the remaining roads m2 land usage by the population (for AML and AMP respectively).



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b Parameter
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→ M4: Spatial analysis
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LI$_i$ = Indirect Land use for mobility mode i [m²]
i = Mobility mode[#]
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f Scale
Brussels: 60.92
0 1 2 3 4 5 6 7 8 9 10
≥125 ≤25 [m2 per capita]
→ 0: ≥ 125 (m²/capita)
→ 10: ≤25 (m²/capita)

Land use for car traffic is almost the same amount as for housing (US; source: Litman). A minimum score of 125 m² is chosen.

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- Indirect land use can also be based on the average unit surfaces for parking and service areas.

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