MODELS, DATA, REALITY, AND YOU

Casey C. Ross

Presented virtually for the University of Pennsylvania Weitzman School of Design
Wednesday, October 6th, 2021

ABOUT ME

Haverford College Class of 2010
B.A. in History - Latin American History & History of Science

Apple Inc. (2010 - 2014)
Genius Bar Technician & Failure Analysis Engineer

Penn Weitzman Class of 2017
M.A. in City Planning - Community Economic Development & Transportation Infrastructure

City of Philadelphia (2017 - *Present*)
Transportation Planner

University of Pennsylvania (2021 - *Present*)
Lecturer in the Department of Urban Studies

TECHNOLOGY USED

PTV Visum

R & RStudio

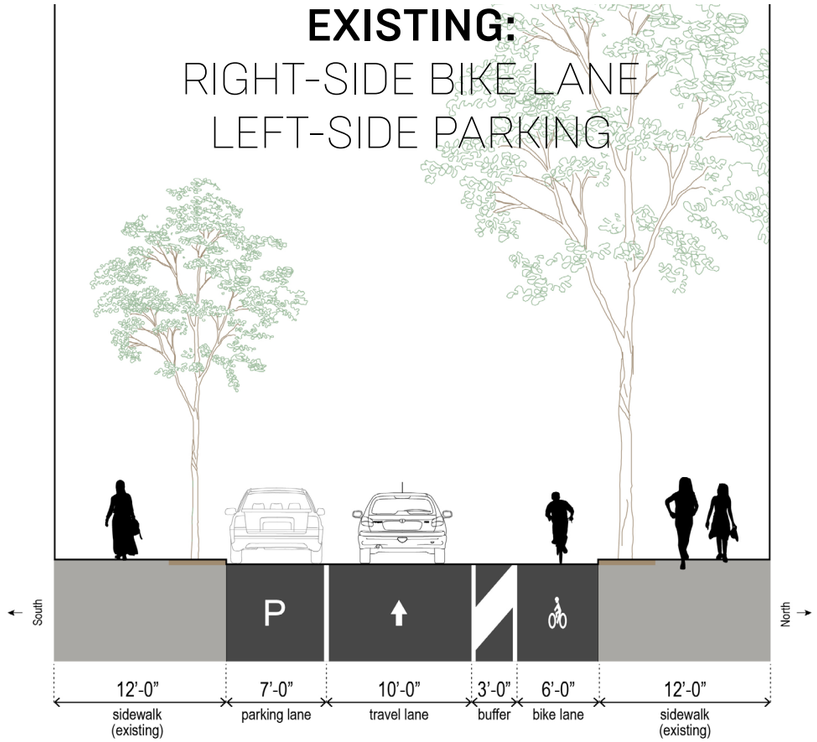
Microsoft Excel

Trafficware Synchro Traffic

Pen & Paper

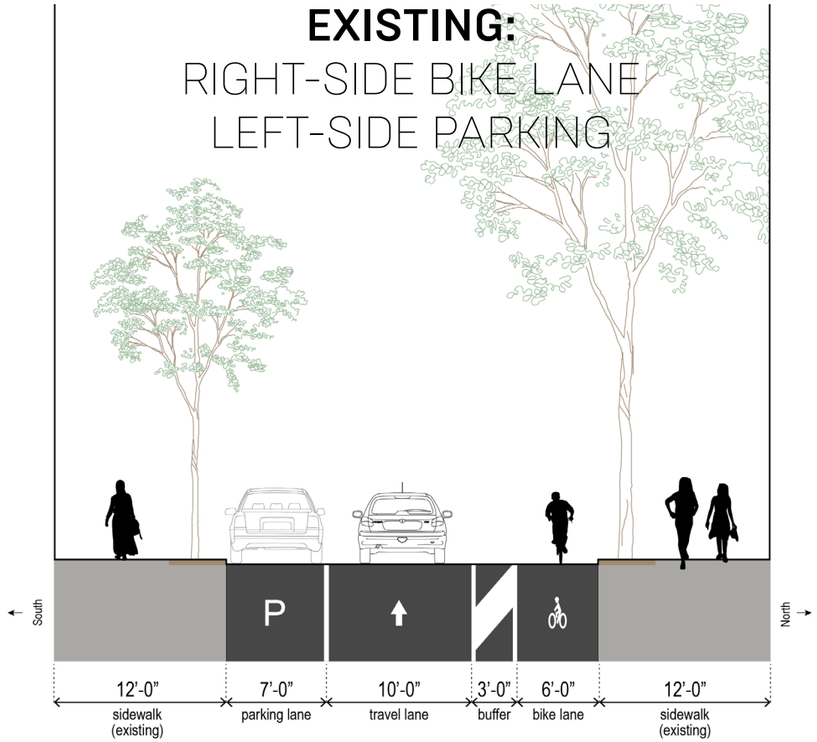
SPRUCE & PINE STREET LEFT-SIDE BIKE LANES

SPRUCE & PINE STREET LEFT-SIDE BIKE LANES

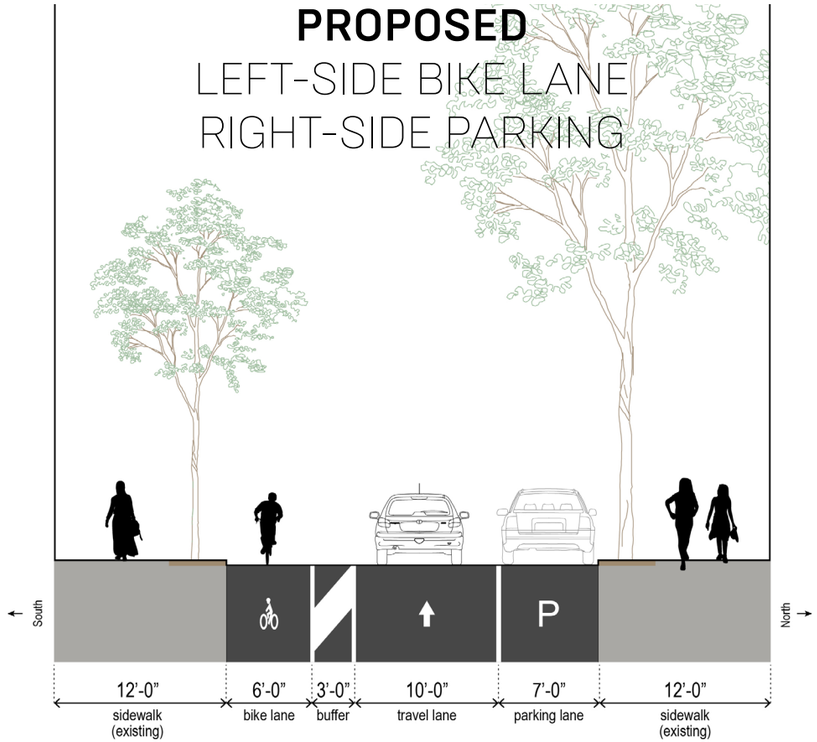


SPRUCE & PINE STREET LEFT-SIDE BIKE LANES

EXISTING:
RIGHT-SIDE BIKE LANE
LEFT-SIDE PARKING

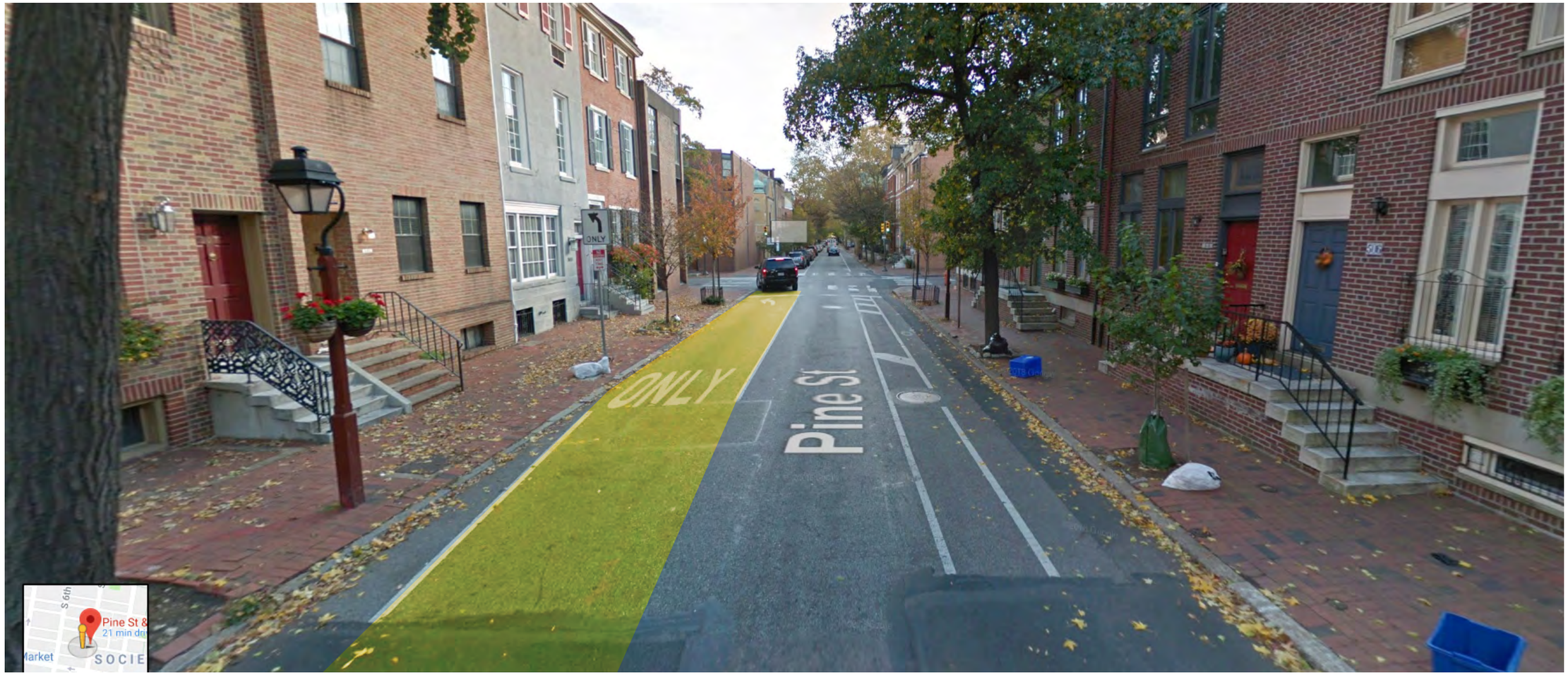


PROPOSED
LEFT-SIDE BIKE LANE
RIGHT-SIDE PARKING



THE PROBLEM:

THE PROBLEM: LEFT-TURN LANES



LOCATIONS WITH LEFT-TURNS

Pine & Front
Pine & 2nd
Pine & 3rd
Pine & 5th
Pine & 7th
Pine & 9th
Pine & 11th
Pine & 13th
Pine & Broad
Pine & 16th
Pine & 18th
Pine & 20th
Pine & 22nd
& 5 small cross streets

Spruce & 2nd
Spruce & 4th
Spruce & 6th
Spruce & 8th
Spruce & 10th
Spruce & 12th
Spruce & Juniper
Spruce & Broad
Spruce & 15th
Spruce & 17th
Spruce & 19th
Spruce & 21st
& 5 small cross streets

LOCATIONS TO LOOK AT

Small, low-volume streets

Pine & Front
Pine & 2nd
Pine & 3rd
Pine & 5th
Pine & 7th
Pine & 9th
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LOCATIONS TO LOOK AT

Small, low-volume streets
Large, high-volume streets

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Pine & 7th
Pine & 9th
Pine & 11th
Pine & 13th
~~Pine & Broad~~
Pine & 16th
Pine & 18th
Pine & 20th
Pine & 22nd
~~& 5 small cross streets~~

Spruce & 2nd
Spruce & 4th
Spruce & 6th
Spruce & 8th
Spruce & 10th
Spruce & 12th
~~Spruce & Juniper~~
~~Spruce & Broad~~
Spruce & 15th
Spruce & 17th
Spruce & 19th
Spruce & 21st
~~& 5 small cross streets~~

LOCATIONS TO LOOK AT

Small, low-volume streets
Large, high-volume streets
Streets w/o existing turn lanes

~~Pine & Front~~
~~Pine & 2nd~~
~~Pine & 3rd~~
Pine & 5th
~~Pine & 7th~~
~~Pine & 9th~~
~~Pine & 11th~~
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~~Pine & Broad~~
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STEPS TO TAKE:

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2. Identify turn nodes (from/to/via) on Spruce & Pine in Visum
3. Export turn volume data from Visum for analysis in R
4. Create AM, MD, PM, and NT data sets
5. Calculate peak-hour AM and PM turn volumes
6. Examine 5th & 13th Streets in context - **do the numbers make sense?**

GETTING THE DATA FROM VISUM

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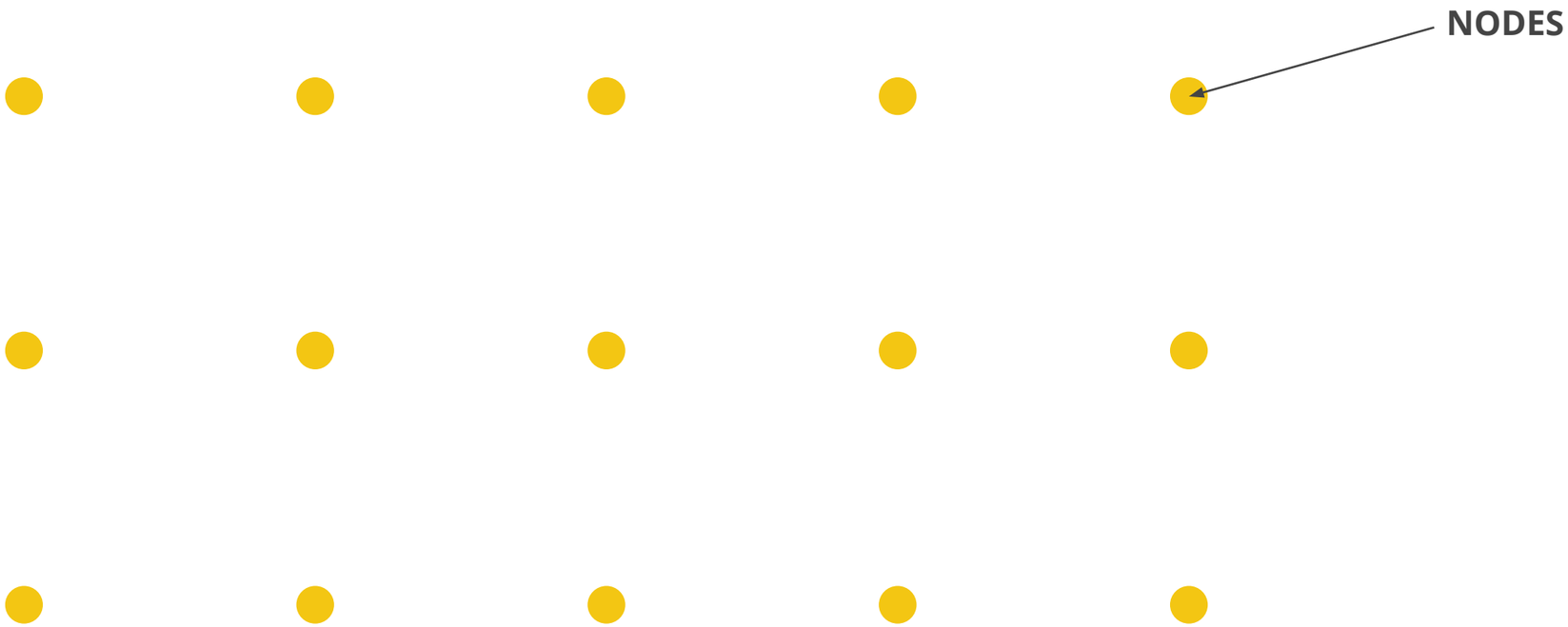

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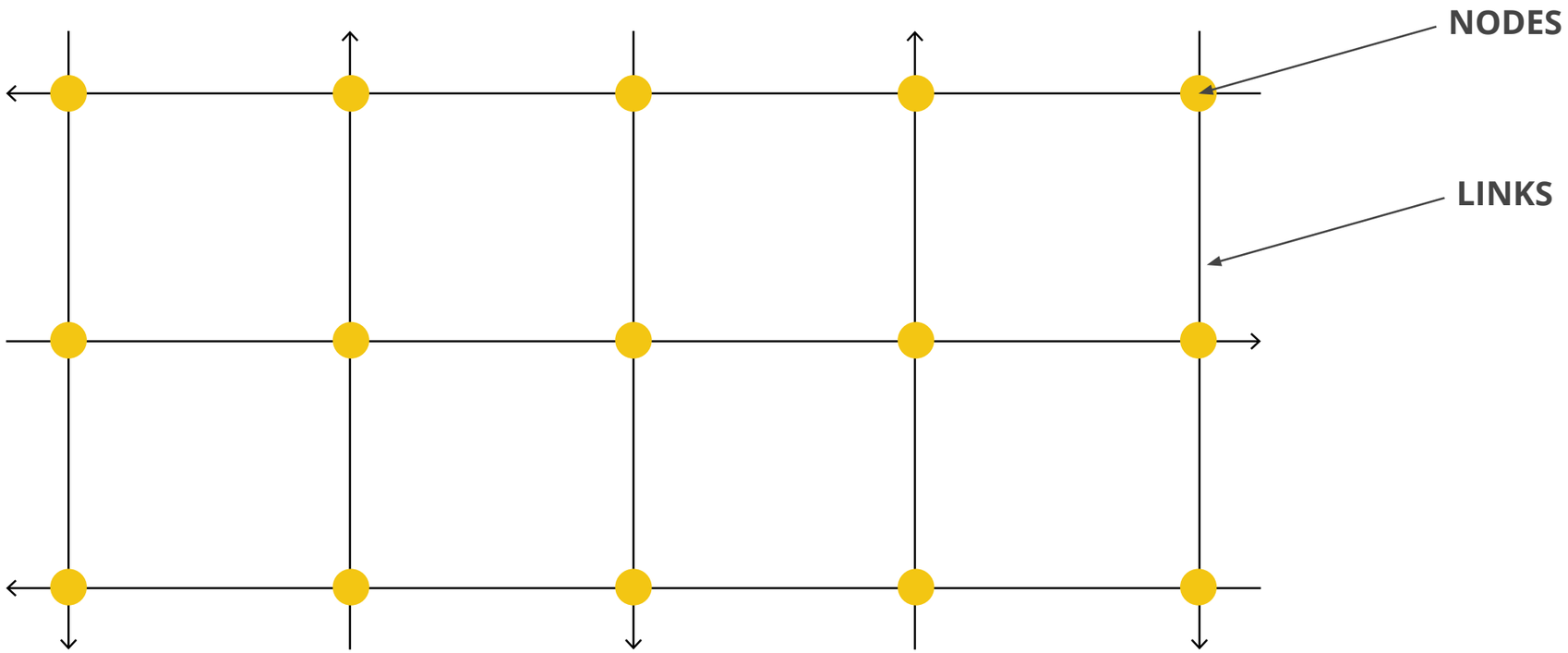

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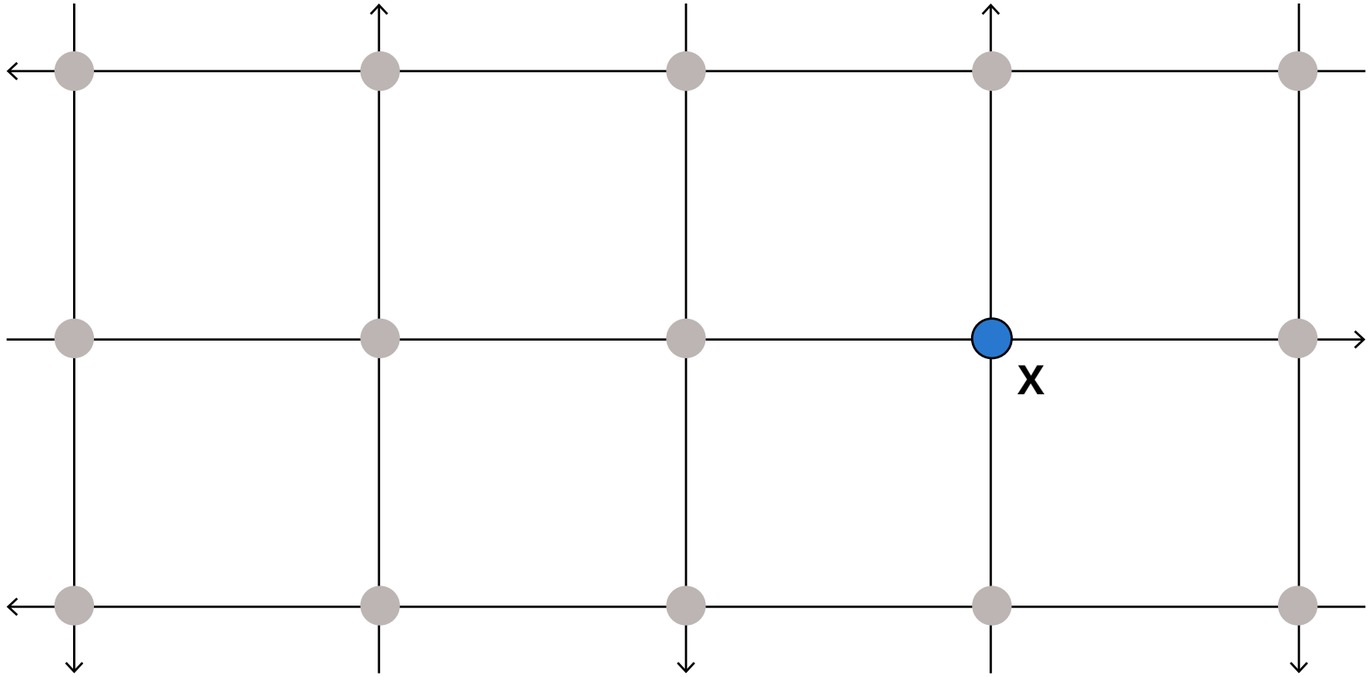

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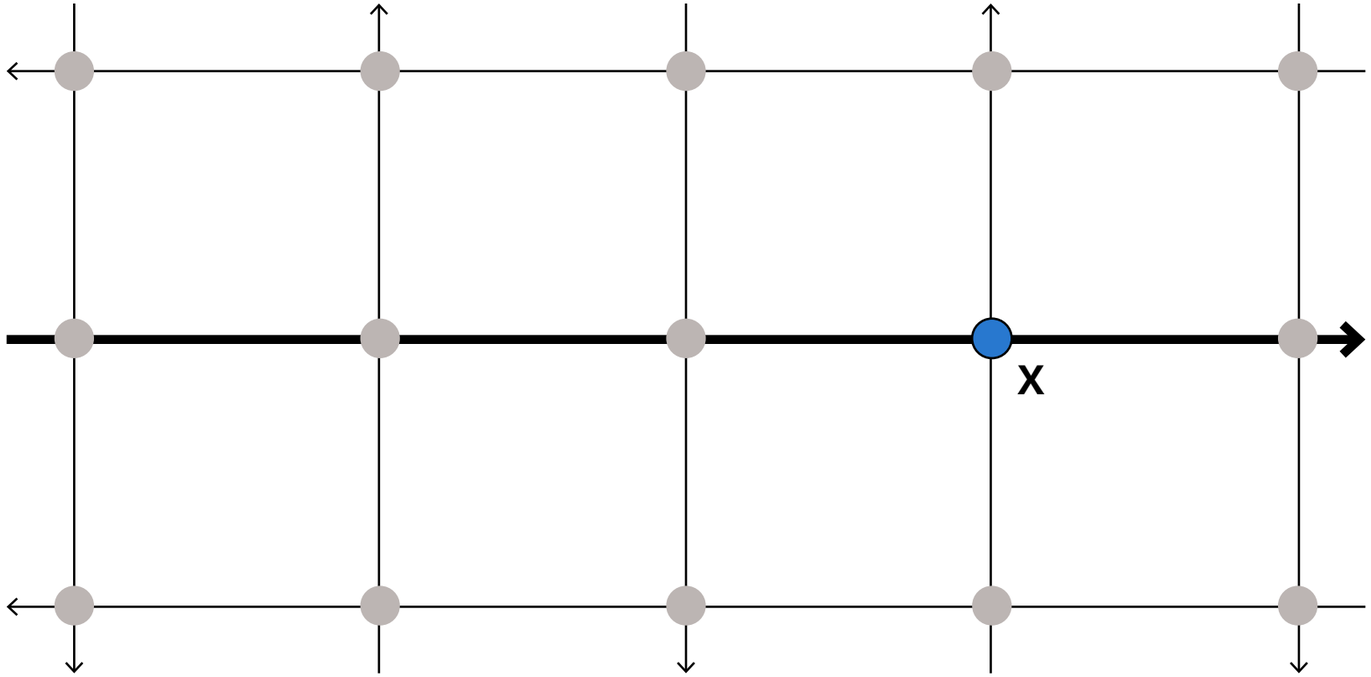
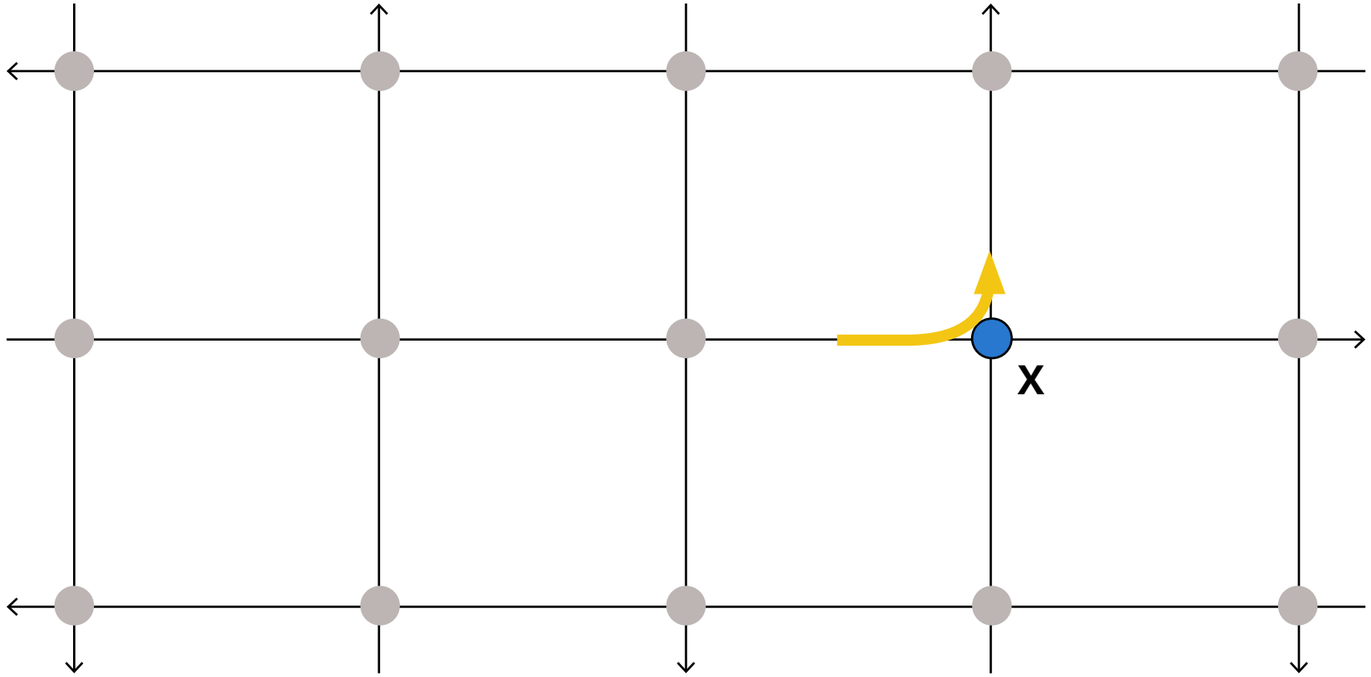


GETTING THE DATA FROM VISUM



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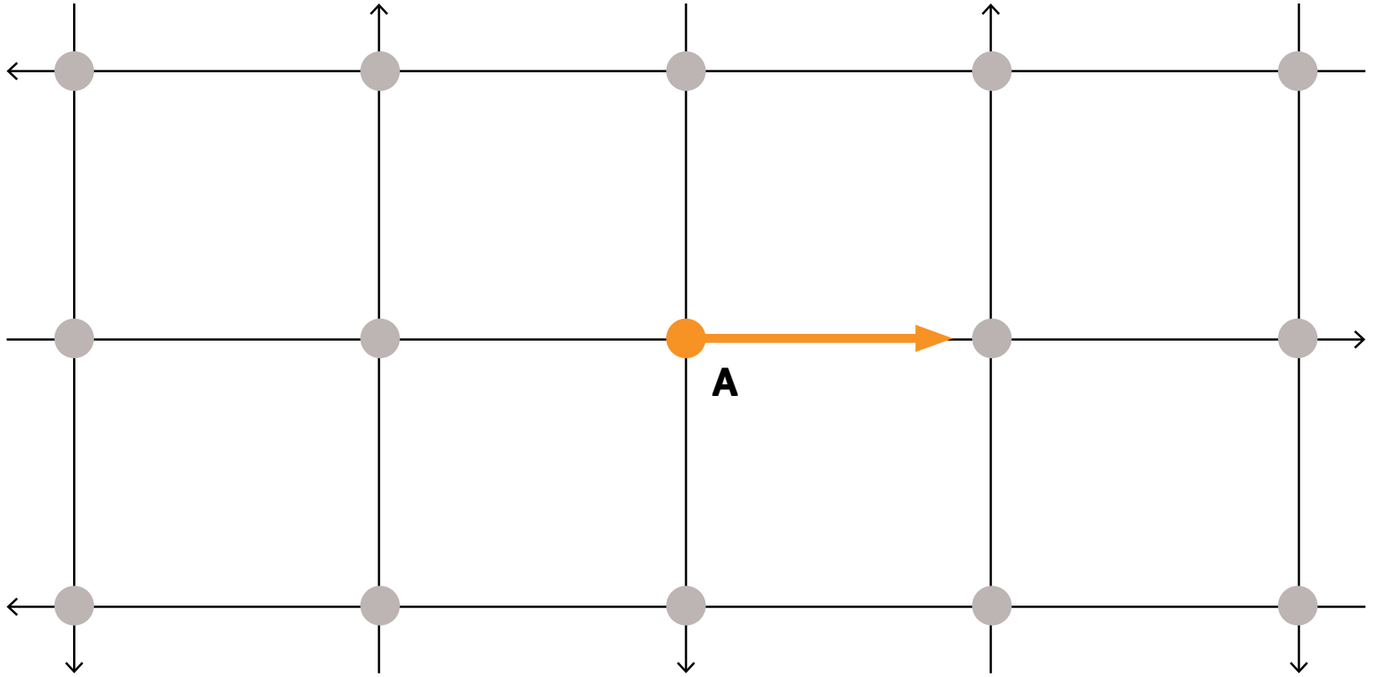
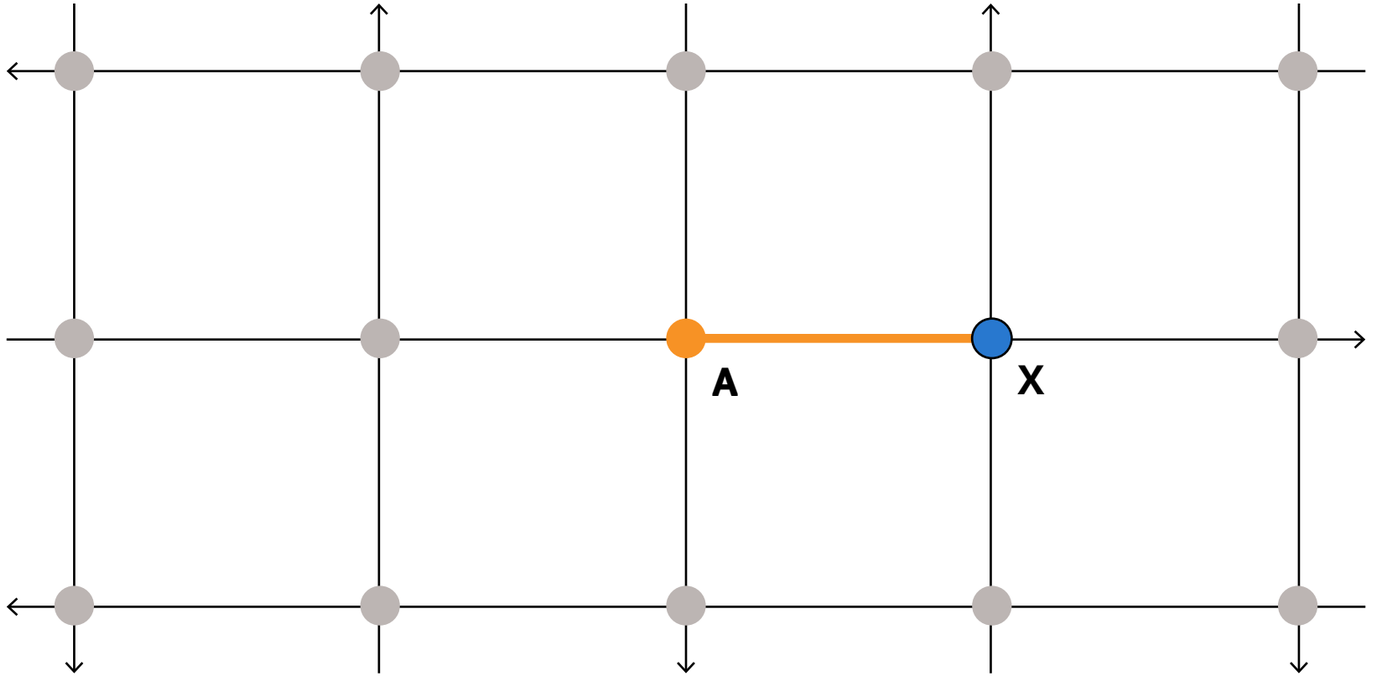


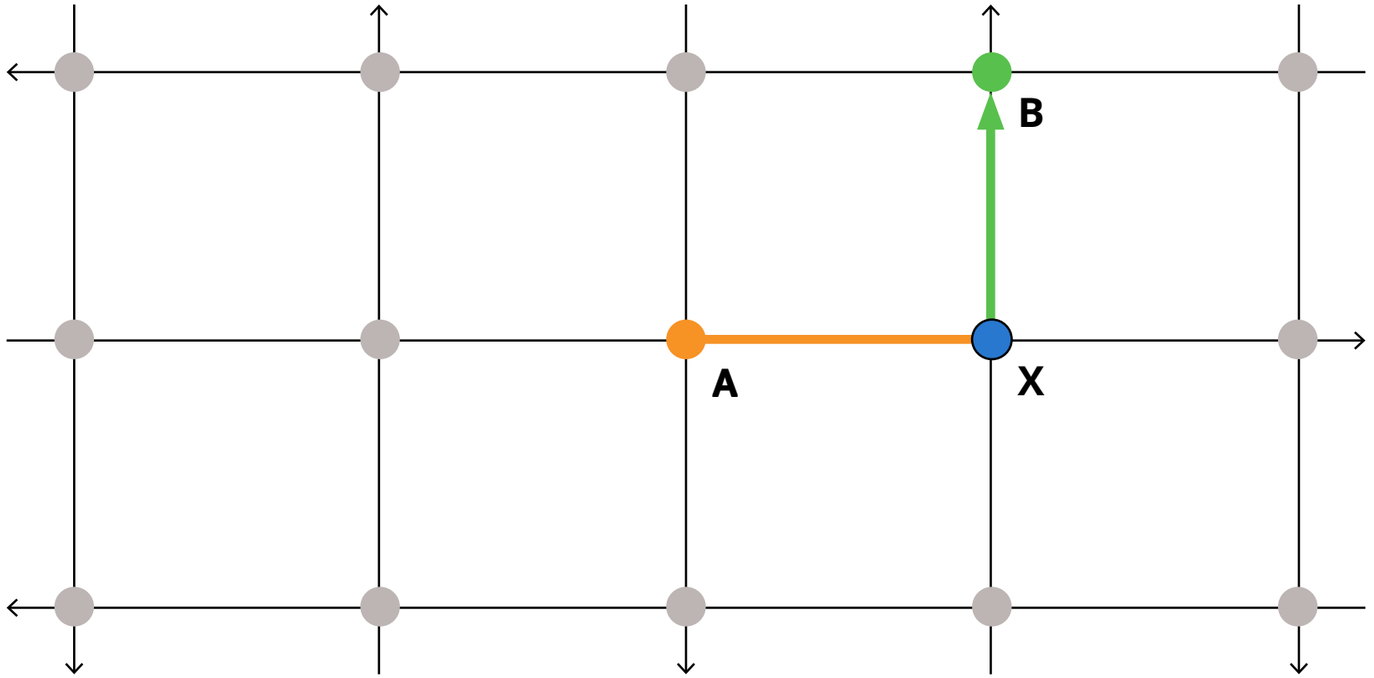
FROM NODE A

GETTING THE DATA FROM VISUM



FROM NODE A
VIA NODE X

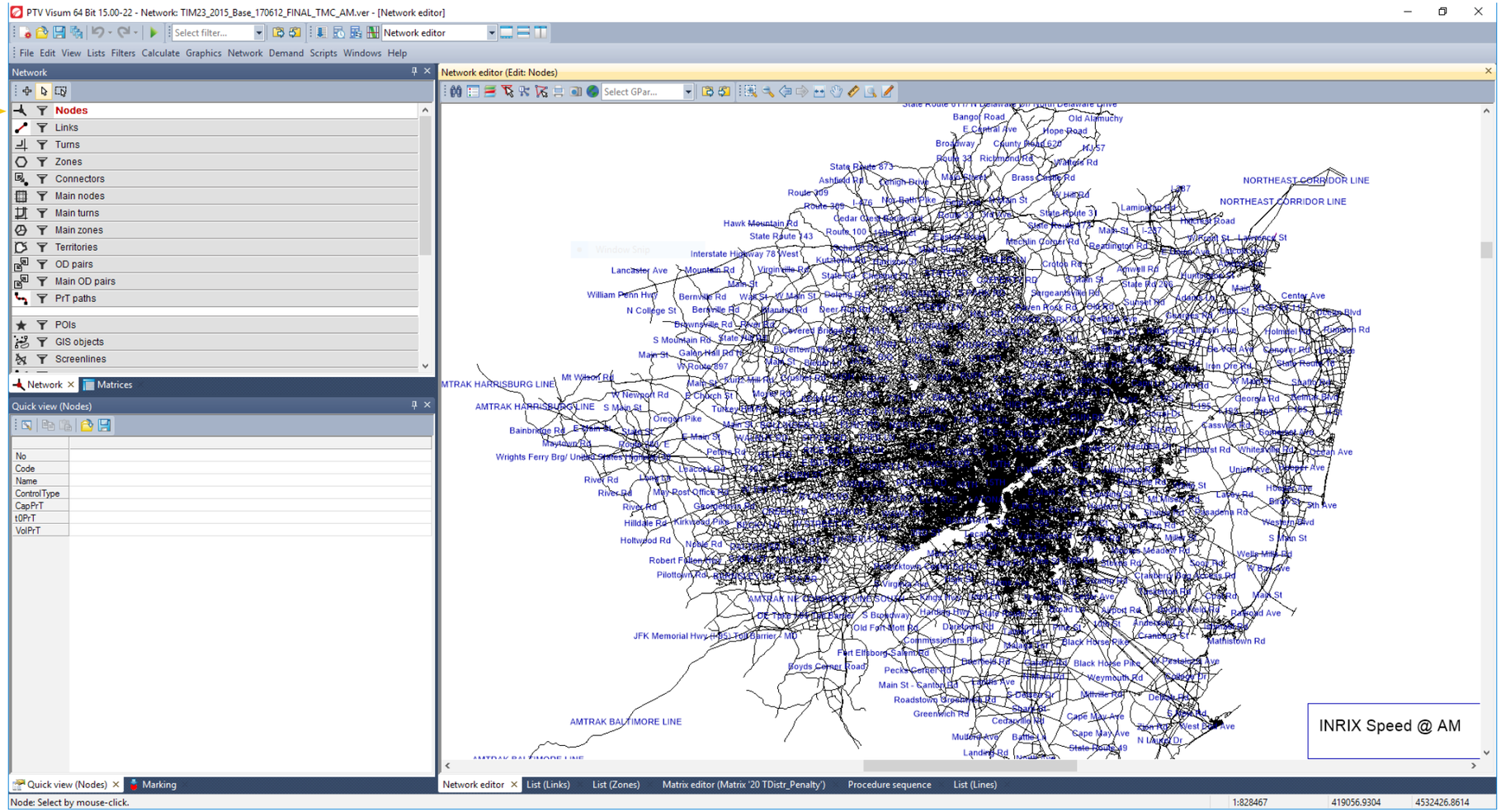
GETTING THE DATA FROM VISUM



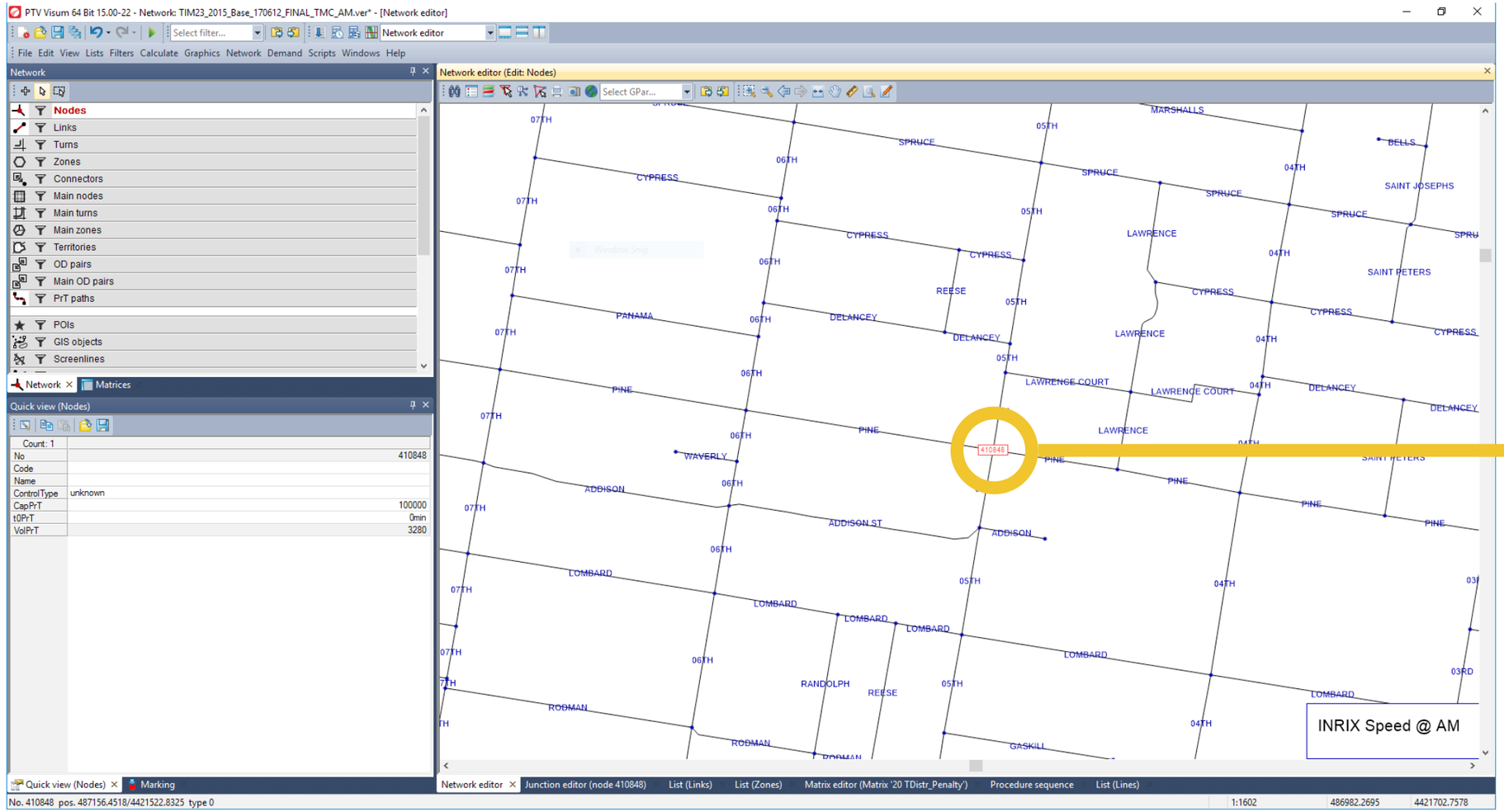
FROM NODE A
VIA NODE X
TO NODE B

GETTING THE DATA FROM VISUM

Looking at the nodes in my regional model network



GETTING THE DATA FROM VISUM



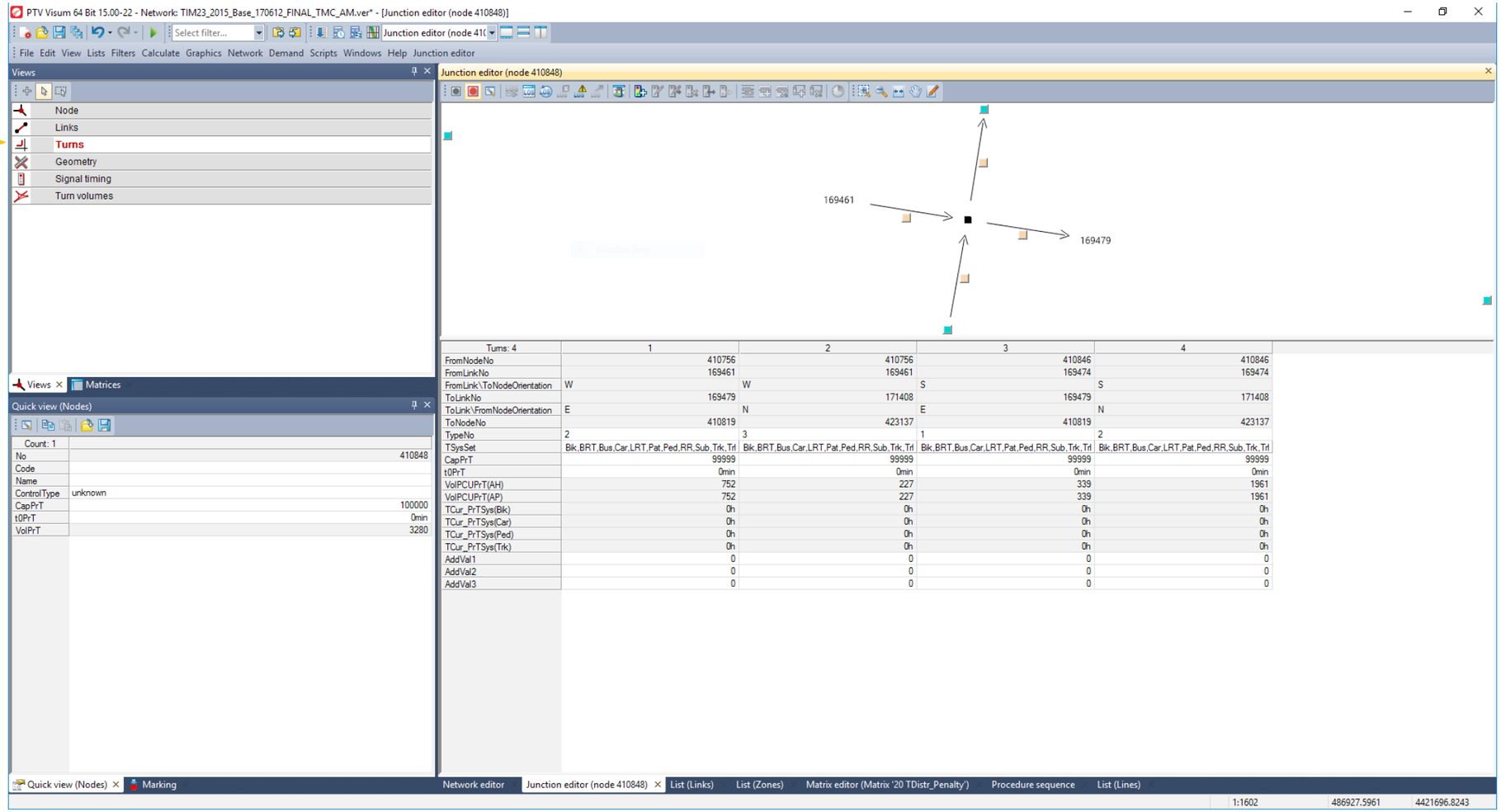
Intersection of 5th Street and Pine Street

This specific node will be my **Via Node**, which I'll use later on.

GETTING THE DATA FROM VISUM

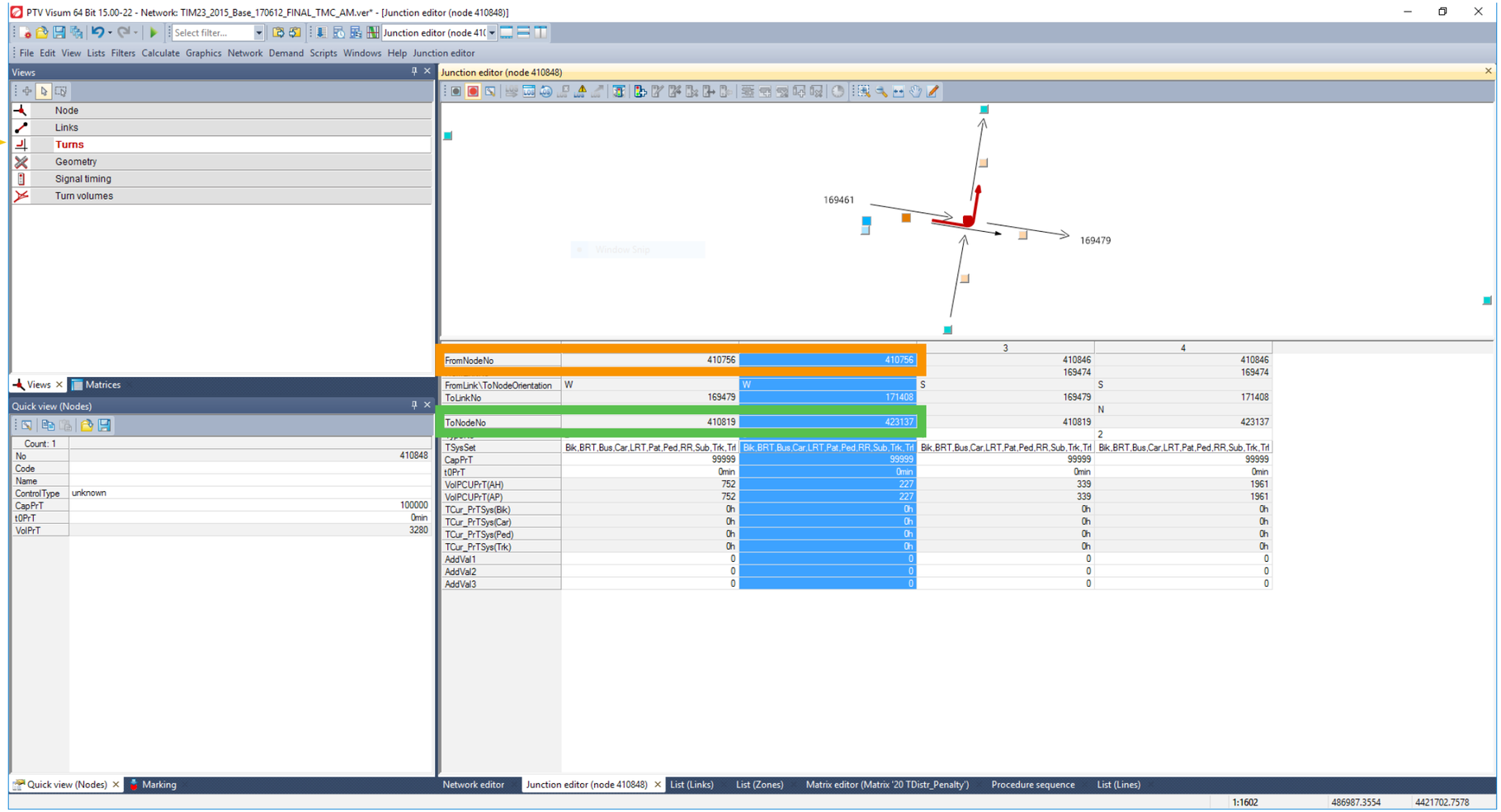
Within an individual node, I can choose the Turns option.

I'm looking at all possible turns that pass through the node that represents 5th and Pine Streets, my **Via Node**.



GETTING THE DATA: INDIVIDUAL TURNS

Within an individual node, I can choose the Turns option.

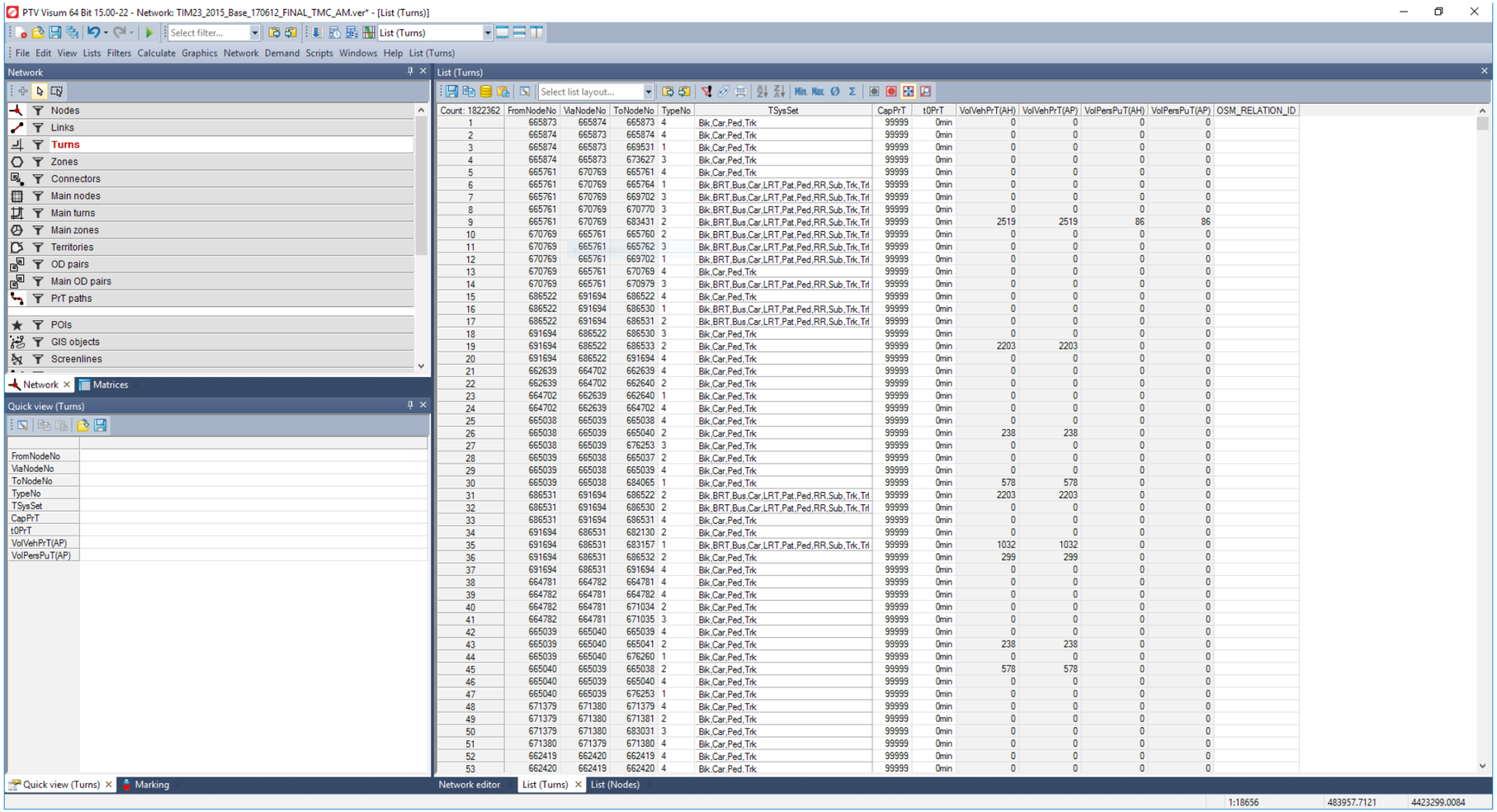


If I select a specific turn movement within the Turns view, I can identify my **From Node** and my **To Node**.

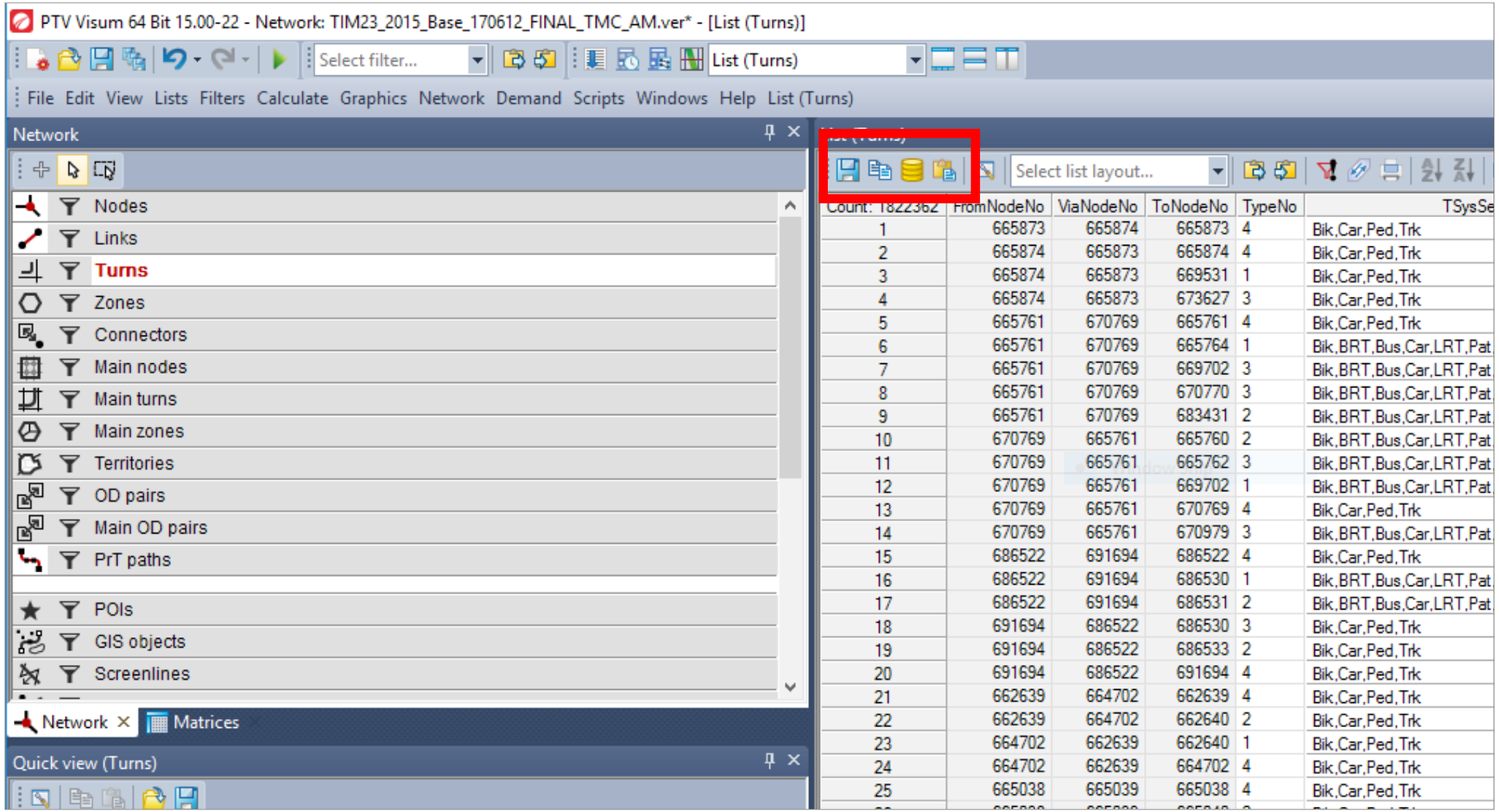
GETTING THE DATA: LISTS OF TURNS

Once I have the following information, I can export my turns list:

FromNodeNo
ViaNodeNo
ToNodeNo

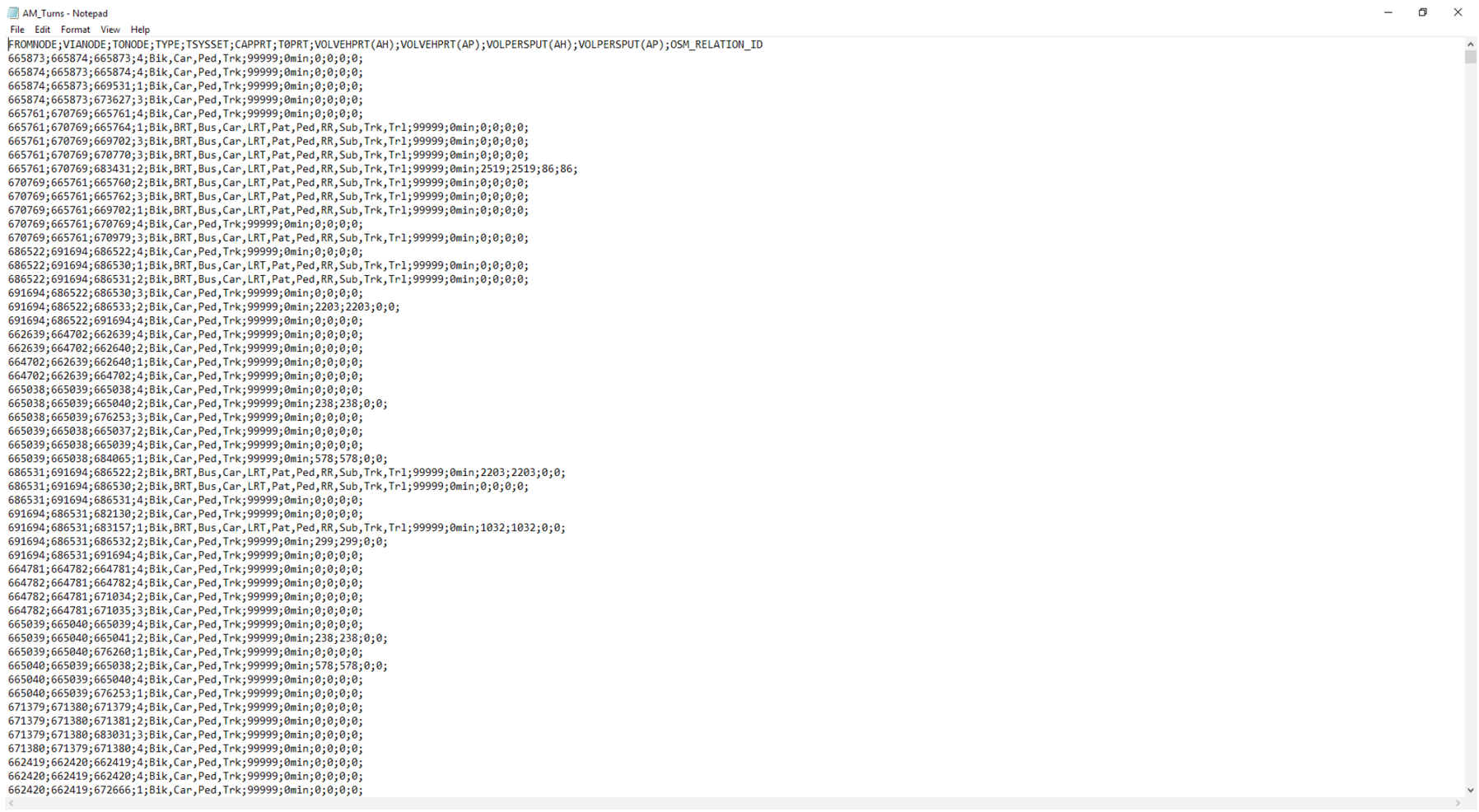


GETTING THE DATA: EXPORTING AS TEXT



GETTING THE DATA: EXPORTING AS TEXT

This is an absolute mess and I hate it. Luckily, I have R.



AM_Turns - Notepad

File Edit Format View Help

```
FROMNODE;VIANODE;TONODE;TYPE;TSYSSET;CAPPRT;T0PRT;VOLVEHPRT(AH);VOLVEHPRT(AP);VOLPERSPUT(AH);VOLPERSPUT(AP);OSM_RELATION_ID
665873;665874;665873;4;Bik,Car,Ped,Trk;99999;0min;0;0;0;0;
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670769;665761;665760;2;Bik,BRT,Bus,Car,LRT,Pat,Ped,RR,Sub,Trk,Trl;99999;0min;0;0;0;0;
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691694;686522;686530;3;Bik,Car,Ped,Trk;99999;0min;0;0;0;0;
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691694;686522;691694;4;Bik,Car,Ped,Trk;99999;0min;0;0;0;0;
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665038;665039;676253;3;Bik,Car,Ped,Trk;99999;0min;0;0;0;0;
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665040;665039;665040;4;Bik,Car,Ped,Trk;99999;0min;0;0;0;0;
665040;665039;676253;1;Bik,Car,Ped,Trk;99999;0min;0;0;0;0;
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662420;662419;672666;1;Bik,Car,Ped,Trk;99999;0min;0;0;0;0;
```
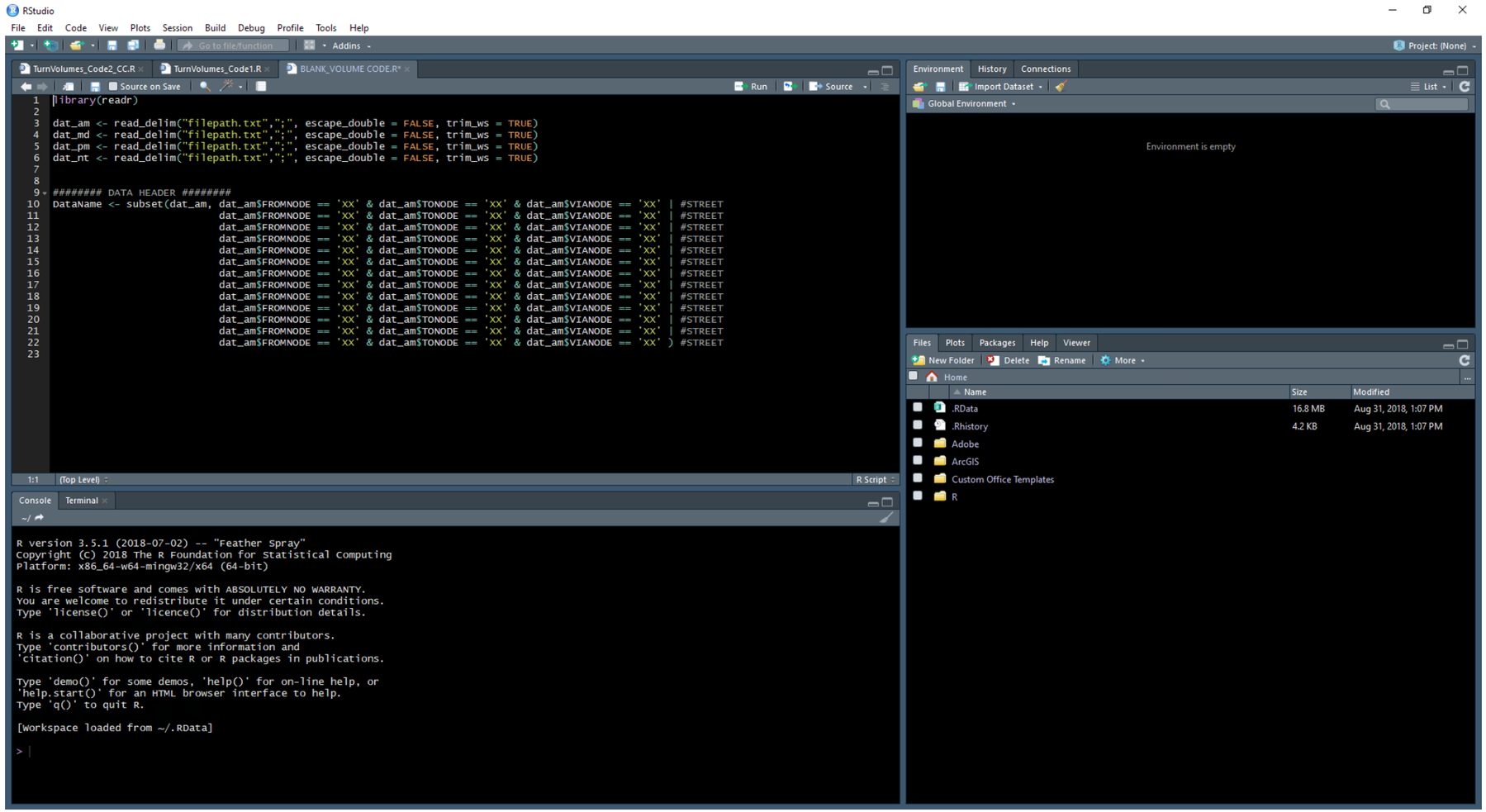
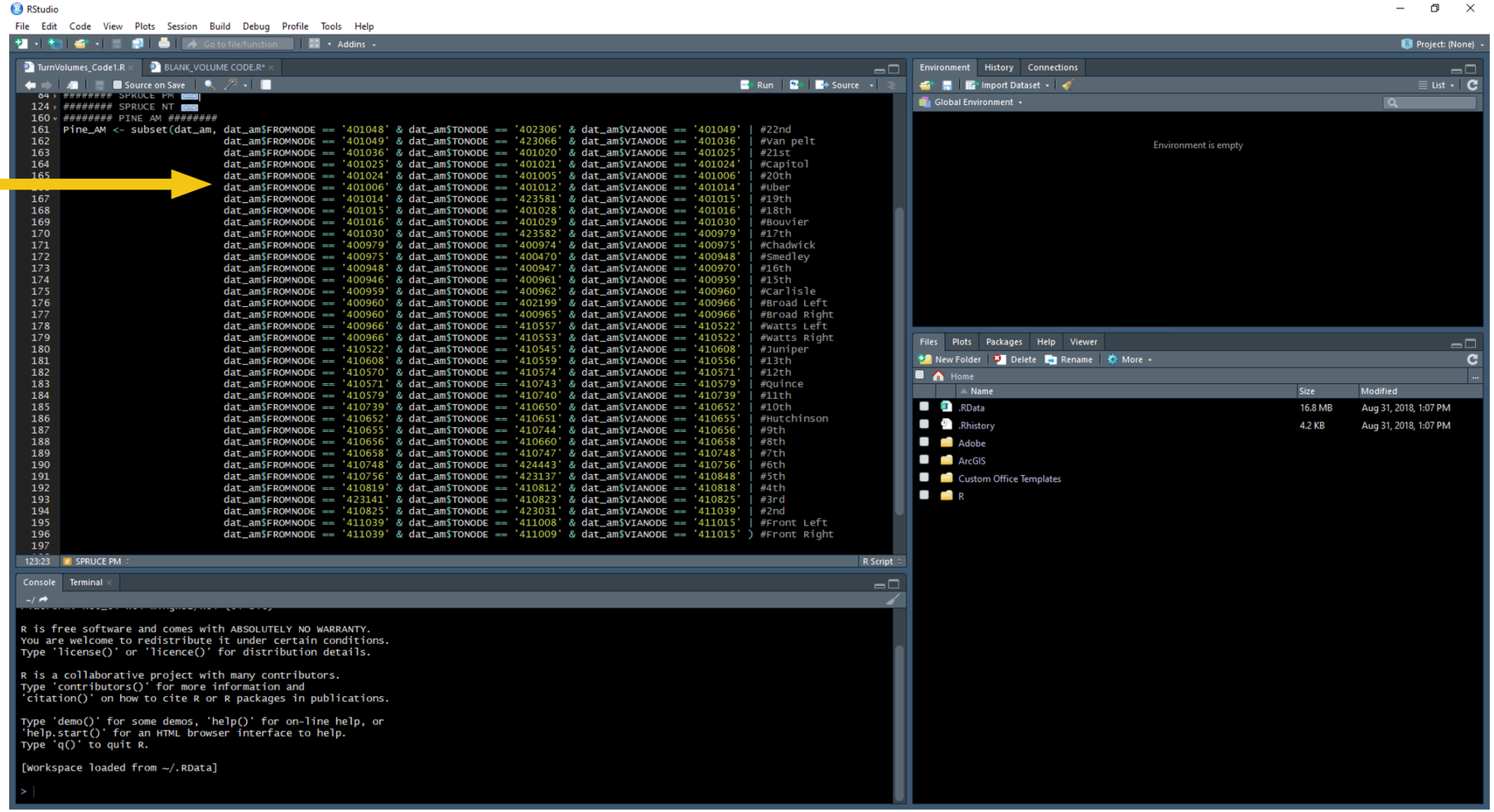

BASE CODE FOR ALL INTERSECTIONS

Seriously, I am so thankful for R all the time. ALL the time.

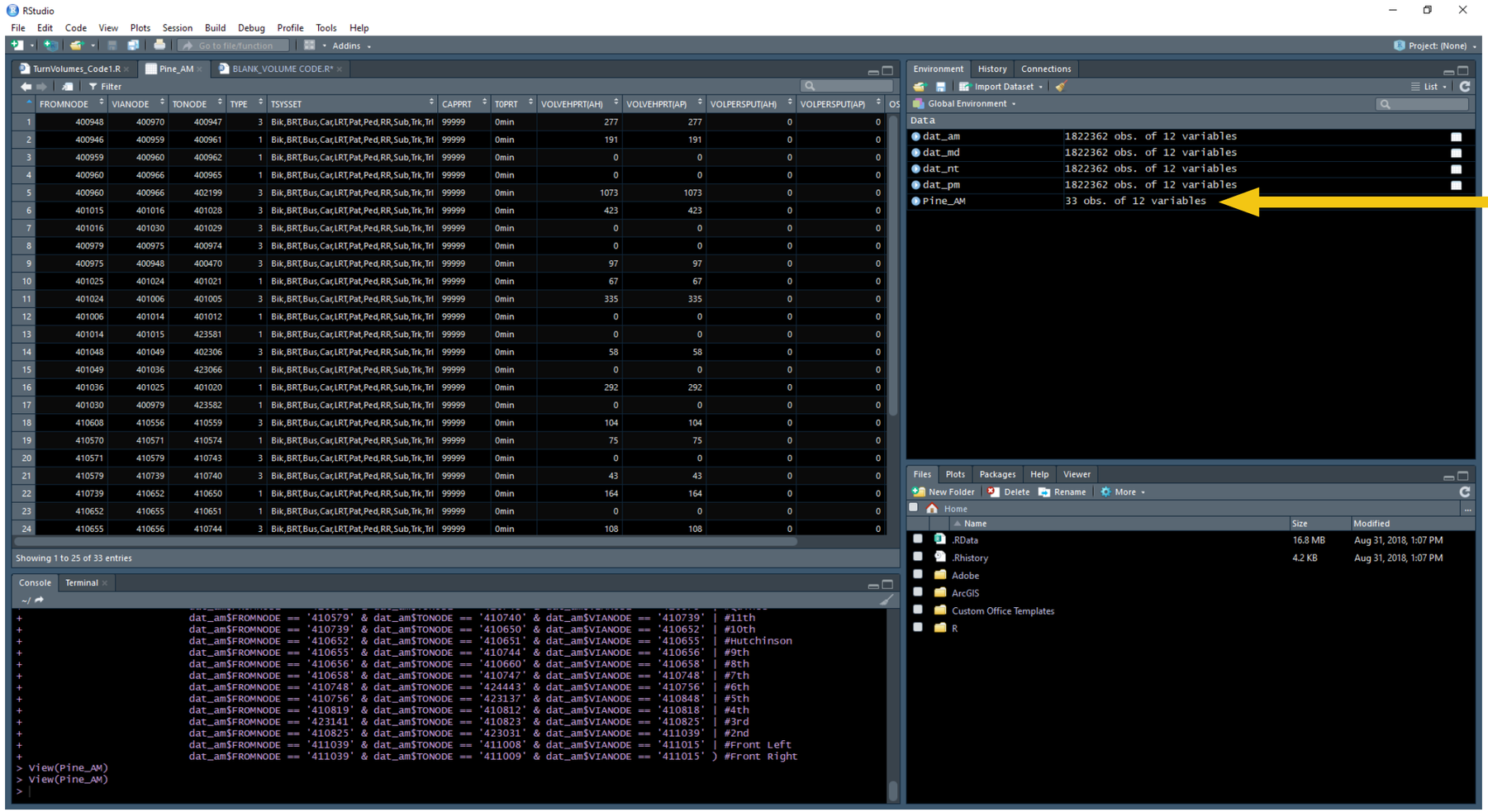


FULL CODE FOR ALL INTERSECTIONS

This code is still tedious, even with the help of R. I have the From, To, and Via nodes for every ntersection under analysis. I'll use that to create a subset of the full table so I'm only looking at the turns I want.



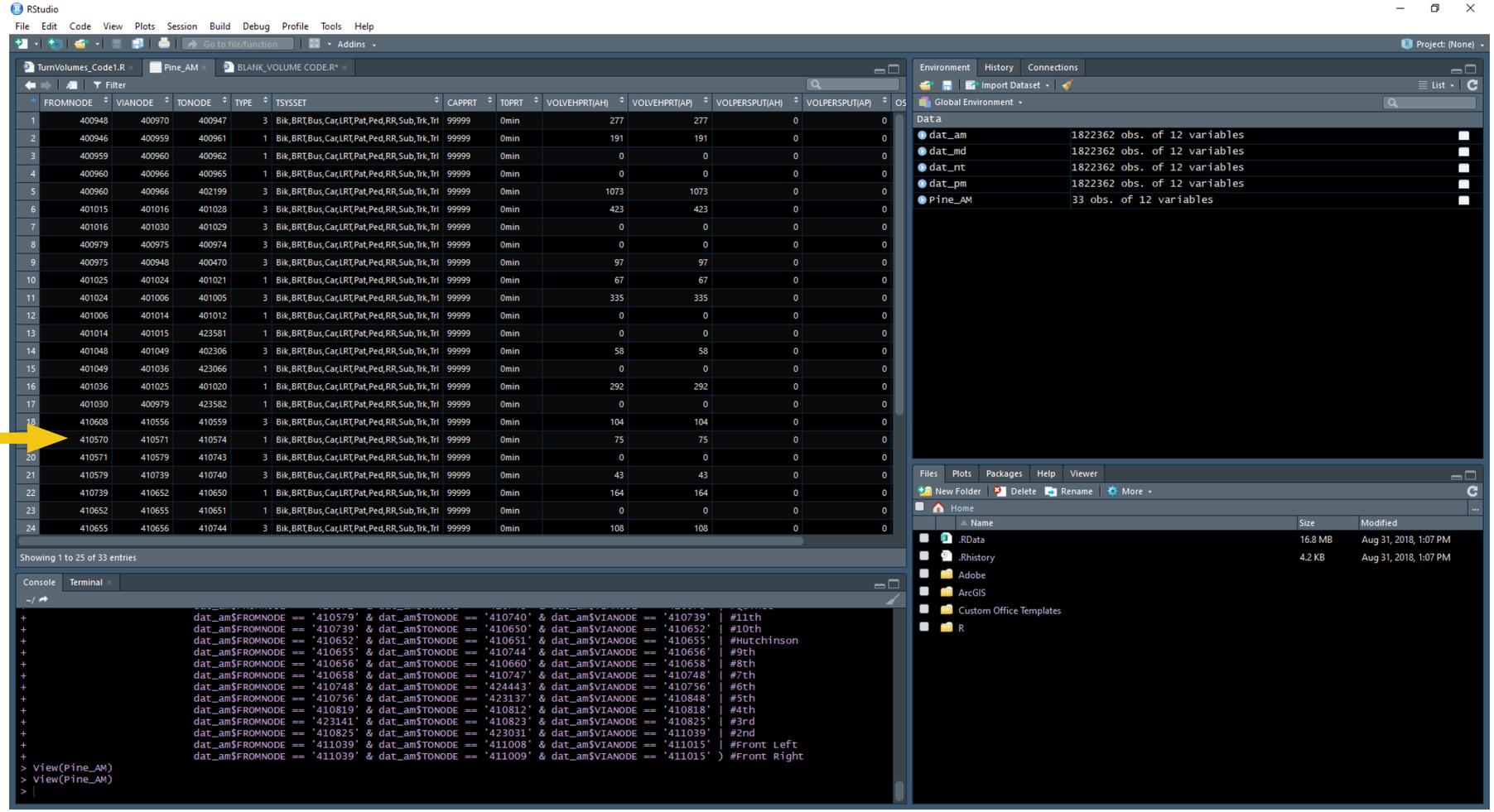
LOOKING AT THE DATA



But now I have subset called Pine_AM. It has 33 observations of 12 variables, which is much more manageable than the full data, which has 1,822,362 observations of 12 variables.

LOOKING AT THE DATA

Because I know the FromNode, ViaNode, and ToNode for the intersection of 5th Street and Pine Street I can find it in my Pine_AM data and see what the model's turn counts are.



CALCULATING PEAK-HOUR NUMBERS

AM VERSION FILE = 6:00am to 10:00am
MD VERSION FILE = 10:00am to 3:00pm
PM VERSION FILE = 3:00pm to 7:00pm
NT VERSION FILE = 7:00pm to 6:00am

CALCULATING PEAK-HOUR NUMBERS

Factored AM Peak Hour Volumes = $(P_n * V_{am}) + (V_{am})$
Factored PM Peak Hour Volumes = $(P_n * V_{pm}) + (V_{pm})$

where

V_{am} = AM turn volumes for a given location in Visum
V_{pm} = PM turn volumes for a given location in Visum

and

P_n corresponds to the appropriate option provided by the DVRPC:

Pine & 5th factors
P_1 = AM peak = 32%
P_2 = PM peak = 28%

Pine & 13th factors
P_3 = AM peak = 32%
P_4 = PM peak = 28%

BUT CAN IT BE TRUSTED?

EXPECTED RESULT

5th Street and 13th Street should have higher left-turn volumes than other streets

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5th Street and 13th Street should have higher left-turn volumes than other streets

ACTUAL RESULT

5th Street and 13th Street aren't in the top 5 left-turn locations according to Visum

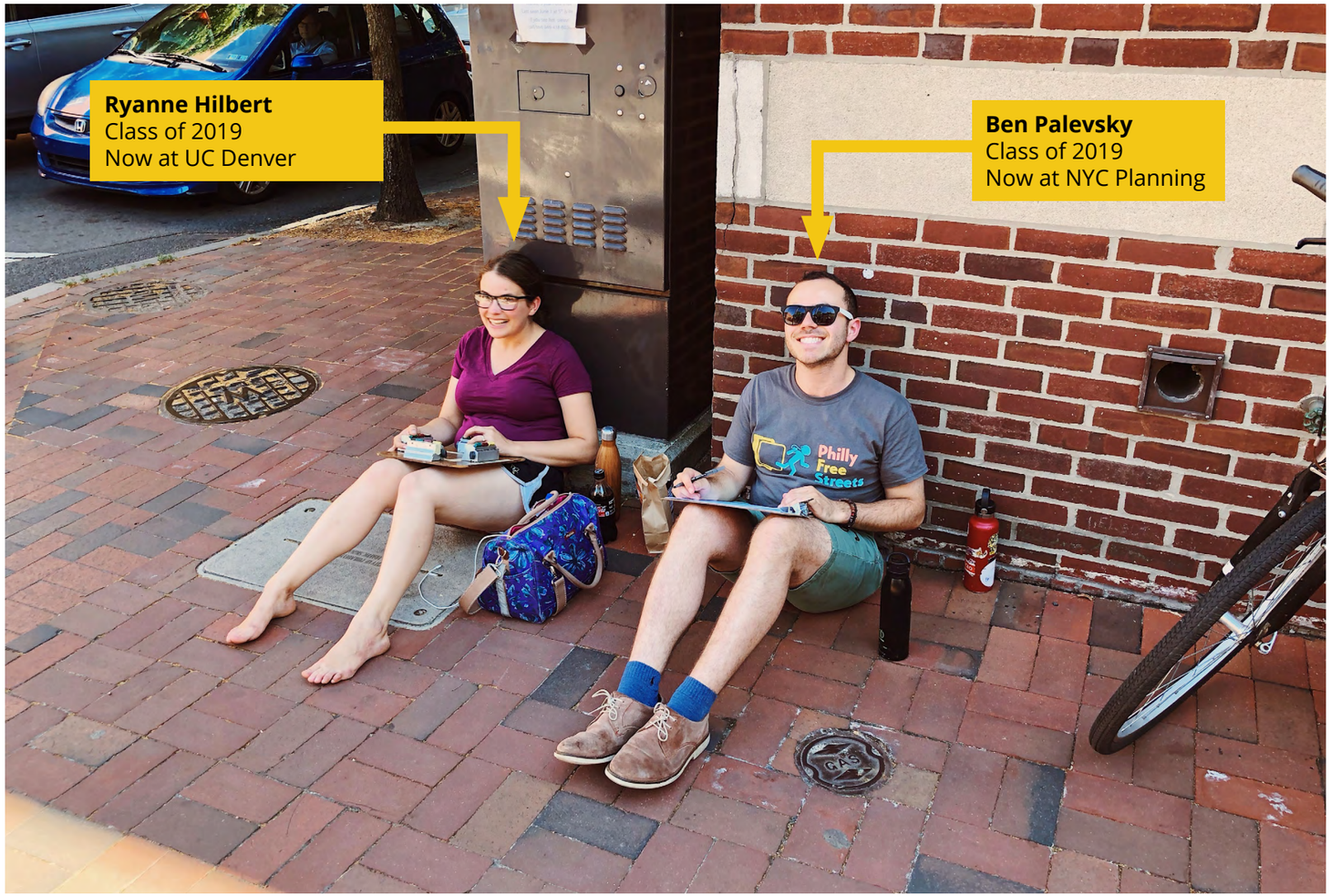
BUT CAN IT BE TRUSTED?

5th Street and 13th S… …es than other streets

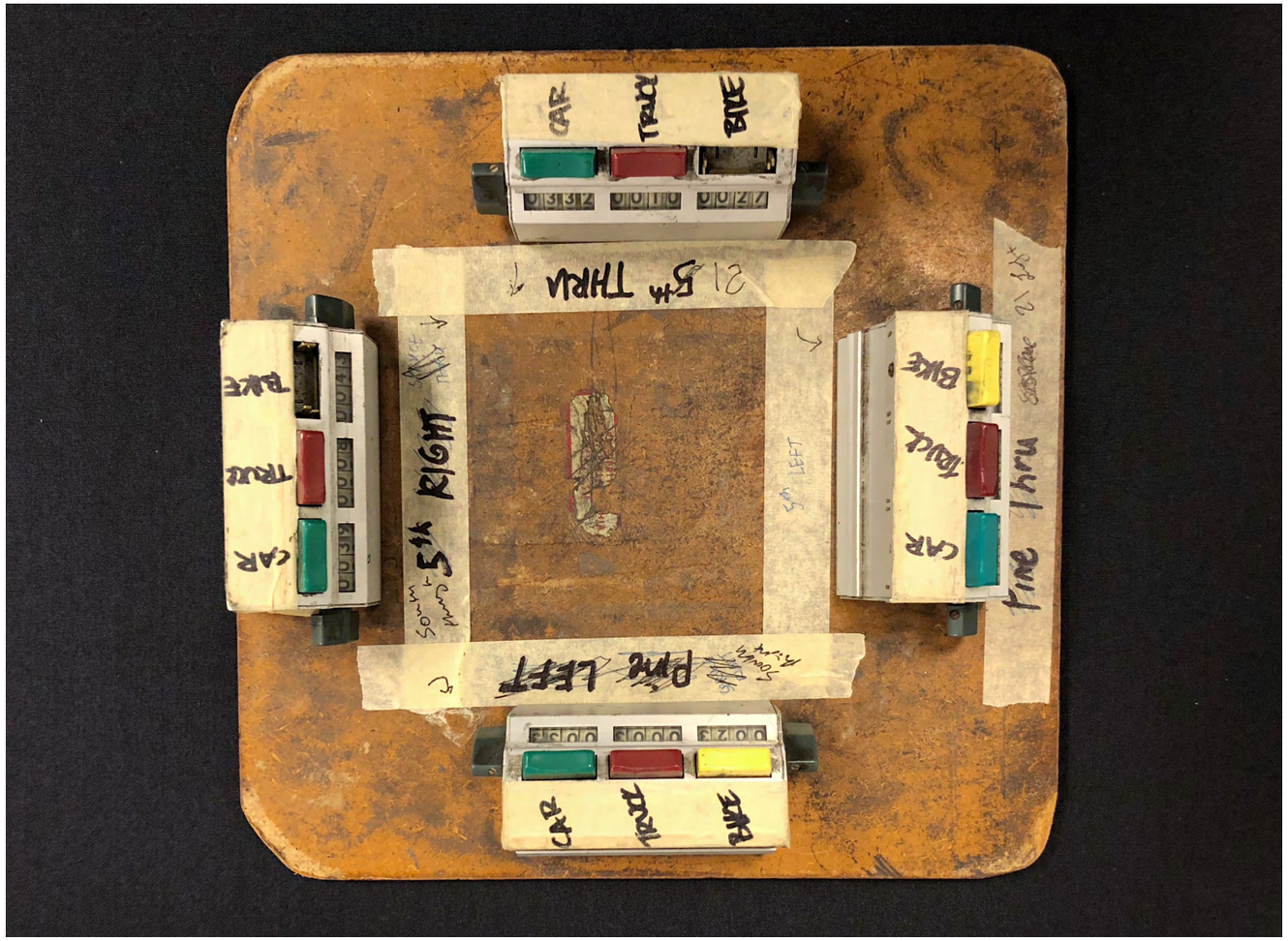
5th Street and 13th… …according to Visum

SO WHAT NOW?

MANUAL COUNTS!



USING THE MOST CUTTING-EDGE TECHNOLOGY



USING THE MOST CUTTING-EDGE TECHNOLOGY

INTERSECTION STREETS: North-South Street 5th Street & East-West Street ~~Pine Street~~ Spruce

DATE: 7/30/18
DAY: Monday
WEATHER: Cloudy, 77°
TAKEN BY: C. Ross, B Palensky

FILE NUMBER:

BUSES:
Spruce Through:
Spruce Right:

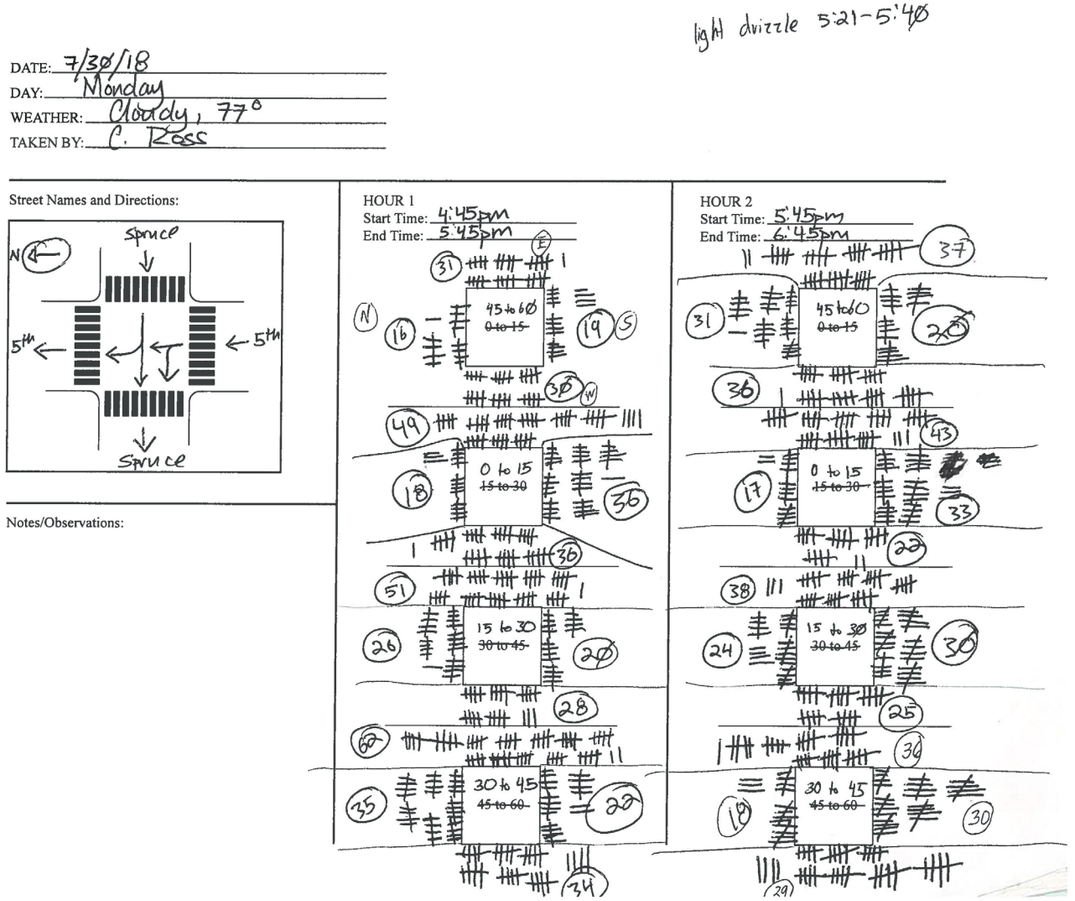
AM INTERVAL COUNTS

5th Street Northbound & ~~Pine~~ Spruce Street Eastbound

STARTING TIME		5th Street Northbound L	Through	TOTAL
4:45pm - 5:00pm	Cars	8	91	
	Trucks	1	13	
	Bikes	1	6	
5:00pm - 5:15pm	Cars	17	183	
	Trucks	1	23	
	Bikes	5	11	
5:15pm - 5:30pm	Cars	25	293	
	Trucks	1	34	
	Bikes	7	17	
5:30pm - 5:45pm	Cars	37	403	
	Trucks	2	37	
	Bikes	8	25	
5:45pm - 6:00pm	Cars	48	504	
	Trucks	2	43	
	Bikes	11	29	
6:00pm - 6:15pm	Cars	66	607	
	Trucks	2	46	
	Bikes	16	33	
6:15pm - 6:30pm	Cars	91	698	
	Trucks	3	55	
	Bikes	21	40	
6:30pm - 6:45pm	Cars	101	806	
	Trucks	3	62	
	Bikes	22	44	

	Spruce Street Eastbound R	Through	TOTAL
Cars	15	68	
Trucks	1	12	
Bikes	Ø	6	
Cars	26	136	
Trucks	1	17	
Bikes	Ø	21	
Cars	37	198	
Trucks	2	25	
Bikes	Ø	36	
Cars	5Ø	283	
Trucks	4	30	
Bikes	Ø	41	
Cars	64	350	
Trucks	5	40	
Bikes	Ø	46	
Cars	79	431	
Trucks	5	41	
Bikes	1	58	
Cars	98	502	
Trucks	5	46	
Bikes	1	65	
Cars	112	581	
Trucks	5	48	
Bikes	1	8Ø	

USING THE MOST CUTTING-EDGE TECHNOLOGY



COMPARING THE NUMBERS

PINE & 5TH
AM PEAK LEFT-TURNS
FROM VISUM

PINE & 5TH
AM PEAK LEFT-TURNS
FROM COUNTS

COMPARING THE NUMBERS

PINE & 5TH
AM PEAK LEFT-TURNS
FACTORED FROM VISUM

99 VEHICLES

PINE & 5TH
AM PEAK LEFT-TURNS
FROM COUNTS

COMPARING THE NUMBERS

PINE & 5TH
AM PEAK LEFT-TURNS
FACTORED FROM VISUM

99 VEHICLES

PINE & 5TH
AM PEAK LEFT-TURNS
FROM COUNTS

247 VEHICLES

MODELING THE INTERSECTION IN SYNCHRO

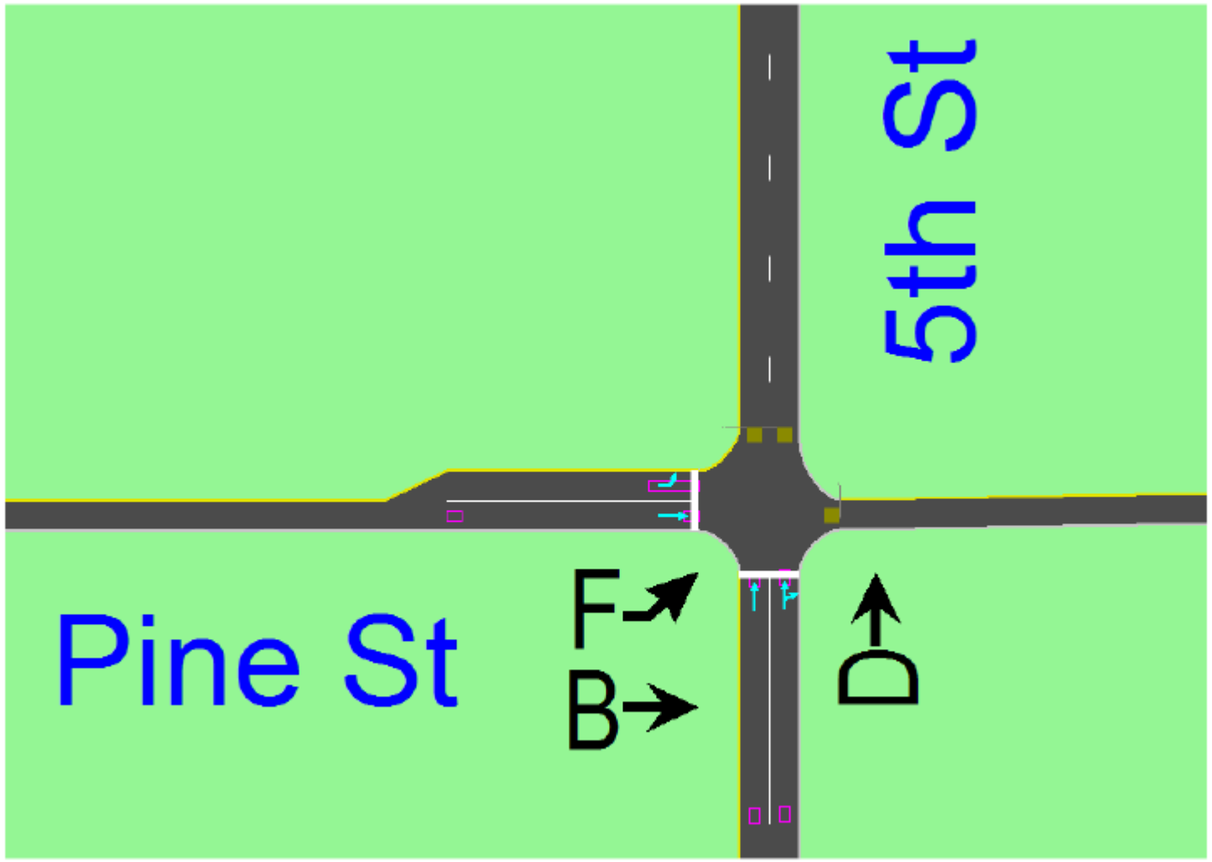


Figure 1: AM Level of Service under existing conditions

Using the count numbers obtained in the field and plugging them into Synchro, we find that the existing left-turn movement operates at an AM peak volume capacity ratio of 1.28 (LOS F), while the through movement maintains LOS B.

MODELING THE INTERSECTION IN SYNCHRO

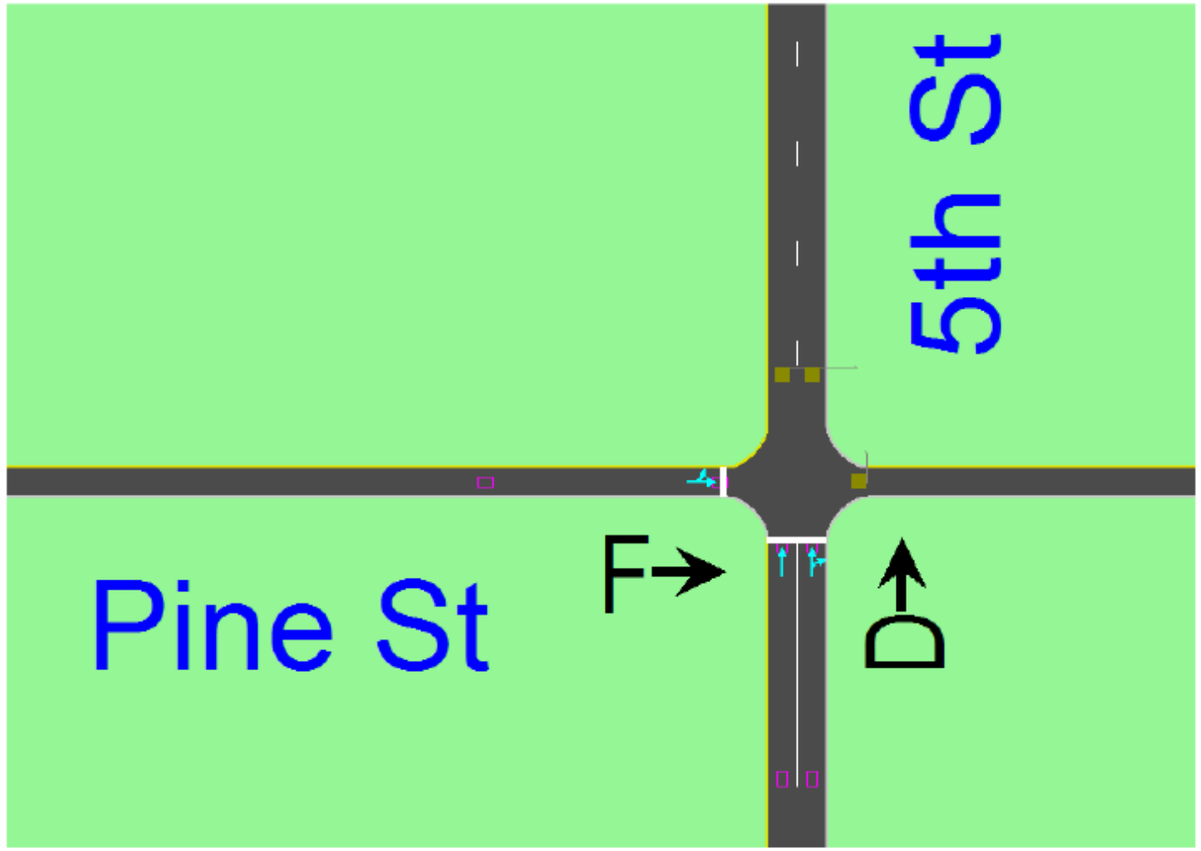
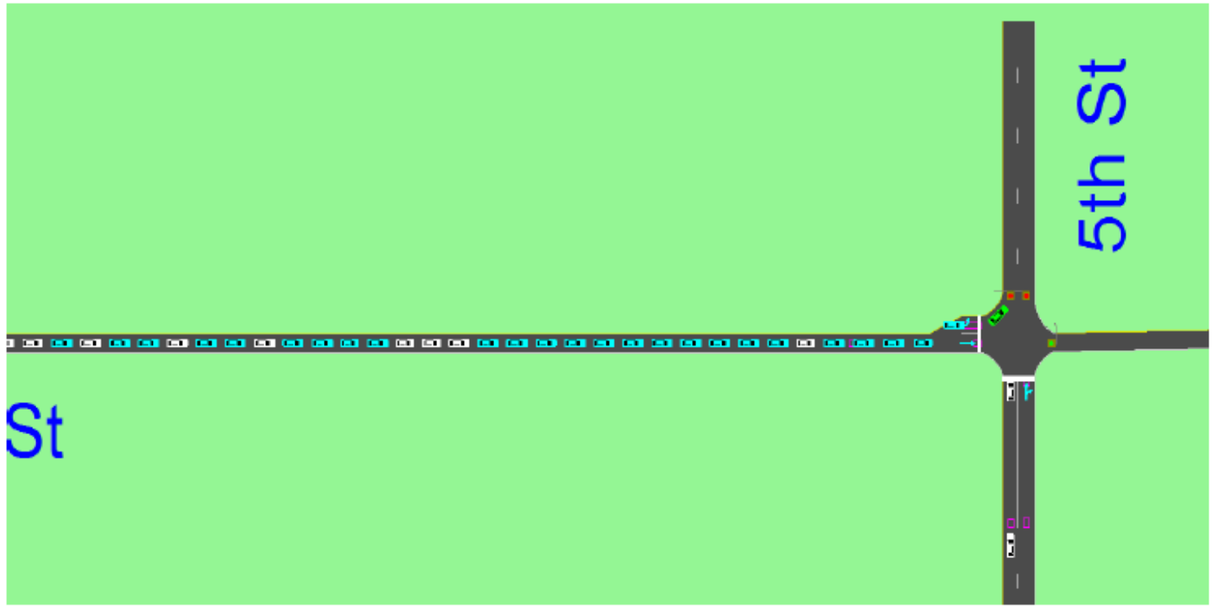


Figure 2: AM Level of Service with EB Lt lane removed.

Using the count numbers obtained in the field and plugging them into Synchro, we find that removing the left-turn lane would bring the remaining lane - which would be used by both turning vehicles and through vehicles - down to LOS F during the AM peak, with a volume to capacity ratio of 1.91.

PM peak has lower volumes and functions with acceptable LOS with and without a left-turn lane.

MODELING THE INTERSECTION IN SYNCHRO



Even if you assume that through traffic will somehow be able to squeeze around turning cars at the intersection, removing the left-turn lane results in a queue that is 1,579’ long.

To put that into perspective, the average block in this part of Center City is only 450’ long, so we are taking about a backup of cars over 3 blocks long.

MODELING THE INTERSECTION IN SYNCHRO

Conclusion:

KEEP THE LEFT-TURN LANE

WHAT THE MODEL DOESN'T ALWAYS CAPTURE

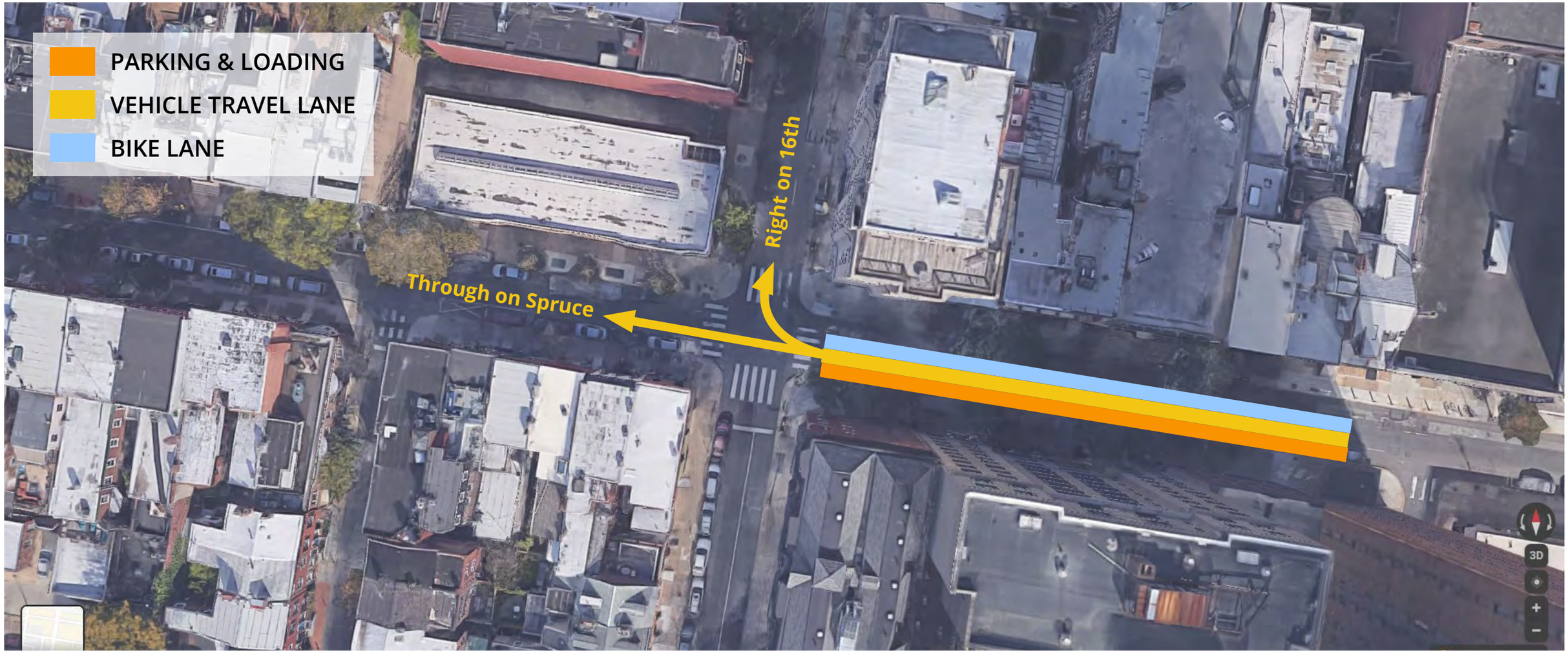
16TH & SPRUCE

16TH & SPRUCE: BEFORE

16TH & SPRUCE: BEFORE

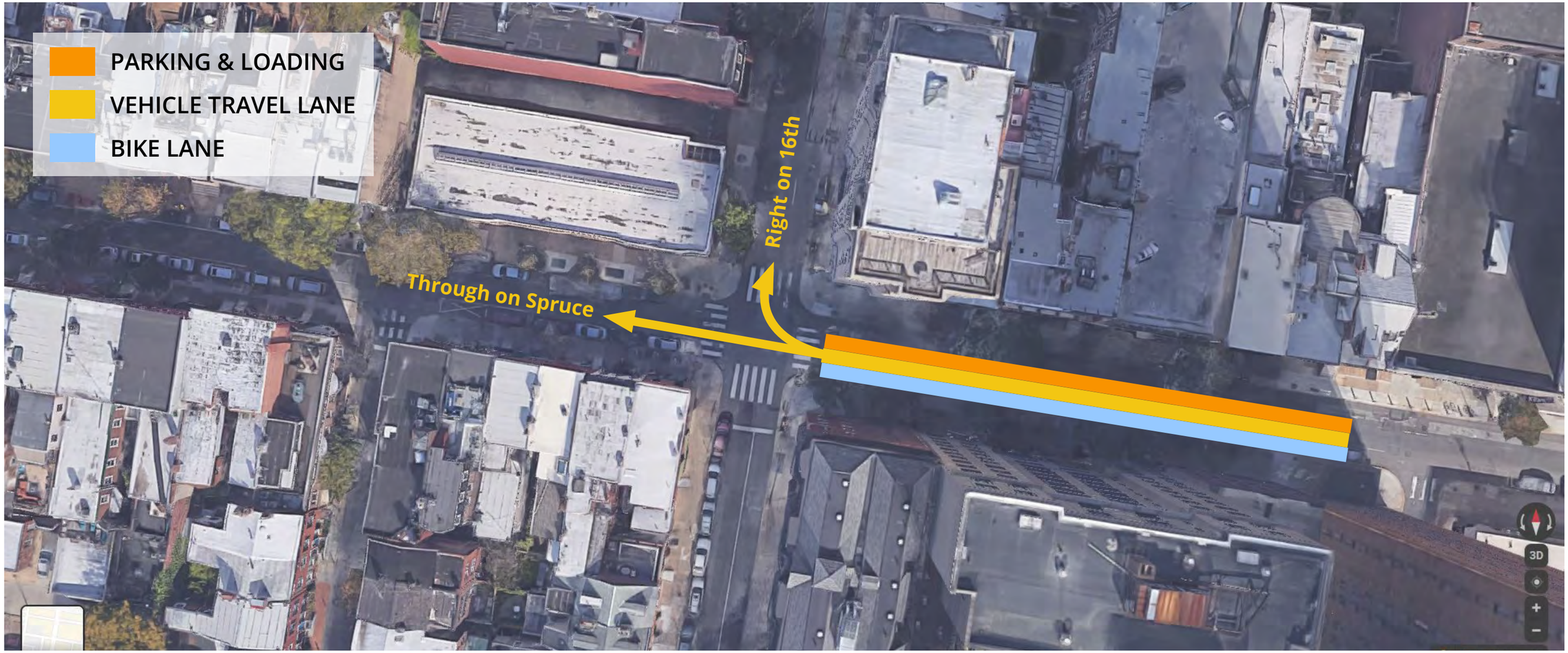
16TH & SPRUCE: BEFORE

16TH & SPRUCE MOVEMENTS

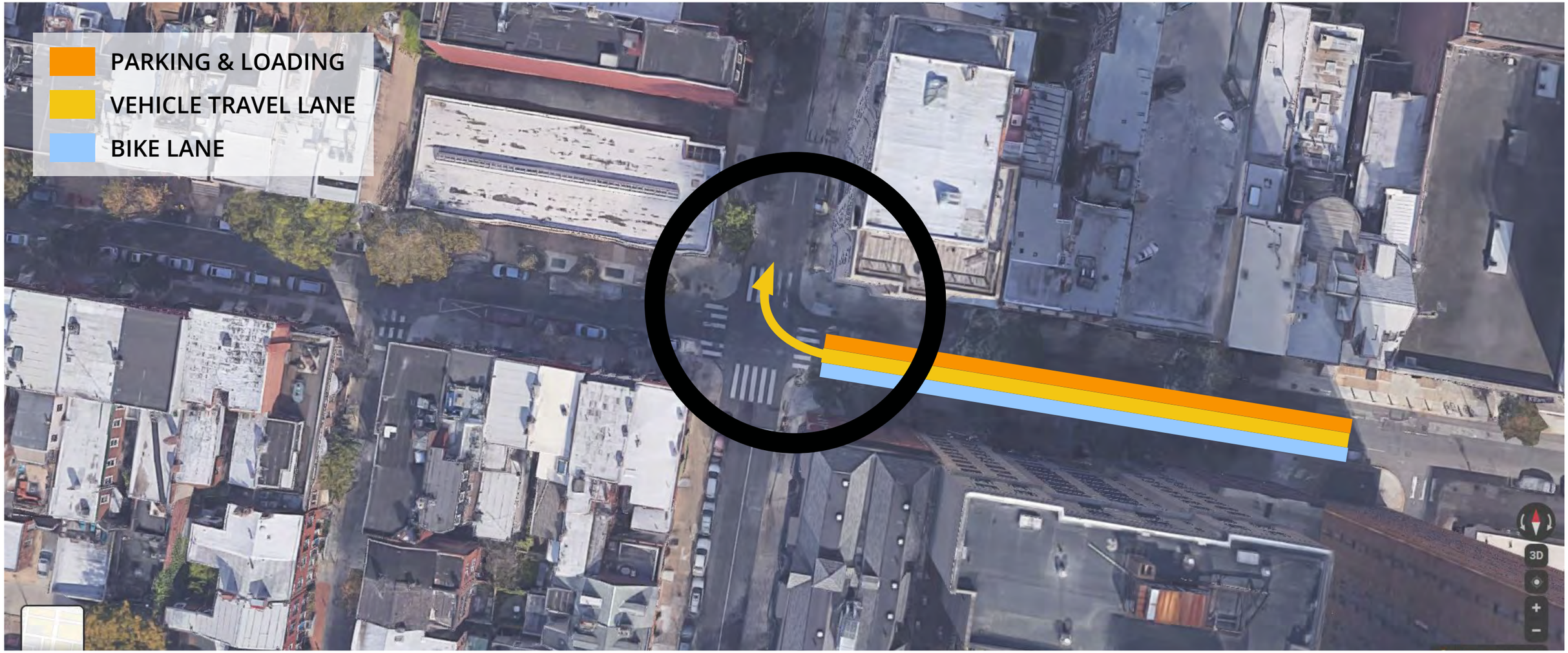


16TH & SPRUCE: AFTER

16TH & SPRUCE MOVEMENTS



A RIGHT-TURN LANE ISN'T NEEDED



UNBEKNOWN TO THE MODEL...

UNBEKNOWN TO THE MODEL...

UNBEKNOWN TO THE MODEL...

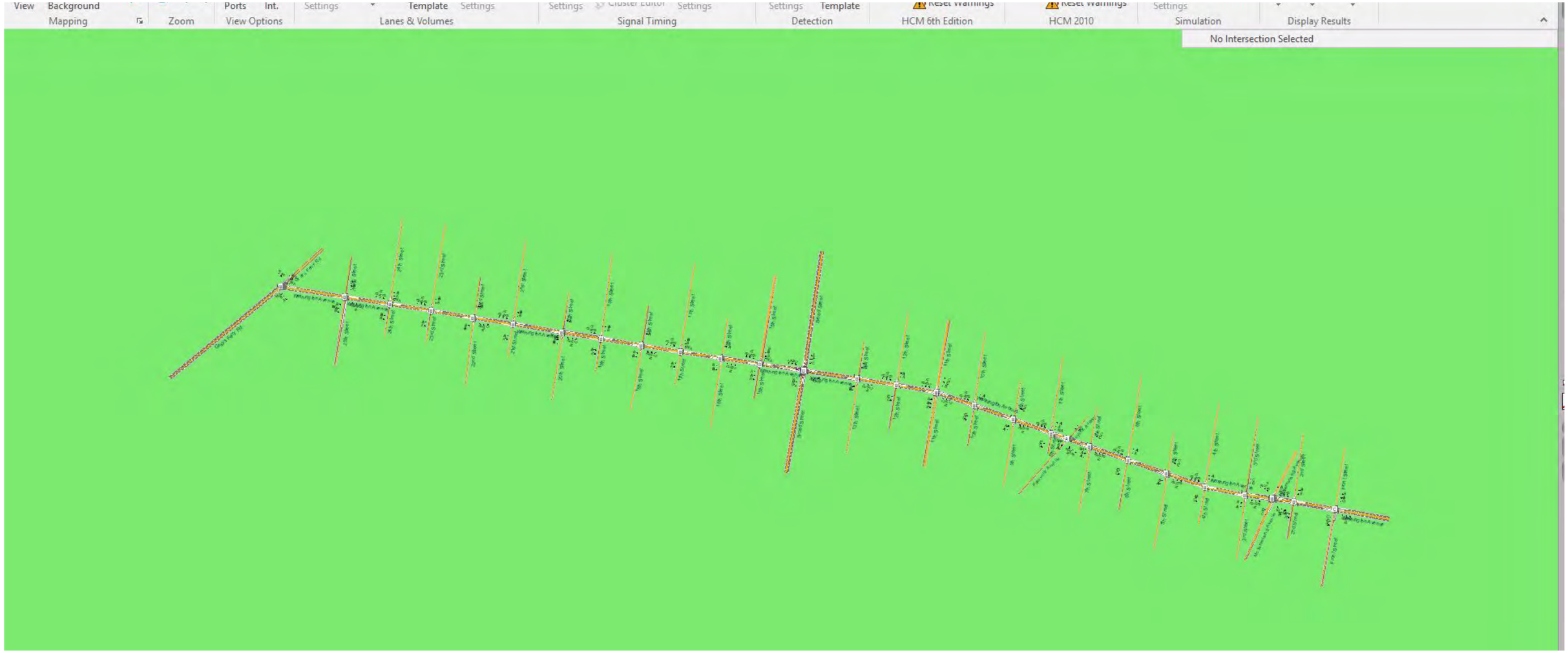
UNBEKNOWN TO THE MODEL...

UNBEKNOWN TO THE MODEL...

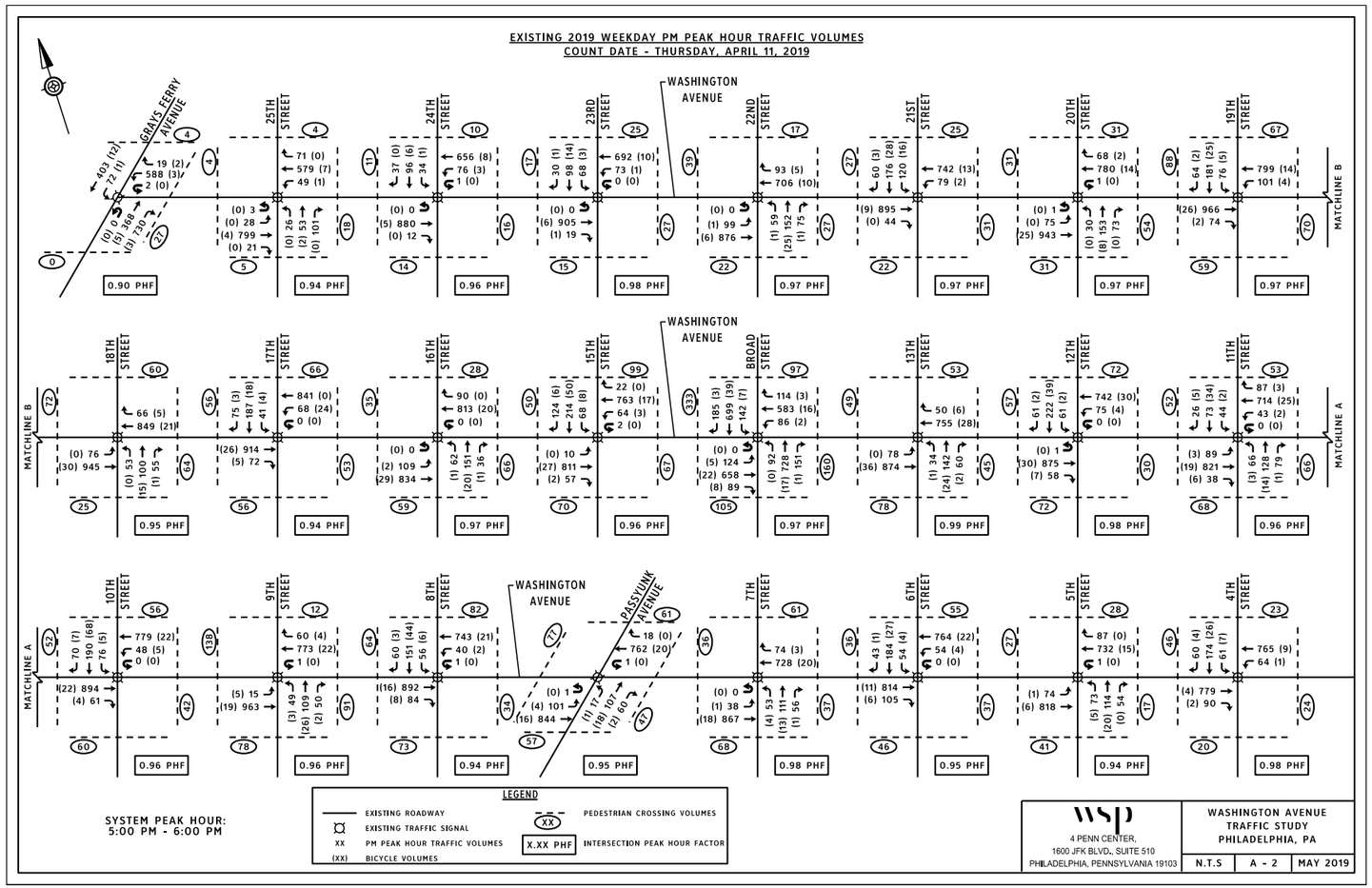
RETROACTIVE ADJUSTMENTS TO THE STREET

RETROACTIVE ADJUSTMENTS TO THE STREET

A MORE COMPLETE MICRO MODEL



WHAT DOES IT TAKE TO CREATE THAT?



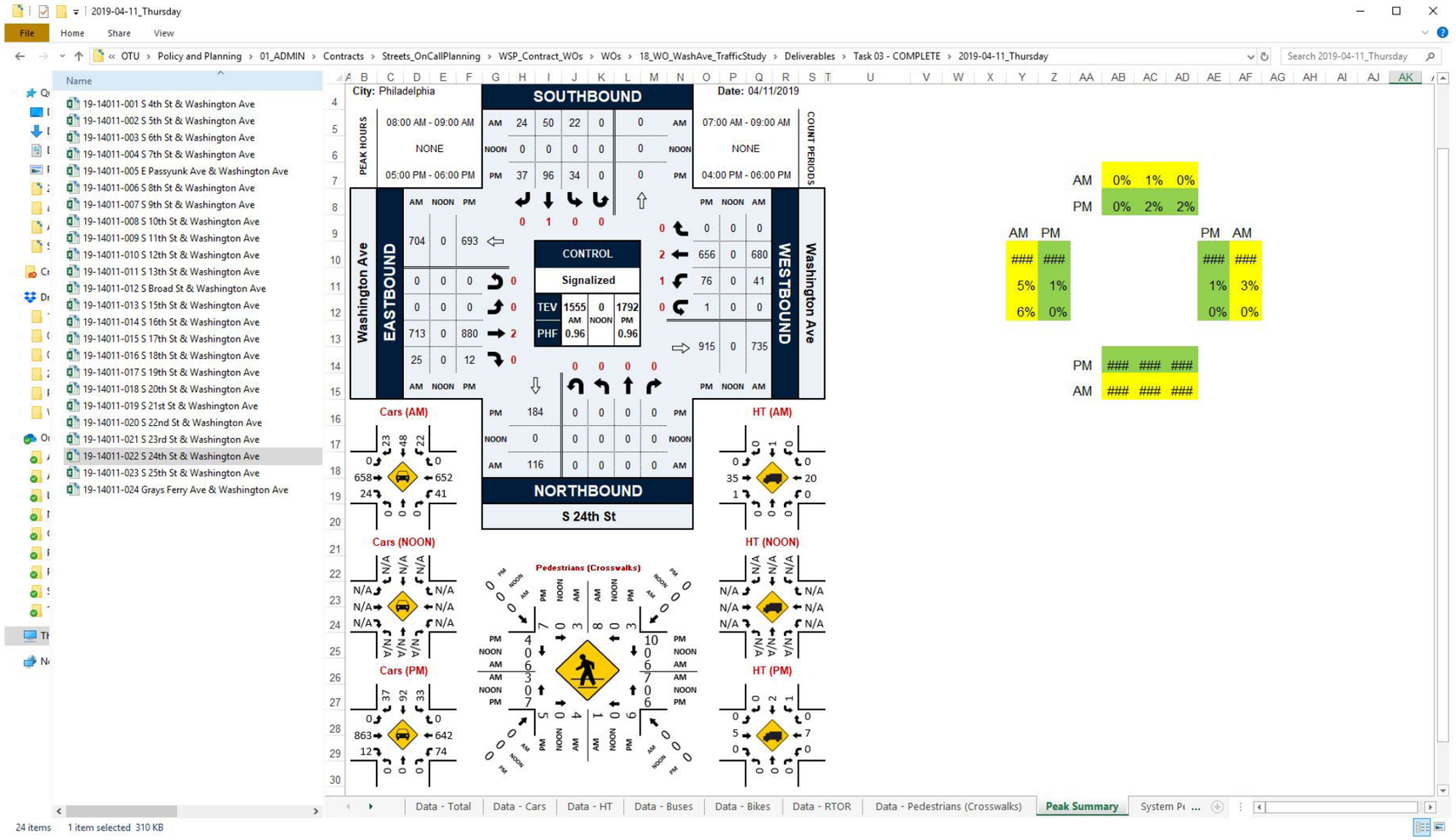
At left:

2019 Weekday PM Peak Hour Traffic Volumes
Washington Avenue, Grays Ferry to 4th Street

Also needed:

2019 Weekday AM Peak Hour Traffic Volumes
2019 Weekend Peak Hour Traffic Volumes

WHAT DOES IT TAKE TO CREATE THAT?



The existing Weekday AM Peak, Weekday PM Peak, and Weekend Peak traffic counts **must be input into the micro model** for each intersection.

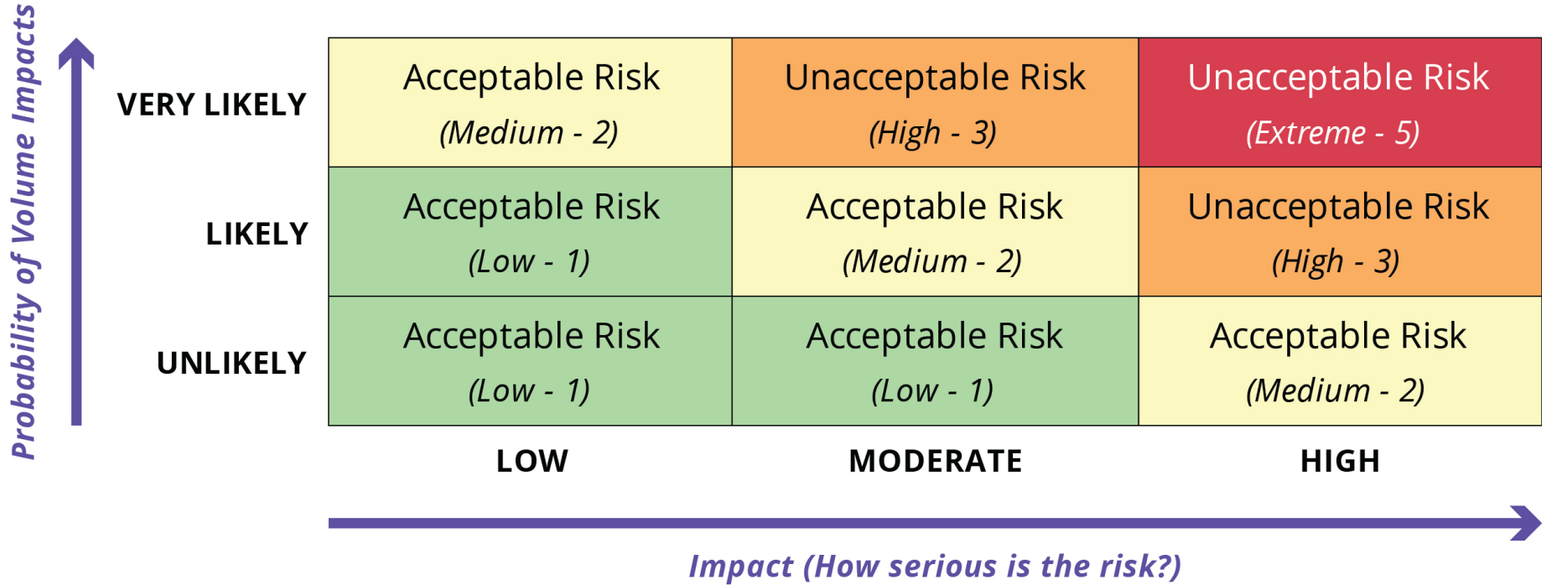
The model must be calibrated to reflect existing travel times, existing delay, and existing roadway uses.

Once the model is calibrated, you can make changes to see **how your design is likely to impact peak-hour traffic**.

RISKS OF TRAFFIC VOLUME PROJECTIONS

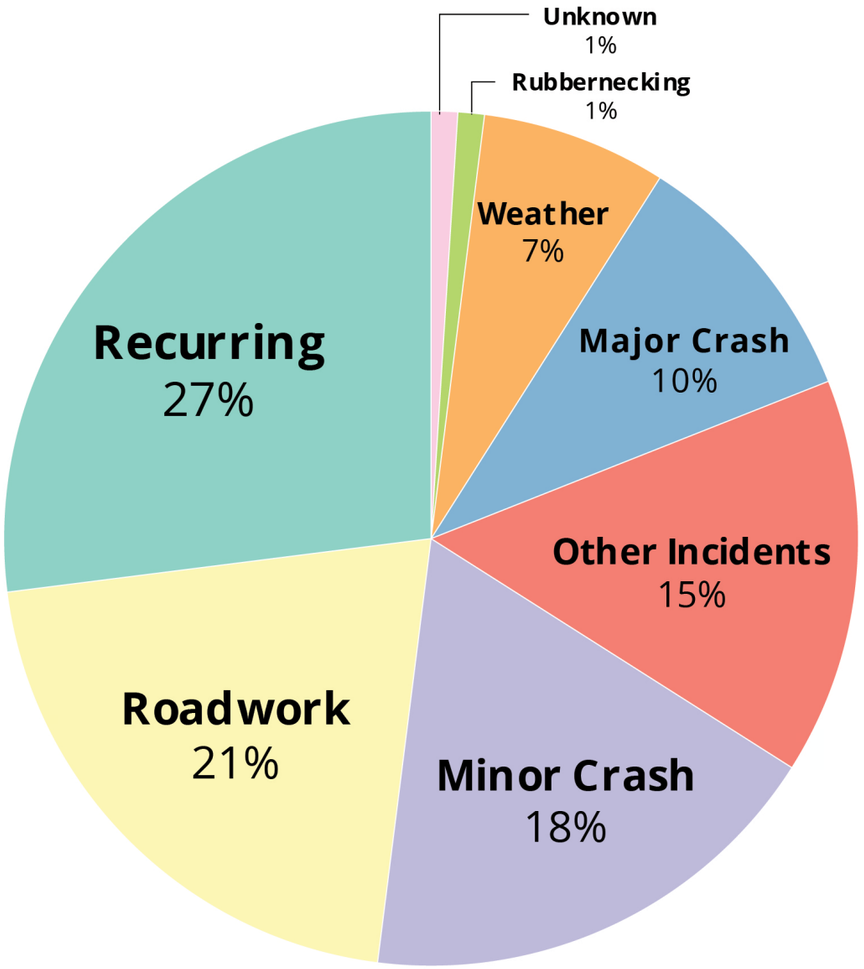
QUESTIONS TO ASK YOURSELF:

What is the probability that the volumes I'm using are not "normal"?
What is the impact of using bad volumes for analysis?



Source: *"What a Transportation Professional Needs to Know About Counts and Studies During a Pandemic," ITE Webinar, 2020.*

CONGESTION PIE CHART (2019 DATA)



WHAT ARE YOU DESIGNING FOR?
WHAT ARE YOUR METRICS OF SUCCESS?

Source: *"Rethinking Traffic Analysis Post-COVID 19," Steve Gault (PennDOT), 2021 MASITE Annual Meeting*

SO WHAT DOES THIS MEAN FOR YOU?

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"No models are good but some models are useful."

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Always look at your data in context.

SO WHAT DOES THIS MEAN FOR YOU?

"No models are good but some models are useful."

Always look at your data in context.

When in doubt: **verify in the field.**

THANK YOU // QUESTIONS

Casey C. Ross

Presented virtually for the University of Pennsylvania Weitzman School of Design
Wednesday, October 6th, 2021