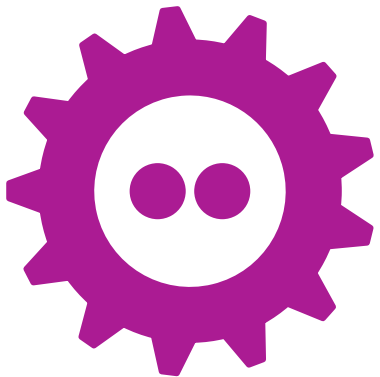
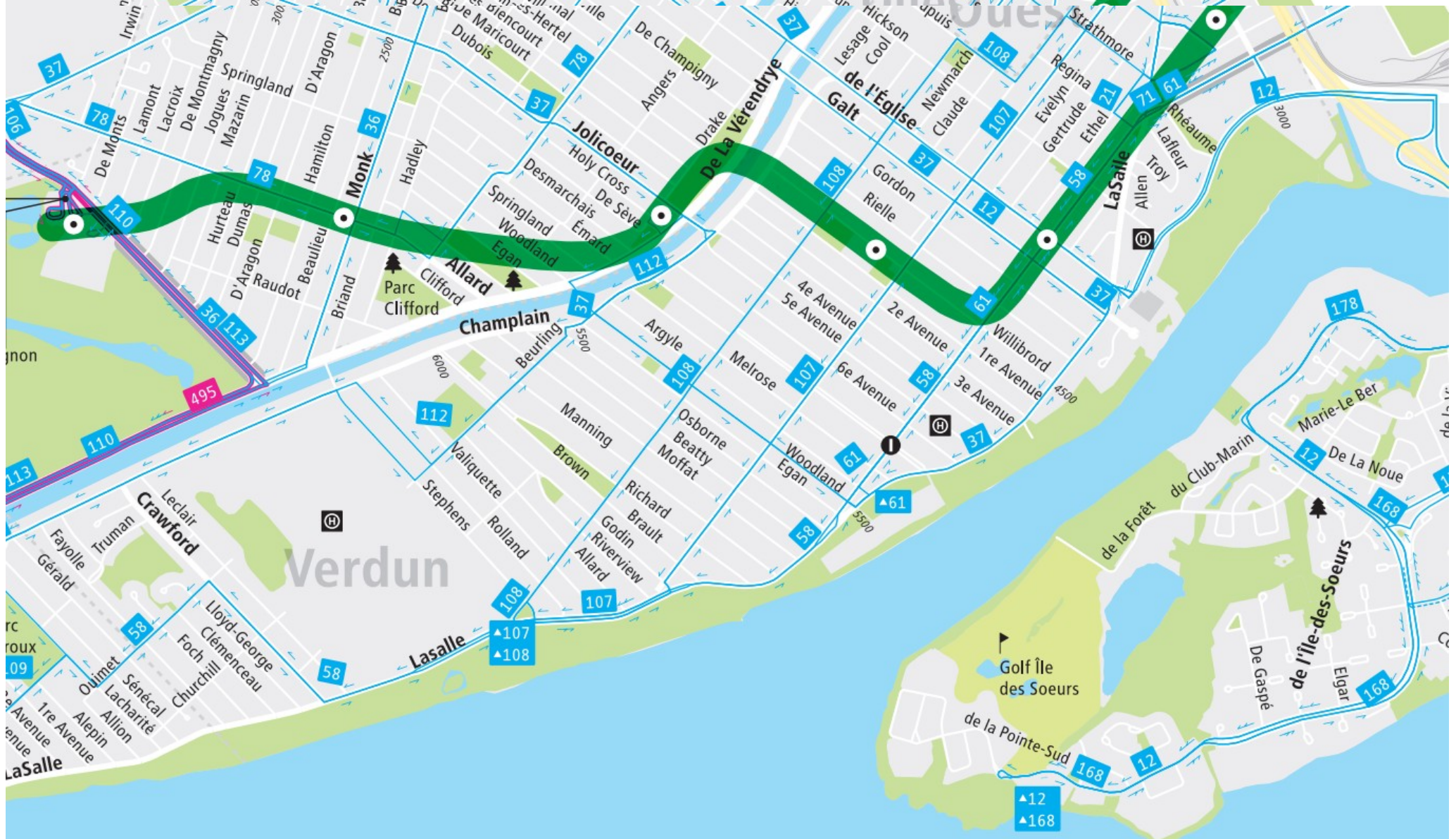


Transit network planning for everyone
optimise your network, reduce transit
time for users!

Presented by Yannick Brosseau

Room: AW1.126
Start: 12:00





Transition

<http://transition.city>

<https://github.com/chairemobilite/transition/>

<https://yannickbrosseau.com>

« Make a transit planning tool that answers the needs of professional planners but is easy enough for everybody »



Who are we?

<https://www.polymtl.ca/mobilite/>



**POLYTECHNIQUE
MONTREAL**

UNIVERSITÉ
D'INGÉNIERIE

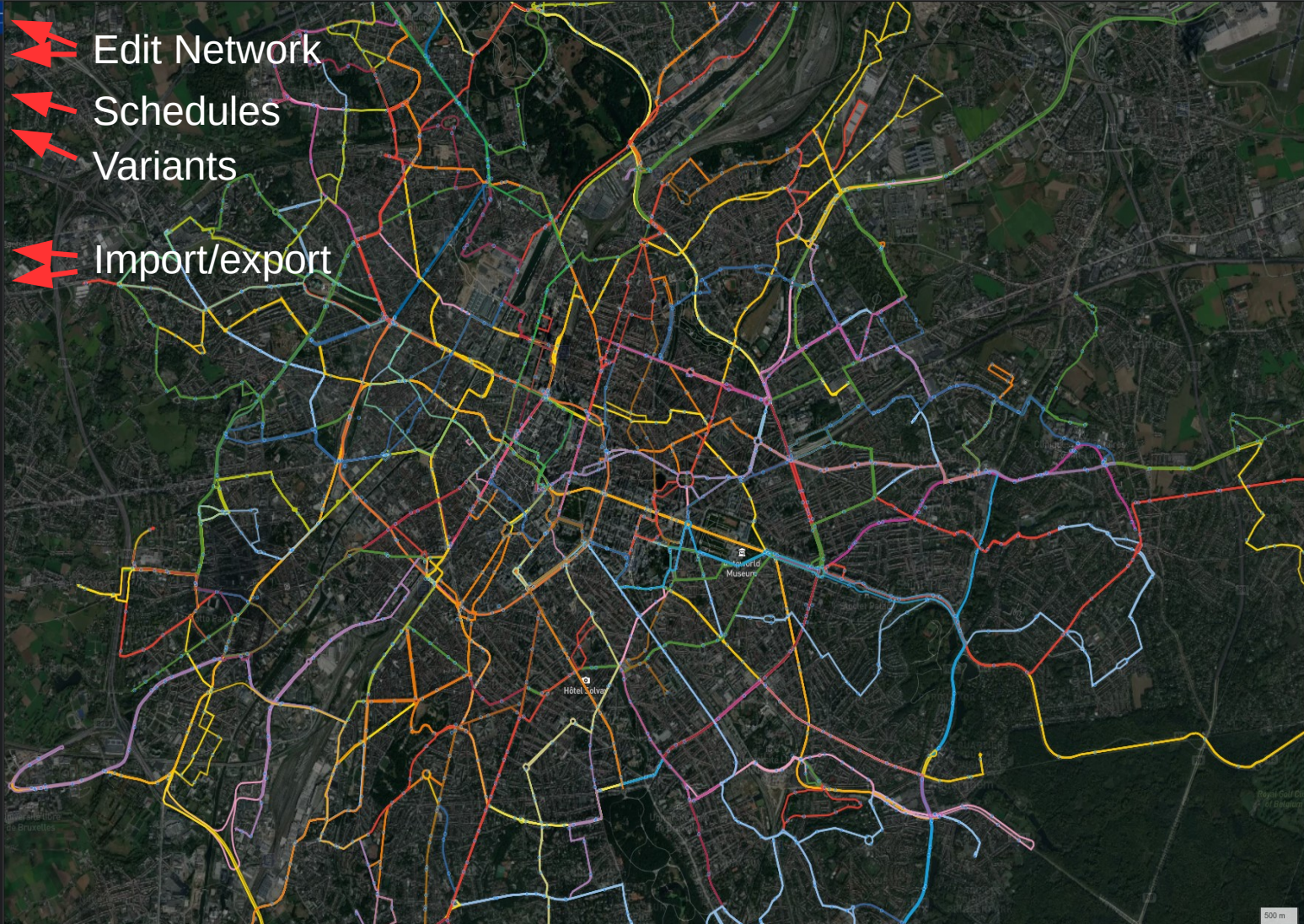


Applied research : Our toolbox

- Evolution (Travel survey platform)
- Os2car (Congestion)
- Octavi (Taxi)
- Transition (Transit planning)
 - Include TrRouting



- ← Edit Network
- ← Schedules
- ← Variants
- ← Import/export



AGENCIES

STIB-MIVB STIB 92 lines

Lines

1	GARE DE LOUEST - STOCKEL	15 paths 3 service
2	SIMONIS - ELISABETH	6 paths 3 service
3	ESPLANADE - CHURCHILL	10 paths 3 service
4	GARE DU NORD - STALLE (P)	13 paths 9 service
5	ERASME - HERRMANN-DEBROUX	20 paths 3 service
6	ROI BAUDOUIIN - ELISABETH	12 paths 3 service
7	VANDERKINDERE - HEYSEL	23 paths 3 service
8	LOUISE - ROODEBEEK	14 paths 3 service
9	SIMONIS - ROI BAUDOUIIN	5 paths 6 service
12	BRUSSELS AIRPORT - BRUSSELS CITY	5 paths 4 service
13	ETANGS NOIRS - UZ-VUB	2 paths 3 service
14	UZ-VUB - GARE DU NORD	2 paths 3 service
17	BEAULIEU - HEILIGENBORRE	4 paths 3 service
19	GROOT-BIJGAARDEN - DE WAND	12 paths 10 service
20	HUNDERENVELD - GARE DU NORD	4 paths 3 service
21	MAES - LUXEMBOURG	6 paths 4 service
25	BOONDAEL GARE - ROGIER	13 paths 3 service
27	LUXEMBOURG - PLEIADES	4 paths 3 service
28	BRABANCONNE - KONKEL	10 paths 4 service
29	DE BROUCKERE - HOF TEN BERG	11 paths 3 service
33	DANSAERT - LOUISE	2 paths 4 service
34	PORTE DE NAMUR - SAINTE-ANNE	15 paths 3 service
36	SCHUMAN - KONKEL	6 paths 3 service
37	ALBERT - GARE DE LINKEBEEK	4 paths 3 service
38	GARE CENTRALE - HEROS	6 paths 3 service
39	MONTGOMERY - BAN-EIK	13 paths 3 service
41	HEROS - TRANSVAAL	11 paths 3 service
42	ROODEBEEK - VIADUC E40	3 paths 3 service
43	OBSERVATOIRE - VIVIER D'OIE	13 paths 3 service
44	MONTGOMERY - TERVUREN STATION	9 paths 3 service
45	ROODEBEEK - SAINT-VINCENT	7 paths 5 service
46	MOORTEBEEK - WTC-GLIBERT	9 paths 5 service
47	HEEMBEEK - VILVOORDE STATION	6 paths 6 service
48	ANNESENS - DECROLY	13 paths 5 service
49	GARE DU MIDI - SIMONIS	14 paths 5 service
50	GARE DU MIDI - LOT STATION	5 paths 4 service
51	STADE - VAN HAELEN	19 paths 6 service
52	GARE CENTRALE - FOREST (BERVOETS)	6 paths 3 service
53	WESTLAND SHOPPING - HOPITAL MILITAIRE	3 paths 4 service
54	TRONE - FOREST (BERVOETS)	3 paths 4 service
55	DA VINCI - ROGIER	8 paths 5 service

Service: 246823001	Periods: Default	323 trips		
Service: 246670500	Periods: Default	207 trips		
Service: 246629600	Periods: Default	163 trips		

+ New timetable

Service: 246823001
 Periods group: Default

Allow second-based timetables Yes No

Save timetable

4:00 → 6:00 • Morning (4-6AM)	6:00 → 9:00 • AM Peak (6-9AM)	9:00 → 15:00 • Midday (9AM-15PM)	15:00 → 18:00 • PM Peak (3-6PM)	18:00 → 23:00 • Evening (6-11PM)	23:00 → 28:00 • Night (11PM-4AM)
Outbound path	Outbound path	Outbound path	Outbound path	Outbound path	Outbound path
Inbound path	Inbound path	Inbound path	Inbound path	Inbound path	Inbound path
Interval (sec.)	Interval (sec.)	Interval (sec.)	Interval (sec.)	Interval (sec.)	Interval (sec.)
Number of units (vehicles)	Number of units (vehicles)	Number of units (vehicles)	Number of units (vehicles)	Number of units (vehicles)	Number of units (vehicles)
First trip start time (HH:MM)	First trip start time (HH:MM)	First trip start time (HH:MM)	First trip start time (HH:MM)	First trip start time (HH:MM)	First trip start time (HH:MM)
4:00	6:00	9:00	15:00	18:00	23:00

Empty timetable

Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound	Outbound	Inbound
4:59:00	5:12:00	6:00:00	6:06:00	9:00:00	9:03:00	15:04:00	15:00:00	18:01:00	18:00:00	23:04:00	23:12:00
5:08:00	5:16:00	6:06:00	6:16:00	9:07:00	9:10:00	15:08:00	15:06:00	18:07:00	18:06:00	23:19:00	23:27:00
5:28:00	5:19:00	6:08:00	6:22:00	9:14:00	9:17:00	15:12:00	15:12:00	18:13:00	18:13:00	23:34:00	23:42:00
5:36:00	5:34:00	6:10:00	6:25:00	9:21:00	9:21:00	15:18:00	15:18:00	18:19:00	18:16:00	23:49:00	23:57:00
	5:44:00	6:20:00	6:27:00	9:27:00	9:24:00	15:24:00	15:24:00	18:25:00	18:22:00	24:04:00	24:11:00
	5:46:00	6:28:00	6:27:00	9:34:00	9:32:00	15:25:00	15:30:00	18:31:00	18:30:00	24:19:00	24:18:00
		6:31:00	6:30:00	9:37:00	9:39:00	15:32:00	15:36:00	18:37:00	18:32:00	24:34:00	24:30:00
		6:36:00	6:37:00	9:43:00	9:46:00	15:39:00	15:43:00	18:43:00	18:41:00	24:48:00	24:42:00
		6:37:00	6:37:00	9:50:00	9:49:00	15:46:00	15:49:00	18:49:00	18:48:00	25:03:00	24:55:00
		6:45:00	6:48:00	9:57:00	9:54:00	15:53:00	15:55:00	18:55:00	18:50:00		25:11:00
		6:49:00	6:49:00	10:05:00	10:01:00	16:00:00	16:01:00	19:00:00	18:57:00		
		6:51:00	6:54:00	10:12:00	10:09:00	16:06:00	16:06:00	19:03:00	19:03:00		
		7:00:00	7:00:00	10:20:00	10:16:00	16:12:00	16:12:00	19:08:00	19:10:00		
		7:01:00	7:07:00	10:27:00	10:24:00	16:18:00	16:18:00	19:14:00	19:19:00		
		7:08:00	7:12:00	10:35:00	10:32:00	16:24:00	16:24:00	19:24:00	19:22:00		
		7:15:00	7:18:00	10:42:00	10:40:00	16:26:00	16:29:00	19:34:00	19:28:00		
		7:21:00	7:24:00	10:49:00	10:47:00	16:30:00	16:35:00	19:44:00	19:36:00		
		7:24:00	7:29:00	10:57:00	10:54:00	16:36:00	16:41:00	19:54:00	19:38:00		

Basic fields

Agency: STIB-MIVB STIB

Number: 8

Name: LOUISE - ROODEBEEK

Mode: Tram

Right-of-way category (ROW):

Color: Yes No

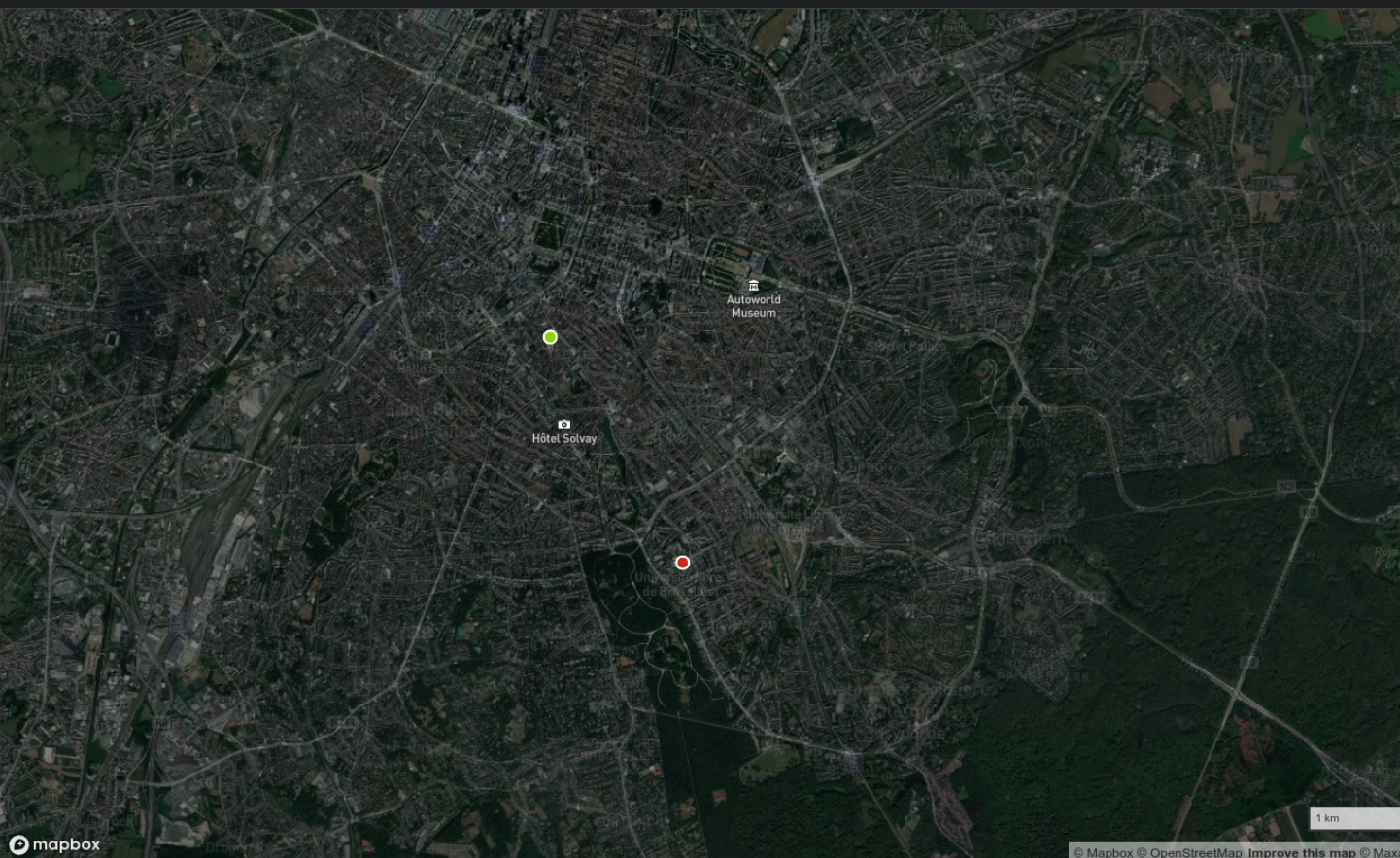
Autonomous vehicles (no driver): Yes No

Allow transferring to the same line: Yes No

Advanced fields

PATHS

Direction	Line	Stops	T _{cp}
Inbound	LOUISE	9 stops	T _{cp} 14 m
Outbound	MUSEE DU TRAM	27 stops	T _{cp} 46.2 m
Inbound	BUYL	16 stops	T _{cp} 24 m
Inbound	BUYL	24 stops	T _{cp} 39.6 m
Outbound	HERRMANN-DEBROUX	23 stops	T _{cp} 39.6 m
Inbound	LOUISE	9 stops	T _{cp} 14 m
Outbound	BUYL	9 stops	T _{cp} 19 m
Outbound	BUYL	9 stops	T _{cp} 20 m
Outbound	ROODEBEEK	23 stops	T _{cp} 32 m
Outbound	ROODEBEEK	31 stops	T _{cp} 46.2 m
Outbound	ROODEBEEK	5 stops	T _{cp} 9 m
Inbound	MUSEE DU TRAM	5 stops	T _{cp} 10 m
Inbound	LOUISE	32 stops	44 m
Inbound	LOUISE	28 stops	T _{cp} 37.4 m



Calculate for the following modes

Transit x | v

Departure time **9:00**

Arrival time

Maximum total travel time including access and egress (minutes) **180**

Minimum waiting time (minutes) **3**
To account for timetable uncertainty, this value should be greater or equal to 1 minute. Suggested value: 3 minutes

Maximum access and egress travel time (minutes) **15**
To avoid long calculation time, this value has a maximum of 20 minutes.

Maximum access travel time when transferring (minutes) **10**
To avoid long calculation time, this value has a maximum of 20 minutes.

Maximum first waiting time (minutes)
If waiting time at first stop is greater than this value for a line, ignore the departure of this line at this stop

Scenario **Test** v

Calculate with alternatives Yes No

Origin latitude **50.8345690819871**

Origin longitude **4.36336056292609**

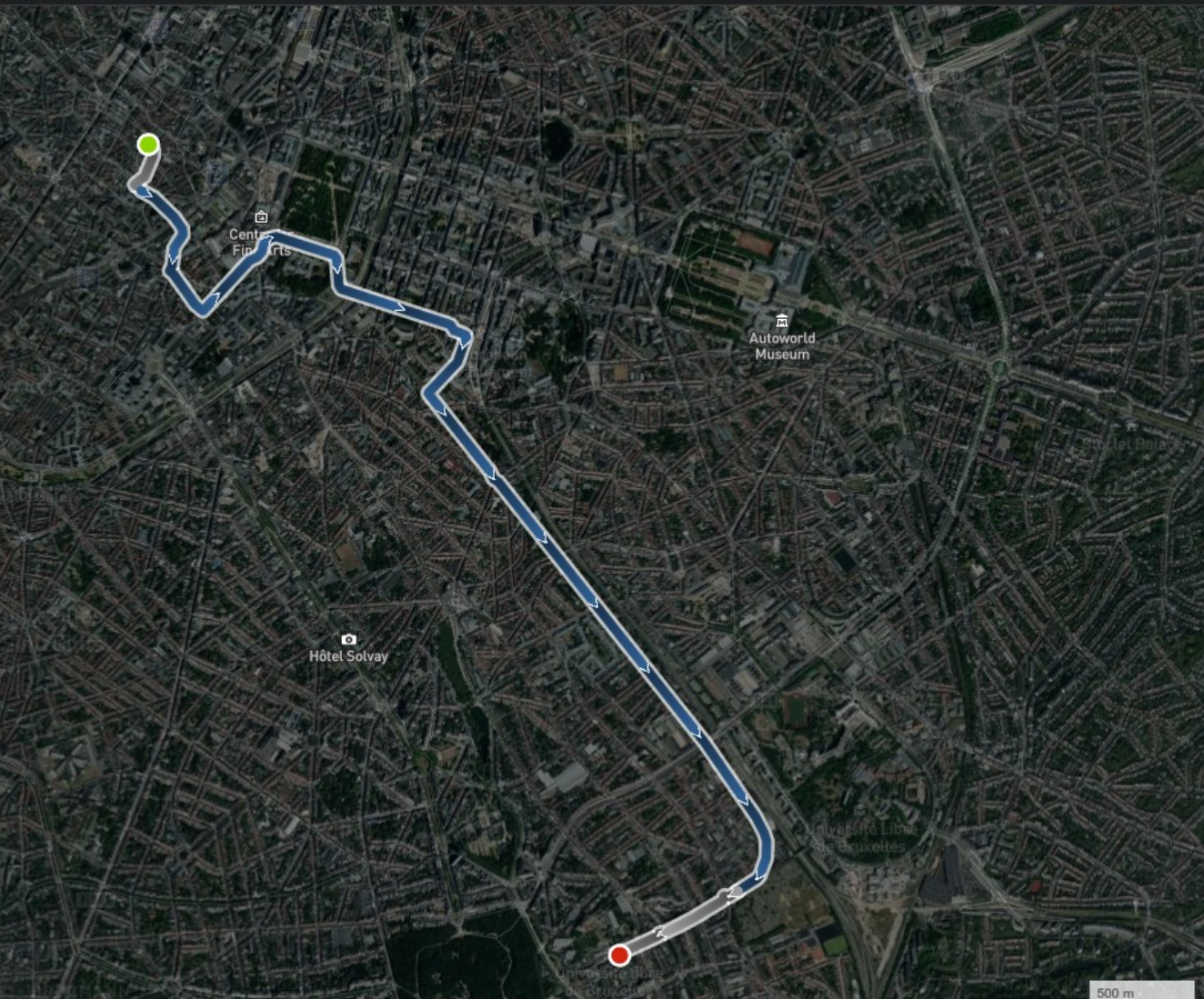
Reverse

Destination latitude **50.813353297926284**

Destination longitude **4.3830041847311065**

Route name

Save this route



Route name

Save this route

Saved routes (CSV) (2)

Reset saved routes

Advanced fields

Transit

Walking

< 1/17 >

Travel time (optimized departure and arrival) 35 min..

Travel time (non-optimized departure and arrival) 35 min..

Optimized departure time 32414

Non optimized departure time 32400

Time lost if departure time not optimized 1 min..

Arrival time 34494

Total distance 6333 m

Access travel time 3 min..

Egress travel time 8 min..

Number of transfers 0

Total access travel time when transferring 0 min..

Total in-vehicle time 21 min..

Total access time (access, egress and access when transferring) 11 min..

Total waiting time when transferring 0 min..

Walk				3 min..	234 m
	GRAND-PLACE			3 min.. (waiting)	
95	GRAND-PLACE - WIENER	WIENER (Outbound)		21 min..	5452 m
	CIM. D'IXELLES				
Walk				8 min..	647 m



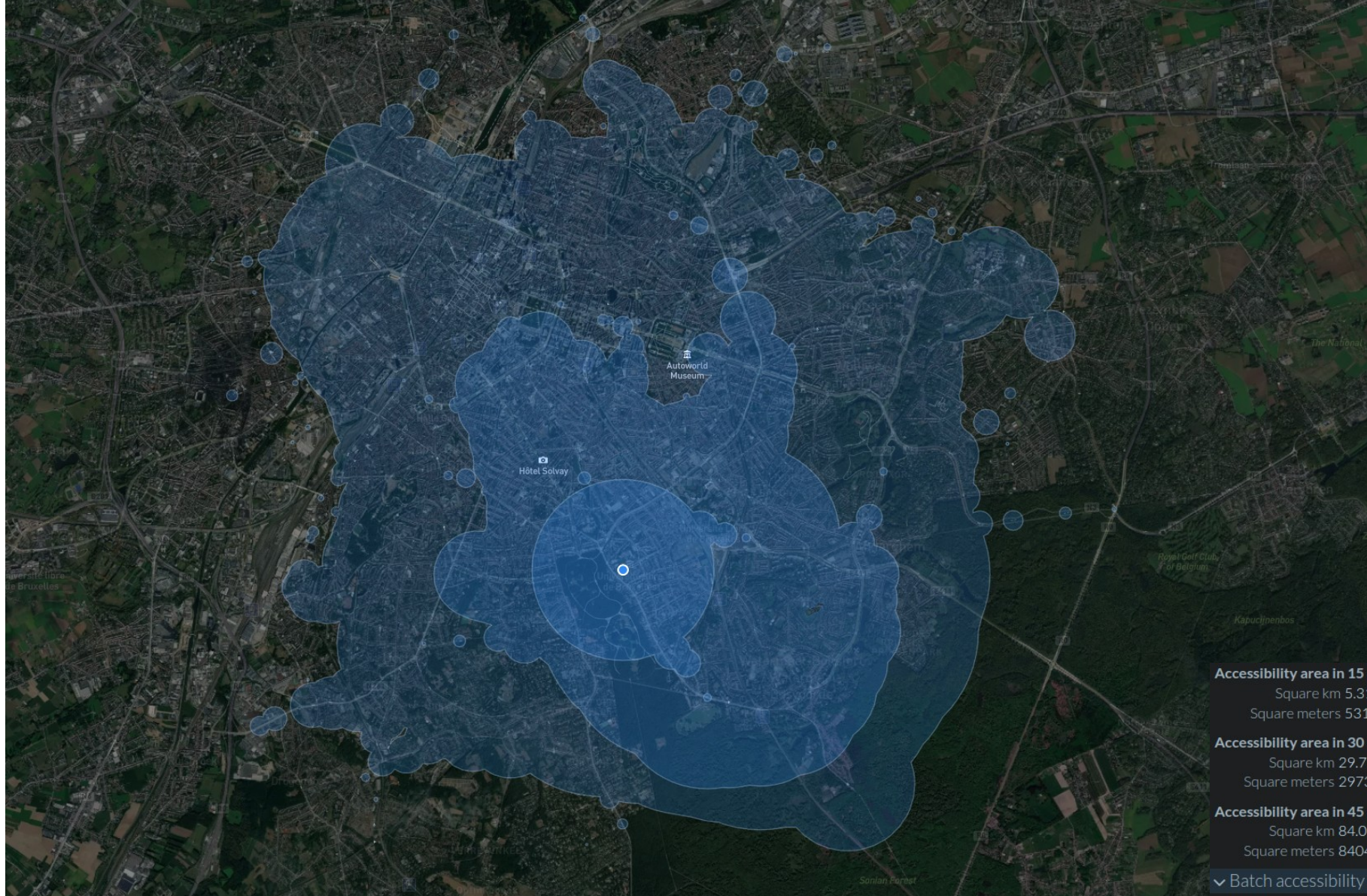
Advanced fields

Transit Walking

< 1/9 >

Travel time (optimized departure and arrival) 37 min..
 Travel time (non-optimized departure and arrival) 39 min..
 Optimized departure time 32496
 Non optimized departure time 32400
 Time lost if departure time not optimized 2 min..
 Arrival time 34710
 Total distance 8444 m
 Access travel time 6 min..
 Egress travel time 2 min..
 Number of transfers 1
 Total access travel time when transferring 4 min..
 Total in-vehicle time 20 min..
 Total access time (access, egress and access when transferring) 11 min..
 Total waiting time when transferring 4 min..

Walk		6 min..	432 m
DE BROUCKERE		3 min.. (waiting)	
5	ERASME - HERRMANN-DEBROUX	HERRMANN-DEBROUX (Outbound)	10 min.. 4962 m
PETILLON			
Walk		4 min..	295 m
PETILLON		4 min.. (waiting)	
25	BOONDAEL GARE - ROGIER	BOONDAEL GARE (Inbound)	10 min.. 2629 m
ULB			
Walk		2 min..	126 m



Accessibility area in 15 minutes

Square km 5.31

Square meters 5310884

Accessibility area in 30 minutes

Square km 29.73

Square meters 29734647

Accessibility area in 45 minutes

Square km 84.05

Square meters 84049972

▼ [Batch accessibility maps \(CSV\)](#)



Autoworld Museum

Hôtel Solvay

Accessibility area in 15 minutes

Square km 5.12
Square meters 5116277

Accessibility area in 30 minutes

Square km 25.17
Square meters 25172466

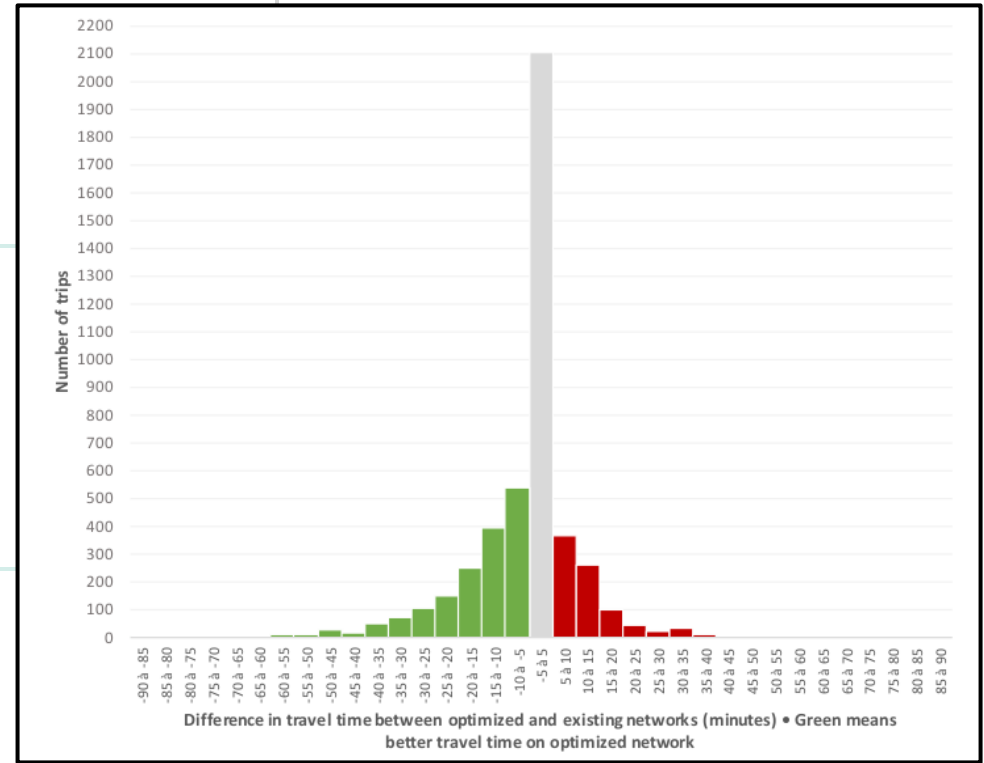
Accessibility area in 45 minutes

Square km 73.87
Square meters 73874145

▼ [Batch accessibility maps \(CSV\)](#)

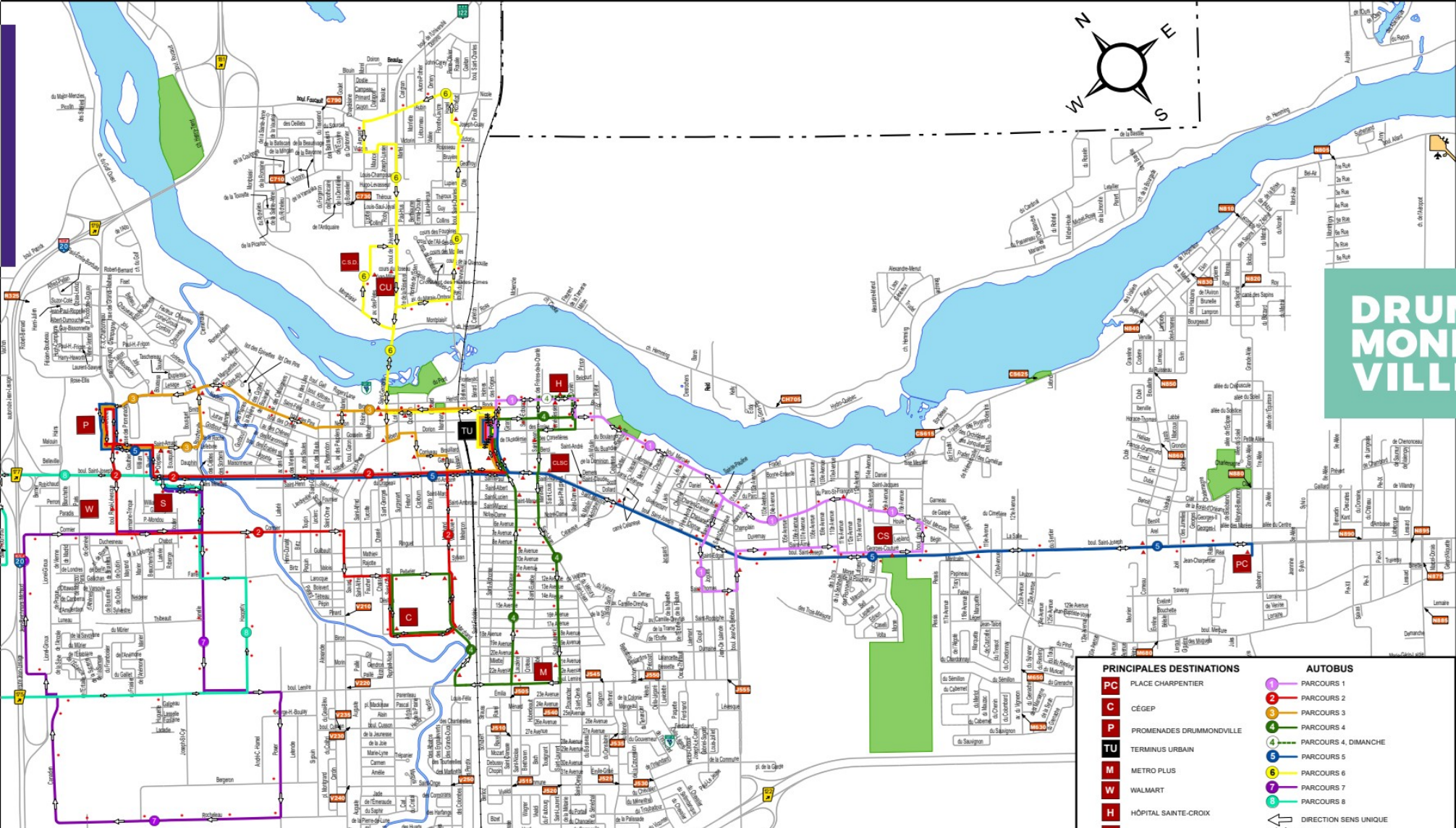
Simulation and optimisation

- Genetic algorithm

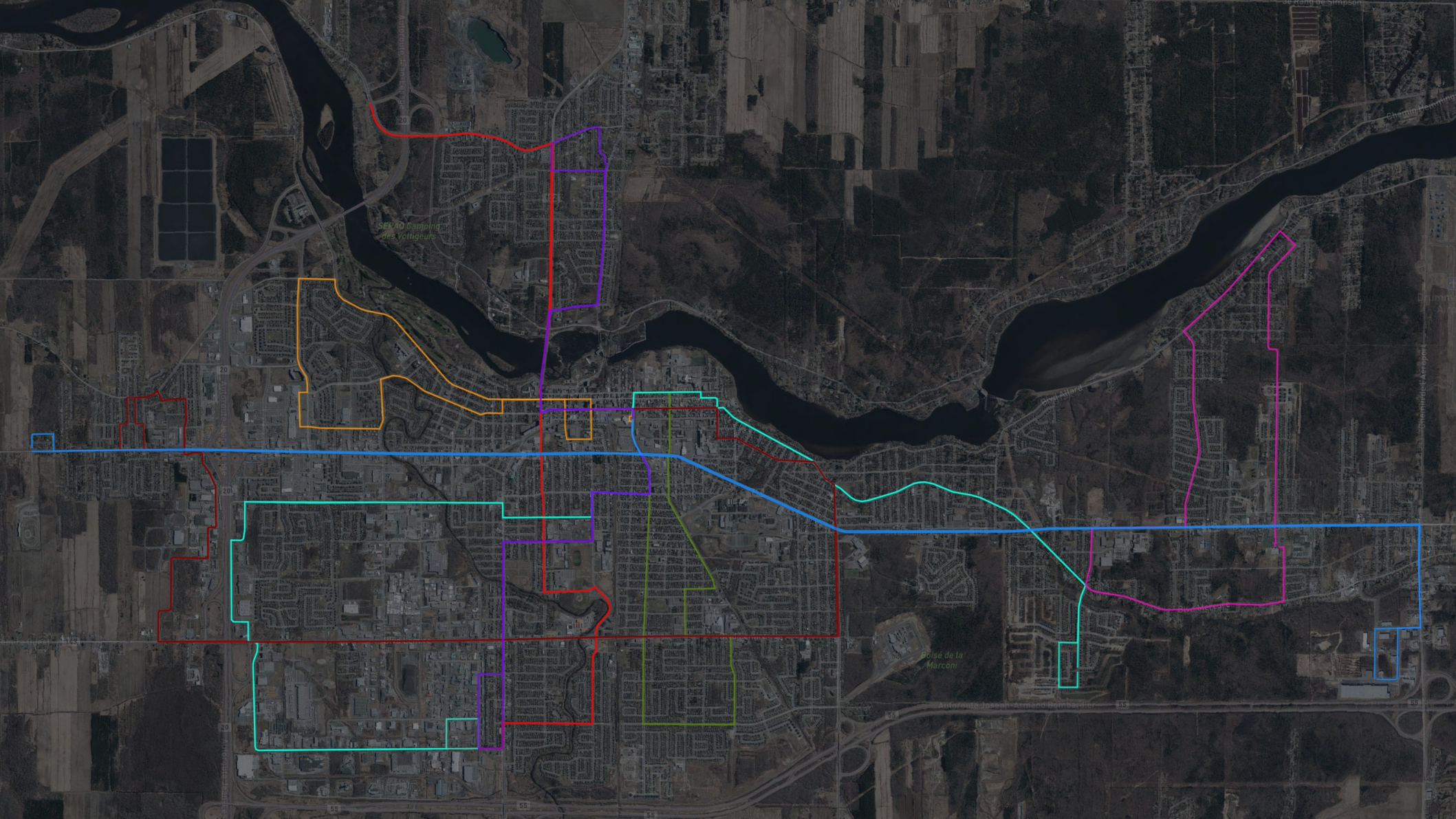


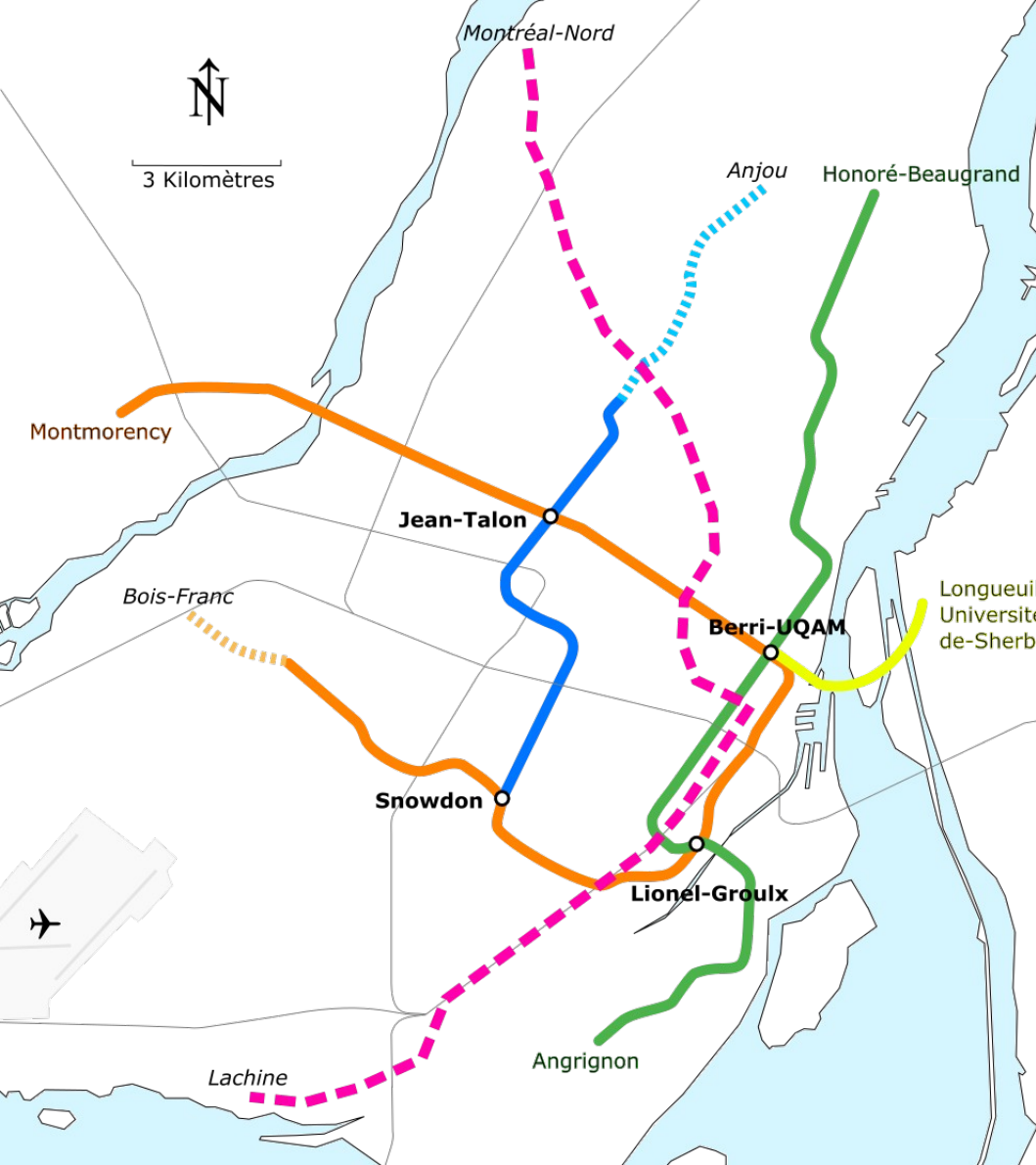


DRUMMONDVILLE

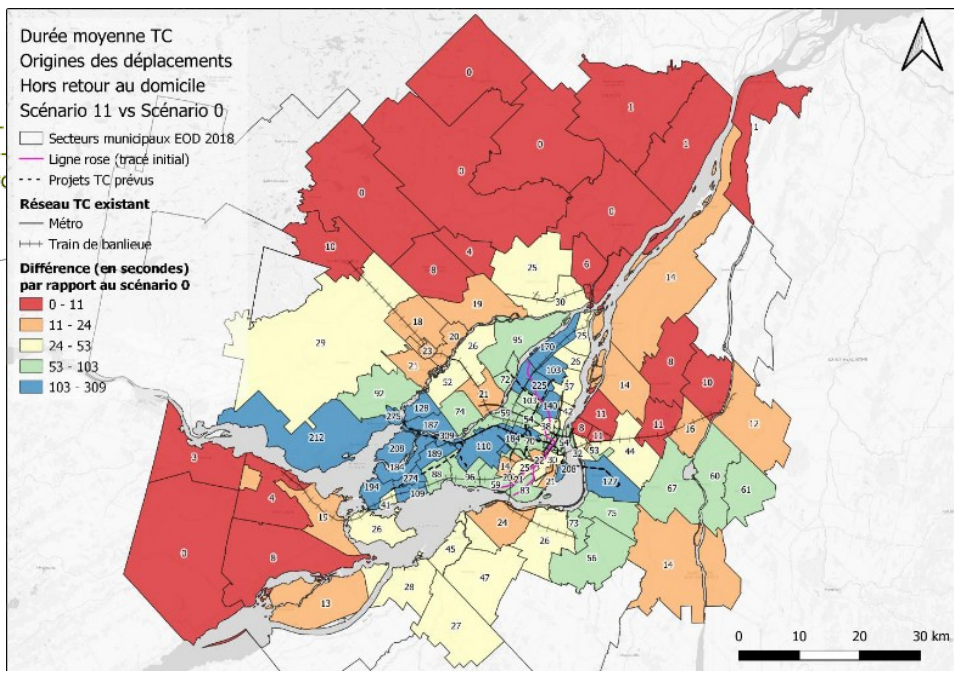


PRINCIPALES DESTINATIONS		AUTOBUS	
PC	PLACE CHARPENTIER	1	PARCOURS 1
C	CÉGEP	2	PARCOURS 2
P	PROMENADES DRUMMONDVILLE	3	PARCOURS 3
TU	TERMINUS URBAIN	4	PARCOURS 4, DIMANCHE
M	METRO PLUS	5	PARCOURS 5
W	WALMART	6	PARCOURS 6
H	HÔPITAL STE-CROIX	7	PARCOURS 7
CLSC	CLSC	8	PARCOURS 8
			DIRECTION SENS UNIQUE
			DIRECTION DOUBLE SENS





Indicateur	Mode	3 - Tracé initial ligne rose ⁴ (NE et GSO)		11 - + projets TC prévus ⁵	
		% dépl.	Gain moy	% dépl.	Gain moy
Durée moyenne [minutes]	Automobile conducteur	4,7%	6,1	14,8%	8,6
	Automobile passager	3,8%	5,9	11,2%	7,3
	Transport en commun	11,5%	5,3	27,3%	6,4
	Marche et vélo	2,9%	3,6	5,0%	3,7
	Autres modes	7,0%	5,6	19,3%	8,9

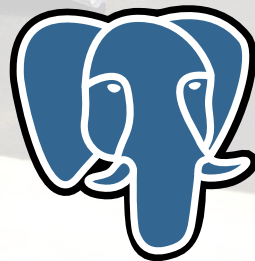
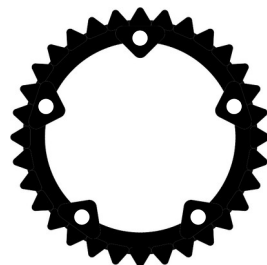




node

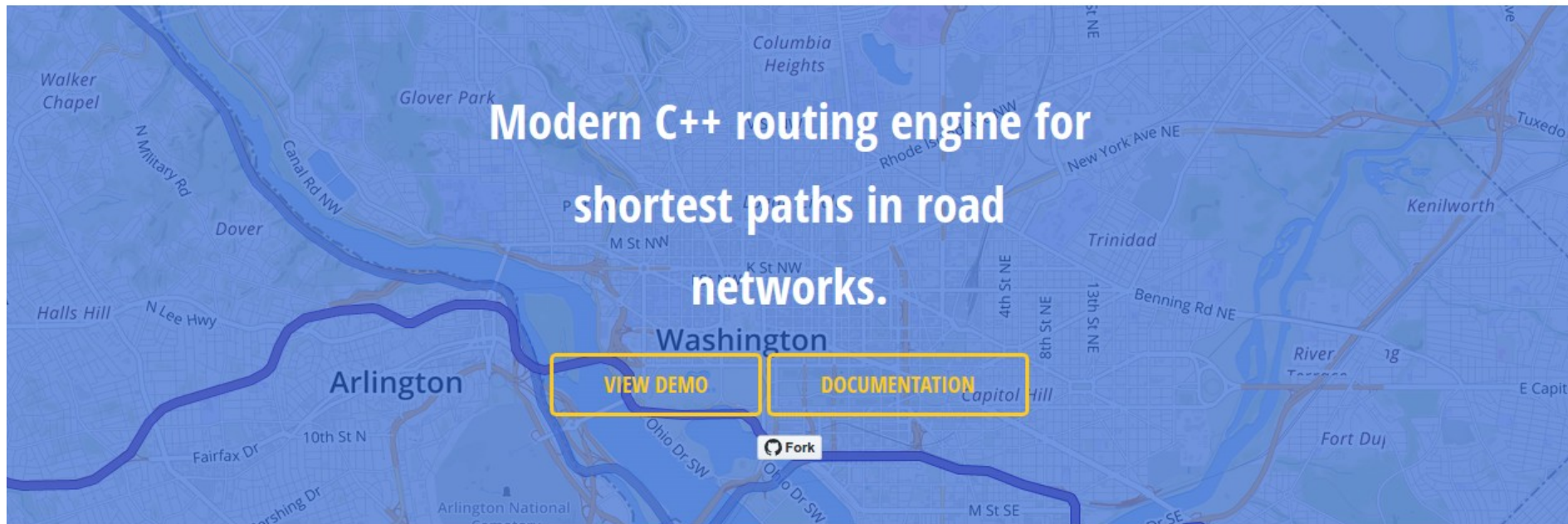
JS[®]

TS





OPEN SOURCE ROUTING MACHINE



Flexible import of
OpenStreetMap data.



Handles continental sized
networks within
milliseconds.



Supports car, bicycle,
walk modes; easily
customized through
profiles.

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trRouting

- Connection Scan Algorithm (CSA)
 - <https://i11www.itl.kit.edu/extra/publications/dpsw-isft-r-13.pdf>
 - Intriguingly Simple and Fast Transit Routing?
 - Julian Dibbelt, Thomas Pajor, Ben Strasser, and Dorothea Wagner, from Karlsruhe Institute of Technology (KIT)
- Written in C++ (Might convert to Rust)

Data Sources

- Road and path network
- Population and places
- Trips

OpenStreetMap

● Most of the required information





Validating the map

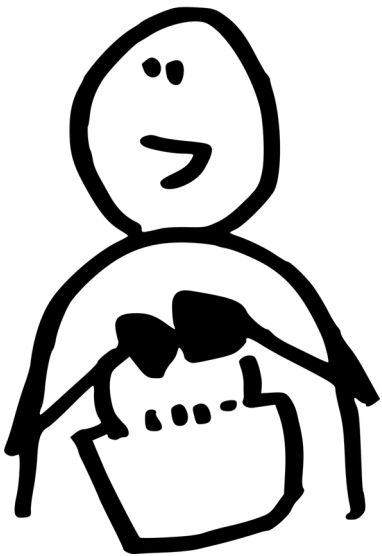
- Pedestrian and cycling link (with connection and access tags)
- Split sidewalks and cycling paths
- Add doors on big buildings
- Realign streets, check one ways, speed limits
- Add all POIs (At least with types and name), draw commercial and industrial buildings, add numbers of floors

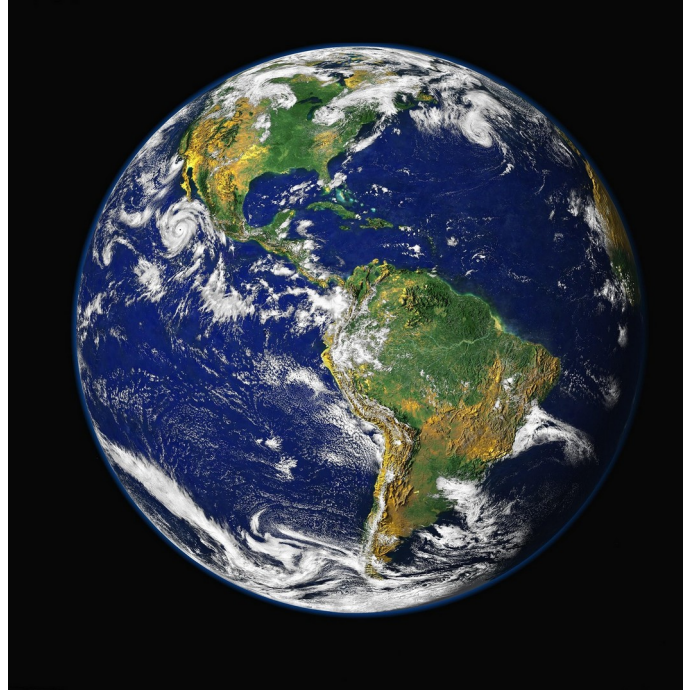
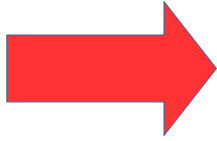
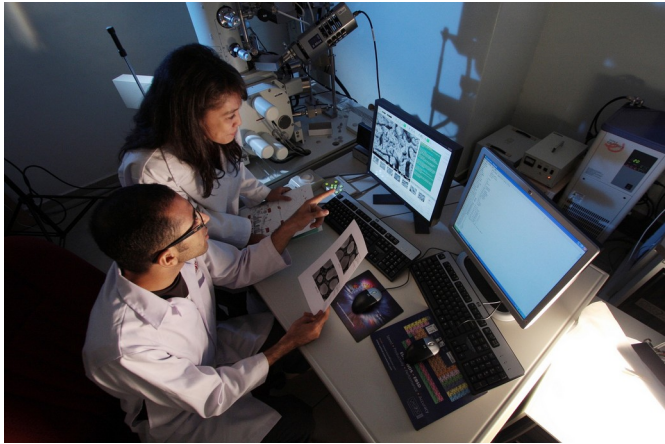


Population

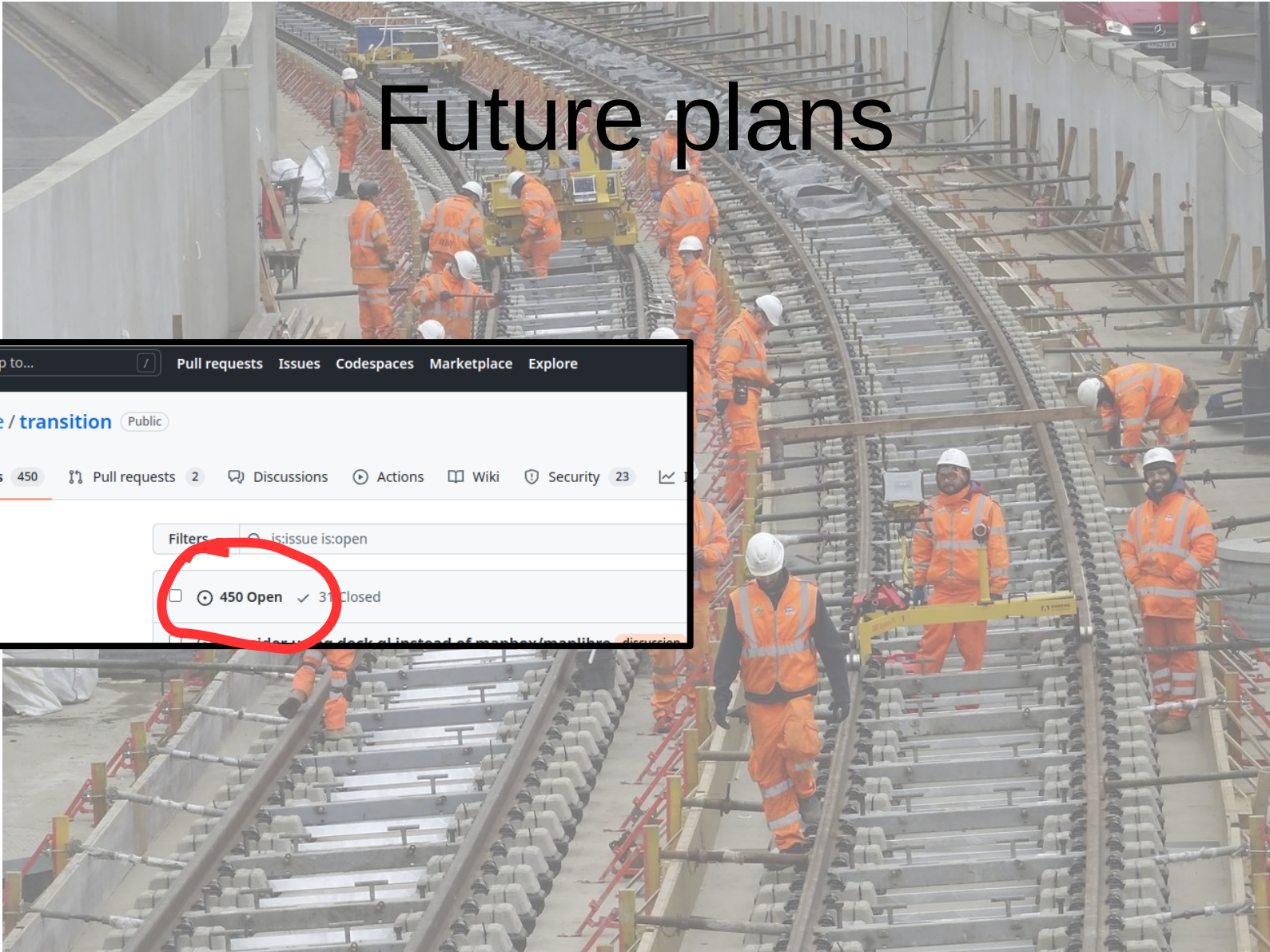
- OSM Buildings
- Land use registers
- Census information

Travel surveys





Future plans



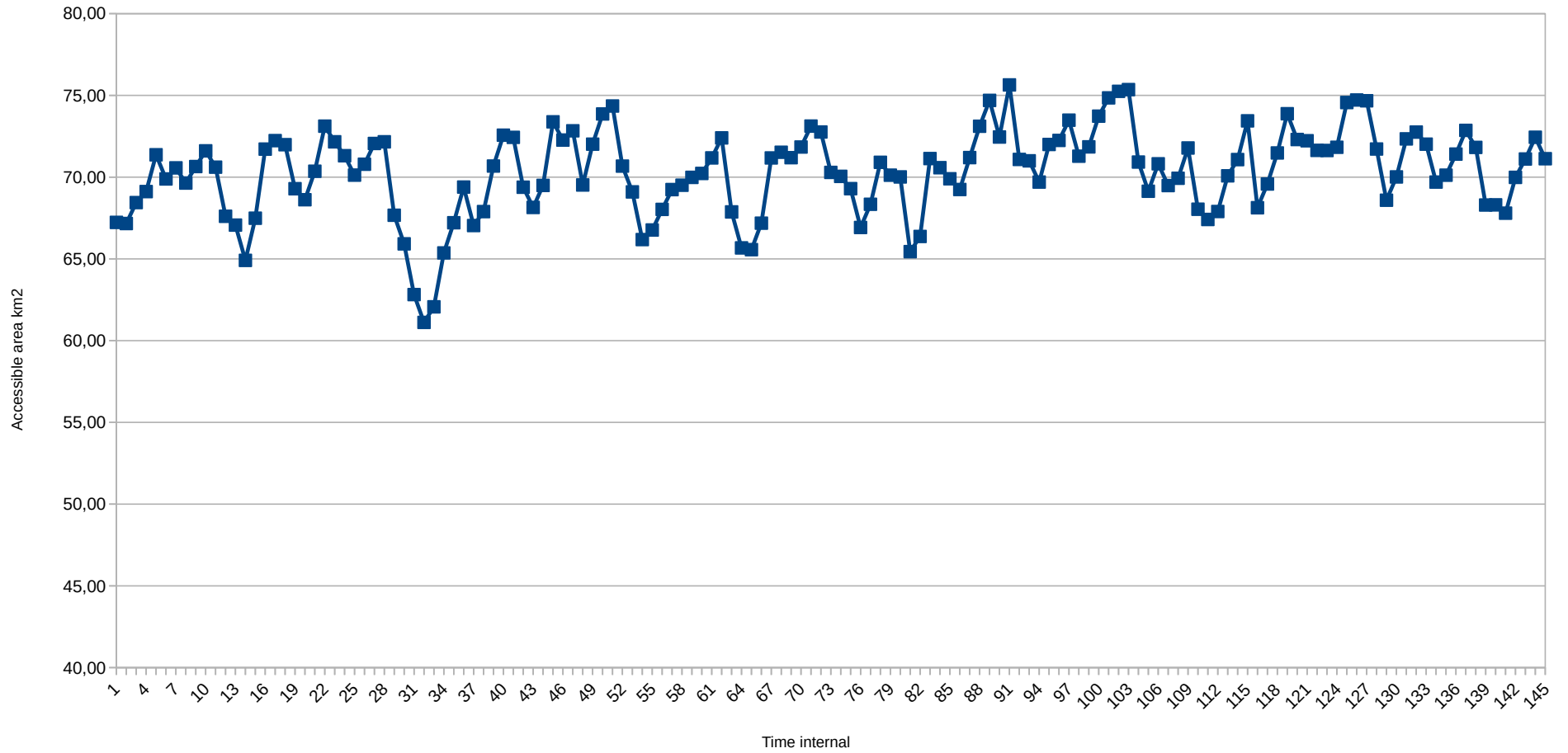
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Filters is:issue is:open

450 Open 31 Closed





References

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 - <https://www.polymtl.ca/mobilite/publications>
- Transit Network Design using a Genetic Algorithm with Integrated Road Network and OD Matrix
 - <https://link.springer.com/article/10.1007/s11116-019-10047-1>
-

Attributions

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