



MADESAI CAPABILITY SHOWCASE

GIS analysis for potential coworking locations

Eindhoven, Netherlands

A retrospective spatial site-screening study using OpenStreetMap data and a QGIS graphical model to identify prospective locations.

Location Selection Criteria

1. Original Selection Criteria

Criterion Number	Topic	Data Type	Criterion	Relevant tag(s)	Short Text Description
1	Eateries	Point	$D_{\max} < 1000 \text{ m}$ and $D_{\max_{\text{bike}}} < 1500 \text{ m}$	Amenity: Bar, Cafe, fast_food	Some sort of eateries should be within 1000m or accessible by bike with 1500m.
2	Banks	Point	$d_{\max} < 1000 \text{ m}$	Amenity: Bank	ATM and Banks should be within 1000 m
3	Office Space Area	Polygon	$\text{Area}_{\min} > 1000 \text{ m}^2$ Building! = apartment	Building=yes Apartments = no	- The functional building area should be a minimum of 1000 m². The official workspace area is 12 to 22 m² per person. For a coworking space, it is assumed to be 12 m². Apart from that, it should also include other accessories. Hence a 15 m² per person usable area is sufficient. - The building is not a residential space. - The building is wheelchair accessible
4	Parking Spots	Point Polygon	$D_{\max} < 300 \text{ m}$ $\text{Area}_{\min} > 45 \text{ m}^2$	Amenity:bicycle_parking And Amenity:parking space Type=site, site :parking	- Bike Parking Spots access should be within walking distance. - Should have an area of minimum 9x5 m².
5	Leisure	Point	$D_{\max} > 500 \text{ m}$	Leisure:fitness center,park	There should be a gym or greenspaces within walking distance.
6	Motorways	Polyline	$D_{\min} \geq 500 \text{ m}$	Highway: Motorway, trunk, primary	There should not be any motorway near the building in about 500 m but should be accessible enough to connect to the other parts and cities.
7	Public Transport	Point	$D_{\max} < 300 \text{ m}$	Public_transport: platform railway: station	Public transport access should be within walking distance

2. Changes Made

Criterion Number	Topic	Data Type	Criterion after changes	Relevant tag(s) after changes	Reason Behind Changes
1	Eateries	Point	$D_{\max} < 1000$ m and $D_{\min} > 250$ m	Amenity: Bar, Amenity: Cafe and Amenity: Restaurant	- Fast food tag was removed as there were too many spots (140). Restaurants were added as they differ in the style of the cuisine they serve. - The bars and cafe should have at least 250 m distance and within 1000 m. This was done to incorporate a buffer to avoid nuisance caused while working due to proximity to bar streets during carnivals and at weekends. - Criteria for accessibility of cafe by bike was removed to avoid redundancy.
2	Finance Centers (renamed from Banks)	Point	$D_{\max} < 1000$ m	Amenity: Bank Amenity: ATM	ATM was added to increase the number of final location as they were too less.
3	Landuse (Rename from Office Space)	Polygon	Gross Floor Area $_{\min} > 1000$ m ²	Landuse:Commercial Landuse:Construction Landuse:Industrial	- Tags Building = "yes" was removed as the selection had to be of three locations where the construction of the development has to be done. - Since this is the construction of coworking spaces, land use was added as a tag
4	Parking Spots	Point Polygon	$D_{\max} < 300$ m $Area_{\min} > 45$ m ²	Amenity:bicycle_parking, Capacity<10 Or (changed from "And") Amenity: parking space ,fee = no	- For bikes, the filter capacity<10 was used to have bike parking spaces with better capacity. - A filter for parking space was applied with fee=no in the query builder for free parking space to reduce the number of parking spots. - The tag "Type=site, site: parking" was not used as it was not available for the area.
5	Leisure	Point	$D_{\max} > 500$ m	Leisure: sports center Leisure: park	Amenity value was changed to sports centre from fitness centre as there was no option for fitness centre present.
6	Motorways	Polyline	$D_{\min} \geq 500$ m	Highway: Motorway Highway: trunk Highway: primary	No changes were made.
7	Public Transport	Point	$D_{\max} < 300$ m	Public_transport: platform, "bus" = 'yes' AND "bench" = 'yes'	To limit the number of bus stops, filter "bus" = 'yes' AND "bench" = 'yes' was applied.

				railway: station	
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Note: During the analysis phase, to increase the number of prospective locations, it was decided to select a place that may have proximity to the railway station or a bus stop or have a car parking or have a bike parking.

3. Reasons to choose the criteria and realistic references

Criterion 1: This is a critical criterion as the listings of coworking spaces include eateries nearby. However, they should not be too close to cafes and bars to avoid workplace nuisance (van de Koevering, 2017).
Criterion 2: Although it is not a necessary trait, but it is an essential need for people to have banks nearby as that increases the usage of this space. And also bank branches can be included as coworking spaces and vice versa. ("10 Things to Consider When Choosing a Location for Your Business," n.d.; "Coworking spaces as ...new banking branches? - Slava Solodkiy - Medium," n.d.; "Digital banking leading the way to coworking spaces AllWork.Space," n.d.)
Criterion 3: The Spatial Planning Act (WRO) sets down how the spatial plans of the state, provinces and municipalities are to be effected. Land-use plans are an essential tool in spatial planning. Such plans set down where construction may take place, what may be built, the size of the structure and what may be the use of the site. (Ministry of Infrastructure and the Environment, 2011)
Criterion 4: An coworking space should be accessible by both public transport and the car. A car is, of course, more convenient (van de Koevering, 2017). The minimum area for a parking space is 45 m ² (Planning Service, n.d.). Hence car parking is necessary. Bike parking is necessary as Eindhoven has a biking community.
Criterion 5: The rule of having a Park or a fitness centre nearby is a realistic consideration in development. Greenery within the city is essential and enhances work atmosphere. Furthermore, the presence of a gym in the area helps to improve fitness. Coworking spaces in cities like Amsterdam have fitness centres for keeping workers healthy (Bojana Trajkovska, 2017).
Criterion 6: This helps in keeping workspace noise-free and still accessible via car.
Criterion 7: A good accessible coworking space by both public transport and the car is, of course, more convenient (van de Koevering, 2017). Hence, the presence of public transport is chosen as necessary.

Data Collection and Preparation

1. Data Source

The data was collected using the query feature of OSM (Open street map) 's Quick OSM and Quick Map Services

2. Data Collection and Preparation

The following table summarizes the data that was collected and what modifications were applied before the analysis was carried out.

S.N o	Grou p	Layer	Type	Cou nt	Key	Value	Layer Extent	Filter used(i f any)	Extraction by Graphical Model		
									Yes/ No	Express ion	
1	Motorw ay	Highway_primary	Polyli ne	528	highway	primary	Eindho ven city		No		
2		Highway_trunk		142		trunk					
3		Highway_motorway		251		motorway					
4	Transp ort Access Points	Public_transport_platfor m_mod*	Point	86	public_trans port	platform					bus" = 'yes' AND "bench" = 'yes'
5		Railway Station		2	railway	station					
6	Landus e ¹	Landuse_industrial	Polyg on	37	landuse	industrial			Yes	area>100 0	
7		Landuse_construction		65		constructio n					
8		Landuse_commercial		5		commercial					
9	Leisure	Sports_center	Point	27	leisure	sports_cent er			No		
10		Park		9		park					
11	Parkin g	Car_parking_mod* ¹	Polyg on	104	amenity	parking_sp ace		"Fee" ='no'	Yes	area>45	
12		Bicycle_parking_mod*	Point	48		bicycle_par king		"Capaci ty" < '10'	No		
13	Eaterie s	Eateries_Restaurant	Point	257		restaurant					
14		Eateries_Bar		30		bar					
15		Eateries_Cafe		88		cafe					
16	Financ e Units	ATM	Point	59		ATM					
17		Bank		15		bank					
18		Eindhoven city**	Polyg on	1							

*Filters applied to layer during the analysis

** Polygon added using Quick Map Services

Note¹: The extraction by Graphical Model was done because it helped in refining selections of the layers on which it was applied to get the right locations. This step was carried out easily using "field calculator" and "selection by attribute algorithms". This step would have been an issue if the extraction was just based on filtering the units using the filter option in Qgis environment.

3. Projection Used

Amersfoort/RD New EPSG 28992 was used as the projection system for layers and the project because Amersfoort / RD New is a coordinate reference system (CRS)for Large and medium scale topographic mapping and engineering survey. it uses the Amersfoort geographic 2D CRS as its base CRS and the RD New (Oblique Stereographic) as its projection which is ideal for the Netherlands. (Georepository, n.d.).This projection is useful for mapping a limited amount of areas centred on the point where the plane of the projection is regarded as tangential to the ellipsoid., e.g. the Netherlands(Libgeotiff, n.d.). In more straightforward language, in this CRS, the value of the x coordinate runs from west to east, that of the y coordinate runs from south to north. The central point of the system has the coordinates x = 155 000 m, y = 463 000 m. By

using these coordinates instead of (0; 0), every point in the European Netherlands on land always has a positive value for x and y and the value of the y coordinate is always higher than the x coordinate. This fact prevents confusion between the x and y coordinates. (Kadaster, n.d.)

Analysis

1. Input Layers

S.No	Layer Name (QGIS)	Input Layers(Graphical Modeller)
1	Highway_primary	Highway_Primary
2	Highway_trunk	Highway_Trunk
3	Highway_motorway	Highway_Motorway
4	Public_transport_platform_mod	Bus Stop
5	Railway Station	Railway Station
6	Landuse_industrial	Landuse_Industrial
7	Landuse_construction	Landuse_Construction
8	Landuse_commercial	Landuse_Commercial
9	Sports_center	Sports_Center
10	Park	Park
11	Car_parking_mod	Car Park
12	Bicycle_parking_mod	Bike_Parking
13	Eateries_Restaurant	Restaurant
14	Eateries_Bar	Bar
15	Eateries_Cafe	Cafe
16	ATM	ATM
17	Bank	Bank
18	Eindhoven city	Eindhoven City

2. Geoprocessing Tools Used

The following geoprocessing tools were used in the analysis.

○ Buffer

Buffer was used to satisfying the following expressions

S.No	Input Layers(Graphical Modeller)	Expression
1	Highway_Primary	The location should be at least 500 m away
2	Highway_Trunk	
3	Highway_Motorway	
4	Bus Stop	The location should be at most 300 m away.
5	Railway Station	
6	Sports_Center	The location should be at most 500 m away.
7	Park	
8	Car Park	The location should be at most 300 m away.
9	Bike_Parking	
10	Restaurant	The eateries should be at least 250 m away from the location and at most 1000 m away. Hence two buffer functions were used.
11	Bar	
12	Cafe	
13	ATM	The location should be at most 1000 m away
14	Bank	

○ Union

Union was used for selecting

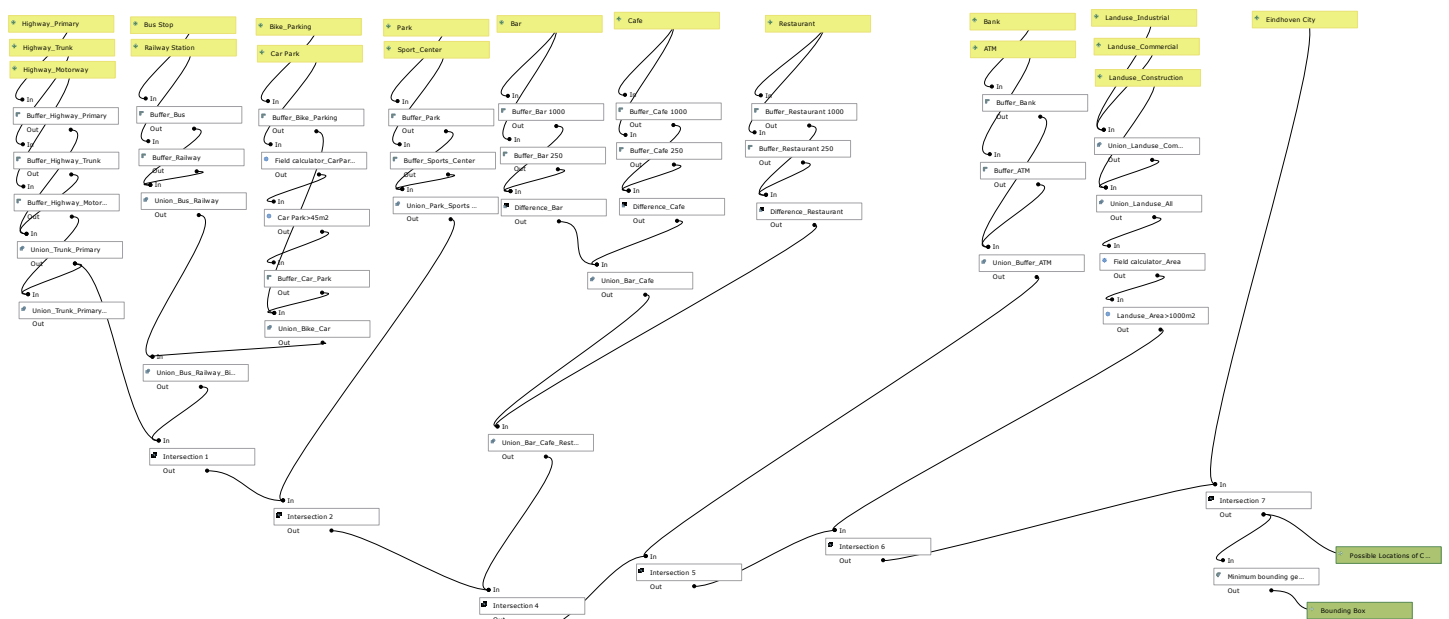
- all the three type of motorways,
- ATMs and banks,
- cafe, bars and eateries,
- bicycle parking space, car parking space with bus platforms and trains

to satisfy the selection of any one of the elements present in the union.

- Difference
The difference was used along with Buffer to satisfy the condition "Eateries should be 250 m away from the location and at most 1000 m away".
- Intersection
The intersection was used to find the places which satisfy all the conditions.
- Field Calculator along with Selection by Attribute
It was used to calculate the area for land use keys and car parking and make subsequent selections, satisfying the conditions $\text{Area} > 1000\text{m}^2$ and $\text{Area} > 45\text{m}^2$ respectively.
- Minimum Bounding Geometry
This was used to create a boundary box for the final locations that were left after the analysis.

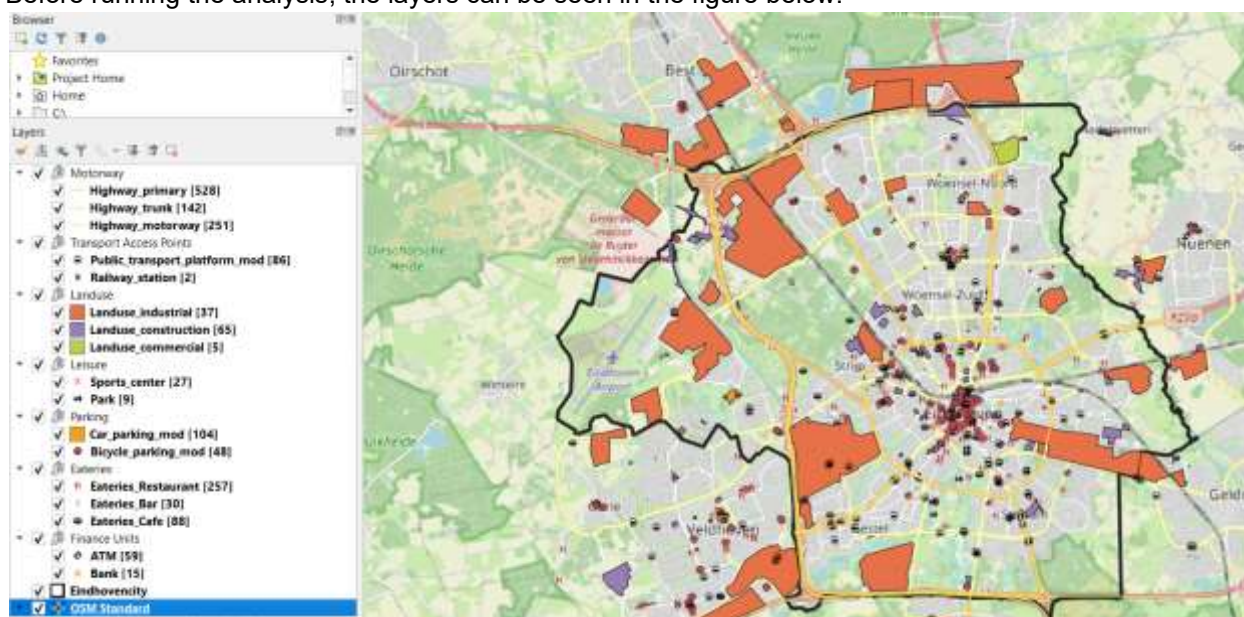
3. The sequence in Graphic Modeller

Please also find the sequence of the geoprocessing tools in Appendix A



4. The output of the model

Before running the analysis, the layers can be seen in the figure below.



The output can be seen in the image below.



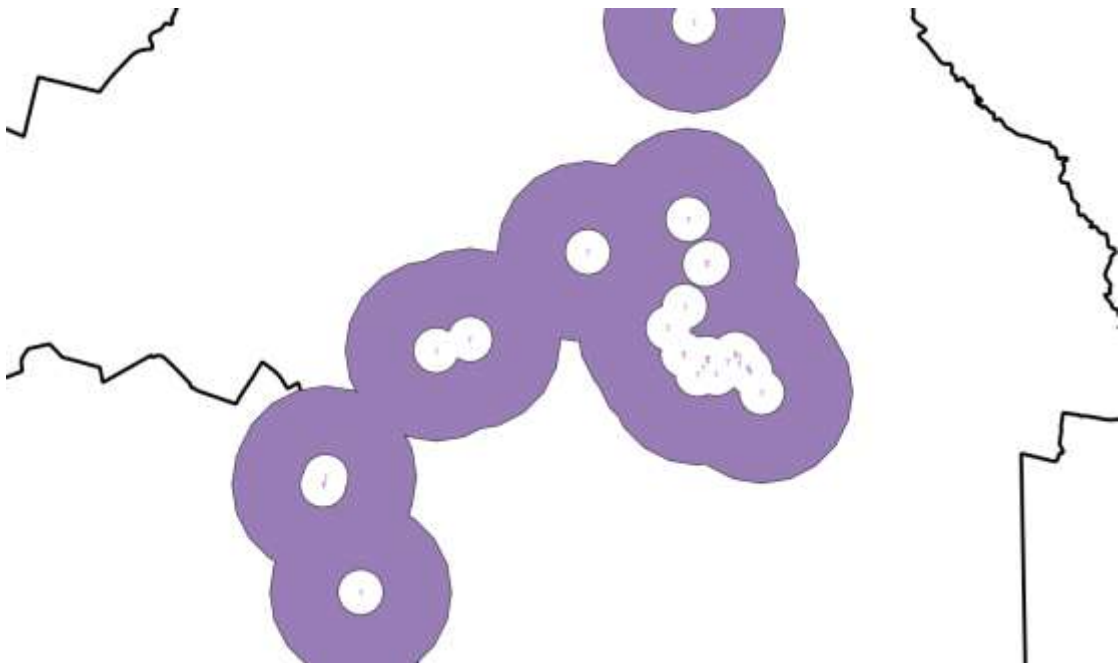
Results

The following images showcase different results rendered during the analysis.

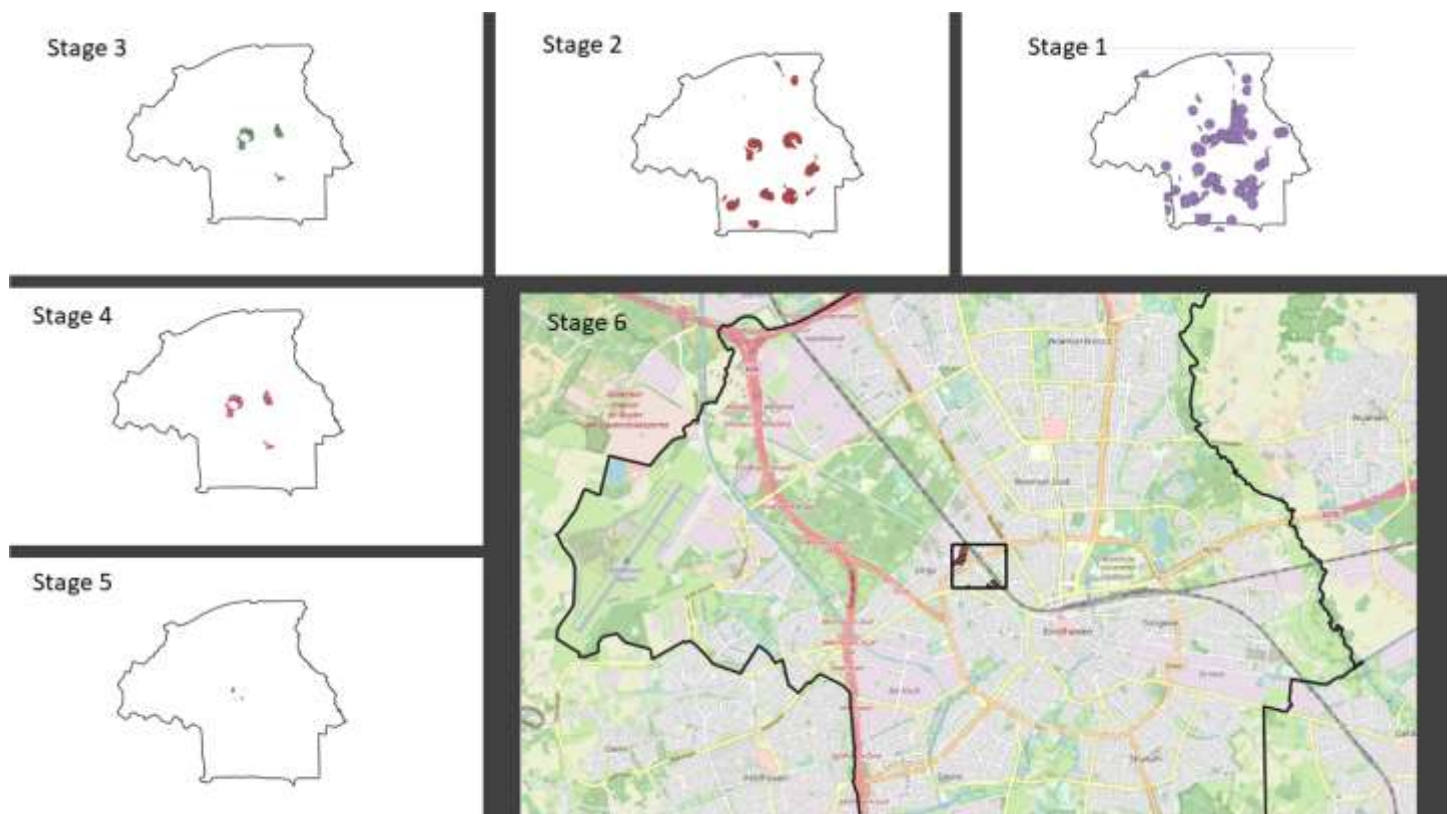
- Car parking with an area greater than 45 m²:



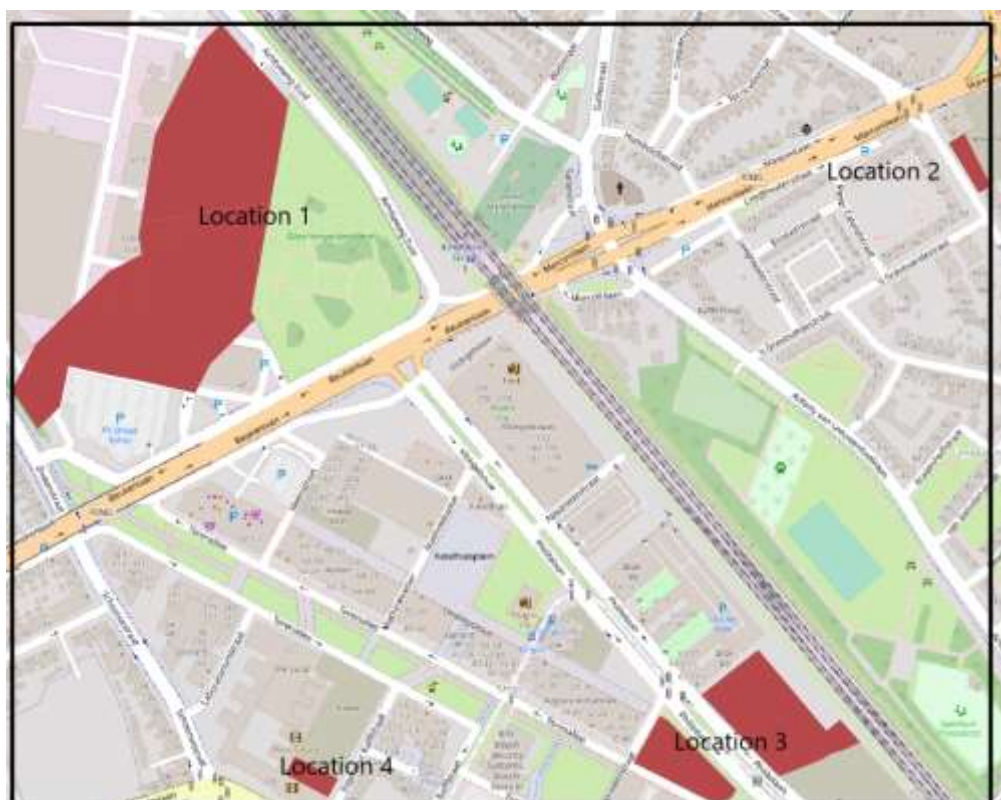
- Bars should be at least 250 m away and at most 1000 m away from the possible locations



- Stages of the intersection leading to the final location:



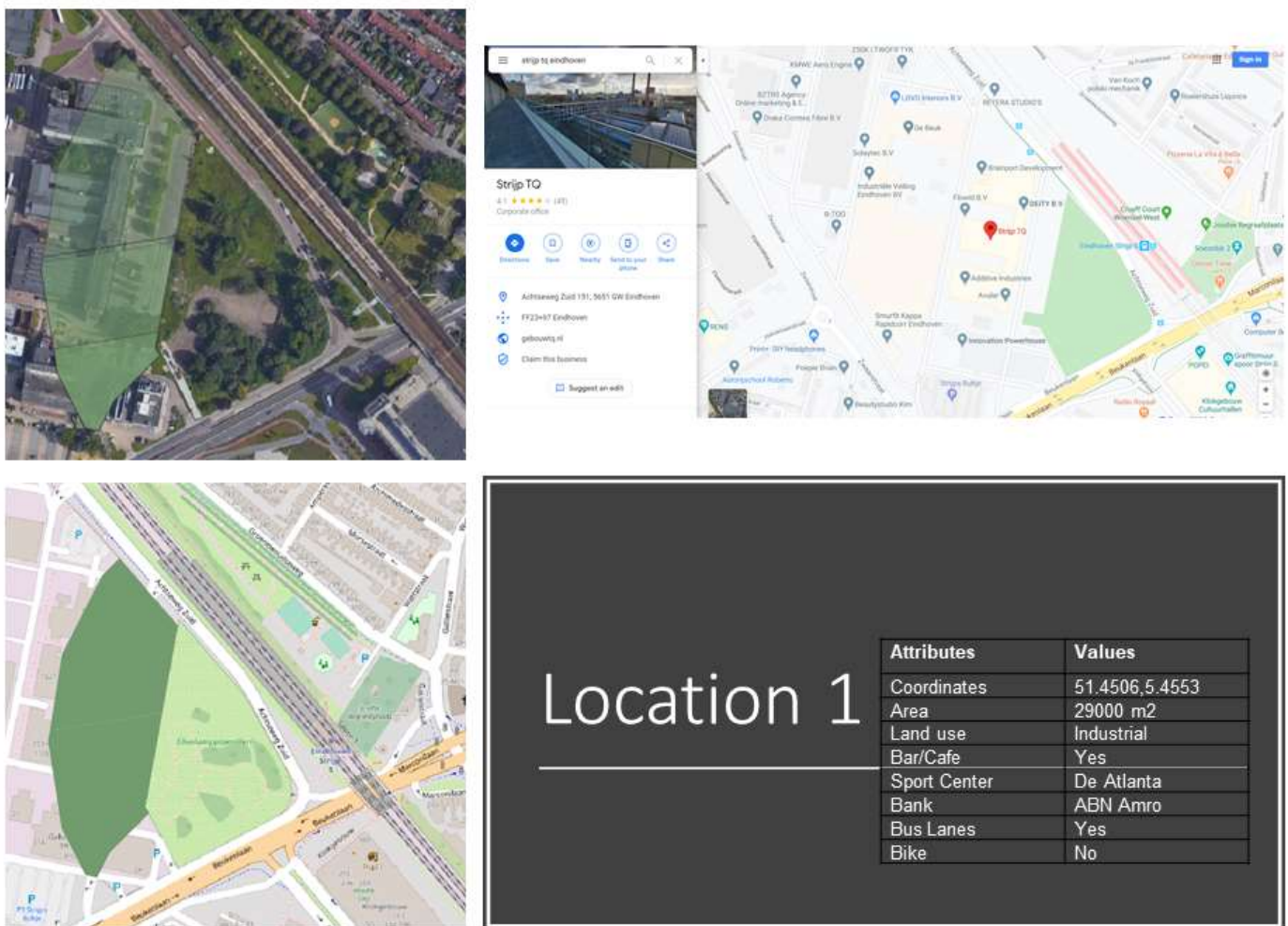
- The final result of the analysis rendered four locations, as shown in the figure below:



Conclusion and Discussion

1. Final three locations

The figures below showcase the comparison of the possible locations on the open street map and google maps.



The area selected in the map has buildings Strijp TQ/Gebouw TQ and Strijps Butje, the parking space. The building Strijp TQ has units available for rent for companies as follows:

- Unit 5.1 – 1630 m²
- Unit 5.4 – 1800 m²
- Storage and Archive Space – 460 m²
- Basement 5.0 – 313 m²
- Nuclear Cellar 5.1 – 400 m²(StrijpT, n.d.).

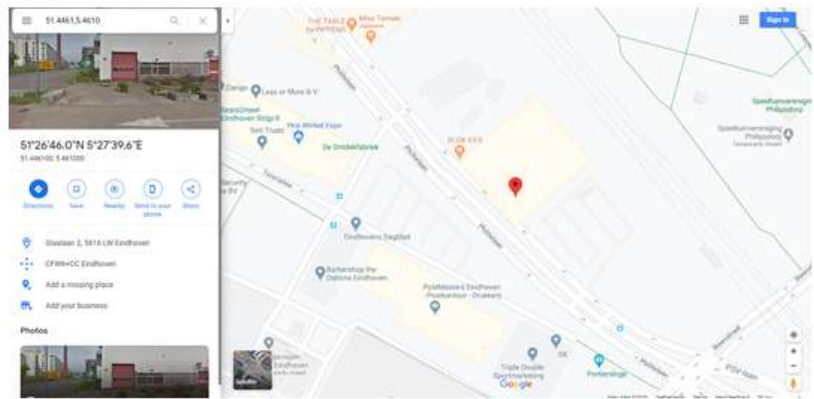
GEVA BV, also the owner of the entire Strijp-T area, has made a plan for the park "Gloeilampplantsoen" that is the front garden of the Strijp TQ, which has just been completely renovated. The developer, owned by the Goevaers family, sees the area as a green buffer between Strijp-S and -T. (Theeuwen, 2019). The nearest bus station 'Eindhoven, Zwaanstraat' is approximately 330 meters away, and the closest train station 'Eindhoven' is at least 2000 meters away from the location. The average WOZ value of the vacant plots with no buildings built is € 218,000. (Drimble, 2020d)



Location 2

Attributes	Values
Coordinates	51.451005,5.463757
Area	750 m2
Land use	Construction
Bar/Cafe	Yes
Sport Center	De Atlanta
Bank	ABN Amro
Bus Lanes	Yes
Bike	No
Car Parking	Yes

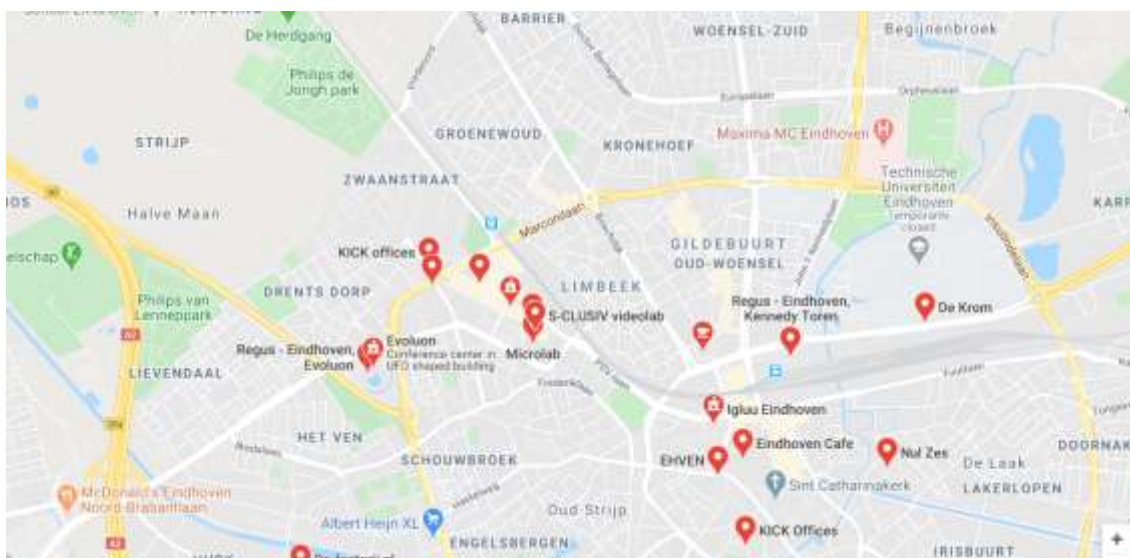
The area is a residential zone with a building permit, and construction permission was granted in 2019. The nearest bus station 'Eindhoven, Gemmastraat' is 119 meters away. The nearest train station 'Eindhoven' is at 1,484 meters away. Avg. WOZ value for the block is € 200,955. (Drimble, 2020b)

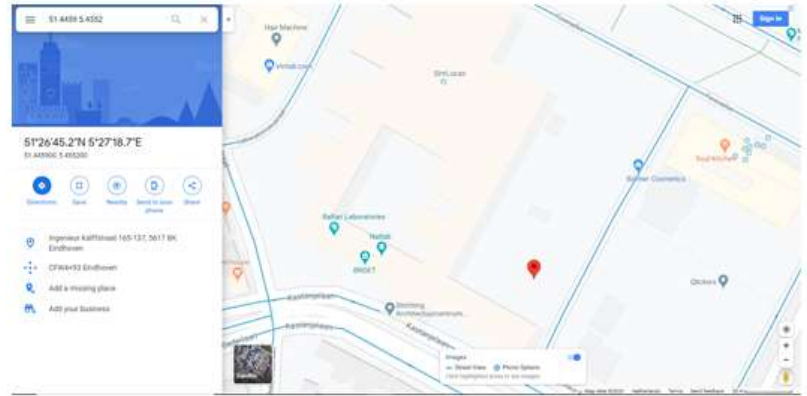


Location 3

Attributes	Values
Coordinates	51.4461, 5.4610
Area	6900 m ²
Land use	Construction
Bar/Cafe	Yes
Sport Center	De Atlanta
Bank	ABN Amro
Bus Lanes	Yes
Bike	No
Car Parking	Yes

The area is around Philetlaan 63-01 and has a cafe nearby named as Blok -63 S. The nearest bus stand is approximately 120 m away. The average WOZ value of the property is € 253,935(Drimble, 2020c). There are already a lot of coworking spaces in Location 3, as shown in the figure below, so there is a lot of competition in the area. However, it can also be assumed that the demand for coworking spaces in the area are more too.





Location 4

Attributes	Values
Coordinates	51.4459 5.4552
Area	800 m2
Land use	Construction
Bar/Cafe	Yes
Sport Center	De Atlanta
ATM	RaboBank
Bus Lanes	No
Bike	No
Car Parking	Yes

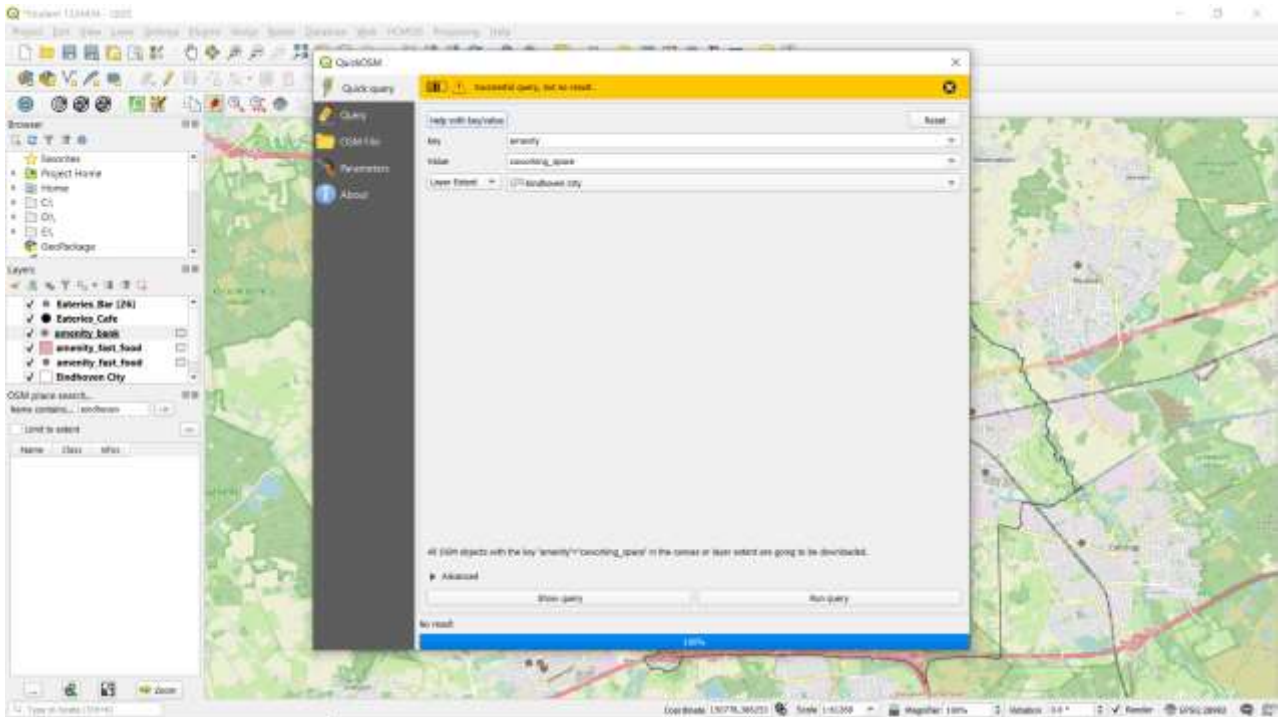
The area is Ir Kalfstraat, 5617BL Eindhoven. The nearest bus station 'Eindhoven, Strijp S-Ir. Kalfstraat' is 186 meters away. The average WOZ value of properties around is € 344,672. The area is mixed with residential and commercial properties around.(Drimble, 2020a)

Among the four locations, location 2 is a residential area, and hence it is not selected. Location 1, 3 and 4 are selected.

S.no	Location Coordinates ^a	Address ^b	Average WOZ Value ^c	Type
1	51.4506,5.4553	Achtseweg Zuid, 5617 AB Eindhoven	€ 218,000	Rental Property
2	51.4461,5.4610	Glaslaan 2, 5616 LW Eindhoven	€ 253,935	New Construction
3	51.4459 5.4552	Ir Kalfstraat, 5617BL Eindhoven.	€ 344,672.	New Construction
Sources a. QGIS b. Google Maps c. Drimble.com				

2. Shortcomings in the project.

- No Coworking spaces were found in Eindhoven after running query in Quick OSM. However, there are a lot of coworking spaces that exist in Eindhoven. So adding them may change the selection criteria for coworking spaces.



- As stated before, during the analysis phase, to increase the number of prospective locations, it was decided to select a place that may have proximity to the railway station or a bus stop or have a car parking or have a bike parking.
- The land use key values can be further refined and looked into to create a better analysis.

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Appendix A

