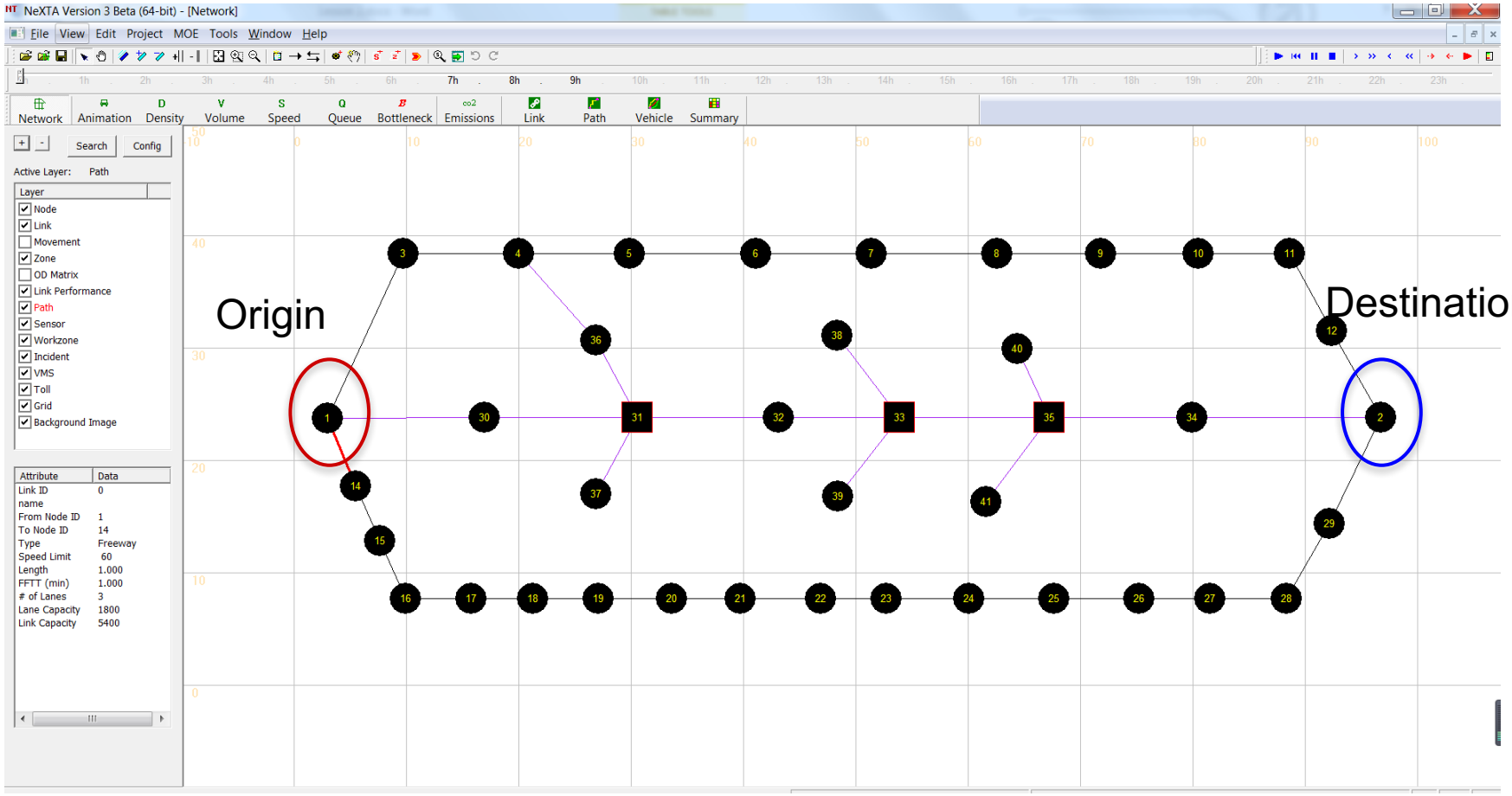
Scenario Analysis and Outputs

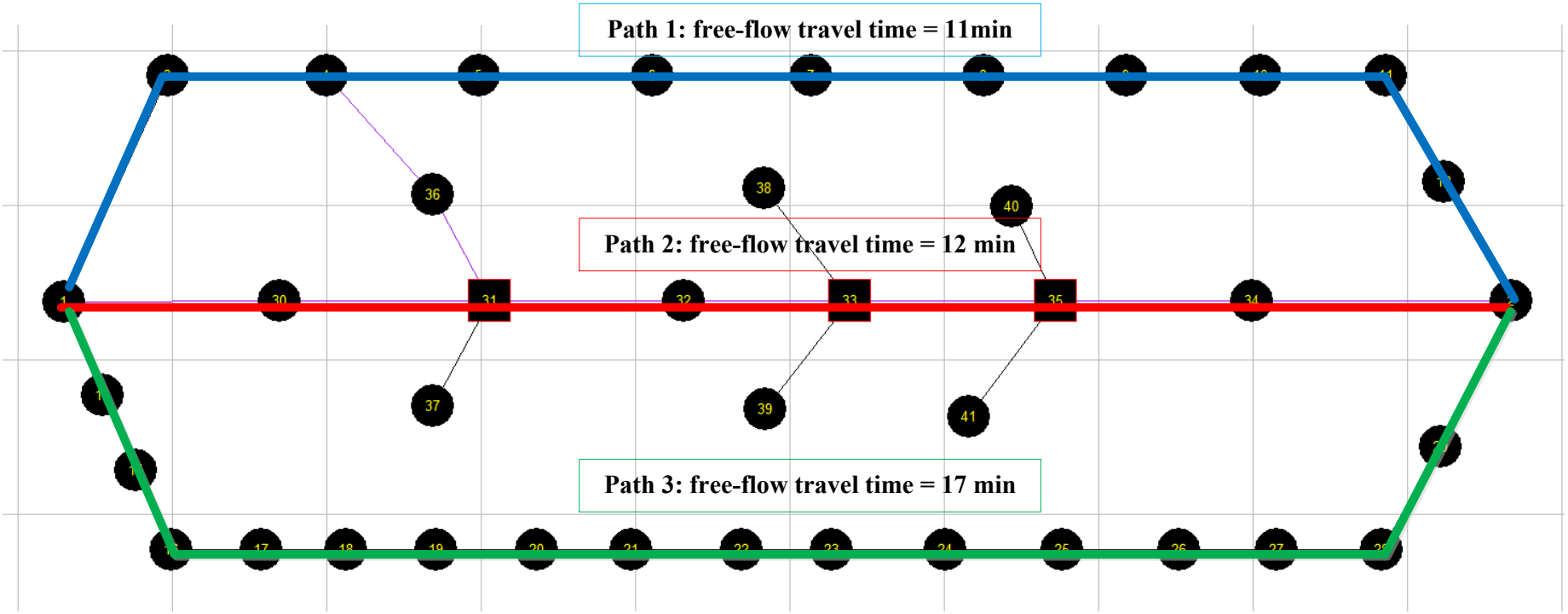
1. Tolling example: 3-corridor network



1. Tolling example: 3-corridor network

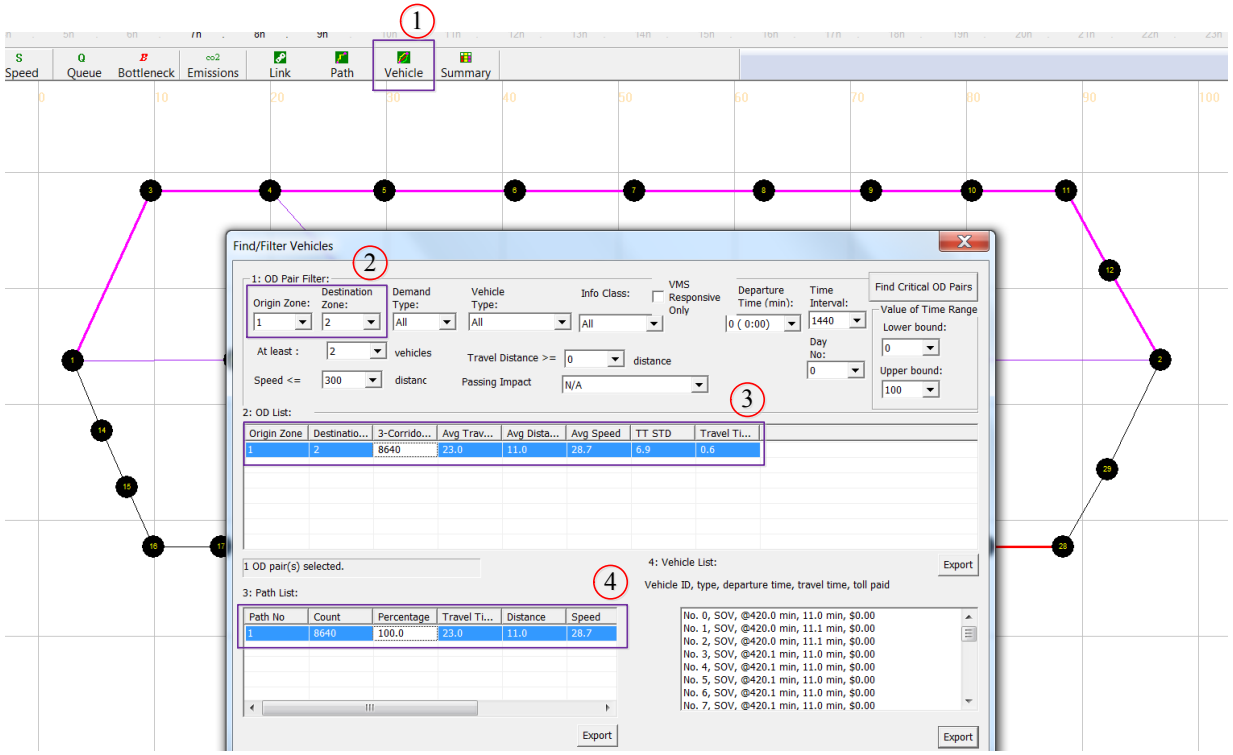
File No.	GIS Layer	Associated Data File	Associated Menu for Data Editing	Important Attributes
1	Node	input_node.csv	Project->Network Data-> Node	node coordinate, control type
2	Link	input_link.csv	Project->Network Data-> Link	from node, to node, speed limit -> free-flow travel time, capacity, number of lanes
3	Zone	input_zone.csv	Project->Network Data-> Zone	zone definition for OD demand
4	Activity Location (similar to centroid)	input_activity_location.csv	Project->Network Data-> Activity Location	mapping from zone number to nodes as origin or destination
5	OD demand matrix	input_demand_file_list.csv input_demand.csv	Project-> Demand Database	# of trips from zone i to zone j

1. Tolling example: 3-corridor network



1. Tolling example: 3-corridor network

- Run 1 iteration: all vehicles choose the least-cost path based on link free-flow travel time.



Step 1: Click “Vehicle” to call the dialogue of “Find/Filter Vehicle”.

Step 2: Choose the target OD pair and corresponding conditions. In this case, we choose OD pair 1→2.

Step 3: Click the OD list to check the general summary of OD pair 1→2.

Step 4: Choose one used path in Path List

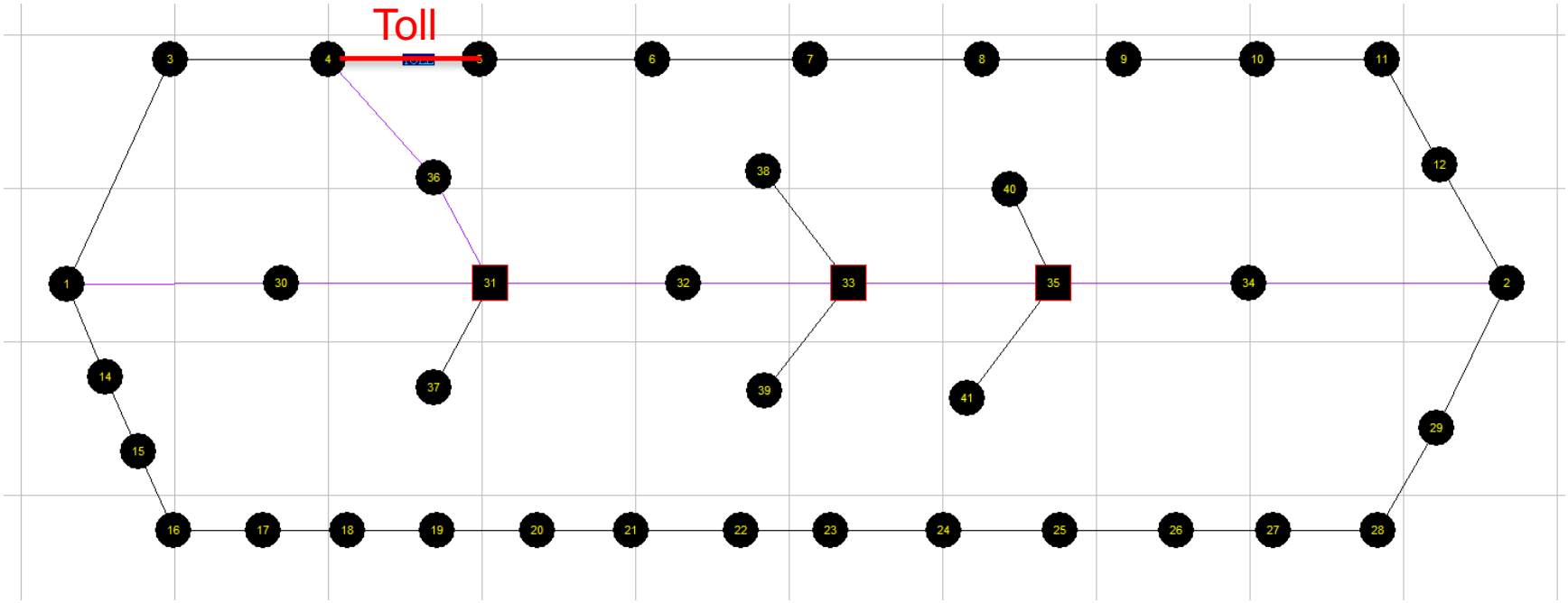
Agent-Based Routing

- Individual generalized cost function

$$Cost = Travel\ Time * VOT + Toll$$

  - Can consider multiple factors
    - Value of time, Value of reliability, Value of safety
  - Perform routing algorithm individually for each vehicle/agent
  - Can adjust origin/destination/departure time/path at each iteration (day)

1. Tolling example: 3-corridor network



The specific toll settings are **input in Scenario_Link_Based_Toll.csv**.

Link	Scenario No	Start Day	End Day	Start Time in Min	End Time in min	Toll for Demand Type 1
[4,5]	0	0	1	420	540	0.2

link-based toll for low-income travelers

Average VOT of SOV in the file **input_demand_type.csv**

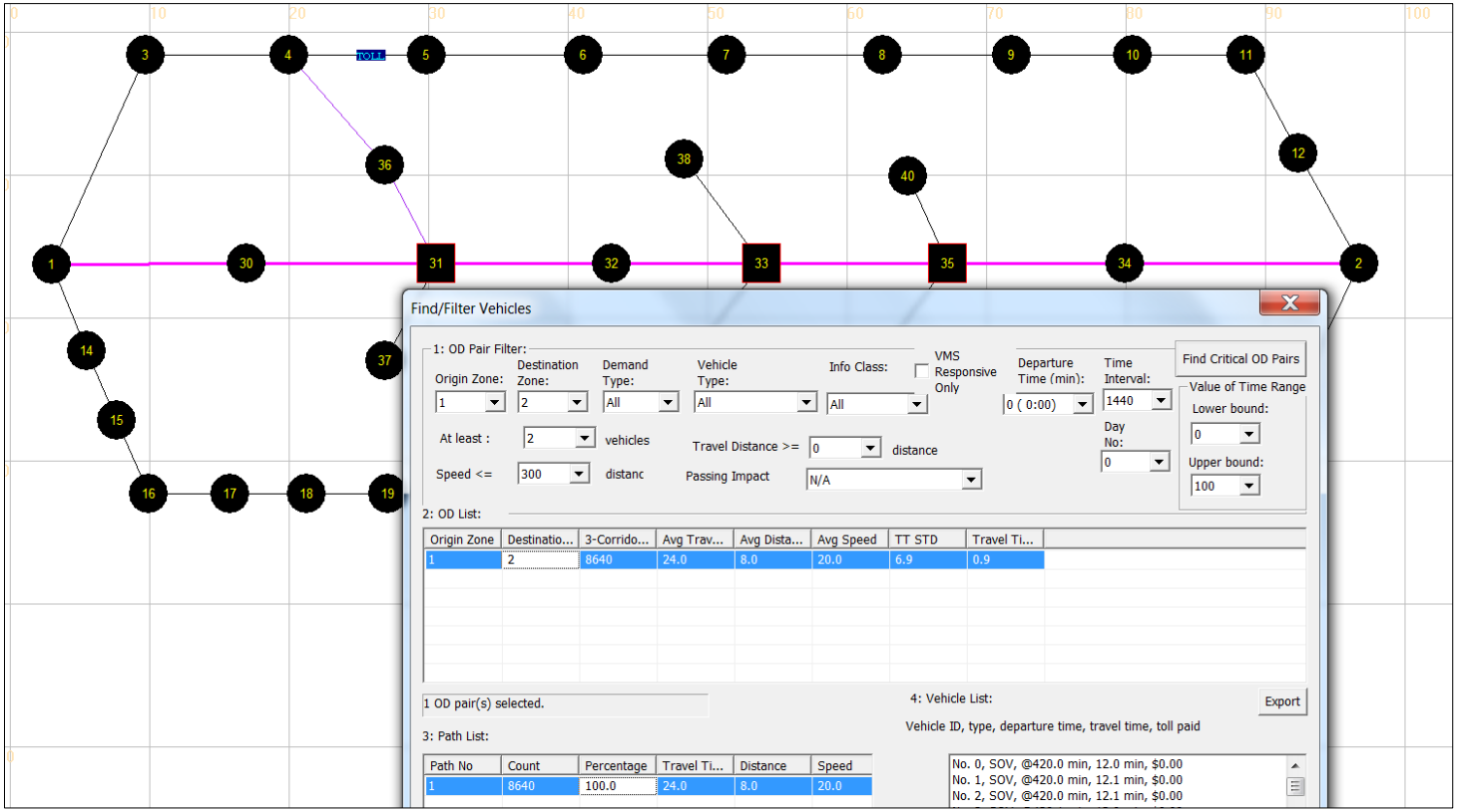
demand_type	demand_type_name	avg_VOT
1	SOV	10

The generalized link travel time can be formulated as $GC_{i,j} = t_{i,j} + \frac{toll_{i,j}}{VOT}$

Path 1 with toll values will have the generalized travel time value of ($11 + \frac{0.2}{10/60}$) = 12.2 min, which is more that the free-flow path travel time of path 2 (12 min).

link-based toll for low-income travelers

- Vehicles will choose path 2

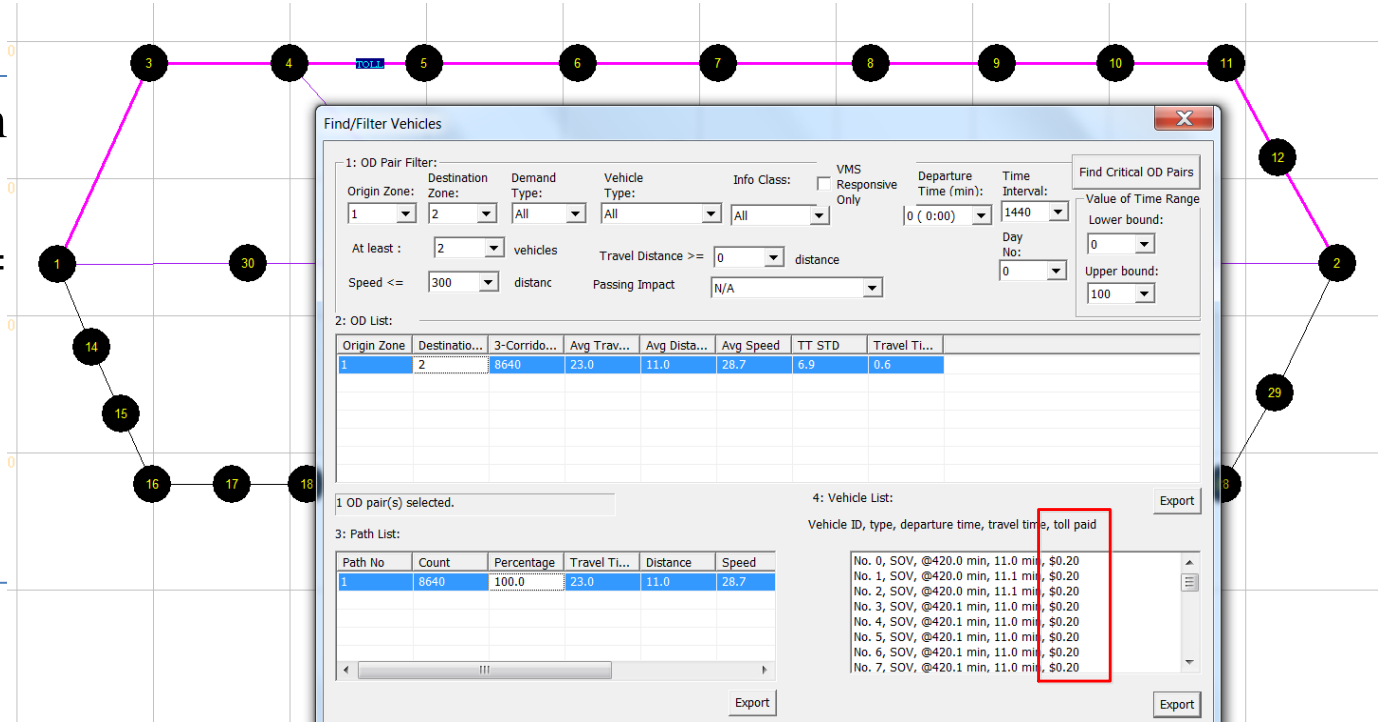


link-based toll for high-income travelers

Average VOT of SOV in the file input_demand_type.csv

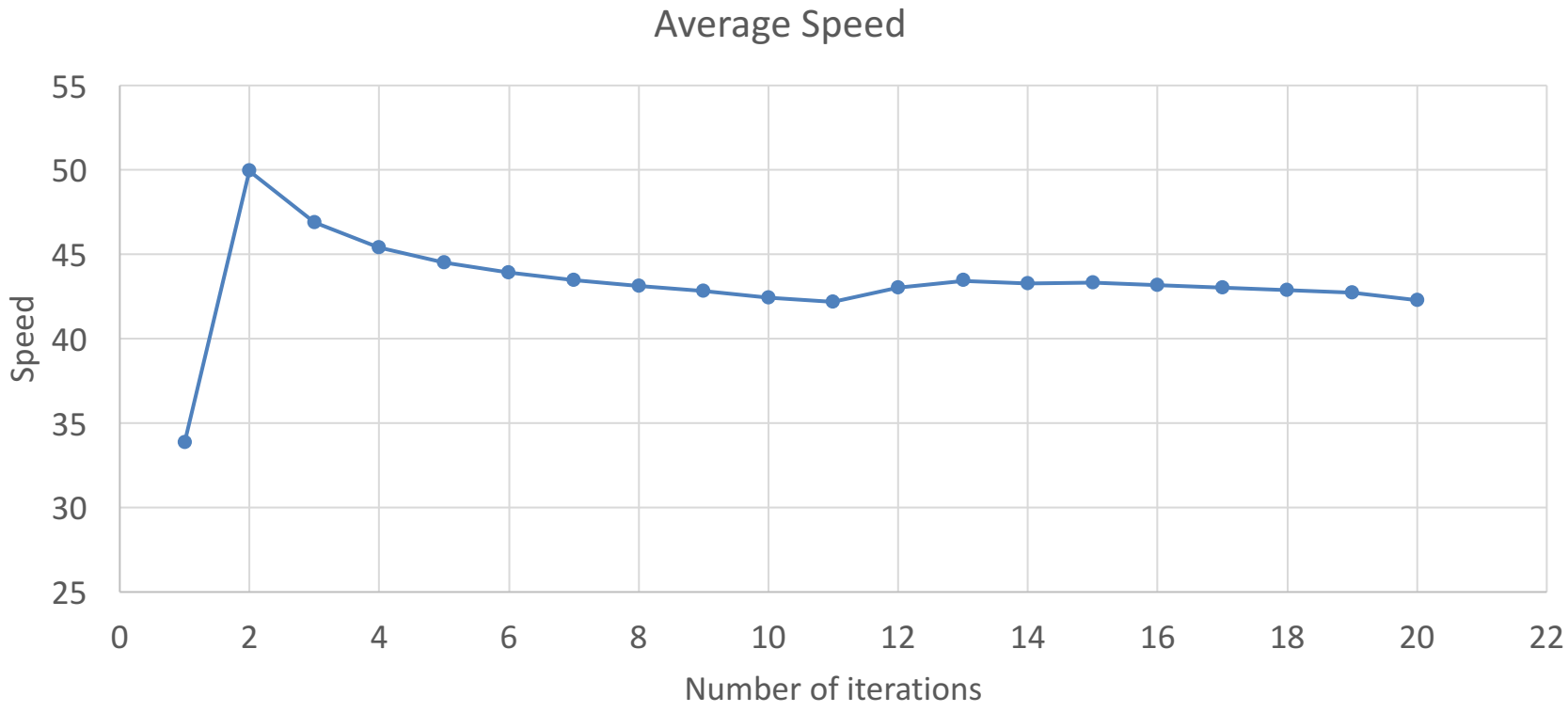
demand_type	demand_type_name	avg_VOT
1	SOV	20

The generalized path travel time of path 1 will be $11 + \frac{0.2}{20/60} = 11.6$ min, which is less than 12 min of path 2's free-flow travel time



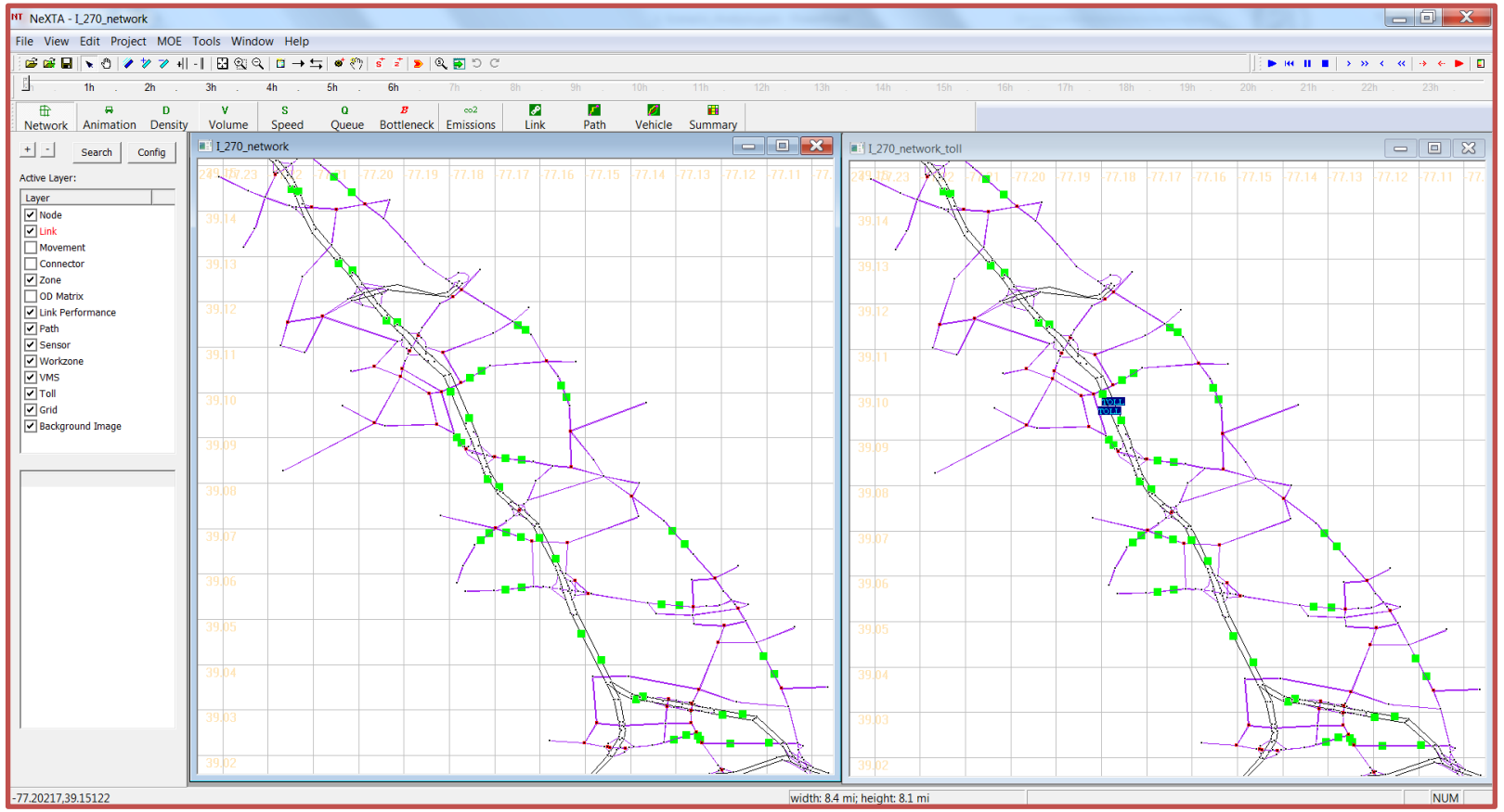
1. Tolling example: 3-corridor network

There are 8000 low-income travelers and 640 high-income travelers.



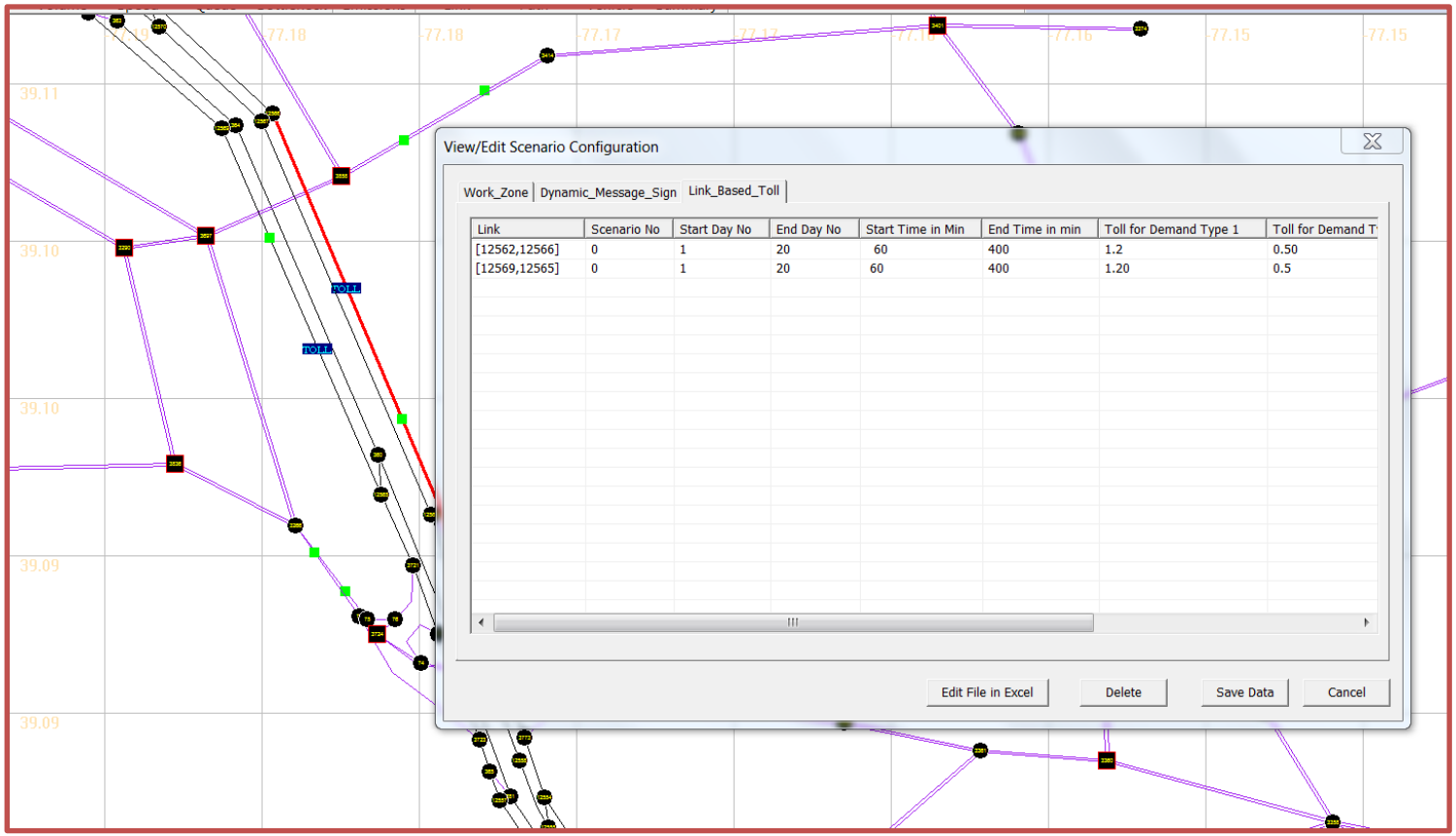
2. Tolling scenario: I-270 network

- Open two projects (base case vs. tolling case)
- Window → Tile vertically



3. Tolling scenario: I-270 network

- Define toll value on links
- Click “Toll” in GIS layer → select the tolled link and right click → add link-based toll (Scenario_Link_Based_Toll.csv)



3. Tolling scenario: I-270 network

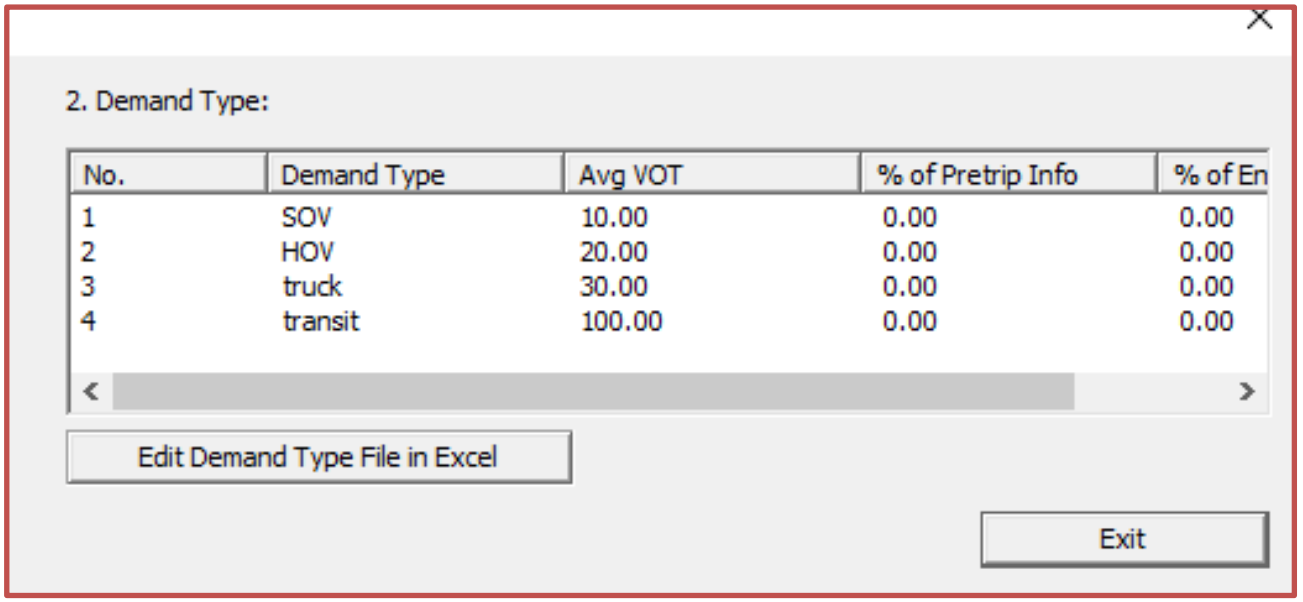
Scenario_Link_Based_Toll.csv

Link	Scenario No	Start Day No	End Day No	Start Time	End Time in min
[12562,12566]	0	1	20	60	400
[12569,12565]	0	1	20	60	400

Toll for Demand Type 1	Toll for Demand Type 2	Toll for Demand Type 3
1.2	0.5	2
1.2	0.5	2

3. Tolling scenario: I-270 network

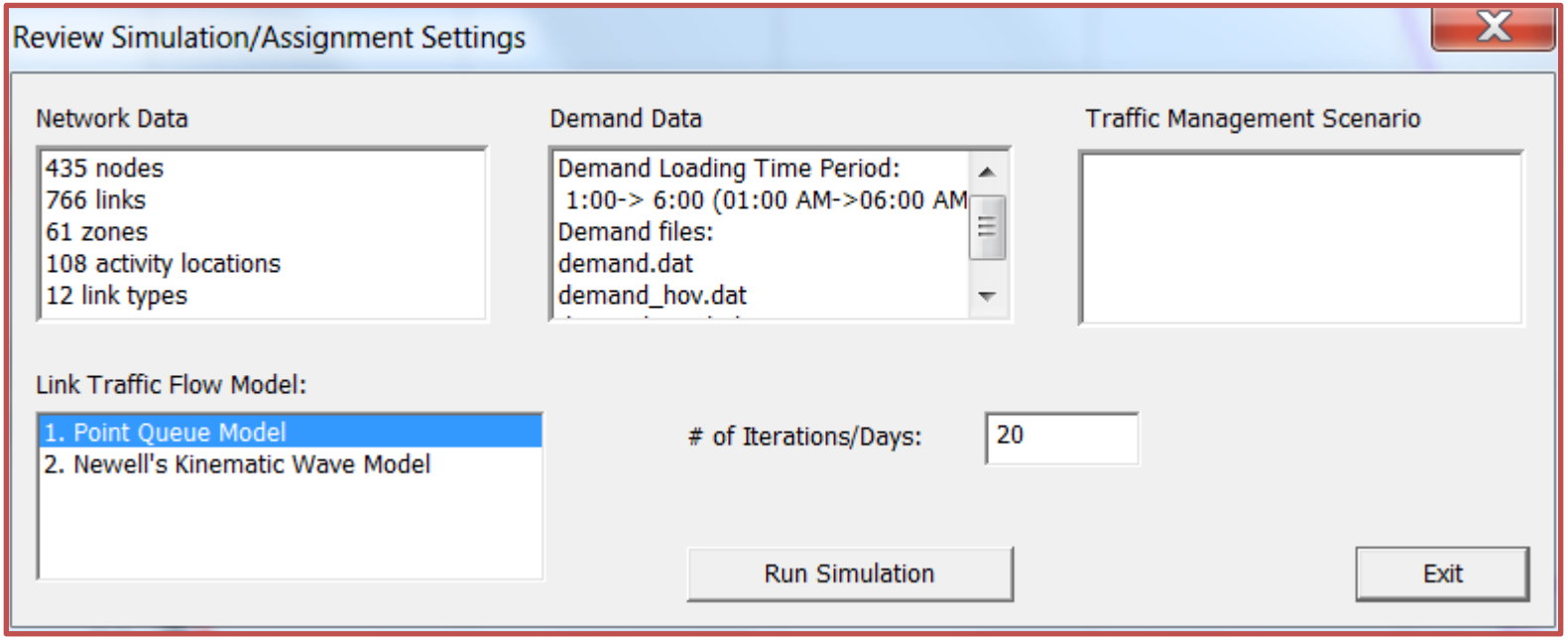
- Define VOT for each demand type
- Project → demand database (input_demand_types.csv)



3. Tolling scenario: I-270 network

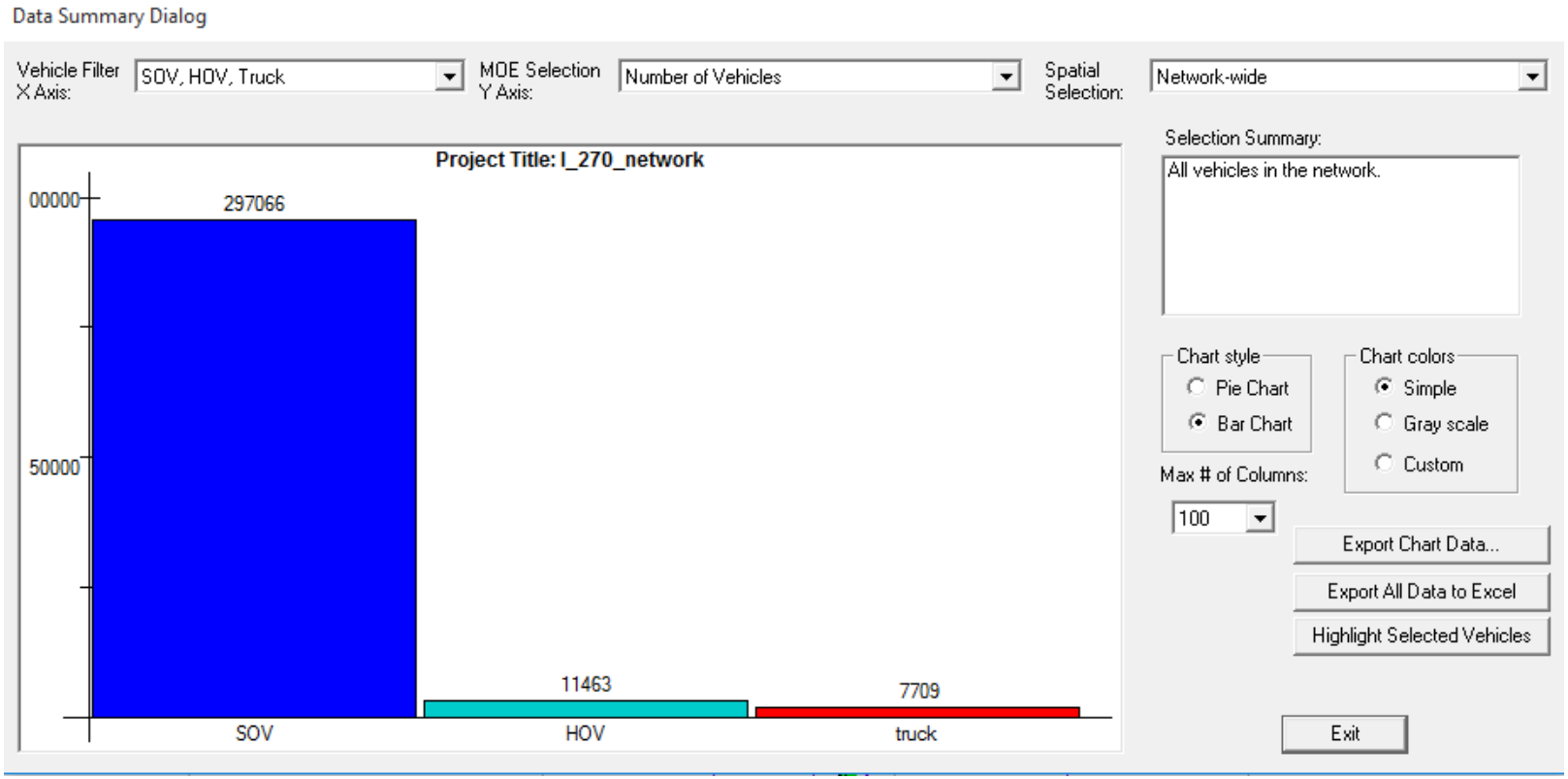
- Check available demand types in input_demand_file_list.csv

format_ty	number_o	loading_m	start_time	end_time_	apply_add	subtotal_i	number_o	demand_type_1
dynasmart	1	1	60	360	0	0	1	1
dynasmart	1	1	60	360	0	0	1	2
dynasmart	1	1	60	360	0	0	1	3



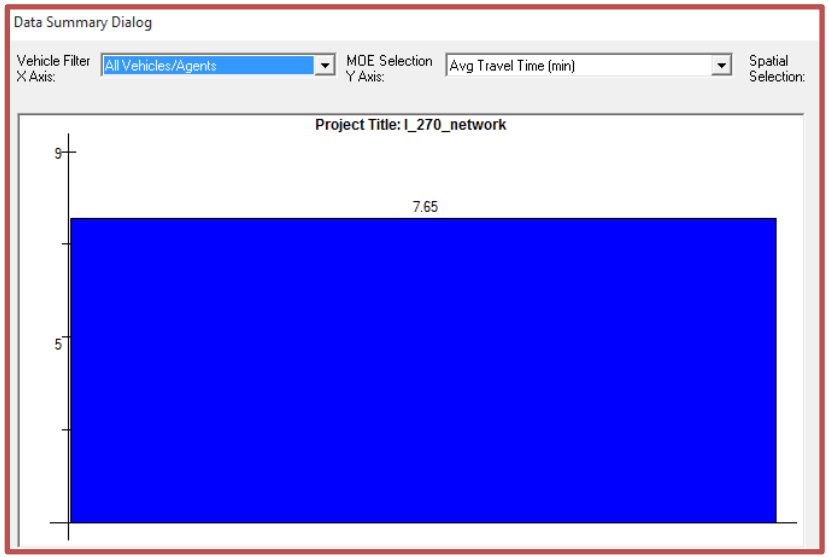
3. Tolling scenario: I-270 network

- Number of vehicles in each demand type



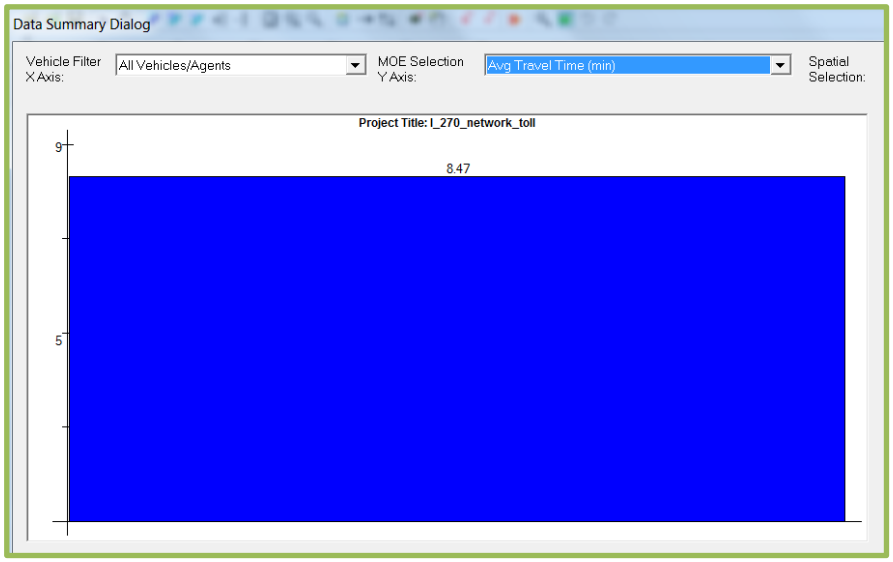
Average vehicle travel time

Case 1: base case



Travel time = 7.65 min

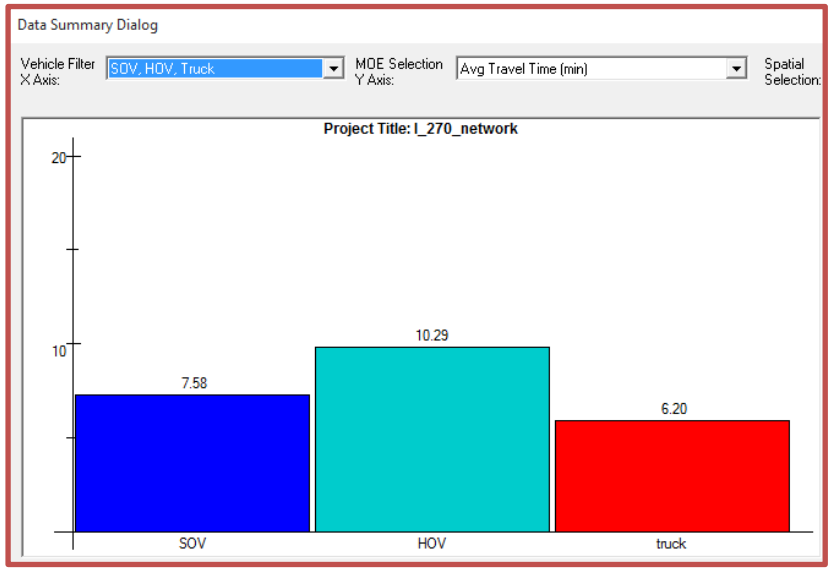
Case 2: tolling case



Travel time = 8.47 min

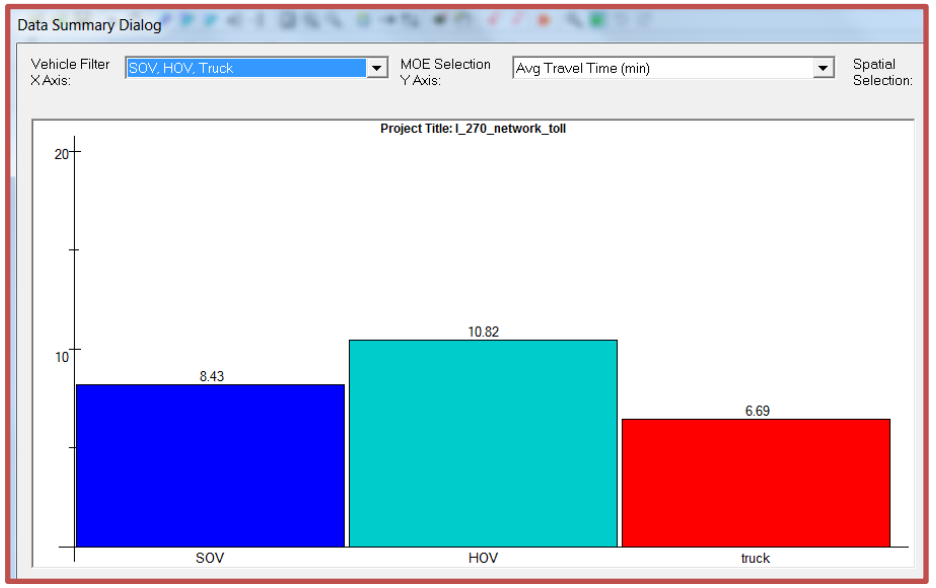
Average travel time in each demand type

Case 1: base case



SOV: 7.58 min
HOV: 10.29 min
TRUCK: 6.20 min

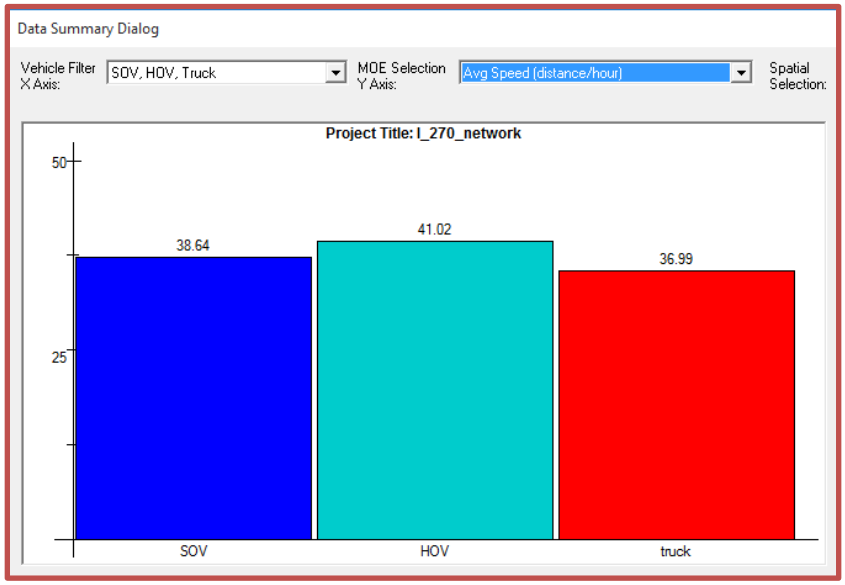
Case 2: tolling case



SOV: 8.43 min
HOV: 10.82 min
TRUCK: 6.69 min

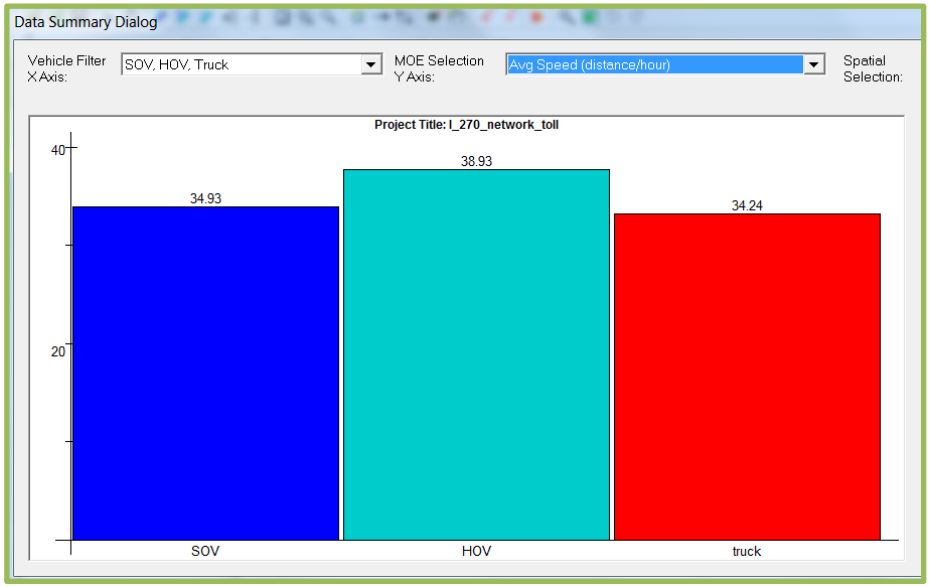
Average speed of each demand type

Case 1: base case



SOV: 38.64 mph
HOV: 41.02 mph
TRUCK: 36.99 mph

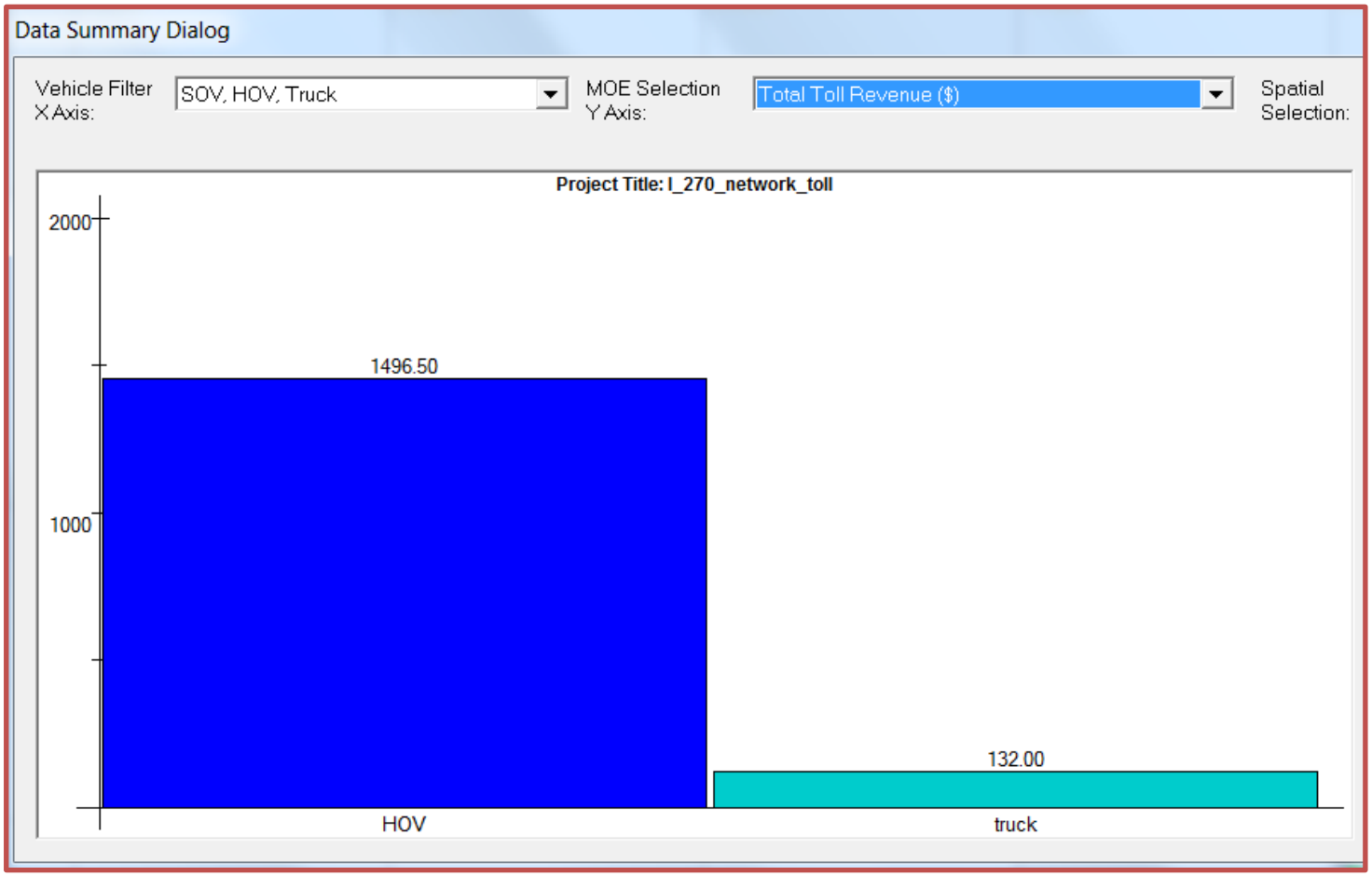
Case 2: tolling case



SOV: 34.93 mph
HOV: 48.93 mph
TRUCK: 34.24 mph

Total Toll Revenues

Case 2: tolling case

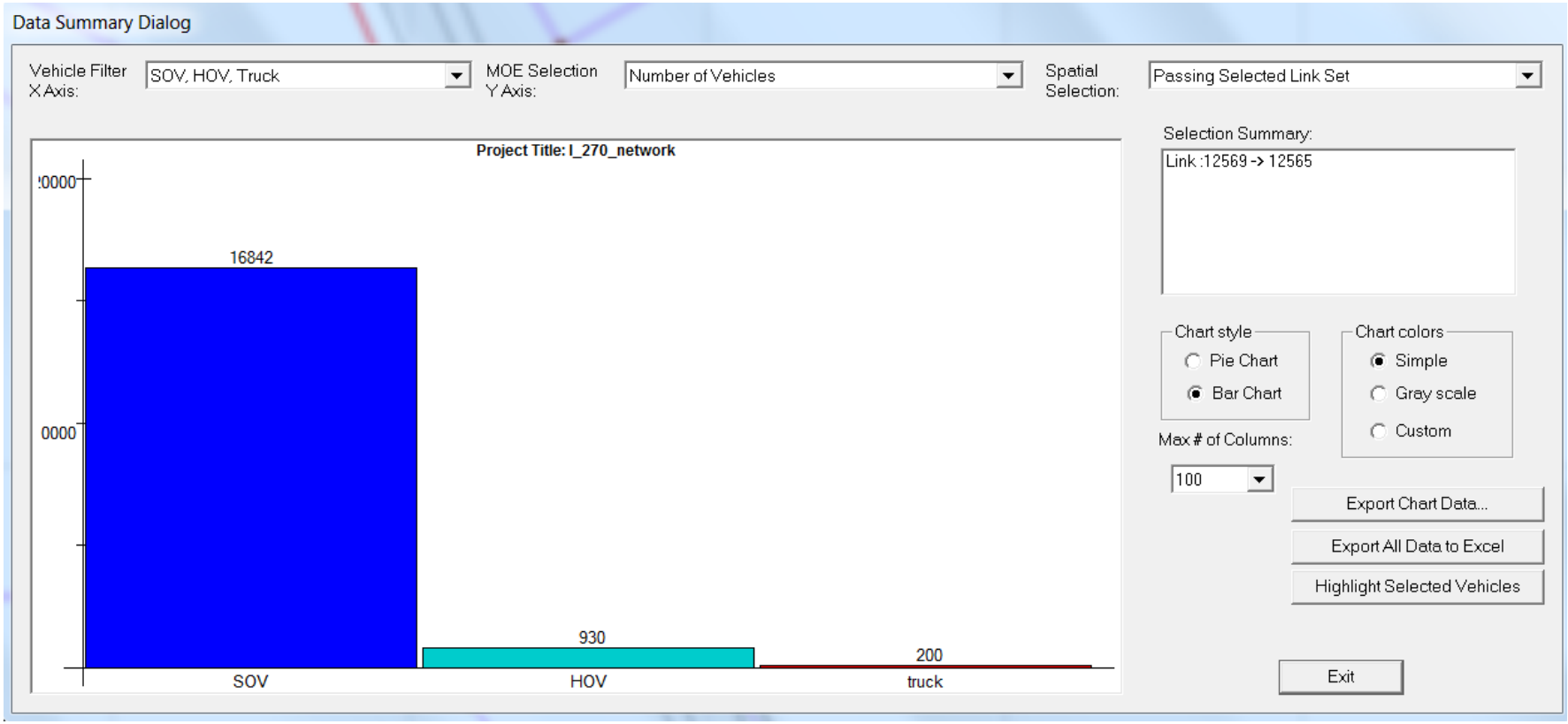


Output_summary.csv

- Network- level performance
- Demand type-level performance
- Link-level performance
- OD-level performance

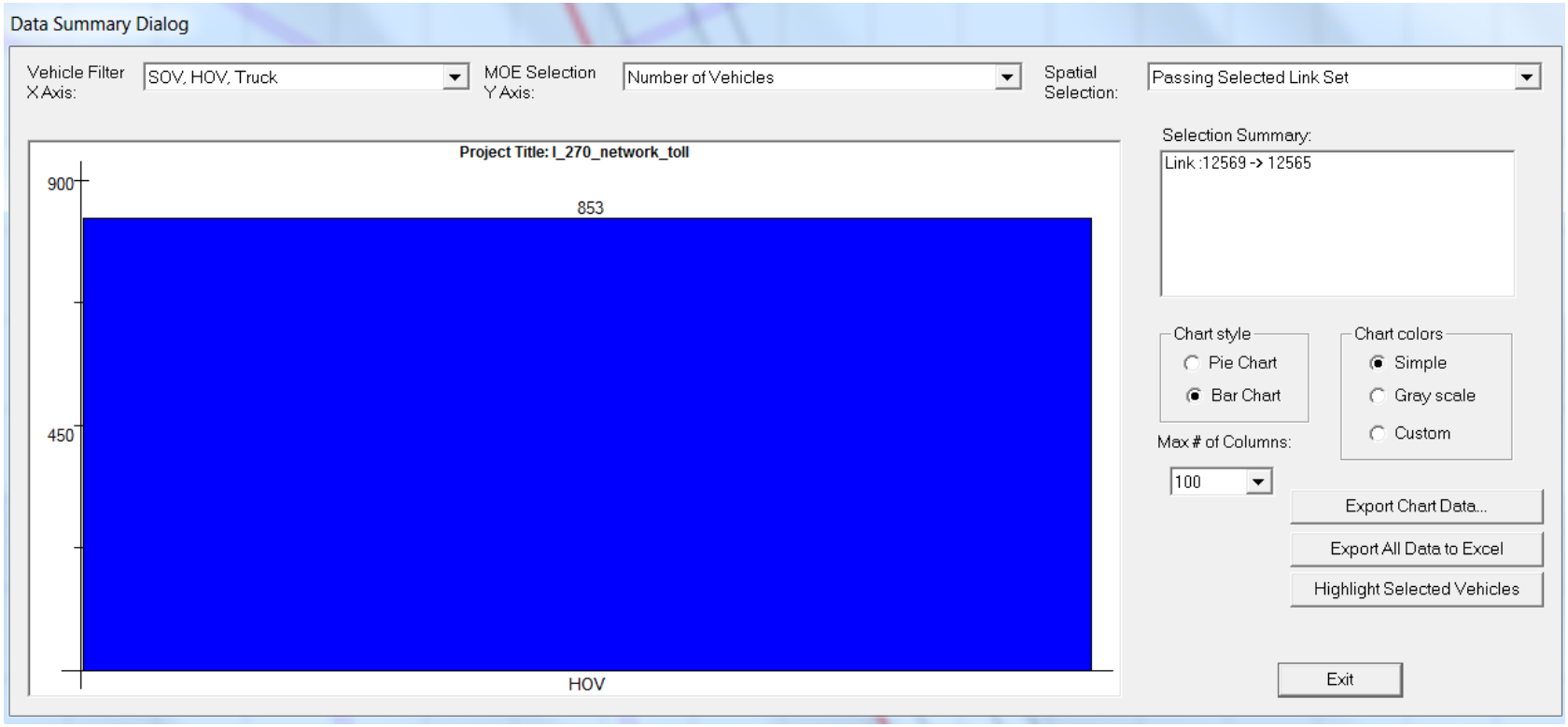
Demand type distribution on link 12569->12565

Without toll



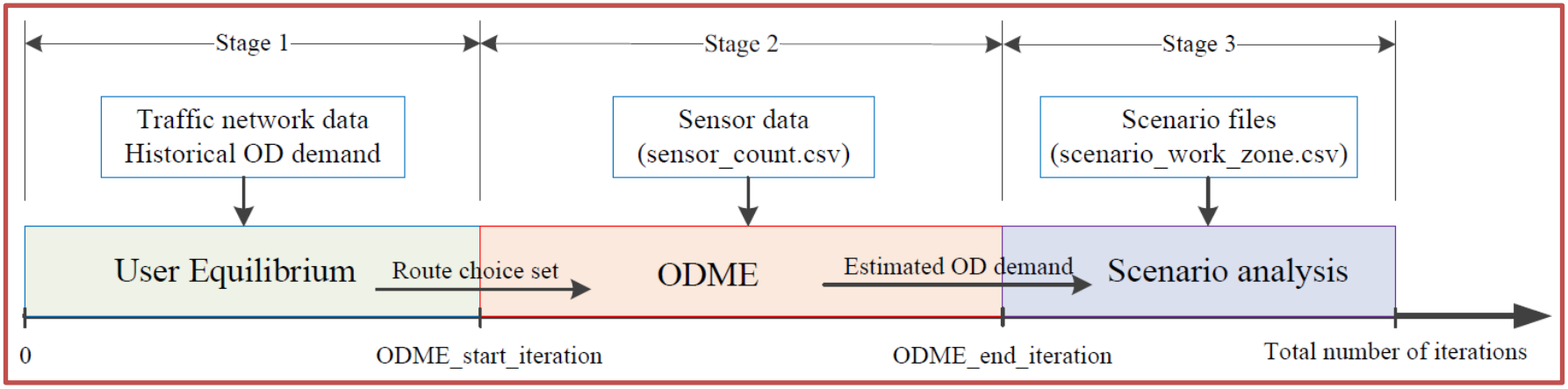
Demand type distribution on link 12569->12565

tolling scenario

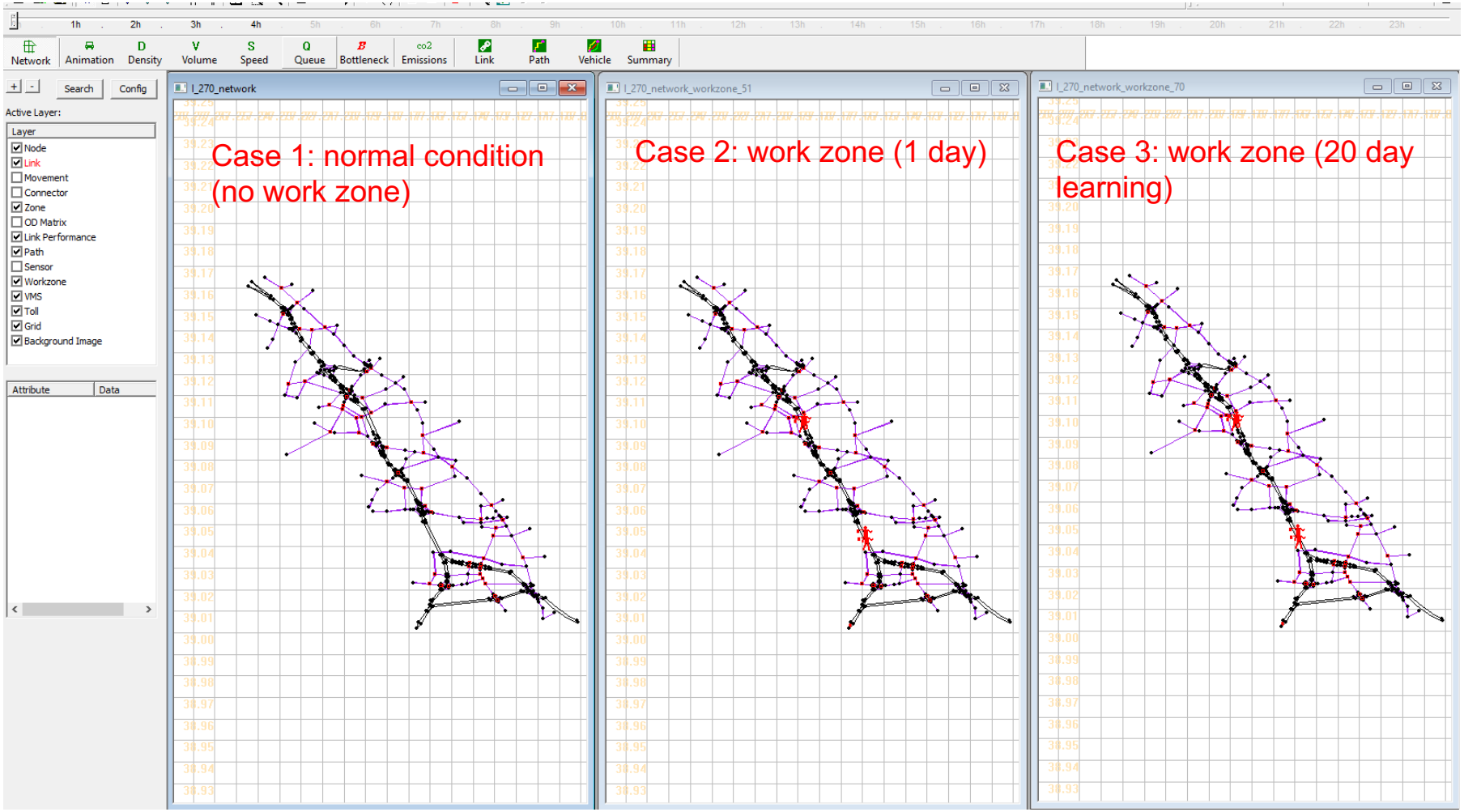


4. Scenario analysis: work zone

- Stage 1: reach user equilibrium through running multiple iterations
- Stage 2: based on the route choice set (UE) at stage 1 and observed sensor data, estimate OD demand
- Stage 3: based on the estimated OD demand at stage 2, analyze different scenarios



Three cases


Network
Animation
Density
Volume
Speed
Queue
Bottleneck
Emissions
Link
Path
Vehicle
Summary
Search
Config
Active Layer:
Layer
Node
Link
Movement
Connector
Zone
OD Matrix
Link Performance
Path
Sensor
Workzone
VMS
Toll
Grid
Background Image
Attribute
Data
I_270_network
I_270_network_workzone_51
I_270_network_workzone_70
Case 1: normal condition (no work zone)
Case 2: work zone (1 day)
Case 3: work zone (20 day learning)

Define work zone in NeXTA

Click “workzone” in GIS layer → select the target link and right click → add workzone on selected link (Scenario_Work_Zone.csv)

Case 2: work zone (1 day)

View/Edit Scenario Configuration

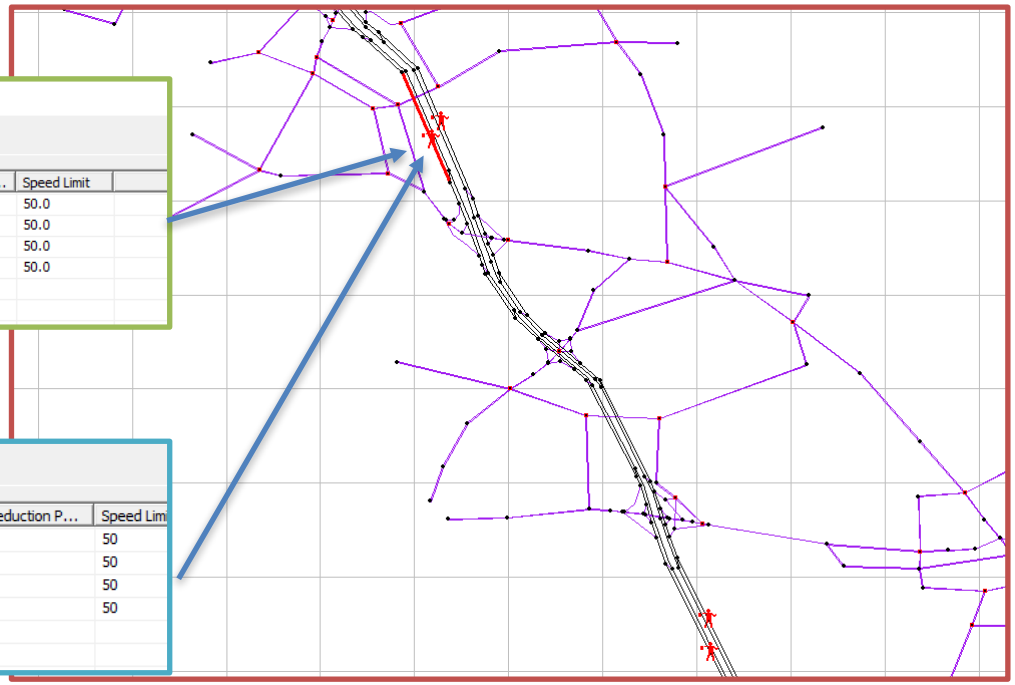
Work_Zone | Dynamic_Message_Sign | Link_Based_Toll

Link	Scenario No	Start Day No	End Day No	Start Time in Min	End Time in min	Capacity Reductio...	Speed Limit
[3765,12534]	0	51	51	0.0	1440.0	50.0	50.0
[12537,3710]	0	51	51	0.0	1440.0	50.0	50.0
[12562,12566]	0	51	51	0.0	1440.0	50.0	50.0
[12569,12565]	0	51	51	0.0	1440.0	50.0	50.0

Case 3: work zone (20 day)

Work_Zone | Dynamic_Message_Sign | Link_Based_Toll

Link	Scenario No	Start Day No	End Day No	Start Time in Min	End Time in min	Capacity Reduction P...	Speed Lim
[3765,12534]	0	51	70	0	1440	50	50
[12537,3710]	0	51	70	0	1440	50	50
[12562,12566]	0	51	70	0	1440	50	50
[12569,12565]	0	51	70	0	1440	50	50

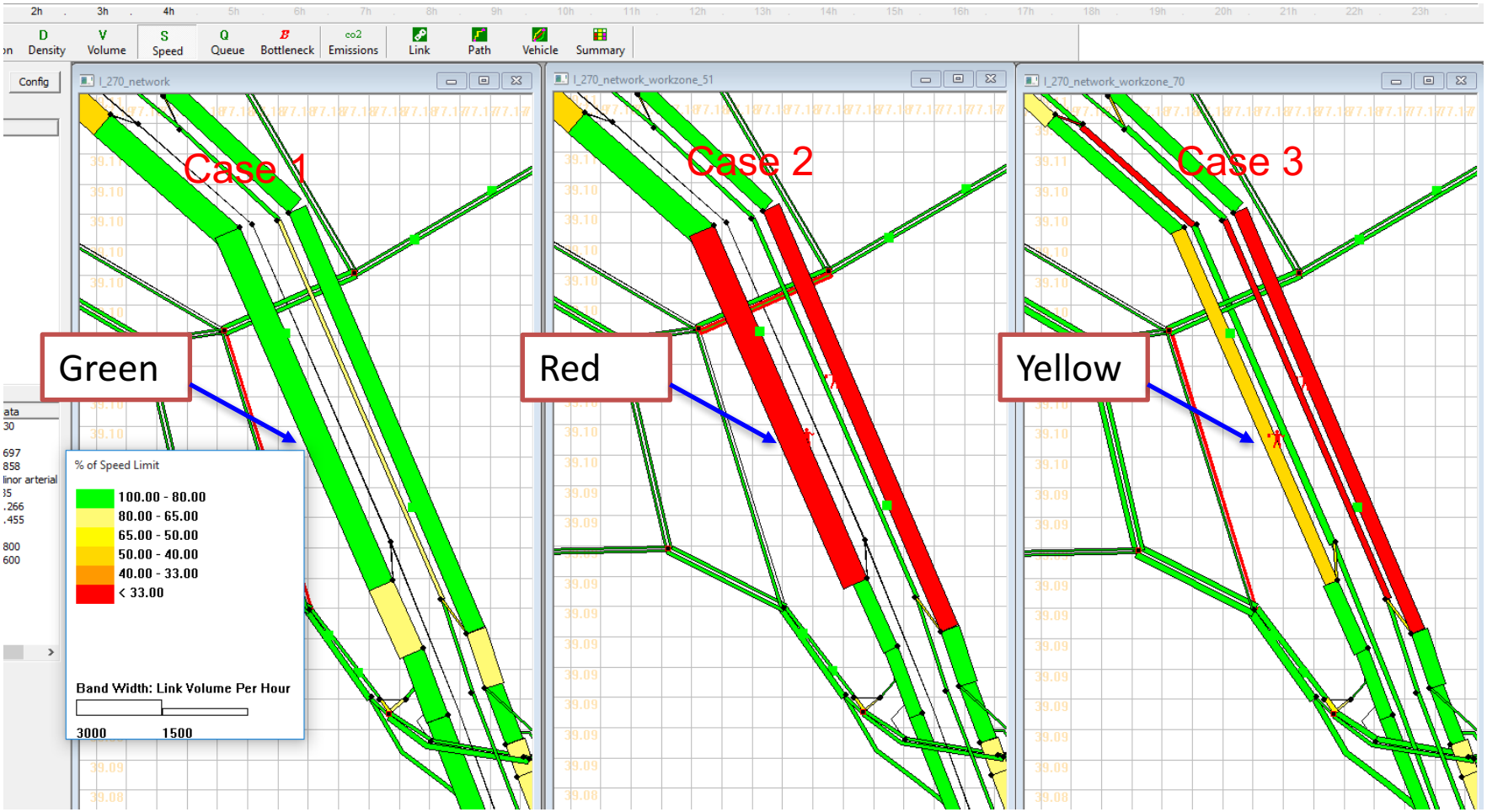


Simulation results of three cases

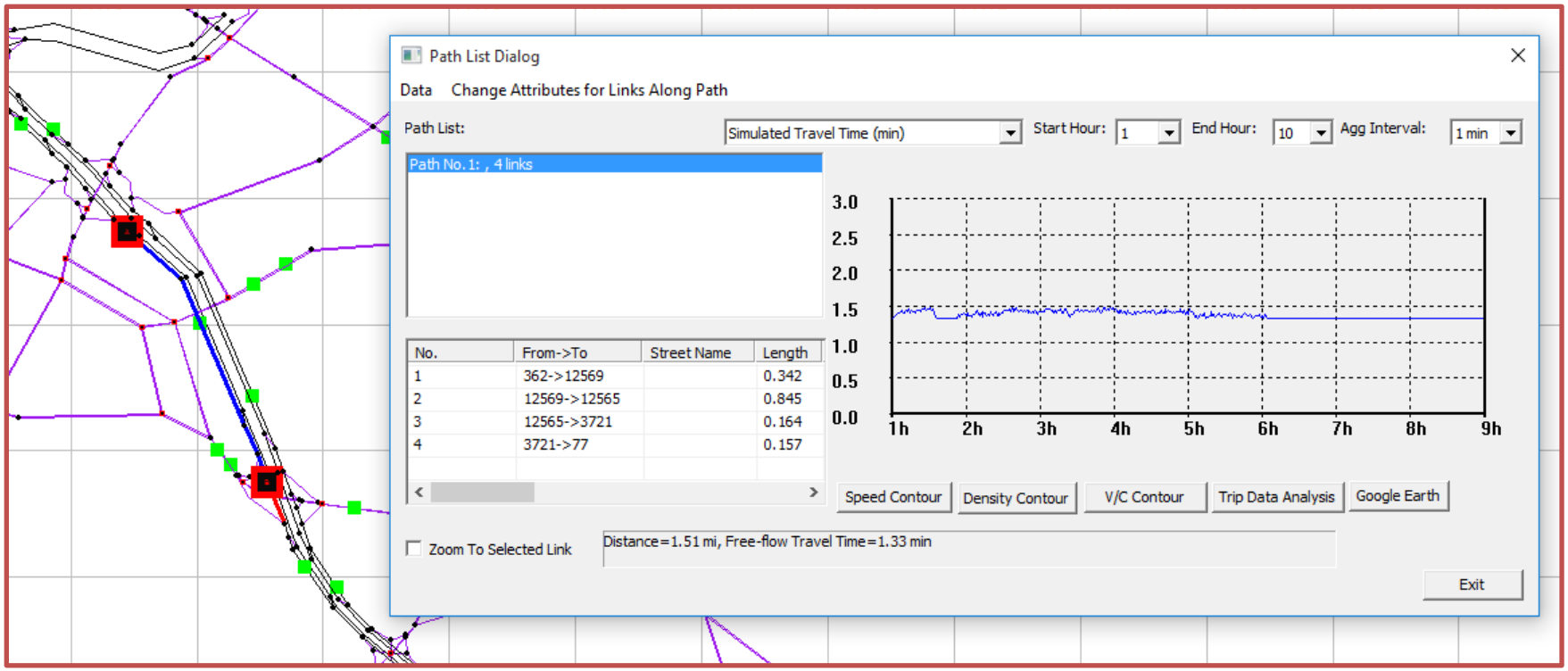
Output_summary.csv

Case No	# of iterations	# of agents (original)	# of agents (calibrated)	Avg Travel Time (min)	Avg Distance	Avg Speed
case 1	51	316238	324073	9.61544	5.16187	32.2099
case 2	51	316238	324073	19.3806	5.16187	15.9805
case 3	70	316238	324073	8.45472	5.19208	36.8462

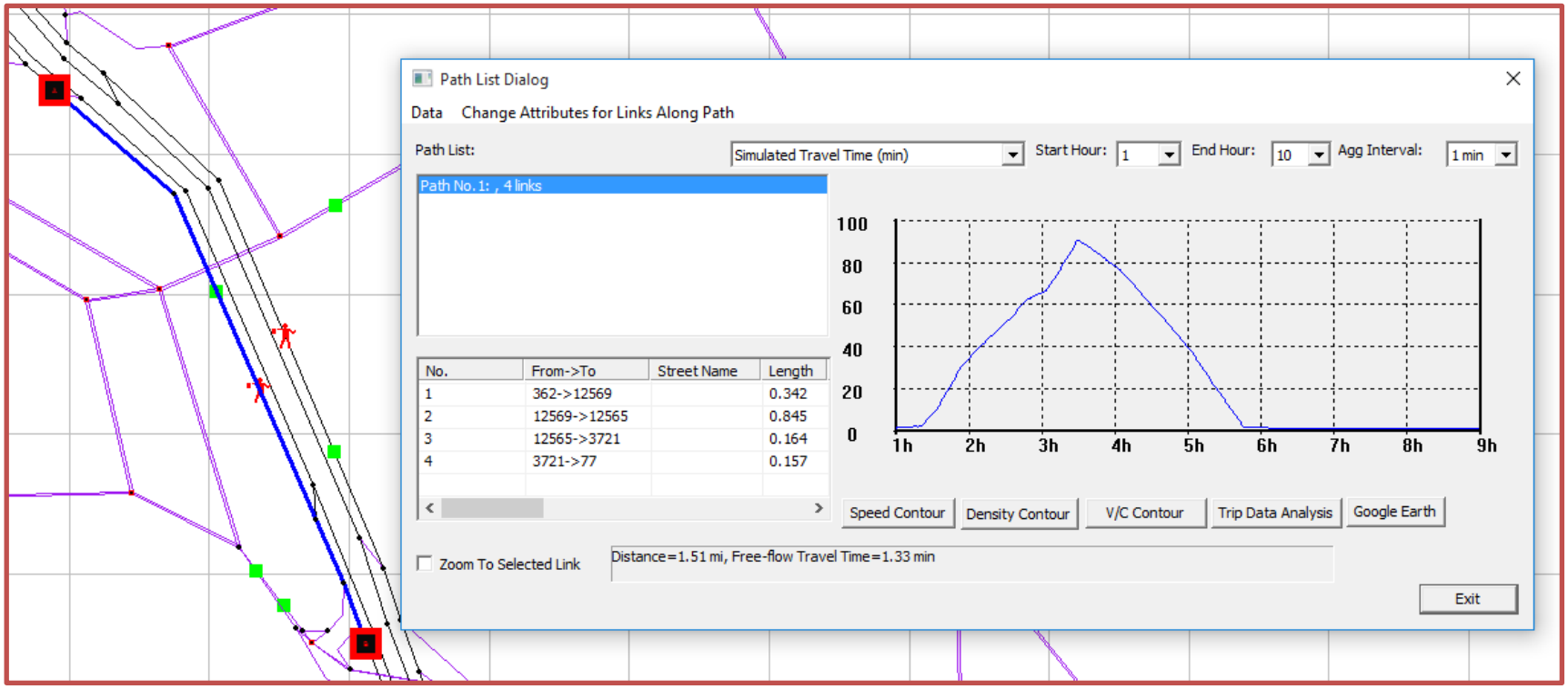
Speed comparison on one work zone link



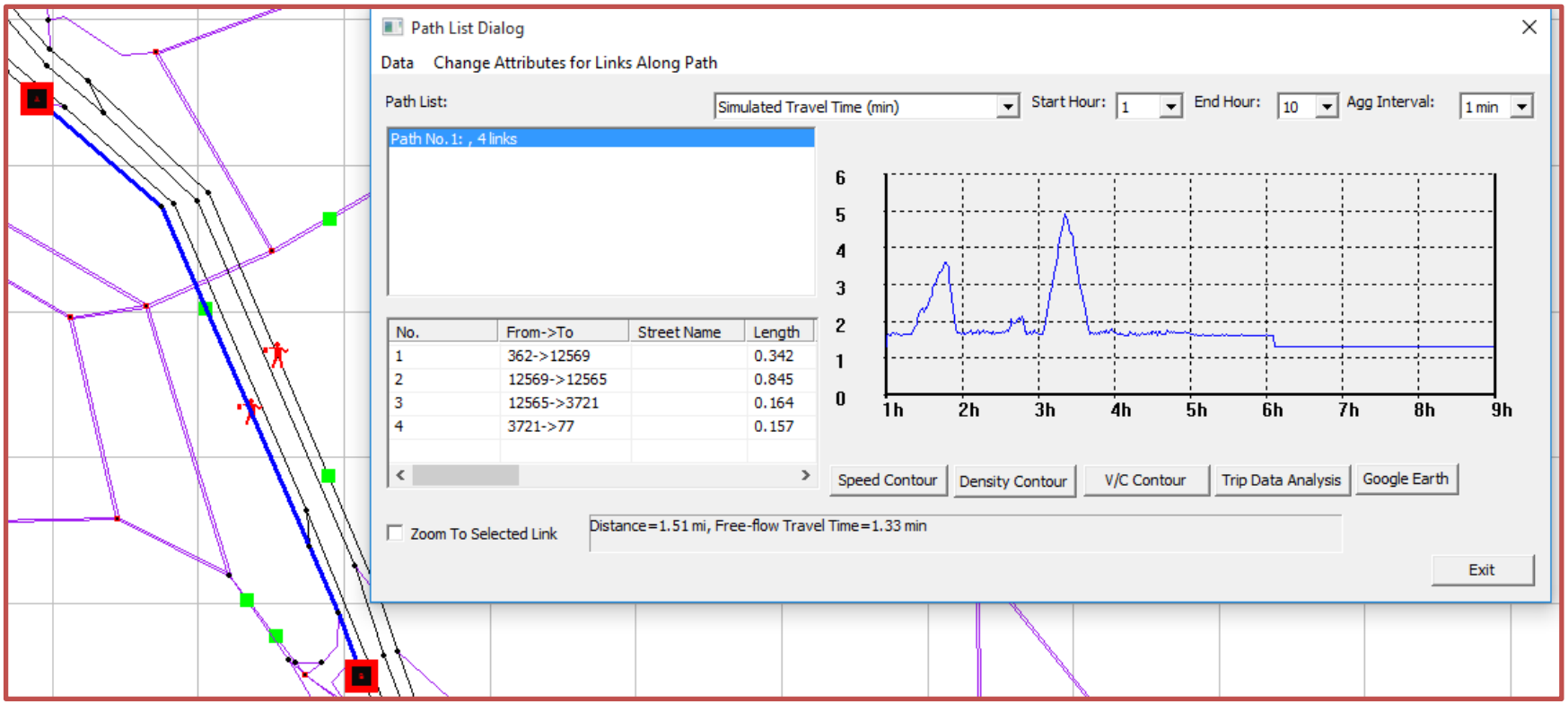
Path MOE in case 1



Path MOE in case 2

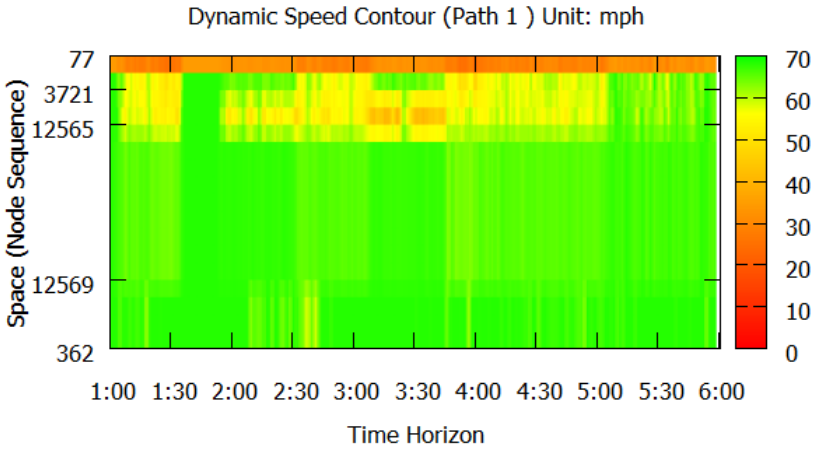


Path MOE in case 3

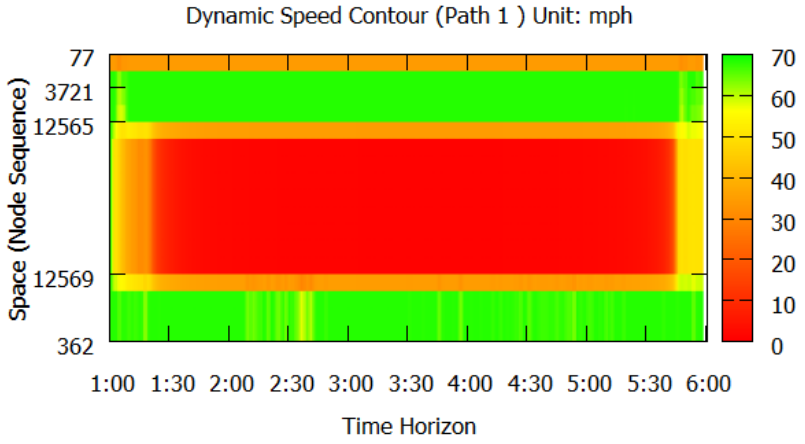


Path speed contour in three cases

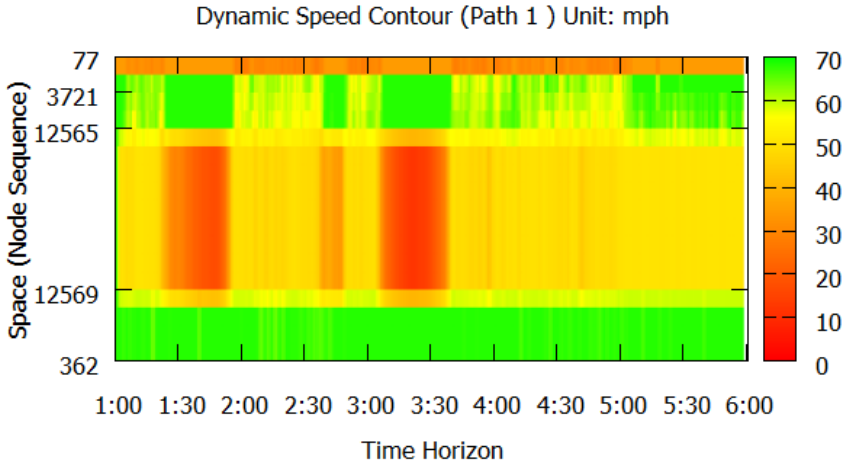
Case 1



Case 2

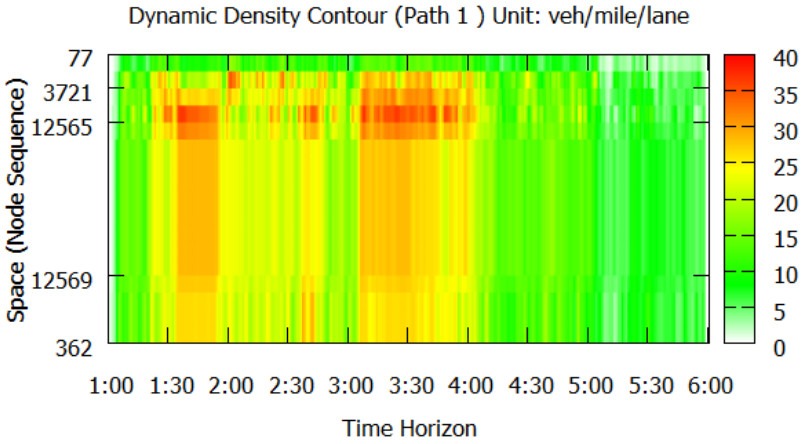


Case 3

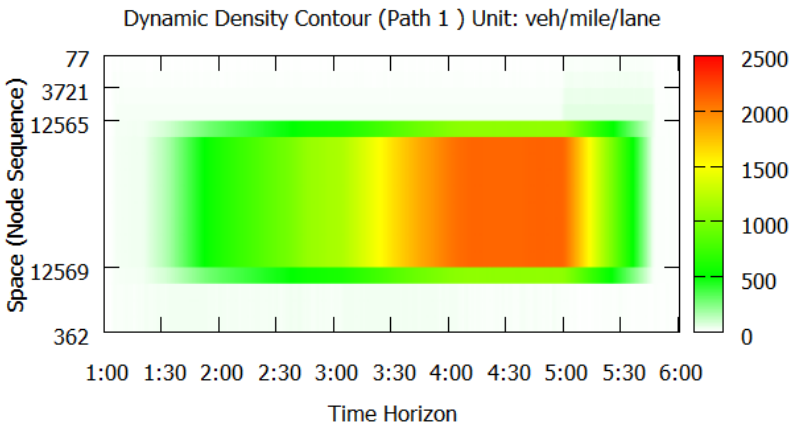


Path density contour in three cases

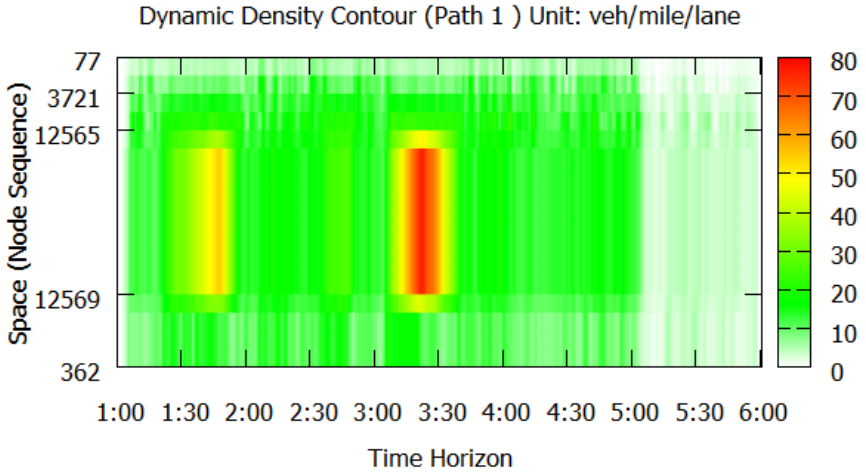
Case 1



Case 2

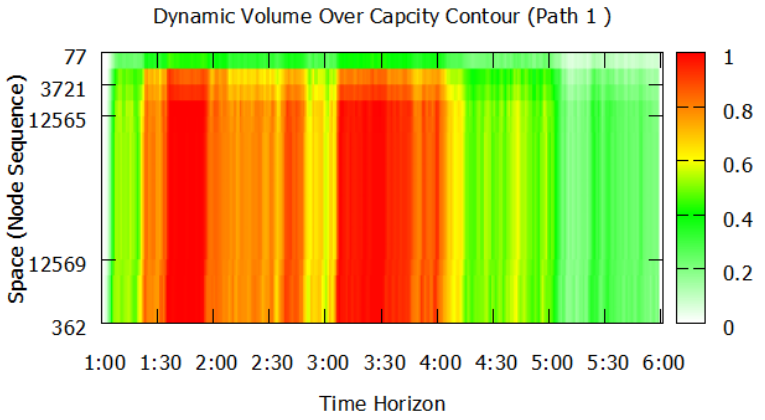


Case 3

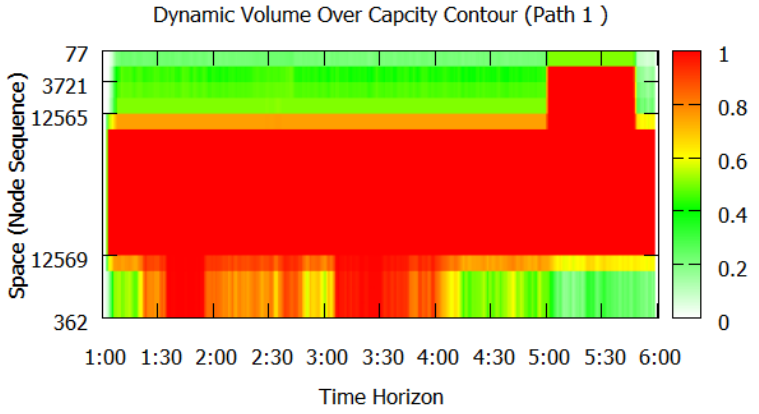


Path v/c contour in three cases

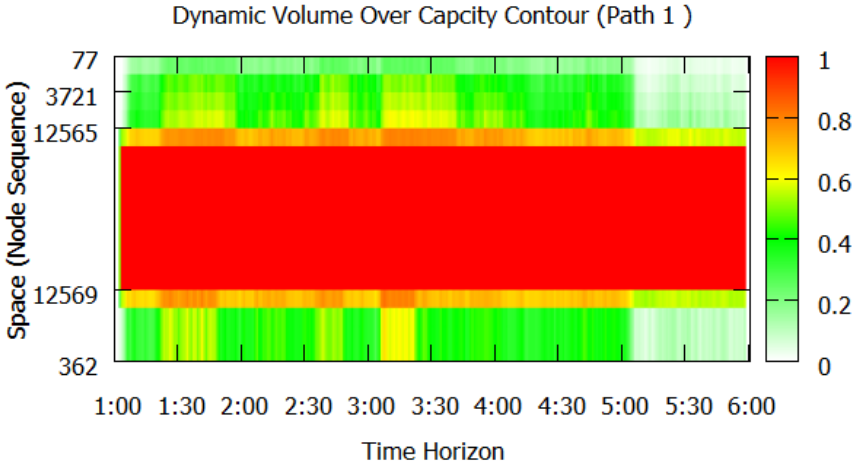
Case 1



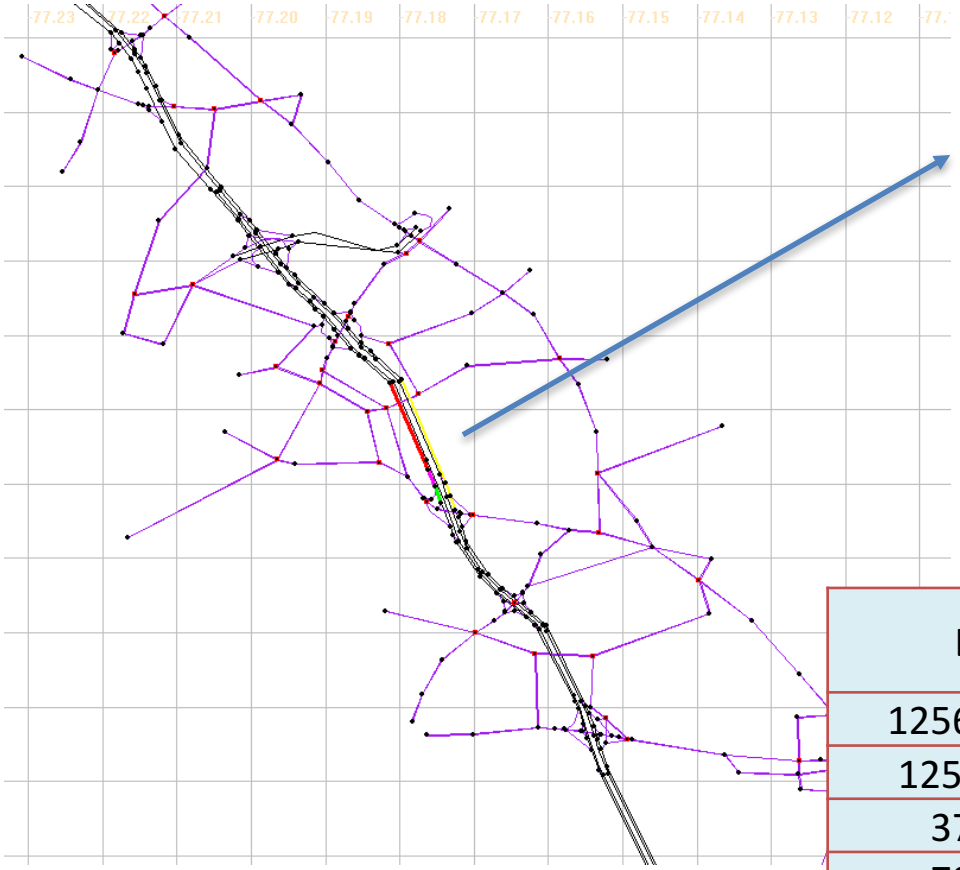
Case 2

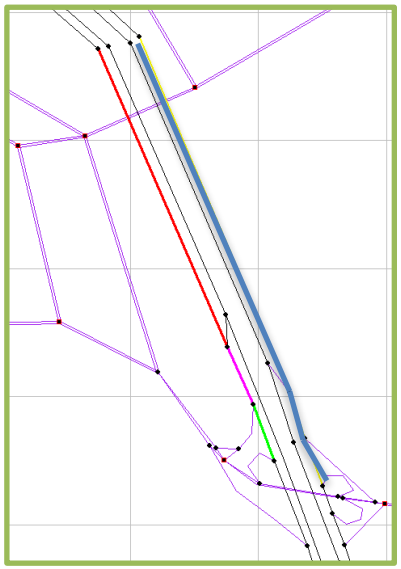


Case 3



4. Scenario analysis: link capacity reduction





Link ID	# of lanes(original)	# of lanes(changed)
12569->12565	5	4
12565->3721	5	4
3721->77	5	4
78->3772	5	4
3772->12562	5	4
12562->12566	5	4

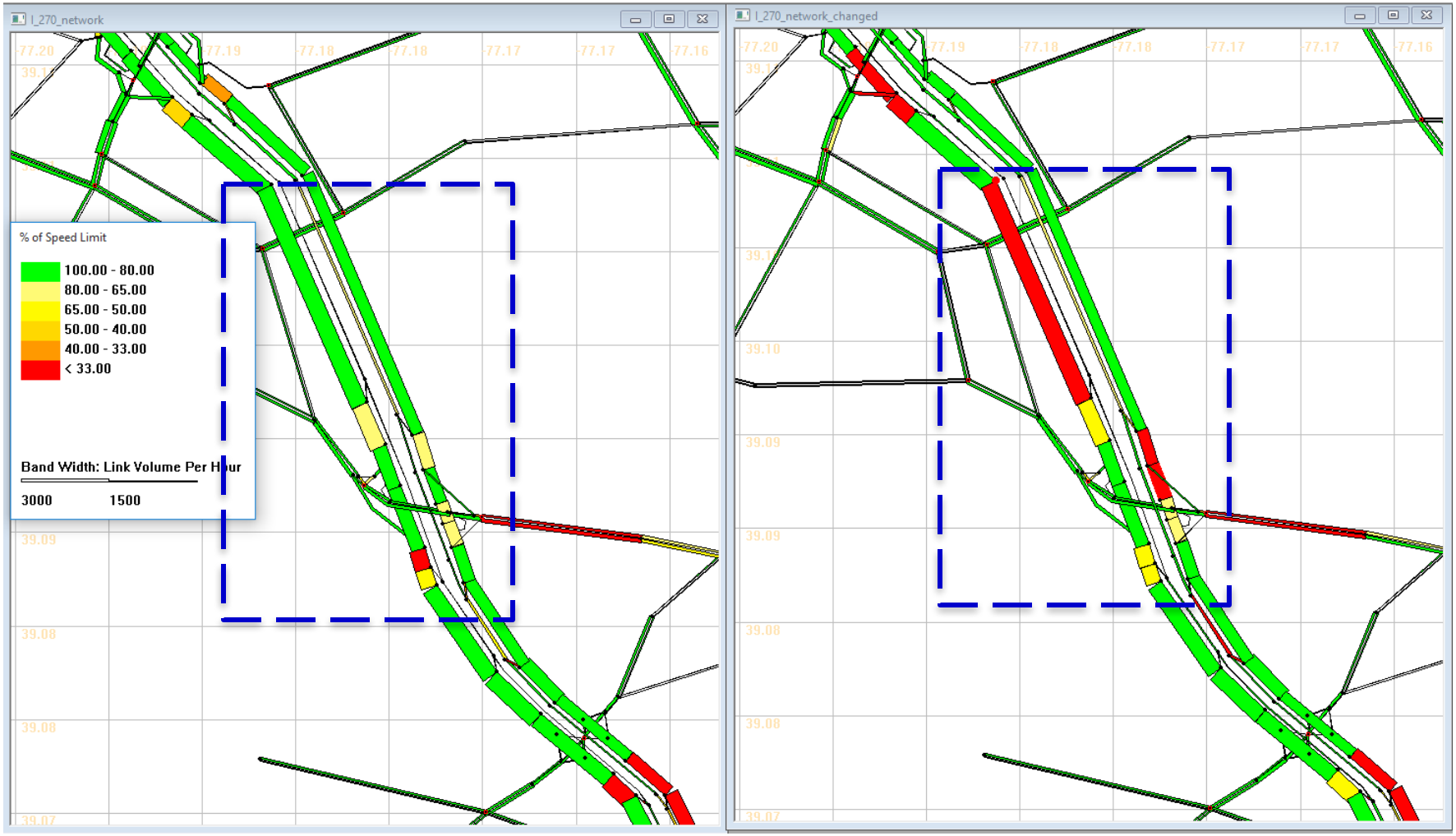
4. Simulation result comparison

Case No	# of agents (original)	# of agents (calibrated)	Avg Travel Time (min)	Avg Distance	Avg Speed
case 1	316238	324073	9.61544	5.16187	32.2099
case 2	316238	322132	10.9497	5.15504	28.2476

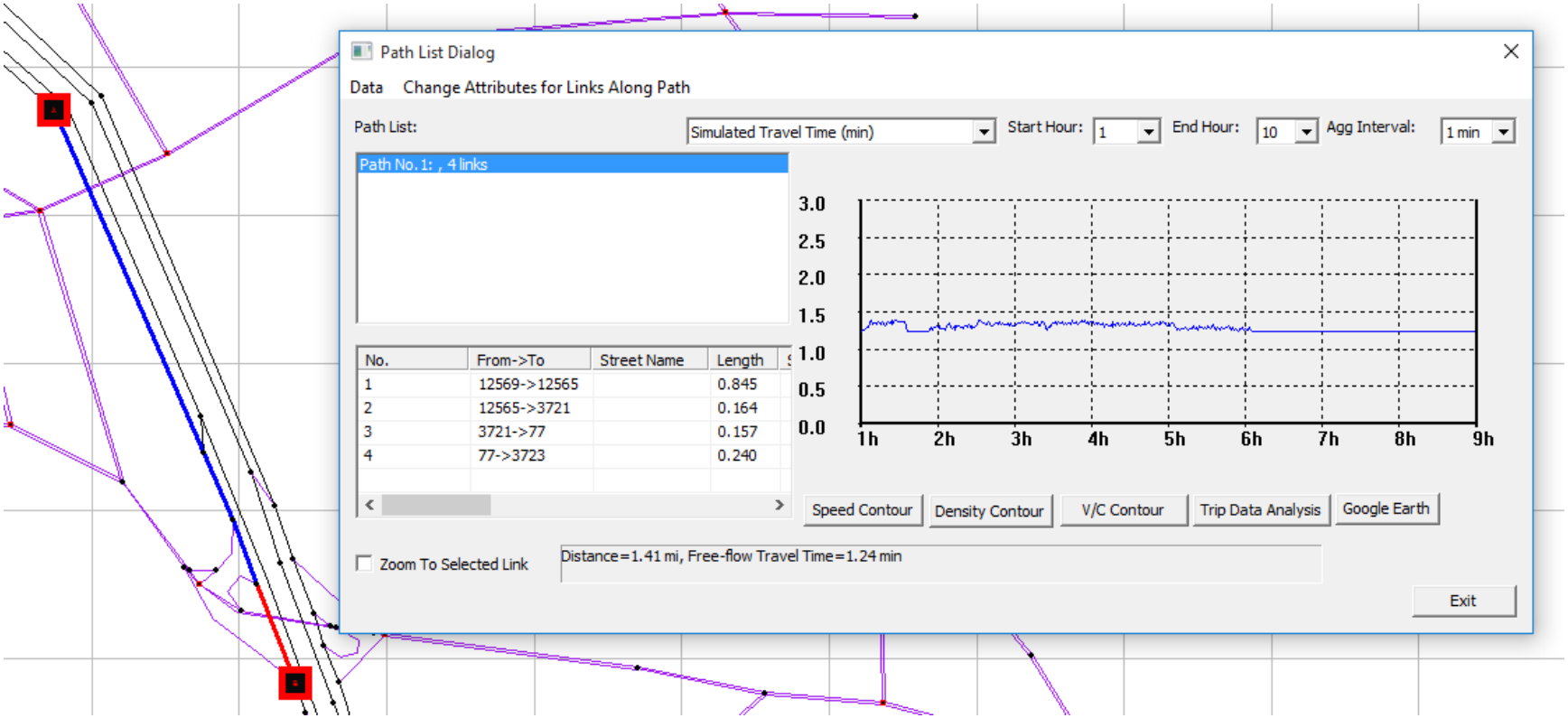
Speed comparison on capacity reduced links

Case 1: normal condition

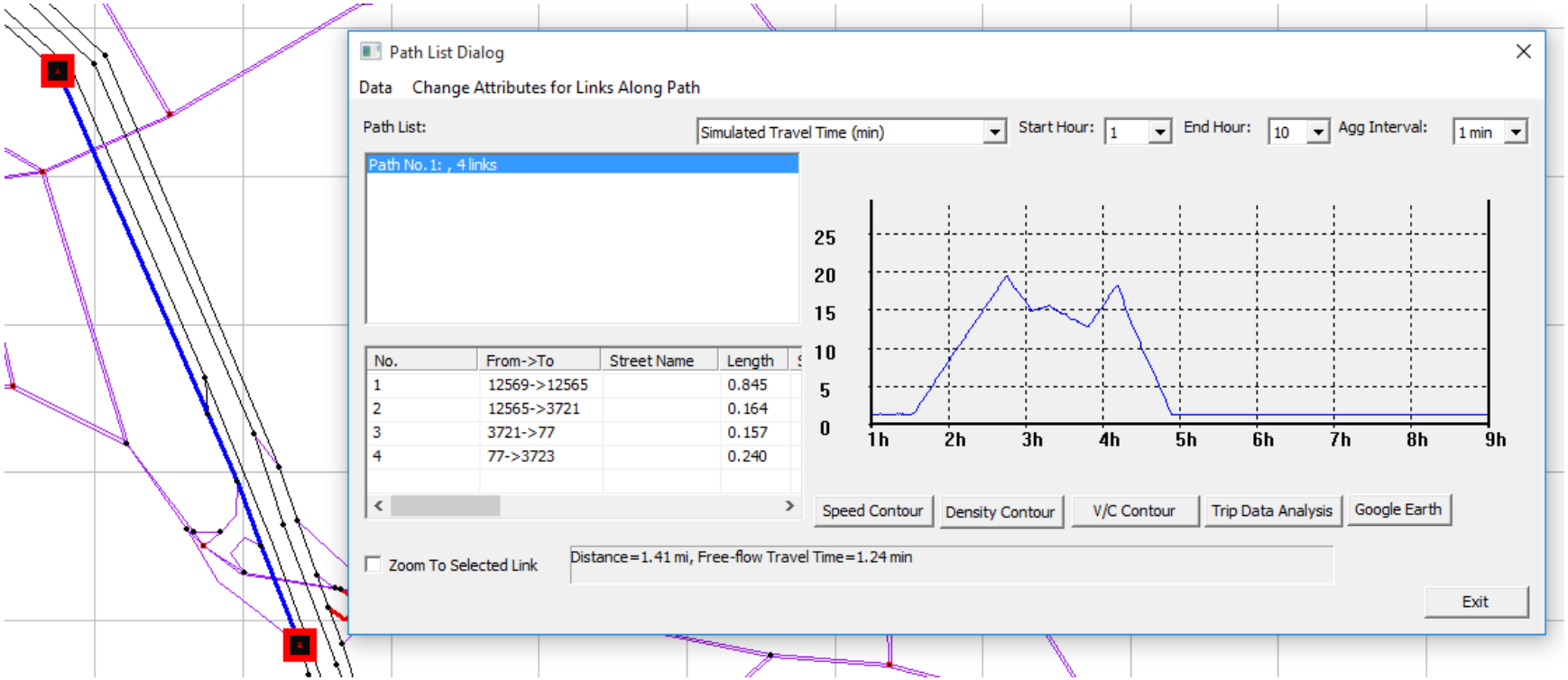
Case 2: capacity reduction



Path MOE in case 1

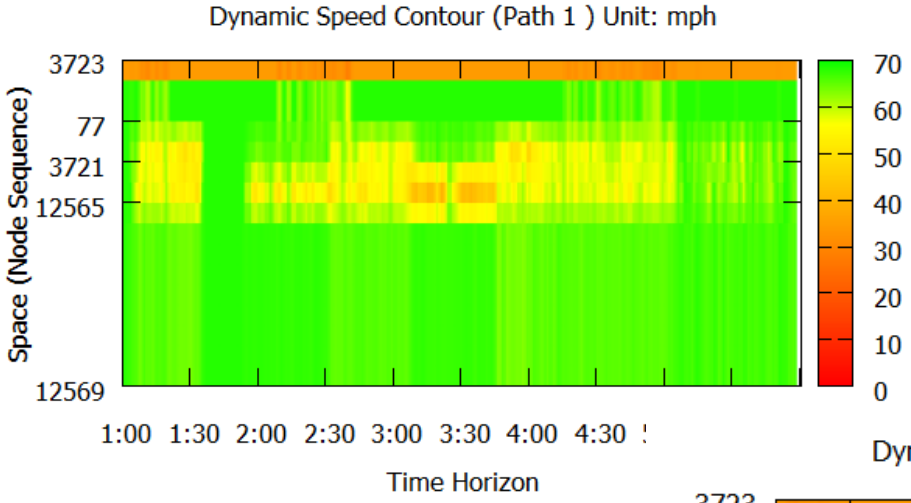


Path MOE in case 2

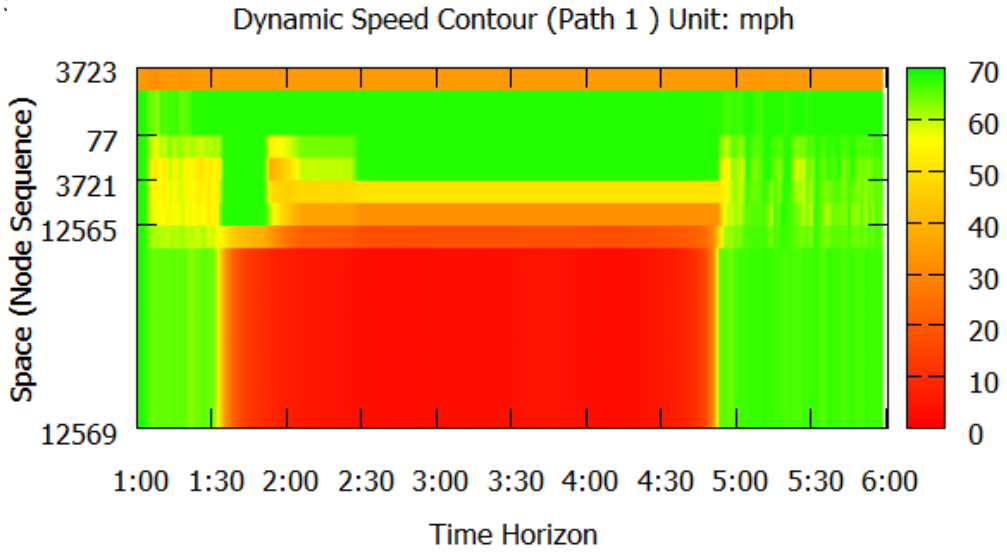


Path speed contour in two cases

Case 1

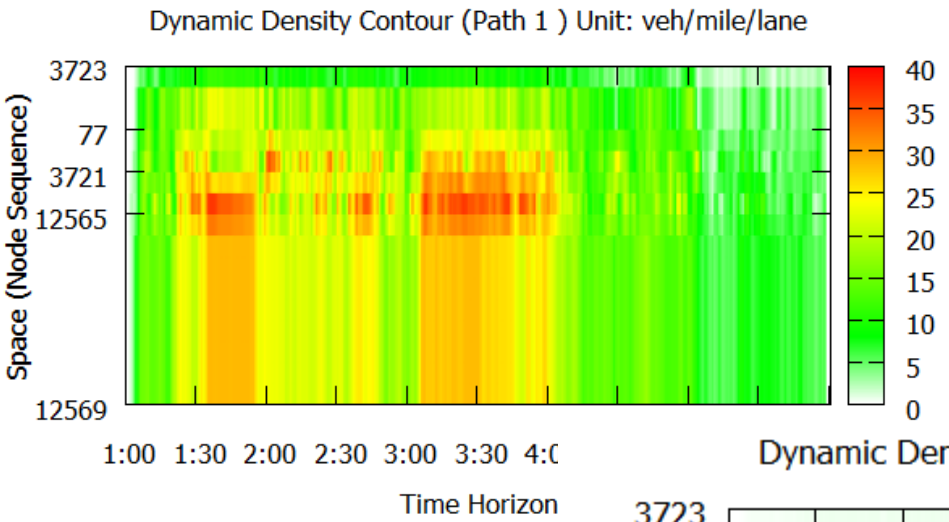


Case 2

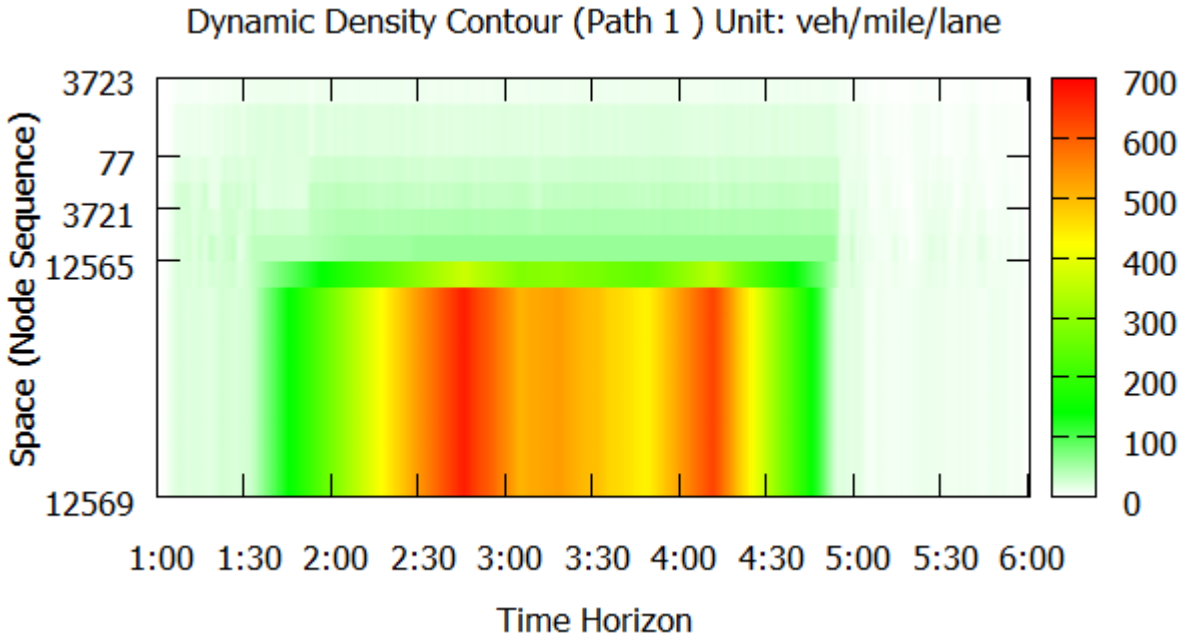


Path density contour in two cases

Case 1

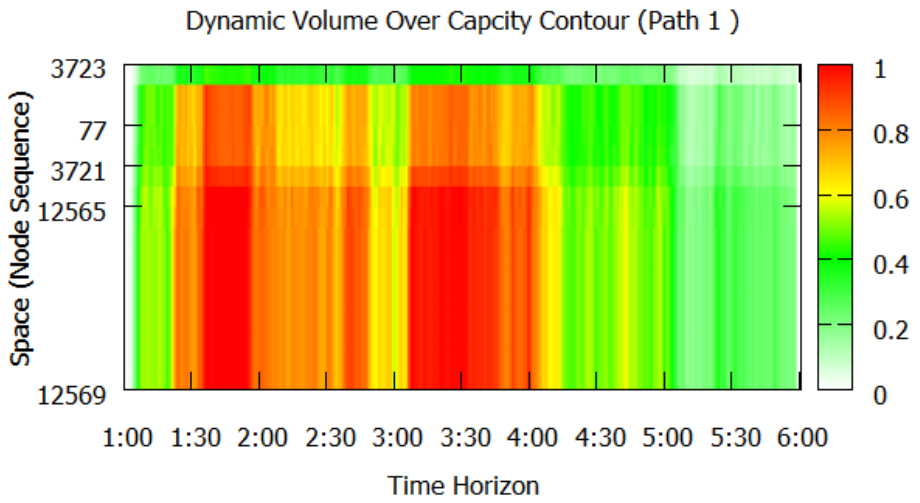


Case 2



Path v/c contour in two cases

Case 1



Case 2

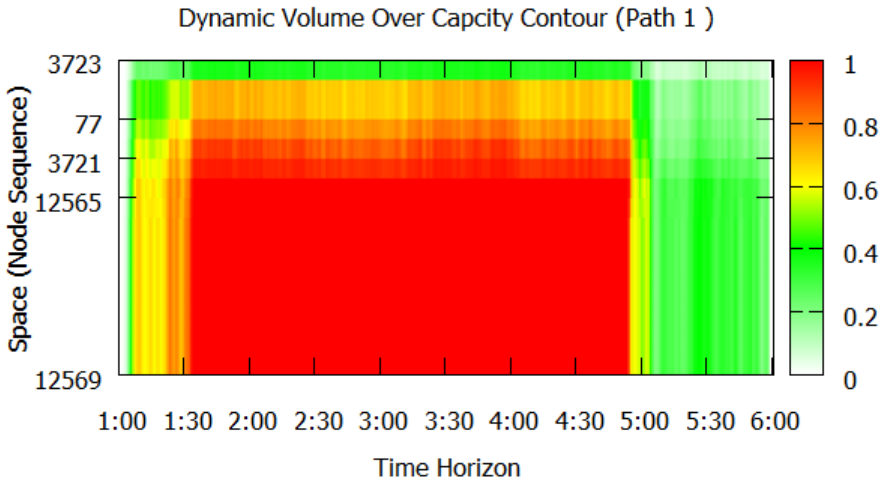
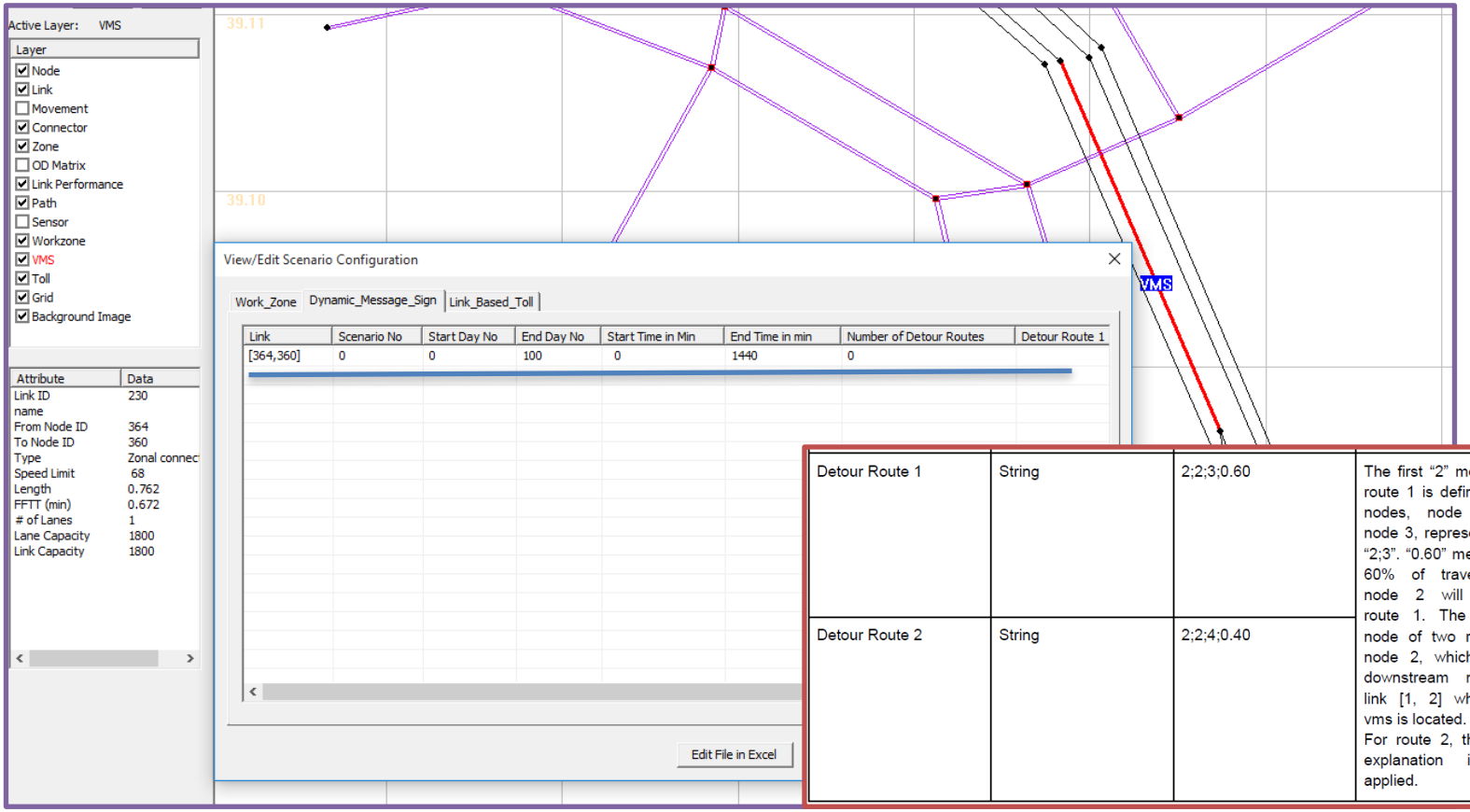


Illustration of VMS (dynamic message sign)

Define VMS on links

Click “VNS” in GIS layer → select the target link and right click → add VMS on selected link (Scenario_Dynamic_Message_Sign.csv)



Detour Route 1	String	2;2;3;0.60	The first “2” means the route 1 is defined by 2 nodes, node 2 and node 3, represented by “2;3”. “0.60” means that 60% of travelers at node 2 will choose route 1. The starting node of two routes is node 2, which is the downstream node of link [1, 2] where the vms is located. For route 2, the same explanation is also applied.
Detour Route 2	String	2;2;4;0.40	

Illustration of Pre-trip and en-route information

Define percent of pre-trip and en-route information for each demand type

Project → demand database (input_demand_types.csv)