

Q-Traf

A Macroscopic Road Traffic Model

Version 1375

Users Manual

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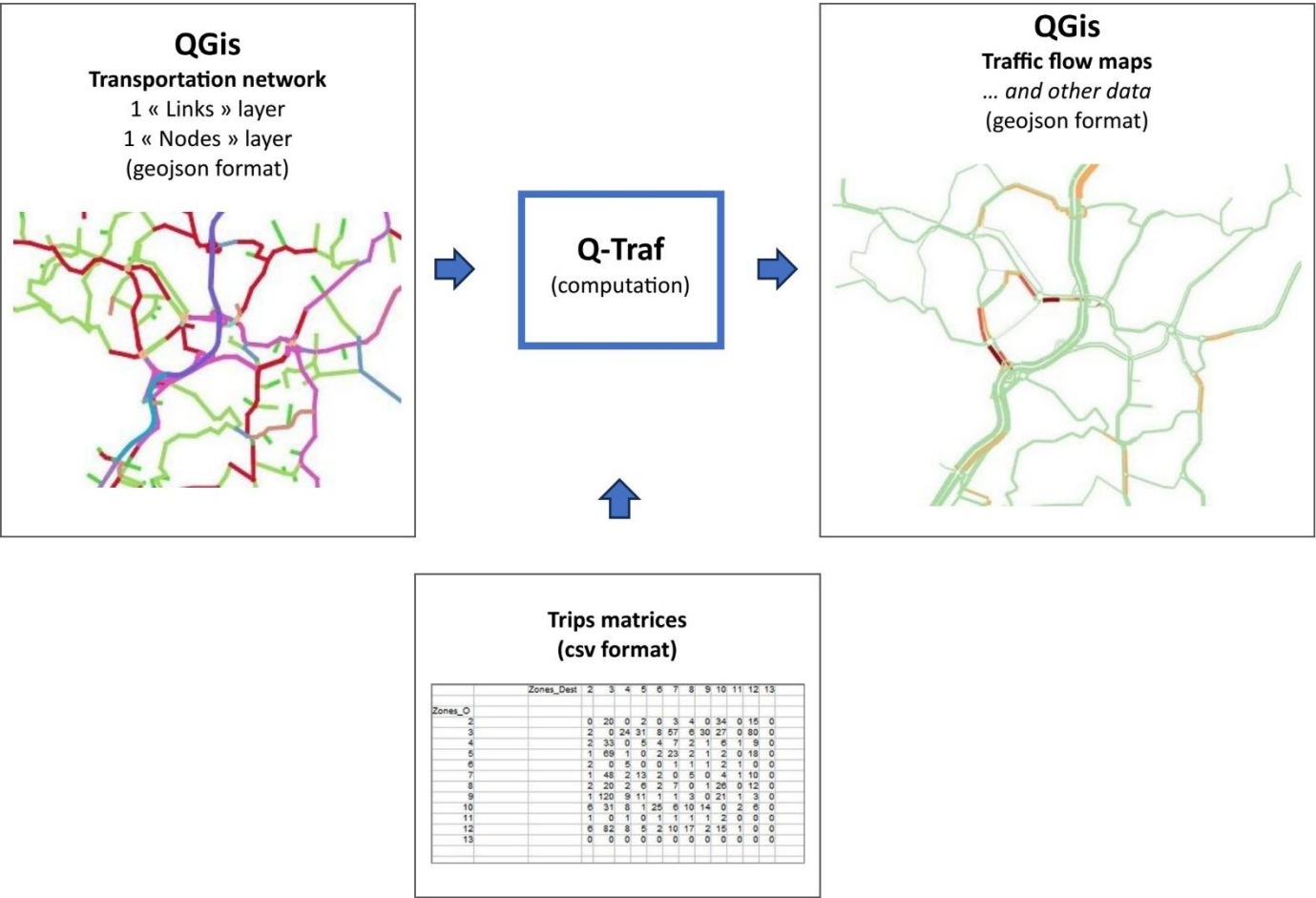
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In this document, the examples and illustrations are given for these softwares :

- GIS : QGis
- Spreadsheet software : OpenOffice, LibreOffice or Excel

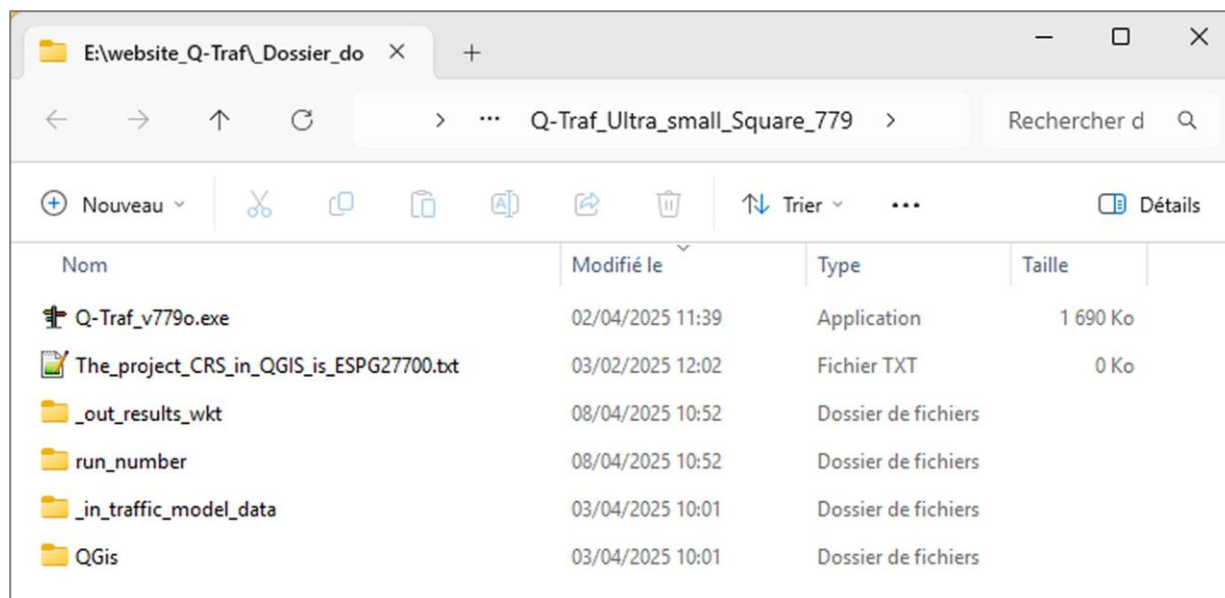
What is Q-Traf ?



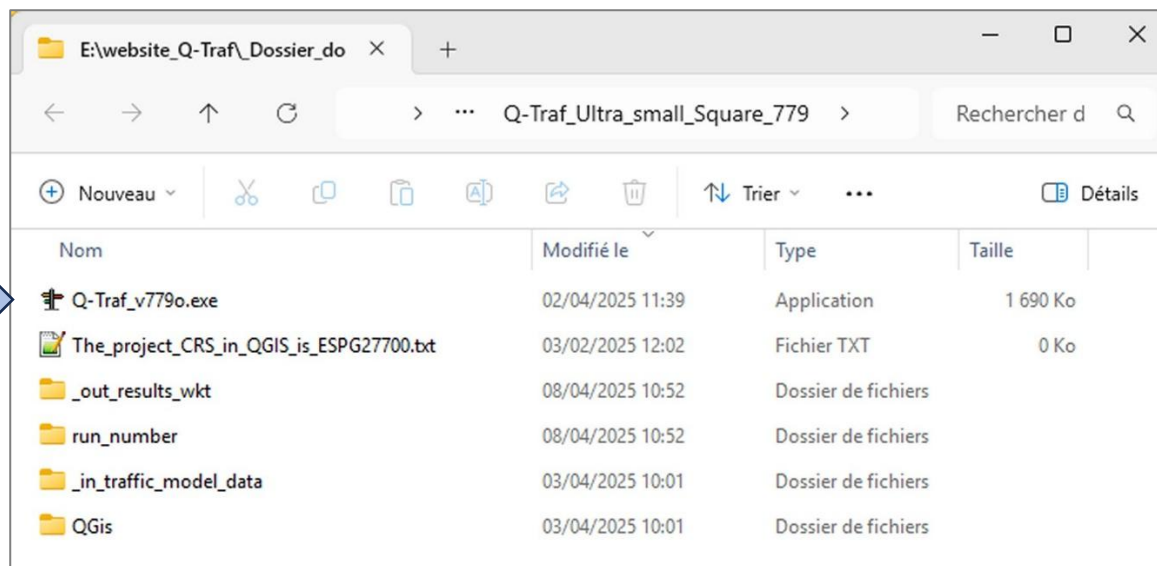
Get started - Calculate and draw your first traffic assignment with one of the examples provided

1. Download an example from the website
2. Unzip the folder

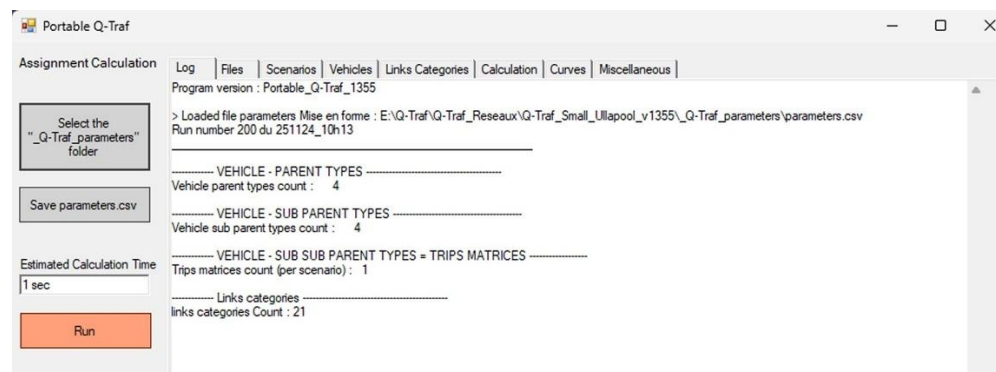
Open the downloaded folder (or “project folder”) (here Ultra_small_square) :)



Launch Q-Traf (double click on Q-Traf_vxxx.exe) :



The window of the program Q-Traf pops-up :



Click “Select the _Q-Traf_parameters folder” and find the parameters.csv file (in the parameters folder)

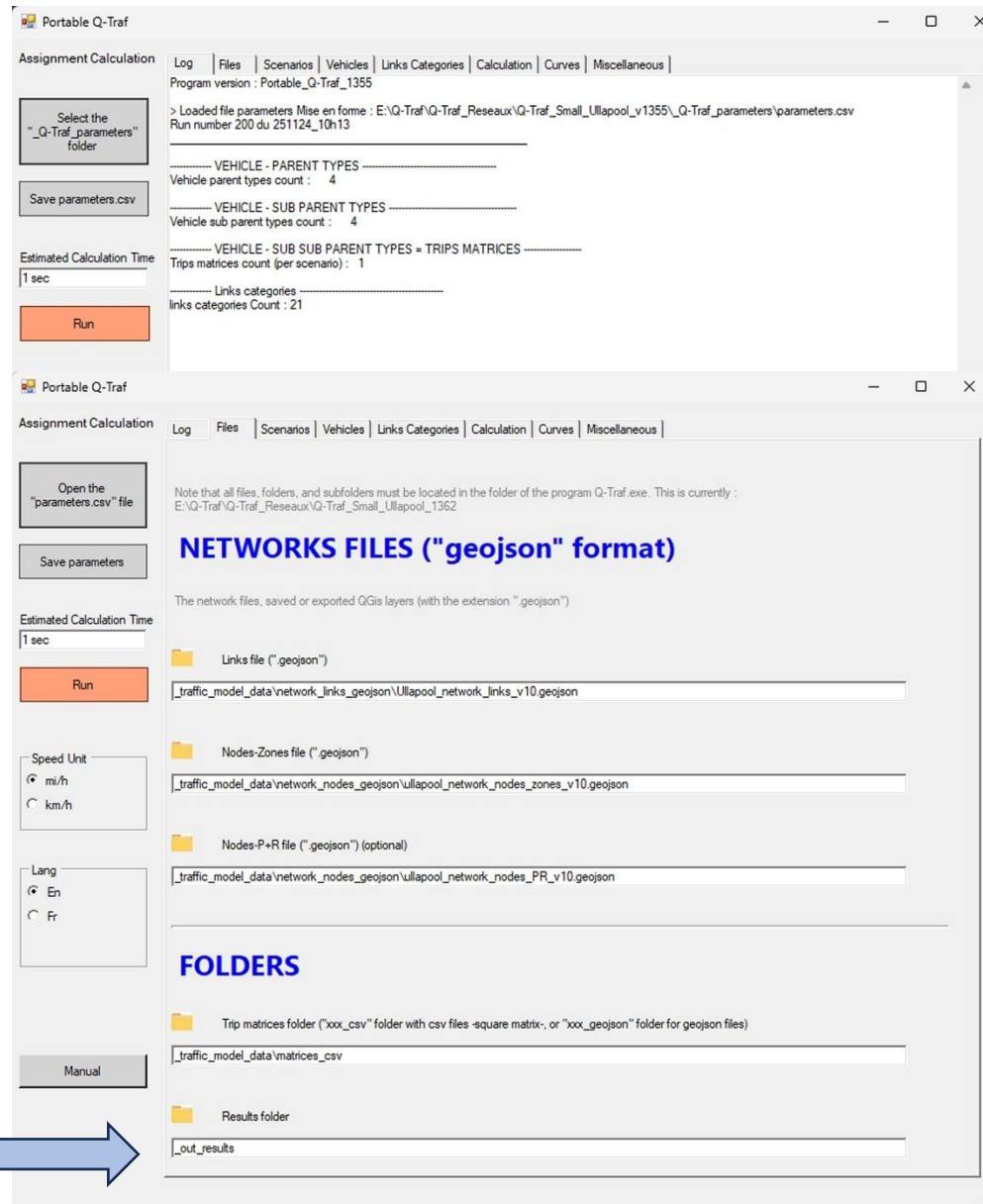
This will load the last saved parameters

Of course, you can then modify each parameter / data.

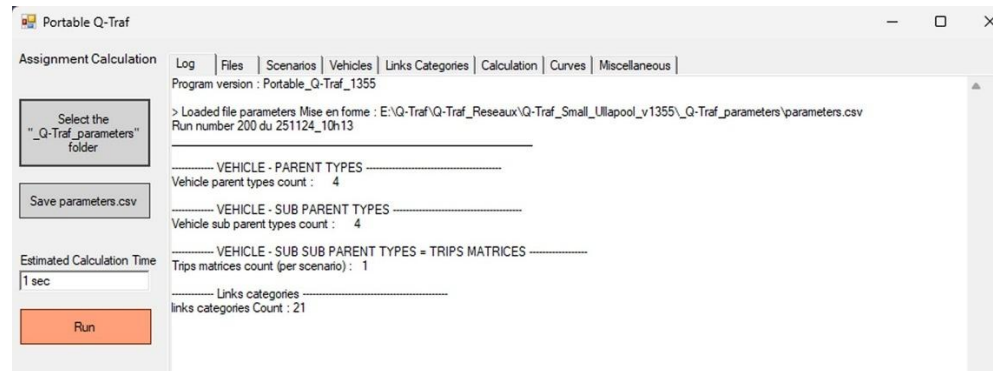
For instance the folder where will be saved all the results.

If you modify some parameters, you need to “save” them before anything else (“save parameters”). Note that this will not erase your previous parameters file, which will be renamed parameters_old_ + a number.

Note that all the files, folders and sub folders must all be in the “project folder”, which is where Portable_Q-Traf.exe is)

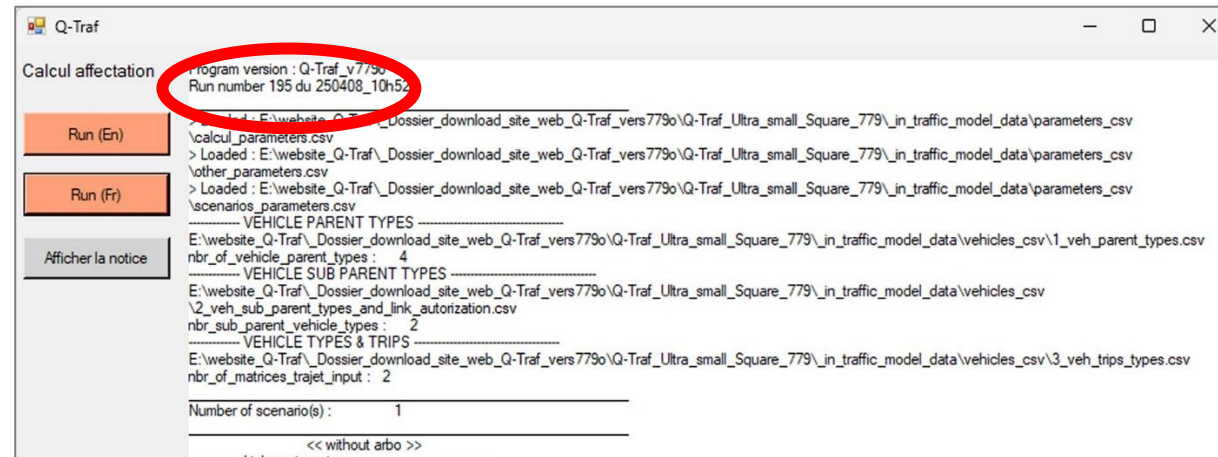


Click « Run » :

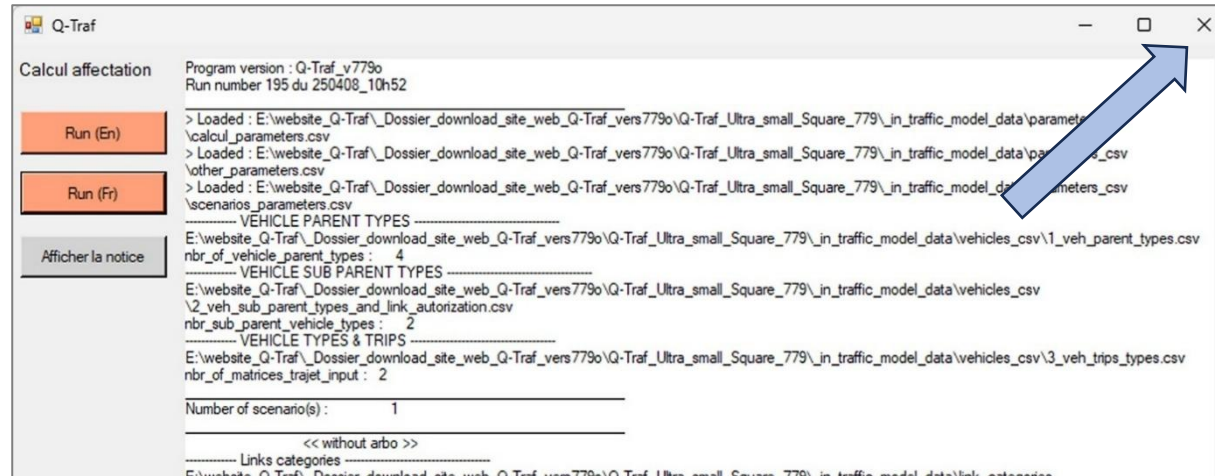


Wait (a few seconds)
until the calculations
are finished :

Note the run number.
The number will be in
the name of your
folder "results".



Close the window :

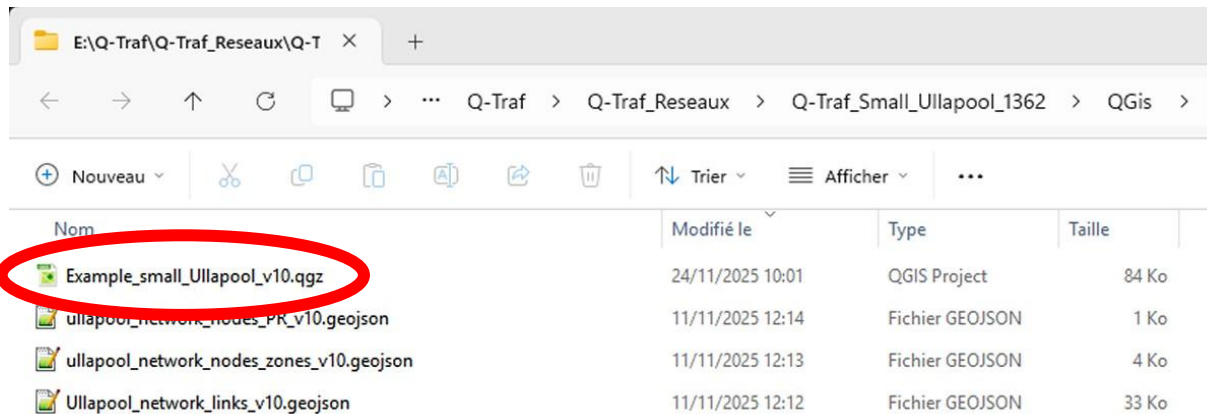


The calculations are now done.

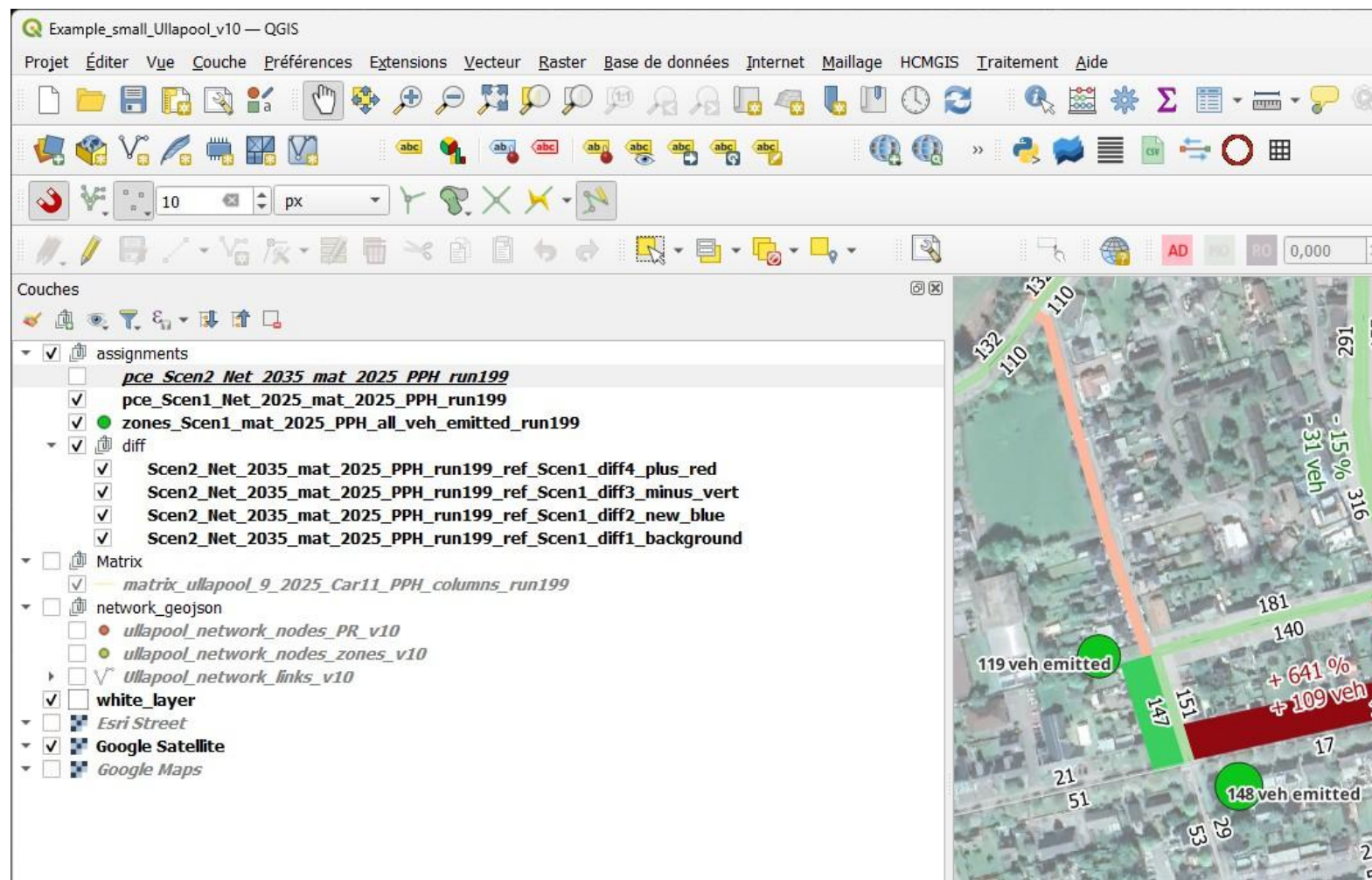
Now open the folder "QGis" and double click on the file "*.qgz"

This will open QGis with your project

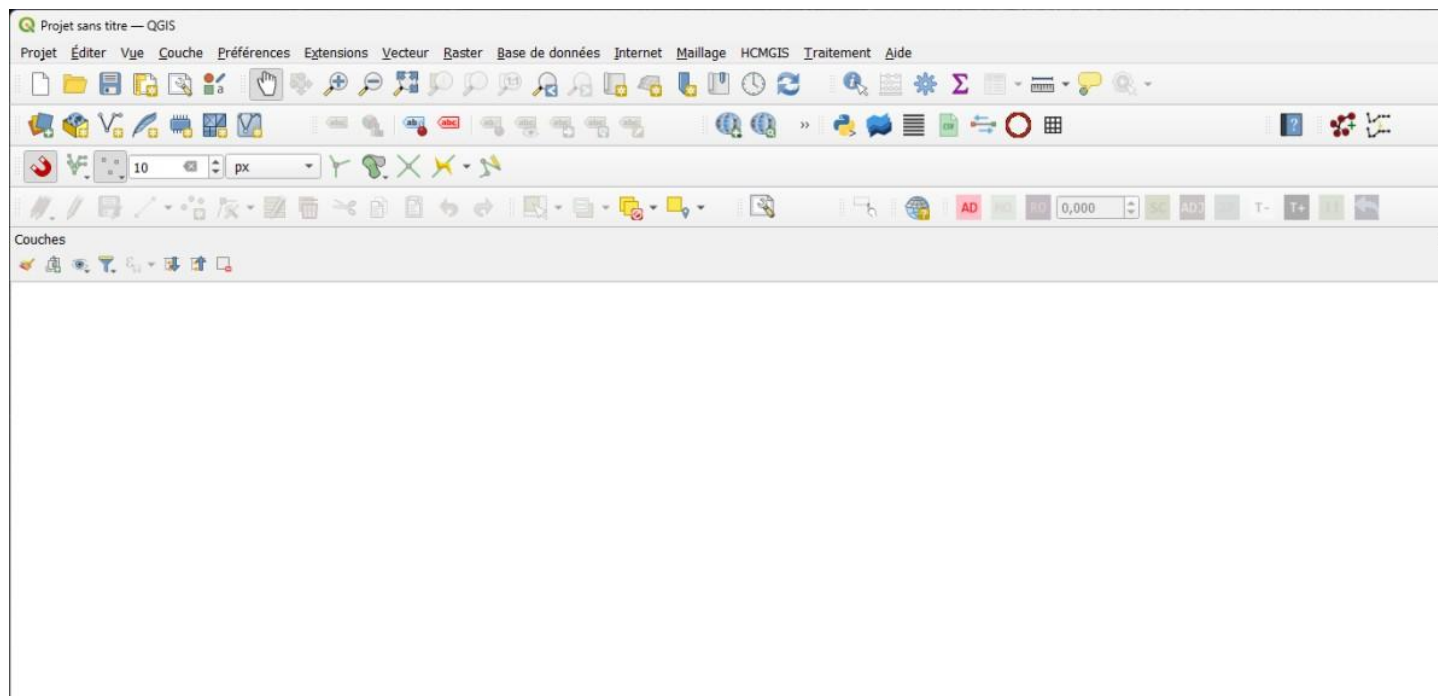
(Note that you need to have QGis already installed on your computer. You can download QGis here : <https://qgis.org/download/>)



QGIS is now open with
your project



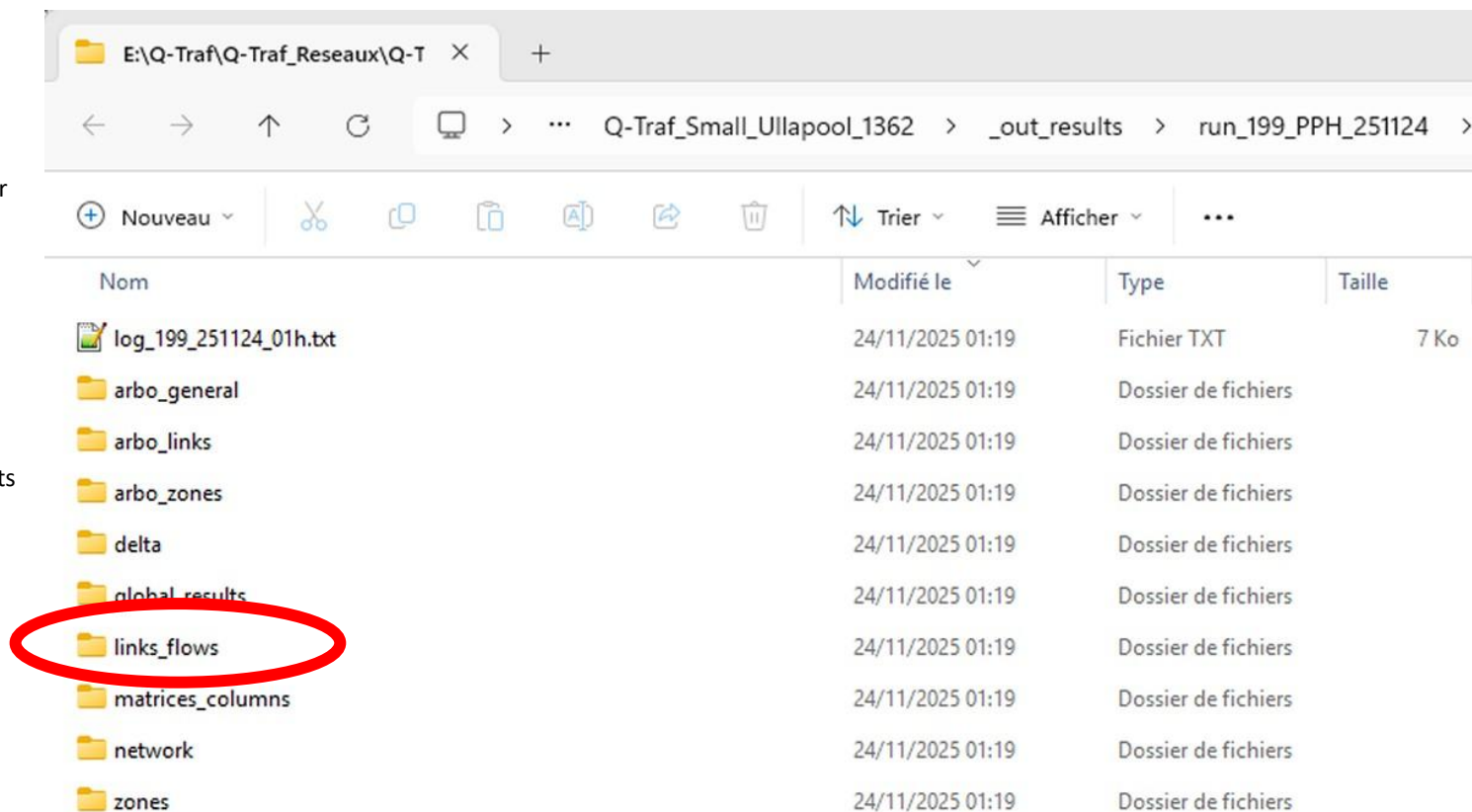
Note that you can directly open QGIS, but QGIS will then be opened without any project loaded



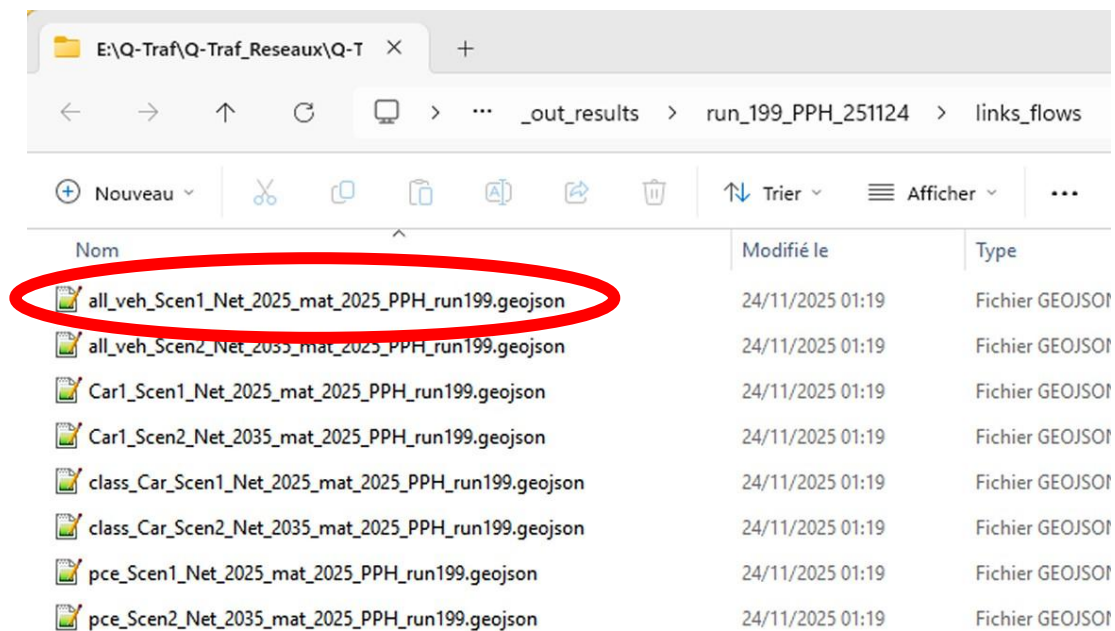
Then you just need to drag'n drop a *.geojson file of your "results" folder in your QGIS window

The first file to draw is generally the traffic flow of all vehicles.

Open the folder Results > run_xxx_xxx > links_flows



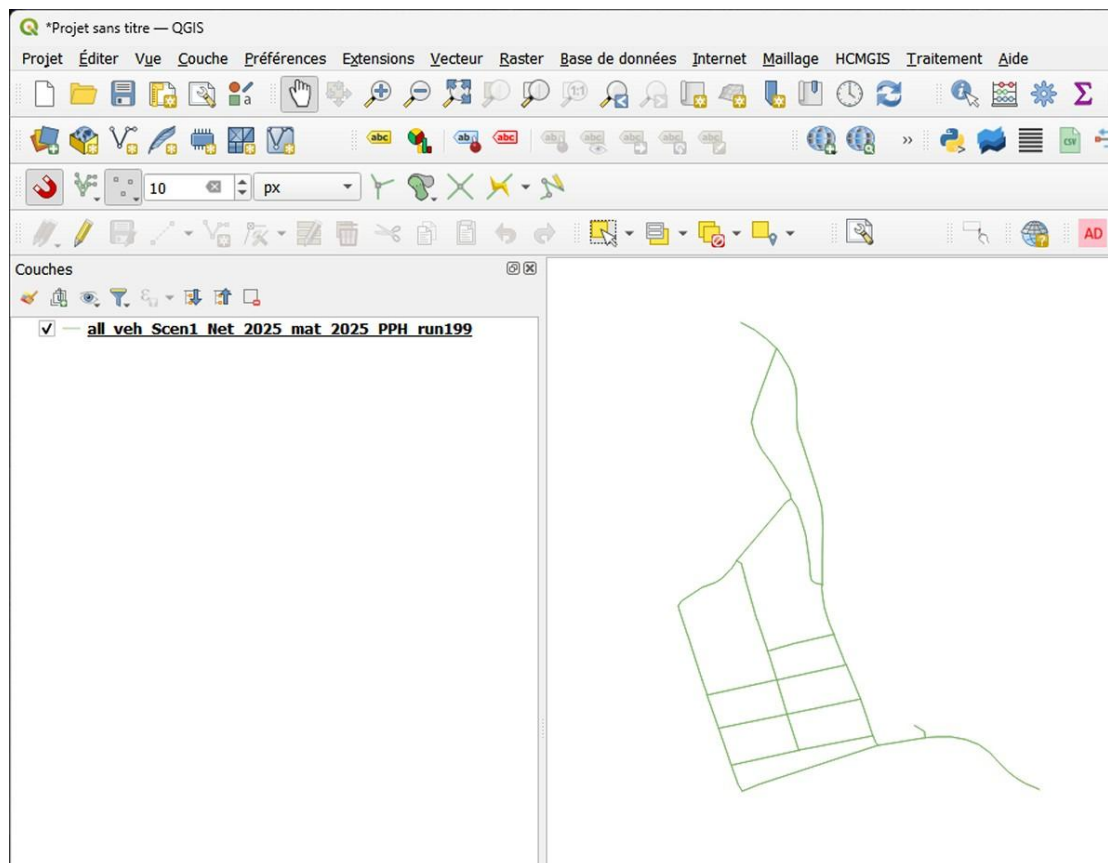
and drag'n drop this
geojson file in your
QGIS window



The layer should appear like this :

(If nothing appears, right click on the layer and select “zoom on the layer”)

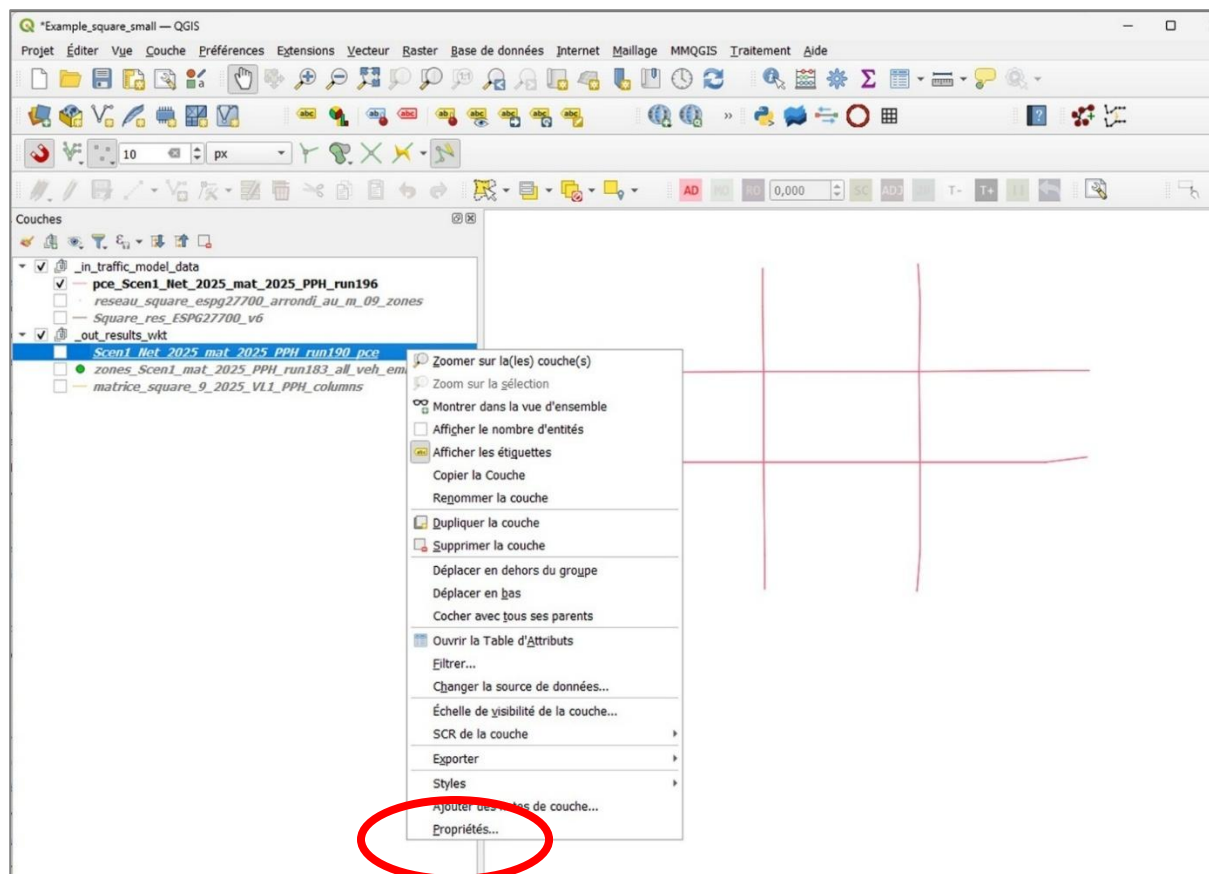
At this step, links are drawn, but without any graphical properties



To apply the graphical parameters, you need to copy/paste them from an existed layer of the same type (i.e. with the same fields) :

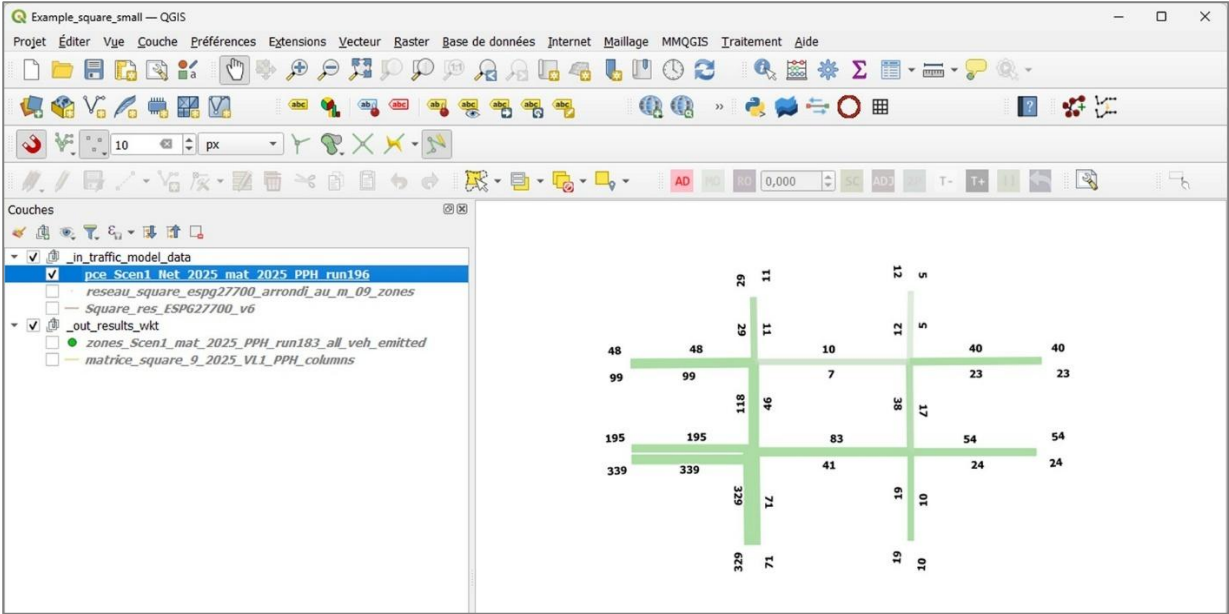
Right-click on an existed layer of the same type > Styles > copy

Right-click on your newly imported layer, and choose « styles > Paste »



...

And the traffic flows are drawn.



1. FILES AND FOLDERS

The 3 file formats – txt, csv and geojson

Q-Traf uses 3 types of files :

	format	File format	How to read it	
GIS layers - Links - Nodes Results (flows, speed, level of service, ...)	Geojson	*.geojson	Used (opened, modified, saved) in QGIS	
- Trip matrices	CSV	*.csv	opened with a spreadsheet Software (Excel, LibreOffice, OpenOffice)	
Other txt data (some results, Log file, ...)	TXT	*.txt		A *.xlsx (Excel) copy is provided for each file. Not used by Q-Traf, these files are simpler to manipulate and can store graphic formatting

Trip matrices

The 2 csv formats

CSV, for « Comma-Separated Values », is a text file format used to store tables / tabular data, where each line represents a record, and columns / fields. It is widely used for data exchange between applications, especially spreadsheets and databases, due to its simplicity and ease of use.

There are 2 main csv formats in the world :

	Column separator	Decimal separator	quotes	
				variant
US-En	Comma “,”	Dot “.”	If there is a comma in a cell, the cell content must be in quotes	All cells are in quotes
Eu	Semicolon “;”	Comma “,”	If there is a semicolon in a cell, the cell content must be in quotes	All cells are in quotes

An example of a US-En csv file with 4 columns and 3 lines :

A, b, c, d

1, 17, red, -92

89, 2, "ballon, kite", 17

- ⇒ **Q-Traf automatically identifies and reads the US-En and Eu variants**
- ⇒ **The Result wkt csv files are automatically in the format defined in the user's Windows OS**

How to manipulate a csv files with a spreadsheet software (LibreOffice, OpenOffice, Excel) - csv files ↔ xlsx files

With OpenOffice :

Import de texte - [all_veh_Scen1_Net_2025_mat_2025_PPH_run196.csv]

Importer

Jeux de caractères : **Unicode (UTF-8)**

Langue : **Par défaut - Français (France)**

À partir de la ligne : **1**

Options de séparateur

☐ Largeur fixe

☒ Séparé par

☐ Tabulation ☐ Virgule ☐ Autres

☒ Point-virgule ☐ Espace

☐ Fusionner les séparateurs

Séparateur de texte : **;**

Autres options

☐ Champ entre guillemets comme texte

☐ Détecter les nombres spéciaux

Champs

Type de colonne : **Standard**

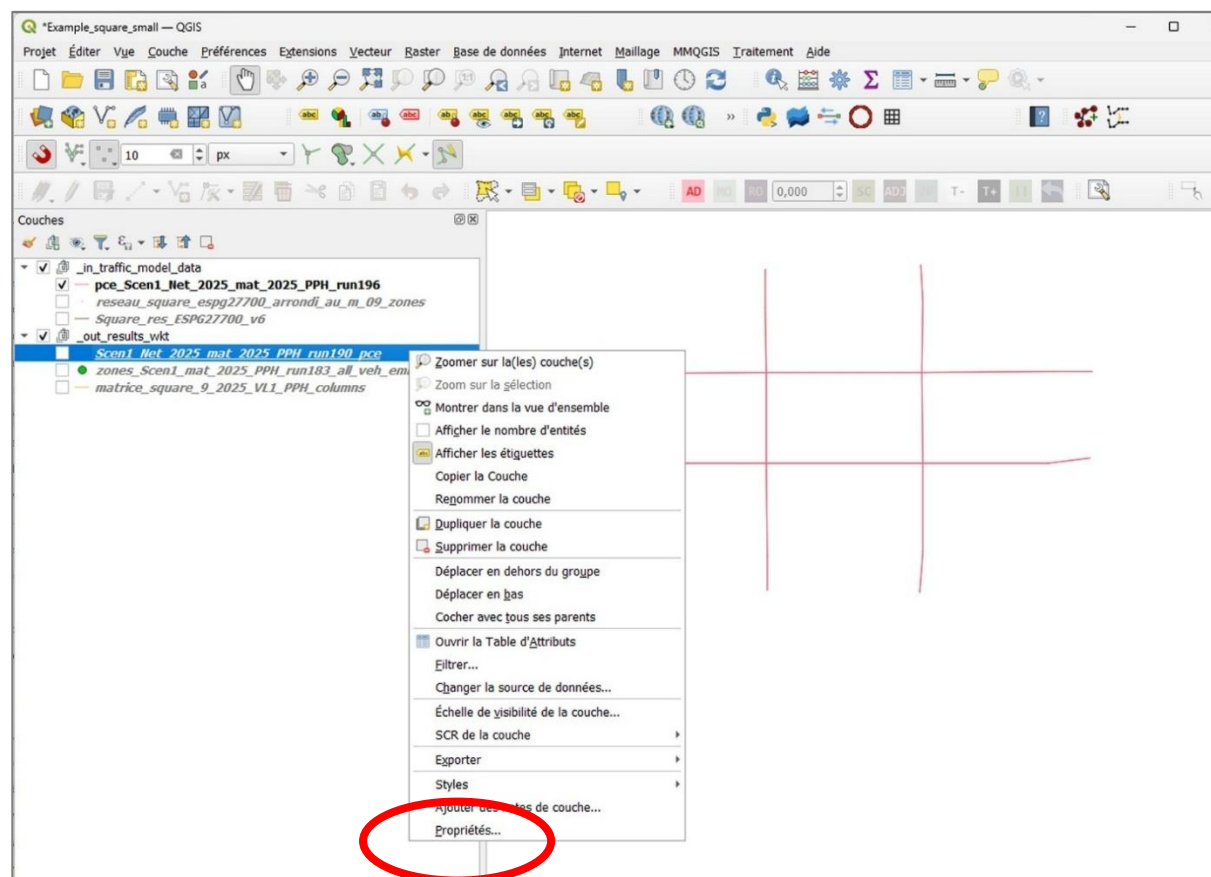
Standard	Standard	Standard
1 WKT	row	Flow_TV_e
2 MULTILINESTRING ((213051 894146, 213173 894146))	1	24
3 MULTILINESTRING ((213050 894234, 213051 894146))	2	38
4 MULTILINESTRING ((213051 894303, 213050 894234))	3	12
5 MULTILINESTRING ((212899 894146, 212900 894056))	4	329
6 MULTILINESTRING ((212899 894234, 212899 894146))	5	118
7 MULTILINESTRING ((212898 894297, 212899 894234))	6	29

Graphic parameters

To apply the graphical parameters, you need to copy/paste them from an existed layer of the same type (with the same fields) :

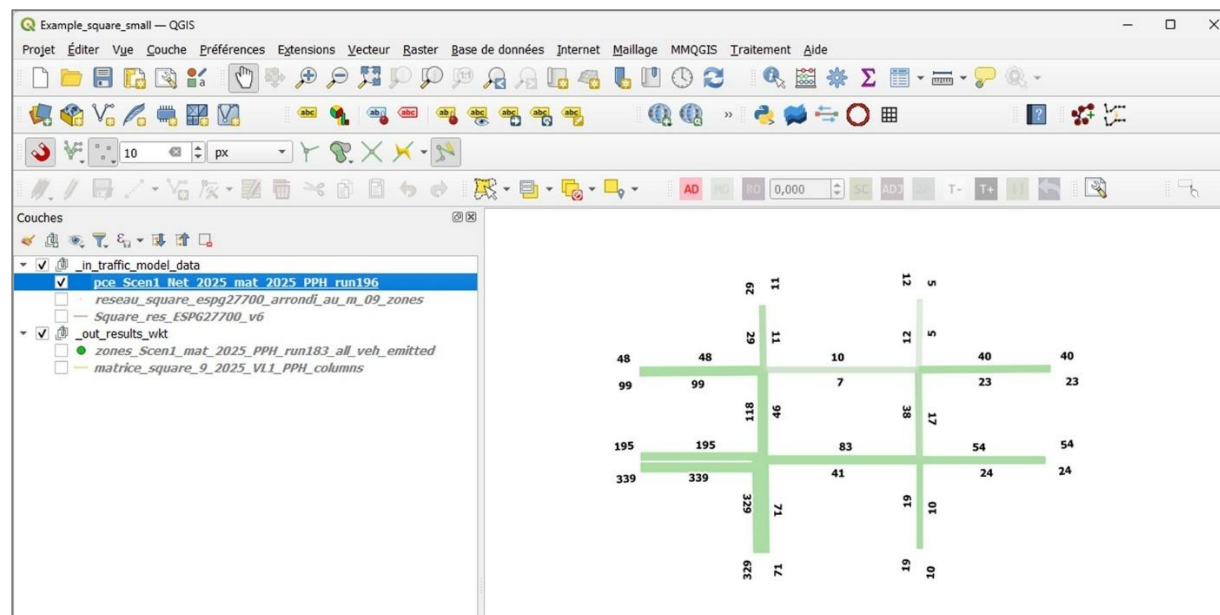
Right-click on an existed layer of the same type >
Styles > copy

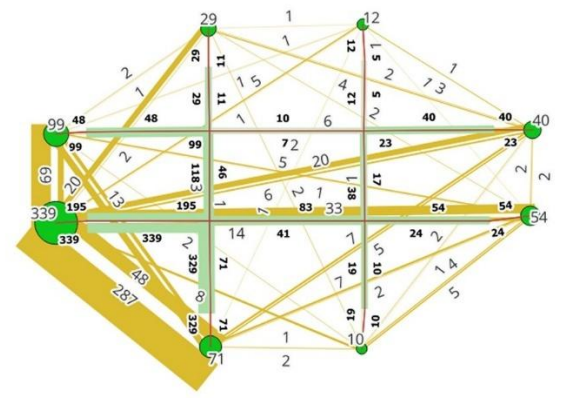
Then Styles > Paste on the new layer



...

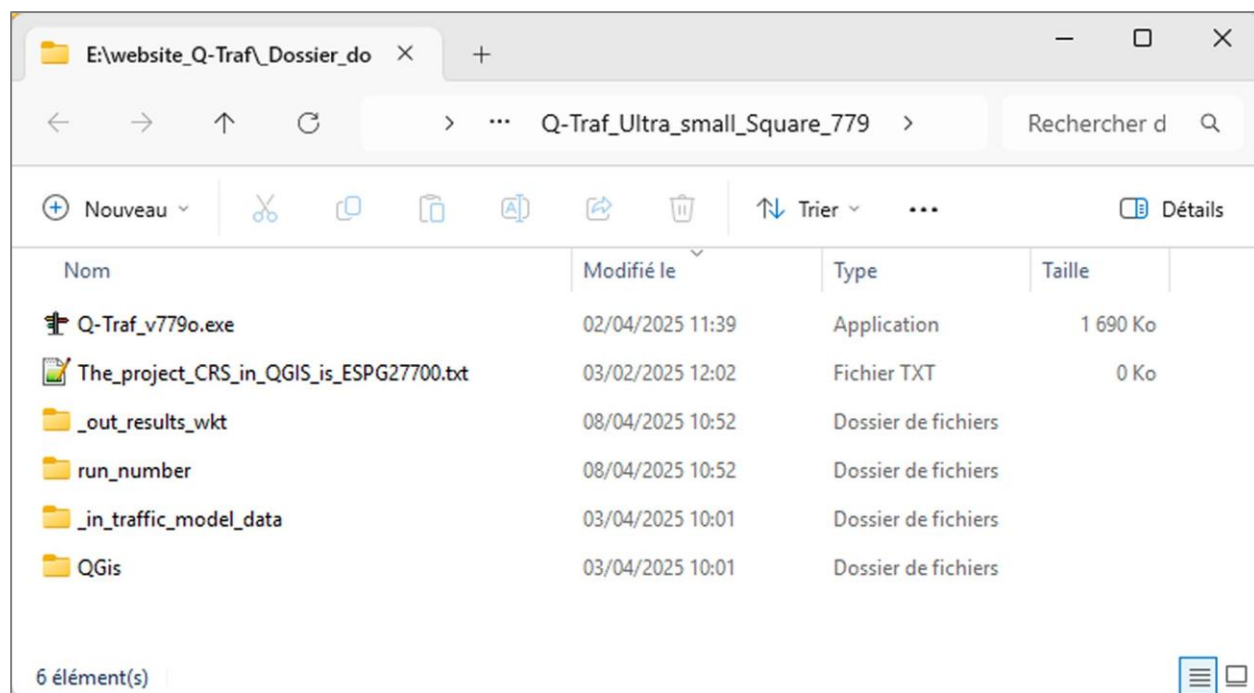
Right-click on your newly imported layer, then choose « styles > Paste »





Q-Traf folders and files

The folders tree structure



⇒ You must **NOT** change these folder names :

- « in_traffic_model_data »
- « out_results »



After all the data is completed, double-click on the program « Q-Traf_v....exe ». After a few seconds a sub-folder result « xxxx » is created in the folder « _out_results ». The files in this sub-folder result are :

- geojson files, which can be opened in QGis
- Txt files

The result files

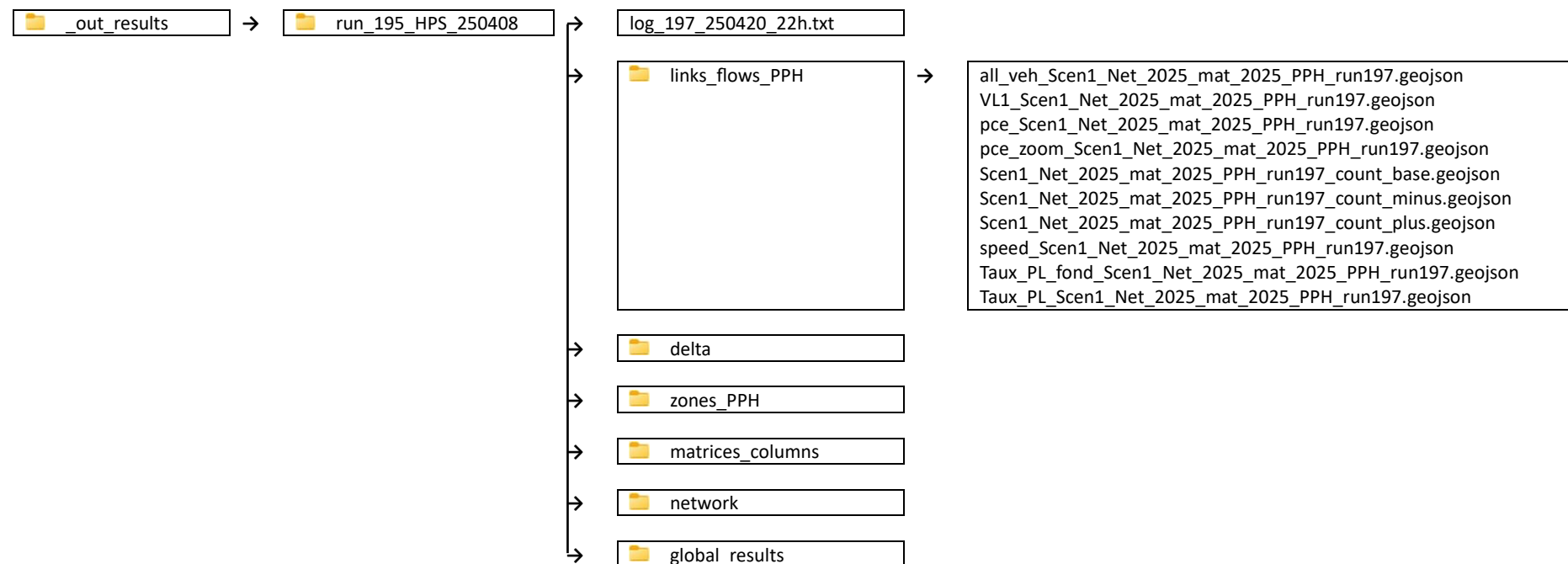
Files type

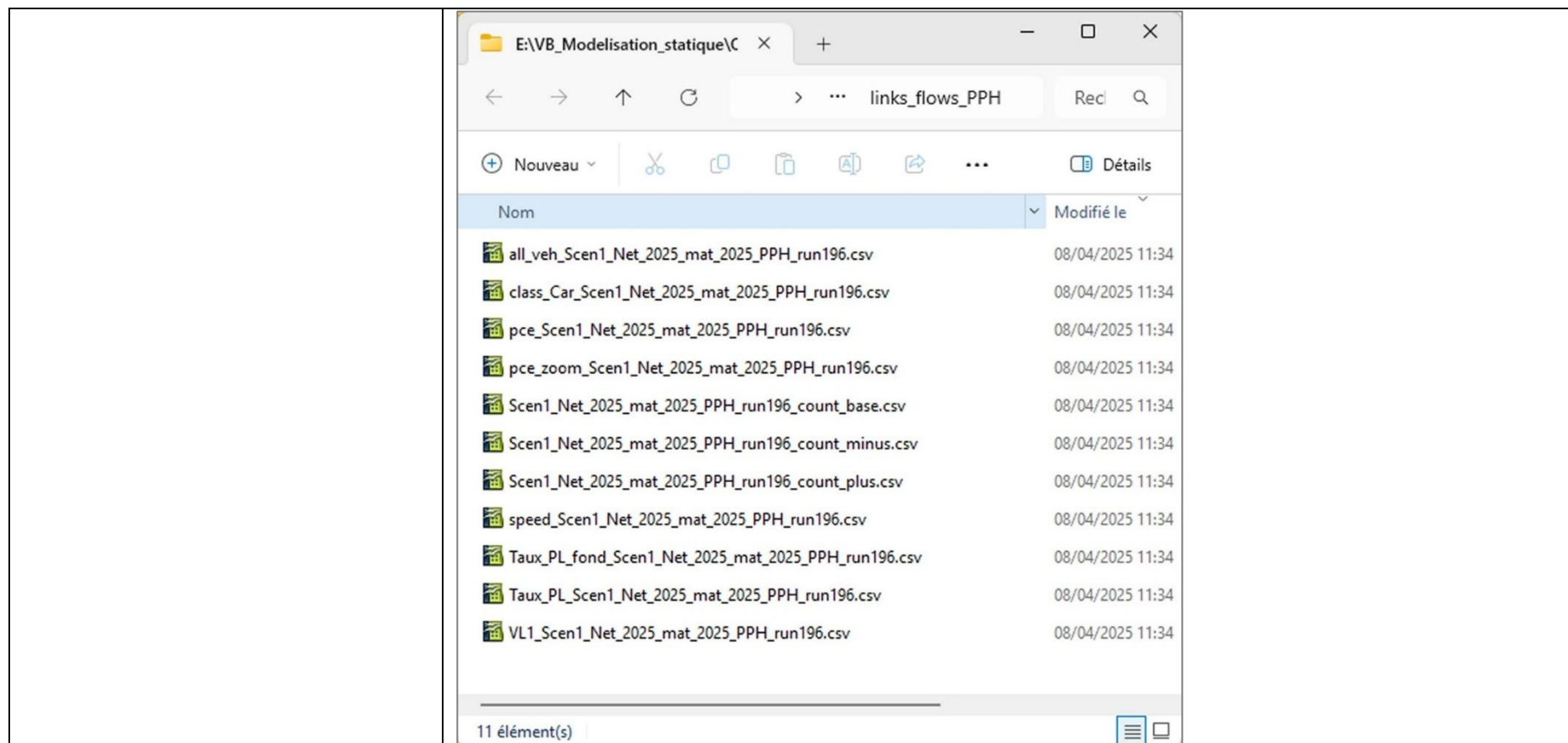
The files « result » are :

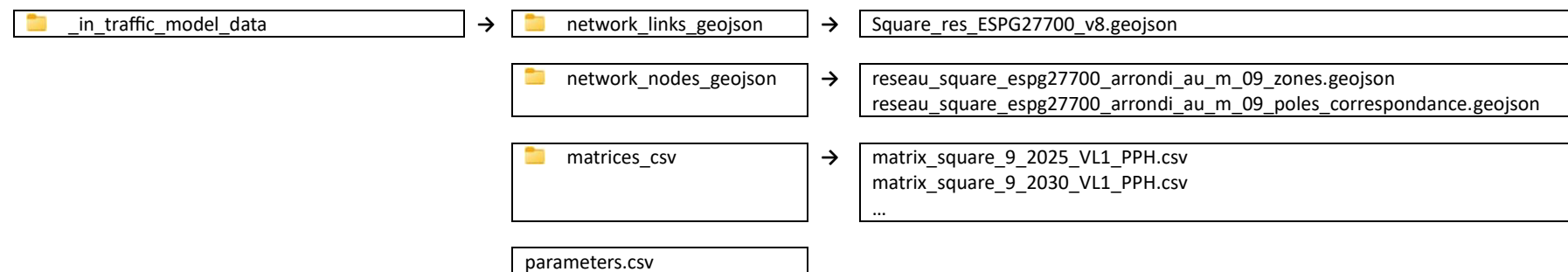
- geojson for most of the files
- *.txt for the log file

Location of the files

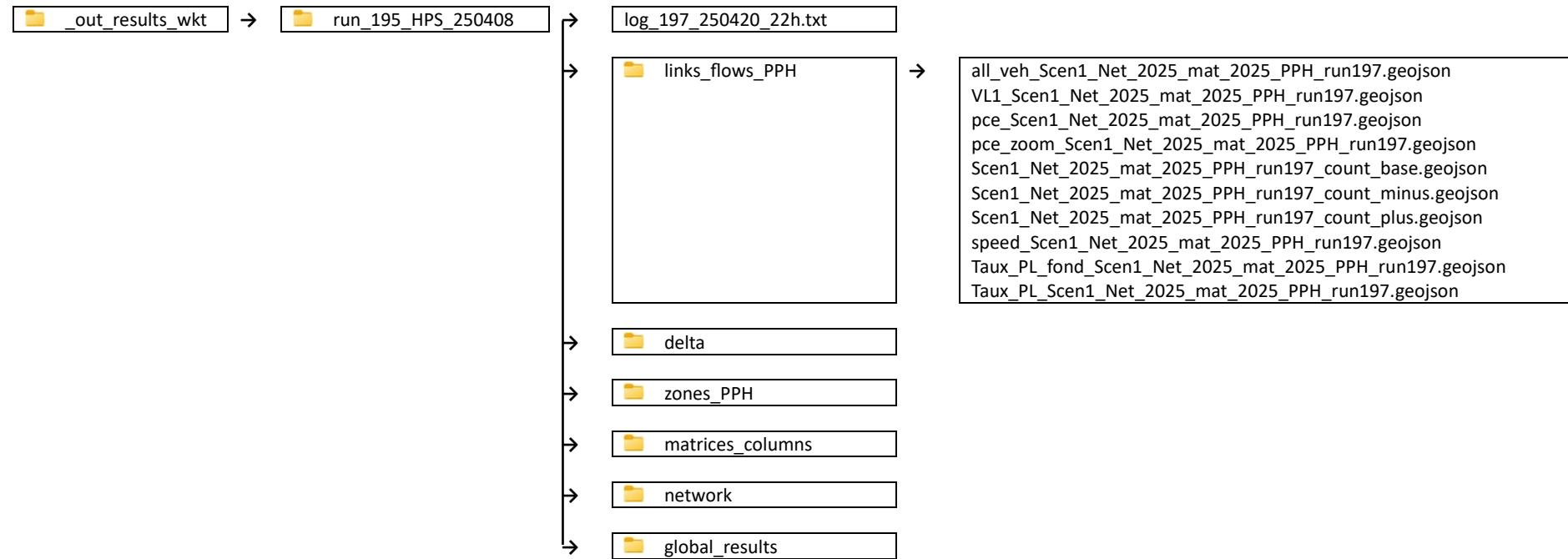
The result files of the calculations are in the folder « _out_results_wkt » :





The Input data folder tree structure

The Results folder tree structure



Q-traf input files – List, structure and location

The file « network_links_geojson »

This *.geojson file must be created with QGis, as a polyline layer.

There are 3 groups of field :

- Essential => Essential to run the program
- Important => Not necessary to run the program, but useful for better assignment
- Optional => Not necessary to run the program, but can provide more functions

The **names** of the fields must be as following. The order of the fields doesn't matter.

	Field Name	Type	Remark
ESSENTIAL	Row	Integer	Link row
	Category	Integer	category id (cf Tab "Links Categories")
	Length	Integer	Link length (in meter)
	Net_01	Integer	List of authorized vehicle sub-classes (cf tab "Vehicles") for each link of the first network. Let Empty If the link is barred
	(other networks. Name of no importance)	Integer	Following fields just after Net_01 The networks must respect the order defined in the "Scenarios – Scenarios" tab
IMPORTANT	PEN_VLx100	Integer	Car penalty in link generalized cost • Empty Or "100" : No penalty • "200" : Generalized cost x 2 • "50" : Generalized cost / 2 • ...
	PEN_PLx100	Integer	Truck penalty
	PEN_Tcx100	Integer	Bus penalty
OPTIONAL	With_arbo	Integer	empty or 1
	Aph_count	Integer	Aph real counting empty or an integer
	Aph_est	Integer	Aph estimation empty or an integer
	Pph_count	Integer	Pph real counting empty or an integer
	Pph_est	Integer	Pph estimation empty or an integer
	Aat_count	Integer	Aat real counting empty or an integer
	Aat_est	Integer	Aat estimation empty or an integer

Row and length can easily be updated in QGis with :

Layer (right-click) > Properties > Fields > Modify > Calculate > Geometry > \$length
Layer (right-click) > Fields > Modify > Calculate > Row_number

The file « network_nodes_geojson »

This *.geojson file must be created with QGis, as a point layer.

The **names** of the fields must be as following. The order of the fields doesn't matter.

	Field Name	Type	Remark
ESSENTIAL	Id	Integer	
	Net_01	Integer	List of authorized vehicle sub-classes (cf tab "Vehicles") for each link of the first network. Let Empty If the link is barred
	(other networks. Name of no importance)	Integer	<u>Following fields just after Net_01</u> The networks must respect the order defined in the "Scenarios – Scenarios" tab

The file « network_poles_correspondances_geojson » (or P&R) (to do)

This *.geojson file must be created with QGis, as a point layer.

The **names** of the fields must be as following. The order of the fields doesn't matter.

	Field Name	Type	Remark
ESSENTIAL	Id	Integer	Zone Id
	Net_01	Integer	List of authorized vehicle sub-classes (cf tab "Vehicles") for each link of the first network. Let Empty If the link is barred
	(other networks. Name of no importance)	Integer	Following fields just after Net_01 The networks must respect the order defined in the "Scenarios – Scenarios" tab

The files « matrices_csv »

Name

- ⇒ The name of the matrices must be : **« suffix » & « name of the matrix » & « name of the vehicles » & « period of analysis » & « .csv »**
- « suffix » is defined in the file « scenarios_parameters.csv »
 - « name of the matrix » is defined in the file « scenarios_parameters.csv »
 - « name of the vehicles » is the name defined in the file « 3_veh_....csv »
 - « period of analysis » (hour or day) is the name defined in the file « scenarios_parameters.csv »

The structure of the *.csv file is the following :

⇒ Note that the Id_zone are the Ids, not the rows. IDs can be in random order, not necessarily in ascending order

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
1			Id_zone_D	6	7	8	9	12	13	14	15	16	17	18	19	20	21	22	23	24
2																				
3	Id_zone_O																			
4	6			0	1	1	1	0	0	0	0	1	1	0	0	0	0	0	1	11
5	7			2	0	5	0	4	7	8	13	1	34	4	5	5	41	35	1	1
6	8			2	7	0	1	4,8	12	7	26	3	6	2	0	2	44	90	2	4
7	9			1	1	3	0	2,4	4	22	4	0	1	0	0	0	2	2	1	0
8	12			18,4	24	6,8	0,8	0	21,2	20,8	4,8	1,2	11,2	0,8	8,4	1,6	12,4	5,6	2,8	2,4
9	13			8	10	15	1	24	0	12	11	17	8	4	10	3	68	20	2	5
10	14			9	4	36	2	12	20	0	10	7	3	0	1	0	8	9	10	5
11	15			3	67	4	0	3,6	6	4	0	2	6	10	1	3	19	14	0	2
12	16			2	2	4	0	2,4	12	2	5	0	5	1	6	10	20	15	1	0
13	17			5	14	4	1	6	7	23	5	5	0	45	10	6	11	5	2	2
14	18			2	8	0	0	2,4	6	0	2	4	38	0	56	12	4	2	1	2
15	19			0	1	1	0	0,4	1	5	6	28	45	2	0	11	25	8	0	1
16	20			1	4	14	0	1,6	4	2	0	6	17	42	58	0	3	6	1	2
17	21			6	84	32	0	20,4	10	7	6	2	2	1	3	5	0	17	2	4
18	22			3	22	18	0	5,2	10	7	13	5	3	0	2	1	5	0	3	3
19	23			1	4	7	1	7,2	13	65	11	1	3	0	1	2	7	6	0	0
20	24			20	0	20	1	7,2	7	6	5	6	2	4	3	2	4	2	1	0
21	25			2	8	5	0	4,4	13	6	9	8	3	0	3	2	12	14	2	8
22	26			10	7	40	0	5,6	8	8	18	8	1	0	3	2	22	27	2	11
23	27			6	2	2	0	12	5	4	4	1	3	0	3	0	2	7	0	1

Or for the *.geosjson file (QGIS line layer), the structure is the following :

	Field Name	Type	Remark
ESSENTIAL	Zone_O	Integer	Zone Origin Id The name doesn't matter here, but it has to be the 1st field
	Zone_D	Integer	Zone Destination Id The name doesn't matter here, but it has to be the 2d field
	Flow	Integer	The name doesn't matter here, but it has to be the 3d field

2. NETWORK AND ZONES MODELLING

How to create a network – With QGIS

Empty paragraph

How to modify a network (with QGIS)

Important

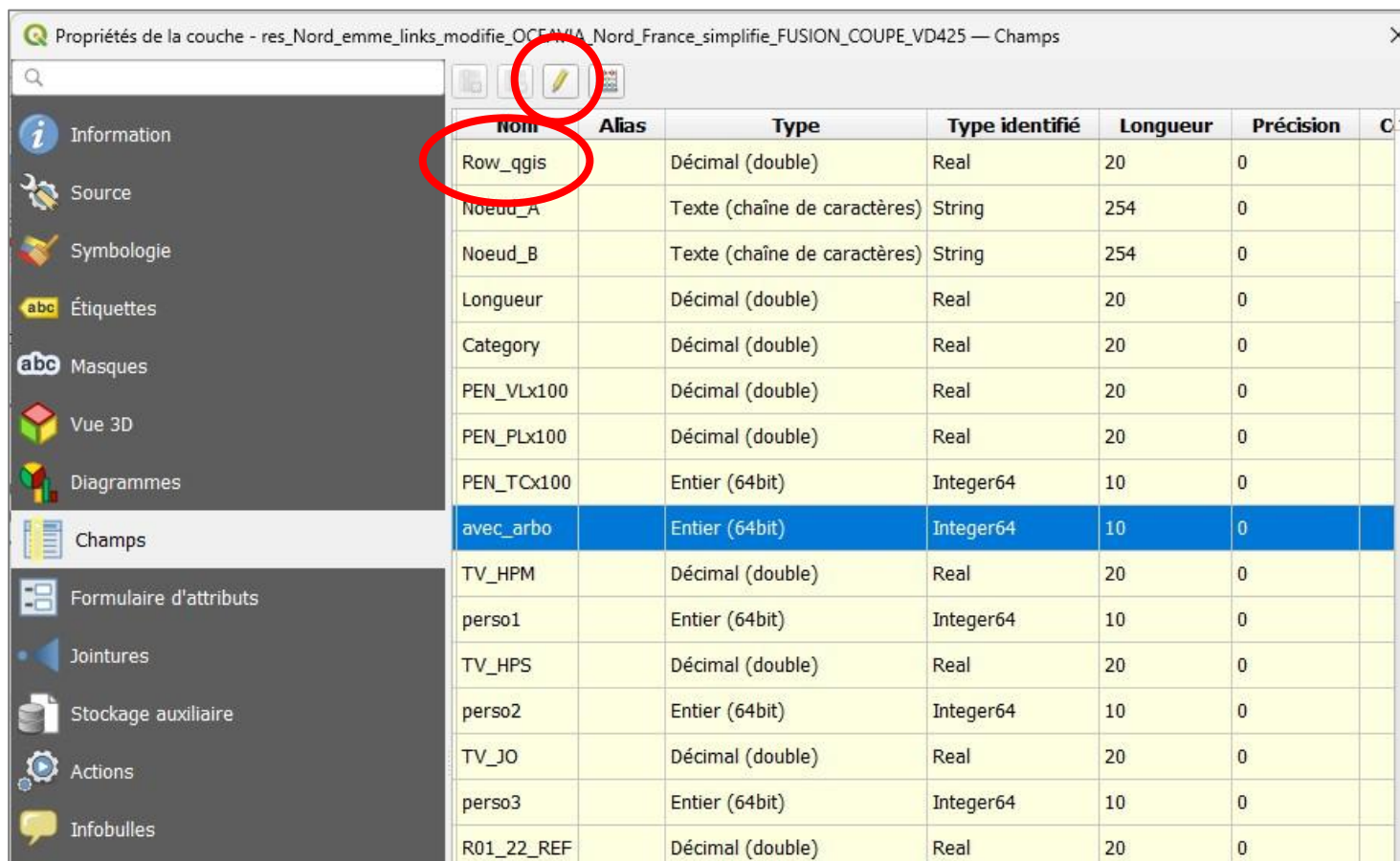
Once you have modified your network with QGIS

You need to do the 2 following steps :

1. Recalculate the field « Row » (every time as a precaution, but theoretically only necessary in case of new links added)
(*round the coordinates*)
2. Recalculate the field « length »

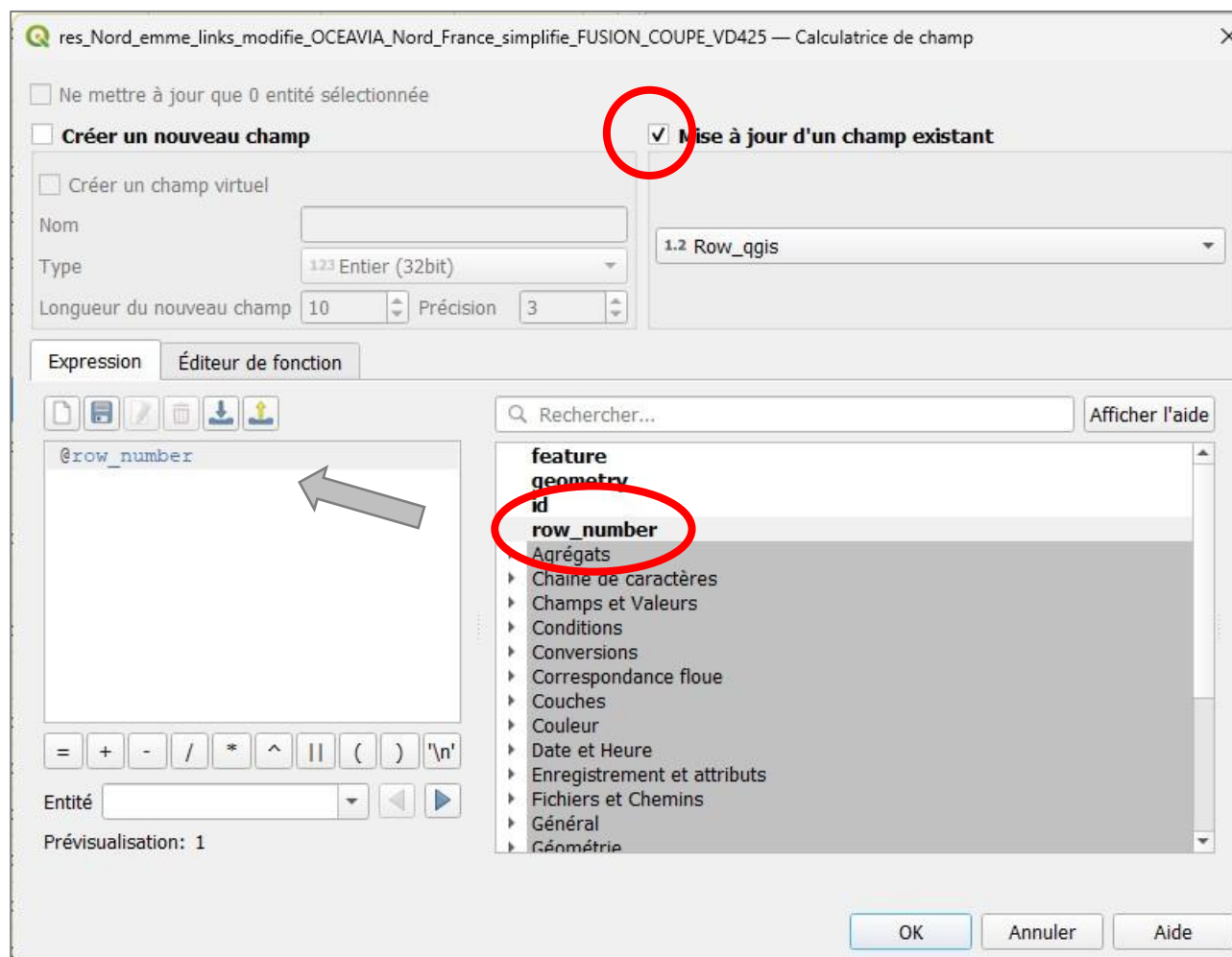
Select the network layer, then select « Layer properties », then « Fields » :

In « edit mode » ( selected), select the field « Row_qgis » :



Nom	Alias	Type	Type identifié	Longueur	Précision	C
Row_qgis		Décimal (double)	Real	20	0	
Noeud_A		Texte (chaîne de caractères)	String	254	0	
Noeud_B		Texte (chaîne de caractères)	String	254	0	
Longueur		Décimal (double)	Real	20	0	
Category		Décimal (double)	Real	20	0	
PEN_VLx100		Décimal (double)	Real	20	0	
PEN_PLx100		Décimal (double)	Real	20	0	
PEN_TCx100		Entier (64bit)	Integer64	10	0	
avec_arbo		Entier (64bit)	Integer64	10	0	
TV_HPM		Décimal (double)	Real	20	0	
perso1		Entier (64bit)	Integer64	10	0	
TV_HPS		Décimal (double)	Real	20	0	
perso2		Entier (64bit)	Integer64	10	0	
TV_JO		Décimal (double)	Real	20	0	
perso3		Entier (64bit)	Integer64	10	0	
R01_22_REF		Décimal (double)	Real	20	0	

Activate « Update a field », then choose « row number » (by double-clicking), then click « OK » :



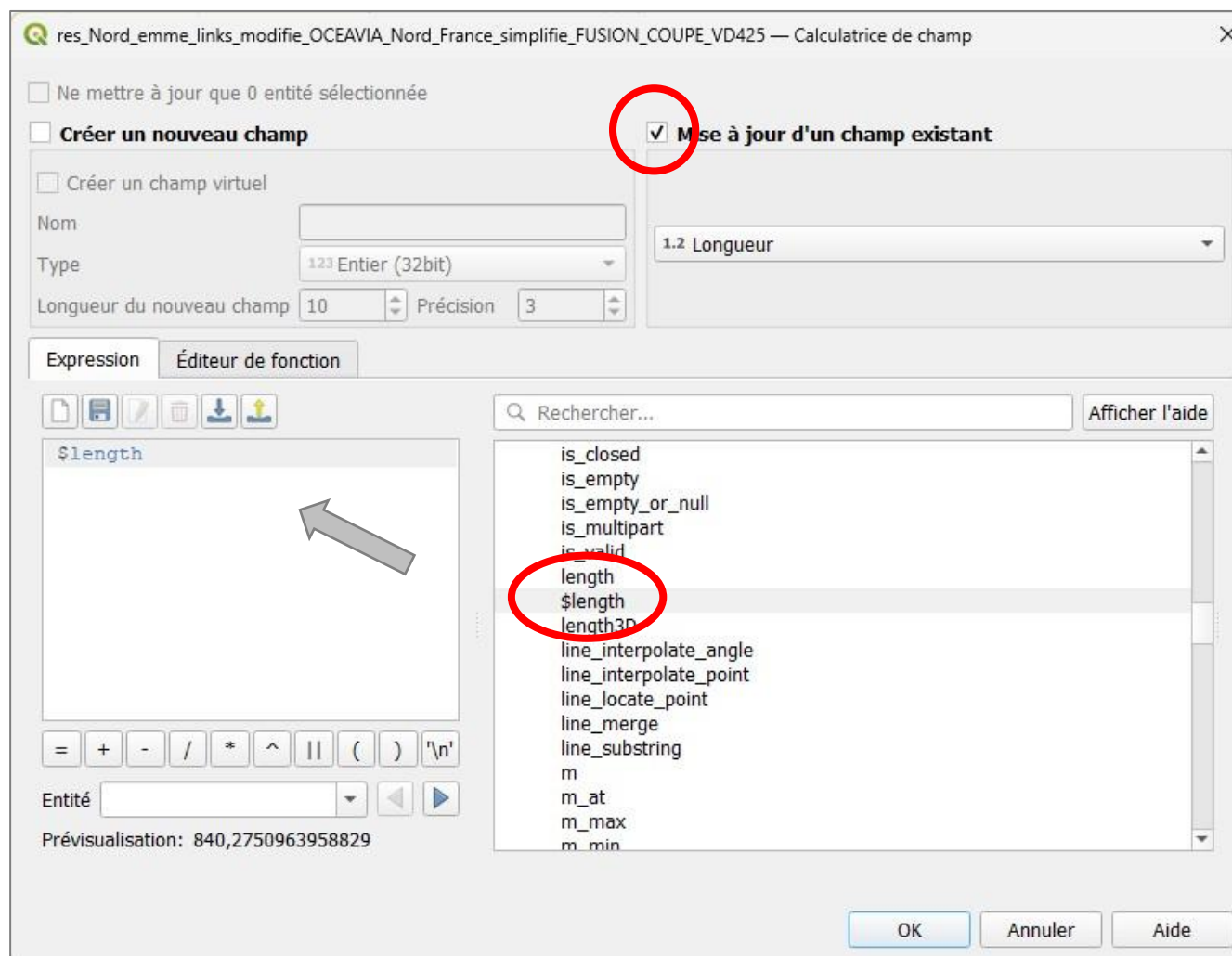
In « edit mode » () , select the field « Longueur » :

Propriétés de la couche - res_Nord_emme_links_modifie_OCEANIA_Nord_France_simplifie_FUSION_COUPE_VD425 — Champs

Information
Source
Symbologie
Étiquettes
Masques
Vue 3D
Diagrammes
Champs
Formulaire d'attributs
Jointures
Stockage auxiliaire
Actions
Infobulles

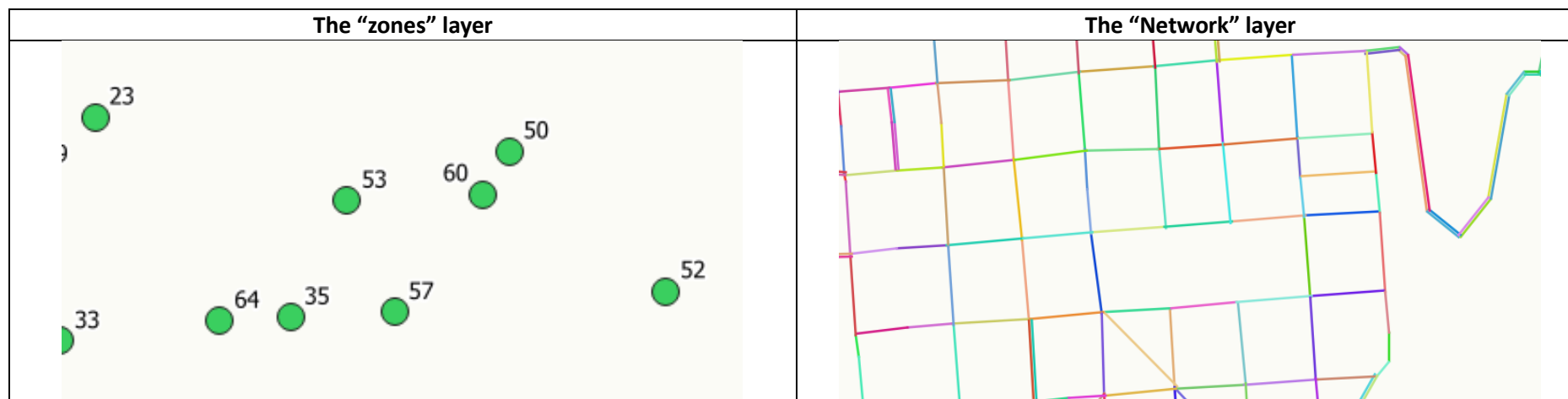
Nom	Alias	Type	Type identifié	Longueur	Précision	C
Row_qgis		Décimal (double)	Real	20	0	
Noeud_A		Texte (chaîne de caractères)	String	254	0	
Noeud_B		Texte (chaîne de caractères)	String	254	0	
Longueur		Décimal (double)	Real	20	0	
Category		Décimal (double)	Real	20	0	
PEN_VLx100		Décimal (double)	Real	20	0	
PEN_PLx100		Décimal (double)	Real	20	0	
PEN_TCx100		Entier (64bit)	Integer64	10	0	
avec_arbo		Entier (64bit)	Integer64	10	0	
TV_HPM		Décimal (double)	Real	20	0	
perso1		Entier (64bit)	Integer64	10	0	
TV_HPS		Décimal (double)	Real	20	0	
perso2		Entier (64bit)	Integer64	10	0	
TV_JO		Décimal (double)	Real	20	0	
perso3		Entier (64bit)	Integer64	10	0	
R01_22_REF		Décimal (double)	Real	20	0	

Activate « Update a field », then select « Geometry » then « \$length » :



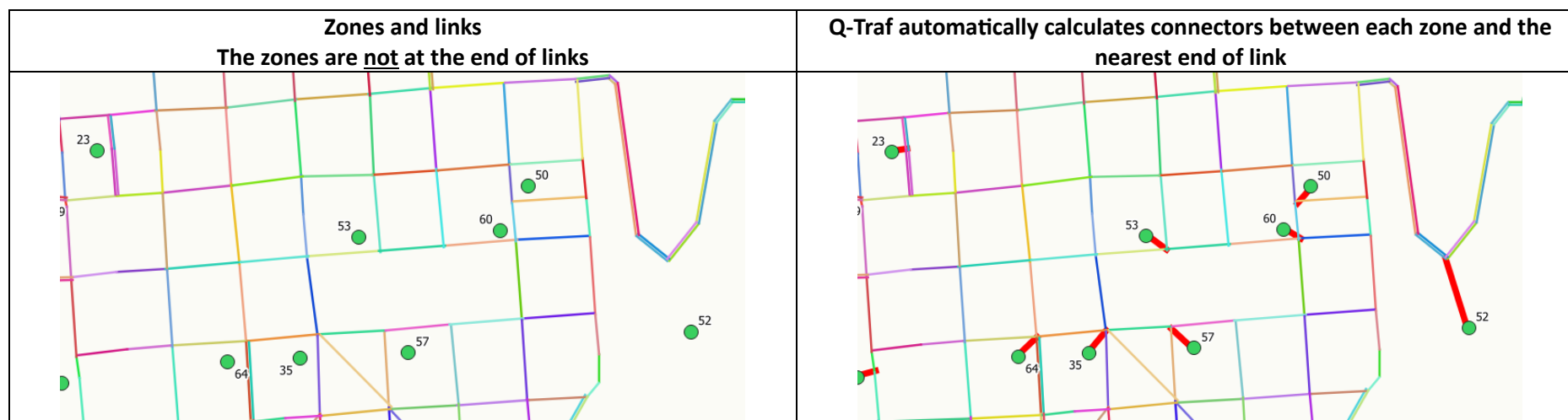
Zones and virtual connectors

Since the "zones" and the "network" are two separate QGIS layers ("point" and "line"), their consistency is not automatically guaranteed.



"Zones" do not need to be located at the exact end of the links.

- ⇒ Q-Traf automatically calculates the connectors between each zone and the nearest end of the links.
- ⇒ Note that there is one and only one connector per zone



⇒ The connectors -or virtual connectors- are **not** displayed in the results

Connectors

How to define connectors

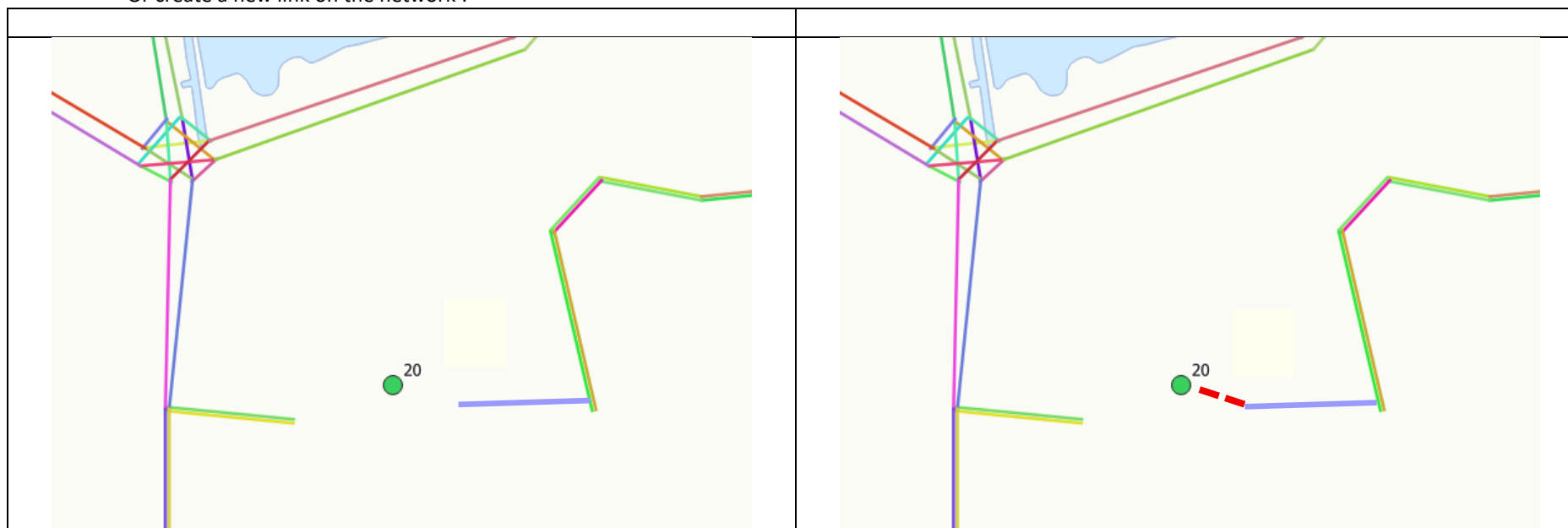
What if a connector is not connected to the “right” end of a link ?

There are 2 solutions:

- Move the zone closer to the right end of the link



- Or create a new link on the network :



- ⇒ The second solution allows to control the traffic flow on the connector
- ⇒ Caution : If the nearest link is prohibited to a (sub-class) vehicle, no traffic will be generated for that sub-class.

Connector category

The link ID category of the connectors is 10.

- ⇒ Don't use this value for other standard links

The connector capacity must be sufficient.

- ⇒ Connectors are always open to all (sub-type) vehicles. Permission can only be set for "zones" and "links".

Links categories

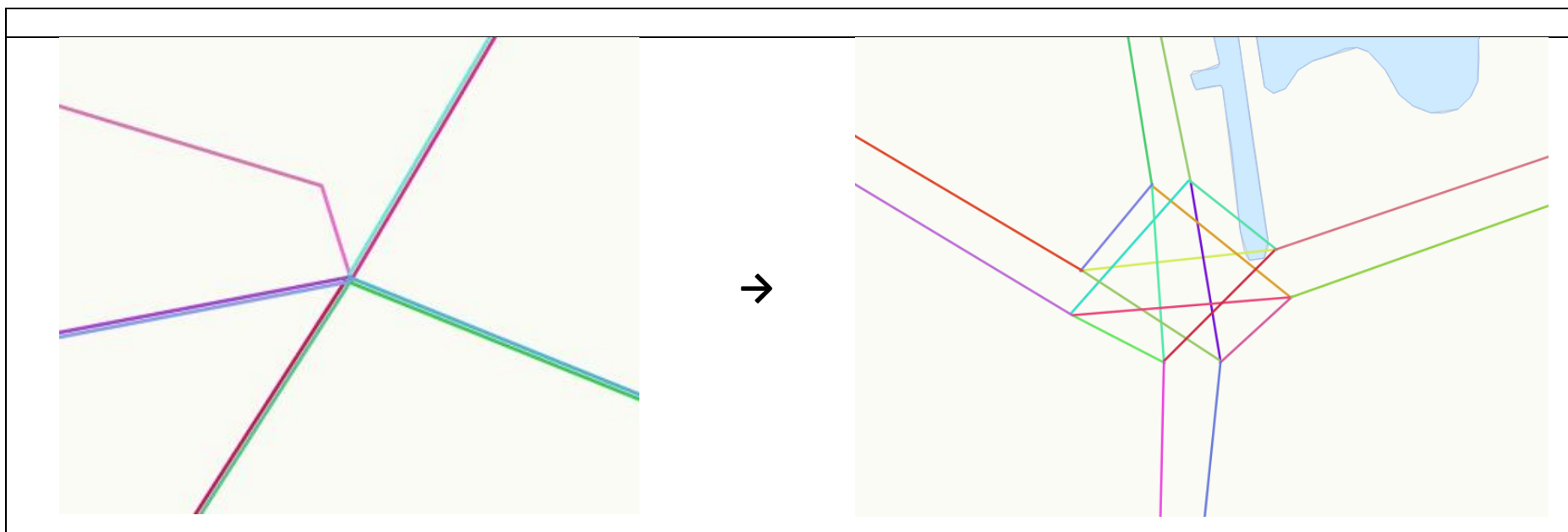
The link category ID must be between 10 and 120 (values 1 to 9 are unused).
10 is reserved for the virtual connectors.

Links

Links are all one-way. A two-way road requires two links.

Prohibiting Turning movements

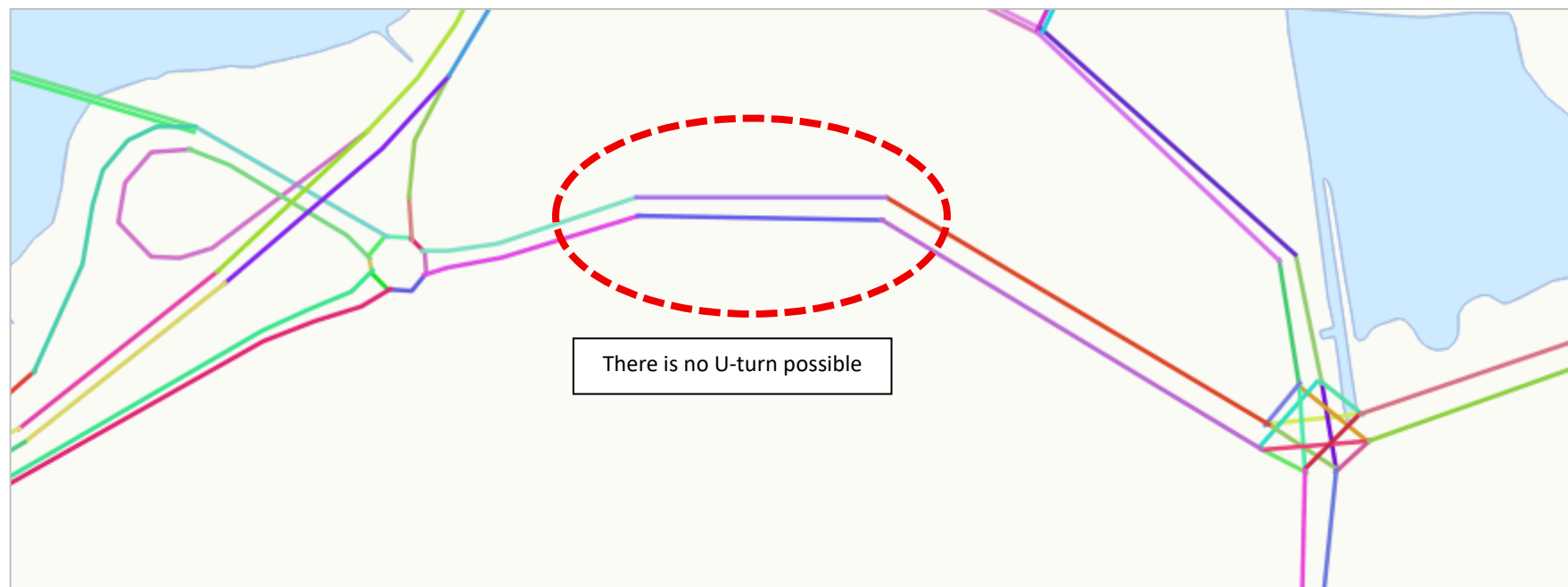
There is no possibility to directly prohibit a turning movement. To do so, the intersections must be coded as follows :



The corresponding link can then be prohibited for certain vehicle sub class.

Prohibiting U-turns

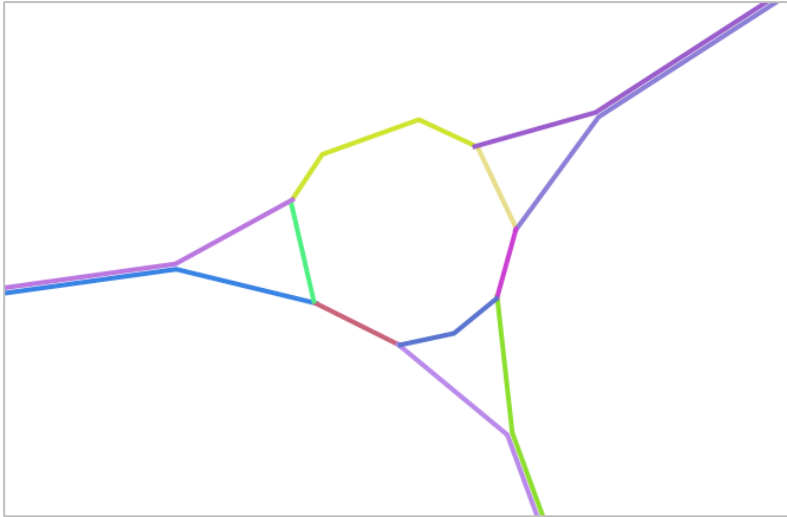
There is no possibility to prohibit a U-turn directly. To do so, both directions of a link must be coded independently, separated by a few meters (at least 2), as follows :



- ⇒ It is not necessary to do this for every link. If a large number of vehicles make a U-turn in the middle of a road, it underlines a real situation / problem with the network, not a modelling problem.

Roundabouts

The best practice to code roundabouts is the following :



This ensures :

- There is no U-turn possible
- All the traffics on the roundabout are known (displayed)

Generalized cost of a link / path

Without penalty

Generalized cost of a link = coefficient_a x travel time (second) + length (meter)

With Penalty

Generalized cost of a link = (cost_factor_x100_troncon / 100) x (coefficient_a x travel time (second) + length (meter))

Generalized cost of a path

Generalized cost of a Path = $\sum$ (Generalized cost of the links of the path)

3. METHOD OF TRAFFIC ASSIGNMENT

The algorithm used in Q-Traf is the Method of Successive Averages ("MSA"). The MSA is a convergence algorithm towards the user equilibrium.

In the first iteration, link flows are calculated on the basis of the free network (without traffic). This is an all or nothing assignment.

At each following iteration i :

- The link flows at the beginning of the iteration are : $(\text{link flows})_{i-1}$
- The new shortest paths are calculated on the basis of the link flows of the previous iteration : $(\text{link flows})_{i-1}$
- 100 % of the traffic is assigned to the new shortest path : $(\text{Link flows on the shortest path})_i$

The new link flows at the end of the iteration i are :

$(\text{link flows}) = \alpha (\text{link flows of the previous iteration}) + \beta (\text{link flows on the shortest path of the last iteration})$

or

$(\text{link flows})_i = \alpha (\text{link flows})_{i-1} + \beta (\text{link flows on the shortest path})_i$

Where:

$\alpha + \beta = 1$ (the total volume of traffic is unchanged between iteration, and always 100%)

and

β must be between $1/i$ and $1/i^2$ (to ensure convergence)

β is here equal to $1/i^{(3/2)}$

So :

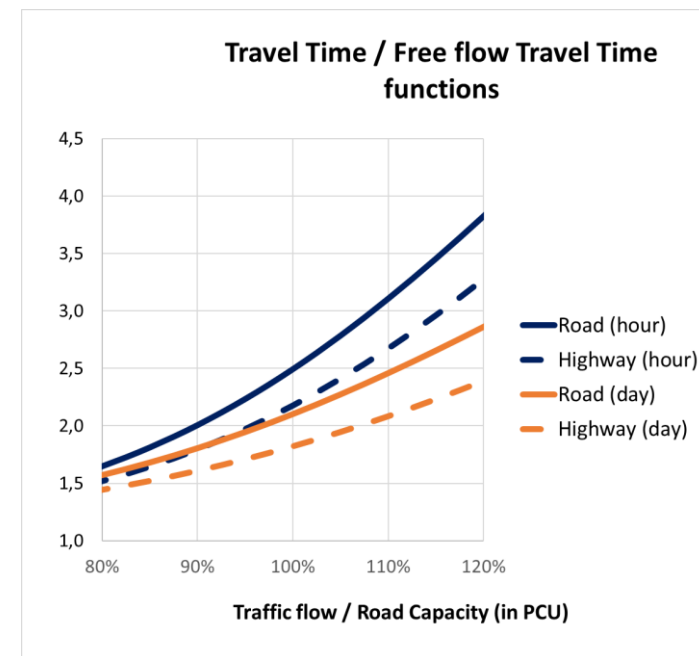
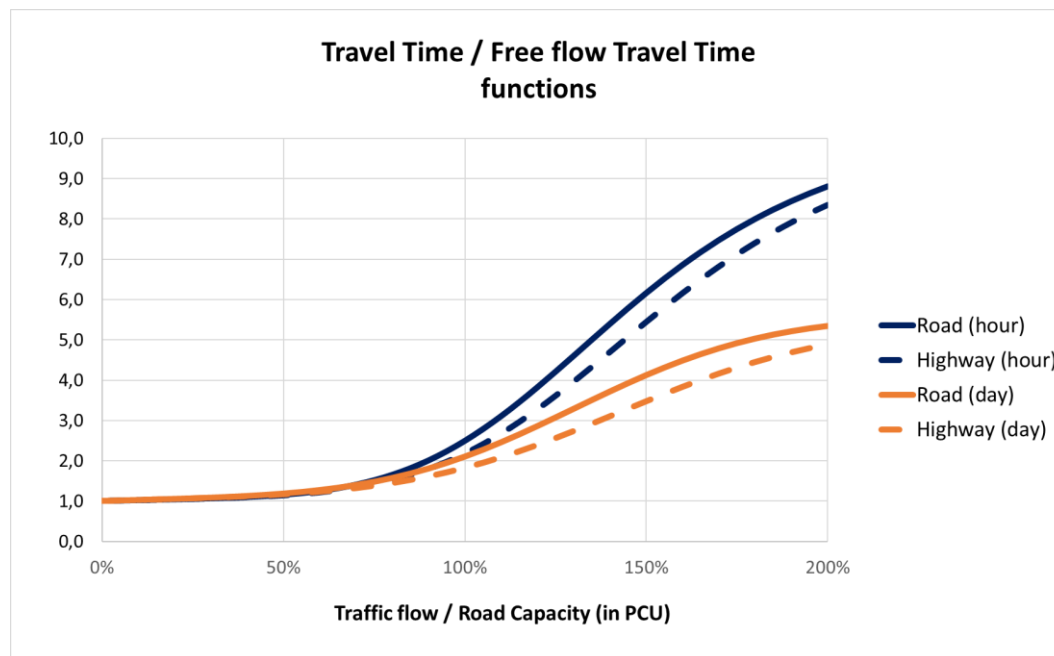
- In the first iteration, all the trips is assigned on the basis of the free network (without traffic)
- For all the other iterations, assignments are done on the basis of a fully charged network
- At each iteration new shortest paths can be found and added
- The more iterations, the less weight for the first iterations

4. LINK TRAVEL TIME (FLOW RATE) FUNCTIONS

There are currently 2 types of functions Delay(flow), for :

- Free-flow / grade-separated roads (highway)
- Other roads

... which are specified in the field “Free-flow / grade-separated roads” in the link categories



- ⇒ The increase of travel time is less important for highways; thus, in case of high traffic volume (and high congestion), highways attract relatively more traffic than other smaller roads
- ⇒ The travel time for daily period is inferior to the travel time for hourly period. It is the consequence of the ponderation of low traffic period (night) and heavy traffic period (peak hours), in the average “Traffic Flow / Road Capacity” ratio (note that the daily capacity is also not 24xhourly capacity).