Traffic impact of Greenfield Bridge closures (PM peak)
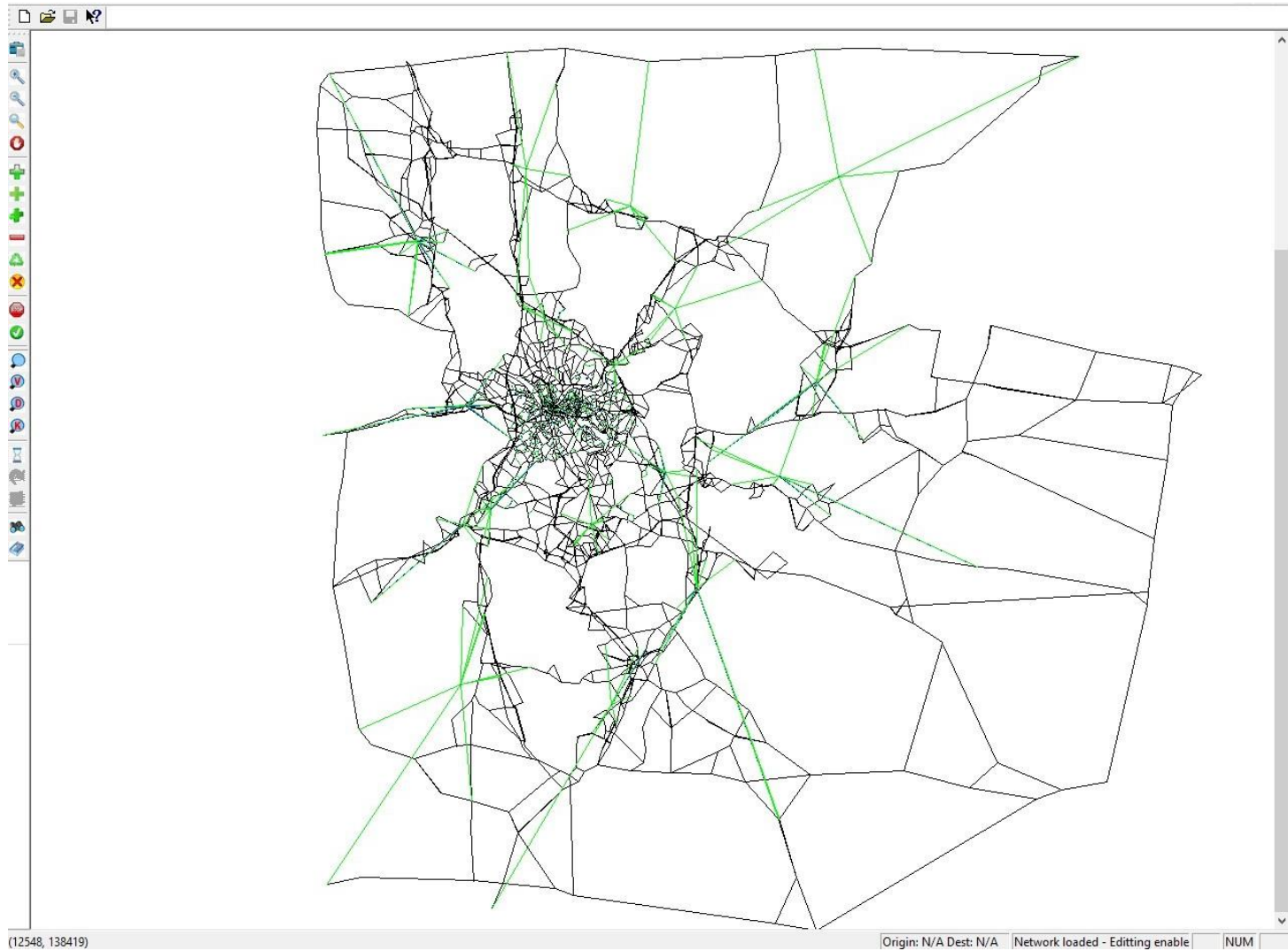
Prepared by:
Wei Ma, Sean Qian
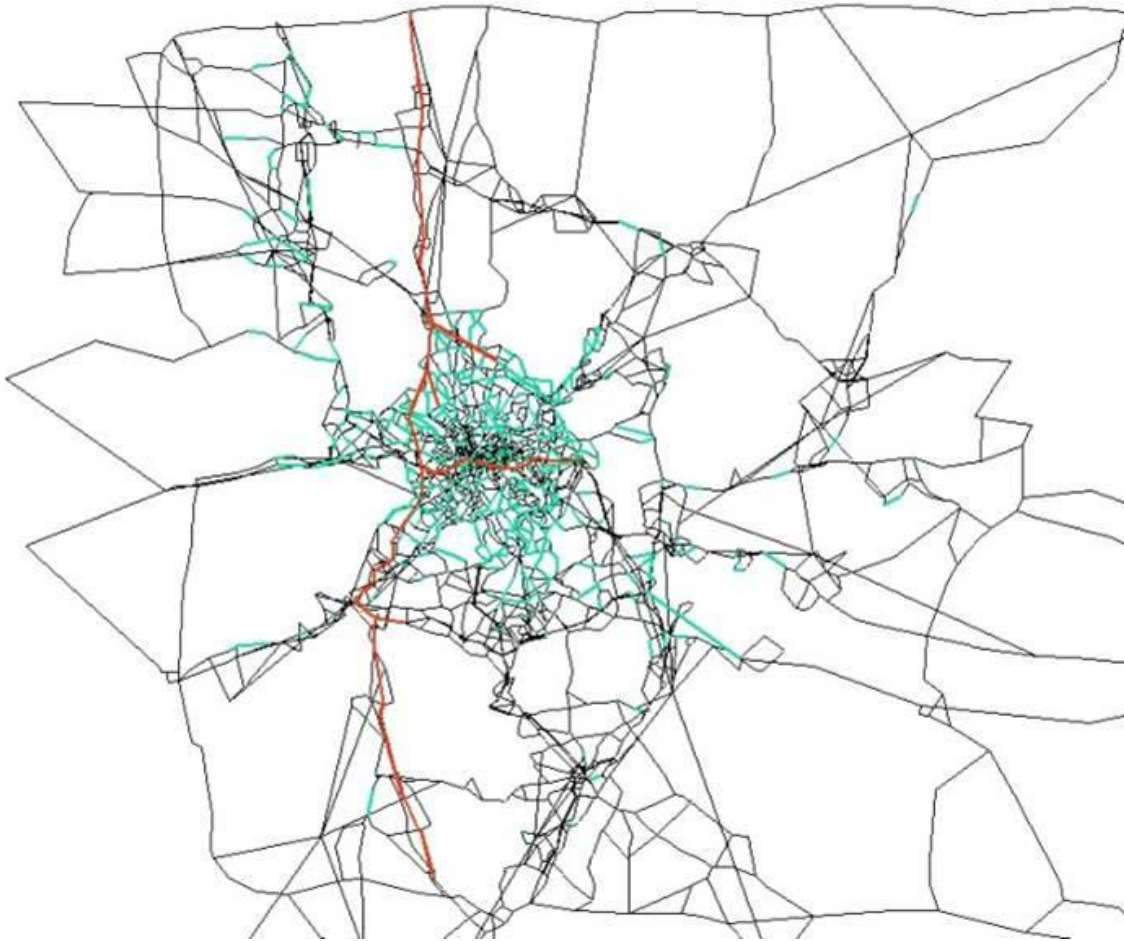Mobility Data Analytics Center (MAC)
Carnegie Mellon University
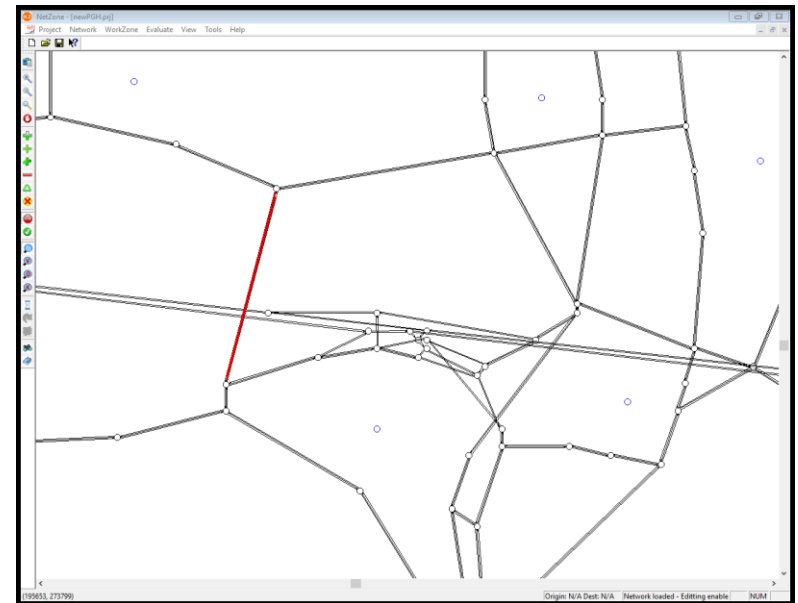
Scope

Data coverage
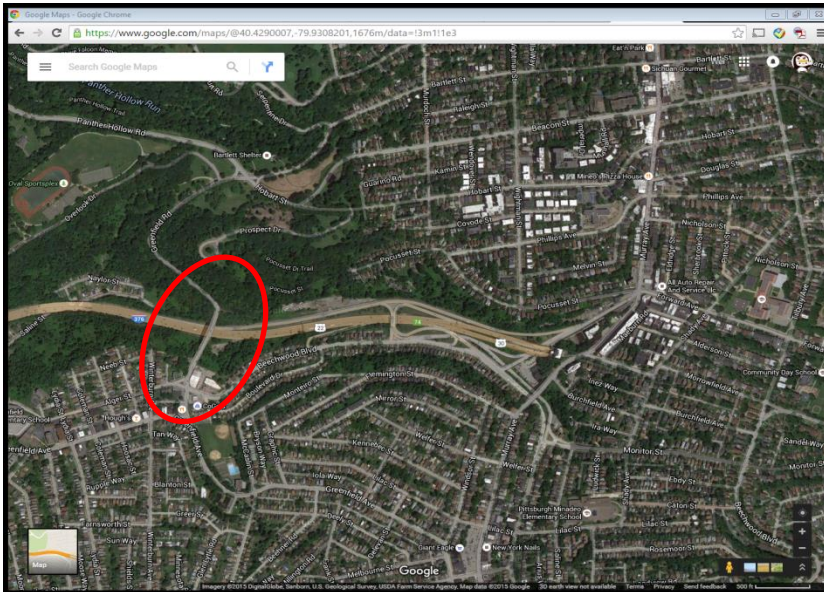

Red: travel speed
(from INRIX and HERE)
Blue: hourly counts
(from SPC and PennDOT)

The Greenfield Bridge

Modeling details

- Scope: SPC region, ten counties, all main roads
- Simulated 0.86 million trips
- Time-of-day period: 2:00-8:00 PM
- Temporal resolution: 5 seconds
- Validated by PennDOT hourly counts data and INRIX and HERE 5-min travel time data

Overall simulation profile
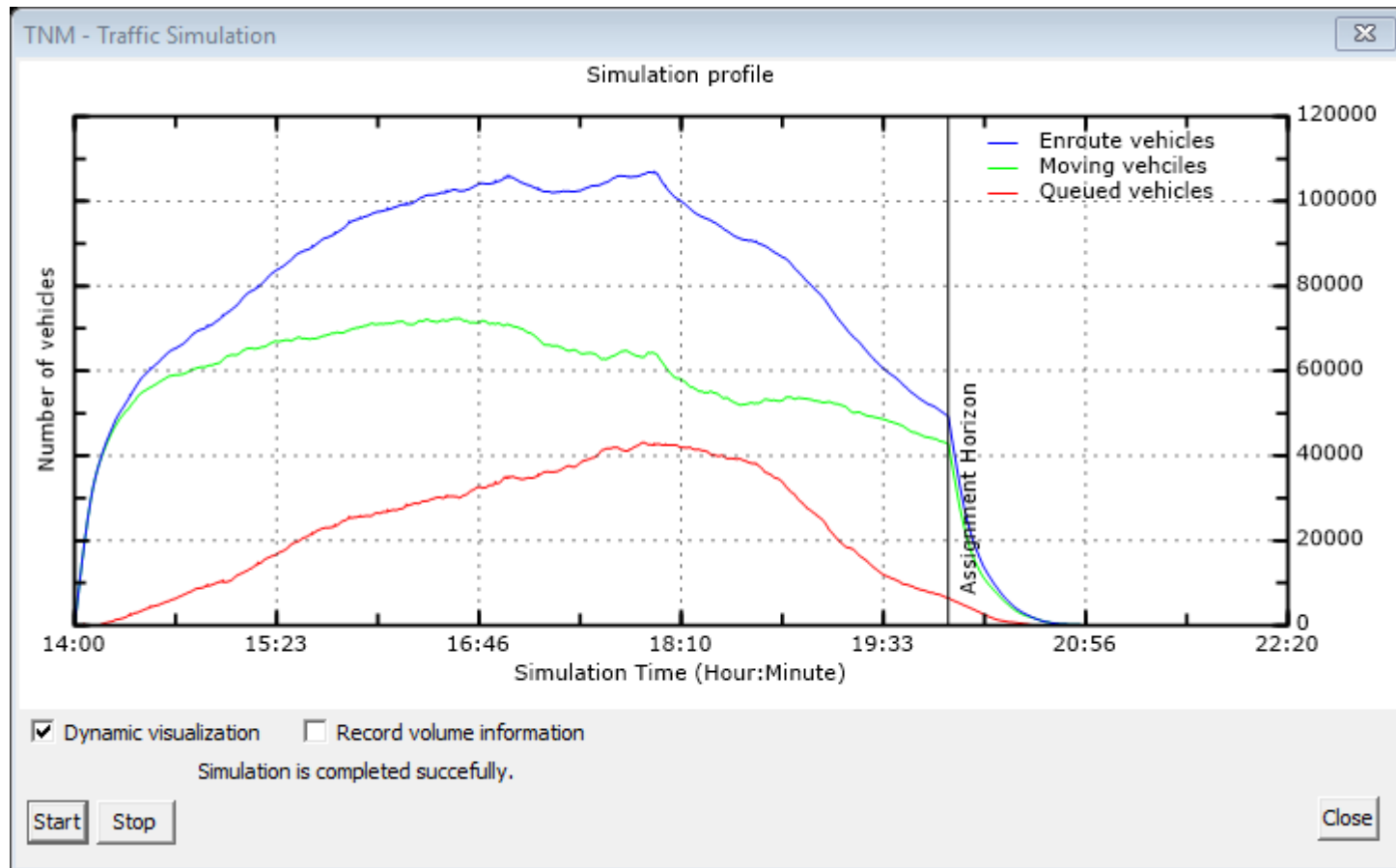
Goodness of Fit

- All sensor counts: $R^2 = 0.47$

- All link speed: $R^2 = 0.90$

- Near Greenfield bridge counts: $R^2 = 0.68$
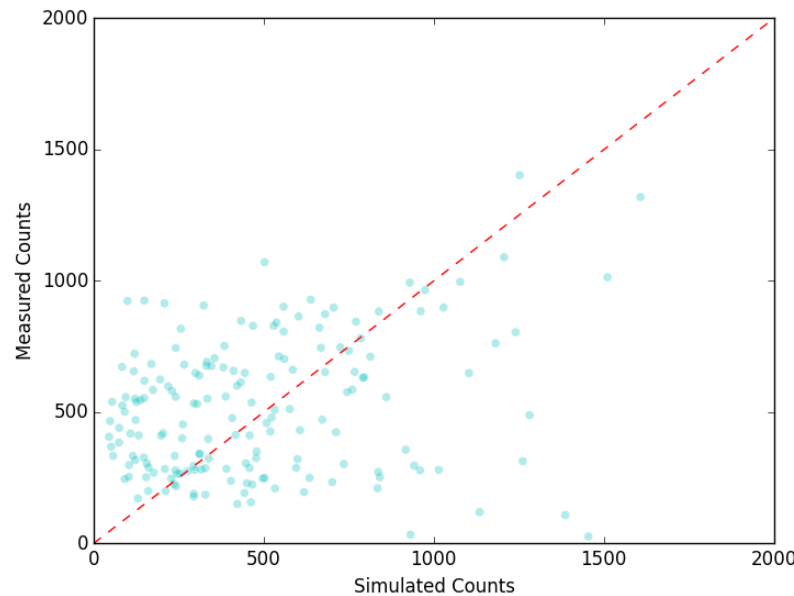
Greenfield Bridge: simulated counts match observations

S to N

N to S

Changes in network performance, fuel use and emissions (from 2pm to 8pm)

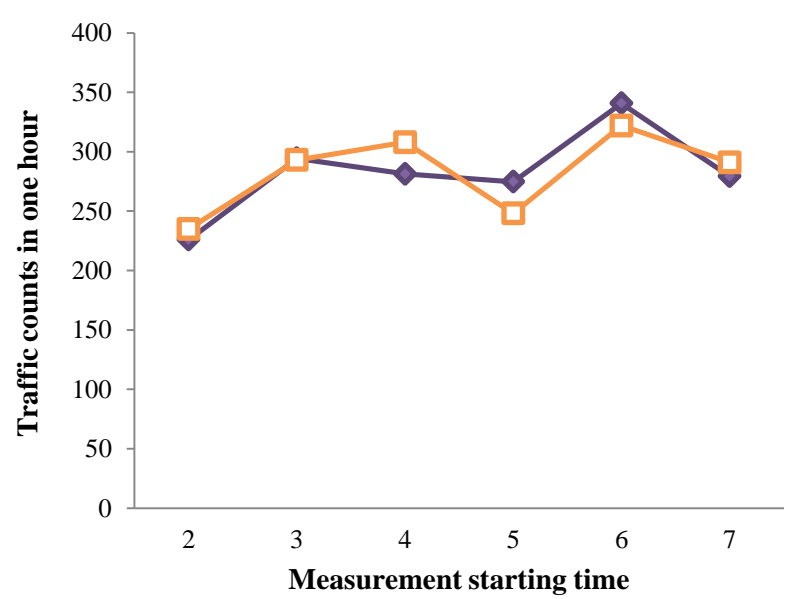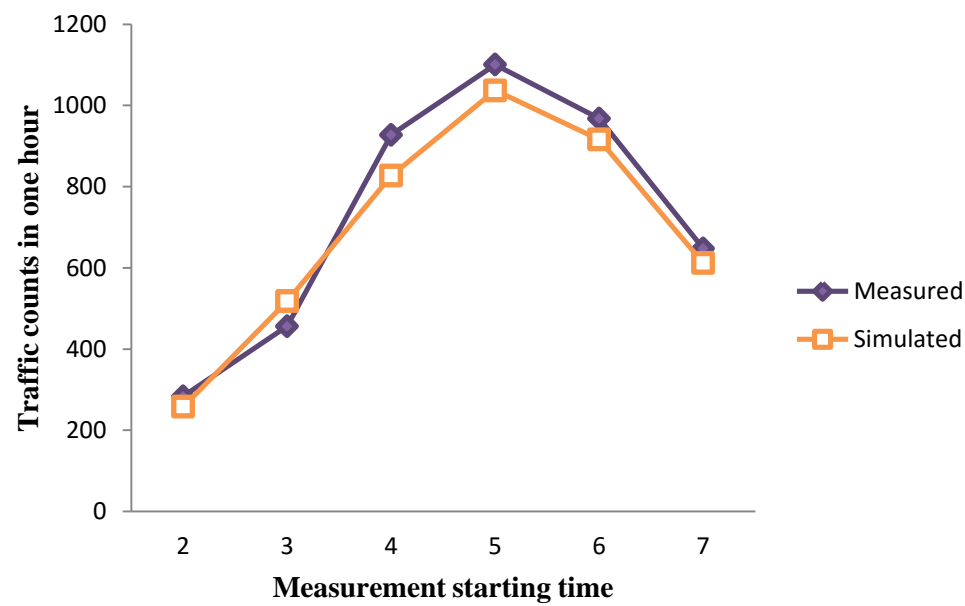| Item	Tot. Number of Travels	Tot. Travel Time	Avg. Travel Time	Tot. Delay	Avg. Delay	Avg. Travel Distance	VMT
Unit	Vehicles	Hour	Minute	Hour	Minute	Mile	Mile
Before closure	862041	247021.15	17.19	67723.97	4.71	9.92	8548397
After closure: do nothing	862041	262284.68	18.26	82070.71	5.71	9.95	8574573
Change by percentage	0.0%	6.2%	6.2%	21.2%	21.2%	0.3%	0.3%
After closure close on-ramp	862041	253336.57	17.63	73569.31	5.12	9.93	8561168
Change by percentage	0.0%	2.6%	2.6%	8.6%	8.7%	0.1%	0.1%

Item	Fuel	CO2	HC	CO	NOX
Unit	Gallon	Ton	Ton	Ton	Ton
Before closure	295909.8	2626.2	6.61	10.53	9.58
After closure: do nothing	296859	2634.62	6.72	10.56	9.63
Change by percentage	0.3%	0.3%	1.7%	0.3%	0.5%
After closure: close on-ramp	296448.3	2630.98	6.67	10.55	9.61
Change by percentage	0.2%	0.2%	0.9%	0.2%	0.3%

Prediction on seven road segments

Three scenarios

- Before Greenfield bridge closure
- After Greenfield bridge closure: do nothing
- After Greenfield bridge closure: ramp closure

Change in traffic flow after closure (total vehicles from 5am to 10am)

ID	1		2		3		4		5	
Name	Second Avenue @ Bates St		Frazier St		Ramp to 376W		Beechwood @ Forward Ave		Murray Ave	
Direction	N to S	S to N	N to S	S to N	N to S	S to N	N to S	S to N	N to S	S to N
Before closure	8456	6745	1911	4694	6777	8839	571	2792	3812	551
After closure	8846	7039	2561	5132	6993	9172	974	2968	4473	974
Change	390	294	650	438	216	333	403	176	661	423
Change by %	5%	4%	34%	9%	3%	4%	71%	6%	17%	77%
After closure: Ramp closure	8656	7292	2319	5118	6850	9304	861	3038	4497	1004
Change	200	547	408	424	73	465	290	246	685	453
Change by %	2%	8%	21%	9%	1%	5%	51%	9%	18%	82%

ID	6		7	
Name	Greenfield Ave. West		Greenfield Ave. East	
Direction	W to E	E to W	W to E	E to W
Before closure	4481	1895	822	1147
After closure	5559	1381	568	900
Change	1078	-514	-254	-247
Change by %	24%	-27%	-31%	-22%
After closure: Ramp closure	3924	1391	473	795
Change	-557	-504	-349	-352
Change by %	-12%	-27%	-42%	-31%

Critical intersection: Murray @ Forward
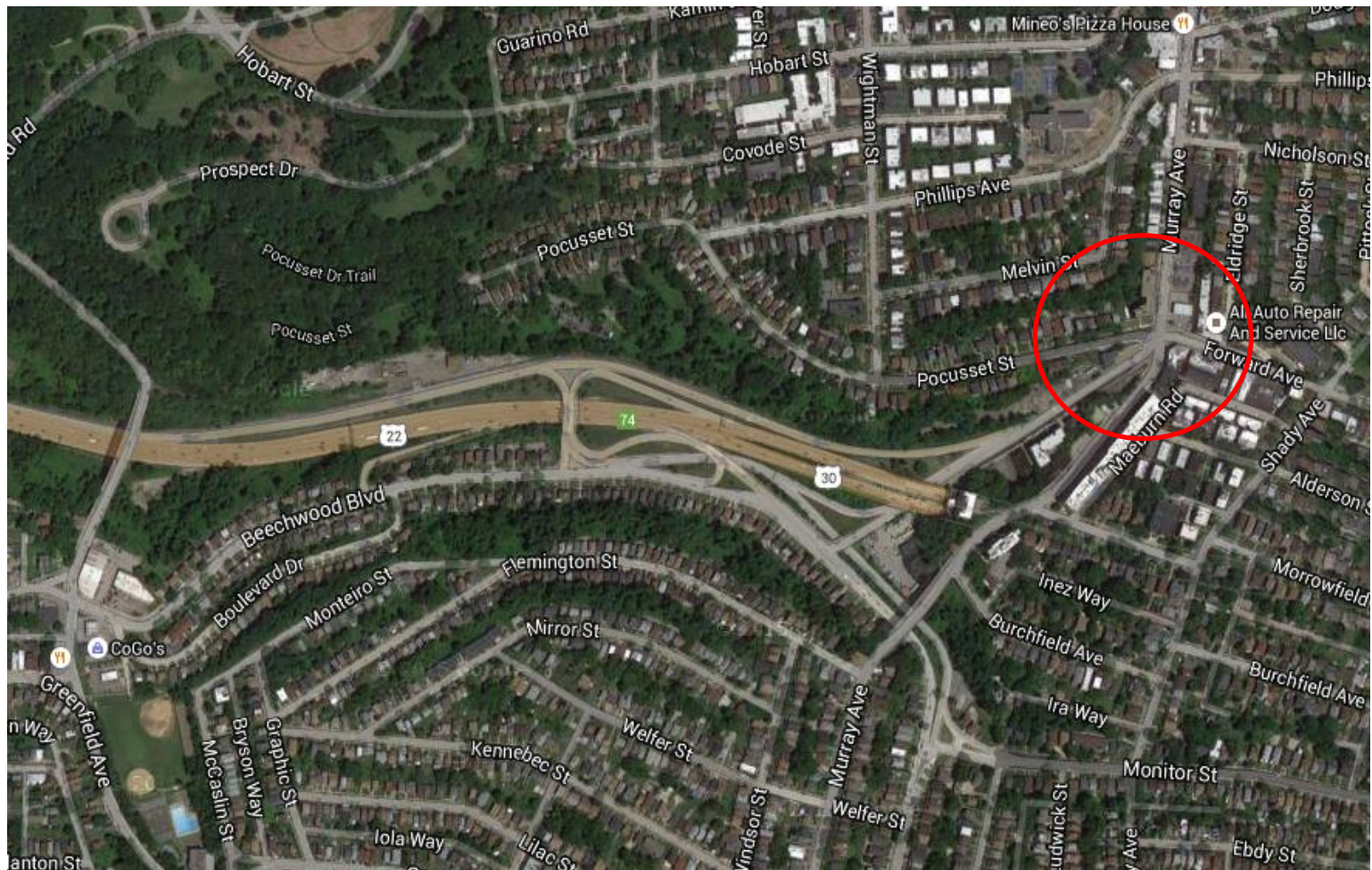
Critical intersection: Murray @ Forward： Bridge closure case
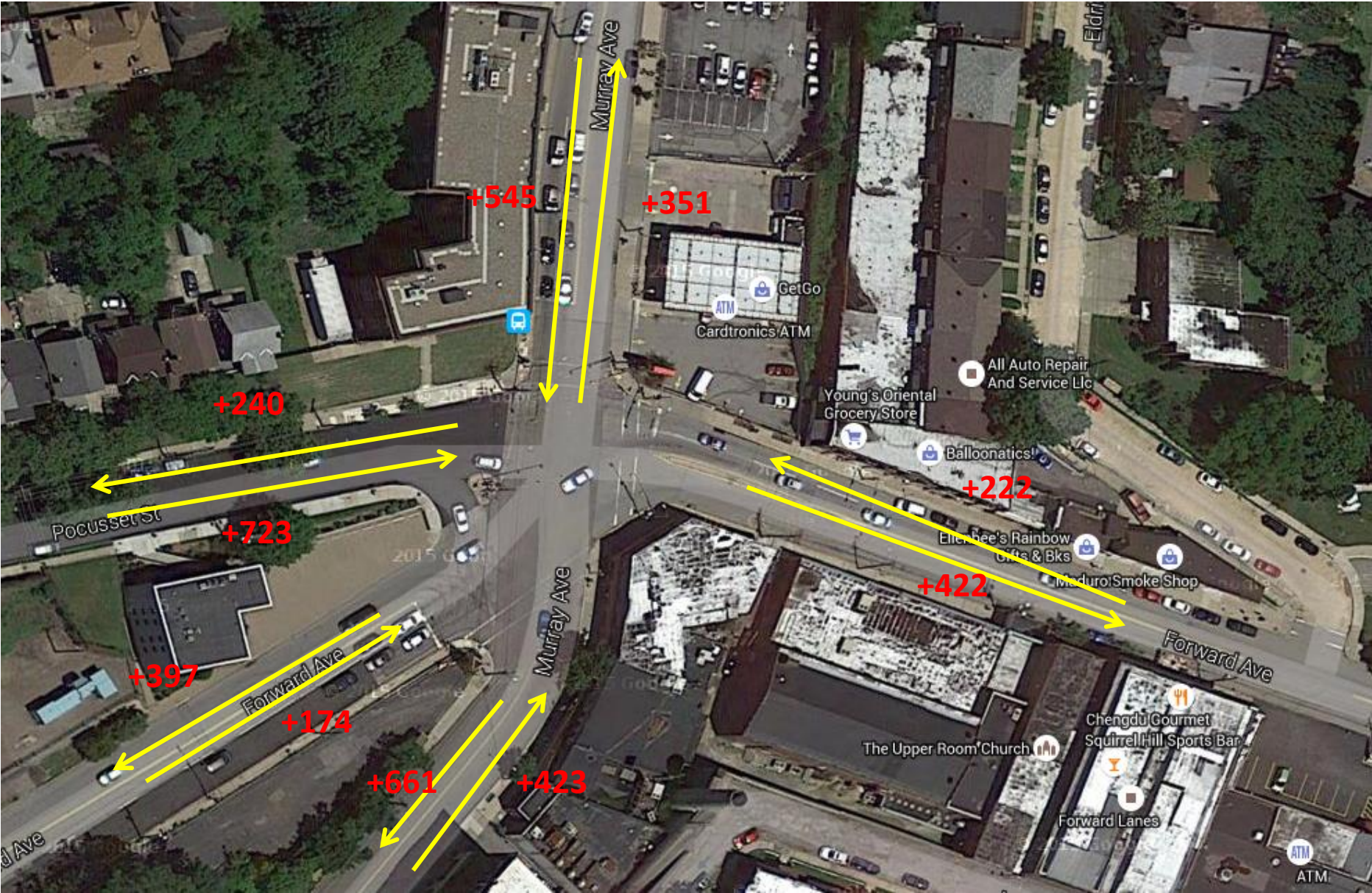
Critical intersection: Murray @ Forward： Bridge closure case

Critical intersection: Murray @ Forward：
Bridge & Ramp closure VS. bridge closure

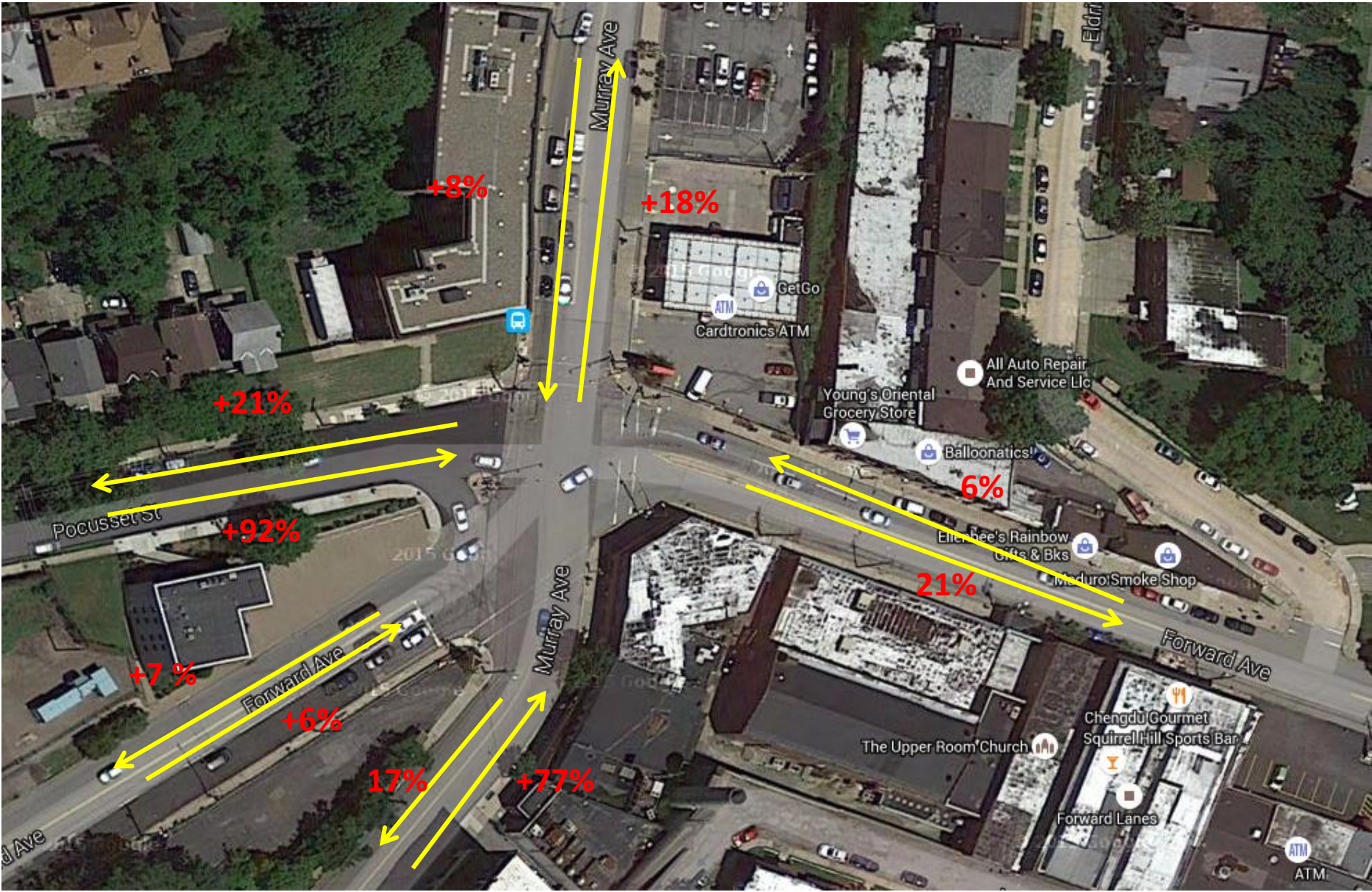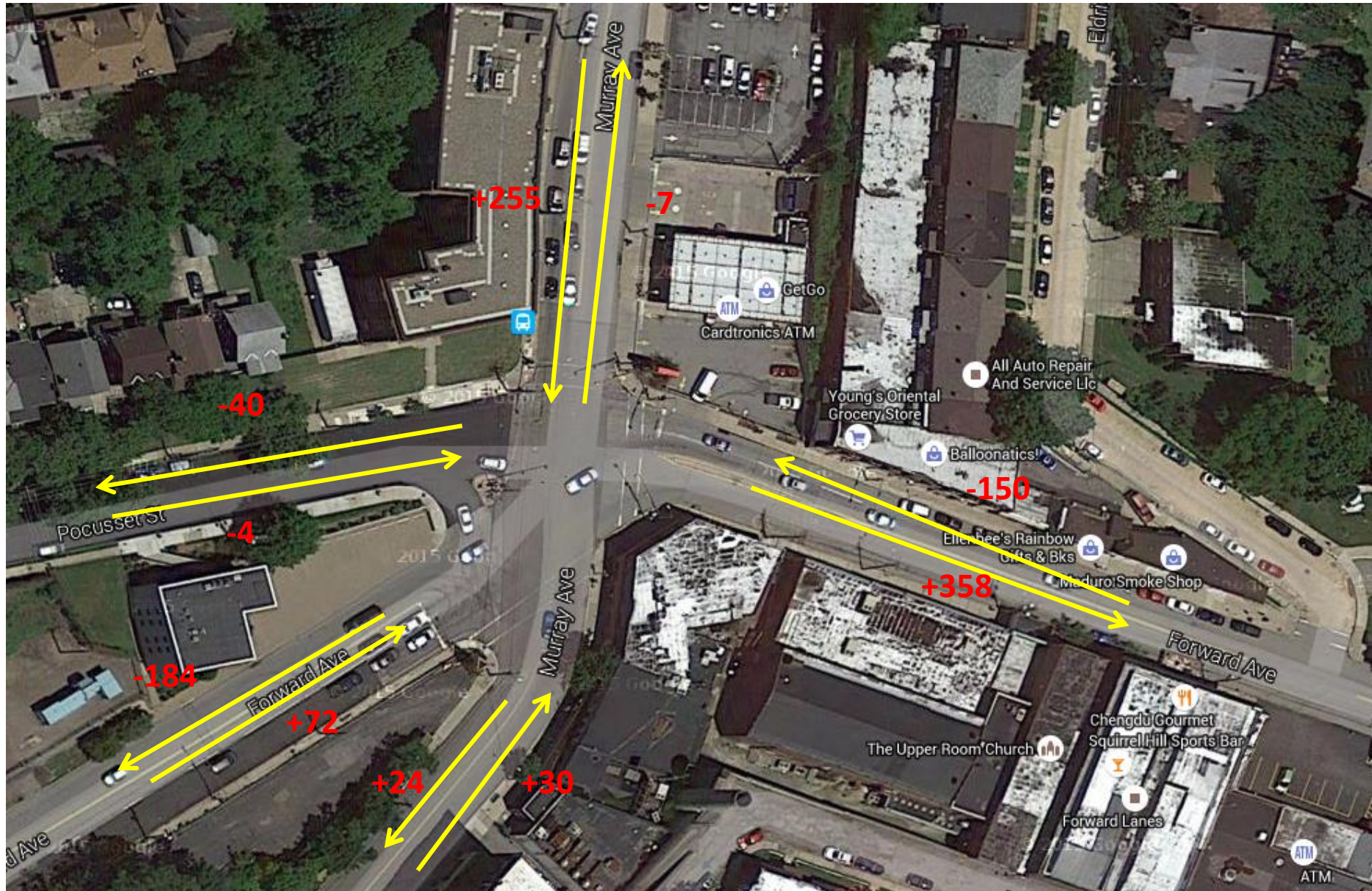| Road	Pocusset St.		Forward Ave. West		Murray Ave. South		Forward Ave. East		Murray Ave. North	
Direction	W to E	E to W	N to S	S to N	N to S	S to N	W to E	E to W	N to S	S to N
Before closure	789	1169	5870	2792	3812	551	2057	3952	6771	1948
After closure	1512	1409	6264	2966	4473	974	2479	4174	7316	2299
Change	723	240	394	174	661	423	422	222	545	351
Change by %	92%	21%	7%	6%	17%	77%	21%	6%	8%	18%
After closure and ramp closure	1472	1405	6080	3038	4497	1004	2837	4024	7571	2292
Change	683	236	210	246	685	453	780	72	800	344
Change by %	87%	20%	4%	9%	18%	82%	38%	2%	12%	18%

Critical intersection: Frazier @ Greenfield
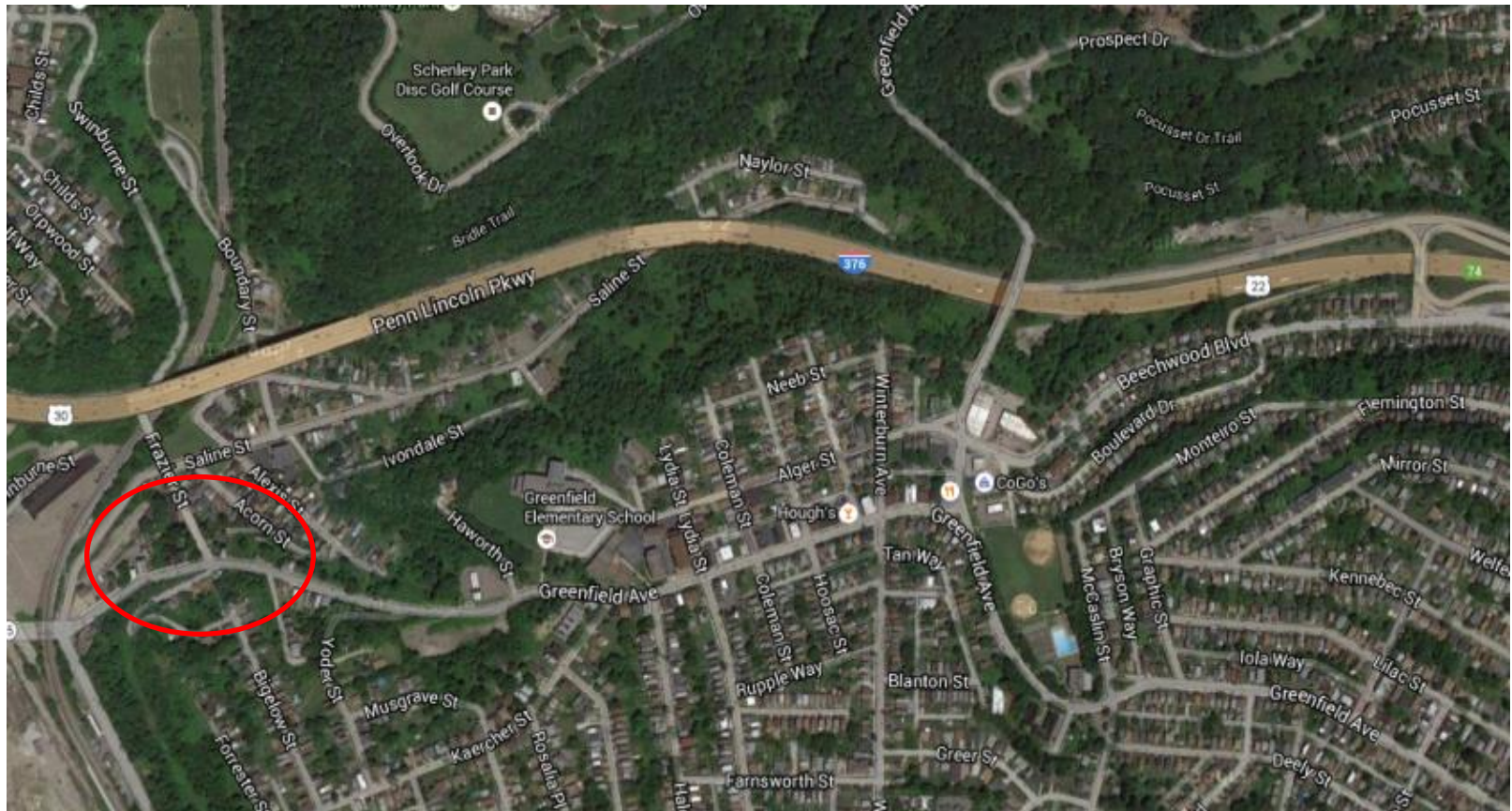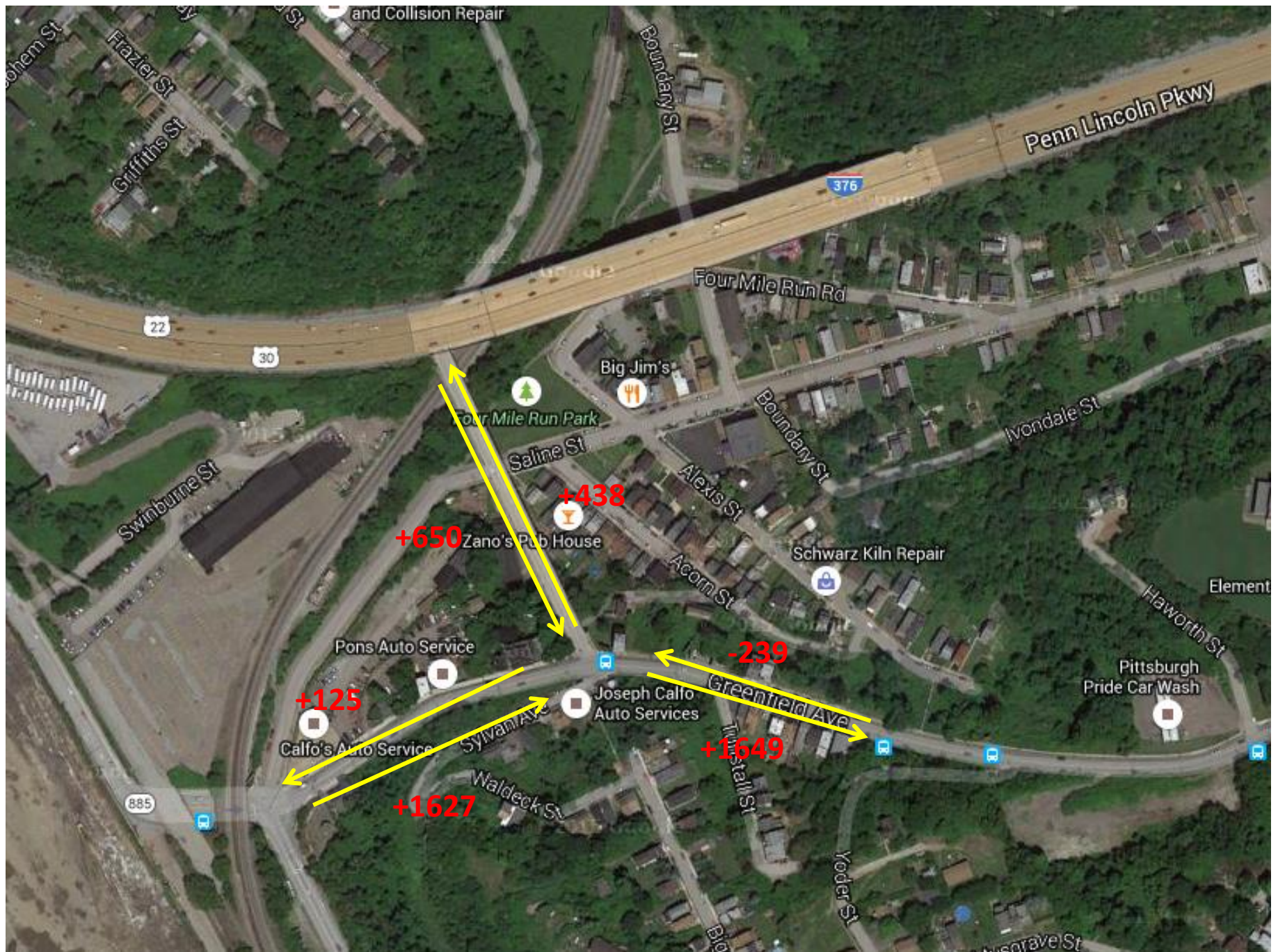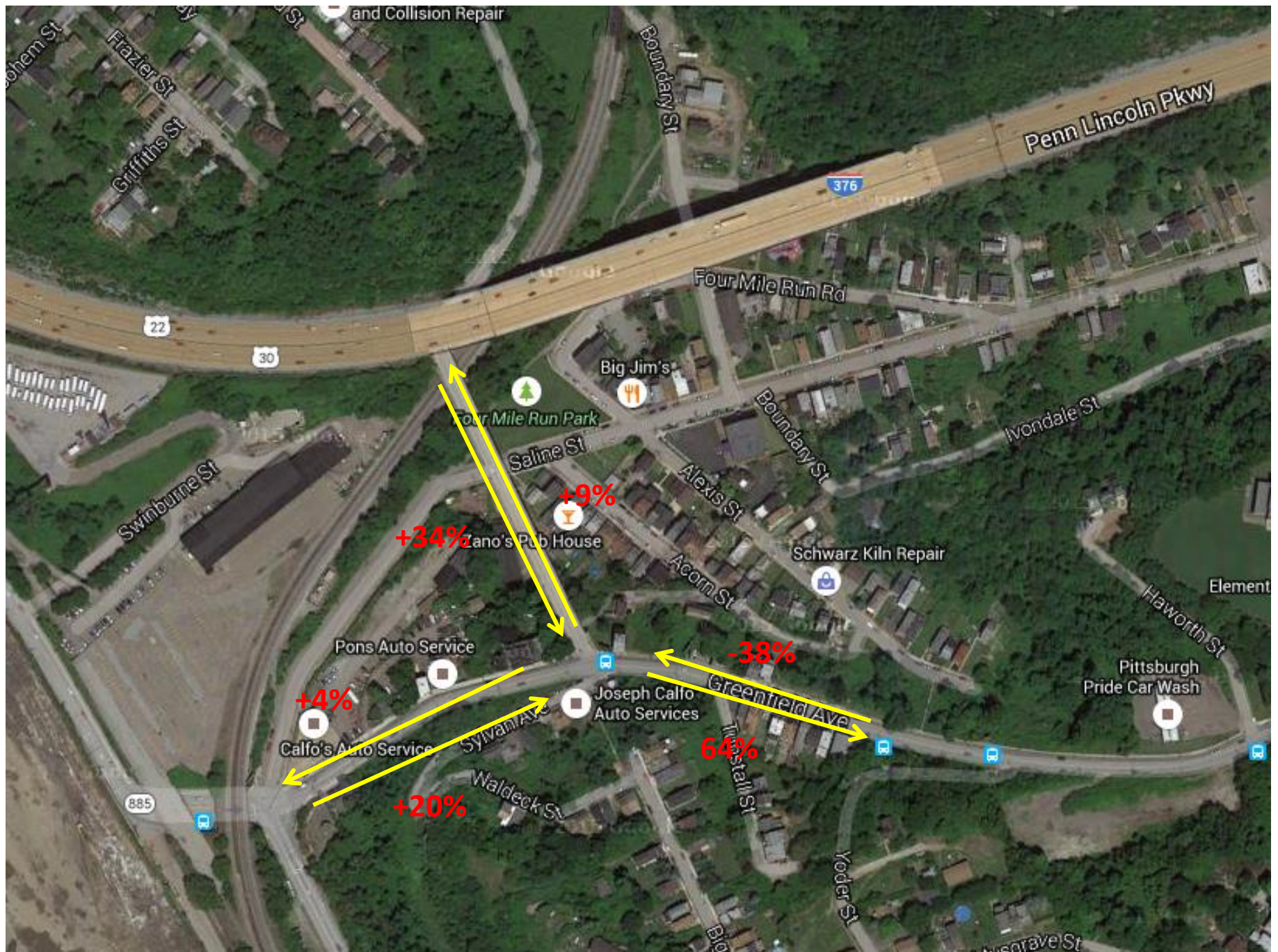
Bridge & Ramp closure case compared to bridge closure
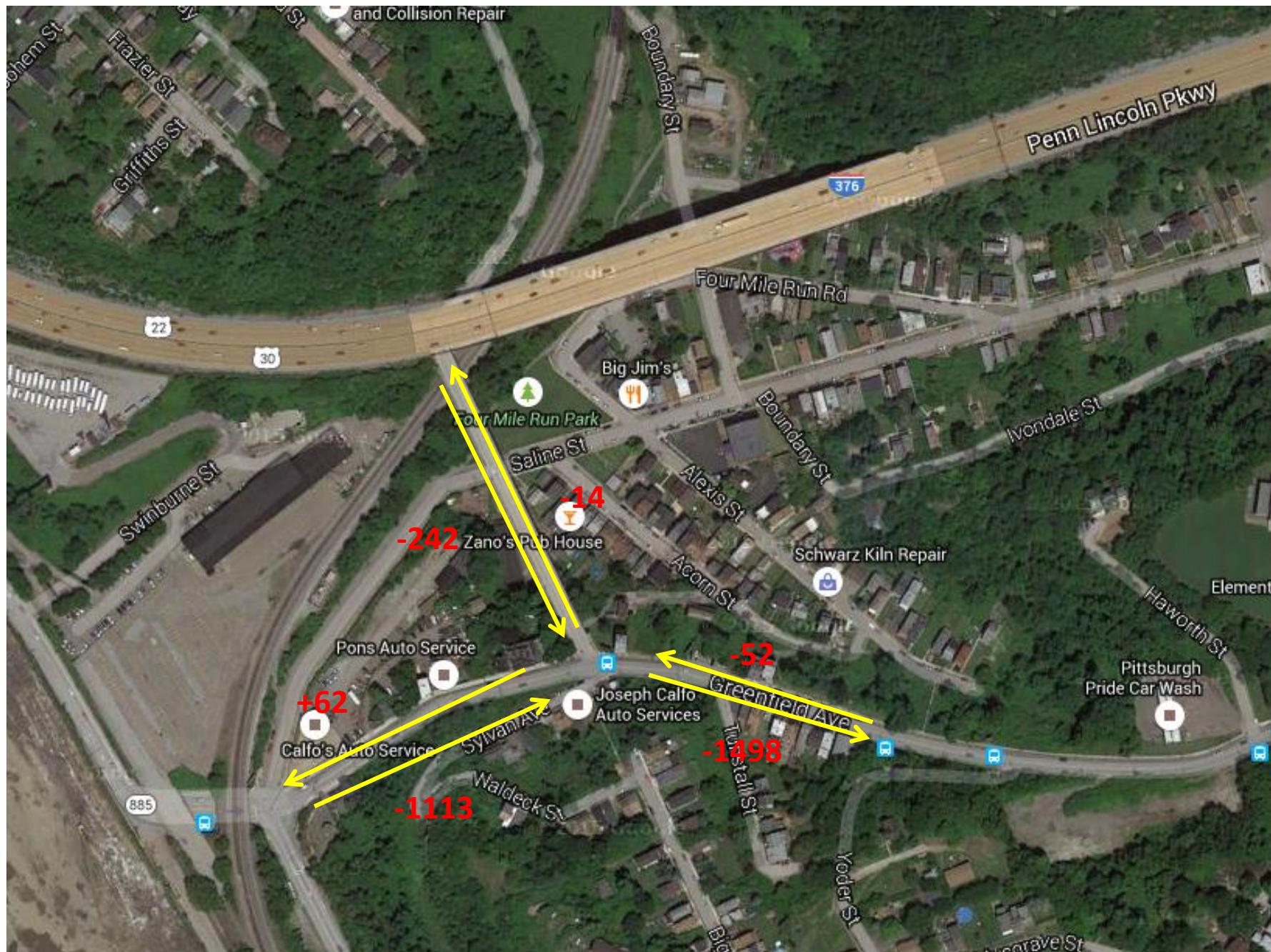
Change in traffic flow on the Greenfield Ave. (from 2pm to 8pm)

Road	Frazier St		Greenfield Ave. (west of Frazier St)		Greenfield Ave. (east of Frazier St)	
Direction	N to S	S to N	W to E	E to W	W to E	E to W
Before closure	1911	4694	8172	2926	2561	626
After closure	2561	5132	9799	3051	4210	387
Change	650	438	1627	125	1649	-239
Change by %	34%	9%	20%	4%	64%	-38%
After closure and ramp closure	2319	5118	8686	3113	2712	335
Change	408	424	514	187	151	-291
Change by %	21%	9%	6%	6%	6%	-46%

Critical intersection: Bates St. @ Second Ave.
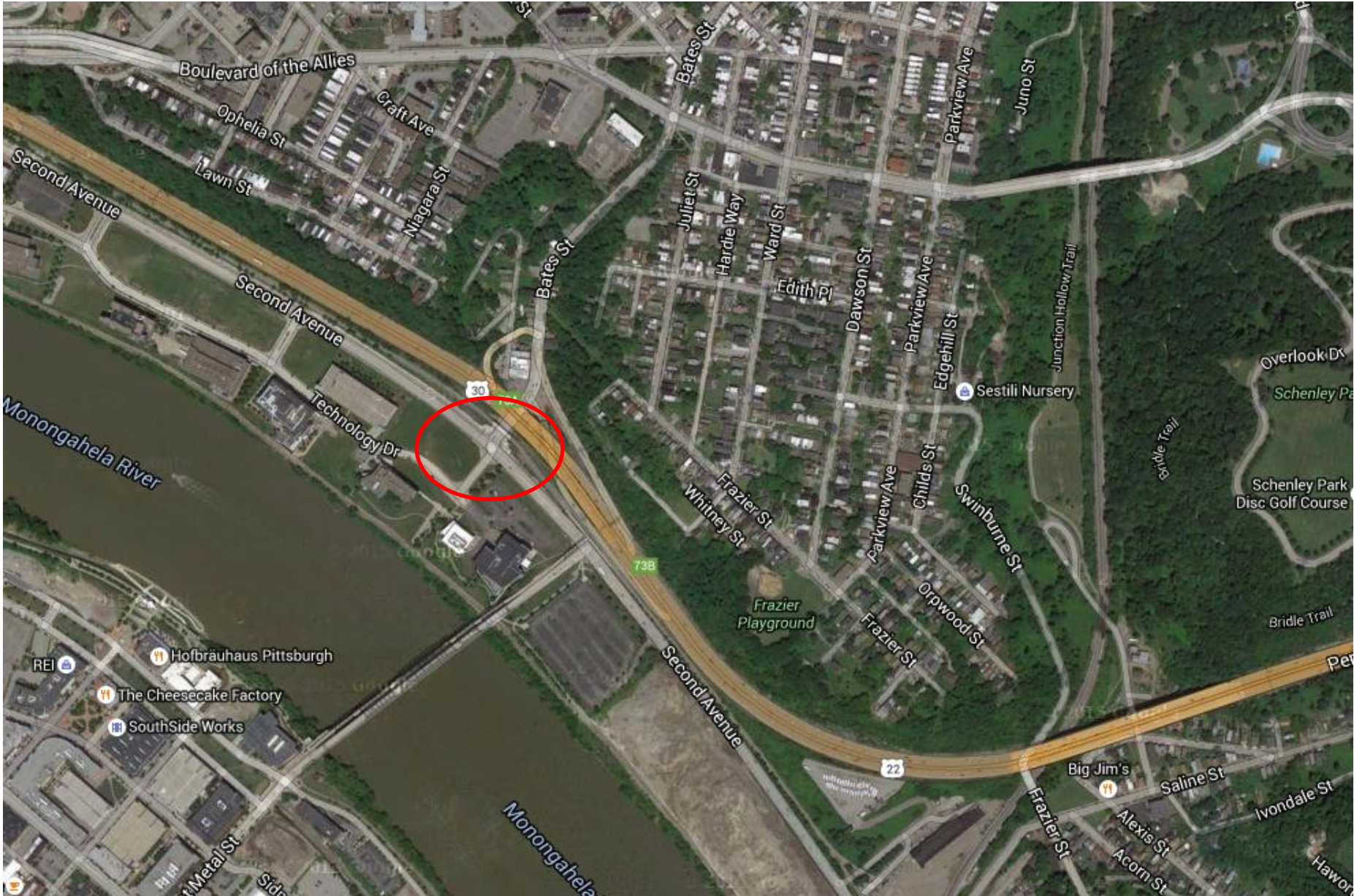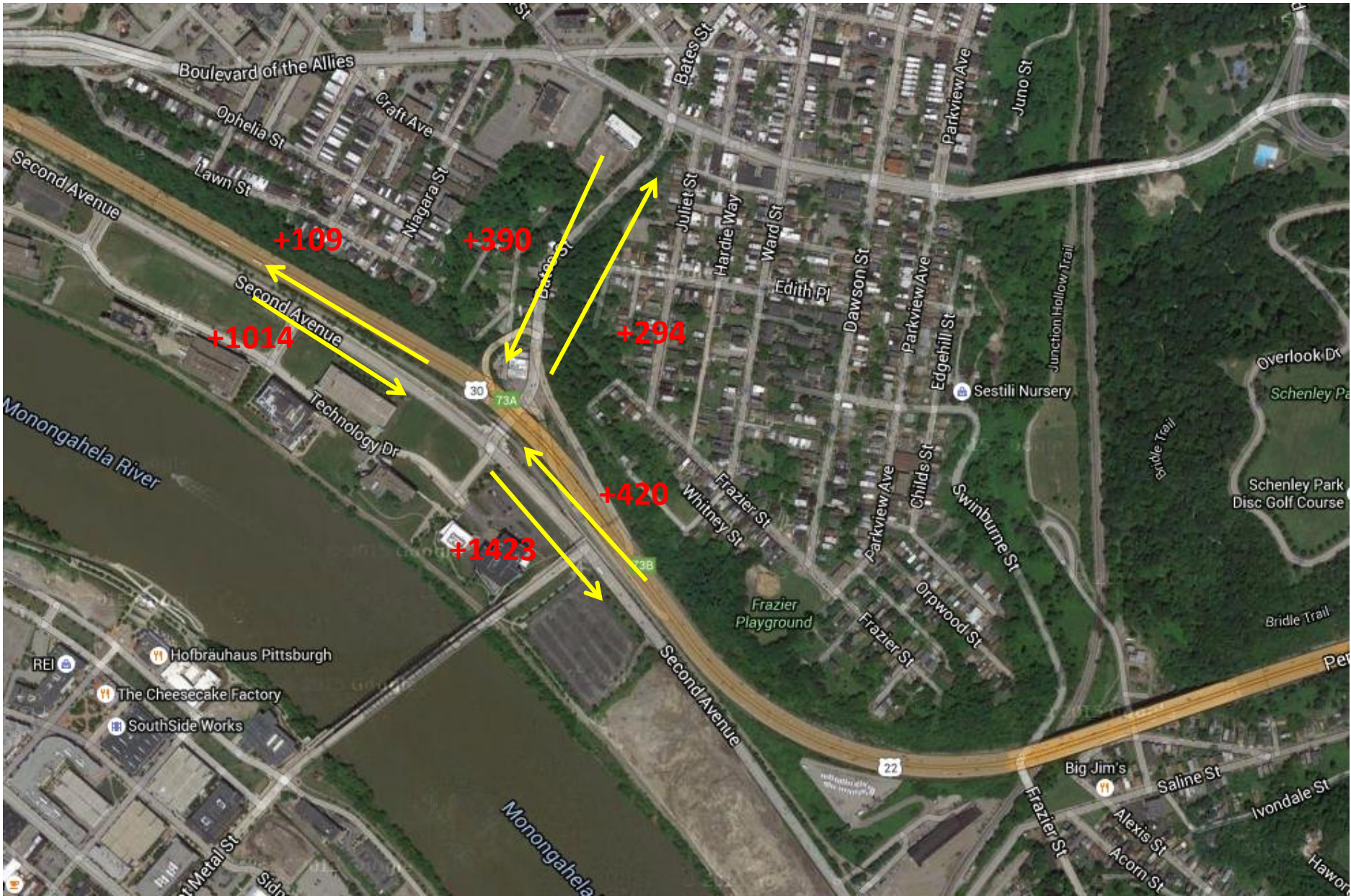
Bridge & Ramp closure case compared to bridge closure

Road	Bates St.		Second Ave. (west of Bates St.)		Second Ave. (east of Bates St.)	
Direction	N to S	S to N	W to E	E to W	W to E	E to W
Before closure	8456	6745	5455	2309	11215	6360
After closure	8846	7039	6469	2418	12638	6780
Change	390	294	1014	109	1423	420
Change by %	5%	4%	19%	5%	13%	7%
After closure and ramp closure	8656	7292	6295	2205	12119	6667
Change	200	547	840	-104	904	307
Change by %	2%	8%	15%	-5%	8%	5%

Change in travel time from CMU

From	To	Time	Before closure	After closure	change by % compared to before	After bridge&ramp closure	Change by % compared to before
CMU North	Glenwood Bridge	03:30	17.12236	17.12236	0%	17.12236	0%
CMU North	Glenwood Bridge	04:00	17.16585	17.20799	0%	17.19638	0%
CMU North	Glenwood Bridge	04:30	17.17443	17.12567	0%	17.24576	0%
CMU North	Glenwood Bridge	05:00	17.12236	17.15564	0%	17.12236	0%
CMU North	Glenwood Bridge	05:30	17.12236	17.13062	0%	17.12236	0%
CMU North	Glenwood Bridge	06:00	17.12236	17.12566	0%	17.12236	0%
CMU North	Squirrel Hill Tunnel	03:30	13.85992	13.98225	1%	13.96379	1%
CMU North	Squirrel Hill Tunnel	04:00	18.86925	18.6927	-1%	18.41912	-2%
CMU North	Squirrel Hill Tunnel	04:30	18.65657	19.78243	6%	19.89883	7%
CMU North	Squirrel Hill Tunnel	05:00	18.49098	19.68222	6%	18.82395	2%
CMU North	Squirrel Hill Tunnel	05:30	18.79403	18.79213	0%	18.23932	-3%
CMU North	Squirrel Hill Tunnel	06:00	14.38712	14.74393	2%	13.81777	-4%
CMU North	Homestead Bridge	03:30	15.69344	15.69344	0%	15.69344	0%
CMU North	Homestead Bridge	04:00	15.69344	15.69344	0%	15.69344	0%
CMU North	Homestead Bridge	04:30	15.69852	15.74828	0%	15.8527	1%
CMU North	Homestead Bridge	05:00	15.76504	16.50177	5%	16.25762	3%
CMU North	Homestead Bridge	05:30	15.69344	16.08525	2%	15.78571	1%
CMU North	Homestead Bridge	06:00	15.69344	16.51123	5%	16.08687	3%

Change in travel time from Carlow Univ.

From	To	Time	Before closure	After closure	change by % compared to before	After bridge&ramp closure	Change by % compared to before
Carlow Univ.	Glenwood Bridge	03:30	12.66181	12.66224	0%	12.66181	0%
Carlow Univ.	Glenwood Bridge	04:00	12.70529	12.76354	0%	12.7697	1%
Carlow Univ.	Glenwood Bridge	04:30	12.71388	12.66619	0%	12.7852	1%
Carlow Univ.	Glenwood Bridge	05:00	12.66181	12.70505	0%	12.66849	0%
Carlow Univ.	Glenwood Bridge	05:30	12.66181	12.67193	0%	12.67634	0%
Carlow Univ.	Glenwood Bridge	06:00	12.66181	12.66551	0%	12.66181	0%
Carlow Univ.	Squirrel Hill Tunnel	03:30	17.49492	18.64347	7%	18.62458	6%
Carlow Univ.	Squirrel Hill Tunnel	04:00	19.73402	21.44224	9%	21.77585	10%
Carlow Univ.	Squirrel Hill Tunnel	04:30	21.22972	22.79096	7%	22.8201	7%
Carlow Univ.	Squirrel Hill Tunnel	05:00	22.43092	22.30593	-1%	21.44464	-4%
Carlow Univ.	Squirrel Hill Tunnel	05:30	19.69047	21.79382	11%	21.26129	8%
Carlow Univ.	Squirrel Hill Tunnel	06:00	17.4441	19.40512	11%	18.47856	6%
Carlow Univ.	Homestead Bridge	03:30	16.29621	18.68776	15%	18.68733	15%
Carlow Univ.	Homestead Bridge	04:00	16.29855	18.70344	15%	18.7212	15%
Carlow Univ.	Homestead Bridge	04:30	16.45429	18.75681	14%	18.77398	14%
Carlow Univ.	Homestead Bridge	05:00	18.23833	19.12547	5%	18.87831	4%
Carlow Univ.	Homestead Bridge	05:30	16.49908	18.90219	15%	18.93631	15%
Carlow Univ.	Homestead Bridge	06:00	16.30441	18.69103	15%	18.68733	15%

Change in travel time from Univ. of Pittsburgh

From	To	Time	Before closure	After closure	change by % compared to before	After bridge&ramp closure	Change by % compared to before
Univ. of Pittsburgh	Glenwood Bridge	03:30	14.91476	14.91476	0%	14.91476	0%
Univ. of Pittsburgh	Glenwood Bridge	04:00	14.95825	15.41286	3%	15.59068	4%
Univ. of Pittsburgh	Glenwood Bridge	04:30	15.05502	14.91806	-1%	15.03815	0%
Univ. of Pittsburgh	Glenwood Bridge	05:00	14.99032	15.37721	3%	15.52566	4%
Univ. of Pittsburgh	Glenwood Bridge	05:30	15.13575	15.03805	-1%	14.94456	-1%
Univ. of Pittsburgh	Glenwood Bridge	06:00	14.91476	15.03989	1%	14.91476	0%
Univ. of Pittsburgh	Squirrel Hill Tunnel	03:30	16.23307	16.35541	1%	16.33694	1%
Univ. of Pittsburgh	Squirrel Hill Tunnel	04:00	21.04783	21.06585	0%	20.79227	-1%
Univ. of Pittsburgh	Squirrel Hill Tunnel	04:30	21.02972	22.15558	5%	22.27198	6%
Univ. of Pittsburgh	Squirrel Hill Tunnel	05:00	20.86413	22.05537	6%	21.1971	2%
Univ. of Pittsburgh	Squirrel Hill Tunnel	05:30	20.80375	21.16528	2%	20.61247	-1%
Univ. of Pittsburgh	Squirrel Hill Tunnel	06:00	16.76028	17.11708	2%	16.19092	-3%
Univ. of Pittsburgh	Homestead Bridge	03:30	17.61236	18.06659	3%	18.06659	3%
Univ. of Pittsburgh	Homestead Bridge	04:00	17.61236	18.06659	3%	18.06659	3%
Univ. of Pittsburgh	Homestead Bridge	04:30	17.76596	18.12144	2%	18.22586	3%
Univ. of Pittsburgh	Homestead Bridge	05:00	18.13819	18.87492	4%	18.63077	3%
Univ. of Pittsburgh	Homestead Bridge	05:30	17.61236	18.4584	5%	18.15886	3%
Univ. of Pittsburgh	Homestead Bridge	06:00	17.61236	18.88438	7%	18.46002	5%