

Python-based Tool for Automatic Transit Coding using GTFS for Cube Models

Diego Galdino, MSc.



MID-OHIO REGIONAL
MORPC
PLANNING COMMISSION

Summary

- Methodology
- Cube App Interface
- Inputs
- Outputs
- Conclusions and Recommendations

Methodology

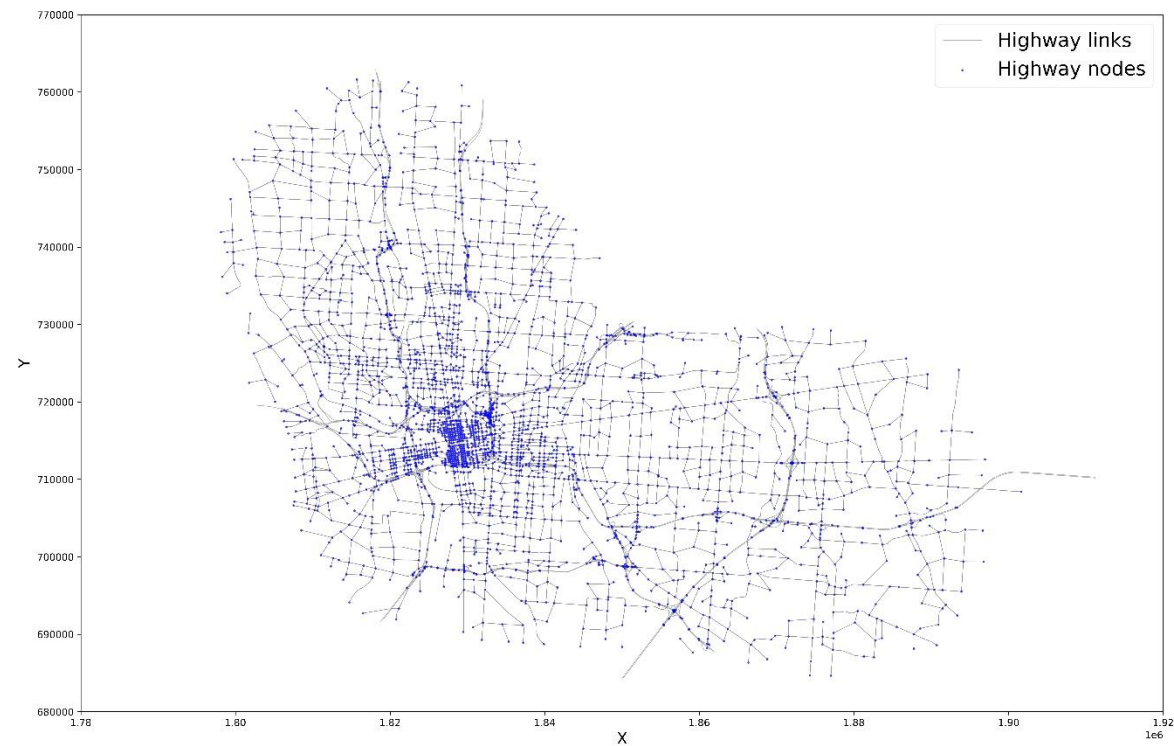


Figure 1. Highway network.

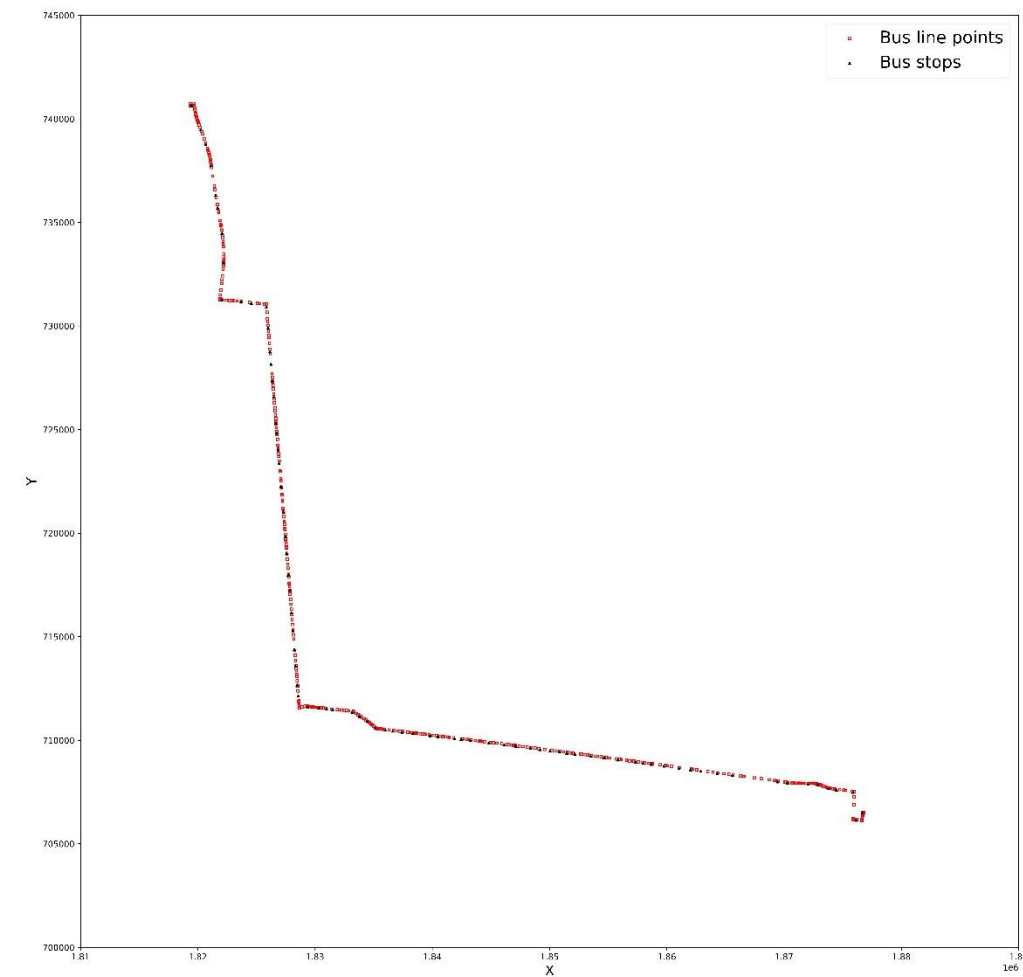


Figure 2. GTFS spatial data.

Methodology

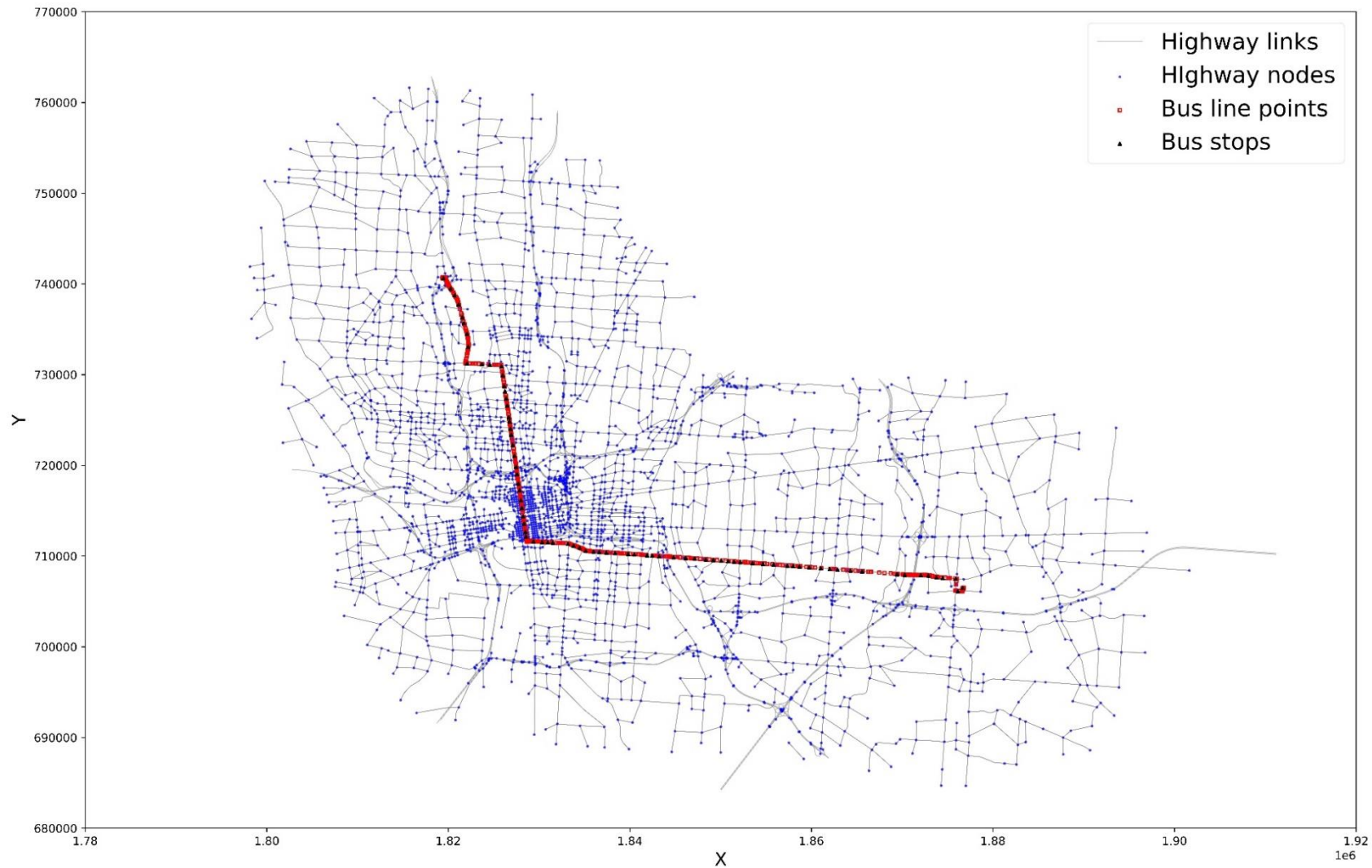


Figure 3. Highway network with the GTFS spatial data.

Methodology

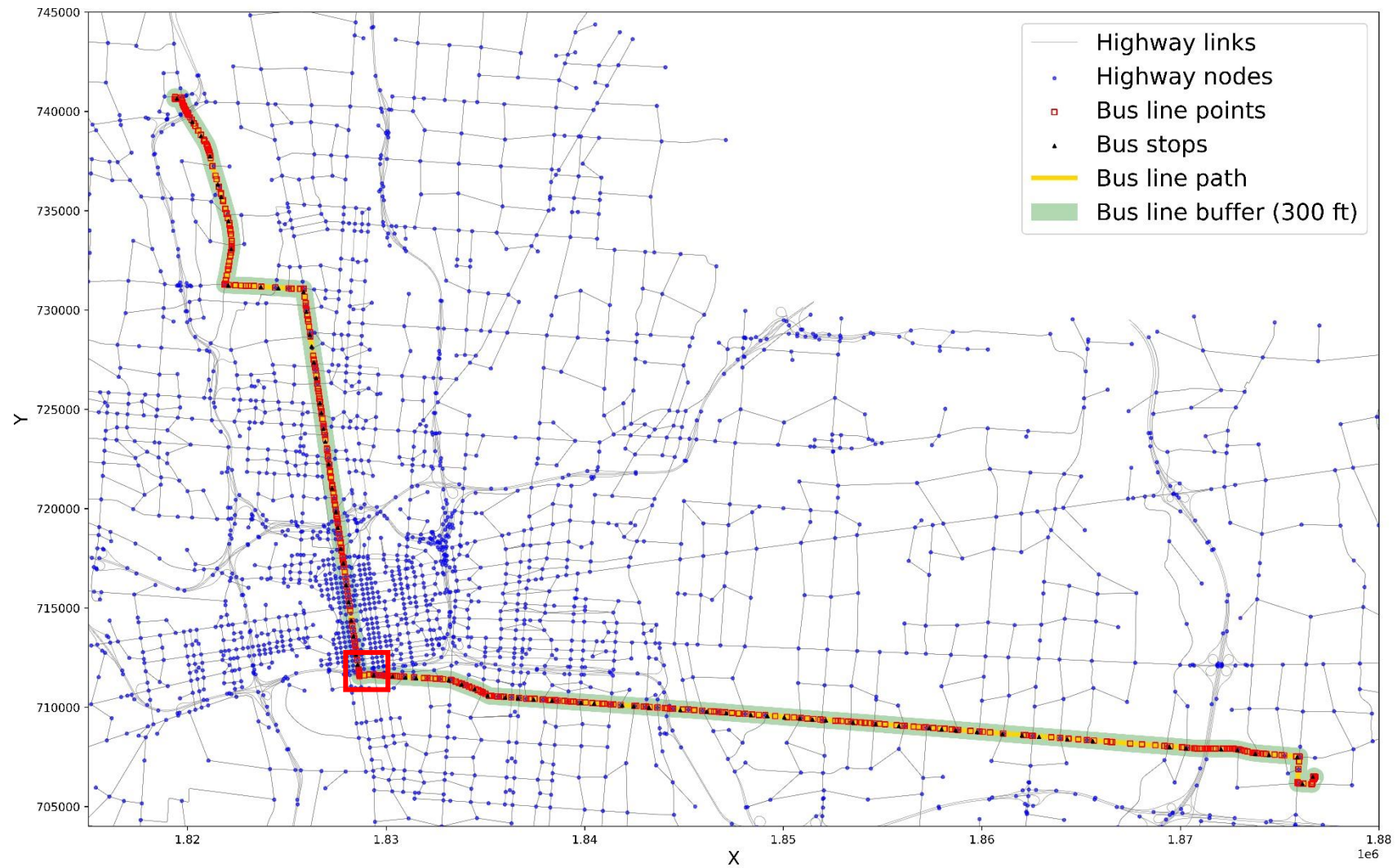


Figure 4. Highway network, GTFS spatial data, and the bus line buffer.

Methodology

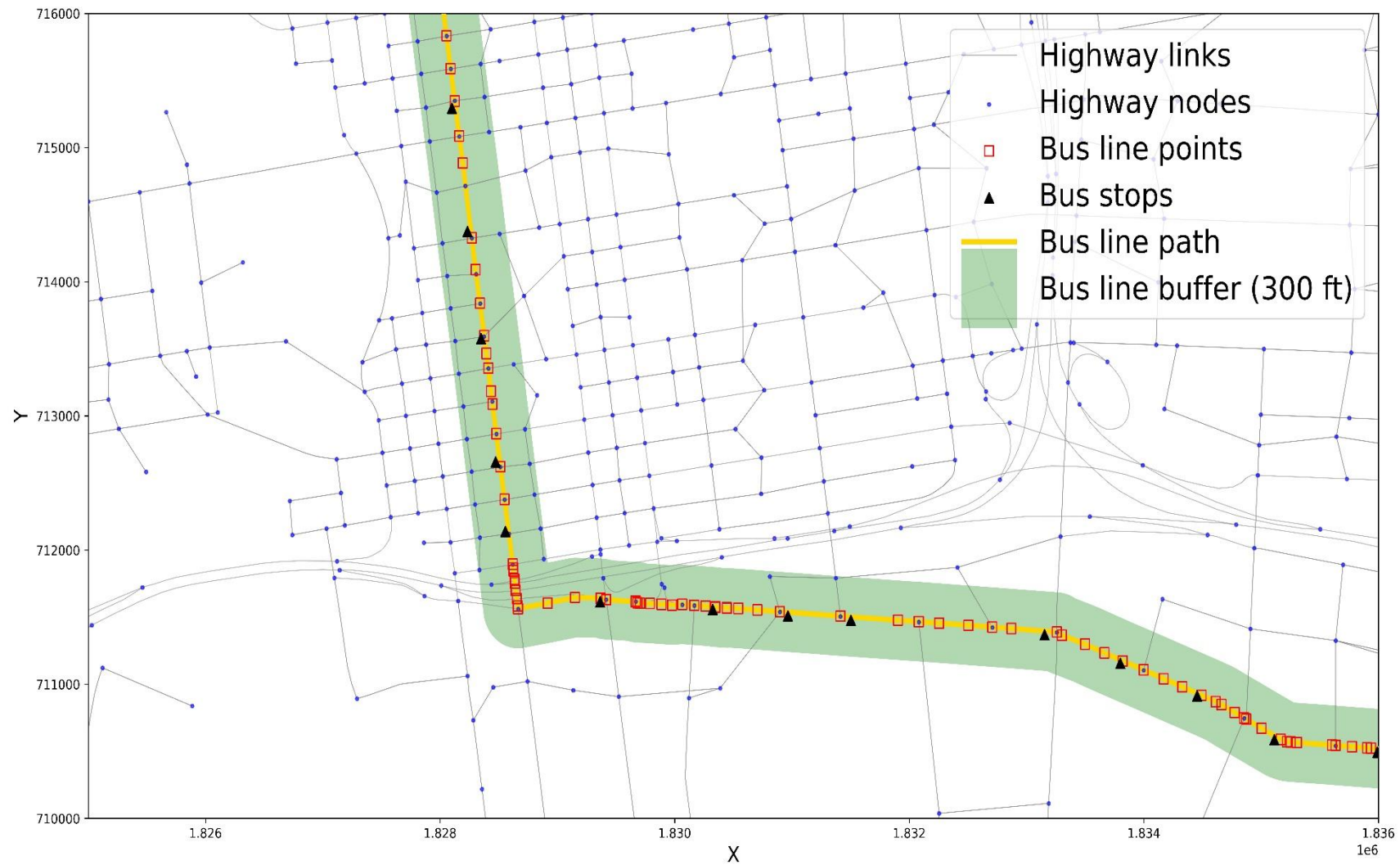


Figure 5. Bus line spatial data with more details.

Methodology

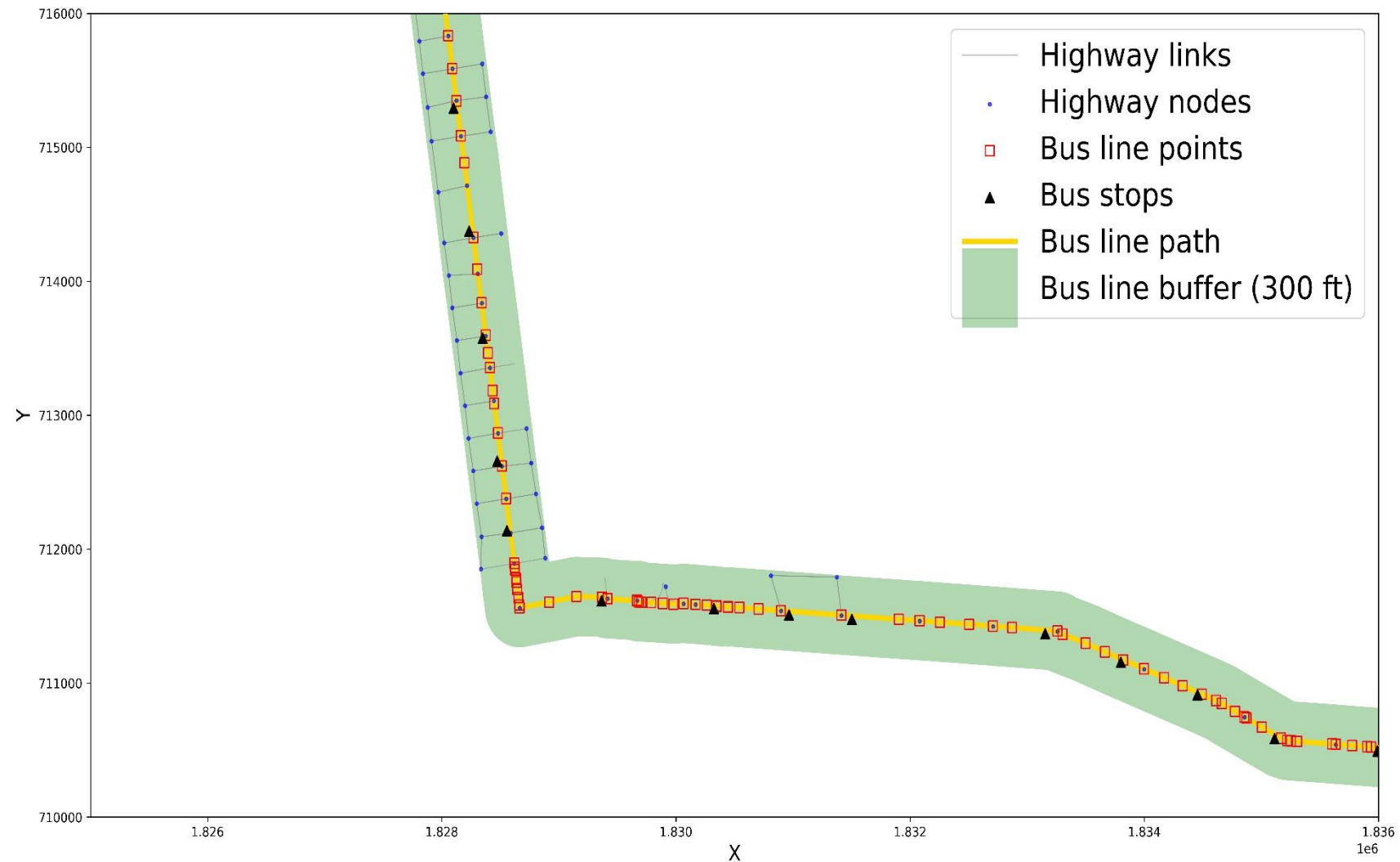


Figure 6. Only the available spatial data found within the bus line buffer.

Methodology

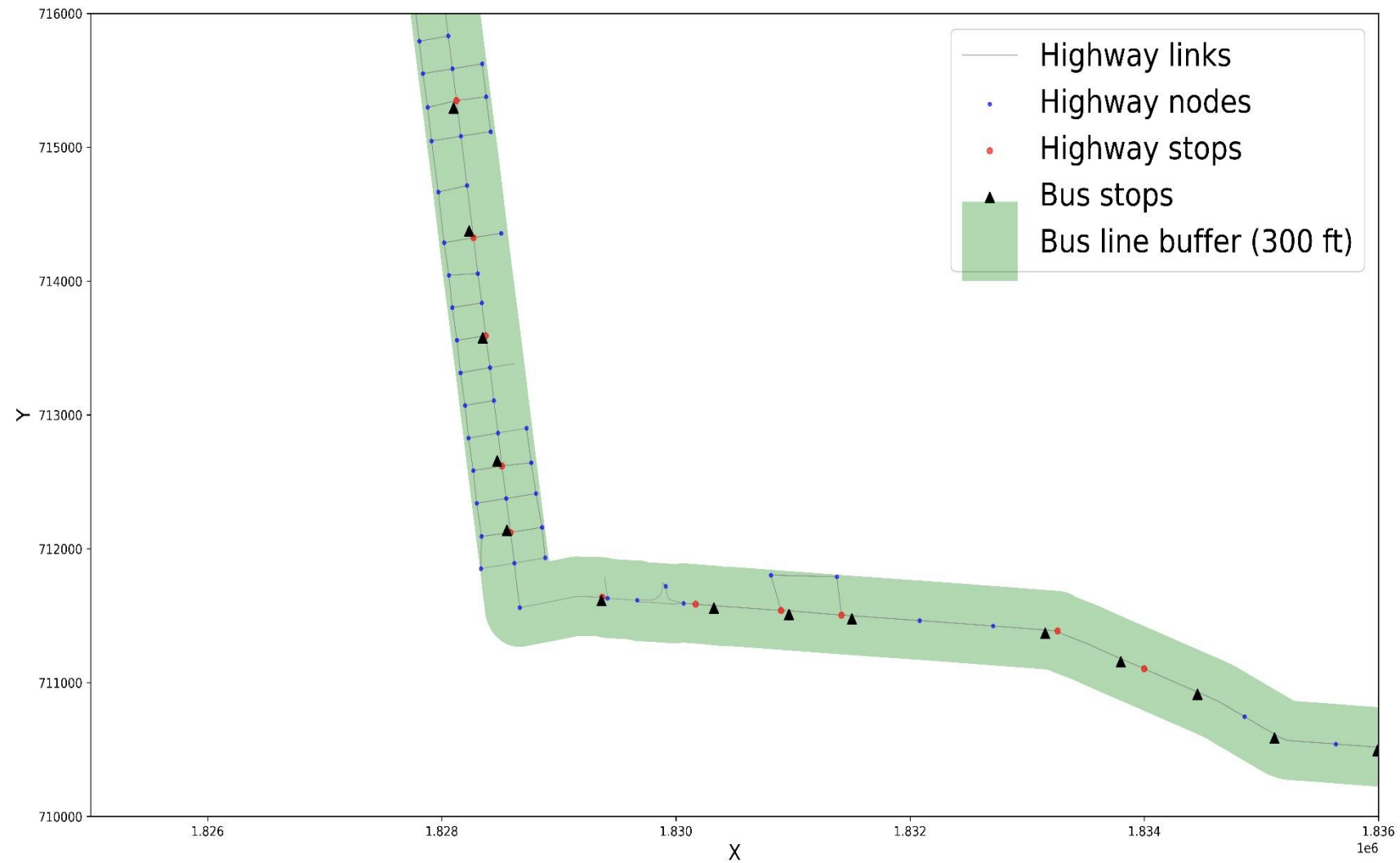


Figure 7. Closest highway nodes to bus stops according to a distance limit.

Methodology

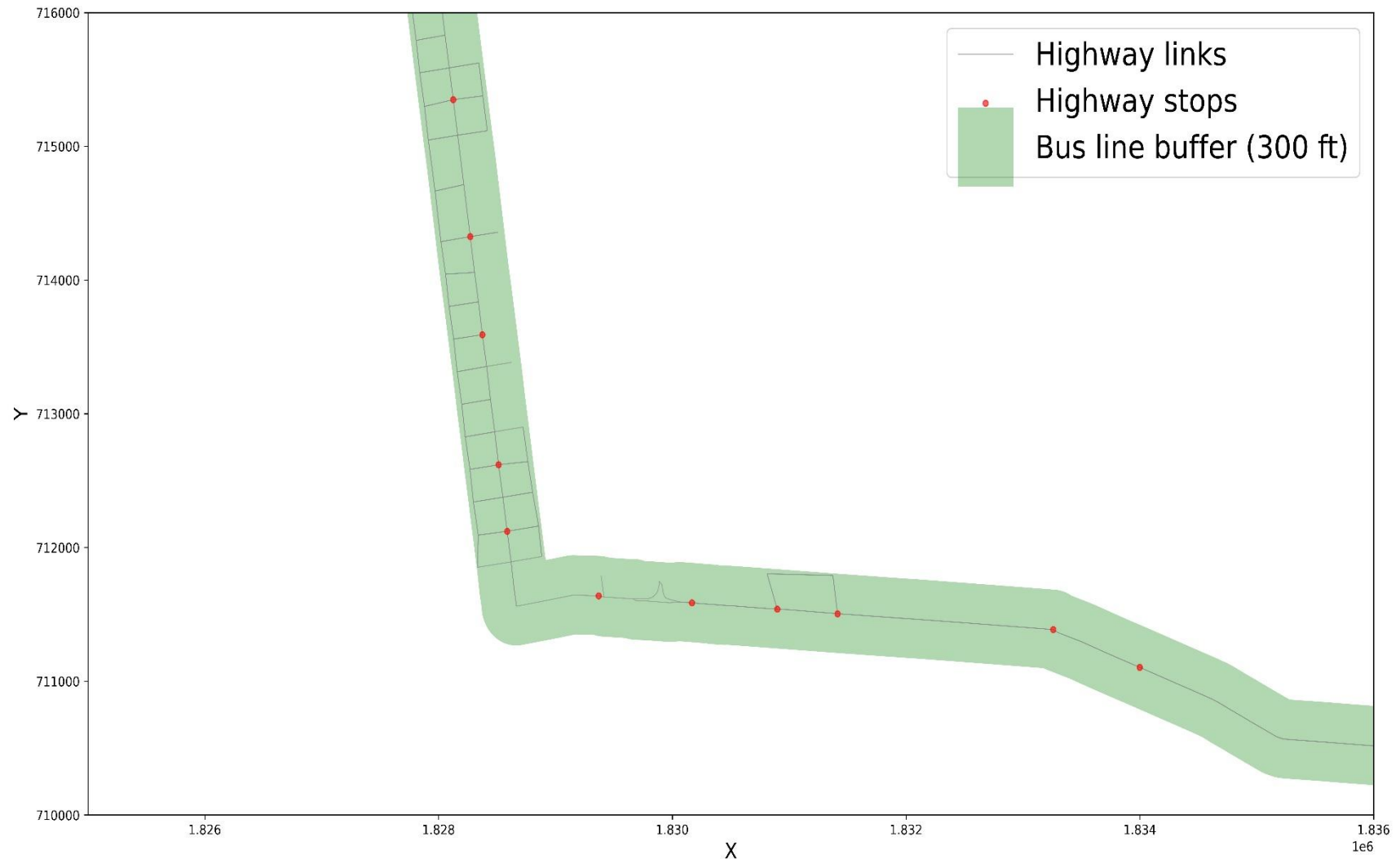


Figure 8. Highway stops and links.

Methodology

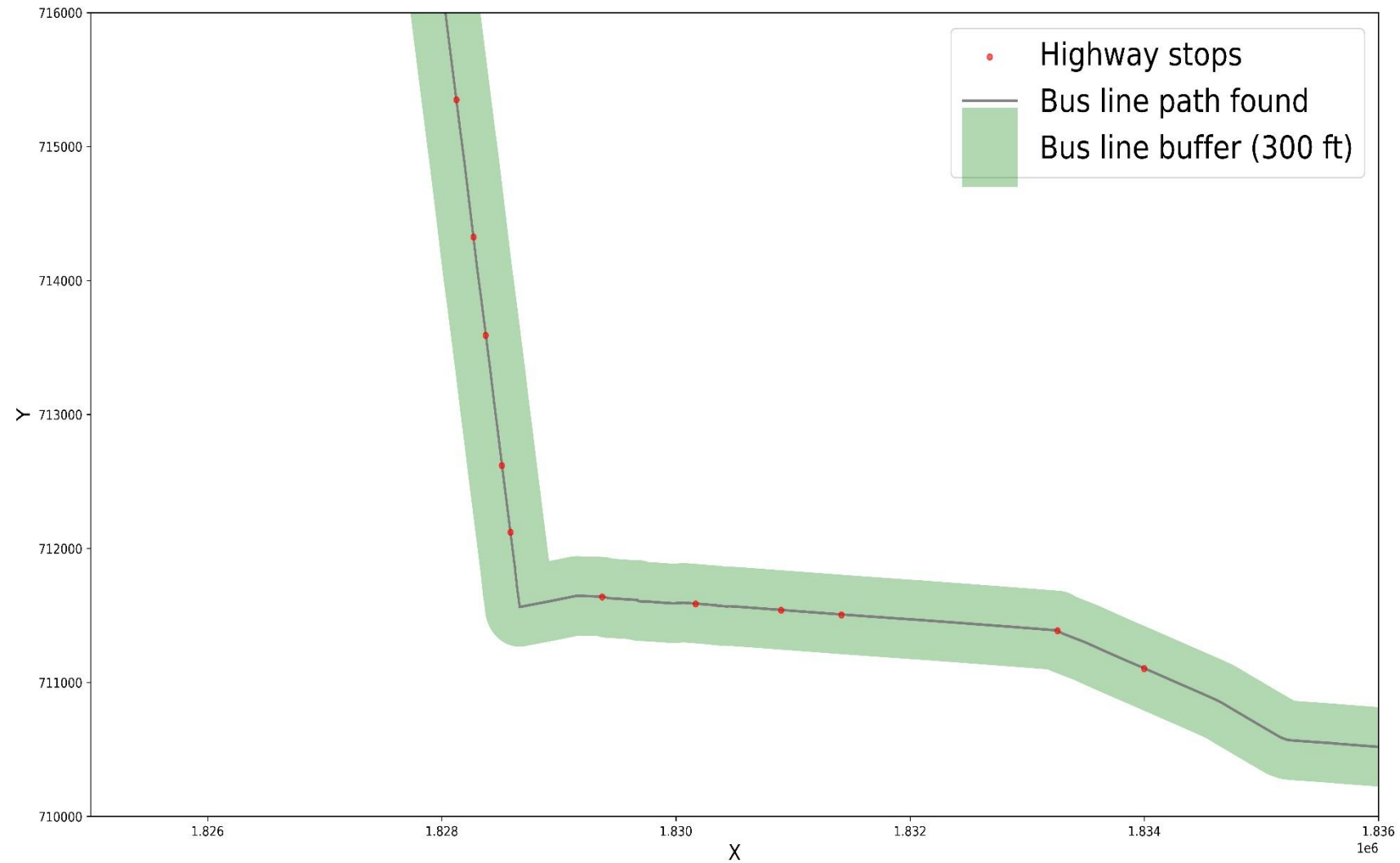


Figure 9. Bus line path found by connecting the highway stops in sequence.

Methodology

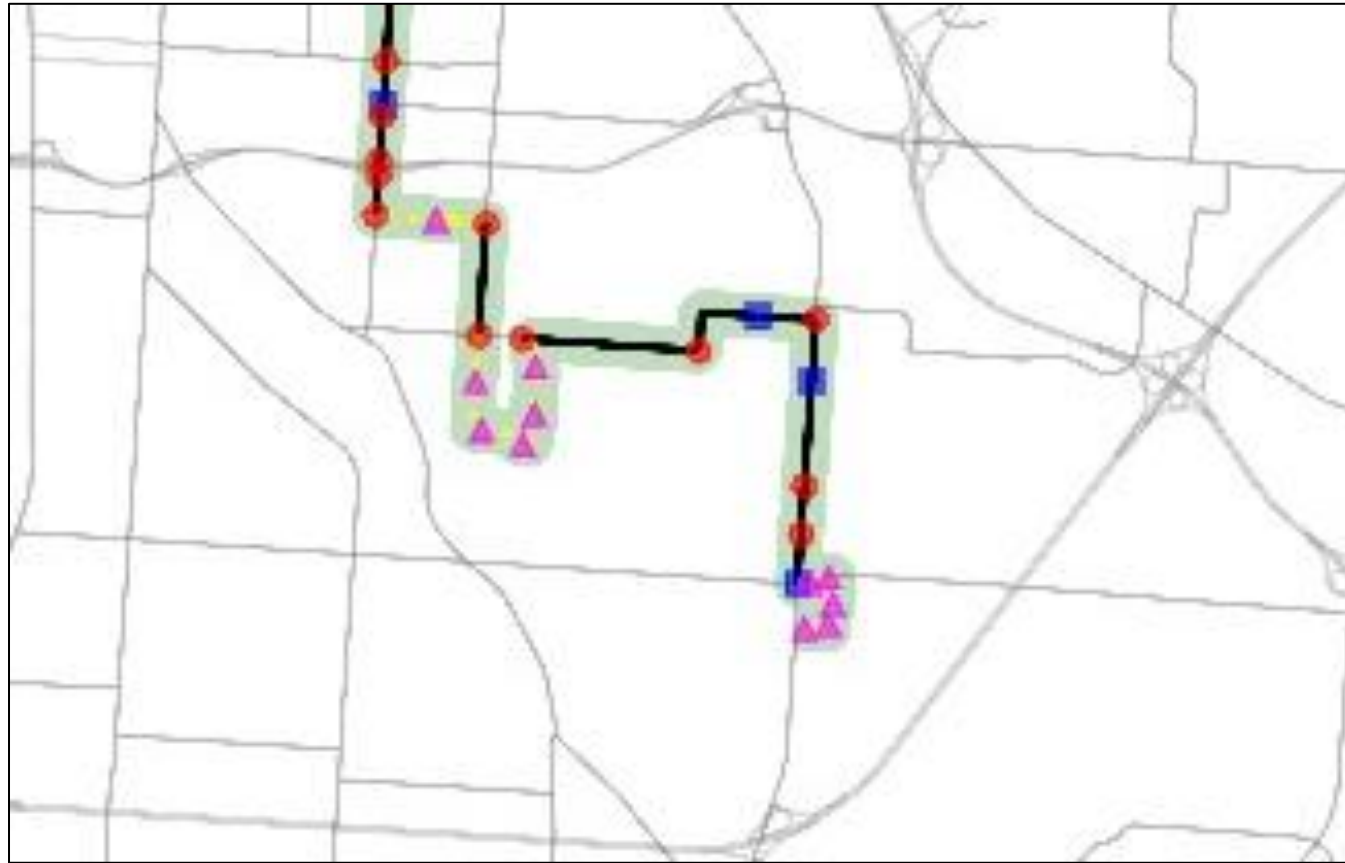


Figure 10. Transit-only nodes and links created to fill in the gaps of the network.

Cube App

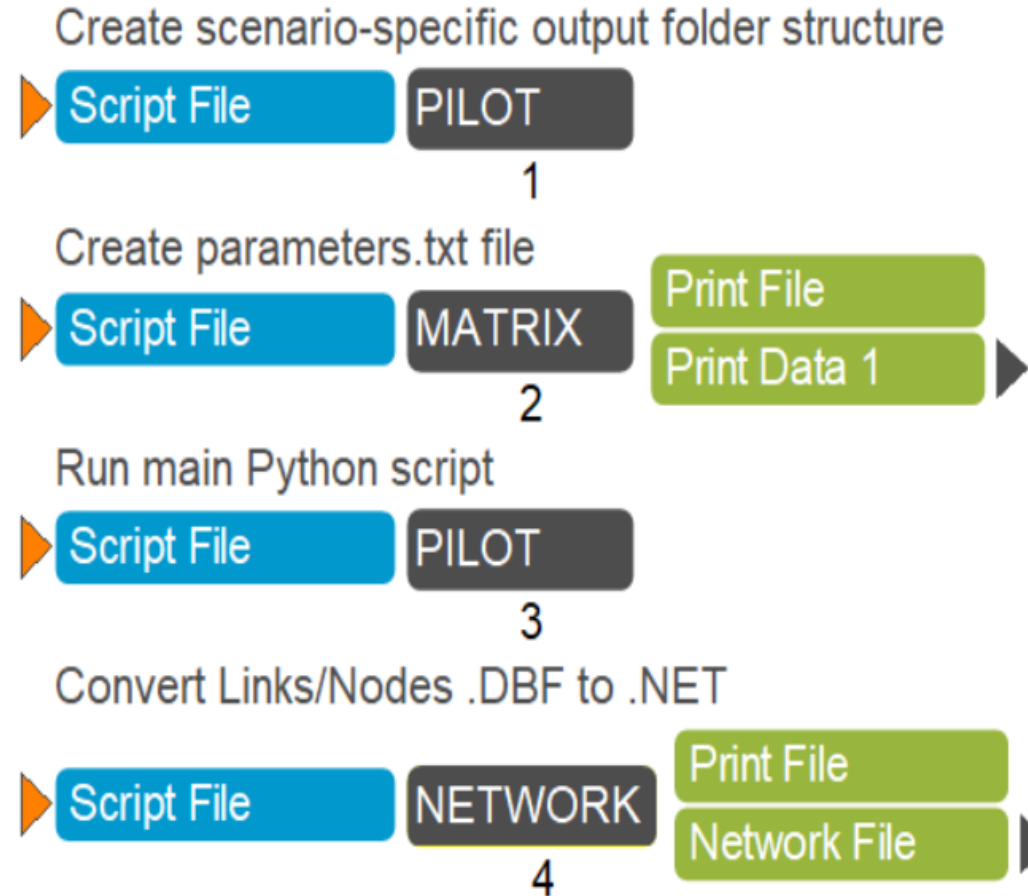


Figure 11. Cube App with 4 processes.

Cube App

GTFS Folder: Enter the Folder Path of the GTFS files (i.e., stops.txt, shapes.txt, trips.txt, routes.txt...)	C:\Projects\GTFS_To_Public_Transit_Network-main\inputs\MORPC\gtfs		
Input Network Folder: Enter the Folder Path of the Node/Link shapefile exported from the Cube higwy Netowrk. TRUE SHAPE preferred!!!	C:\Projects\GTFS_To_Public_Transit_Network-main\inputs\c		
nodes_file: Enter the name of the Node shapefile that is located in the Input Network Folder. Include the .shp at the end.	OSTM2020NODE.shp		
links_shp_file: Enter the name of the Link shapefile that is located in the Input Network Folder. Include the .shp at the end.	OSTM2020LINK.shp		
routes mode table: bus routes assigned with transit mode	C:\Diego Galdino\GTFS_To_Public_Transit_Network\inputs\MORPC\route-info\modes_table.csv	Browse ...	Edit ...
day_type: Select 'monday' for weekdays or 'saturday' for weekends.			
<input checked="" type="radio"/> monday			
<input type="radio"/> saturday			
period_times_1: Select time period 1 (up to 5) from the suggested list or edit accordingly.	"AM":["06:00:00","09:00:00"]		
period_times_2: Select time period 2 (up to 5) from the suggested list or edit accordingly.	"MD":["09:00:00","15:00:00"]		
period_times_3: Select time period 3 (up to 5) from the suggested list or edit accordingly.	"PM":["15:00:00","19:00:00"]		
period_times_4: Select time period 4 (up to 5) from the suggested list or edit accordingly.	"NT":["19:00:00","24:00:00"]		
period_times_5: Select time period 5 (up to 5) from the suggested list or edit accordingly.	"EA":["04:30:00","06:00:00"]		
<input checked="" type="checkbox"/> bus: Check to include bus lines.			
<input type="checkbox"/> train: Check to include train lines (if available).			
transit_only_attributes: Enter the common attributes for transit-only links.	"FACTYPE":65,"LINKGRP":22,"CSPEEDAM":15,"CSPEEDMD":15,"CSPEEDPM":15,"CSPEEDNT":15,"NOTE":"BUS"		
factype_to_avoid: Inform facility type(s) to avoid (e.g., centroid connectors). Comma separated.	70		
nodes_ranges_to_avoid: Inform node ranges to avoid (e.g., previously created transit-only nodes). [0,0] was included only to show how to list ranges. Both ends inclusive.	[0,0],[0,2500]		
w_bffr: Buffer (in ft) to be used in the within analysis.	328		
i_bffr: Buffer (in ft) to be used in the intersecting analysis. This is just important if you are plotting the coded line. If not, enter a low number to save a bit of processing time.	16400		
net_proj: Network projection ESRI code. Make sure projection and buffer values represent the same units.	ESRI:102723		
<input checked="" type="checkbox"/> plot: Check to plot the coded lines.			
<div>SaveCloseRun</div>			

Figure 12. MORPC scenario in the Cube app.

Inputs

- Network (True shape)
 - Open the .NET file in Cube, activate the True Shape, and export the network as Link and Node Shape Files (*.shp)
- General Transit Feed Specification (GTFS)
 - “data specification that allows public transit agencies to publish their transit data in a format that can be consumed by a wide variety of software applications” (GTFS.ORG, 2023)
 - All required information: stops, shapes, trips, routes, stop times, calendar, etc.
 - <https://database.mobilitydata.org> (download their CSV spreadsheet)
- Route Mode Table
 - CSV spreadsheet with columns ROUTE_ID, ROUTE_NO, LONG_NAME, and MODE.
 - ROUTE_ID, ROUTE_NO, LONG_NAME: Take this info from GTFS “routes.txt”.
 - MODE: Your own definition. This will be used in .LIN.

Outputs

- Network
 - The Python script exports Link and Node shapefiles. The Cube app combine them back to .NET.
 - The new network contains the transit-only links and nodes.
- Transit-only
 - Transit-only links and nodes are exported as CSV spreadsheets.
 - Line file (.LIN) with transit lines basic information (name, mode, headways, oneway, allstops, vehicle type, circular) and sequence of nodes.
- Images
 - The tool can export images of the final routes like the ones in the next slides.

Outputs

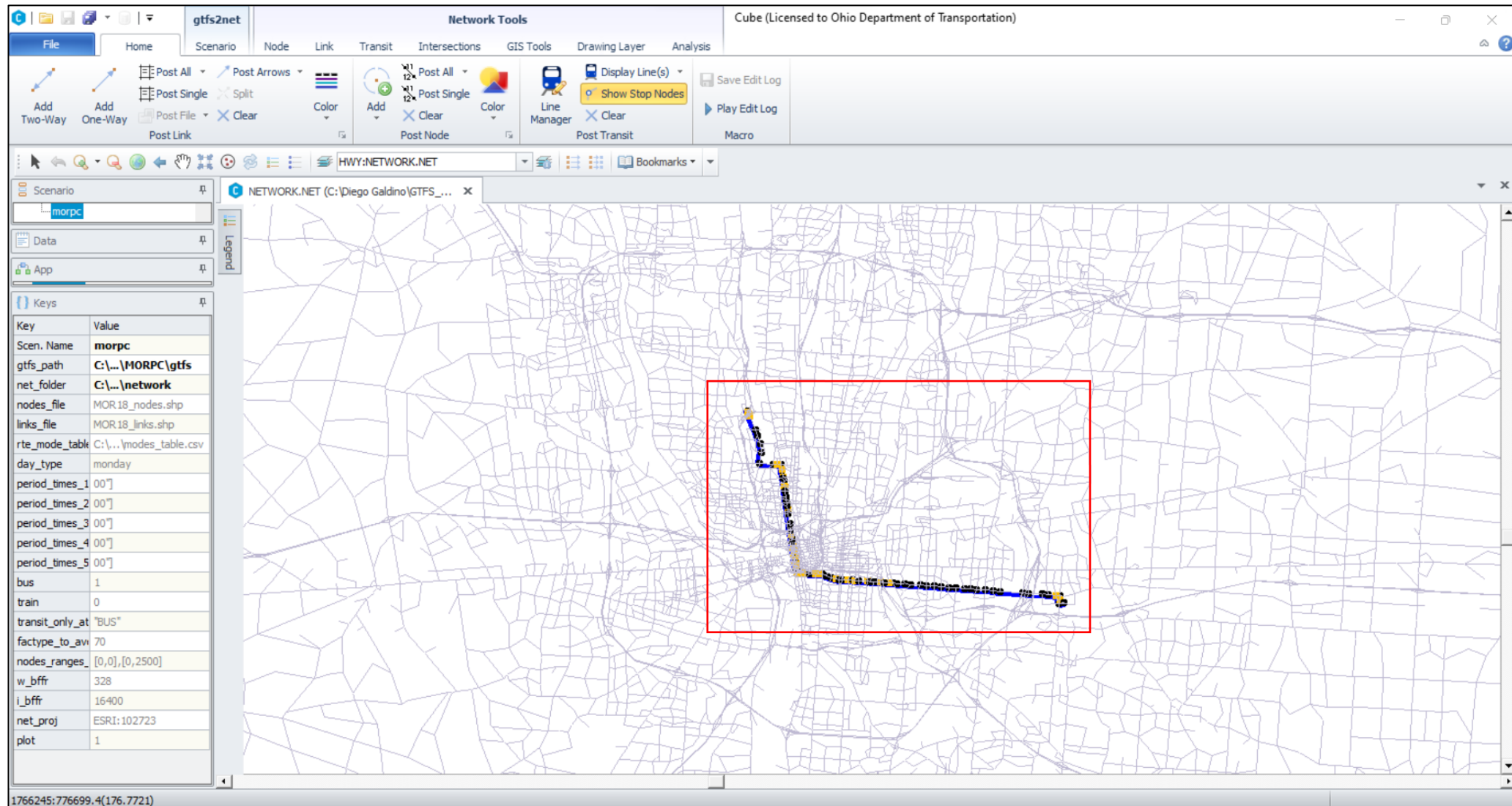


Figure 13. MORPC network with lines loaded and route 1 selected.

Outputs



Figure 14. MORPC network with lines loaded and route 1 selected and in zoom.

Outputs

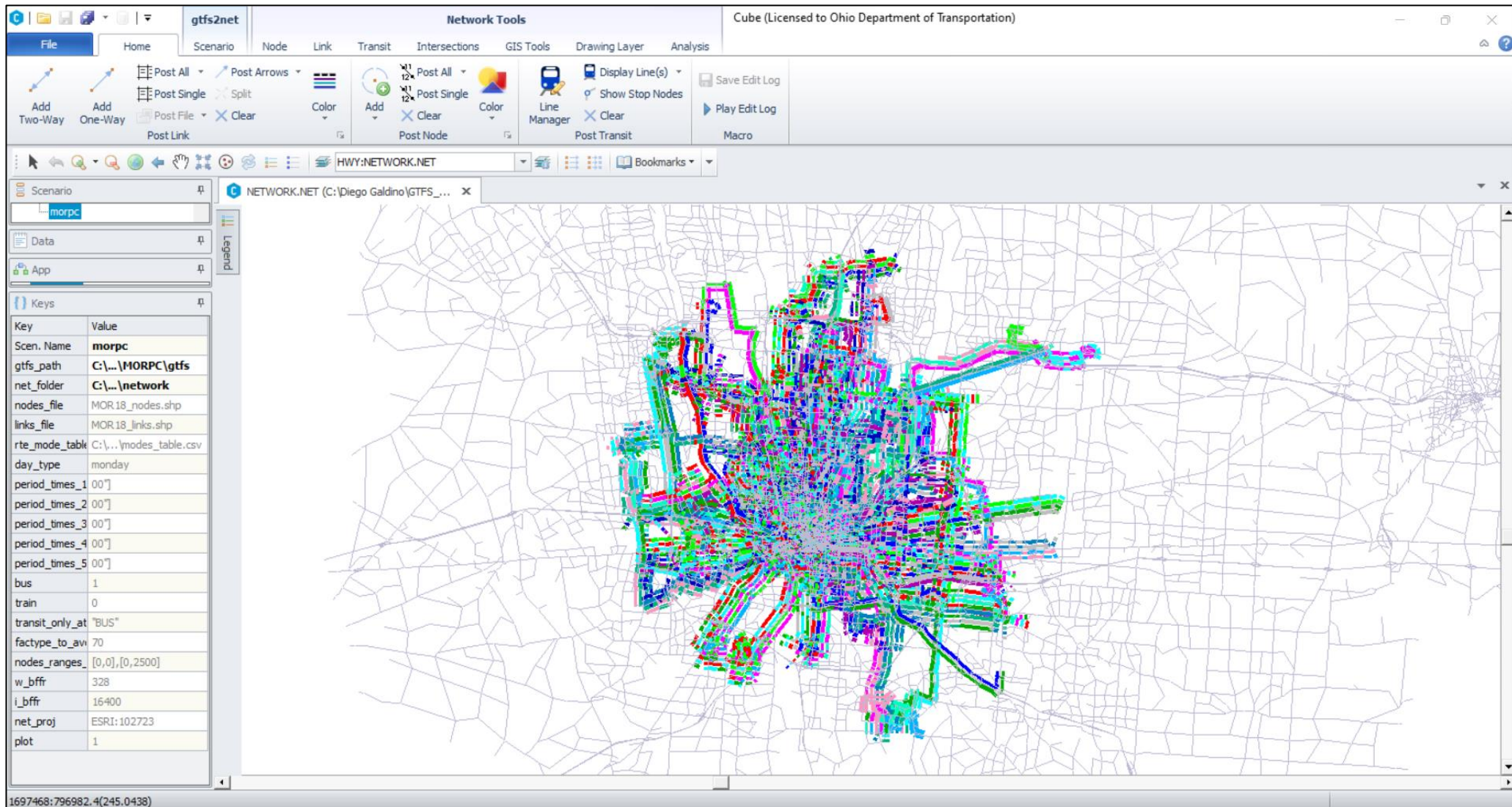
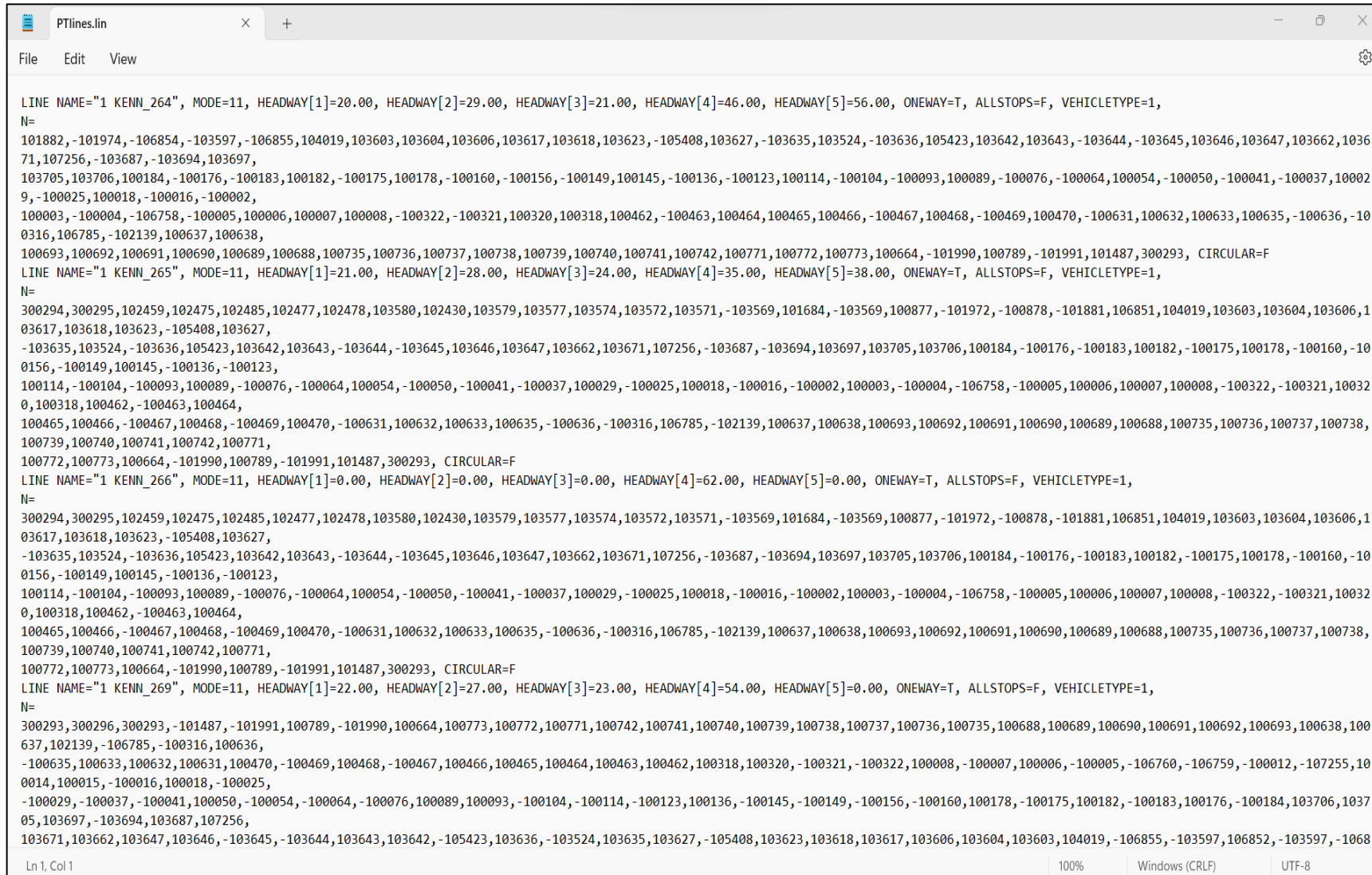


Figure 15. MORPC network with lines loaded and all routes selected.

Outputs



```
PTlines.lin
File Edit View

LINE NAME="1 KENN_264", MODE=11, HEADWAY[1]=20.00, HEADWAY[2]=29.00, HEADWAY[3]=21.00, HEADWAY[4]=46.00, HEADWAY[5]=56.00, ONEWAY=T, ALLSTOPS=F, VEHICLETYP=1,
N=
101882,-101974,-106854,-103597,-106855,104019,103603,103604,103606,103617,103618,103623,-105408,103627,-103635,103524,-103636,105423,103642,103643,-103644,-103645,103646,103647,103662,1036
71,107256,-103687,-103694,103697,
103705,103706,100184,-100176,-100183,100182,-100175,100178,-100160,-100156,-100149,100145,-100136,-100123,100114,-100104,-100093,100089,-100076,-100064,100054,-100050,-100041,-100037,10002
9,-100025,100018,-100016,-100002,
100003,-100004,-106758,-100005,100006,100007,100008,-100322,-100321,100320,100318,100462,-100463,100464,100465,100466,-100467,100468,-100469,100470,-100631,100632,100633,100635,-100636,-10
0316,106785,-102139,100637,100638,
100693,100692,100691,100690,100689,100688,100735,100736,100737,100738,100739,100740,100741,100742,100771,100772,100773,100664,-101990,100789,-101991,101487,300293, CIRCULAR=F
LINE NAME="1 KENN_265", MODE=11, HEADWAY[1]=21.00, HEADWAY[2]=28.00, HEADWAY[3]=24.00, HEADWAY[4]=35.00, HEADWAY[5]=38.00, ONEWAY=T, ALLSTOPS=F, VEHICLETYP=1,
N=
300294,300295,102459,102475,102485,102477,102478,103580,102430,103579,103577,103574,103572,103571,-103569,101684,-103569,100877,-101972,-100878,-101881,106851,104019,103603,103604,103606,1
03617,103618,103623,-105408,103627,
-103635,103524,-103636,105423,103642,103643,-103644,-103645,103646,103647,103662,103671,107256,-103687,-103694,103697,103705,103706,100184,-100176,-100183,100182,-100175,100178,-100160,-10
0156,-100149,100145,-100136,-100123,
100114,-100104,-100093,100089,-100076,-100064,100054,-100050,-100041,-100037,100029,-100025,100018,-100016,-100002,100003,-100004,-106758,-100005,100006,100007,100008,-100322,-100321,10032
0,100318,100462,-100463,100464,
100465,100466,-100467,100468,-100469,100470,-100631,100632,100633,100635,-100636,-100316,106785,-102139,100637,100638,100693,100692,100691,100690,100689,100688,100735,100736,100737,100738,
100739,100740,100741,100742,100771,
100772,100773,100664,-101990,100789,-101991,101487,300293, CIRCULAR=F
LINE NAME="1 KENN_266", MODE=11, HEADWAY[1]=0.00, HEADWAY[2]=0.00, HEADWAY[3]=0.00, HEADWAY[4]=62.00, HEADWAY[5]=0.00, ONEWAY=T, ALLSTOPS=F, VEHICLETYP=1,
N=
300294,300295,102459,102475,102485,102477,102478,103580,102430,103579,103577,103574,103572,103571,-103569,101684,-103569,100877,-101972,-100878,-101881,106851,104019,103603,103604,103606,1
03617,103618,103623,-105408,103627,
-103635,103524,-103636,105423,103642,103643,-103644,-103645,103646,103647,103662,103671,107256,-103687,-103694,103697,103705,103706,100184,-100176,-100183,100182,-100175,100178,-100160,-10
0156,-100149,100145,-100136,-100123,
100114,-100104,-100093,100089,-100076,-100064,100054,-100050,-100041,-100037,100029,-100025,100018,-100016,-100002,100003,-100004,-106758,-100005,100006,100007,100008,-100322,-100321,10032
0,100318,100462,-100463,100464,
100465,100466,-100467,100468,-100469,100470,-100631,100632,100633,100635,-100636,-100316,106785,-102139,100637,100638,100693,100692,100691,100690,100689,100688,100735,100736,100737,100738,
100739,100740,100741,100742,100771,
100772,100773,100664,-101990,100789,-101991,101487,300293, CIRCULAR=F
LINE NAME="1 KENN_269", MODE=11, HEADWAY[1]=22.00, HEADWAY[2]=27.00, HEADWAY[3]=23.00, HEADWAY[4]=54.00, HEADWAY[5]=0.00, ONEWAY=T, ALLSTOPS=F, VEHICLETYP=1,
N=
300293,300296,300293,-101487,-101991,100789,-101990,100664,100773,100772,100771,100742,100741,100740,100739,100738,100737,100736,100735,100688,100689,100690,100691,100692,100693,100638,100
637,102139,-106785,-100316,100636,
-100635,100633,100632,100631,100470,-100469,100468,-100467,100466,100465,100464,100463,100462,100318,100320,-100321,-100322,100008,-100007,100006,-100005,-106760,-106759,-100012,-107255,10
0014,100015,-100016,100018,-100025,
-100029,-100037,-100041,100050,-100054,-100064,-100076,100089,100093,-100104,-100114,-100123,100136,-100145,-100149,-100156,-100160,100178,-100175,100182,-100183,100176,-100184,103706,1037
05,103697,-103694,103687,107256,
103671,103662,103647,103646,-103645,-103644,103643,103642,-105423,103636,-103524,103635,103627,-105408,103623,103618,103617,103606,103604,103603,104019,-106855,-103597,106852,-103597,-1068
```

Ln 1, Col 1

100% Windows (CRLF) UTF-8

Figure 16. Line file produced by the tool.

Outputs

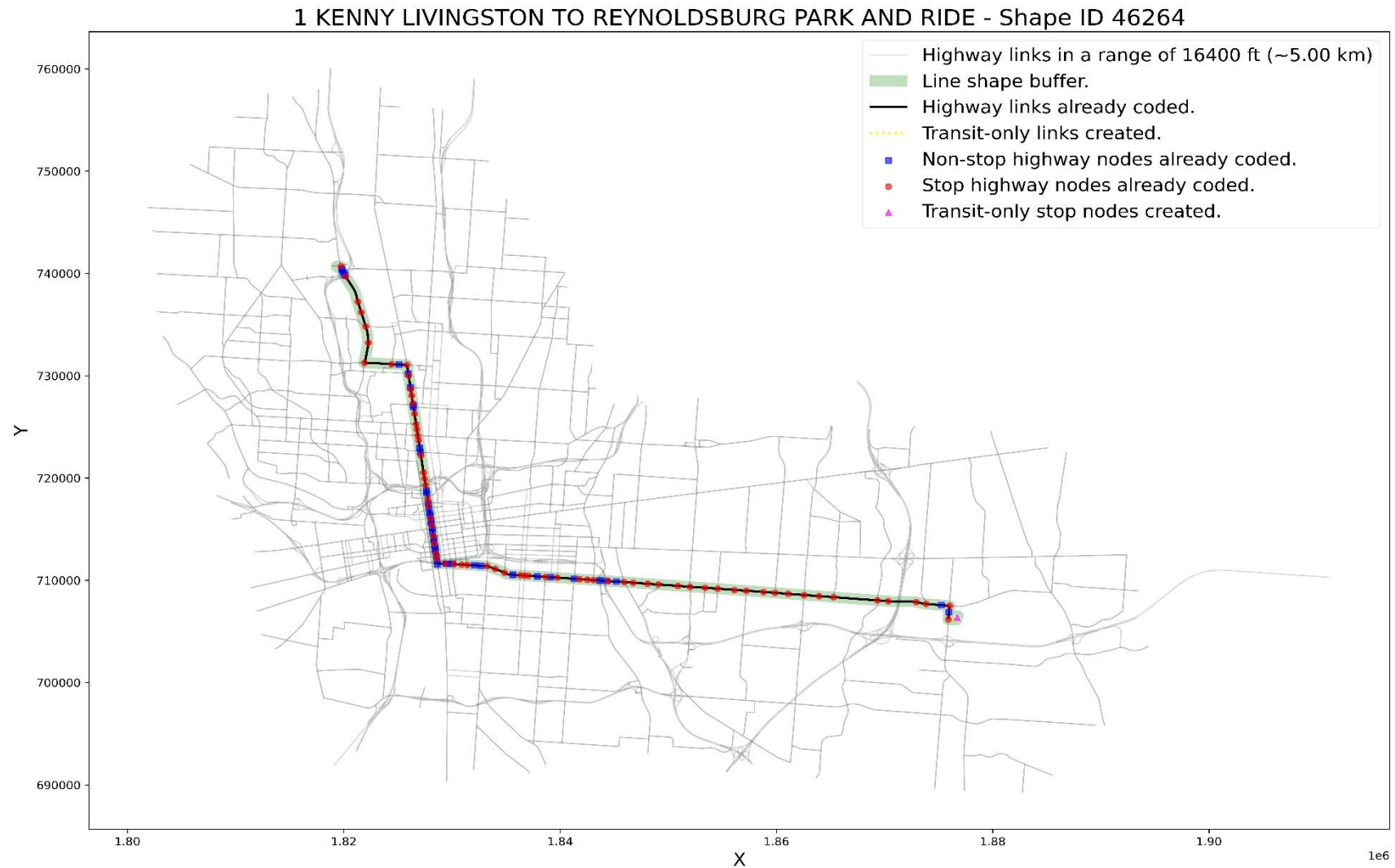


Figure 17. COTA line 1 with MORPC network.

Conclusions and Recommendations

- The four main core functions of the Python-based tool are related to:
 - The bus line buffer.
 - The highway stops.
 - The shortest path that connects the highway stops.
 - The creation of transit-only elements (links and nodes).
- The two most important inputs are the network “trueshape” and the “within_buffer”.
- The tool does not perform well with bus lines that ride roads in both directions (e.g., circular bus lines).
- The tool was only tested with bus lines, but it should work for any mode if the right network is provided.
- Create indicators to assess the quality of the coded lines (e.g., % of transit-only elements, geometry analysis).
- Revise the selection of highway stops.
- Introduce an auto selection function for the “within_buffer”.
- Adapt Google’s or Microsoft’s “Snap to Road” tools for this application.

DIEGO GALDINO, MSc.

Associate Engineer

Mid-Ohio Regional Planning Commission

dgaldino@morpc.org

111 Liberty Street, Suite 100
Columbus, OH 43215



MID-OHIO REGIONAL
MORPC
PLANNING COMMISSION

GitHub: <https://github.com/morpc/morpc-gtfs-to-public-transit-network>

Outputs

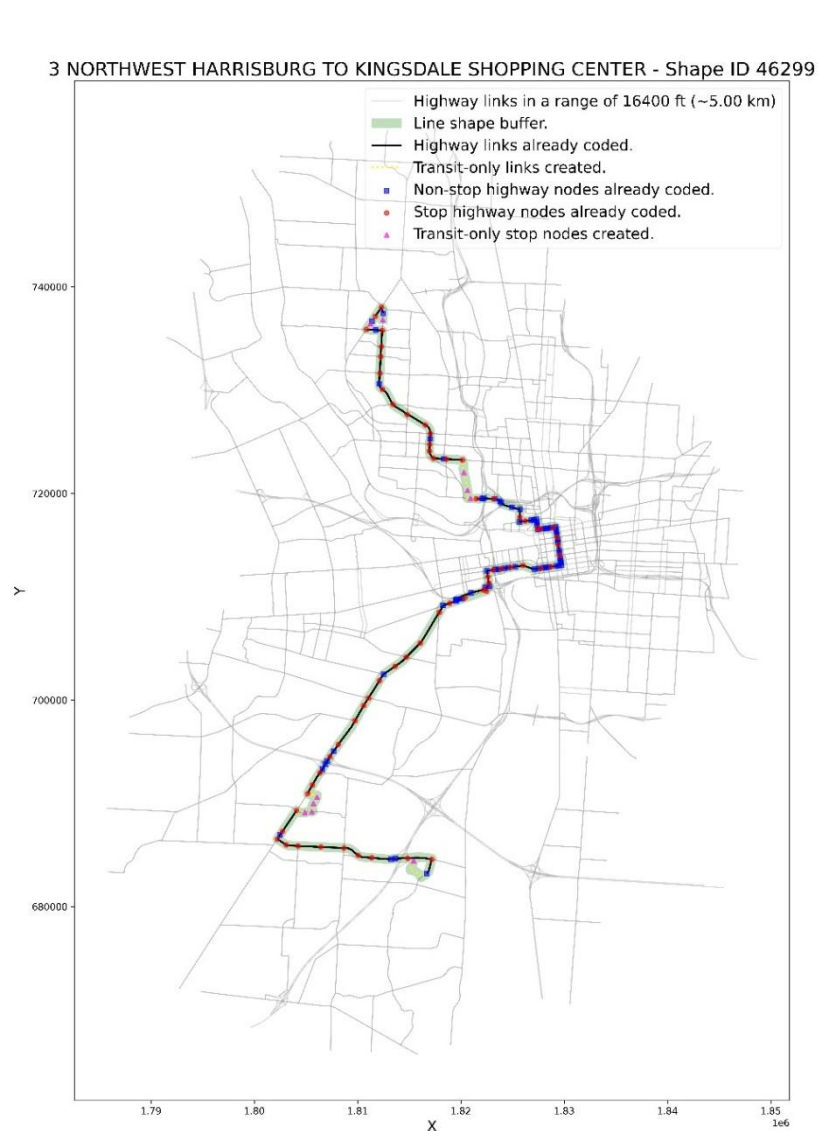


Figure 18. COTA line 3 with MORPC network.

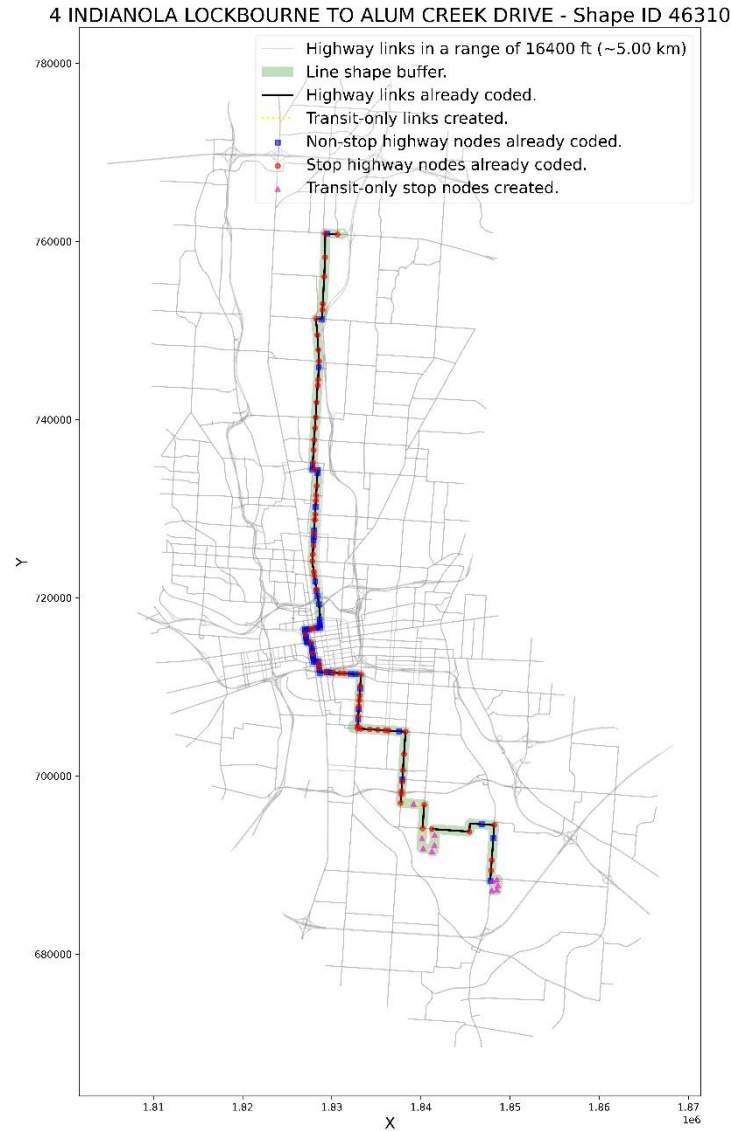


Figure 19. COTA line 4 with MORPC network.

Outputs

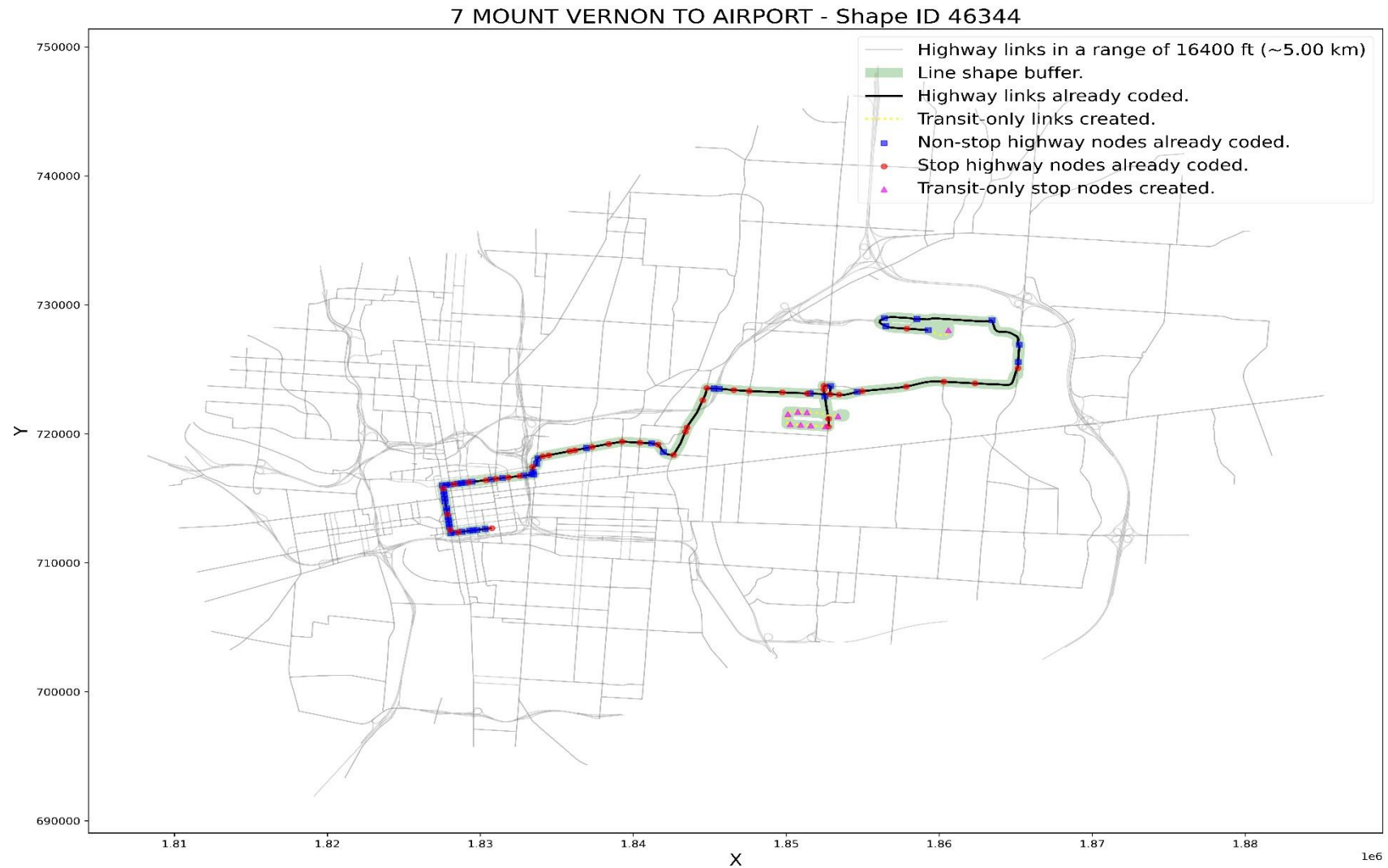


Figure 20. COTA line 7 with MORPC network.

Outputs

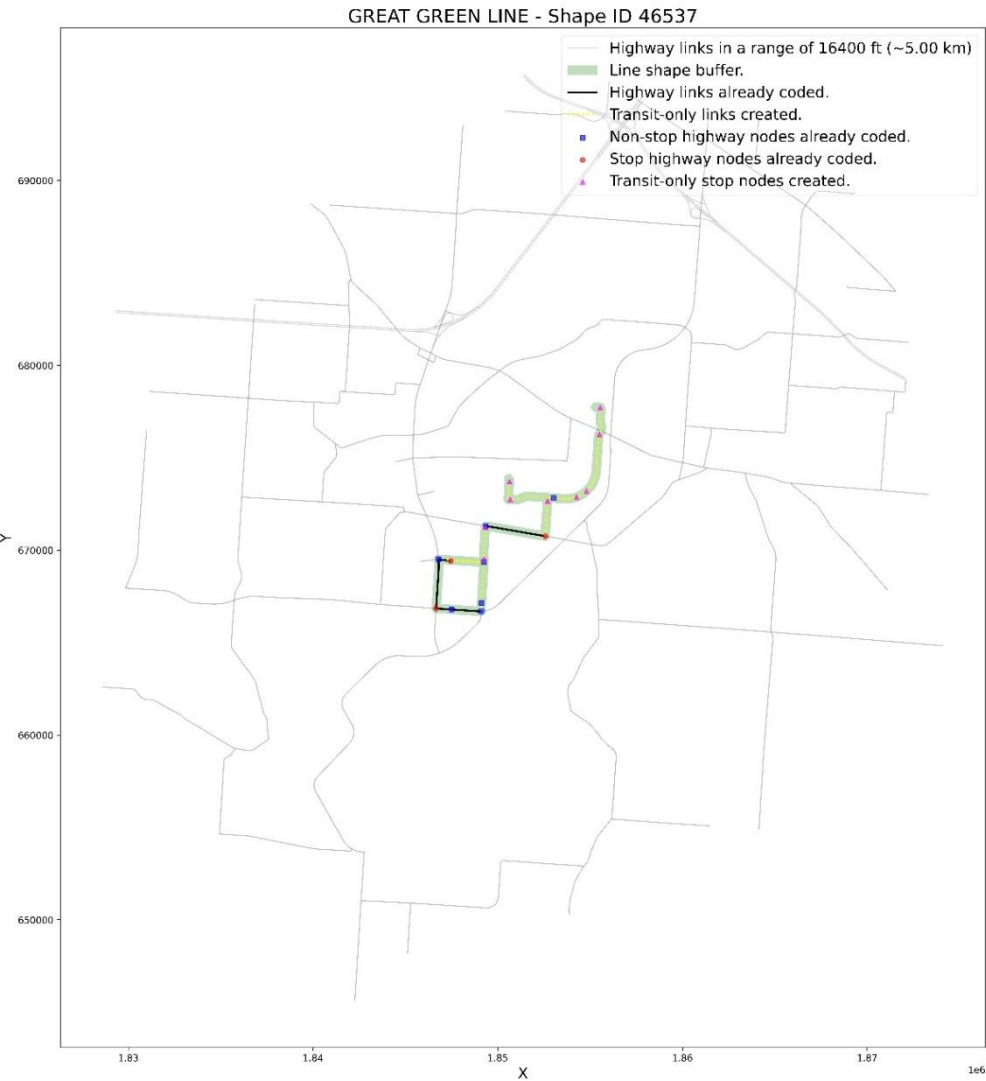


Figure 21. COTA line Great Green with MORPC network.

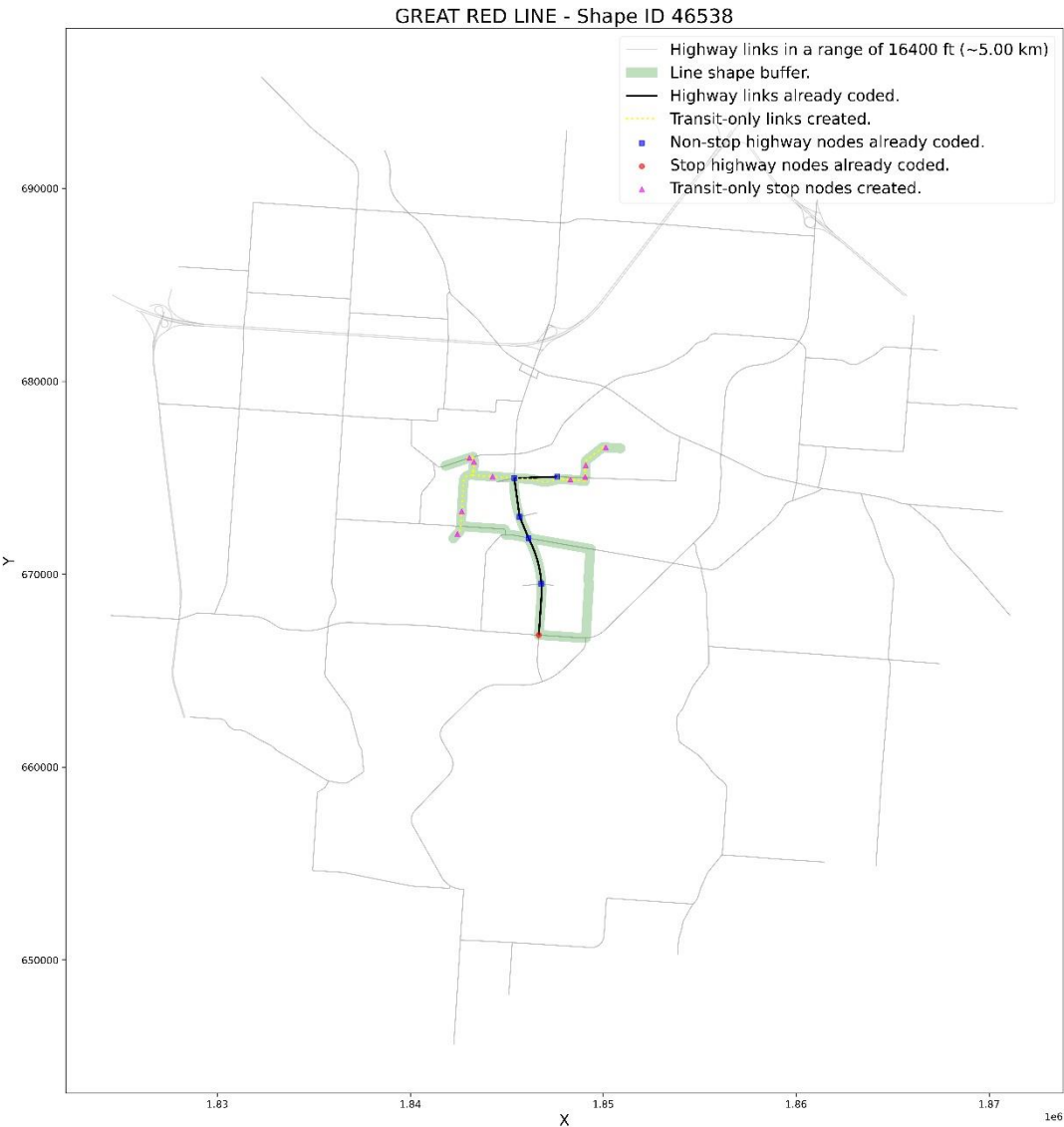


Figure 22. COTA line Great Red with MORPC network.

Outputs

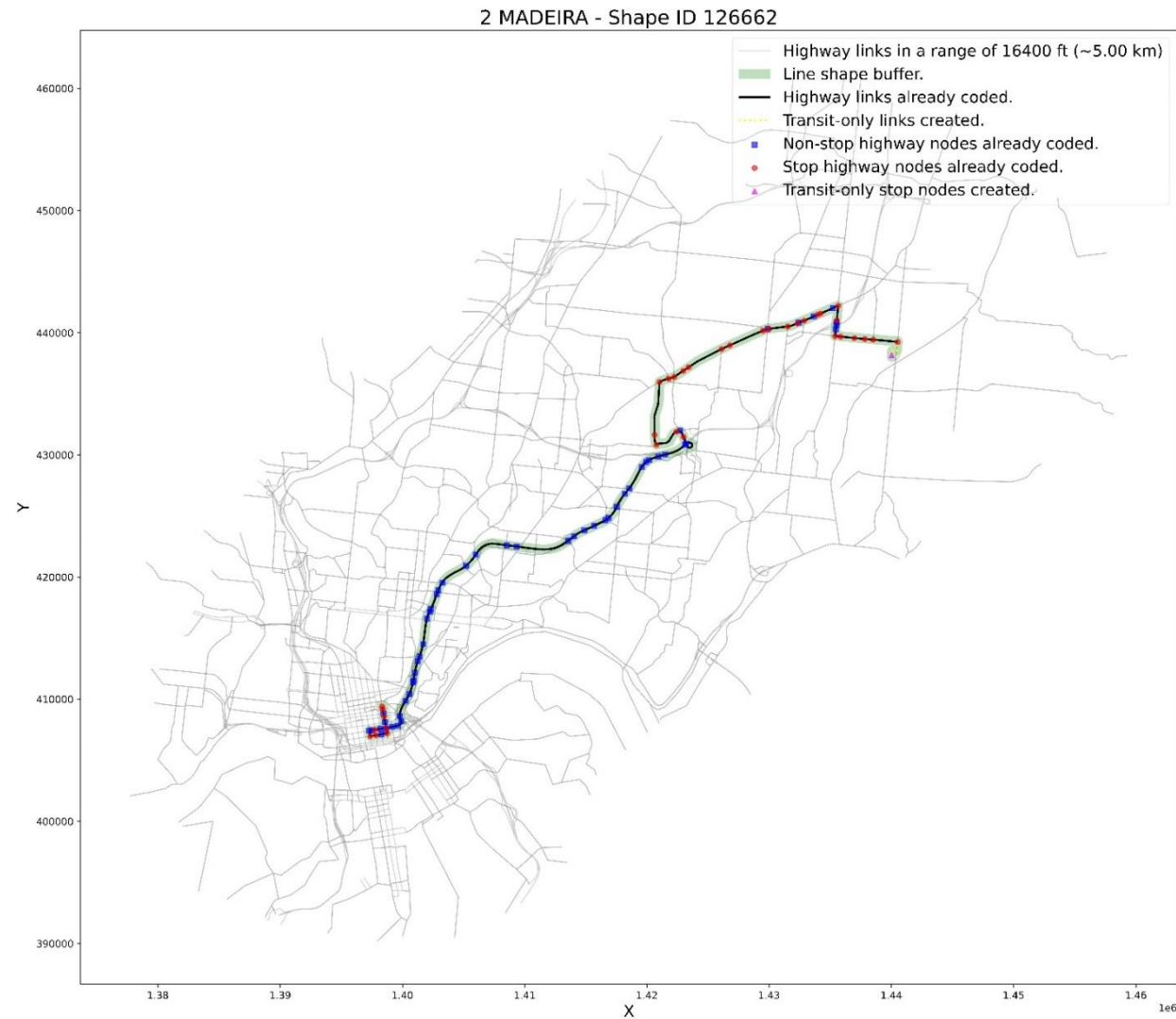


Figure 23. GOMETRO/SORTA line 2 with statewide network.

Outputs

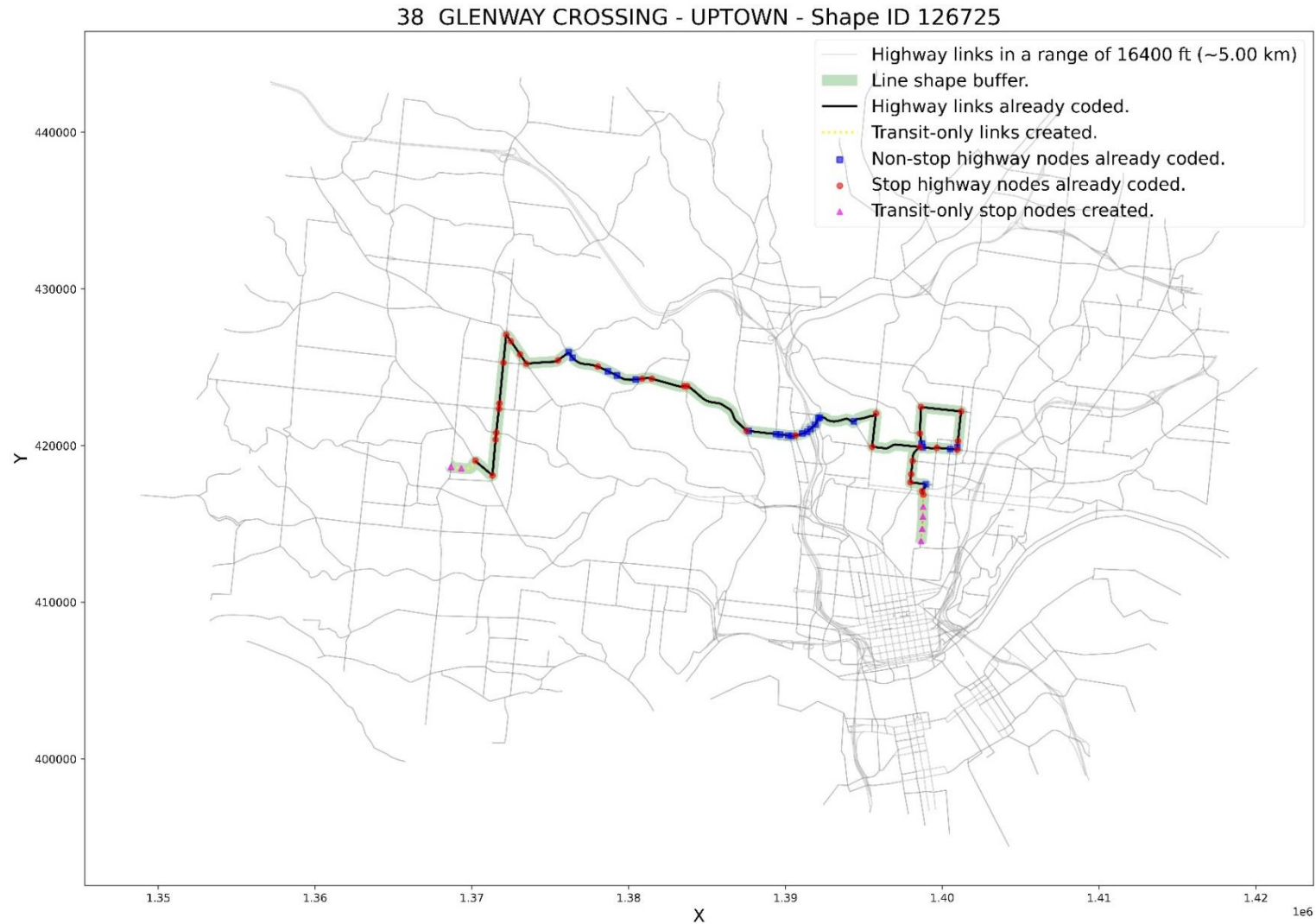


Figure 24. GOMETRO/SORTA line 38 with statewide network.