2010-2012 Green Bay Metropolitan Area Intersection Crash Study

Brown County Planning Commission/Green Bay MPO
February 2015

Brown County Planning Commission
Green Bay MPO

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Green Bay MPO Planning Area Communities

City of Green Bay
City of De Pere
Village of Allouez
Village of Ashwaubenon
Village of Bellevue
Village of Hobart
Village of Howard
Village of Suamico (part)
Town of Green Bay (part)
Town of Lawrence (part)
Town of Ledgeview (part)
Town of Rockland (part)
Town of Scott (part)
Town of Little Suamico (part)

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U.S. Department of Transportation Federal Transit Administration

Wisconsin Department of Transportation

Brown County Established 1818

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Information in this report is subject to change based on the final disposition of the federal transportation reauthorization bill Moving Ahead for Progress in the 21st Century (MAP-21).

2010-2012 Green Bay Metropolitan Area Intersection Crash Study

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Table of Contents

Maps and Figures

I. Introduction

The Green Bay Metropolitan Area experiences hundreds of vehicle crashes every year that are caused by a variety of factors, and most of these crashes occur at intersections because these are the main conflict points in the street system. In 2001, MPO staff completed a study that examined the 30 metropolitan area intersections that experienced at least 15 reportable crashes and had the highest average annual crash rates between 1997 and 1999. In 2006, MPO staff updated this study by identifying the 30 most hazardous metropolitan area intersections between 2002 and 2004. The 2006 study also examined the status of each of the 30 intersections profiled in the 2001 study to determine how they were performing five years later. A third study was completed in 2010, and this study identified and analyzed the 30 most hazardous metropolitan area intersections between 2007 and 2009. This study also examined the status of the 30 intersections profiled in the 2006 study to see if improvements had occurred.

The findings of the previous three studies have been used by the state, county, and communities to improve safety at intersections. MPO staff is now completing a fourth study that examines the 10 metropolitan area intersections that experienced at least 15 reportable crashes and had the highest estimated average annual crash rates between 2010 and 2012 to determine the primary causes for the incidents and propose methods of correcting many of the major problems that appear to exist at the intersections. This study also examines the status of the 10 most hazardous intersections that were profiled in the 2010 study to see if improvements have occurred.

The number of intersections that are profiled in this study is 10 instead of 30 because the previous crash studies have shown that the intersections with unusually high crash rates and numbers tended to be ranked in the top 10. Like the previous three intersection crash studies, the 2010-2012 study does not include intersections at metropolitan area freeway interchanges because reliable crash rates could not be calculated using the available information.

The crash information for this study was obtained from the University of Wisconsin's Traffic Operations and Safety (TOPS) Laboratory database and through reviews of each intersection in the report. The TOPS Laboratory records are very extensive and provide a detailed summary of the information provided on the forms completed by law enforcement officers at the scene of every reportable crash. The summary information, field visits, and the experience of observing and using many of the intersections on a daily basis enabled staff to develop observations and comments for the study.

II. Explanation of Terms Used in the Study

Estimated Crash Rate

The crash rates for nearly all of the intersections in this study were estimated using Wisconsin Department of Transportation (WisDOT) Annual Average Daily Traffic (AADT) volume data from 2009 and 2012. The AADT volumes from 2009 and 2012 were averaged to develop estimates of entering vehicles over the three-year study period. For intersections where WisDOT AADT volume data were not available for the study period, MPO staff used traffic count data from the affected jurisdictions.

The estimated crash rates identified in this study represent the number of crashes that occurred for every million vehicles that entered each intersection in a year. The intersections were ranked by crash rate because this was assumed to be the most appropriate indication of safety problems, but many intersections with relatively low rates experienced many property damage and injury crashes throughout the three-year study period and should not be disregarded merely because of their lower rates. Each intersection's estimated crash rate during the study period is shown in Map 1, and the number of crashes experienced at each intersection during the study period is shown in Map 2.

Reportable Crashes During the Study Period

This study only includes crashes that are considered to be reportable by the law enforcement officer who was at the scene because these are believed to be the most severe and are the incidents that are submitted to the TOPS Laboratory in Madison. For a crash to be reportable, an officer has to believe that government property has sustained a minimum of $200 damage, that non-government property has sustained a minimum of $1,000 damage, or that an injury or death has occurred. Crashes where these criteria are not met are typically noted by officers but are not submitted to the TOPS Laboratory for inclusion in the database.

Estimated Property Damage Cost During the Study Period

To estimate the property damage costs at each intersection for the period between 2010 and 2012, staff used the National Safety Council's (NSC's) 2011 average per-crash property damage estimate of $12,800.

Fatalities During the Study Period

This statistic identifies the number of people who were killed at each intersection during the three-year study period.

Estimated Fatality Cost During the Study Period

To estimate the fatality costs at each intersection for the period between 2010 and 2012, staff used the NSC's 2011 average estimate of $1,420,000 per fatality.

Injuries During the Study Period

This statistic identifies the number of people who were injured at each intersection during the three-year study period. Like the injury figures in the MPO's 2007-2009 intersection crash study, the 2010-2012 study classifies injuries based on three levels of severity as determined by the law enforcement officers completing the reports. These are:

- Incapacitating injuries (Class A)
- Non-incapacitating injuries (Class B)
- Possible injuries (Class C)

Estimated Injury Cost During the Study Period

To estimate the average annual injury costs at each intersection for the period between 2010 and 2012, staff used the NSC's 2011 average per-injury estimates for Incapacitating, Non-incapacitating, and Possible injuries. These are:

- Incapacitating injuries (Class A): $70,500 per injury
- Non-incapacitating injuries (Class B): $22,700 per injury
- Possible injuries (Class C): $12,800 per injury

Crash Type

The crash reports provided by the TOPS Laboratory identify several types of crashes, but this study focuses on right angle, rear end, head on, and side swipe crashes because these were usually the most common and severe types of crashes at each intersection. The study also notes the percentage of crashes that involved pedestrians and bicyclists to determine if the intersections are relatively unsafe for these transportation modes.

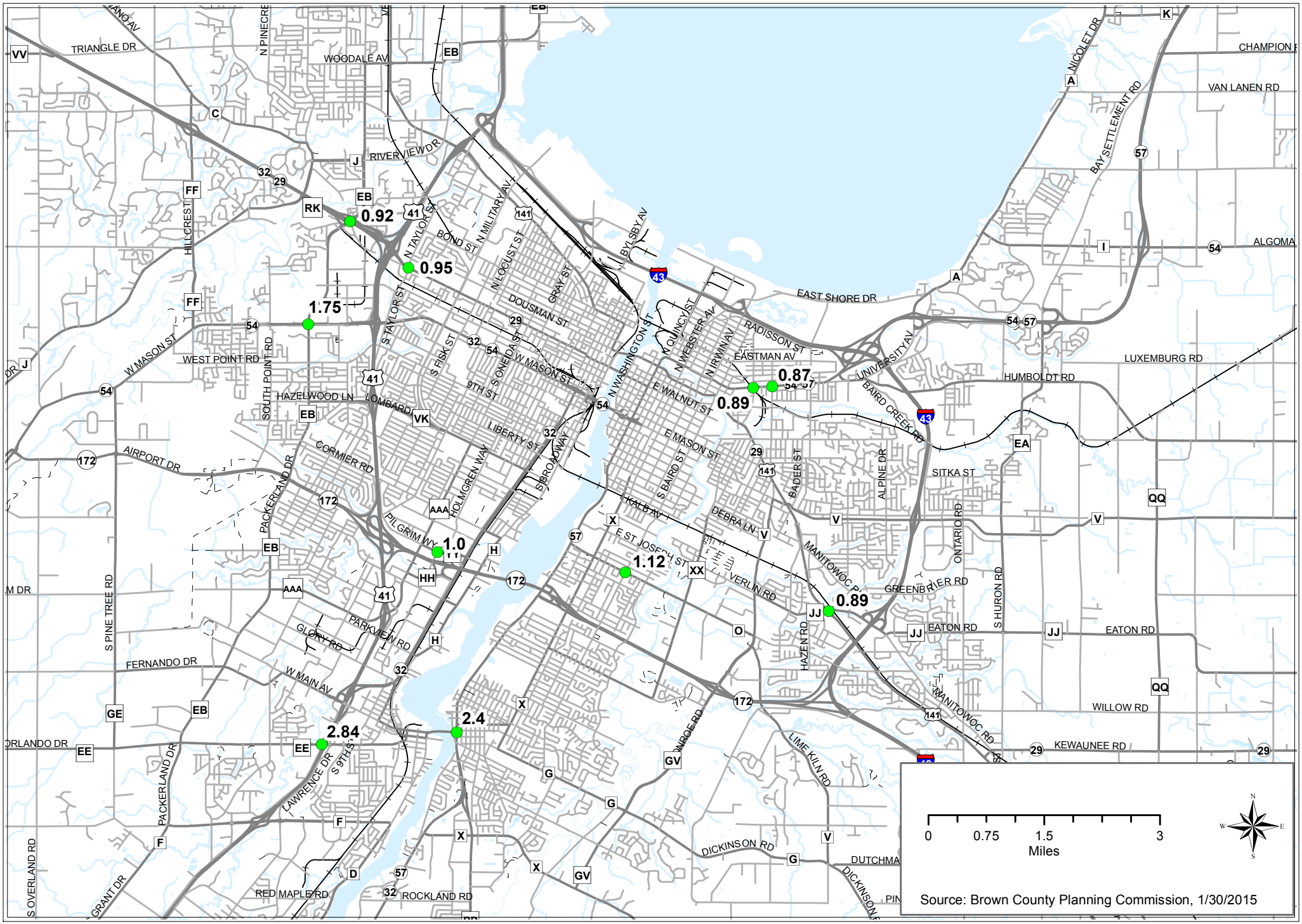
Driver Factor

The TOPS Laboratory reports also identify several factors that caused the intersection-related crashes, but this study focuses on crashes that involved drivers disregarding traffic controls, failing to yield, driving inattentively, and traveling too fast for conditions. The study also notes the percentage of crashes that were caused by the condition of the drivers, which typically meant that one or more of the drivers was under the influence of alcohol or another substance.

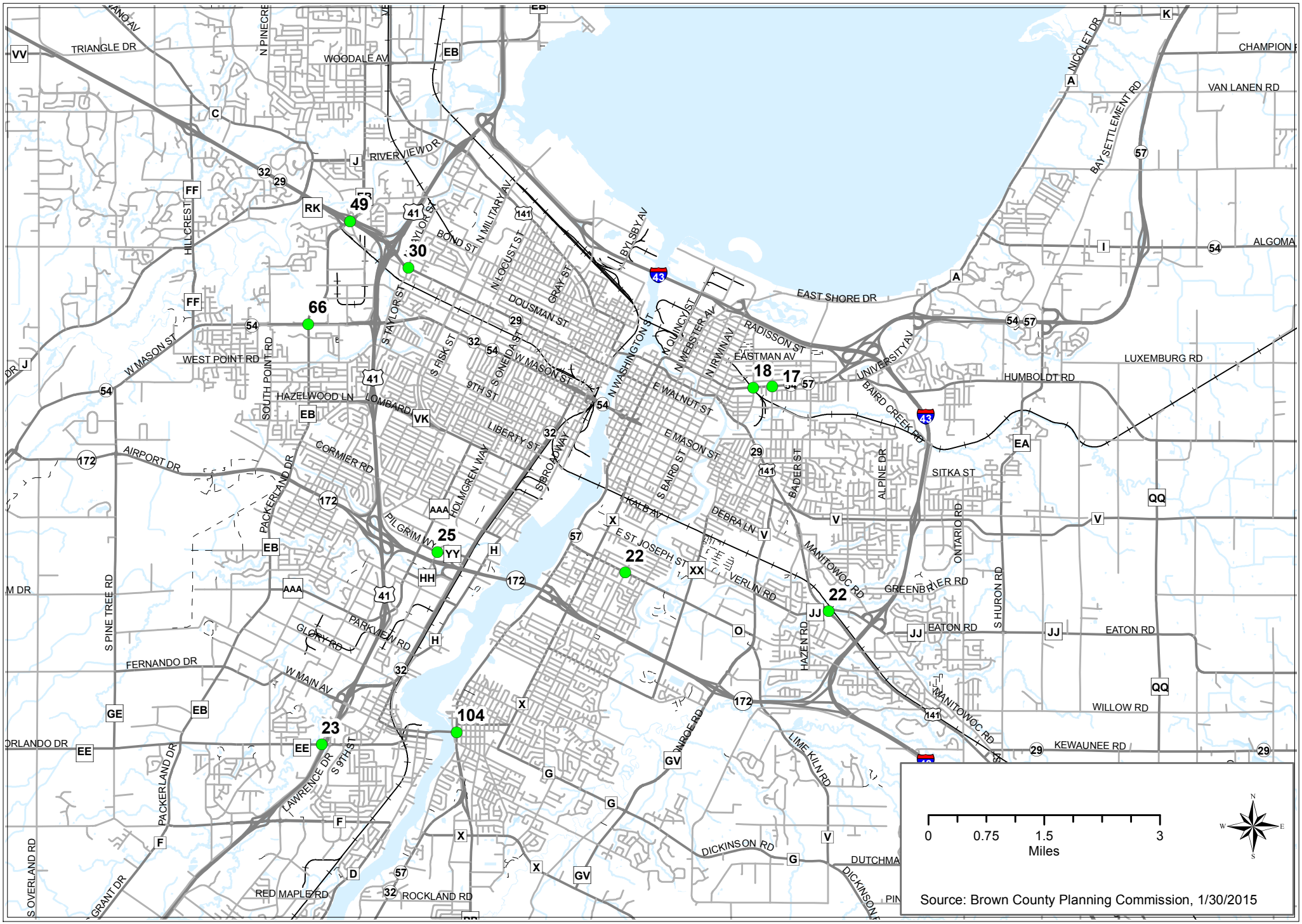
Observations

The observations for the intersections are based on an extensive review of the crash data and visits to the intersections to identify problems and confirm the existence of hazards.

Map 1: Top 10 Metropolitan Area Estimated Intersection Crash Rates, 2010 - 2012



Map 2: Number of Reportable Crashes at Intersections with the Highest Crash Rates, 2010 - 2012



III. Comparison of 2007-2009 and 2010-2012 Crash Statistics

1. Claude Allouez Bridge - Broadway (De Pere)

	2007-2009	2010-2012	Difference	% Difference
Estimated Crash Rate	2.09	2.40	0.31	15%
Reportable Crashes During Period	89	104	15	17%
Incapacitating (A) Injuries During Period	0	2	2	NA
Non-Incapacitating (B) Injuries During Period	3	3	0	0%
Possible (C) Injuries During Period	10	14	4	40%
Crash Type				
Right Angle	18	19	1	6%
Rear End	18	16	-2	-11%
Side Swipe	51	64	13	0%
Head On	0	0	0	0%
Bicycle/Pedestrian	1	1	0	0%
Other (Single Vehicle Crash, Etc.)	1	4	3	300%
Driver Factor				
Disregard Traffic Control	5	7	2	40%
Failure To Yield	30	27	-3	-10%
Inattentive Driving	17	14	-3	-18%
Too Fast For Conditions	0	0	0	0%
Driver Condition (Alcohol)	0	1	1	NA
Other/No Factor Indicated	37	55	18	49%

Comparison of the 2007-2009 and 2010-2012 Study Periods:

- During the 2010-2012 study period, one of the two "A" injuries was sustained by a motorcyclist and the other "A" injury was sustained by a bicyclist. There were no “A” injuries during the 2007-2009 study period.
- The three "B" injuries during the 2010-2012 study period were all sustained by motorcyclists, and all three motorcyclists were determined to be at fault in the crashes (one was intoxicated). During the 2007-2009 study period, two of the three “B” injuries were sustained by a bicyclist and a moped rider.
- Three of the 14 "C" injuries during the 2010-2012 study period were sustained by motorcyclists.
- The crash involving the intoxicated motorcyclist was the only alcohol-related crash during the 2010-2012 study period, and there were no alcohol-related crashes during the 2007-2009 study period.
- The crash types and driver factors were similar between the 2007-2009 and 2010-2012 study periods.

2. Holmgren Way - Pilgrim Way (Ashwaubenon)

	2007-2009	2010-2012	Difference	% Difference
Estimated Crash Rate	1.37	1.00	-0.37	-27%
Reportable Crashes During Period	22	25	3	14%
Incapacitating (A) Injuries During Period	0	1	1	NA
Non-Incapacitating (B) Injuries During Period	2	4	2	100%
Possible (C) Injuries During Period	6	14	8	133%
Crash Type				
Right Angle	8	4	-4	-50%
Rear End	11	15	4	36%
Side Swipe	1	2	1	100%
Head On	0	1	1	NA
Bicycle/Pedestrian	0	1	1	NA
Other (Single Vehicle Crash, Etc.)	2	2	0	0%
Driver Factor				
Disregard Traffic Control	1	1	0	0%
Failure To Yield	3	4	1	33%
Inattentive Driving	7	9	2	29%
Too Fast For Conditions	4	0	-4	-100%
Driver Condition (Alcohol)	1	1	0	0%
Other/No Factor Indicated	6	10	4	67%

Comparison of the 2007-2009 and 2010-2012 Study Periods:

- The most common property damage and injury incidents at this intersection during the 2007-2009 and 2010-2012 study periods were rear end crashes on Pilgrim Way where westbound drivers hit other motorists who were stopped at the signal or in a vehicle queue.

3. Main Street - Verlin Road (Bellevue)

	2007-2009	2010-2012	Difference	% Difference
Estimated Crash Rate	1.35	0.89	-0.46	-34%
Reportable Crashes During Period	34	22	-12	-35%
Incapacitating (A) Injuries During Period	2	0	-2	-100%
Non-Incapacitating (B) Injuries During Period	12	0	-12	-100%
Possible (C) Injuries During Period	7	7	0	0%
Crash Type				
Right Angle	12	2	-10	-83%
Rear End	11	7	-4	-36%
Side Swipe	7	6	-1	-14%
Head On	2	1	-1	-50%
Bicycle/Pedestrian	0	0	0	0%
Other (Single Vehicle Crash, Etc.)	2	6	4	200%
Driver Factor				
Disregard Traffic Control	1	0	-1	-100%
Failure To Yield	14	3	-11	-79%
Inattentive Driving	4	5	1	25%
Too Fast For Conditions	1	3	2	200%
Driver Condition (Alcohol)	2	5	3	150%
Other/No Factor Indicated	12	6	-6	-50%

Comparison of the 2007-2009 and 2010-2012 Study Periods:

- This intersection was signalized until the early spring of 2010. The intersection was reconstructed during the spring, summer, and fall of 2010, and a roundabout opened at the intersection in late 2010.
- There were two “A” injuries and 12 “B” injuries reported at this intersection during the 2007-2009 study period (when the intersection was controlled by traffic signals). However, the intersection did not experience any "A" or "B" injury crashes during the 2010-2012 study period after the traffic signals were replaced by a roundabout.
- The right angle, head on, and side swipe crashes resulted in both “A” injuries and 11 of the 12 “B” injuries at this intersection during the 2007-2009 study period (when the intersection was controlled by traffic signals). However, during the 2010-2012 study period, the right angle and side swipe crashes resulted in no injuries at the intersection. The only head on crash during the 2010-2012 study period resulted in a “C” injury, but this crash occurred in 2010 when the intersection was still controlled by traffic signals.

4. West Mason Street - Taylor Street (Green Bay)

	2007-2009	2010-2012	Difference	% Difference
Estimated Crash Rate	1.25	0.81	-0.44	-35%
Reportable Crashes During Period	44	33	-11	-25%
Incapacitating (A) Injuries During Period	0	0	0	0%
Non-Incapacitating (B) Injuries During Period	9	2	-7	-78%
Possible (C) Injuries During Period	25	19	-6	-24%
Crash Type				
Right Angle	29	14	-15	-52%
Rear End	13	14	1	8%
Side Swipe	2	5	3	150%
Head On	0	0	0	0%
Bicycle/Pedestrian	0	0	0	0%
Other (Single Vehicle Crash, Etc.)	0	0	0	0%
Driver Factor				
Disregard Traffic Control	12	2	-10	-83%
Failure To Yield	18	9	-9	-50%
Inattentive Driving	3	8	5	167%
Too Fast For Conditions	2	2	0	0%
Driver Condition (Alcohol)	1	2	1	100%
Other/No Factor Indicated	8	10	2	25%

Comparison of the 2007-2009 and 2010-2012 Study Periods:

- A roundabout was constructed at this intersection in 2012, so it is difficult to compare the two study periods at this time.
- 22 of the crashes and 17 of the injuries during the 2010-2012 study period occurred while traffic lights were present at the intersection.

5. West Mason Street - Packerland Drive (Green Bay)

(Note: Both periods include the Packerland Drive frontage road intersections)

	2007-2009	2010-2012	Difference	% Difference
Estimated Crash Rate	1.11	1.75	0.64	58%
Reportable Crashes During Period	42	66	24	57%
Incapacitating (A) Injuries During Period	0	2	2	NA
Non-Incapacitating (B) Injuries During Period	5	8	3	60%
Possible (C) Injuries During Period	23	41	18	78%
Crash Type				
Right Angle	26	36	10	38%
Rear End	8	20	12	150%
Side Swipe	6	6	0	0%
Head On	0	2	2	NA
Bicycle/Pedestrian	0	0	0	0%
Other (Single Vehicle Crash, Etc.)	2	2	0	0%
Driver Factor				
Disregard Traffic Control	5	7	2	40%
Failure To Yield	21	29	8	38%
Inattentive Driving	7	14	7	100%
Too Fast For Conditions	2	3	1	50%
Driver Condition (Alcohol)	1	1	0	0%
Other/No Factor Indicated	6	12	6	100%

Comparison of the 2007-2009 and 2010-2012 Study Periods:

- 22 of the 40 crashes and 21 of the 34 injuries at the Packerland-Mason intersection during the 2010-2012 study period were right angle or head on crashes that happened when people made left turns in front of oncoming vehicles or disregarded the traffic signals. Right angle injury crashes were also the most common incidents at this intersection during the 2007-2009 study period, but there were far fewer crashes and injuries at the intersection during the 2007-2009 study period.

- During the 2010-2012 study period, the frontage road intersections on the north and south sides of Mason Street experienced many of the same kinds of right angle crashes that occurred during the 2007-2009 study period. In most cases during both study periods, these right angle crashes happened when vehicles on Packerland Drive collided with vehicles that were attempting to cross or make left turns onto Packerland Drive from the frontage roads.

6. Main Street - Baird Street (Green Bay)

	2007-2009	2010-2012	Difference	% Difference
Estimated Crash Rate	1.10	0.62	-0.48	-44%
Reportable Crashes During Period	25	17	-8	-32%
Incapacitating (A) Injuries During Period	0	0	0	0%
Non-Incapacitating (B) Injuries During Period	4	1	-3	-75%
Possible (C) Injuries During Period	16	13	-3	-19%
Crash Type				
Right Angle	19	12	-7	-37%
Rear End	2	1	-1	-50%
Side Swipe	0	0	0	0%
Head On	1	0	-1	-100%
Bicycle/Pedestrian	1	2	1	100%
Other (Single Vehicle Crash, Etc.)	2	2	0	0%
Driver Factor				
Disregard Traffic Control	6	2	-4	-67%
Failure To Yield	11	10	-1	-9%
Inattentive Driving	0	1	1	0%
Too Fast For Conditions	1	0	-1	-100%
Driver Condition (Alcohol)	2	3	1	50%
Other/No Factor Indicated	5	1	-4	-80%

Comparison of the 2007-2009 and 2010-2012 Study Periods:

- The most common incidents at this intersection between 2010 and 2012 were right angle crashes that occurred when westbound drivers made left turns in front of oncoming eastbound drivers. These were also the most common crashes during the 2007-2009 study period.

- 11 of the 14 injuries that occurred at the intersection during the 2010 - 2012 study period occurred when drivers on Main Street made left turns in front of drivers traveling through the intersection on Main Street. These were also the most common injury crashes during the 2007-2009 study period.

7. STH 172 - Babcock Road (Ashwaubenon)

	2007-2009	2010-2012	Difference	% Difference
Estimated Crash Rate	1.07	0.79	-0.28	-26%
Reportable Crashes During Period	31	24	-7	-23%
Incapacitating (A) Injuries During Period	0	1	1	NA
Non-Incapacitating (B) Injuries During Period	5	3	-2	-40%
Possible (C) Injuries During Period	22	11	-11	-50%
Crash Type				
Right Angle	11	6	-5	-45%
Rear End	14	12	-2	-14%
Side Swipe	1	2	1	100%
Head On	1	1	0	0%
Bicycle/Pedestrian	2	0	-2	-100%
Other (Single Vehicle Crash, Etc.)	2	3	1	50%
Driver Factor				
Disregard Traffic Control	3	2	-1	-33%
Failure To Yield	8	6	-2	-25%
Inattentive Driving	9	4	-5	-56%
Too Fast For Conditions	2	3	1	50%
Driver Condition (Alcohol)	3	0	-3	-100%
Other/No Factor Indicated	6	9	3	50%

Comparison of the 2007-2009 and 2010-2012 Study Periods:

- During the 2007-2009 study period, seven of the 24 reportable crashes on STH 172 happened when drivers on STH 172 made left turns in front of drivers going straight on STH 172. There were three injuries associated with these crashes. During the 2010-2012 study period, two of the 19 reportable crashes on STH 172 happened when drivers on STH 172 made left turns in front of drivers going straight on STH 172. Neither of these crashes resulted in injuries.

- There were no right angle crashes on Babcock Road during the 2007-2009 study period. During the 2010-2012 study period, three of the five incidents on Babcock Road were right angle crashes that happened when drivers made left turns in front of drivers going straight. The intersection's only "A" injury occurred during one of these right angle crashes.

- One of the five “B” injuries and nine of the 22 “C” injuries that occurred during the 2007-2009 study were a result of rear end crashes on STH 172. During the 2010-2012 study period, two of the three "B" injuries and five of the 11 “C” injuries were a result of rear end crashes on STH 172.

8. Allouez Avenue - Libal Street (Allouez)

	2007-2009	2010-2012	Difference	% Difference
Estimated Crash Rate	1.04	1.12	0.08	8%
Reportable Crashes During Period	21	22	1	5%
Incapacitating (A) Injuries During Period	0	0	0	0%
Non-Incapacitating (B) Injuries During Period	1	2	1	100%
Possible (C) Injuries During Period	0	2	2	NA
Crash Type				
Right Angle	6	5	-1	-17%
Rear End	4	8	4	100%
Side Swipe	7	8	1	14%
Head On	0	0	0	0%
Bicycle/Pedestrian	1	0	-1	-100%
Other (Single Vehicle Crash, Etc.)	3	1	-2	-67%
Driver Factor				
Disregard Traffic Control	0	0	0	0%
Failure To Yield	9	13	4	44%
Inattentive Driving	7	4	-3	-43%
Too Fast For Conditions	1	0	-1	-100%
Driver Condition (Alcohol)	1	0	-1	-100%
Other/No Factor Indicated	3	5	2	67%

Comparison of the 2007-2009 and 2010-2012 Study Periods:

- The intersection experienced a variety of reportable crashes during the 2007-2009 and 2010-2012 study periods. During the 2007-2009 study period, at least half of the crashes appear to have been directly or indirectly caused by eastbound drivers entering and passing through the roundabout at relatively high speeds. During the 2010-2012 study period, more than half of the crashes at the intersection were caused by eastbound and westbound drivers. These crashes tended to be rear end and side swipe incidents.

- During the 2007-2009 study period, the intersection's only injury involved a bicyclist. During the 2010-2012 study period, one of the "B" injuries involved a person on a moped and the other "B" injury involved a person on a motorcycle. The two "C" injuries during the 2010-2012 study period occurred as a result of separate rear end crashes that involved motorists.

9. Reid Street - Fourth Street (De Pere)

	2007-2009	2010-2012	Difference	% Difference
Estimated Crash Rate	1.03	0.52	-0.51	-50%
Reportable Crashes During Period	21	10	-11	-52%
Fatalities During Period	1	0	-1	-100%
Incapacitating (A) Injuries During Period	0	0	0	0%
Non-Incapacitating (B) Injuries During Period	1	2	1	100%
Possible (C) Injuries During Period	3	3	0	0%
Crash Type				
Right Angle	11	3	-8	-73%
Rear End	7	6	-1	-14%
Side Swipe	3	1	-2	-67%
Head On	0	0	0	0%
Bicycle/Pedestrian	0	0	0	0%
Other (Single Vehicle Crash, Etc.)	0	0	0	0%
Driver Factor				
Disregard Traffic Control	9	0	-9	-100%
Failure To Yield	3	3	0	0%
Inattentive Driving	5	3	-2	-40%
Too Fast For Conditions	0	0	0	0%
Driver Condition (Alcohol)	1	1	0	0%
Other/No Factor Indicated	3	3	0	0%

Comparison of the 2007-2009 and 2010-2012 Study Periods:

- During the 2007-2009 study period, nine of the 21 incidents at the intersection were right angle crashes that occurred when southbound and eastbound drivers disregarded the traffic signals. However, none of these crashes occurred during the 2010-2012 study period. This was the primary reason why the total number of crashes decreased by more than 50 percent between the two study periods.

- During the 2007-2009 study period, the single “B” injury and two of the three “C” injuries were the result of right angle crashes that involved motorists. During the 2010-2012 study period, both "B" injuries and two of the three 3 "C" injuries were the result of rear end crashes that involved motorists. The third "C" injury during the 2010-2012 study period was a result of an angle crash when a motorist disregarded a flashing traffic signal.

- The single fatality that occurred during the 2007-2009 study period was a result of a motorist rear ending another vehicle on Reid Street at a high speed. The driver of the speeding car was killed, and the report suggests that the driver was impaired by something other than alcohol at the time of the crash.

10. Oneida Street-Willard Drive (Ashwaubenon)

	2007-2009	2010-2012	Difference	% Difference
Estimated Crash Rate	1.00	0.49	-0.51	-51%
Reportable Crashes During Period	26	14	-12	-46%
Fatalities During Period	2	0	-2	-100%
Incapacitating (A) Injuries During Period	1	0	-1	-100%
Non-Incapacitating (B) Injuries During Period	0	3	3	NA
Possible (C) Injuries During Period	8	1	-7	-88%
Crash Type				
Right Angle	10	6	-4	-40%
Rear End	10	7	-3	-30%
Side Swipe	1	1	0	0%
Head On	0	0	0	0%
Bicycle (1)/Pedestrian (2)	3	0	-3	-100%
Other (Single Vehicle Crash, Etc.)	2	0	-2	-100%
Driver Factor				
Disregard Traffic Control	3	1	-2	-67%
Failure To Yield	6	5	-1	-17%
Inattentive Driving	7	6	-1	-14%
Too Fast For Conditions	0	0	0	0%
Driver Condition (Alcohol)	1	0	-1	-100%
Other/No Factor Indicated	9	2	-7	-78%

Comparison of the 2007-2009 and 2010-2012 Study Periods:

- The two fatalities and single “A” injury during the 2007-2009 study period occurred as a result of one high-speed right angle crash that was caused by an intoxicated driver failing to yield at the intersection. The intoxicated driver sustained the “A” injury, and the two occupants of the other vehicle were killed.

- Because this intersection was within the Oneida Street reconstruction project area during the 2010-2012 study period, a reasonable comparison between the two study periods cannot be developed.

IV. Metropolitan Area Intersections with the Highest Estimated Crash Rates Between 2010 and 2012

1. Grant Street – Mid Valley Drive (Lawrence)

Estimated Crash Rate:	2.84	
Total Reportable Crashes During Period:	23	
Property Damage Crashes:	14	
Estimated Property Damage Cost:	$179,200	
Injury Crashes:	9	
Incapacitating (A) Injuries During Period:	3	
Non-Incapacitating (B) Injuries During Period:	1	
Possible (C) Injuries During Period	8	
Estimated Total Injury Cost:	$336,600	
Crash Type		
Right Angle	13	57%
Rear End	8	35%
Side Swipe	2	8%
Head On	0	0%
Bicycle/Pedestrian	0	0%
Other (Single Vehicle Crash, Etc.)	0	0%
Driver Factor		
Disregard Traffic Control	0	0%
Failure To Yield	14	61%
Inattentive Driving	6	26%
Too Fast For Conditions	1	5%
Driver Condition (Alcohol)	0	0%
Other/No Factor Indicated	2	8%

Observations for the 2010-2012 Study Period:

- The most common incidents during the 2010-2012 study period were right angle crashes that occurred when northbound and southbound drivers on Mid Valley Drive attempted to cross Grant Street and collided with vehicles traveling west on Grant. There were ten of these incidents during the study period, and in every case the Grant Street vehicle was westbound when the crashes occurred. These crashes resulted in one moped rider sustaining an “A” injury and four vehicle occupants sustaining “C” injuries.

- The intersection also experienced four incidents where vehicles waiting to make left turns from Grant to Mid Valley were either rear ended or side swiped by vehicles approaching from behind them. These crashes resulted in one “A” injury and the intersection’s only “B” injury.

- The third “A” injury resulted from a side swipe crash that occurred when an eastbound driver collided with a westbound driver who was attempting to make a left turn at the intersection.

- 16 of the intersection’s 23 crashes (69.6%) happened between approximately 2:00 p.m. and 5:00 p.m. 13 of the 16 crashes that occurred during this three-hour period happened on weekdays.

- Only three crashes (13.0%) happened between approximately 6:00 a.m. and 10:00 a.m. Two of the crashes happened at approximately 7:00 a.m., and one happened at approximately 8:00 a.m. All three of the crashes happened on weekdays.

Based on the information in the crash database and the field observations performed by staff, it appears that many of the crashes during the study period could have been caused by northbound and southbound drivers not being able to see or accurately assess the speeds of westbound vehicles until the westbound vehicles emerged from the shadow of the nearby US 41 underpass.

Because the west edge of the underpass is approximately 130 feet from the center of the Grant-Mid Valley intersection, it would only take about two seconds for a westbound vehicle traveling 30 miles per hour to reach the intersection after emerging from the underpass. This does not provide much time for northbound and southbound drivers to clear the intersection after they commit to crossing it, which would explain why all ten of the northbound and southbound drivers who were involved in right angle crashes collided with westbound vehicles.

The crashes that involved northbound and southbound drivers crossing Grant Street as well as most of the other types of crashes that happened during the study period could be addressed by constructing a single lane roundabout at the intersection. In addition to eliminating the opportunity for right angle crashes, a roundabout would minimize the likelihood of high speed rear end crashes on Grant Street by allowing left-turning drivers to clear the intersection without having to wait for gaps in oncoming traffic. The presence of a roundabout at this location would also encourage westbound and eastbound drivers to approach the intersection at lower speeds.

Aerial and ground-level views of the Grant Street – Mid Valley Drive intersection are shown on the following page.

Aerial View of the Grant Street – Mid Valley Drive Intersection
(Gray Lines = Existing Right-of-Way)

View of the US 41 Underpass from the Grant-Mid Valley Intersection

2. Claude Allouez Bridge - Broadway (De Pere)

Estimated Crash Rate:	2.40	
Total Reportable Crashes During Period:	104	
Property Damage Crashes:	85	
Estimated Property Damage Cost:	$1,088,000	
Injury Crashes:	19	
Incapacitating (A) Injuries During Period:	2	
Non-Incapacitating (B) Injuries During Period:	3	
Possible (C) Injuries During Period	14	
Estimated Total Injury Cost:	$388,300	
Crash Type		
Right Angle	19	18%
Rear End	16	15%
Side Swipe	64	62%
Head On	0	0%
Bicycle/Pedestrian	1	1%
Other (Single Vehicle Crash, Etc.)	4	4%
Driver Factor		
Disregard Traffic Control	7	7%
Failure To Yield	27	26%
Inattentive Driving	14	13%
Too Fast For Conditions	0	0%
Driver Condition (Alcohol)	1	1%
Other/No Factor Indicated	55	53%

Observations for the 2010-2012 Study Period:

- One of the two "A" injuries was a motorcyclist, and the other "A" injury was a bicyclist.
- The three "B" injuries were all motorcyclists, and all three motorcyclists were determined to be at fault in the crashes (one was intoxicated).
- Three of the 14 "C" injuries were motorcyclists.
- The crash involving the intoxicated motorcyclist was the only alcohol-related crash during the 2010-2012 study period.
- 48% of the crashes during the three-year study period happened between the months of May and July (a three-month period).
- 30 of 104 crashes (29%) happened between approximately 10 a.m. and noon.
- Traffic volumes were presumably consistent throughout the year each year (with the possible exception of summer when school was out).

- Most crashes happened in months where travel conditions were "favorable" (no snow or ice) and at times when traffic volumes were somewhat high but not as high as volumes during the weekday morning and afternoon peak travel periods.

It is possible that most of the crashes at the intersection could have been caused by people traveling relatively fast and being less cautious because the streets were not slick and congestion was not present (but traffic volumes were still fairly high). Conversely, it looks like people drove slower and were more cautious during winter (slick) months and when traffic was congested, so the number of crashes during these periods was much lower.

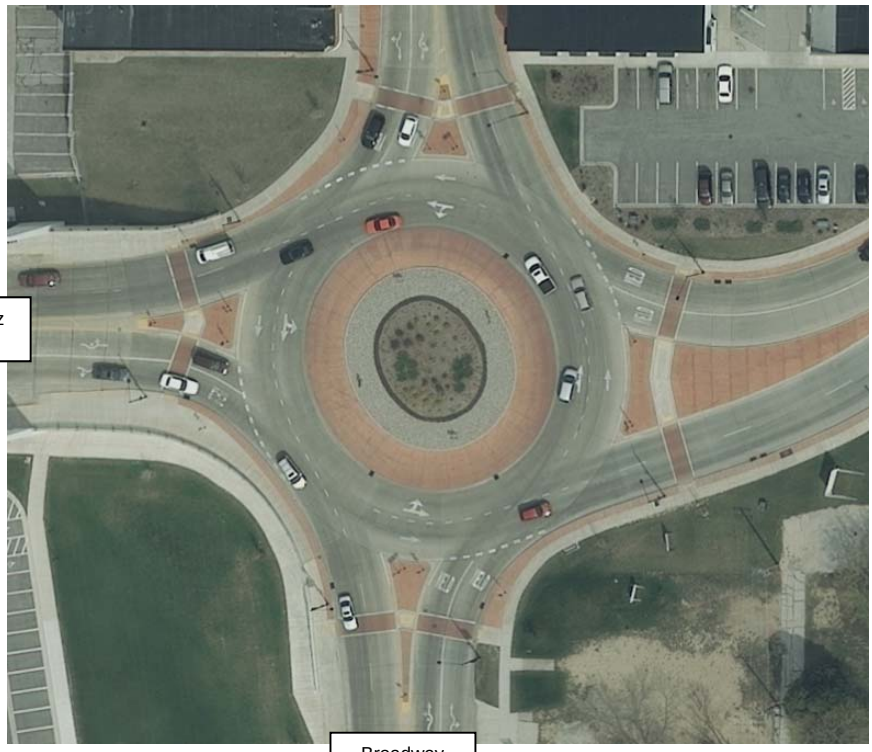
Judging by the crash data, it appears that the likelihood of crashes was much higher when people felt comfortable driving (and were able to drive) faster, when they possibly did not feel the need to be extra alert, and when many (but not too many) other vehicles were present.

The roundabout's lane configuration and turning movements were modified by WisDOT in 2013. According to the TOPS Laboratory database, there were only 13 crashes at the roundabout in 2013, and preliminary crash data indicate that there were 14 crashes at the roundabout in 2014[1]. These figures strongly suggest that the modifications WisDOT made to the roundabout in 2013 have significantly reduced crashes, and the intersection should be monitored to determine if annual crash totals continue to remain low.

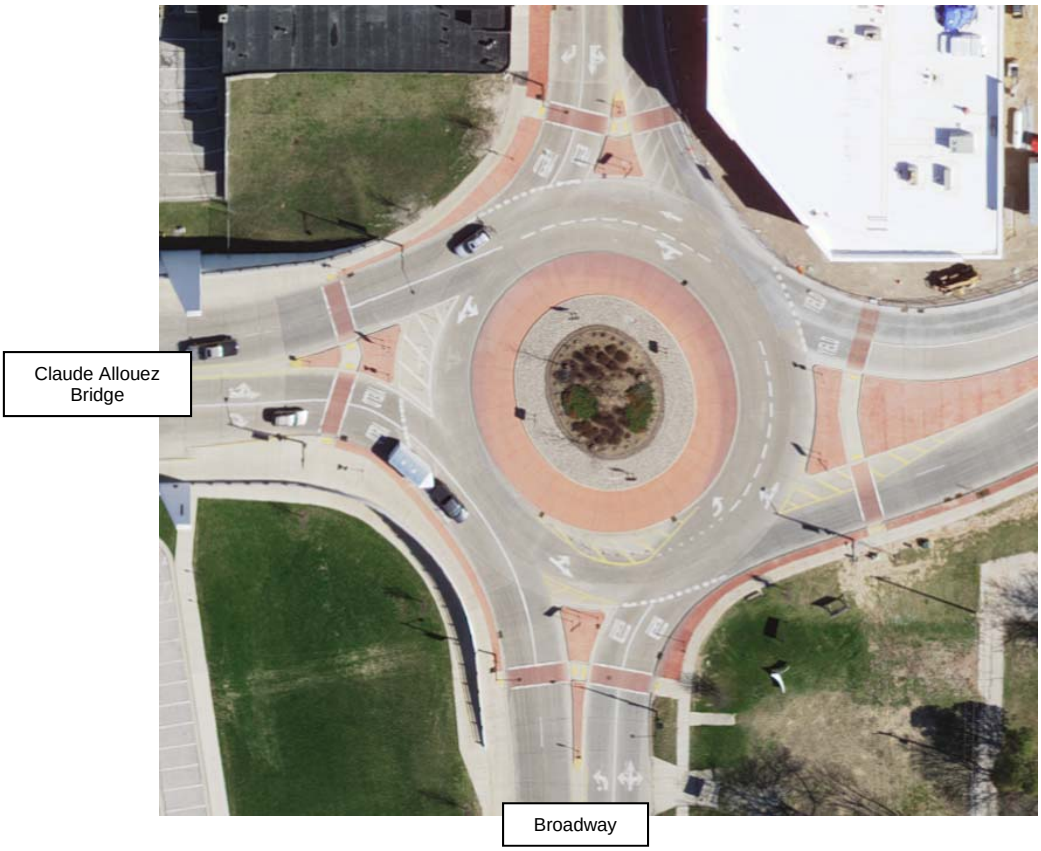
Aerial views of the roundabout before and after these modifications are shown on the following page.

[1] Preliminary 2014 crash data as of January 2015. The crash dataset for each year is listed as preliminary by the TOPS Laboratory until all of the records for the year are entered. This entry process is typically completed by the middle of the following year.

Aerial View of the Claude Allouez Bridge – Broadway Roundabout
Before the 2013 Lane Reconfiguration



Aerial View of the Claude Allouez Bridge – Broadway Roundabout
After the 2013 Lane Reconfiguration



3. West Mason Street - Packerland Drive (Green Bay)

(Note: These statistics include the Packerland Drive frontage road intersections)

Estimated Crash Rate:	1.75	
Total Reportable Crashes During Period:	66	
Property Damage Crashes:	28	
Estimated Property Damage Cost:	$358,400	
Injury Crashes:	38	
Incapacitating (A) Injuries During Period:	2	
Non-Incapacitating (B) Injuries During Period:	8	
Possible (C) Injuries During Period	41	
Estimated Total Injury Cost:	$847,400	
Crash Type		
Right Angle	36	55%
Rear End	20	30%
Side Swipe	6	9%
Head On	2	3%
Bicycle/Pedestrian	0	0%
Other (Single Vehicle Crash, Etc.)	2	3%
Driver Factor		
Disregard Traffic Control	7	11%
Failure To Yield	29	44%
Inattentive Driving	14	21%
Too Fast For Conditions	3	5%
Driver Condition (Alcohol)	1	1%
Other/No Factor Indicated	12	18%

Observations for the 2010-2012 Study Period:

- 22 of the 40 crashes and 21 of the 34 injuries at the Packerland-Mason intersection were angle or head on crashes that happened when people made left turns in front of oncoming vehicles or disregarded the traffic signals.

- Both of the "A" injuries and all of the "B" injuries at the Packerland-Mason intersection occurred during right angle and head on crashes.

- 14 of the 15 rear end crashes at the Packerland-Mason intersection occurred on Mason Street. Of these 14 Mason Street rear end crashes, 8 were eastbound and 6 were westbound.

- 10 of the 14 Mason Street rear end crashes occurred on weekday afternoons between noon and 6:00 p.m. Only 1 of the 14 rear end crashes occurred on a weekend.

- 35 of the 40 crashes at the Packerland-Mason intersection occurred during weekdays.

- 18 of 25 crashes at the two Packerland Drive frontage road intersections were right angle or opposite direction side swipe crashes.

- The one "B" injury at the two Packerland Drive intersections was a motorcyclist. The remaining 16 injuries at these intersections were all "C" injuries.

Like the previous two three-year crash study periods, the Mason-Packerland intersection and the two Packerland frontage road intersections frequently experienced the following incidents during the 2010-2012 study period:

  - Right angle crashes that were caused by left-turning drivers pulling in front of oncoming vehicles on Packerland and Mason. These crashes likely happened because the turning drivers could not see approaching traffic around opposing vehicles that were waiting to make left turns.

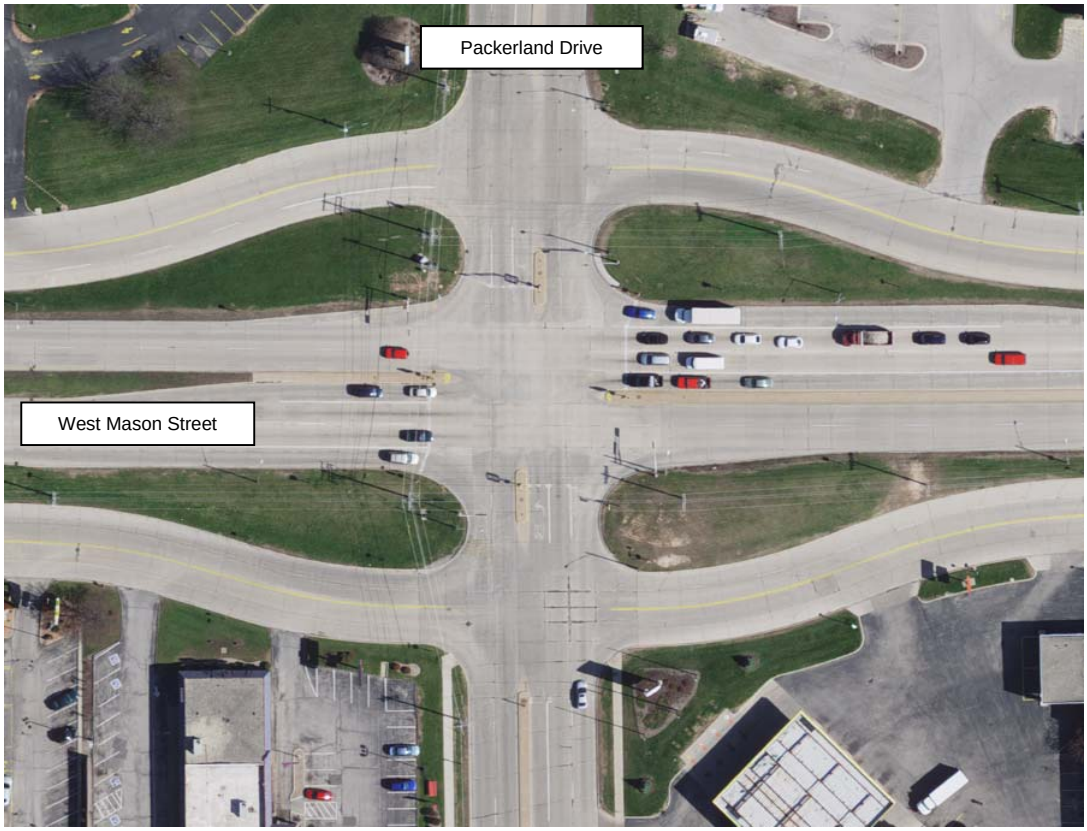
  - Right angle crashes that involved drivers on the frontage roads pulling in front of drivers traveling north or south on Packerland Drive.

The data continue to suggest that many of the crashes and injuries could be eliminated by constructing a roundabout at the intersection. The data also continue to suggest that crashes and injuries could be further reduced by incorporating the frontage road intersections into a roundabout or by only allowing frontage road users to make right turns when they enter and exit Packerland Drive. These turning movement restrictions were imposed at various times during the 2010-2012 study period (while the US 41 – Mason Street interchange was being reconstructed), and the data suggest that crashes at the frontage road intersections decreased significantly when the restrictions were in place.

If a roundabout cannot be constructed at the intersection, another method of reducing the number of right angle and head on injury crashes at the Mason-Packerland intersection would be to replace the existing left turn lanes with positive-offset left turn lanes that enable drivers to see oncoming vehicles before making left turns. Adding positive-offset left turn lanes to the intersection approaches will also allow (and possibly require) the frontage road movements to be restricted to right turns, which will further reduce the number of crashes at the intersection.

Aerial and ground-level views of the Mason – Packerland intersection and the frontage road intersections are shown on the following page. The ground-level view shows the turn restriction barriers that were placed at the frontage road intersections during the US 41-Mason Street interchange reconstruction project.

Aerial View of the West Mason Street – Packerland Drive Intersection



View of the West Mason – Packerland Intersection from the Westbound Travel Lanes
(Picture Includes Barriers at the Frontage Road Intersections)

4. Allouez Avenue - Libal Street (Allouez)

Estimated Crash Rate:	1.12	
Total Reportable Crashes During Period:	22	
Property Damage Crashes:	18	
Estimated Property Damage Cost:	$230,400	
Injury Crashes:	4	
Incapacitating (A) Injuries During Period:	0	
Non-Incapacitating (B) Injuries During Period:	2	
Possible (C) Injuries During Period	2	
Estimated Total Injury Cost:	$71,000	
Crash Type		
Right Angle	5	23%
Rear End	8	36%
Side Swipe	8	36%
Head On	0	0%
Bicycle/Pedestrian	0	0%
Other (Single Vehicle Crash, Etc.)	1	5%
Driver Factor		
Disregard Traffic Control	0	0%
Failure To Yield	13	59%
Inattentive Driving	4	18%
Too Fast For Conditions	0	0%
Driver Condition (Alcohol)	0	0%
Other/No Factor Indicated	5	23%

Observations for the 2010-2012 Study Period:

- More than half of the crashes at the intersection were caused by eastbound and westbound drivers. These crashes tended to be rear end and side swipe incidents.
- One of the "B" injuries involved a person on a moped and the other "B" injury involved a person on a motorcycle. The two "C" injuries occurred as a result of separate rear end crashes that involved motorists.
- During the previous three-year crash study period, it appeared that high eastbound entry and circulation speeds could have led to many of the intersection's crashes. Judging by the crashes that happened during this three-year study period, it appears that high entry and circulation speeds could have been factors in many of these crashes as well.

The chances of crashes occurring at the intersection would likely be reduced if eastbound drivers were forced to enter the roundabout at lower speeds. This could be accomplished by increasing the horizontal deflection at the roundabout's eastbound approach. Increasing the horizontal deflection at the other approaches might also reduce the likelihood of crashes at the intersection.

Aerial and ground-level views of the Allouez - Libal intersection are shown on the following page.

Aerial View of the Allouez Avenue – Libal Street Intersection
(Green Lines = Existing Right-of-Way)

View of the Allouez - Libal Roundabout from the Eastbound Approach

5. Holmgren Way – Pilgrim Way (Ashwaubenon)

Estimated Crash Rate:	1.00	
Total Reportable Crashes During Period:	25	
Property Damage Crashes:	12	
Estimated Property Damage Cost:	$153,600	
Injury Crashes:	13	
Incapacitating (A) Injuries During Period:	1	
Non-Incapacitating (B) Injuries During Period:	4	
Possible (C) Injuries During Period	14	
Estimated Total Injury Cost:	$340,500	
Crash Type		
Right Angle	4	16%
Rear End	15	60%
Side Swipe	2	8%
Head On	1	4%
Bicycle/Pedestrian	1	4%
Other (Single Vehicle Crash, Etc.)	2	8%
Driver Factor		
Disregard Traffic Control	1	4%
Failure To Yield	4	16%
Inattentive Driving	9	36%
Too Fast For Conditions	0	0%
Driver Condition (Alcohol)	1	4%
Other/No Factor Indicated	10	40%

Observations for the 2010-2012 Study Period:

- The most common property damage and injury incidents at this intersection during the 2010-2012 study period were rear end crashes on Pilgrim Way where westbound drivers hit other vehicles who were stopped at the signal or in a vehicle queue. These were also the most common incidents at this intersection during the 2007-2009 study period.

- The “A” injury was an alcohol-related crash that involved a single vehicle.

- One "B" injury was sustained by a bicyclist. The remaining three "B" injuries and all of the "C" injuries occurred during crashes that involved two or more vehicles.

- No crashes that involved two or more vehicles occurred in November or January during the three-year study period, and only one crash that involved two or more vehicles occurred in December during the study period (on Christmas Eve).

- 19 of the 23 crashes that involved two or more vehicles occurred between April and October during the three-year study period.

- 20 of the 23 crashes that involved two or more vehicles occurred between 10:00 a.m. and 4:00 p.m. during the three-year study period.

- 17 of the 23 crashes that involved two or more vehicles occurred on Thursdays, Fridays, and Saturdays during the three-year study period. Eight of these crashes occurred on Fridays.

The intersection's westbound approach is part of the Pilgrim Way reconstruction project that is currently scheduled to occur in 2016. This project is an opportunity to increase the amount of queueing capacity between the STH 172 ramps and the Holmgren - Pilgrim intersection, and this should help to reduce the number of crashes at the intersection.

Aerial and ground-level views of the Holmgren – Pilgrim intersection are shown on the following page.

Aerial View of the Holmgren Way – Pilgrim Way Intersection
(With STH 172 Ramps)

View of the Holmgren – Pilgrim Intersection from the Westbound Approach

6. Shawano Avenue – Taylor Street (Green Bay/Howard)

Estimated Crash Rate:	0.95	
Total Reportable Crashes During Period:	30	
Property Damage Crashes:	27	
Estimated Property Damage Cost:	$345,600	
Injury Crashes:	3	
Incapacitating (A) Injuries During Period:	0	
Non-Incapacitating (B) Injuries During Period:	0	
Possible (C) Injuries During Period	3	
Estimated Total Injury Cost:	$38,400	
Crash Type		
Right Angle	10	33%
Rear End	6	20%
Side Swipe	12	40%
Head On	1	3%
Bicycle/Pedestrian	0	0%
Other (Single Vehicle Crash, Etc.)	1	3%
Driver Factor		
Disregard Traffic Control	2	7%
Failure To Yield	17	57%
Inattentive Driving	6	20%
Too Fast For Conditions	0	0%
Driver Condition (Alcohol)	1	3%
Other/No Factor Indicated	4	13%

Observations for the 2010-2012 Study Period:

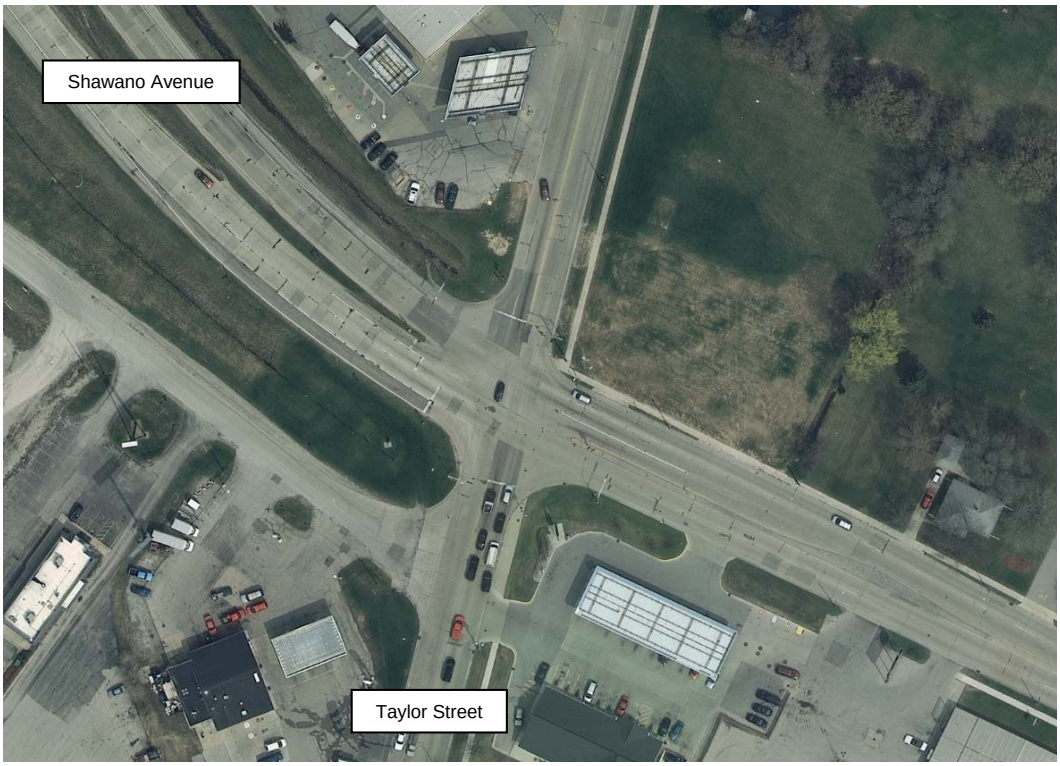
- This intersection was signalized until early spring of 2011. The intersection was reconstructed during the spring, summer, and fall of 2011, and a roundabout opened at the intersection in the fall of 2011.
- Between 2010 and 2012, the intersection experienced 30 reportable crashes. Although this was higher than the 17 reportable crashes that occurred at the intersection during the previous three-year period (2007-2009), the crashes that occurred during the 2010 to 2012 period were far less severe. The injury statistics for the two periods are summarized below.

2007 – 2009	**2010 – 2012**
Property Damage Crashes: 6	Property Damage Crashes: 27
Injury Crashes: 11	Injury Crashes: 3
"A" Injuries: 1 "B" Injuries: 4 "C" Injuries: 12	"A" Injuries: 0 "B" Injuries: 0 "C" Injuries: 3

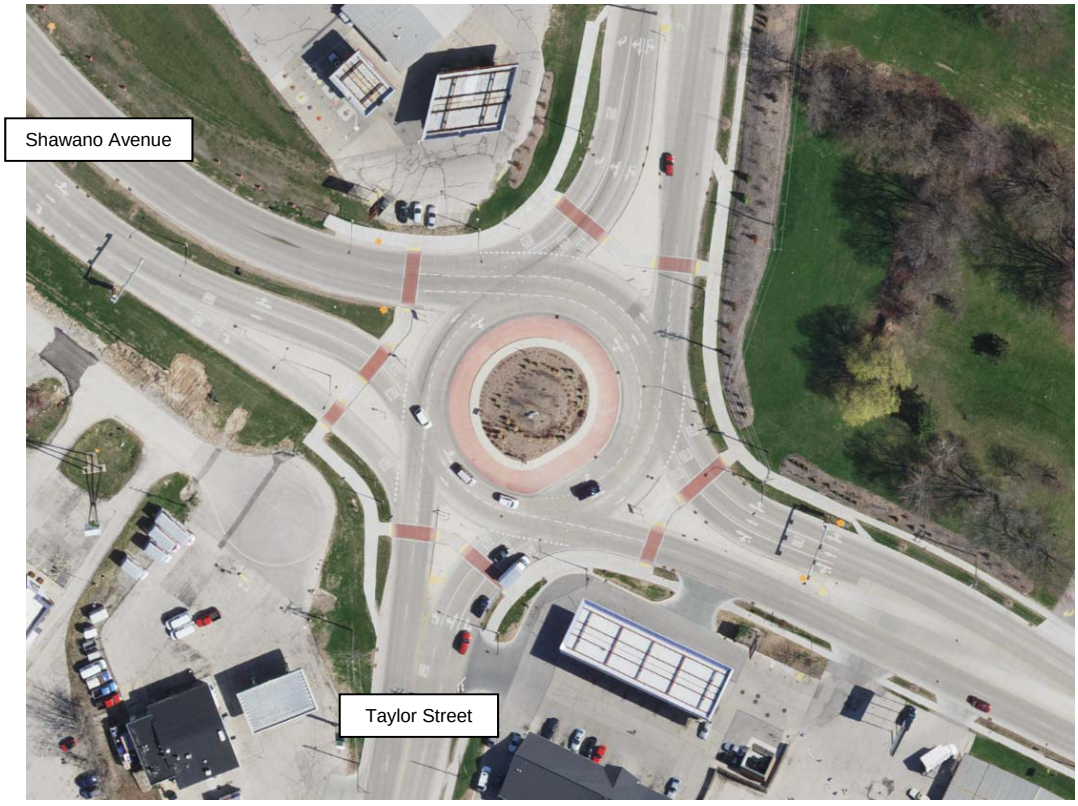
It appears that replacing the traffic signals with a roundabout has made the intersection much safer than it was in the past. But because the roundabout is relatively new, the intersection should be monitored to determine if it continues to be safer than it was when it was signalized.

Aerial views of the intersection before and after the roundabout was constructed are shown on the following page.

Aerial View of the Shawano Avenue – Taylor Street Intersection
Before Roundabout Construction



Aerial View of the Shawano Avenue – Taylor Street Intersection
After Roundabout Construction



7. STH 29 – Packerland Drive/Cardinal Lane (Howard)

Estimated Crash Rate:	0.92	
Total Reportable Crashes During Period:	49	
Property Damage Crashes:	38	
Estimated Property Damage Cost:	$486,400	
Injury Crashes:	11	
Incapacitating (A) Injuries During Period:	1	
Non-Incapacitating (B) Injuries During Period:	1	
Possible (C) Injuries During Period	12	
Estimated Total Injury Cost:	$246,800	
Crash Type		
Right Angle	5	10%
Rear End	39	80%
Side Swipe	4	8%
Head On	0	0%
Bicycle/Pedestrian	0	0%
Other (Single Vehicle Crash, Etc.)	1	2%
Driver Factor		
Disregard Traffic Control	0	0%
Failure To Yield	4	8%
Inattentive Driving	15	31%
Too Fast For Conditions	5	10%
Driver Condition (Alcohol)	3	6%
Other/No Factor Indicated	22	45%

Observations for the 2010-2012 Study Period:

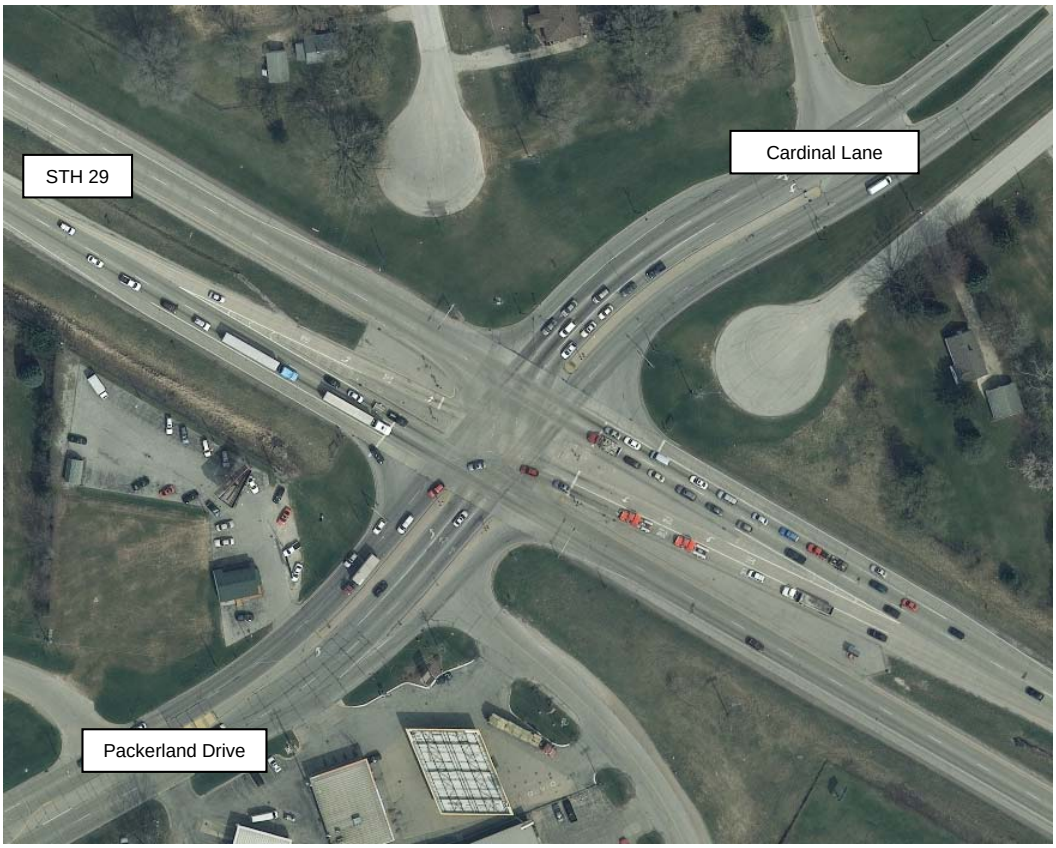
- The most common incidents at the intersection during the study period were eastbound rear end crashes. 23 of the intersection's 39 rear end crashes involved eastbound drivers.

- 30 of the intersection's 39 rear end crashes did not result in injuries. However, the "A" injury, "B" injury, and eight of the 12 "C" injuries occurred when eastbound drivers rear ended other eastbound vehicles.

The traffic signals that were present during the 2010-2012 study period were recently replaced by roundabouts as a part of the US 41/STH 29 interchange reconstruction project. The interchange reconstruction project also separated the highway traffic from local traffic at this intersection. Because these modifications are new, the intersection (which is now two intersections) should be monitored to determine if safety improves at this location.

Aerial views of the intersection before and during the reconstruction project are shown on the following page.

Aerial View of the STH 29 – Packerland Drive/Cardinal Lane Intersection
Before Reconstruction Project



Aerial View of the STH 29 – Packerland Drive/Cardinal Lane Intersection
During Reconstruction Project (2014)

T8. University Avenue – Elizabeth Street (Green Bay)

Estimated Crash Rate:	0.89	
Total Reportable Crashes During Period:	18	
Property Damage Crashes:	4	
Estimated Property Damage Cost:	$51,200	
Injury Crashes:	14	
Incapacitating (A) Injuries During Period:	4	
Non-Incapacitating (B) Injuries During Period:	6	
Possible (C) Injuries During Period	14	
Estimated Total Injury Cost:	$597,400	
Crash Type		
Right Angle	15	85%
Rear End	1	5%
Side Swipe	1	5%
Head On	1	5%
Bicycle/Pedestrian	0	0%
Other (Single Vehicle Crash, Etc.)	0	0%
Driver Factor		
Disregard Traffic Control	2	0%
Failure To Yield	9	8%
Inattentive Driving	3	31%
Too Fast For Conditions	0	10%
Driver Condition (Alcohol)	2	6%
Other/No Factor Indicated	2	45%

Observations for the 2010-2012 Study Period:

- 15 of the intersection's 18 incidents during the study period were right angle crashes, and 12 of these 15 right angle crashes were responsible for 22 of the intersection's 24 injuries during the study period. All of the "A" injuries and five of the six "B" injuries at this intersection occurred as a result of these right angle crashes.

- The most serious incident during the study period was a right angle crash that occurred when two intoxicated drivers collided at the intersection. The crash resulted in a total of five injuries, and at least two of these were "A" injuries (only two injuries were recorded in the crash database). The crash occurred when the intersection's traffic signals were in flash mode at approximately 2:00 a.m.

Of the remaining 14 right angle crashes at the intersection:

- Seven occurred when drivers on University Avenue disregarded or failed to yield at the traffic signals and collided with vehicles traveling through the intersection on Elizabeth Street.

- Four of these seven University Avenue drivers were traveling westbound and three were traveling eastbound when they ran the red lights. Six of these seven crashes occurred during daylight hours, and the seventh occurred at dusk.

- These seven crashes resulted in four "B" injuries and eight "C" injuries.

- The remaining seven right angle crashes occurred when left-turning drivers on University Avenue failed to yield to oncoming vehicles on University Avenue. This conflict was also the cause of the only head on crash at the intersection.

  - Eastbound drivers were at fault in six of the eight right angle/head on crashes that were caused by drivers making left turns in front of oncoming vehicles. Although these six crashes resulted in only three injuries, two of the three were "A" injuries. The third was a "B" injury.

  - There are no left turn lanes at the intersection, so it is likely that the left-turning drivers were not able to see oncoming vehicles because their views were blocked by opposing vehicles that were waiting to turn left at the intersection.

  - Five of the six right angle/head on crashes where eastbound left-turning drivers were at fault occurred on clear days between approximately 2:00 p.m. and 4:00 p.m., which means that the westbound drivers involved in these crashes might have had a hard time noticing (and avoiding) the left-turning drivers because they were looking toward the sun.

Based on these findings, it is possible that the two conditions that likely contributed to most of the crashes during the three-year study period were:

- Left-turning drivers having a hard time seeing vehicles approaching in the outside travel lanes because their views were blocked by opposing motorists who were waiting to turn left at the intersection. The approaching drivers might have also had a hard time noticing and reacting to the left-turning vehicles because they were looking toward the sun.

- Drivers having a difficult time noticing and reacting to the University Avenue traffic signals before entering the intersection. This could be due to the presence of the overhead railroad crossing signals, utility poles, and overhead wires at and near the intersection. The traffic signals might also be difficult to see at certain times on sunny days because University Avenue is an east-west street.

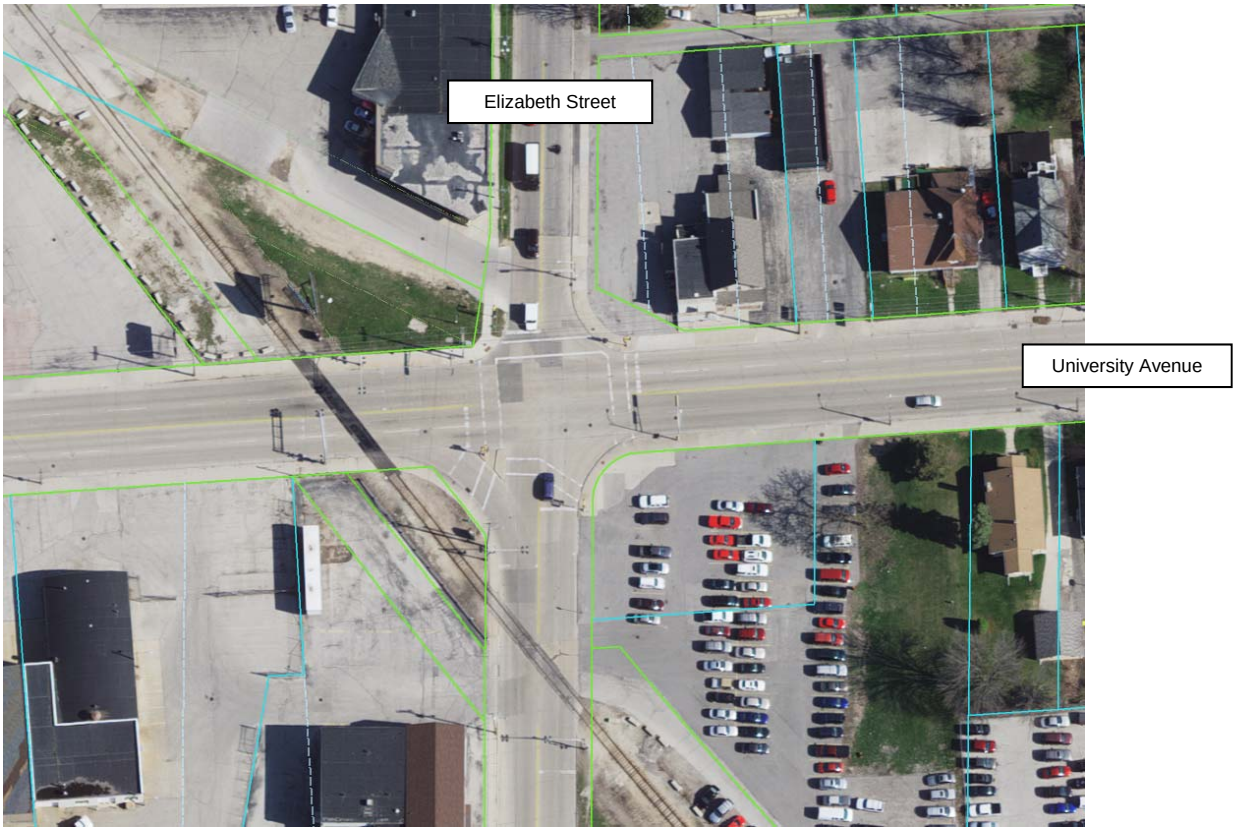
The data suggest that the conditions that contributed to nearly all of the crashes and injuries during the three-year study period could be addressed by replacing the signalized intersection with a roundabout, but this might not be feasible because of the limited amount of right-of-way and proximity of the two railroad crossings to the intersection.

Another method of improving safety at the intersection would be to add positive-offset left turn lanes at the eastbound and westbound approaches. However, there is currently not enough right-of-way present at the intersection to accommodate the left turn lanes.

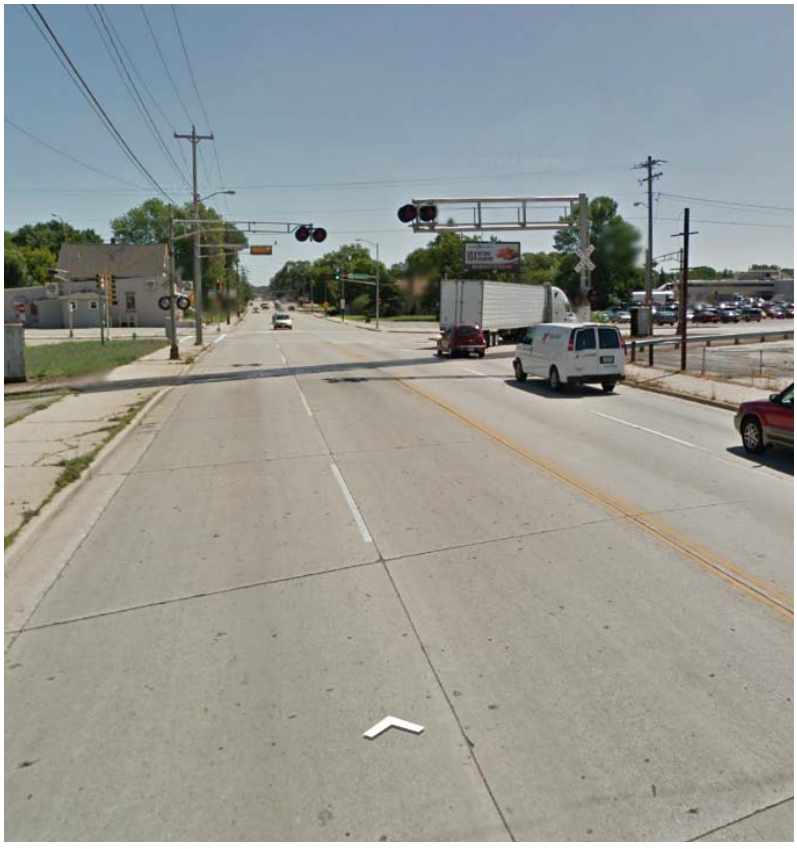
If a roundabout or positive-offset left turn lanes are not feasible, a method of reducing the likelihood of some of the types of crashes that occurred during the study period might be to reduce the visual clutter at and near the intersection by removing the utility poles, burying the wires, and, if possible, modifying the overhead railroad crossing signals so they do not block drivers' views of the traffic signals. The likelihood of crashes might also be reduced by adding a protected left turn phase to the eastbound signals.

Aerial and ground-level views of the intersection are shown on the following page.

Aerial View of the University Avenue – Elizabeth Street Intersection
(Green Lines = Existing Right-of-Way)



View of the University – Elizabeth Intersection's Eastbound Approach



T8. Main Street – Verlin Road (Bellevue)

Estimated Crash Rate:	0.89	
Total Reportable Crashes During Period:	22	
Property Damage Crashes:	16	
Estimated Property Damage Cost:	$204,800	
Injury Crashes:	6	
Incapacitating (A) Injuries During Period:	0	
Non-Incapacitating (B) Injuries During Period:	0	
Possible (C) Injuries During Period	7	
Estimated Total Injury Cost:	$89,600	
Crash Type		
Right Angle	2	9%
Rear End	7	32%
Side Swipe	6	27%
Head On	1	5%
Bicycle/Pedestrian	0	0%
Other (Single Vehicle Crash, Etc.)	6	27%
Driver Factor		
Disregard Traffic Control	0	0%
Failure To Yield	3	13%
Inattentive Driving	5	23%
Too Fast For Conditions	3	13%
Driver Condition (Alcohol)	5	23%
Other/No Factor Indicated	6	28%

Observations for the 2010-2012 Study Period:

- This intersection was signalized until the early spring of 2010. The intersection was reconstructed during the spring, summer, and fall of 2010, and a roundabout opened at the intersection in late 2010.
- The intersection did not experience any "A" or "B" injury crashes after the traffic signals were replaced by a roundabout in late 2010.
- The single head on crash occurred when the intersection was still signalized.
- Six of the intersection's 22 crashes were single vehicle incidents. Three of these single vehicle incidents involved alcohol.
- Five of the crashes during the study period involved intoxicated drivers.
- Two of the six single vehicle crashes occurred on the same day at about the same time due to icy conditions.

It appears that replacing the traffic signals with a roundabout has made the intersection much safer than it was in the past. But because the roundabout is relatively new, the intersection should be monitored to determine if it continues to be safer than it was when it was signalized.

Aerial views of the intersection before and during the roundabout project are shown on the following page.

Aerial View of the Main Street – Verlin Road Intersection
Before the Roundabout Project

Aerial View of the Main Street – Verlin Road Intersection
After the Roundabout Project

10. University Avenue – Henry Street (Green Bay)

Estimated Crash Rate:	0.87	
Total Reportable Crashes During Period:	17	
Property Damage Crashes:	6	
Estimated Property Damage Cost:	$76,800	
Injury Crashes:	11	
Incapacitating (A) Injuries During Period:	1	
Non-Incapacitating (B) Injuries During Period:	3	
Possible (C) Injuries During Period	11	
Estimated Total Injury Cost:	$279,400	
Crash Type		
Right Angle	10	59%
Rear End	4	23%
Side Swipe	0	0%
Head On	1	6%
Bicycle/Pedestrian	1	0%
Other (Single Vehicle Crash, Etc.)	1	12%
Driver Factor		
Disregard Traffic Control	7	41%
Failure To Yield	1	6%
Inattentive Driving	2	12%
Too Fast For Conditions	2	12%
Driver Condition (Alcohol)	1	6%
Other/No Factor Indicated	4	23%

Observations for the 2010-2012 Study Period:

- The "A" injury was sustained by a westbound motorcyclist who was hit by a southbound vehicle that disregarded the traffic signal.
- One of the three "B" injuries was sustained by a child bicyclist, and the crash was determined to be the fault of the bicyclist. The other "B" injuries were sustained by an occupant of a vehicle that was rear-ended by an intoxicated driver and by the occupant of a vehicle that was involved in a head on crash with a vehicle making a left turn.
- The two most common crashes at the intersection during the study period were right angle crashes caused by westbound and eastbound drivers disregarding the traffic signals and rear end crashes that happened at the eastbound intersection approach.

It is difficult to tell what caused drivers to disregard the traffic signals during the study period, but it is possible that the drivers had a difficult time seeing the signals during daylight hours if sun glare was a problem. If this was the case, it may be possible to improve the visibility of the signals by replacing the trombone signal arms with monotube arms that have signal heads over each lane.

Aerial and ground-level views of the intersection are shown on the following page.

Aerial View of the University Avenue – Henry Street Intersection

View from the University – Henry Intersection's Eastbound Approach

V. Conclusions

The statistics for the 10 intersections in this study suggest that many of the crashes that occurred between 2010 and 2012 were the result of only a handful of problems. For example, most of the intersections experienced at least a few crashes that were likely caused by the inability of left-turning motorists to see oncoming motorists, and this appeared to the primary cause of many crashes at some of the intersections. Many of the intersections in the study also experienced crashes attributable to drivers disregarding traffic signals or stop signs, and most of these incidents were probably the result of people failing to beat red lights or simply not seeing the signal or sign until it was too late. Rear end crashes were common, and in most cases these crashes appeared to have been caused by drivers not paying attention, following the vehicles in front of them too closely, and driving too fast in all types of weather. There were several crashes that did not fit into these categories, but these seemed to be the most common crashes at the 10 metropolitan area intersections during the three-year study period.

Since most of the crashes appear to fit into one of the categories listed above, it should be reasonably easy to correct many of the problems and significantly reduce the number of crashes in the area. Some of the intersection summaries presented in Section IV of the study recommended methods of improving safety, and these and other recommendations are discussed below.

Roundabouts

Roundabouts are often recommended because they can significantly reduce the number and severity of the types of crashes that were common at many intersections featured in this study (e.g. right angle crashes and crashes caused by people disregarding traffic controls). Roundabouts also improve traffic capacity, pedestrian and bicyclist accessibility, and the attractiveness of an area. In many cases, roundabouts are less expensive to build than new or expanded signalized intersections, and they allow streets that would ordinarily be expanded for vehicle storage to remain narrow because traffic is often able to flow virtually uninterrupted at intersections.

Single Lane Roundabout Safety

Most of the single lane roundabouts in the metropolitan area experience few or no reportable crashes each year. Injuries are also rare at these roundabouts, and those that have occurred since the area's first roundabouts were built in 1999 have been minor or possible injuries. Single lane roundabouts have helped to significantly reduce the number of crashes and injuries at many problem intersections throughout the metropolitan area over the last 15 years, and crashes and injuries at other intersections have likely been avoided by constructing single lane roundabouts before safety problems appeared.

The metropolitan area's single lane roundabouts significantly reduced or eliminated right angle and head on crashes when they replaced traffic signals and stop signs, which is why this crash study recommends the construction of a single lane roundabout at the intersection of Grant Street and Mid Valley Drive in Lawrence. But despite the overall success of these roundabouts, this crash study and the previous (2007-2009) crash study found that the single lane roundabout at the Allouez Avenue - Libal Street intersection in Allouez experienced unusually high crash rates during both study periods.

Although nearly all of these crashes resulted in minor property damage and a handful of minor and possible injuries during the two study periods, this intersection should be studied to determine if eastbound vehicle entry and circulation speeds are the primary problem or if other issues are contributing to the roundabout's unusually high crash rates.

Multi-Lane Roundabout Safety

Multi-lane roundabouts also minimize the likelihood of serious crashes and injuries because they are designed to prevent right angle and head on conflicts and to encourage drivers to enter and pass through the intersections at reasonable speeds. The multi-lane roundabouts that were built at the Main Street – Verlin Road and Shawano Avenue – Taylor Street intersections during the 2010-2012 study period appear to have made both intersections much safer than when they were signalized, and the 2012 data for the multi-lane roundabout at the West Mason Street – Taylor Street intersection suggest that safety has improved at this intersection as well.

Although these relatively new multi-lane roundabouts appear to be operating efficiently and safely, this crash study and the previous (2007-2009) crash study found that the multi-lane roundabout at the intersection of the Claude Allouez Bridge and Broadway in De Pere experienced relatively high crash numbers and rates during both study periods. But the lane modifications that occurred in 2013 appear to have significantly reduced the number of crashes at the roundabout.

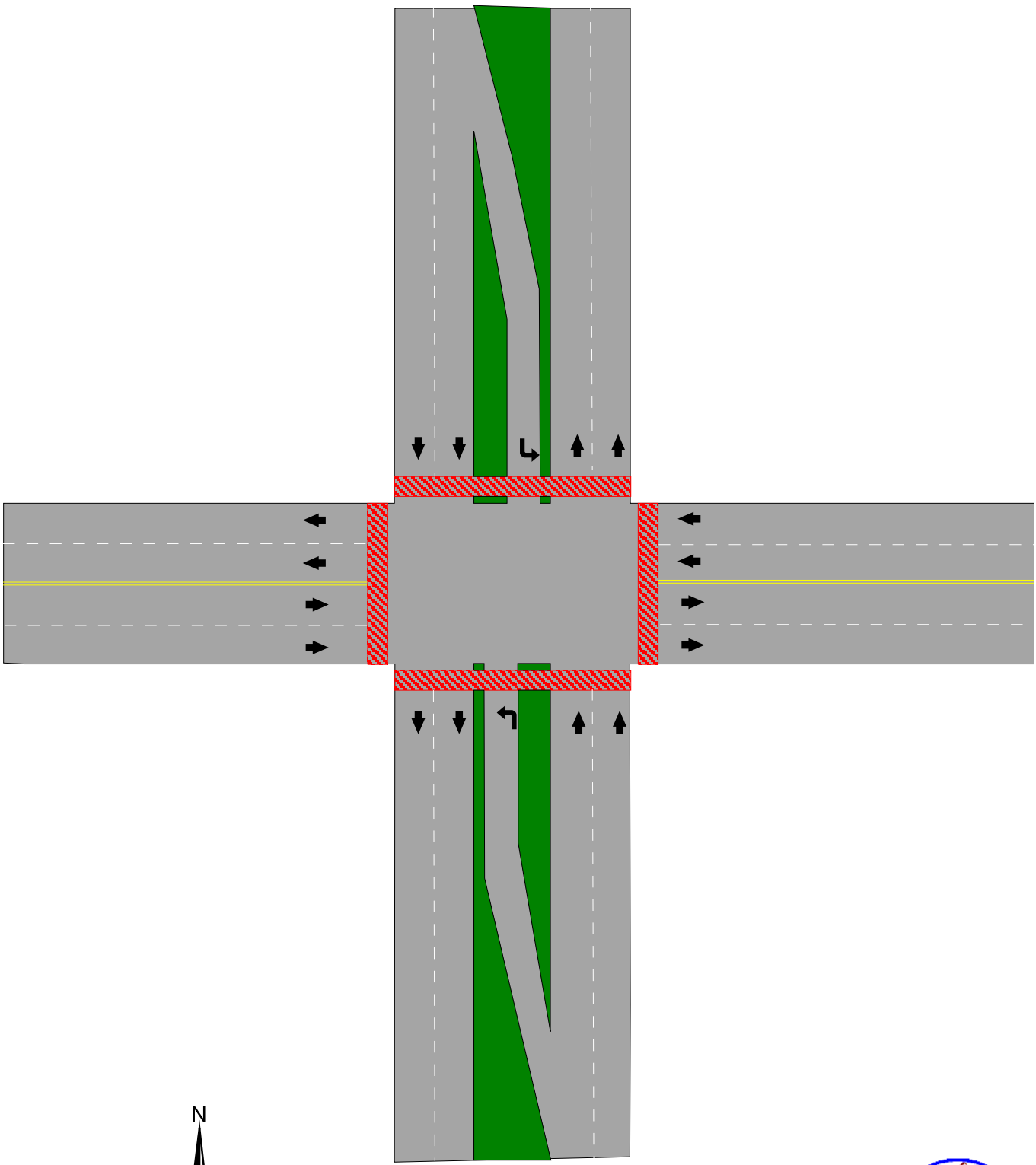
The TOPS Laboratory crash database indicates that the Claude Allouez Bridge - Broadway roundabout experienced an average of 34.7 crashes per year during the 2010 to 2012 study period. However, there were only 13 crashes at the roundabout in 2013, and preliminary crash data currently indicate that there were 14 crashes at the roundabout in 2014[2]. These figures strongly suggest that the modifications WisDOT made to the roundabout in 2013 have significantly reduced crashes, and the intersection should be monitored to determine if annual crash totals continue to remain low.

Positive-Offset Left Turn Lanes

Positive-offset left turn lanes are recommended in this study and in previous crash studies because they improve the ability of left-turning motorists to see oncoming vehicles. The 2010-2012 crash data suggest that the positive-offset left turn lanes that were built in 2003 at intersections along STH 172 and Ashland Avenue have made the intersections safer, which is why this study recommends that they be installed at other intersections when space is available to reduce the likelihood of these types of crashes. A diagram showing positive-offset left turn lanes is included in Figure 1 on the following page.

[2] Preliminary 2014 crash data as of January 2015. The crash dataset for each year is listed as preliminary by the TOPS Laboratory until all of the records for the year are entered. This entry process is typically completed by the middle of the following year.

Figure 1: Positive-Offset Left Turn Lanes (Four Lane Street Example)



Frontage Roads

Some of the intersections that have been profiled in crash studies since the late 1990s include frontage roads on one or both sides of the primary streets. The crash data and field reviews from these studies suggest that vehicle movements to and from the frontage roads make the intersections very hazardous at peak travel times and moderately hazardous during off-peak times. Unfortunately, the problems posed by the existing frontage roads are very difficult to fix because existing buildings make it nearly impossible to move the connection points farther away from the intersections. Since the connection points cannot be moved, the only way to reduce crashes at the frontage roads would be to restrict vehicle movements to and from the roads or make the existing movements safer (e.g. by incorporating them into a roundabout).

As development occurs and streets are constructed or reconstructed, the addition of frontage roads should be avoided. Instead, access to buildings along major streets and highways should be from driveways that connect to side streets, roads that run behind the buildings, and, if no alternative exists, from shared driveways that directly connect to the major streets or highways.

VI. Implementation

This study identifies safety problems at several intersections, identifies the estimated property damage and injury costs associated with these problems, and, in some cases, recommends remedies to the problems that would likely be paid for by the cost savings associated with the resulting crash and injury reductions. Although the financial impact of improving safety at these and other intersections in the area would be very significant, the most important reason to make intersections as hazard-free as possible is to protect the drivers, pedestrians, bicyclists, and other users of the transportation system from injury. After all, a dented fender can be fixed, but many injuries never completely heal. To provide everyone safer access to a variety of destinations, the study should be used by the affected communities, Brown County Department of Public Works, and Wisconsin Department of Transportation as a means of identifying the existence of hazards, determining why the hazards exist, and financially justifying corrections that will reduce or eliminate the hazards.