



Willey St-Richwood Ave Intersection Improvement Study

Final Report (*Draft*)

June, 2019

Prepared for

City of Morgantown

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Appendix A: Data Collection Documentation

Appendix B: Pedestrian Signal Warrant Analysis

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Executive Summary

The purpose of the Study is to determine the impact of correcting the subject intersection's unsafe skew. This skew affects traffic operation in the area and to determine the impact of any correction on the larger transportation network including transit, pedestrians, and bicycles. Specifically, the study intends to identify alternatives that

- Improve traffic operation efficiency and safety.
- Improve pedestrian safety and transit operations.
- Support future development in the study area.

MPO staff held a community meeting for the Study on June 3, 2019 at Crosley's Banquet Center, 616 Richwood Ave, Morgantown, WV. The meeting was as a part of the June Woodburn Neighborhood Association Meeting, which approximately 10 residents attended.

The following opportunities were identified during the study data collection and evaluation process:

- **Increasing traffic operation capacity**

Currently, the southbound left-turn from Willey St to Richwood Ave and southbound right-turn from Richwood Ave to Willey St movements are prohibited at the intersection of Willey St and Richwood Ave due to safety concerns. Improving the intersection geometry and allowing the prohibited turns will increase the operational capacity of the intersection.

- **Optimizing land use**

The triangle area at the intersection of Willey St-Richwood is used as an unpaved surface parking lot. Many empty parking spaces were observed throughout the day. The triangle area could be used for more productive purposes. (District: Third Ward, Map: 26, Parcel: 412)

- **E Prospect Street (Paper Street)**

A paper street exists between E Prospect St and Willey St. Currently the paper street is marked as a pedestrian walking path across the parking lot in the project area.

The study identified two alternatives to improve the intersection. The following table shows proposed alternatives address issues identified in the study.

Identified Issues	Countermeasures	
	Alternative 1	Alternative 2
Safety at the Willey St/Richwood Ave intersection	- Converting the Richwood Ave between Willey St and E Prospect St into a one-way street.	- Close the intersection of Willey St and Richwood Ave - Extend sidewalk on Willey St. Provide additional crosswalk on Willey St
Pedestrian crossing Safety on Willey St near the Little General store	- Create a three-way intersection at the E Prospect St and Willey St, including installing pedestrian signal and high-visibility crosswalk. (Information about the pedestrian signal warrant is included in the Appendix B)	
Insufficient lighting on Willey St near the Little General store	- Install light pole at multiple locations in the intersection area. - Enhance existing lighting infrastructure.	
Road safety at the Willey St/Price St intersection	- Install a "slow" sign on Willey St (Southbound) passing Prospect St.	
Pedestrian-vehicle conflict on the parking lot of the Little General store	- further analysis on the impact of potential assessment management at the Little General Store	

Alternative 1-One Way Circle (Short Term)



Alternative 2-Two Way E Prospect St (Long Term)



Study Description

The purpose of the Study is to determine the impact of correcting the subject intersection's unsafe skew on traffic operation in the area and to determine the impact of any correction on the larger transportation network including transit, pedestrians, and bicycles.

Specifically, the study intends to identify alternatives that

- Improve traffic operation, efficiency, and safety.
- Improve pedestrian safety and transit operations.
- Support future development in the study area.

The study area is shown below:



Alternatives considered

- **Signal Warrant.** Evaluate if the existing and proposed traffic pattern meets any warrants for a traffic signal at the study intersection
- **Street Realignment, Street Closure, One-way-street.** Identify and evaluate potential roadway changes on E Prospect, Richwood Ave, and Willey Street.
- **Pedestrian Infrastructure Improvement.** Identify opportunities to improve pedestrian travel in the study area, including enhanced crosswalks, pedestrian signage, lighting, and ADA compliance
- **Access Management.** Evaluate the need for access management in the study area.

Existing Conditions Analysis

Data Collection Process

MPO staff conducted data collection during the fall of 2018, as described in the following table.

Data Types	Description
Turning movement counts	September 4 (Tuesday) and 5 (Wednesday), 2018. 7:30-10:30 AM, 3:30 -6:30 PM
Pedestrian count	September 11 (Tuesday) and 12 (Wednesday), 2018. 7:30-10:30 AM, 3:30 -6:30 PM
Daily traffic volume	August 29 (Wednesday) and 30 (Thursday), 2018. 48-hour period Station 34 on Willey Street, Station 72 on Richwood Ave
Forecasted traffic volume	MPO Travel Demand Model (West Ridge scenario) future year volume in the intersection area
Crash Data	WV DOH crash data, 2013-2017
Observation	Multiple site visits

Data Collection Summary

Traffic Split

		Willey St, NB			Willey St, SB	
		LT	TH	RT	LT	TH
Willey St & Richwood Ave	AM Peak	--	76%	24%	--	--
	PM Peak	--	58%	42%	--	--
Willey St & Prospect St	AM Peak	4%	96%	--	15%	85%
	PM Peak	5%	95%	--	23%	77%

Pedestrian Counts

- Pedestrian volume average 167/per hour during AM three hours count and 257/per hour during PM three hours count.

Traffic Signal Warrant

- Project site does not meet traffic signal warrant.
- Project site meets the 2009 MUTCD Pedestrian signal warrant, for both four-hour-volume warrant and peak-hour warrant. Detailed traffic signal warrant information is included in the Appendix B: Pedestrian Signal Warrant Analysis.

Crashes

Many crashes occurred at night when it is dark and visibility is low. During the evaluation period (2013-2017), top three crash locations are

- 15 crashes at the intersection of Willey St and Price Street
- 6 crashes at the intersection of Willey St and Richwood Ave
- 4 crashes at the intersection of Willey St and Fife St

Identified Issues

The following issues were identified during the data collection and evaluation process:

- **Safety at the Willey St/Richwood Ave intersection**

The intersection is skewed and on a steep slope. Due to the skew of the intersection and the curvature of Willey Street, motorists entering Willey St from Richwood Ave have limited vision, which increases safety concerns for both motorists and pedestrians.

- **Pedestrian crossing Safety on Willey St near the Little General store**

High pedestrian volumes were observed during AM and PM hours. There is a crosswalk, but in most cases, pedestrians do not use it to cross the street. The location meets the 2009 MUTCD Pedestrian signal warrant, for both four-hour-volumes and peak-hour volumes.

- **Insufficient lighting on Willey St near the Little General store**

Many crashes occurred at night when it is dark and visibility is low. MPO staff observed that in evenings, NB motorists on Willey are often blinded by the lights from the SB vehicles on Richwood Ave, making it difficult for motorists to identify pedestrians crossing the street. While there are street lights attached to utility poles in the intersection area, lighting is not sufficient to provide a safe travel environment for pedestrians.

- **Road safety at the Willey St/Price St intersection**

There is a sight line concern at the intersection of Willey St and Price St. This intersection has exceptionally high crash frequency (rear end and opposite direction angle), compared to other intersections within the project area.

- **Pedestrian-vehicle conflict on the parking lot of the Little General store**

The parking lot of the Little General Store was frequently used by the store customers. Several pedestrian-vehicle near misses were observed due to pedestrians passing through the area.

The following opportunities were identified during the data collection and evaluation process:

- **Increasing traffic operation capacity**

Currently, the southbound left-turn from Willey St to Richwood Ave and southbound right-turn from Richwood Ave to Willey St movements are prohibited at the intersection of Willey St and Richwood Ave due to safety concerns. Improving the intersection geometry and allowing the prohibited turns will increase the operational capacity of the intersection.

- **Optimizing land use**

The triangle area at the intersection of Willey St-Richwood is used as an unpaved surface parking lot. Many empty parking spaces were observed throughout the day. The triangle area could be used for more productive purposes. (District: Third Ward, Map: 26, Parcel: 412)

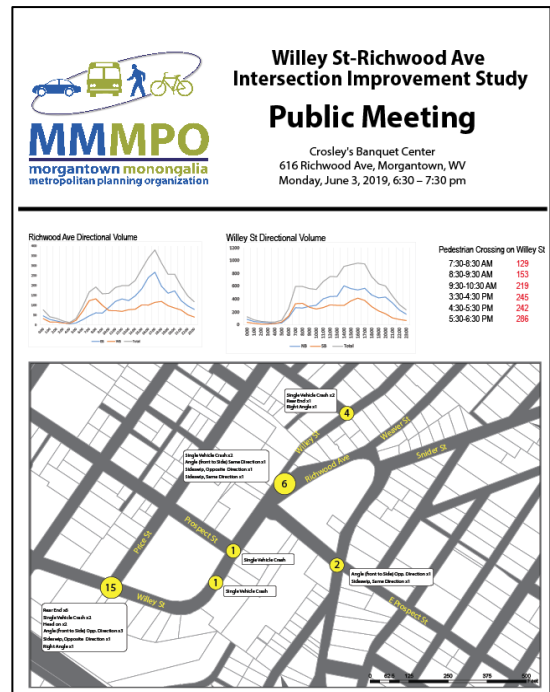
- **E Prospect Street (Paper Street)**

A paper street exists between E Prospect St and Willey St. Currently the paper street is marked as a pedestrian walking path across the parking lot in the project area.

Community Involvement

MPO staff held a community meeting for the Study on June 3, 2019 at Crosley's Banquet Center, 616 Richwood Ave, Morgantown, WV. The meeting was as a part of the June Woodburn Neighborhood Association Meeting, which approximately 10 residents attended.

Materials presented during the meeting included: 1) major findings from data analysis and site observation, 2) information about traffic volume, pedestrians, and crash data, and 3) alternatives for the intersection improvement. Materials were available on the MPO's website for review. Interested participants were encouraged to submit their comments online at www.plantogether.org/comments before June 17, 2019.



Public Comments Summary

Alternative Preference

Both proposed alternatives will bring positive changes to the intersection. When funding is sufficient for both alternatives, Alternative 2 is preferred over Alternative 1. By completely closing the Wiley St/Richwood Ave intersection, Alternative 2 presents a safer condition for both vehicle drivers and pedestrians, and is seen as a more intuitive option which will be easier for users to adapt to.

Pedestrian Safety

The study adequately addressed pedestrian issues in the intersection areas at the planning level. The safety of pedestrians crossing Wiley St should continue to be a major consideration during engineering design process. Channelizing pedestrian crossing on Wiley Street through engineering design may improve the travel environment for both pedestrians and vehicles.

The type of pedestrian crossing signal should be more specifically identified.

Land Use

Transportation improvements should coordinate with future land use development. It appears that Alternative 2 provides more opportunity for land development, as it allows more direct access to parcel 412 on E Prospect St from both directions. Land use strategies in the study area should be clarified before making a final decision on the street improvements.

The Little General Store located in the intersection area attracts considerable pedestrian and vehicle traffic. Potential impact to the store caused by roadway improvements should be considered.

Turning signals

Install a sign requiring right-turn vehicles use right turn signal at the intersection for traffic approaching from downtown and turning into Richwood Ave.

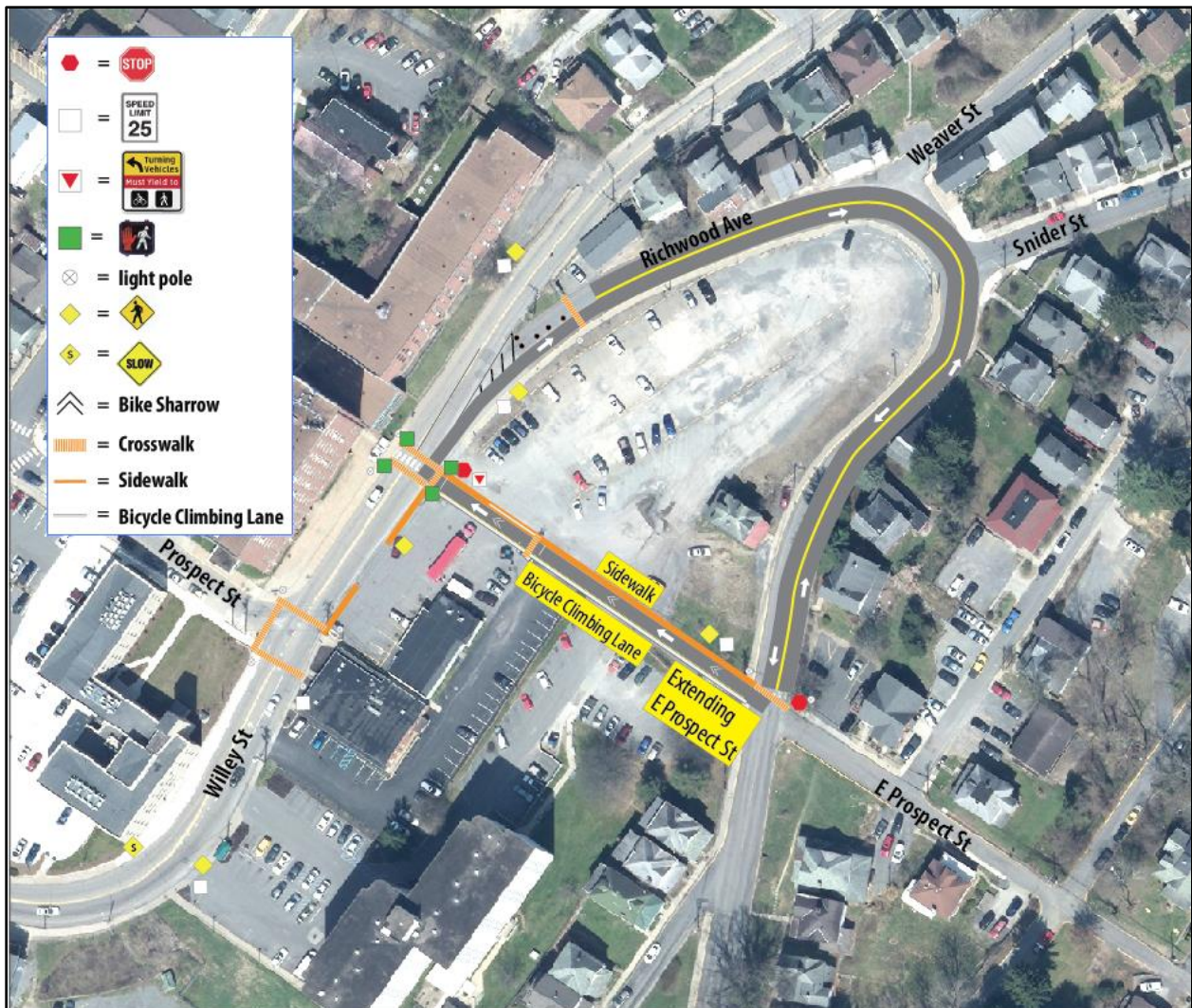
Public comments are documented in the Appendix D.

Recommendations

Alternative Description

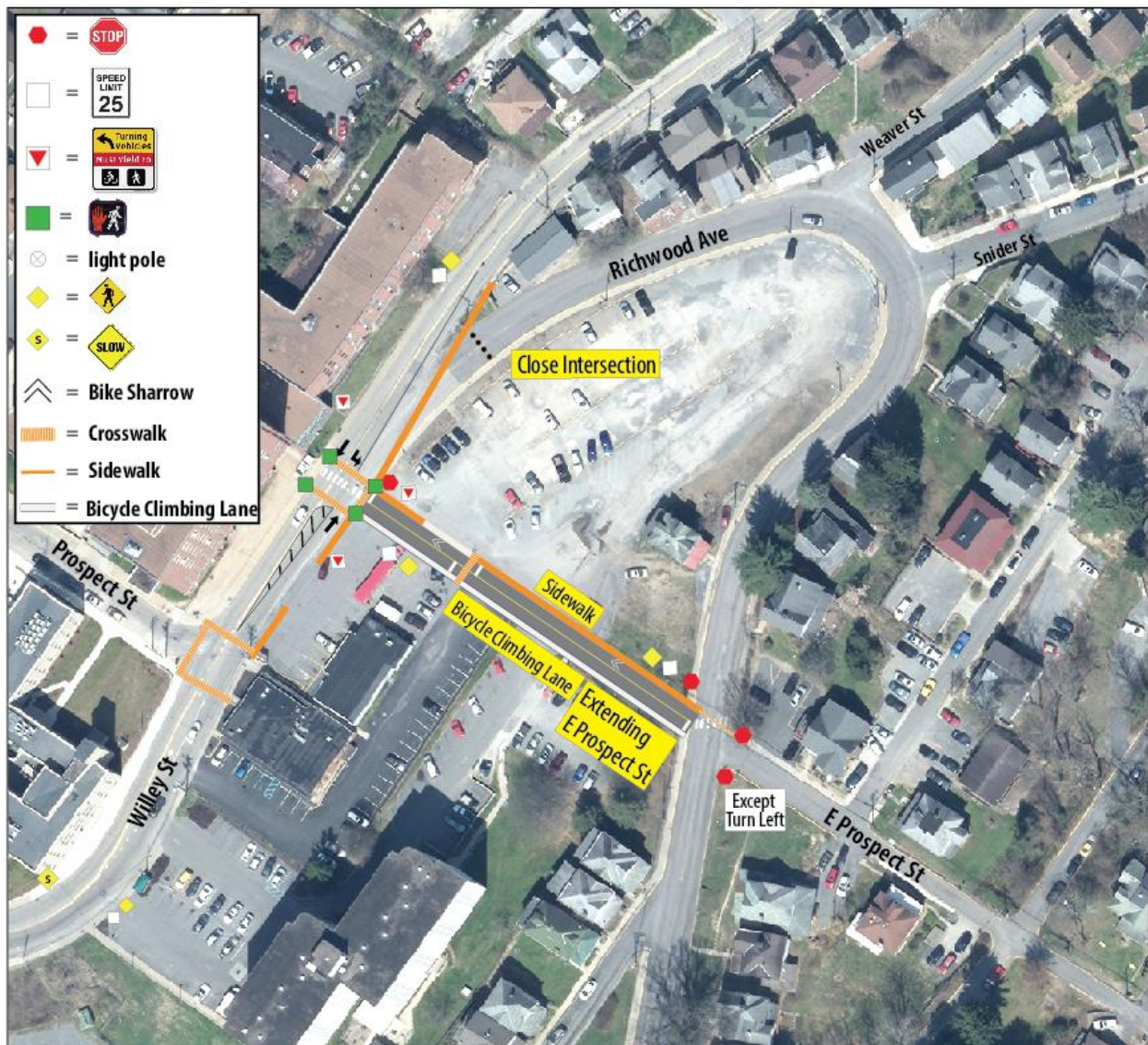
Alternative 1-One Way Circle (Short Term)

- Converting the Richwood Ave between Willey St and E Prospect St into a one-way street. (two way access only for traffic to Weaver St and Snider St)
- Extending E Prospect St to Willey St as a one-way street.
- Create a standard stop-controlled T intersection at the E Prospect St and Willey St.
 - Free-flow on Willey St and stop-control on E Prospect St
 - Improving lighting for pedestrian safety
 - Install pedestrian signal (HAWK) and high-visibility crosswalk
- Provide additional crosswalks on Willey St near the intersection Willey St and Prospect St.
- Add pedestrian warning signs in the intersection area.
- Reduce the speed limit on Willey St and Richwood Ave to 25 MPH in the intersection area.
- Add an additional driveway to access the parcel 412 (District 3, Map: 26)
- Install a “slow” sign on Willey St (Southbound) passing Prospect St.



Alternative 2-Two Way E Prospect St (Long Term)

- Close the intersection of Willey St and Richwood Ave
- Extend E Prospect St to Willey St as a two-way street.
- Create a four-way intersection at Richwood Ave and E Prospect St
 - Free flow for right-turn traffic from E Prospect St to Richwood Ave and left-turn traffic from Richwood Ave to E Prospect St.
- On the extended E Prospect St
 - Install right turn/left turn vehicles-yield-to-pedestrian signs
- Create a three-way intersection at the E Prospect St and Willey St.
 - Free-flow on Willey St and stop-control on E Prospect St
 - Add dedicated left-turn bay on Willey St.
 - Install pedestrian signal (HAWK) and high-visibility crosswalk
- Extend sidewalk on Willey St. Provide additional crosswalk on Willey St near the intersection Willey St and Prospect St.
- Reduce the speed limit on Willey St to 25 MPH in the intersection area.
- Add an additional driveway to access the parcel 412 (District 3, Map: 26)
- Install a “slow” sign on Willey St (Southbound) passing Prospect St.



Alternative Comparison

The first table shows how proposed alternatives address identified issues in the study. The second table compares the advantages and disadvantages of the proposed alternatives:

Identified Issues	Countermeasures	
	Alternative 1	Alternative 2
Safety at the Willey St/Richwood Ave intersection	- Converting the Richwood Ave between Willey St and E Prospect St into a one-way street.	- Close the intersection of Willey St and Richwood Ave - Extend sidewalk on Willey St. Provide additional crosswalk on Willey St
Pedestrian crossing Safety on Willey St near the Little General store	- Create a three-way intersection at the E Prospect St and Willey St, including installing pedestrian signal and high-visibility crosswalk.	
Insufficient lighting on Willey St near the Little General store	- Install light poles at multiple locations in the intersection area. - Enhance existing lighting infrastructure.	
Road safety at the Willey St/Price St intersection	- Install a “slow” sign on Willey St (Southbound) passing Prospect St.	
Pedestrian-vehicle conflict on the parking lot of the Little General store	- Further analysis of the impact of potential change. Work with the management at the Little General Store	

	Advantage		Disadvantage	
	Alt 1	Alt 2	Alt 1	Alt 2
Safety	Better sight-distance for the turning vehicles from E Prospect St (currently Richwood Ave)		Pedestrians need to cross at the extended E Prospect St to get to the Little General Store.	
	More intuitive right-turn from Willey St to Richwood Ave			
	Safer pedestrian crossing on Willey St and Richwood Ave			
	More defined walking path in the parking lot			
		Safer pedestrian travel on Willey St through new sidewalk connection		
Traffic Operation	Allowing right-turn from E Prospect St to Willey, which is currently prohibited (right-turn from Richwood Ave to Willey St)		Increasing travel time for residents living close to the intersection.	
		Allowing left-turn from Willey to E Prospect St, which is currently prohibited (left-turn from Willey St to Richwood Ave)	Less room for freight movement in the parking lot	

Next Steps

The following steps have been identified after the completion of this study:

Identify land use strategies at parcel 412 (District 3, Map: 26) and it's surrounding area, including desirable access point to potential development on that parcel from Richwood Ave and E Prospect St.

Conduct engineering level design based on the information presented in this report, including an impact analysis. Work with the management at the Little General Store located near the intersection. Consider the utilization of the existing use such as ingress/egress, parking, on-site maneuvering, and delivery accommodation.

Richwood Ave & Willey St Intersection Study

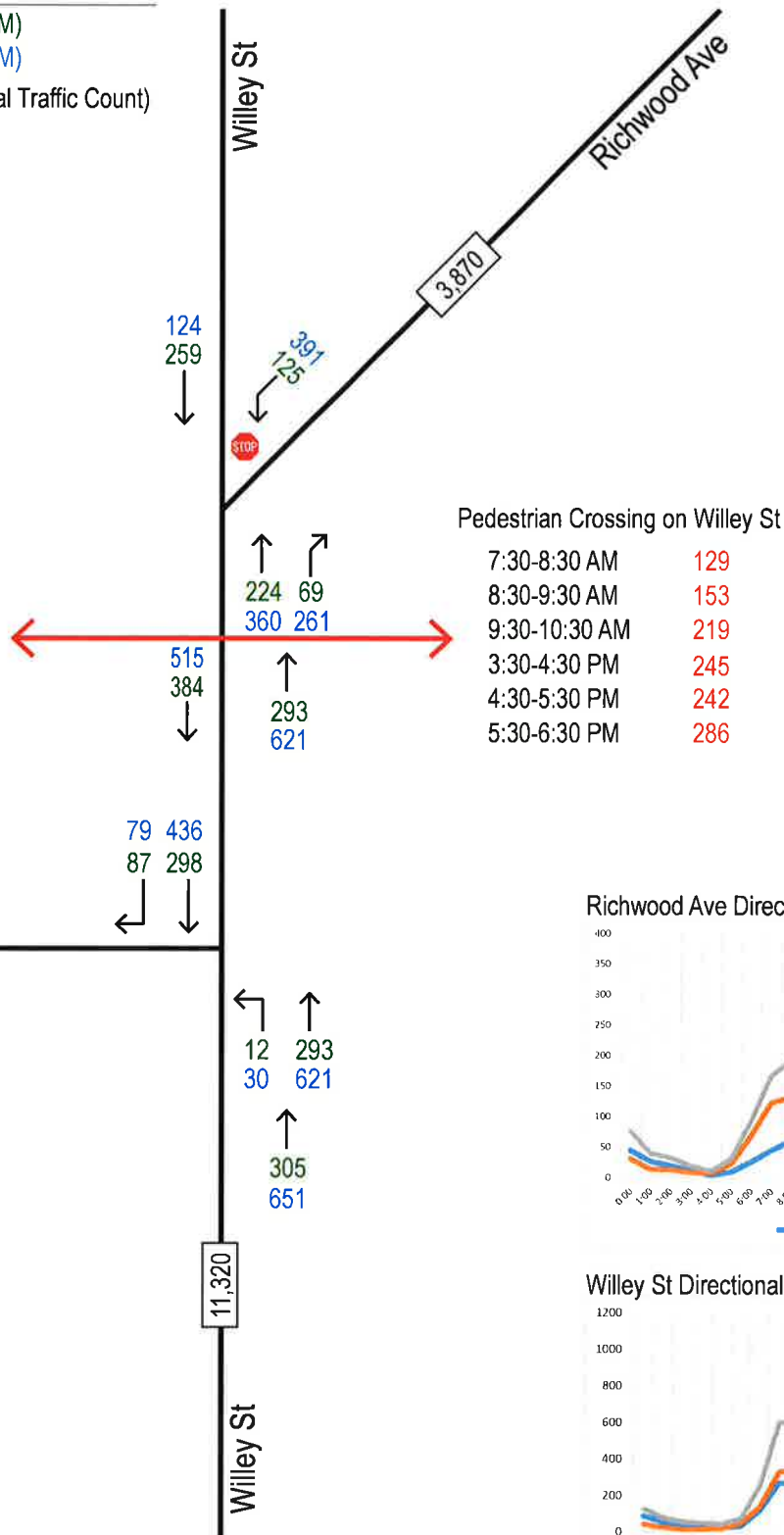
Turning Movement Counts & Pedestrian Volume Summary

Key

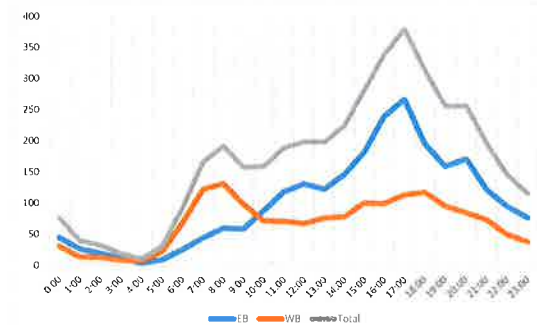
259 = AM Peak (8:30-9:30 AM)

124 = PM Peak (4:30-5:30 PM)

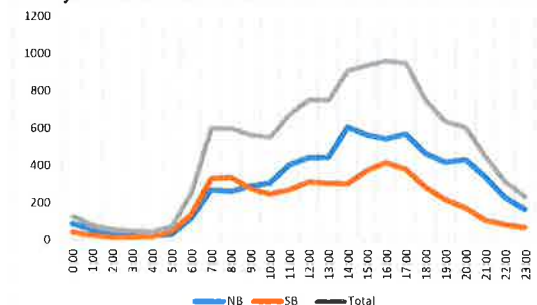
3,872 = 2018 ADT (Annual Traffic Count)



Richwood Ave Directional Volume



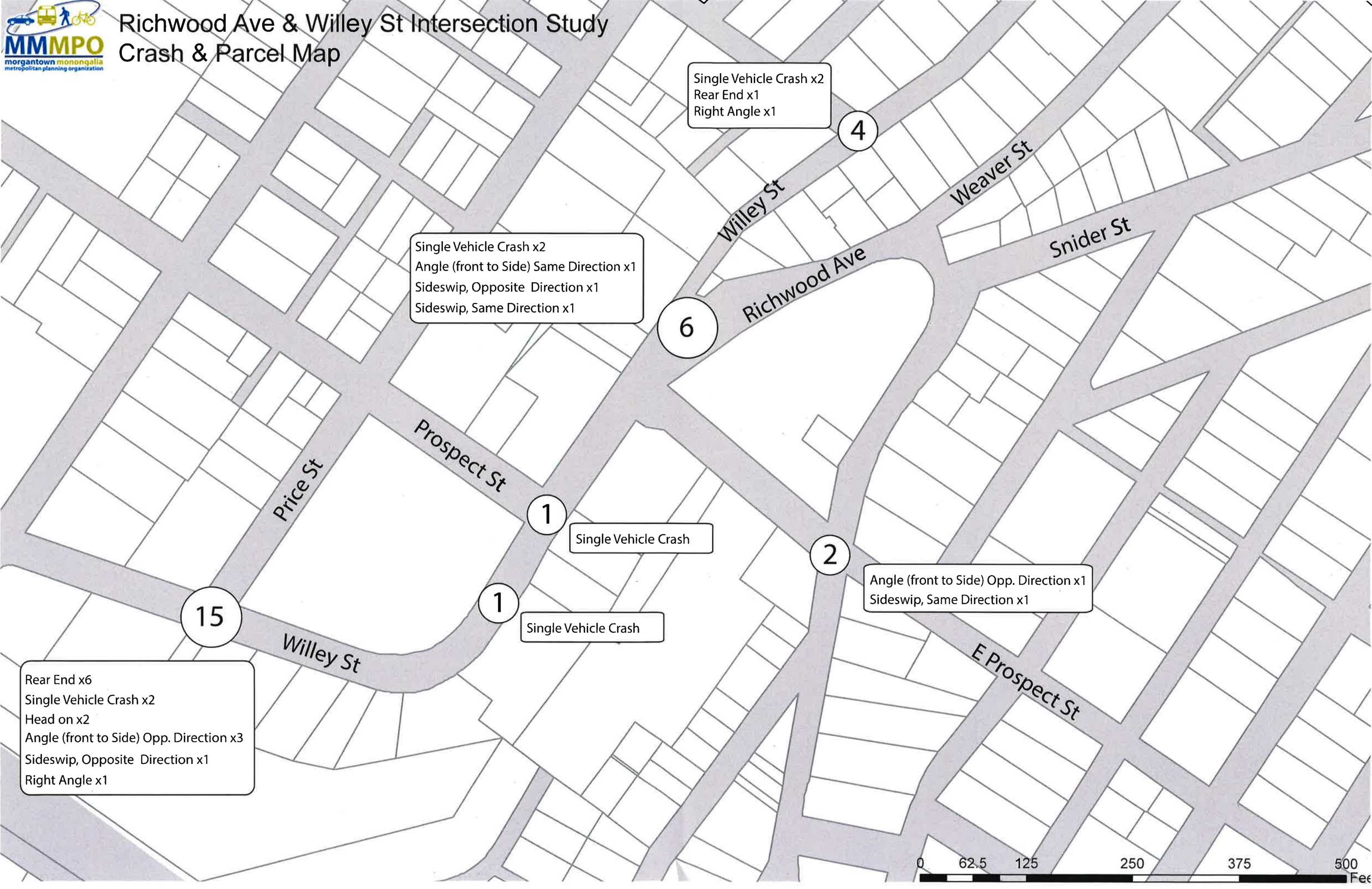
Willey St Directional Volume





Richwood Ave & Willey St Intersection Study

Crash & Parcel Map



Vehicle Traffic Counts

Sept. 4 & 5, Average

			Willey St				Richwood Ave		
			SB	NB			SEB		
AM Peak Hours	From	To	TH	TH	RT	Sub-Total	RT	Total	
	7:30	7:45	32	62	13	75	30	211	
	7:45	8:00	22	58	18	76	43	216	
	8:00	8:15	101	59	17	76	32	285	
	8:15	8:30	66	45	21	65	40	236	
	7:30	8:30	221	223	68	291	145	947	
	8:30	8:45	55	59	14	73	37	236	
	8:45	9:00	63	54	24	77	32	249	
	9:00	9:15	76	61	15	76	27	254	
	9:15	9:30	66	51	17	68	31	231	
	8:30	9:30	259	224	69	293	125	969	
	9:30	9:45	63	49	17	66	20	214	
	9:45	10:00	65	63	15	78	27	248	
	10:00	10:15	55	57	20	77	22	232	
	10:15	10:30	58	57	15	72	23	224	
	9:30	10:30	241	226	66	292	92	917	
	AM Total (3 hours)								2833
	AM Average (3 hours)								944
			Willey St				Richwood Ave		
			SB	NB			SEB		
PM Peak Hours	From	To	TH	TH	RT	Sub-Total	RT	Total	
	15:30	15:45	40	97	37	134	76	383	
	15:45	16:00	54	106	45	150	68	422	
	16:00	16:15	38	101	42	143	87	410	
	16:15	16:30	25	92	61	153	80	411	
	15:30	16:30	157	395	184	579	311	1625	
	16:30	16:45	46	102	53	155	83	439	
	16:45	17:00	48	91	57	148	92	436	
	17:00	17:15	13	73	73	146	114	418	
	17:15	17:30	18	94	78	172	102	464	
	16:30	17:30	124	360	261	621	311	1757	
	17:30	17:45	49	89	72	161	90	460	
	17:45	18:00	44	77	63	140	76	399	
	18:00	18:15	24	71	61	132	73	360	
	18:15	18:30	14	93	55	148	81	390	
	17:30	18:30	131	329	250	579	391	1608	
	PM Total (3 hours)								4990
	PM Average (3 hours)								1663

Vehicle Traffic Counts

Sept. 4 & 5, Average

			Willey St							
			SB			NB				
AM Peak Hours	From	To	TH	RT	Sub-Total	LT	TH	Sub-Total	Total	
	7:30	7:45	52	10	62	0	75	75	136	
	7:45	8:00	52	13	65	1	76	76	141	
	8:00	8:15	119	14	133	3	76	78	211	
	8:15	8:30	84	22	106	2	65	67	173	
	7:30	8:30	307	59	365	5	291	296	661	
	8:30	8:45	81	11	91	5	73	78	169	
	8:45	9:00	72	23	95	1	77	78	172	
	9:00	9:15	78	25	103	1	76	77	179	
	9:15	9:30	68	29	96	6	68	73	169	
	8:30	9:30	298	87	384	12	293	305	689	
	9:30	9:45	72	11	83	6	66	71	154	
	9:45	10:00	71	21	92	9	78	87	179	
	10:00	10:15	61	17	78	13	77	90	167	
	10:15	10:30	62	20	81	11	72	82	163	
	9:30	10:30	265	68	333	38	292	329.5	663	
	AM Total (3 hours)									2012
	AM Average (3 hours)									671
			Willey St							
			SB			NB				
PM Peak Hours	From	To	TH	RT	Sub-Total	LT	TH	Sub-Total	Total	
	15:30	15:45	96	21	116	3	134	137	273	
	15:45	16:00	105	17	122	8	150	158	296	
	16:00	16:15	103	22	125	11	143	153	300	
	16:15	16:30	86	20	106	15	153	167	292	
	15:30	16:30	389	79	468	36	579	614	1161	
	16:30	16:45	118	12	129	12	155	167	296	
	16:45	17:00	116	25	140	2	148	150	290	
	17:00	17:15	105	22	126	9	146	155	281	
	17:15	17:30	99	22	120	9	172	181	301	
	16:30	17:30	436	79	515	30	621	651	1166	
	17:30	17:45	118	21	139	6	161	166	305	
	17:45	18:00	99	21	120	8	140	148	268	
	18:00	18:15	81	16	97	15	132	146	243	
	18:15	18:30	85	11	95	6	148	154	249	
	17:30	18:30	382	68	450	34	579	613	1063	
	PM Total (3 hours)									3390
	PM Average (3 hours)									1130

Richwood Ave & Willey St Intersection Study

Pedestrian Counts

Sept. 11, Tuesday, 2018

	From	To	WB	EB	SB	NB	Conflict Total	Total
AM Peak Hours	7:30	7:45	15	0	7	0	15	22
	7:45	8:00	30	3	10	0	33	43
	8:00	8:15	27	4	11	0	31	42
	8:15	8:30	15	5	7	0	20	27
	7:30	8:30	87	12	35	0	99	134
	8:30	8:45	20	3	4	0	23	27
	8:45	9:00	27	0	9	3	27	39
	9:00	9:15	33	7	2	0	40	42
	9:15	9:30	37	2	2	1	39	42
	8:30	9:30	117	12	17	4	129	150
	9:30	9:45	35	11	10	3	46	59
	9:45	10:00	41	10	11	2	51	64
	10:00	10:15	27	9	6	4	36	46
	10:15	10:30	22	10	3	1	32	36
	9:30	10:30	125	40	30	10	165	205
	AM Total (3 hours)							489
	AM Average (3 hours)							163
PM Peak Hours	15:30	15:45	11	33	7	11	44	62
	15:45	16:00	14	19	3	11	33	47
	16:00	16:15	24	26	5	7	50	62
	16:15	16:30	22	50	9	14	72	95
	15:30	16:30	71	128	24	43	199	266
	16:30	16:45	17	40	5	15	57	77
	16:45	17:00	22	22	7	8	44	59
	17:00	17:15	25	11	6	3	36	45
	17:15	17:30	12	25	4	18	37	59
	16:30	17:30	76	98	22	44	174	240
	17:30	17:45	33	23	3	22	56	81
	17:45	18:00	26	40	0	13	66	79
	18:00	18:15	19	24	3	15	43	61
	18:15	18:30	28	26	6	17	54	77
	17:30	18:30	106	113	12	67	219	298
	PM Total (3 hours)							804
	PM Average (3 hours)							268

Richwood Ave & Willey St Intersection Study

Pedestrian Counts

Sept. 12 Wednesday, 2018

	From	To	WB	EB	SB	NB	Conflict Total	Total
AM Peak Hours	7:30	7:45	7	0	8	0	7	15
	7:45	8:00	29	0	8	2	29	39
	8:00	8:15	26	8	9	0	34	43
	8:15	8:30	11	5	9	2	16	27
	7:30	8:30	73	13	34	4	86	124
	8:30	8:45	33	5	3	0	38	41
	8:45	9:00	20	2	2	0	22	24
	9:00	9:15	31	5	3	2	36	41
	9:15	9:30	41	4	2	2	45	49
	8:30	9:30	125	16	10	4	141	155
	9:30	9:45	33	10	11	4	43	58
	9:45	10:00	40	15	20	3	55	78
	10:00	10:15	22	16	7	3	38	48
	10:15	10:30	24	15	4	5	39	48
	9:30	10:30	119	56	42	15	175	232
	AM Total (3 hours)							511
	AM Average (3 hours)							170
PM Peak Hours	15:30	15:45	10	40	5	10	50	65
	15:45	16:00	10	21	4	9	31	44
	16:00	16:15	29	22	6	9	51	66
	16:15	16:30	33	42	7	15	75	97
	15:30	16:30	82	125	22	43	207	272
	16:30	16:45	20	40	5	14	60	79
	16:45	17:00	35	33	7	10	68	85
	17:00	17:15	26	21	6	6	47	59
	17:15	17:30	20	11	4	25	31	60
	16:30	17:30	101	105	22	55	206	283
	17:30	17:45	22	13	3	20	35	58
	17:45	18:00	25	33	0	9	58	67
	18:00	18:15	20	33	3	11	53	67
	18:15	18:30	30	35	6	10	65	81
	17:30	18:30	97	114	12	50	211	273
	PM Total (3 hours)							828
	PM Average (3 hours)							276

Richwood Ave & Willey St Intersection Study

Pedestrian Counts

Two Day Average (Sept. 11 and 12, 2018)

	From	To	WB	EB	SB	NB	Conflict Total	Total
AM Peak Hours	7:30	7:45	11	0	8	0	11	19
	7:45	8:00	30	2	9	1	31	41
	8:00	8:15	27	6	10	0	32.5	43
	8:15	8:30	13	5	8	1	18	27
	7:30	8:30	80	13	35	2	93	129
	8:30	8:45	27	4	4	0	30.5	34
	8:45	9:00	24	1	6	2	24.5	32
	9:00	9:15	32	6	3	1	38	42
	9:15	9:30	39	3	2	2	42	46
	8:30	9:30	121	14	14	4	135	153
	9:30	9:45	34	11	11	4	44.5	59
	9:45	10:00	41	13	16	3	53	71
	10:00	10:15	25	13	7	4	37	47
	10:15	10:30	23	13	4	3	35.5	42
	9:30	10:30	122	48	36	13	170	219
	AM Total (3 hours)							500
	AM Average (3 hours)							167
PM Peak Hours	15:30	15:45	11	37	6	11	47	64
	15:45	16:00	12	20	4	10	32	46
	16:00	16:15	27	24	6	8	50.5	64
	16:15	16:30	28	46	8	15	73.5	96
	15:30	16:30	77	127	23	43	203	269
	16:30	16:45	19	40	5	15	58.5	78
	16:45	17:00	29	28	7	9	56	72
	17:00	17:15	26	16	6	5	41.5	52
	17:15	17:30	16	18	4	22	34	60
	16:30	17:30	89	102	22	50	190	262
	17:30	17:45	28	18	3	21	45.5	70
	17:45	18:00	26	37	0	11	62	73
	18:00	18:15	20	29	3	13	48	64
	18:15	18:30	29	31	6	14	59.5	79
	17:30	18:30	102	114	12	59	215	286
	PM Total (3 hours)							816
	PM Average (3 hours)							272

Warrant 4: Pedestrian Volume

2: Willey St & Richwood Ave

Intersection Information

	Major Street	Minor Street
Street Name	Richwood Ave	-
Direction	NB/SB/SWB	
Number of Lanes	1	1
Approach Speed	30	0

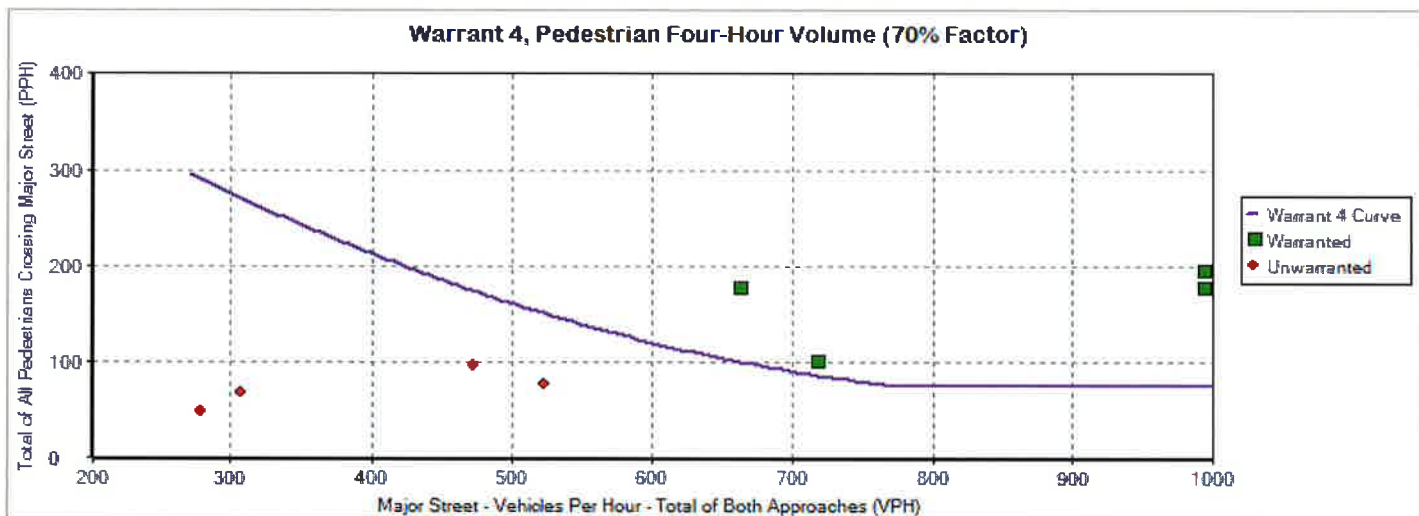
WARRANT 4 MET ? **Yes**

Details

Pedestrian Four Hour Volume Warrant Met? **Yes**

Pedestrian Peak Hour Warrant Met? **Yes** Notes 4 Hours met (4 required)

Speed Limit or 85th Percentile Speed on Major Street > 35mph, or
Intersection lies within an Isolated Community with Population < 10,000? **Yes**

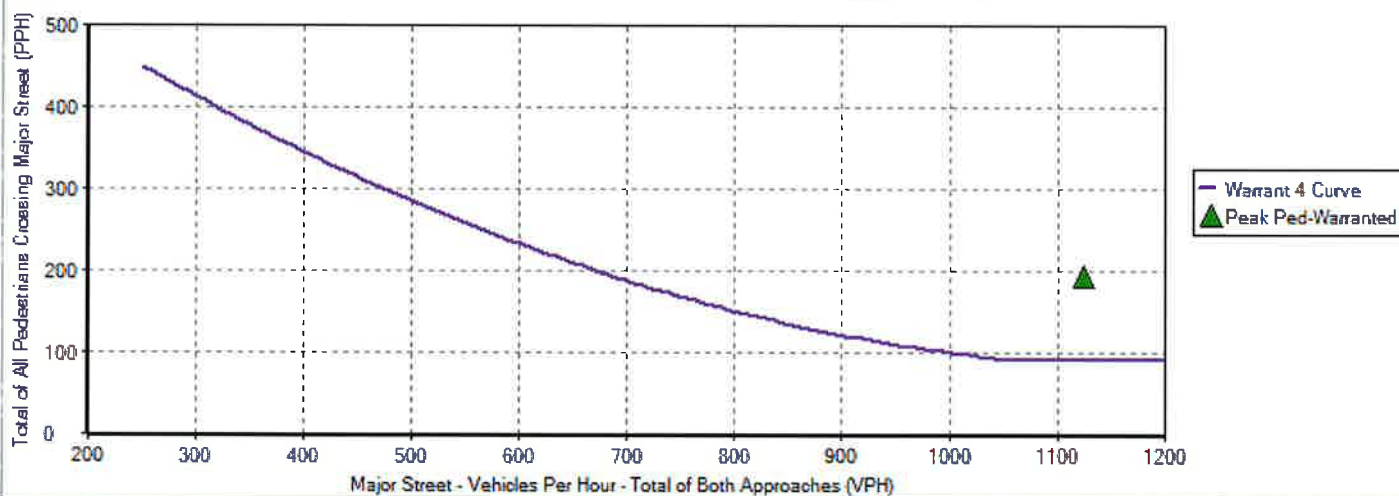


Warrant 4: Pedestrian Volume

2: Willey St & Richwood Ave

Hour	Major Street Vehicle Vol (vph)	Pedestrians Crossing Major
7:00	278	48
8:00	719	101
9:00	663	176
10:00	307	68
15:00	523	77
16:00	1,098	176
17:00	1,125	195
18:00	472	97

Warrant 4, Pedestrian Peak Hour (70% Factor)



Pedestrian Peak Hour

Hour	Vehicular Volume	Pedestrian Volume
17:00:00	1125	195

Appendix C: MPO Regional Travel Demand Model-Land Use Information Documentation

This Appendix includes a map showing transportation analysis zones in the MPO's Travel Demand Model and a table of social economic data (base year and future year) used in the model.

MPO staff selected pertinent data for TAZs considered to have relatively high impact to the Richwood Ave/Willey St intersection area. The TAZs cover the following:

- Willey St-Mileground Corridor
- Richwood Corridor
- Downtown/Greenmont Area
- Wiles Hill/Sunnyside Area

Notes to the social economy data table:

- TAZ = Transportation Analysis Zone
- SE_Households = Estimated number of households (base year)
- SE_RetailEmployment = Estimated number of retail employment (base year)
- NonRetailEmployment = Estimated number of non-retail employment (base year)

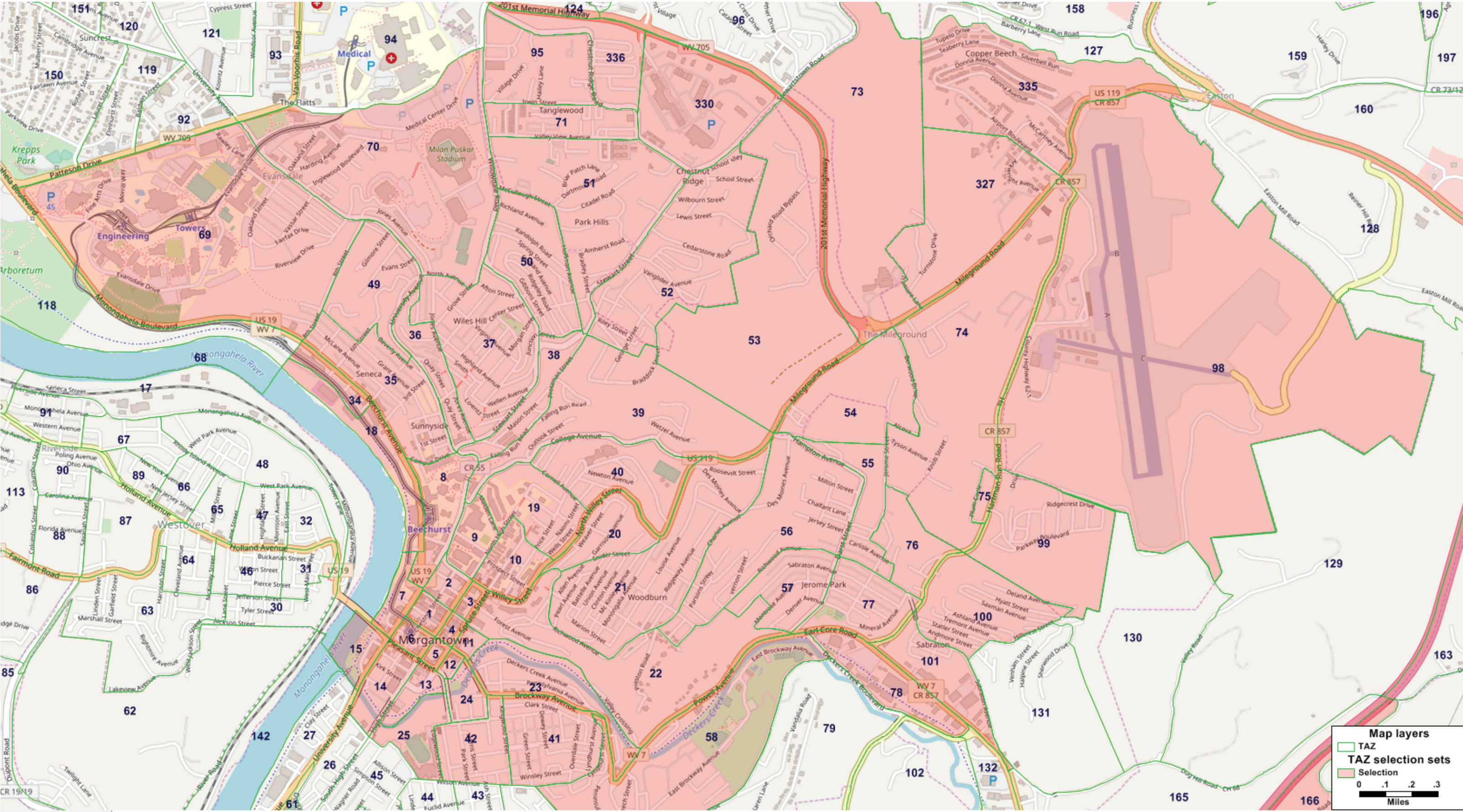
Based year data was developed in 2010, based on 2010 Census information, and was updated in 2017.

- Retail40 = Estimated number of retail employment in 2040
- NonRetail40 = Estimated number of non-retail employment in 2040
- Households40 = Estimated number of households in 2040

TAZ	SE_Households	SE_RetailEmployment	NonRetailEmployment	Retail40	NonRetail40	Households 40
1	53	201	74	215	146	60
2	37	223	95	295	216	50
3	54	159	145	171	210	60
4	46	125	308	142	503	40
5	27	119	44	131	92	35
6	21	20	377	32	573	30
7	58	56	10	78	28	55
8	53	0	238	2	349	89
9	0	0	513	2	741	0
10	201	68	78	79	124	221
11	4	0	0	9	3	15
12	10	0	33	9	57	15
13	19	75	89	95	157	35
14	32	141	123	170	221	40
15	54	26	9	38	22	64
18	75	0	739	23	1114	71
19	124	0	143	2	215	133
20	199	0	17	0	24	338
21	534	11	0	11	1	677
22	338	51	117	54	163	316
23	210	16	16	16	23	295
24	77	7	2	10	3	49
25	1	16	14	16	19	0
34	58	62	32	87	55	71
35	696	67	218	103	337	924
36	254	0	14	0	22	320
37	384	0	13	0	20	568
38	321	7	0	17	0	320
39	313	12	1243	14	1697	355
40	78	0	117	2	178	355
41	448	5	16	5	23	640
42	224	0	0	0	20	443

49	268	0	35	2	57	284
50	173	419	138	461	258	284
51	833	30	50	33	73	852
52	559	8	12	10	19	701
53	10	0	184	0	289	40
54	35	34	38	58	58	60
55	56	5	20	6	28	113
56	200	0	34	0	49	271
57	100	0	0	0	0	113
58	192	10	62	13	89	246
69	241	234	985	304	1414	298
70	475	182	1900	216	2659	551
71	529	0	1	0	1	140
73	23	0	4	3	5	40
74	65	150	312	238	488	80
75	10	0	0	0	0	6
76	24	0	98	0	136	45
77	113	0	15	0	20	147
78	2	180	100	180	100	2
95	524	79	583	87	815	568
98	7	45	72	70	200	30
99	158	0	1	0	1	180
100	78	0	3	1	4	147
101	24	70	120	6	0	45
327	30	0	1361	50	2000	30
330	0	100	200	150	300	0
335	250	10	10	50	30	350
336	200	0	0	0	0	300

Transportation Analysis Zone Map





Wiley St-Richwood Ave Intersection Improvement Study

Public Meeting

The event will be held as a part of the Woodburn Neighborhood Association Meeting

Crosley's Banquet Center, 616 Richwood Ave, Morgantown, WV

Monday, June 3, 2019, 6:30 – 7:30 pm



Contacts:
Bill Austin, AICP
Executive Director
Morgantown Monongalia MPO
243 High Street Room 110
Morgantown, WV 26505

Office: 304-291-9571

Submit your comment online at

www.plantgether.org/comments

Comments Due:

Thursday, June 6, 2019

Purpose of the Public Meeting

The purpose of this meeting is to provide information on the proposed improvements to the intersection of Willey St and Richwood Ave. This meeting is an opportunity for the community to provide comments on proposed alternatives and additional input on how to improve the intersection. Comments received during the meeting and from online will be documented in the final study report.

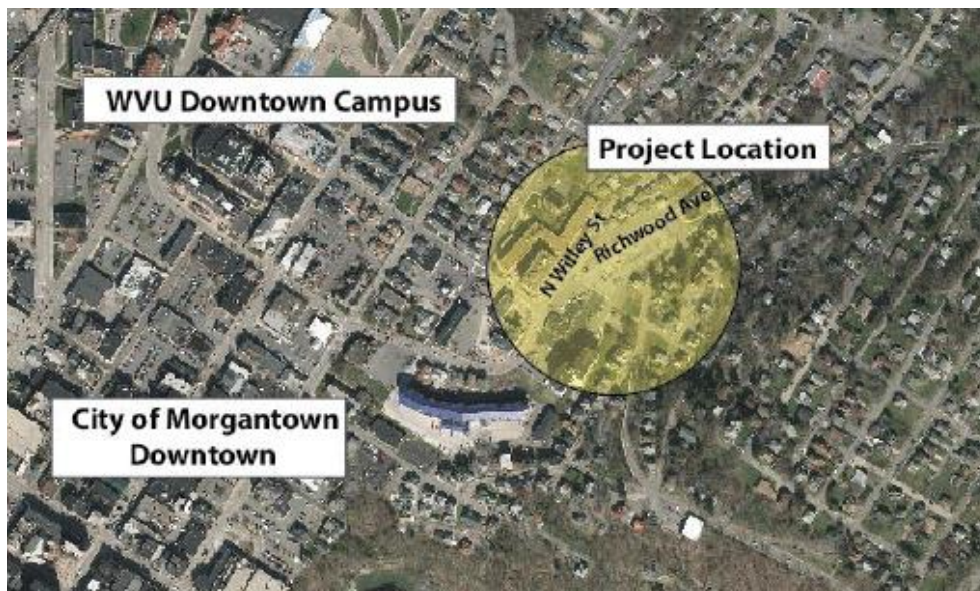
About the Project

The purpose of the Study is to determine the impact of correcting the subject intersection's unsafe skew on traffic operation in the area and to determine the impact of any correction on the larger transportation network including transit, pedestrians, and bicycles.

Specifically, the study intends to identify alternatives that

- Support future development in the study area.
- Improve traffic operation efficiency and safety.
- Improve pedestrian safety and transit operations.

The study area is shown below:



Alternatives considered

- **Signal Warrant.** Evaluate if the existing and proposed traffic pattern meet any warrants for a traffic signal at the study intersection
- **Street Realignment, Street Closure, One-way-street.** Identify and evaluate potential roadway changes on E Prospect, Richwood Ave, and Willey Street.
- **Pedestrian Infrastructure Improvement.** Identify opportunities to improve pedestrian travel in the study area, including enhanced crosswalks, pedestrian signage, lighting, and ADA compliance
- **Access Management.** Evaluate the need for access management in the study area.

Identified Issues

The following issues were identified during the data collection and evaluation process:

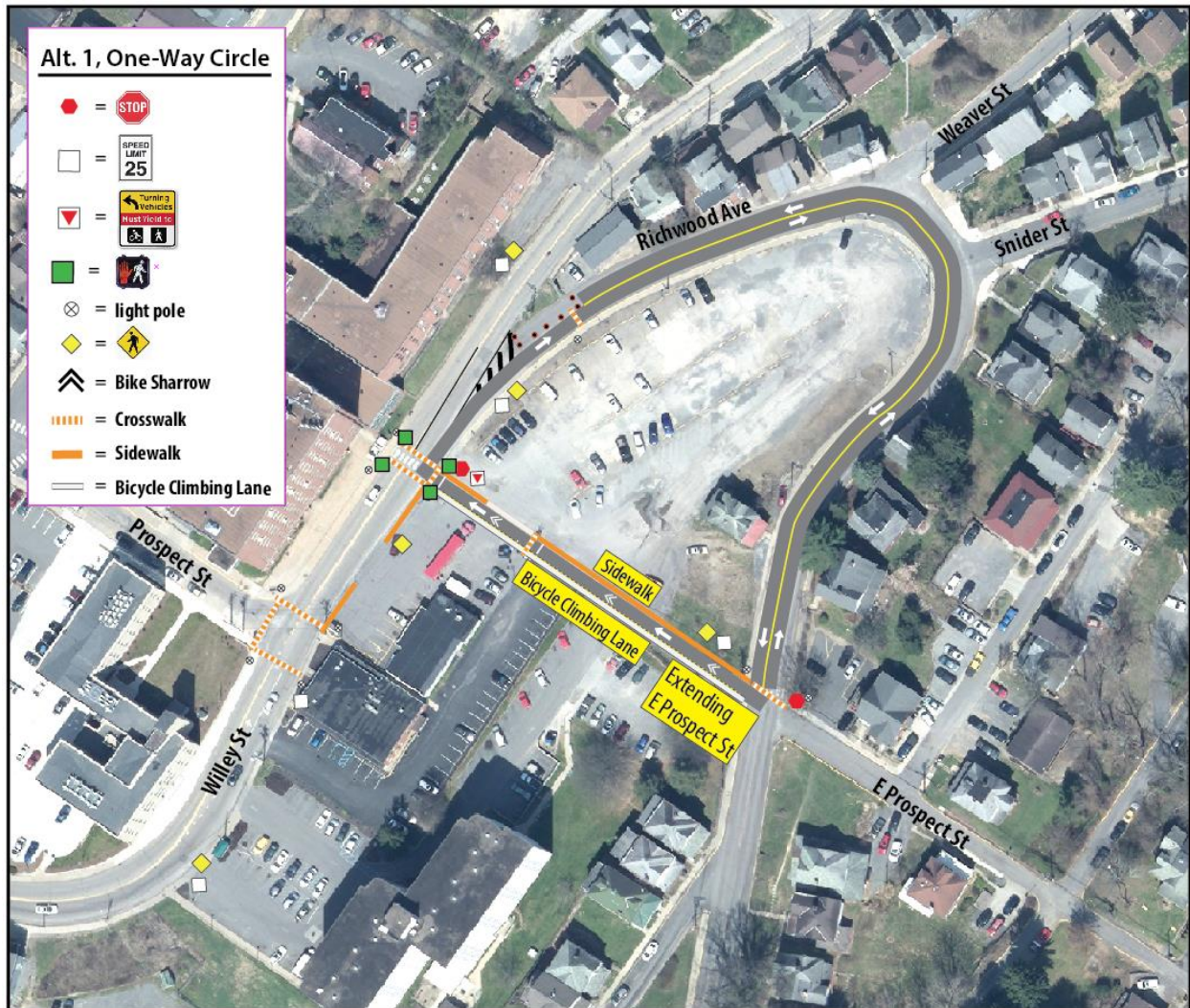
- **Safety at the Willey St/Richwood Ave intersection**
The intersection is skewed and on a steep slope. Due to the skew of the intersection and the curvature of Willey Street, motorists entering Willey St from Richwood Ave have limited vision, which increases safety concerns for both motorists and pedestrians.
- **Pedestrian crossing Safety on Willey St near the Little General store**
High pedestrian volumes were observed during AM and PM hours. There is a crosswalk, but in most cases, pedestrians do not use it to cross the street. The location meets the 2009 MUTCD Pedestrian signal warrant, for both four-hour-volumes and peak-hour volumes.
- **Insufficient lighting on Willey St near the Little General store**
Many crashes occurred at night when it is dark and visibility is low. MPO staff observed that in evenings, NB motorists on Willey are often blinded by the lights from the SB vehicles on Richwood Ave, making it is difficult for motorists to identify pedestrians crossing the street. While there are street lights attached to utility poles in the intersection area, lighting is not sufficient to provide a safe travel environment for pedestrians.
- **Road safety at the Willey St/Price St intersection**
There is a sight line concern at the intersection of Willey St and Price St. This intersection has exceptionally high crash frequency (rear end and opposite direction angle), compared to other intersections within the project area.
- **Pedestrian-vehicle conflict on the parking lot of the Little General store**
The parking lot of the Little General Store was frequently used by the store customers. Several pedestrian-vehicle near misses were observed due to pedestrians passing through the area.

The following opportunities were identified during the data collection and evaluation process:

- **Increasing traffic operation capacity**
Currently, the southbound left-turn from Willey St to Richwood Ave and southbound right-turn from Richwood Ave to Willey St movements are prohibited at the intersection of Willey St and Richwood Ave due to safety concerns. Improving the intersection geometry and allowing the prohibited turns will increase the operational capacity of the intersection.
- **Optimizing land use**
The triangle area at the intersection of Willey St-Richwood is used as an unpaved surface parking lot. Many empty parking spaces were observed throughout the day. The triangle area could be used for more productive purposes. (District: Third Ward, Map: 26, Parcel: 412)
- **E Prospect Street (Paper Street)**
A paper street exists between E Prospect St and Willey St. Currently the paper street is marked as a pedestrian walking path across the parking lot in the project area.

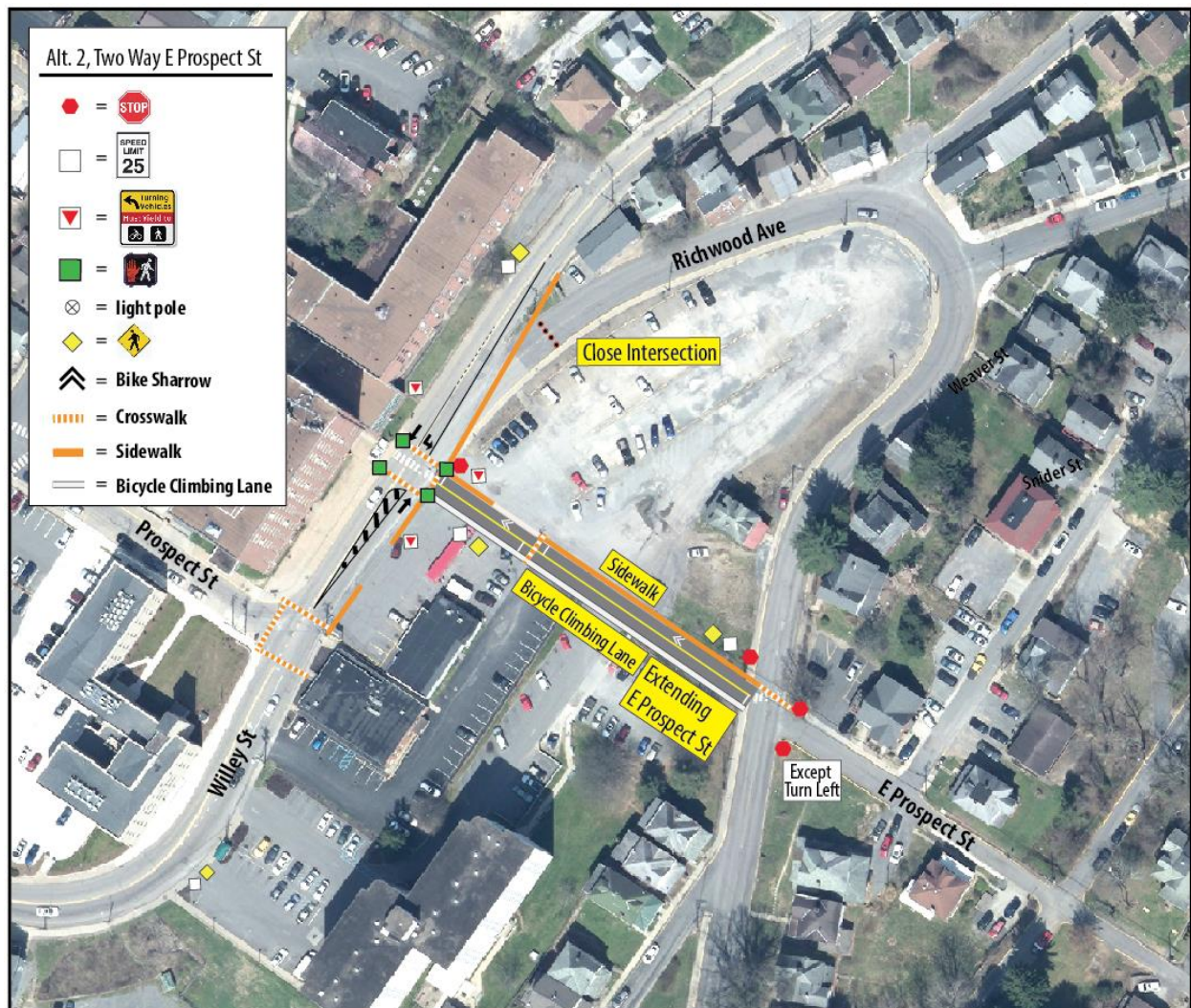
Alternative 1-One Way Circle (Short Term)

- Converting the Richwood Ave between Willey St and E Prospect St into a one-way street. (two way access only for traffic to Weaver St and Snider St)
- Extending E Prospect St to Willey St as a one-way street.
- Create a standard stop-controlled T intersection at the E Prospect St and Willey St.
 - Free-flow on Willey St and stop-control on E Prospect St
 - Improving lights for pedestrians safety
 - Install pedestrian signal and high-visibility crosswalk
- Provide additional crosswalks on Willey St near the intersection Willey St and Prospect St.
- Add pedestrian warning signs in the intersection area
- Reduce the speed limit on Willey St and Richwood Ave to 25 MPH in the intersection area.
- Add an additional driveway to access the parcel 412 (District 3, Map: 26)



Alternative 2-Two Way E Prospect St (Long Term)

- Close the intersection of Willey St and Richwood Ave
- Extend E Prospect St to Willey St as a two-way street.
- Create a four-way intersection at Richwood Ave and E Prospect St
 - Free flow for right-turn traffic from E Prospect St to Richwood Ave and left-turn traffic from Richwood Ave to E Prospect St.
- On the extended E Prospect St
 - Install right turn/left turn vehicles-yield-to-pedestrian signs
- Create a three-way intersection at the E Prospect St and Willey St.
 - Free-flow on Willey St and stop-control on E Prospect St
 - Add dedicated left-turn bay on Willey St.
 - Install pedestrian signal and high-visibility crosswalk
- Extend sidewalk on Willey St. Provide additional crosswalk on Willey St near the intersection Willey St and Prospect St.
- Reduce the speed limit on Willey St to 25 MPH in the intersection area.
- Add an additional driveway to access the parcel 412 (District 3, Map: 26)

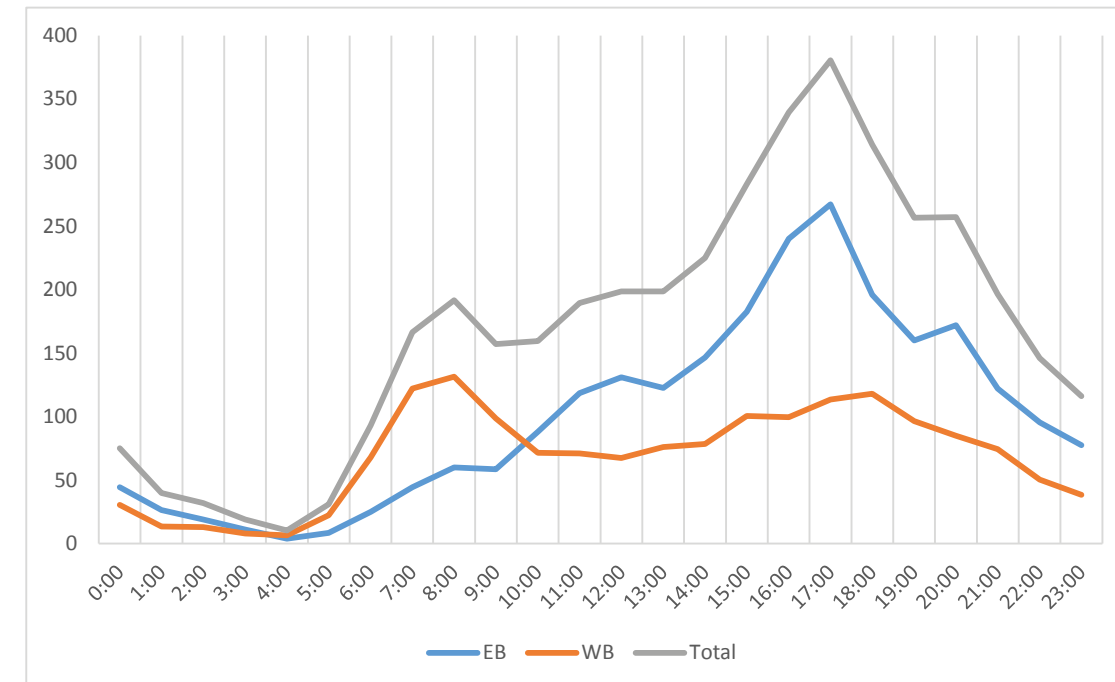




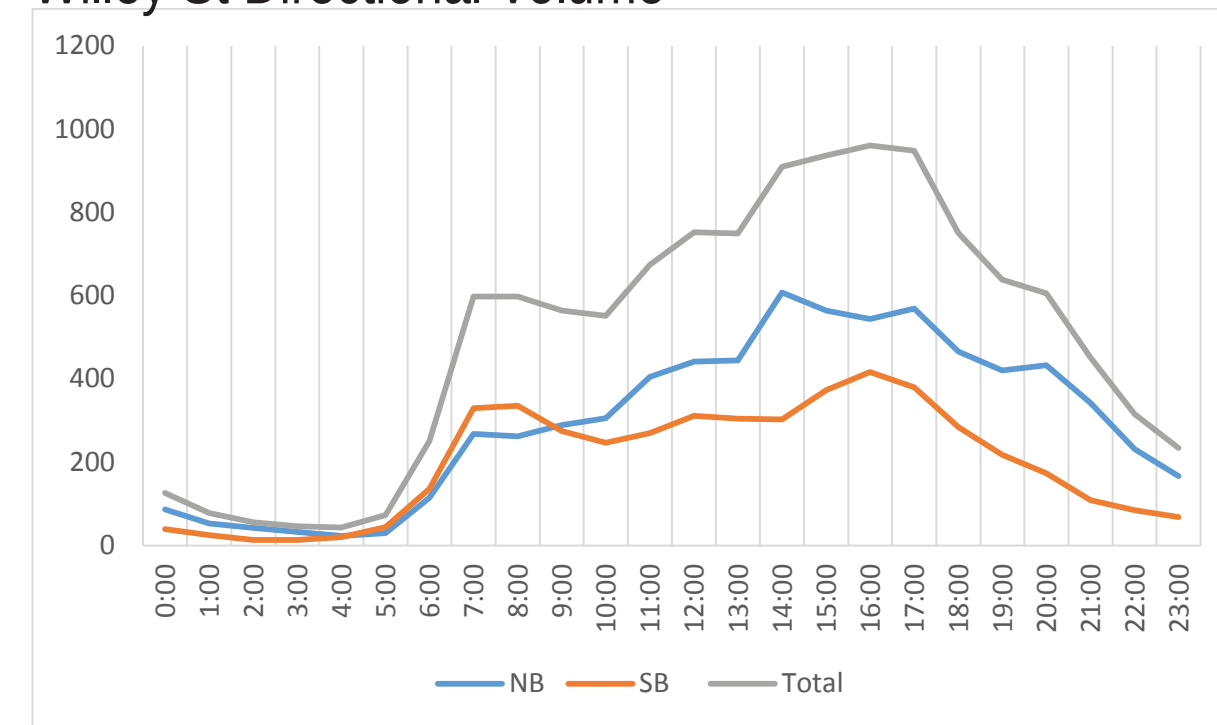
Willey St-Richwood Ave Intersection Improvement Study Public Meeting

Crosley's Banquet Center
616 Richwood Ave, Morgantown, WV
Monday, June 3, 2019, 6:30 – 7:30 pm

Richwood Ave Directional Volume

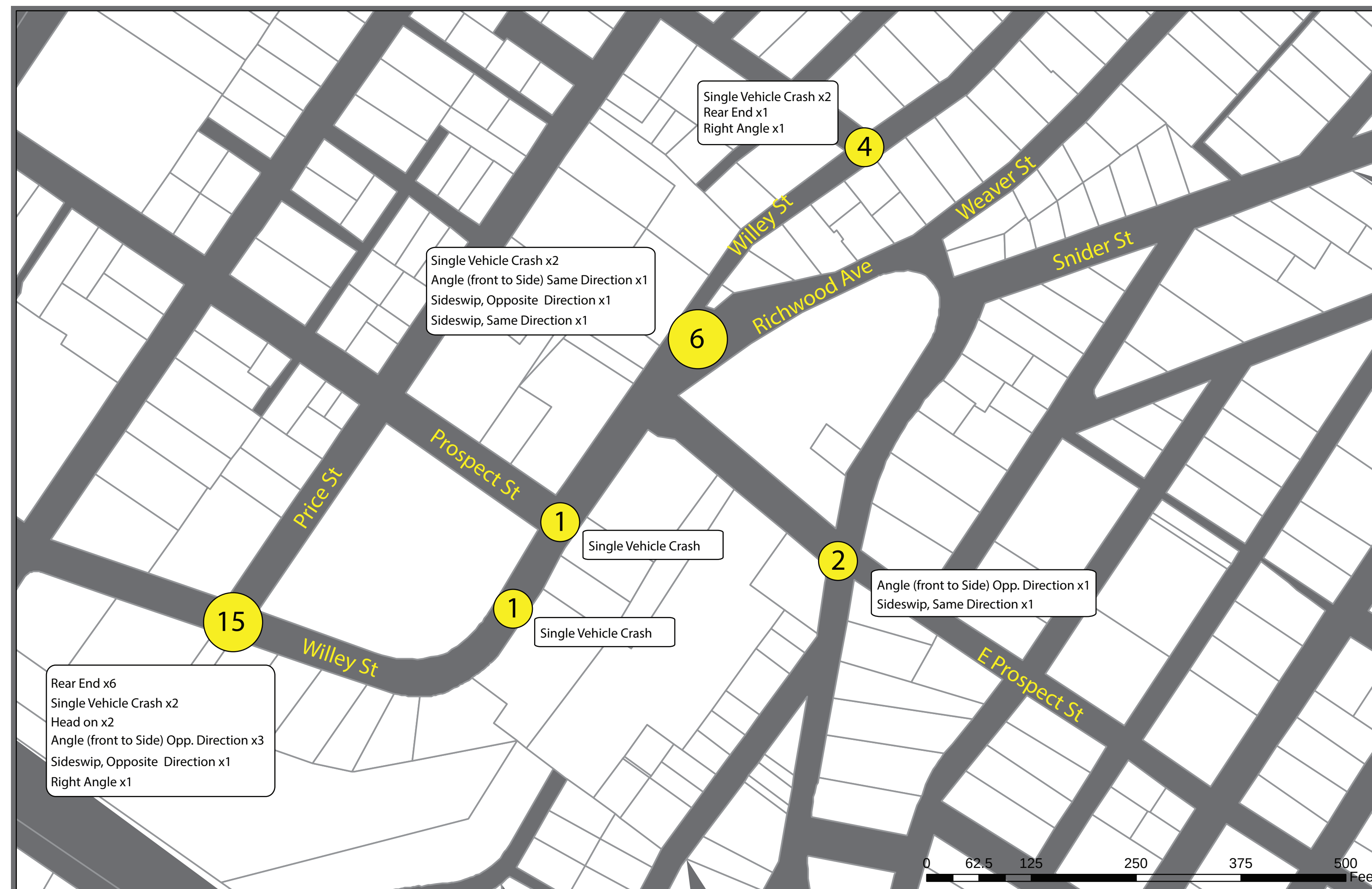


Willey St Directional Volume



Pedestrian Crossing on Willey St

7:30-8:30 AM	129
8:30-9:30 AM	153
9:30-10:30 AM	219
3:30-4:30 PM	245
4:30-5:30 PM	242
5:30-6:30 PM	286



The following issues were identified during the data collection and evaluation process:

Safety at the Willey St/Richwood Ave intersection

The intersection is skewed and on a steep slope. Due to the skew of the intersection and the curvature of Willey Street, motorists entering Willey St from Richwood Ave have limited vision, which increases safety concerns for both motorists and pedestrians.

Pedestrian crossing Safety on Willey St near the Little General store

High pedestrian volumes were observed during AM and PM hours. There is a crosswalk, but in most cases, pedestrians do not use it to cross the street. The location meets the 2009 MUTCD Pedestrian signal warrant, for both four-hour-volumes and peak-hour volumes.

Insufficient lighting on Willey St near the Little General store

Many crashes occurred at night when it is dark and visibility is low. MPO staff observed that in evenings, NB motorists on Willey are often blinded by the lights from the SB vehicles on Richwood Ave, making it difficult for motorists to identify pedestrians crossing the street. While there are street lights attached to utility poles in the intersection area, lighting is not sufficient to provide a safe travel environment for pedestrians.

Road safety at the Willey St/Price St intersection

There is a sight line concern at the intersection of Willey St and Price St. This intersection has exceptionally high crash frequency (rear end and opposite direction angle), compared to other intersections within the project area.

Pedestrian-vehicle conflict on the parking lot of the Little General store

The parking lot of the Little General Store was frequently used by the store customers. Several pedestrian-vehicle near misses were observed due to pedestrians passing through the area.

The following opportunities were identified during the data collection and evaluation process:

Increasing traffic operation capacity

Currently, the southbound left-turn from Willey St to Richwood Ave and southbound right-turn from Richwood Ave to Willey St movements are prohibited at the intersection of Willey St and Richwood Ave due to safety concerns. Improving the intersection geometry and allowing the prohibited turns will increase the operational capacity of the intersection.

Optimizing land use

The triangle area at the intersection of Willey St-Richwood is used as an unpaved surface parking lot. Many empty parking spaces were observed throughout the day. The triangle area could be used for more productive purposes. (District: Third Ward, Map: 26, Parcel: 412)

E Prospect Street (Paper Street)

A paper street exists between E Prospect St and Willey St. Currently the paper street is marked as a pedestrian walking path across the parking lot in the project area.

Alternative 1

One Way Circle (Short Term)

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light pole

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Bike Sharrow

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Crosswalk

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Sidewalk

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Bicycle Climbing Lane

- Convert Richwood Ave between Willey St and E Prospect St into a one-way street. (two way access only for traffic to Weaver St and Snider St)
- Extend E Prospect St to Willey St as a one-way street.
- Create a standard stop-controlled T intersection at the E Prospect St and Willey St intersection
- Free-flow on Willey St and stop-control on E Prospect St
 - Improving lighting for pedestrians safety
 - Install pedestrian signal and high-visibility crosswalk
- Provide additional crosswalks on Willey St near the intersection of Willey St and Prospect St.
- Add pedestrian warning signs in the intersection area
- Reduce the speed limit on Willey St and Richwood Ave to 25 MPH in the intersection area.
- Add an additional driveway to access parcel 412 (District 3, Map: 26)



Two Way E Prospect St (Long Term)



Close the intersection of Willey St and Richwood Ave

Extend E Prospect St to Willey St as a two-way street.

Create a four-way intersection at Richwood Ave and E Prospect St
 -- Free flow for right-turn traffic from E Prospect St to
 Richwood Ave and left-turn traffic from Richwood Ave to E Prospect St.

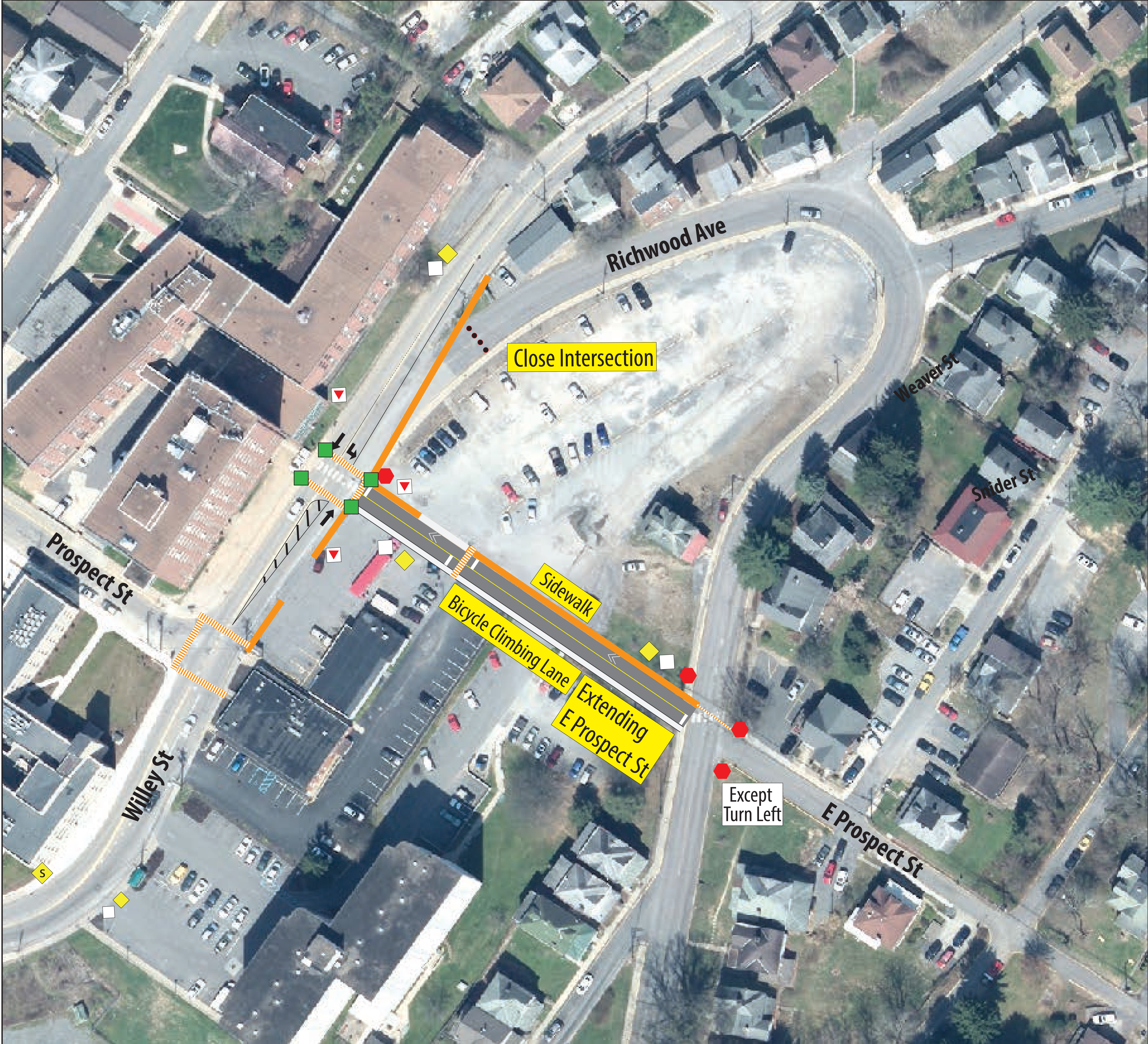
On the extended E Prospect St
-- Install right turn/left turn vehicles-yield-to-pedestrian signs

- Free-flow on Willey St and stop-control on E Prospect St
- Add dedicated left-turn bay on Willey St.
- Install pedestrian signal and high-visibility crosswalk

Extend sidewalk on Willey St. Provide additional crosswalk on Willey St near the intersection of Willey St and Prospect St.

Reduce the speed limit on Willey St to 25 MPH in the intersection area.

Add an additional driveway to access parcel 412 (District 3, Map: 26)



Jing Zhang

From: no-reply@parastorage.com
Sent: Thursday, June 06, 2019 9:11 AM
To: jzhang@plantogether.org
Subject: New message via your website, from [REDACTED]

A site visitor just submitted a new Contact Form
<https://www.plantogether.org/>

Message Details:

[REDACTED]
[REDACTED]
Subject: Intersection of Willey St and Richwood Ave

Message: I guess I'm glad something is being done, but even just a "use right turn signal" sign for traffic approaching from downtown could have made a huge difference here. If you want to save some money, I'd give that a shot first! I live in Woodburn up E. Prospect and the only reason I've ever seen congestion there is because most vehicles don't signal when they turn right from Willey onto Richwood, making it impossible for traffic on Richwood to flow smoothly onto Willey. Presumably this phenomenon also interferes with bike traffic, though I don't see much of that. In my experience, most bicyclists are already using the parking lot in essentially the same way some of these plans outline.

To edit your email settings, go to your Inbox on desktop.

Jing Zhang

From: no-reply@parastorage.com
Sent: Thursday, June 06, 2019 2:25 PM
To: jzhang@plantogether.org
Subject: New message via your website, from [REDACTED]

A site visitor just submitted a new Contact Form
<https://www.plantogether.org/>

Message Details:

[REDACTED]

Subject: Willey Street/Richwood Avenue
Message: Hello, I am the Sixth Ward Representative for the City of Morgantown Traffic Commission. I live in Jerome Park and use the Willey Street and Richwood Avenue intersection fairly frequently. I reviewed the documentation provided from the public meeting on 6/3/2019. It appears from a simple online records search that the triangle area parcel at the intersection is owned by Chico Enterprises, Inc., or Chico's Bakery. I would encourage for Chico's to be contacted in order to discuss a potential acquisition of the parcel, which is a terribly under-utilized space in a prime location (even during the school year, it remains mostly empty), before moving forward with the long term alternative. I would also like to request that cost estimates be provided for both alternatives, as well as details regarding potential funding for these projects as the improvements would occur on both state- and city-owned streets. Thank you, Erica Bowe Sixth Ward Representative, City of Morgantown Traffic Commission

To edit your email settings, go to your Inbox on desktop.

Jing Zhang

From: no-reply@parastorage.com
Sent: Thursday, June 06, 2019 11:38 PM
To: jzhang@plantogether.org
Subject: New message via your website, from [REDACTED]

A site visitor just submitted a new Contact Form
<https://www.plantogether.org/>

Message Details:

[REDACTED]

Subject: Willey/Richwood Plans

Message: I agree with the need for improvements at the Willey/Richwood intersection. I support Alternative #2. If you're going to build a new connector roadway, do it right and make it 2-way. Plans for signalization of the new E Prospect/Willey intersection are as clear as mud. The diagrams and text talk about putting up a pedestrian signal but having traffic be stop sign-controlled. This is contrary to guidance under the MUTCD Sections 4C.05, 4C.06, and 4F.02. If you're going to have a pedestrian signal, vehicular traffic should also be signal-controlled. I could support a traffic signal at this intersection if it meets the warrants and is coordinated with other nearby signals along Willey Street. I would not support a half-signal contrary to the MUTCD.

To edit your email settings, go to your Inbox on desktop.

Jing Zhang

From: no-reply@parastorage.com
Sent: Friday, June 07, 2019 9:35 AM
To: jzhang@planttogether.org
Subject: New message via your website, from [REDACTED]

A site visitor just submitted a new Contact Form
<https://www.planttogether.org/>

Message Details:

[REDACTED]

Subject: Willey Street - Richwood Avenue

Message: Good morning, I think Alternative 2 is better in the long run, I wish something could be done sooner, but the long term planning of Alternative 2 is the better plan. Thank you Mike Janes 701 Richwood Ave.

To edit your email settings, go to your Inbox on desktop.

TECHBRIEF



Pedestrian and Bicycle Safety



U.S. Department of Transportation
Federal Highway Administration

Research, Development, and
Technology

Turner-Fairbank Highway
Research Center

6300 Georgetown Pike
McLean, VA 22101-2296

www.tfhrc.gov

Safety Effectiveness of the HAWK Pedestrian Crossing Treatment

FHWA Publication No.: FHWA-HRT-10-045

FHWA Contact: Ann Do, HRDS-07, (202) 493-3319,
ann.do@dot.gov

This document is a technical summary of the Federal Highway Administration report, *Safety Effectiveness of the HAWK Pedestrian Crossing Treatment*, FHWA-HRT-10-042.

Objective

The city of Tucson, AZ, developed the High intensity Activated crossWaIk (HAWK) pedestrian crossing beacon in the late 1990s to assist in pedestrian crossings, especially at major arterials with minor street intersections.⁽¹⁾ Previous research found driver yielding percentages above 95 percent for the HAWK treatment, even on major streets with multiple lanes or higher speeds.⁽²⁾ Because of the limited number of treatments with high yielding rates for major arterials, the Federal Highway Administration (FHWA) sponsored this current study to evaluate the safety effectiveness of the HAWK device. This TechBrief provides a summary of the research findings, while the corresponding main technical report (FHWA-HRT-10-042) provides additional details.⁽³⁾

Background

While several roadway treatments are available to address pedestrian concerns, only a few are appropriate for high-speed or wide-crossing conditions. The HAWK beacon was developed to address these conditions. At a HAWK crossing, drivers receive multiple cues to emphasize the potential presence of a pedestrian. These cues include a unique configuration of the HAWK beacon (two red lenses over a single yellow lens), high-visibility crosswalk markings (ladder-style markings as opposed to only two transverse white lines), a stop bar approximately 50 ft from the crosswalk, 8-inch solid lane lines between through travel lanes, signs that can be illuminated and read "CROSSWALK," and School Warning signs. When activated, the HAWK uses a red indication to inform drivers to stop, thereby creating a time period for pedestrians to cross

the major roadway. Figure 1 shows an example of the current head configuration for the HAWK. At the time of this study, HAWKs were used at more than 60 locations in Tucson, AZ.

The HAWK beacon is not illuminated until it is activated by a pedestrian, triggering the warning flashing yellow lens on the major street. After a set amount of time, the indication changes to a solid yellow light to inform drivers to prepare to stop. The beacon then displays a dual solid red light to drivers on the major street and a walking person symbol to pedestrians. At the conclusion of the walk phase, the beacon displays an alternating flashing red light, and pedestrians are shown an upraised hand symbol with a countdown display informing them of the time left to cross. During the alternating flashing red lights, drivers can proceed after coming to a

full stop and checking that pedestrians have already crossed their lane of travel. Each successive driver is legally required to come to a full stop before proceeding during the alternating flashing red phase.

The alternating flashing red phase allows the driver delay to match the actual crossing needs of the pedestrian. Drivers can proceed with a stop-and-go operation during the flashing red phase if a pedestrian walks faster than the assumed walking speed and clears the lanes or roadway, as appropriate. If pedestrians need more time, then the drivers remain stopped until they finish crossing. The ability to balance the needs of the pedestrians with driver delay is a valuable component of the HAWK treatment. Concerns have been expressed regarding driver behavior and understanding of the dark phase (not illuminated) and the



Figure 1. Example of a HAWK treatment in Tucson, AZ.

flashing red phase. Experiences in Tucson, AZ, have demonstrated that, with proper education and with experience, drivers understand when they should stop and when they should resume travel. The city has conducted public campaigns and increased enforcement to teach and encourage appropriate driver and pedestrian behavior at HAWK crossings as well as at all pedestrian crossings.

Following the completion of this study but prior to publication, the 2009 *Manual on Uniform Traffic Control Devices* (MUTCD) was released.⁽⁴⁾ The 2009 MUTCD includes information about the pedestrian hybrid beacon, which is similar to the HAWK. The material in the 2009 MUTCD differs from the HAWKs included in this safety study in the following ways:

- Section 4F.02 of the 2009 MUTCD has the following guidance statement: “When an engineering study finds that installation of a pedestrian hybrid beacon is justified, then:
 - A. The pedestrian hybrid beacon should be installed at least 100 feet from side streets or driveways that are controlled by STOP or YIELD signs.”⁽⁴⁾
- All 21 HAWKs included in this study were located either at a minor intersection (where the minor street was controlled by a STOP sign) or at a major driveway (where the driveway was controlled by a STOP sign).
- The 2009 MUTCD includes an R10-23 sign with the symbolic red circle and a white background for the crosswalk section of the sign.⁽⁴⁾ The signs typically used at the HAWK locations in Tucson, AZ, do not have the symbolic red circle, and the background is yellow for the crosswalk section of the sign.

Methodology

This TechBrief presents the findings from an FHWA study that determined safety benefits of the HAWK device. Before-after evaluations compared crash predictions for the after period

(which assumed the treatment had not been applied) to the observed crash frequency for the after period (with the treatment installed) using an empirical Bayes (EB) method.⁽⁵⁾

Development of Safety Performance Functions

The first step in the before-after EB method was to develop and calibrate safety performance functions (SPFs) using data from a reference group. Development of the SPFs involved determining which predictor variables should be used in the model, how variables should be grouped, and what model form should be used. The major street and minor road average daily traffic (ADT) values are often the key variables in developing SPFs for intersections. In addition, pedestrian volumes are likely to play an important role in pedestrian crashes. To account for additional intersection-to-intersection variability (other than that caused by the differences in traffic volumes and pedestrian volumes), intersection type, median refuge presence, number of lanes, and major street speed limit were also considered in the SPF predictions.

Site Selection and Geometric Data

The city of Tucson, AZ, provided the research team with a list of all HAWKs that were installed or planned. Sites planned or installed less than 18 months prior to this study were not evaluated. Only sites with the current head configurations (see figure 1) that were newly installed (21 locations) were included in the before-after study. The previous head configuration had a similar appearance as a vertical traffic signal.

Crash evaluations benefit when a reference group of similar sites without treatment is identified. Researchers identified two potential reference groups—reference group 1 and reference group 2—and derived the safety effectiveness estimate for HAWKs using each reference group. Reference group 1 included 36 signalized and 35 unsignalized intersections. Because of concerns with including signalized intersections, reference group 2 was developed and consisted of 102 unsignalized intersections.

Traffic Counts

Several sources were used to obtain vehicle counts, including traffic counts (or historical maps) available on the Web and historical counts from the Pima Association of Governments.^(6,7) Vehicle counts from existing sources were identified for most of the major streets of the intersections. None of the existing sources had pedestrian counts available. Therefore, 2-h pedestrian counts were collected during spring 2008 and spring 2009. The city of Tucson, AZ, provided the research team with 24-h video surveillance of five HAWK sites. The number of pedestrians crossing for each hour was counted from the videos, and pedestrian crossing distributions were determined and used to adjust the 2-h count into 24-h pedestrian counts. Appropriate seasonal variations were determined from *Traffic Volumes Map*, which noted that winter visitors and college students contributed to higher volumes during the spring.⁽⁷⁾

Study Periods

For the before-after study, the goal was to have 36 months of before data and 36 months of after data. The before period reflected month 38 to month 2 prior to the installation date of the HAWK. The calculations assumed 2 months prior to the installation date as construction. The 2 months following installation of the HAWK were assumed to be a learning period for drivers to become familiar with the treatment. The after period occurred 2 to 38 months following the installation of the HAWK or until December 31, 2007, which was the limit of crash data available.

The number of months in the after period for the 21 HAWK sites varied depending on when the HAWK was installed. The majority of the sites had a 32-month or greater after period, with more than 80 percent of the sites having at least a 28-month after period. Reference group sites had the same time period in their before and after periods as their corresponding HAWK site.

Crash Data

Crash data were supplied by the city of Tucson, AZ, and street names were used to match crashes with the geometric database. Identifying all crashes with matching street names should capture the crashes that could be influenced by the intersection's traffic control; however, it may also capture crashes that would not have been influenced. The intersection-related (IR) variable may provide insight into whether the crash is related to the intersection's traffic control. The permitted responses for IR crashes were "yes," "no," or blank, and about $\frac{1}{3}$ of the crashes had this field blank. A comparison of the number of IR crashes for a sample of intersections to material available in a previous study indicated that the IR variable may be too restrictive. Therefore, the following two crash datasets were used in the evaluations:

- Intersecting street name (ISN) crashes were identified by matching the street names for the intersection.
- IR crashes were identified as the crashes in the ISN crash dataset with "yes" for the IR code.

The following types of crashes from each of the crash datasets were considered:

- Total crashes included all crashes identified.
- Severe crashes included all crashes with an injury severity code of possible injury, nonincapacitating injury, incapacitating injury, or fatal injury.
- Pedestrian crashes included all crashes with the type of collision coded as pedestrian.

Aggregating Crash Data

In developing the SPFs, the crash counts at reference sites can be treated as aggregated data over the entire study period (including both the before and after periods) or as disaggregated data with two crash counts from each intersection—one for the before period and one for the after period. Aggregating the data is

one way to account for the correlations that might be present in the crash counts when the intersections are included twice (once for the before period and once for the after period) in estimating the SPFs. Disaggregating the data provides the opportunity to account for a general time trend (if any exists) within the two periods. For the disaggregated data, it is desirable to use the generalized estimating equation approach in estimating the SPF coefficients to incorporate the potential correlation in the before and after crash counts from the same intersection. Both approaches were explored in this study.

Observations

Table 1 summarizes the number of crashes by control type. HAWKs are installed to assist pedestrians in crossing the roadway; therefore,

installing the device should have a notable impact on pedestrian crashes. The impact on total or severe crashes is not as intuitive. Using IR crashes, the HAWK sites experienced a decrease in the total crash rate of about 35 percent after installation. The 102 unsignalized intersections in reference group 2 experienced a 9 percent decrease, and signalized intersections in reference group 1 had a 17 percent decrease. These observations indicate that citywide conditions may have contributed to the reduction in crashes since all types of intersection control showed reductions in total IR crashes.

The HAWK sites experienced a large decrease of 86 percent in the pedestrian IR crash rate after installation. The 102 unsignalized intersections experienced an increase in pedestrian crashes of 143 percent. Therefore, if citywide

Table 1. Crash data for before-after study by groups.

Treatment Group	Measure	ISN Crashes			IR Crashes		
		Before	After	Percent Change (%)	Before	After	Percent Change (%)
HAWK sites (21)	Frequency	11.0	9.2	-17	5.0	3.3	-34
	Total crashes/MEV&P	0.748	0.618	-17	0.341	0.223	-35
	Severe crashes/MEV&P	0.265	0.210	-21	0.138	0.094	-32
	Pedestrian crashes/MEV&P	0.029	0.005	-83	0.017	0.002	-86
	Pedestrian crashes/MEP	3.081	0.511	-83	1.826	0.255	-86
Reference group 1: Signalized intersections (36)	Frequency	44.9	41.9	-7	19.6	16.8	-14
	Total crashes/MEV&P	1.953	1.788	-8	0.854	0.716	-16
	Severe crashes/MEV&P	0.549	0.503	-8	0.294	0.241	-18
	Pedestrian crashes/MEV&P	0.020	0.016	-23	0.010	0.008	-16
	Pedestrian crashes/MEP	2.051	1.546	-25	1.025	0.839	-18
Reference group 1: Unsignalized intersections (35)	Frequency	4.2	4.3	3	1.6	1.3	-17
	Total crashes/MEV&P	0.285	0.292	2	0.108	0.090	-17
	Severe crashes/MEV&P	0.098	0.088	-10	0.043	0.038	-10
	Pedestrian crashes/MEV&P	0.006	0.009	52	0.003	0.004	42
	Pedestrian crashes/MEP	1.383	2.078	50	0.615	0.866	41
Reference group 2: Unsignalized intersections (102)	Frequency	5.9	6.1	3	2.4	2.1	-9
	Total crashes/MEV&P	0.418	0.430	3	0.166	0.150	-9
	Severe crashes/MEV&P	0.140	0.141	0	0.060	0.056	-6
	Pedestrian crashes/MEV&P	0.006	0.011	93	0.001	0.003	143
	Pedestrian crashes/MEP	1.233	2.297	86	0.257	0.602	134

Crashes/MEV&P = Type of given crash (total, severe, or pedestrian crashes) per million entering vehicles and pedestrians.

Pedestrian crashes/MEP = Pedestrian crashes per million entering pedestrians.

Note: Frequency is expressed as the average annual number of total crashes for a site with the given intersection control and study period.

conditions were contributing to reductions in total crashes, these conditions were not having the same impact on pedestrian crashes, or other factors were contributing to a rise in pedestrian crashes at unsignalized intersections but not at signalized and HAWK intersections.

From table 1, it is observed that HAWK locations have crash rates higher than unsignalized intersections. For this dataset, the HAWK locations were associated with a slightly greater number of crashes per million entering vehicles and pedestrians, as compared to the nearby unsignalized intersections. This observation does not imply that if the HAWK was removed, the crash rate for a given intersection would be similar to the crash rate identified for the neighboring unsignalized intersections. When the sites were unsignalized intersections (i.e., before the HAWK was installed), the crash rate at the sites exceeded the crash rate for nearby unsignalized intersections. Therefore, conditions at the HAWK locations before the treatment was installed were generating crashes in greater numbers than the unsignalized intersections. This indicates that those intersections were associated with conditions that resulted in a higher number of crashes. Addressing those conditions with a HAWK resulted in a decrease in total crashes and a large decrease in pedestrian crashes. The following section provides the findings from the statistical evaluation.

Results

To account for the effects of variables in crash reduction as well as the potential regression-

to-the-mean bias, the EB approach was employed to identify the safety effectiveness of the HAWK treatment. The corresponding main report includes the reasonable SPFs identified in this study.⁽³⁾ Although the magnitude of the safety effectiveness estimate varied to some extent as different predictors were included in the SPFs, the results did not seem to change materially. Table 2 summarizes the percent reduction and whether the finding was significant at the 95 percent confidence level from the different approaches used in evaluating the HAWK beacon.

The results for total crashes were similar regardless of the approach used to evaluate the data. The reduction was about 16 percent for ISN crashes (14 to 19 percent) and 27 percent for IR crashes (23 to 29 percent), all of which were significant at the 95 percent confidence level.

There were similar results for pedestrian crashes, with the disaggregate approach resulting in higher reductions (65 or 69 percent) than the aggregate approaches (between 51 and 59 percent). As seen in several evaluations, severe crash results were not at the desired confidence levels. The smaller sample size probably affected the results.

Although the safety effectiveness estimate did not change significantly with which reference group was used, reference group 2 was chosen as the more appropriate reference group, since in most cases, the HAWK was installed at a previously unsignalized intersection.

Table 2. Summary of results.

Reference Group (Aggregation)	Percent Reduction (Significant at the 95 Percent Confidence Level)		
	Total Crashes	Severe Crashes	Pedestrian Crashes
ISN Crashes			
1 (aggregated)	15 (Yes)	11 (No)	57 (Yes)
2 (aggregated)	14 (Yes)	13 (No)	59 (Yes)
2 (disaggregated)	19 (Yes)	14 (No)	69 (Yes)
IR Crashes			
1 (aggregated)	29 (Yes)	18 (No)	56 (No)
2 (aggregated)	29 (Yes)	15 (No)	51 (No)
2 (disaggregated)	23 (Yes)	8 (No)	65 (Yes)

Summary and Conclusions

The objective of this study was to evaluate the safety effectiveness of the HAWK device. This study used a before-after EB method which accounted for possible regression-to-the-mean bias as well as traffic, weather, citywide public relations campaigns, and other factors that changed over time. SPFs were developed using reference site data consisting of nearby intersections that did not have HAWK treatments. The study included 21 intersections where a HAWK had been installed and two reference groups. Evaluation approaches explored the following:

- Three types of crashes (total, severe, and pedestrian).
- Two methods for identifying crashes (ISN and IR).
- Two reference groups (reference group 1 with 36 signalized and 35 unsignalized intersection and reference group 2 with 102 unsignalized intersections).
- Two ways to combine the reference group before and after data (aggregated and disaggregated).

The crash prediction during the before period was calculated from SPFs and combined with the observed crash count for the before period by using a weighted average to control for regression-to-the-mean bias. This weighted average was adjusted for differences in duration and traffic volumes (and general time trends if any existed) between the before and after periods. This led to a crash prediction for the after period had the treatment not been applied. EB then compared this predicted value to the observed crash frequency for the after period.

Two crash datasets were used in the before-after evaluation. In theory, the IR crash dataset should have better represented those crashes that would be affected by the traffic control at the intersection. A closer review revealed that the IR code was not used in over a $\frac{1}{3}$ of the crashes; therefore, too many crashes may have

been eliminated. The ISN crash dataset, however, may include crashes that are not related to the traffic control. Therefore, both datasets were considered. The IR crashes were considered as the more appropriate dataset for total and severe crashes. The ISN crash dataset, however, may be more representative of the change in pedestrian crashes since the HAWK device could induce pedestrians to walk an additional distance to benefit from an activated traffic control device.

The before-after evaluation results were as follows:

- There was a 29 percent reduction in total crashes, which is statistically significant at the 95 percent confidence level.
- There was a 69 percent reduction in pedestrian crashes, which is statistically significant at the 95 percent confidence level.
- There was a 15 percent reduction in severe crashes, which is not statistically significant at the 95 percent confidence level.

The prime objective of a HAWK is to provide pedestrians with safe crossing opportunities. As such, a reduction in pedestrian crashes would be expected to be associated with the HAWK, and a statistically significant reduction in pedestrian crashes was found. The installation of the HAWK was also found to be associated with a statistically significant reduction in total crashes. It should be noted that the HAWK treatment, just like any other warning traffic control device, may not work as effectively if it is overused. In addition, such high crash reductions identified in this study may not be achieved at future locations if the site has different characteristics, such as less pedestrian activity.

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