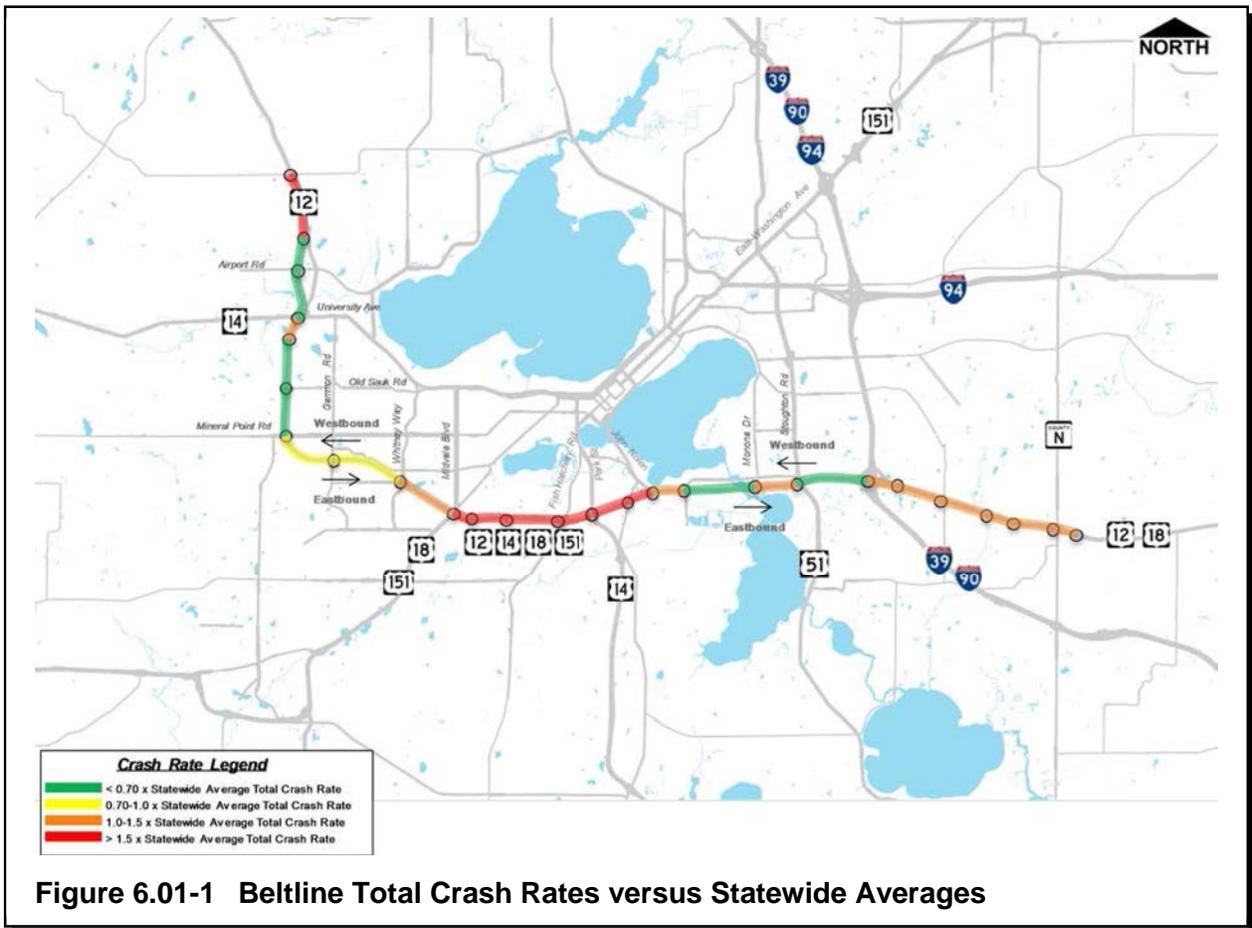


SECTION 6
MOTOR VEHICLE CRASHES

6.01 SUMMARY OF CRASH ANALYSIS

From 2008 through 2012, over 2,300 crashes, or over a crash per day, occurred along the US 12/14/18/151/Beltline Highway (Beltline) from County K at the northwest end to North Star Road at the southeast end of the corridor. Approximately 1 of every 4 crashes along the Beltline involved injuries, including 8 crashes involving fatalities over the 5-year time frame.

Typically crash rates for highways and roadways are compared to similar highways or roadways across Wisconsin. For the Beltline from 2008 through 2012, approximately 10.6 miles, or 60 percent, of the freeway portion (Parmenter Street to I-39/90) was over the statewide average total crash rate for Large Urban Freeways. For the same stretch, approximately 9.7 miles, or 55 percent, of the freeway portion was over the statewide average injury crash rate for Large Urban Freeways. The expressway portions analyzed, County K to Parmenter Street and I-39/90 to North Star Road, were both over the statewide average total crash rate for Rural and Small Urban Expressways. Figure 6.01-1 compares the 2008-2012 total crash rates along the Beltline to the statewide average total crash rates.



The location with the highest total crash rate and injury crash rate in the study area was the Beltline/County K intersection. A total of 4 fatal accidents occurred at intersections from 2008-2012 in the study area, 3 of which occurred at intersections with direct access to the Beltline. The following sections describe the background and methodology, corridor crash analysis, and intersection crash analysis performed for the study.

6.02 BACKGROUND AND METHODOLOGY

The Wisconsin Department of Transportation (WisDOT) provided 2008-2012 crash data along the Beltline from County K at the northwest end through North Star Road in the Town of Cottage Grove at the southeast end of the corridor.

A. Crash Analysis Methodology

Segments of a roadway and intersections each have their own respective methods of calculating crash rates. For roadway segments, crash rates are calculated as the number of crashes per hundred million vehicle miles traveled (HMVMT). For intersections, crash rates are calculated as the number of crashes per million entering vehicles (MEV).

1. Identifying Locations of Crashes

The University of Wisconsin-Madison Traffic Operations and Safety (TOPS) Laboratory developed a crash data user guide in 2010. This guide was used to help identify unique characteristics of each crash provided by WisDOT. The categories that were primarily used to identify the location of each crash are as follows:

- a. ONHWY—The name of the highway on which the crash took place.
- b. ONHWYDIR—Primary direction of travel for the ONHWY.
- c. RPNMBR—Reference Point number where a crash occurred.
- d. RPDIS—Distance in miles in the cardinal direction from the RPNMBR listed.
- e. ACCD LOC—The type of location at which a crash occurred. This field was used to identify intersection and nonintersection crashes.
- f. INTDIR—Cardinal direction of the distance of the intersecting highway that is used to identify the location of the crash. This was primarily used for locating intersection crashes. For example, an intersection crash at US 51/Stoughton Road and Broadway with “E” would stand for east of US 51/Stoughton Road on Broadway.
- g. INTDIS—Intersection distance in hundredths of a mile from intersection location listed.
- h. TRVLDIR 1/2—The direction of travel of a unit (vehicle, bicycle, or pedestrian) prior to the crash based on the primary road direction.
- i. TRFCNTRL 1/2—The traffic controls in effect at the time of the crash. This field helped identify intersection crashes with signals, stop signs, or yield signs.
- j. DRVRDO 1/2—What the unit was doing at the time of the crash. This field helped identify if there was congestion during the crash or if the vehicle was making a maneuver typical to either an intersection or the freeway.

Using the data within the fields described above and engineering judgment, crashes were assigned to an individual segment or an individual intersection or identified as being out of the corridor.

2. Highway Segments

Individual segment crash rates were generally calculated from interchange overpass to interchange overpass along the Beltline. Table 6.02-1 shows the segments that were analyzed.

Segment	2008-2012 AADT	Length (miles)	Interchanges or Intersections?	Number of Beltline Lanes
County K-Parmenter	25,370	1.1	S, I	4
Parmenter-Airport	31,810	1.0	I	4
Airport-University	31,000	1.1	I	4
University-Greenway	45,380	0.5	I	4
Greenway-Old Sauk	48,140	1.1	I	4
Old Sauk-Mineral Point	65,330	1.0	I	4
Mineral Point-Gammon	60,450	1.2	I	4
Gammon-Whitney Way	74,280	1.6	I	4
Whitney Way-Verona	92,620	1.2	I	4
Verona-Todd	122,810	1.6	I	6
Todd-Fish Hatchery	121,100	0.8	I	6
Fish Hatchery-Park	128,000	0.7	I	6
Park-Rimrock	125,150	0.9	I	6
Rimrock-John Nolen	102,920	0.5	I	6
John Nolen-South Towne	124,000	0.8	I	6
South Towne-Monona	123,230	1.5	I	6
Monona-Stoughton	116,050	0.9	I	6
Stoughton-I-39	78,200	1.5	I	7
I-39-Long	15,230	4.6	I, U	4
Long-County AB			U	4
County AB-Femrite			U	4
Femrite-Vilas			U	4
Vilas-County N			U, I	4
County N-North Star			I, U	4

I = Interchange(s)
 S = Signalized Intersection(s)
 U = Unsignalized Intersection(s)

Table 6.02-1 Beltline Segments and Characteristics

Annual average daily traffic (AADT) volumes over the 5-year period from 2008-2012 were calculated using WisDOT resources for use in the segment crash rate calculations.

3. Intersections

Intersections in the crash analysis included interchange ramp terminals, intersections along the Beltline, and typically major intersections adjacent to interchanges. The intersections along the Beltline include County K on the northwest end and Long Drive, County AB, Femrite Drive/Siggelkow Road, Vilas Road, and North Star Road on the southeast end of the corridor.

Overall, 88 intersections were included in the crash analysis. Intersection entering AADT volumes were calculated mainly using WisDOT resources. Individual intersection traffic counts were used to estimate entering volumes where AADT volumes were available.

B. Wisconsin Statewide Average Crash Rates

The calculated crash rates along the Beltline were compared to statewide average crash rates based on the functional class of the highway segment. These functional classes are based on the WisDOT Meta-Manager Management System Database. The statewide average crash rates are reported as a 5-year average to account for variability in traffic volumes and crash trends between years.

For the Beltline, most of the individual segments were identified as “Large Urban Freeways.” At and near the existing at-grade intersections on the outer limits of the study area, the “Rural and Small Urban Expressways” functional classification was used. The statewide average crash rates for each type of roadway are shown in Table 6.02-2.

Meta-Manager Class		2008-2012 Statewide Average Crash Rate (crashes per HMVMT)					
#	Description	Total	Fatal	Type A Injury	Type B Injury	Type C Injury	Property Damage Only
2	Rural and Small Urban Expressways	51.1	0.6	2.9	6.6	6.7	34.3
7	Large Urban Freeways	73.3	0.3	1.5	6.0	12.6	52.9
<p><u>Type A:</u> Incapacitating Injury - Any injury other than a fatal injury, which prevents the injured person from walking, driving, or from performing other activities, which he/she performed before the accident. An example of a Type A injury may be a concussion or being knocked unconscious.</p> <p><u>Type B:</u> Nonincapacitating Injury - Any injury, other than fatal or incapacitating, which is evident at the scene. Evidence of injury may include known symptoms of an injury, which are not directly observable. An example of a Type B injury may be a broken limb.</p> <p><u>Type C:</u> Possible Injury - Any injury which is not observable or evident at the scene but is claimed by the individual or suspected by the law enforcement officer. An example of a Type C injury may be neck or back pain.</p>							
<p>Table 6.02-2 Wisconsin Statewide Average Crash Rates (2008-2012)</p>							

WisDOT considers an intersection crash rate of 1.5 crashes per MEV as a threshold for evaluation. Rates above 1.5 typically warrant considerations of improvements. Rates from 1.0 to 1.5 typically warrant watching. Intersections that exceed either of these thresholds will be discussed in Section 6.04.

C. Concurrent Studies

There are several ongoing studies in Dane County that overlap with portions of the Beltline PEL study area. These are as follows:

1. US 12 Freeway Conversion—WIS 19 to Parmenter Street
2. US 12/18 Freeway Conversion Study—I-39/90 to County N
3. Stoughton Road Environmental Impact Statement—WIS 19 to Terminal Drive

The recommendations, safety analysis, and other aspects from these studies will be taken into account during alternative development for the Beltline.

D. Previous Crash Analysis

The Madison Beltline Operational Needs Assessment report was completed in 2008. The limits of this study were from US 14/University Avenue to County N. A crash analysis was completed using crash data from 2000 through 2004.

This study used a similar methodology to the Beltline PEL to compute corridor crash rates between interchange overpasses. These corridor crash rate results of the Operational Needs Assessment crash analysis will be compared against the 2008-2012 crash analysis being performed for the Beltline PEL. Other comparisons of the crash data will include, but are not limited to, the following:

1. Total number and frequency of crashes
2. Daily traffic volumes
3. Corridor crash rates
4. The effect of construction since 2004

The results of the comparisons between the 2008-2012 crash analysis to the 2000-2004 crash analysis are discussed in Section 6.03.

E. Construction

During the study time frame and since the time of the Operational Needs Assessment, many construction projects have been completed and several more are currently underway or planned in the near future. Examples of some of the projects that have been completed, currently underway, or are planned are located in Figure 6.02-1 and Table 6.02-3.

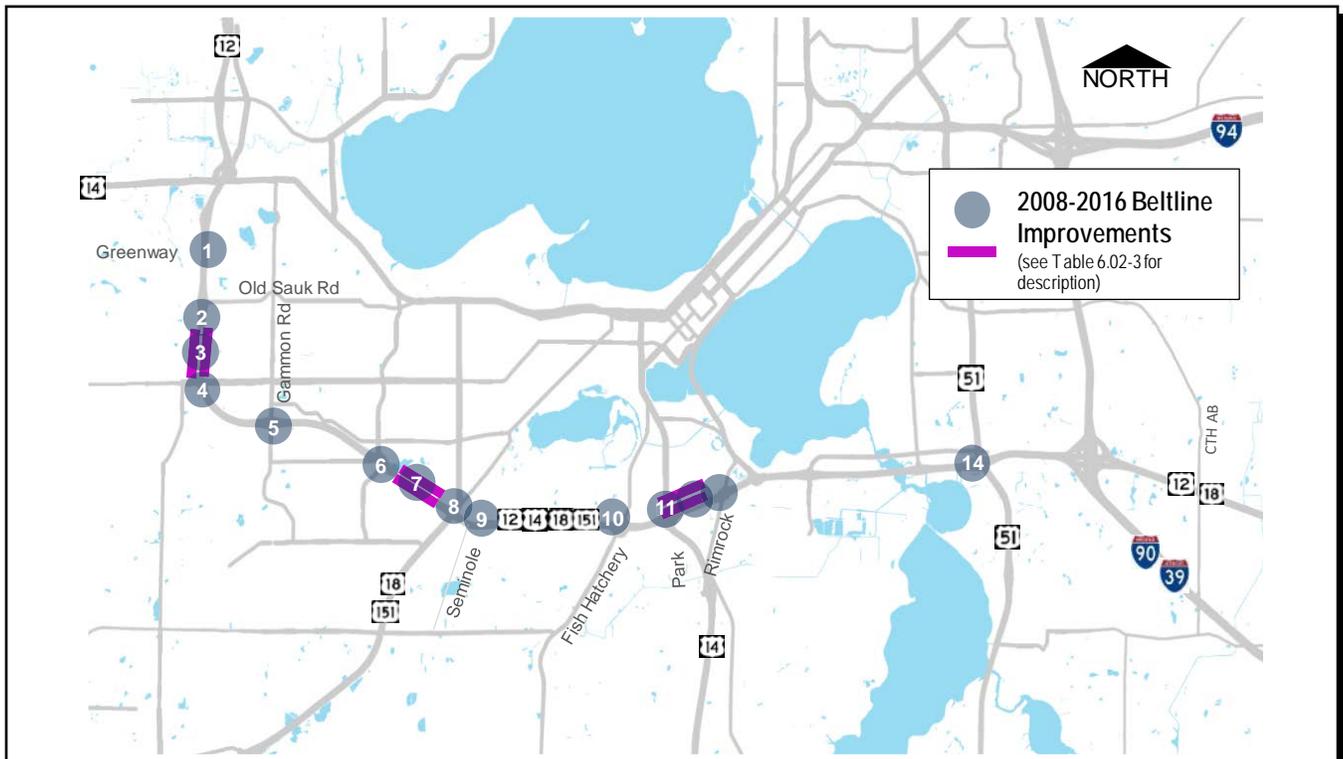


Figure 6.02-1 Madison Beltline Interim Safety and Operational Improvements (2008-2016)

ID	Location	Construction Year (s)
1	Greenway Boulevard Interchange ramps	2014
2	Old Sauk Road Interchange off ramps	2008
3	Mineral Point Road to Old Sauk Road Auxiliary Lanes	2014
4	Mineral Point Road Interchange off ramps	2008 and 2014
5	Gammon Road Interchange ramps	2009 and 2012
6	Whitney Way Interchange ramps	2015/2016
7	Whitney Way to Verona Road Expansion to 6 Lanes	Opens in 2015
8	Verona Road/US 18/151 Interchange	2013-2016
9	Seminole Highway Interchange	2008, 2013
10	Fish Hatchery Road Interchange	2009 and 2012/13
11	Park Street Interchange	2010
12	Park Street to Rimrock Road Auxiliary Lanes	2010
13	Rimrock Road Interchange off ramps	2008
14	Stoughton Road (US 51) Interchange off ramps	2008

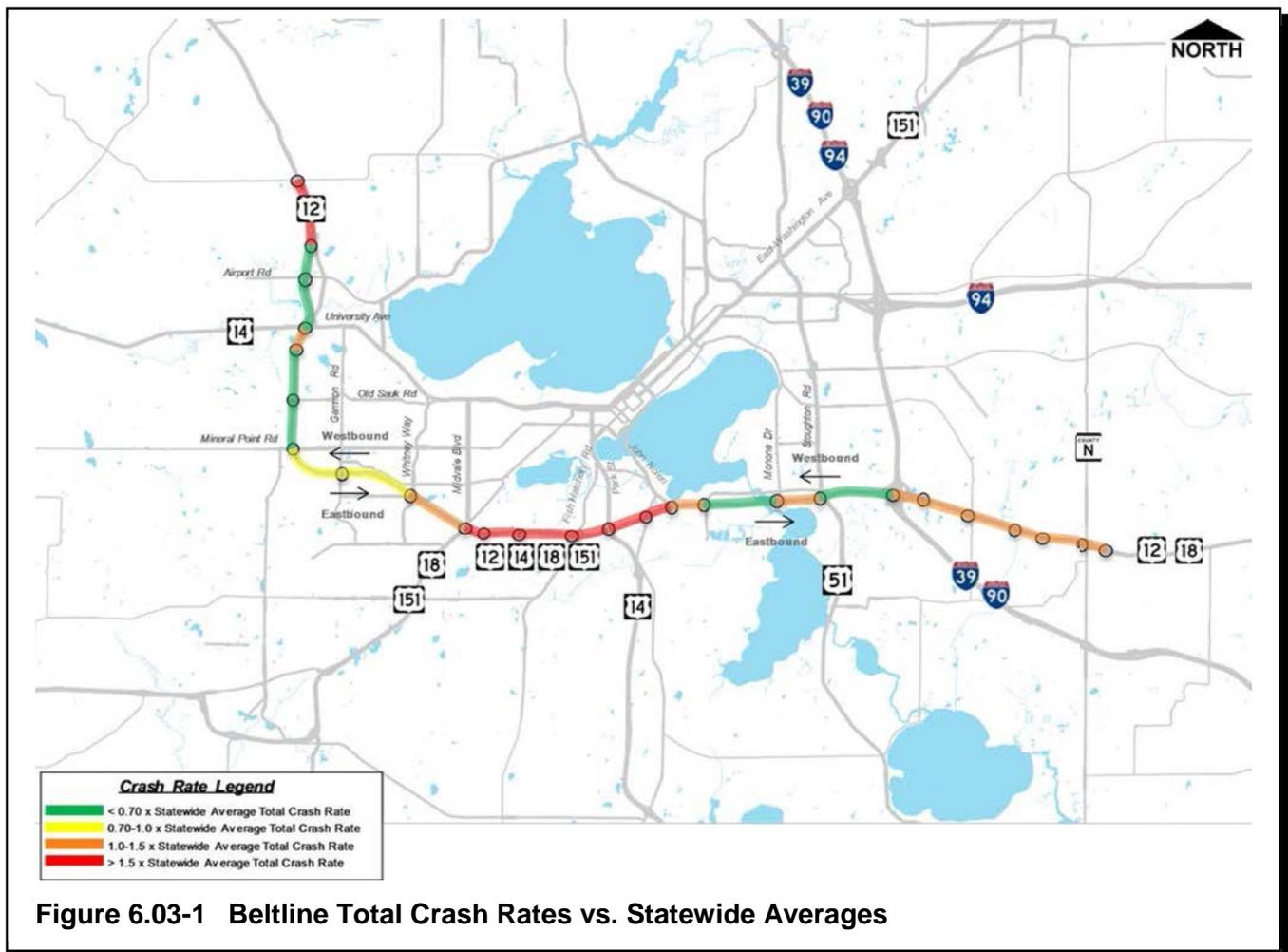
Table 6.02-3 Madison Beltline Interim Safety and Operational Improvements (2008-2016)

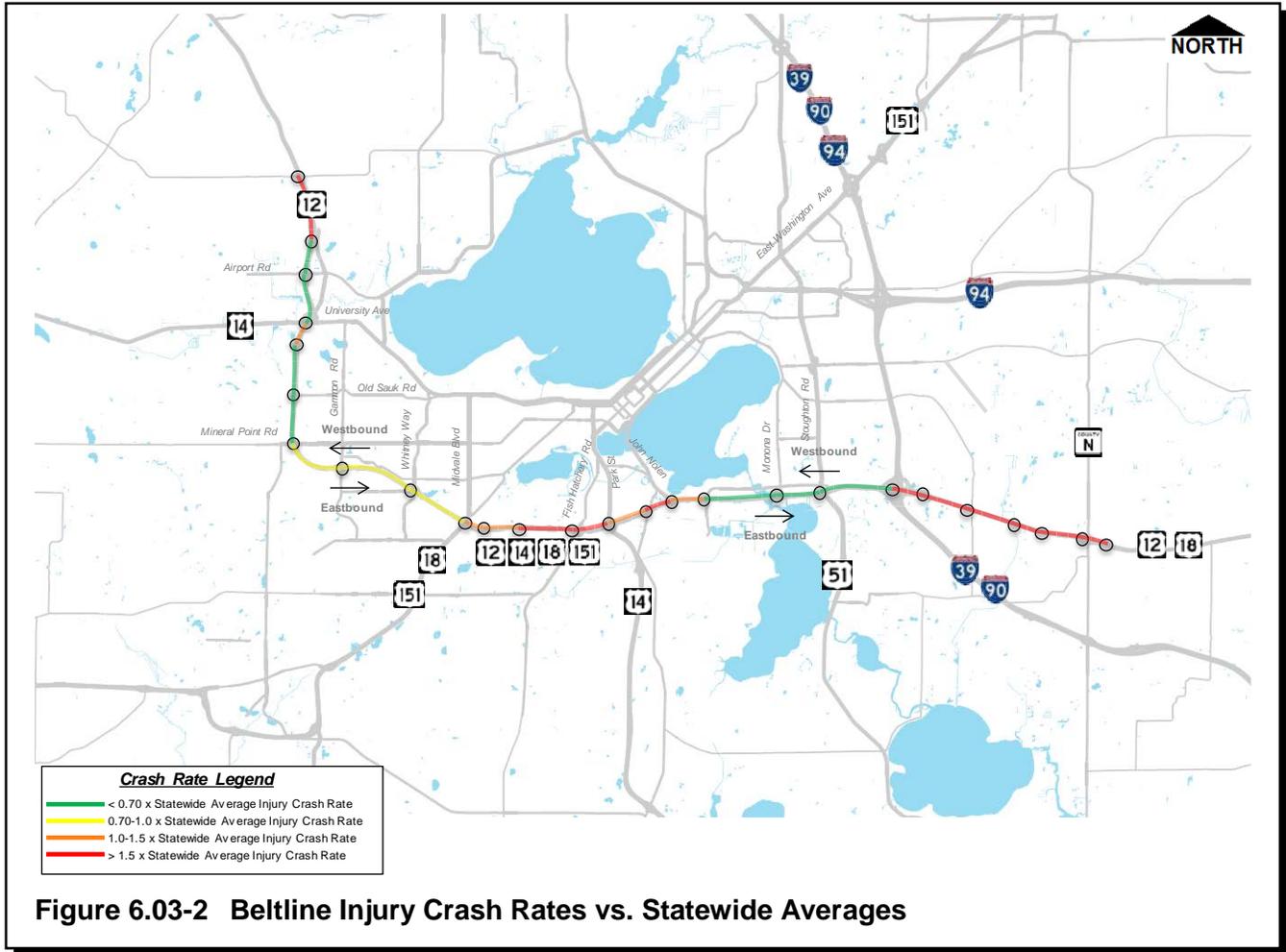
For the purposes of the Beltline PEL crash analysis, crashes that occurred during construction were included in the analysis.

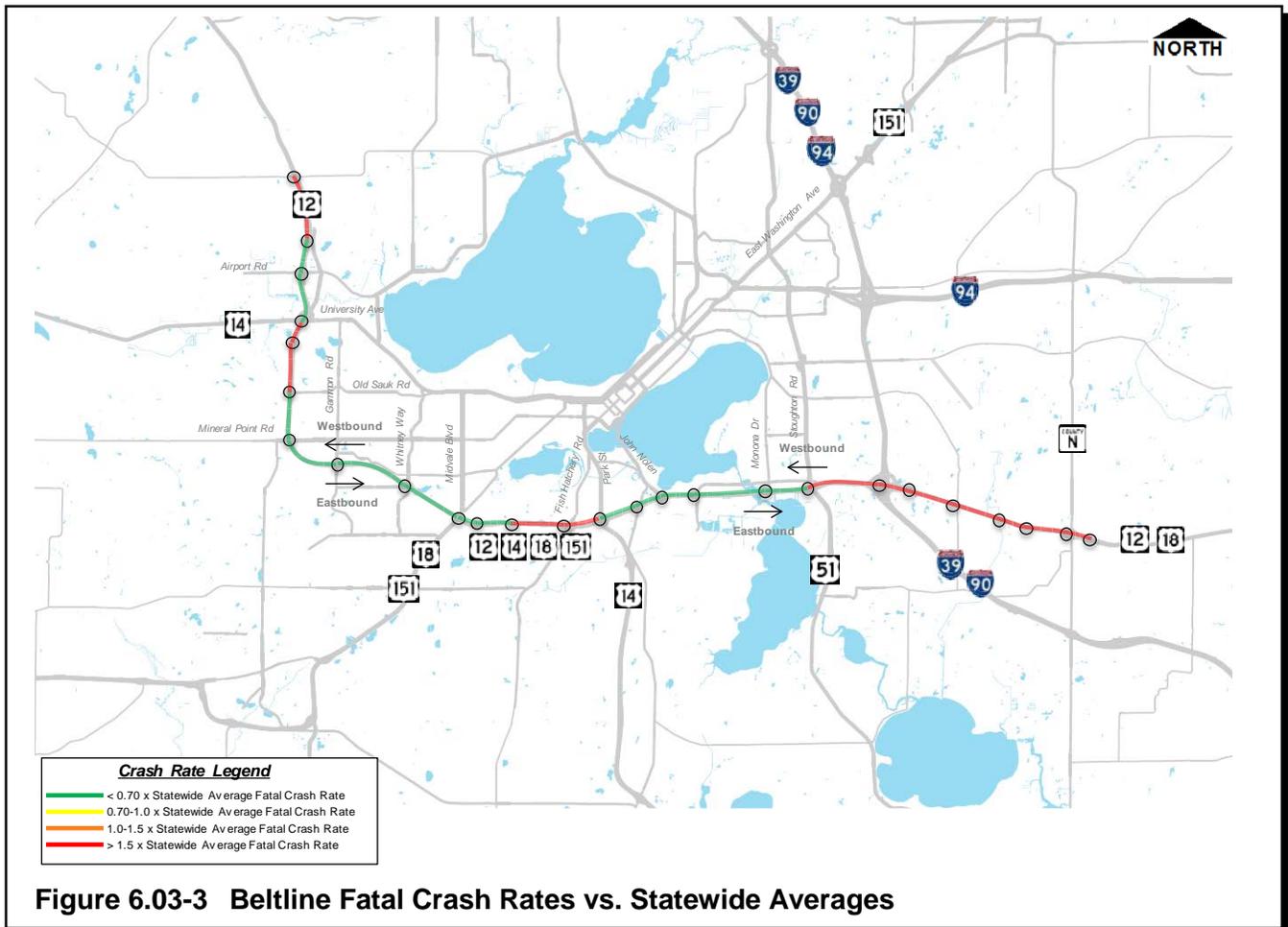
6.03 CORRIDOR CRASH ANALYSIS

A. Results

The results from the initial crash analysis indicate that 10.6 miles, or approximately 60 percent, of the Beltline classified as Urban Freeway is currently over or approaching the statewide average total crash rate and that 9.7 miles, or approximately 55 percent, is over or approaching the statewide average injury and fatal crash rate. Maps showing the total crash rates, injury crash rates, and fatal injury crash rates related to statewide average crash rates are shown in Figures 6.03-1 to 6.03-3, respectively.







The rural expressway portions of the Beltline are each over the total, total injury, and fatal statewide average crash rates. The segment from County K to Parmenter is over 2.7 times the statewide average crash rates for total crashes, injury crashes, and fatal crashes. The segment from I-39/90 to North Star Road is over 1.4 times the statewide average crash rates for total crashes, injury crashes, and fatal crashes.

There were 8 fatal crashes along the Beltline during the study period, 3 of which occurred in the rural expressway portions of the corridor.

Completed details of each segment’s crash rates and comparison to the statewide average crash rates are located in Figure 6.03-4 and Table 6.03-1.

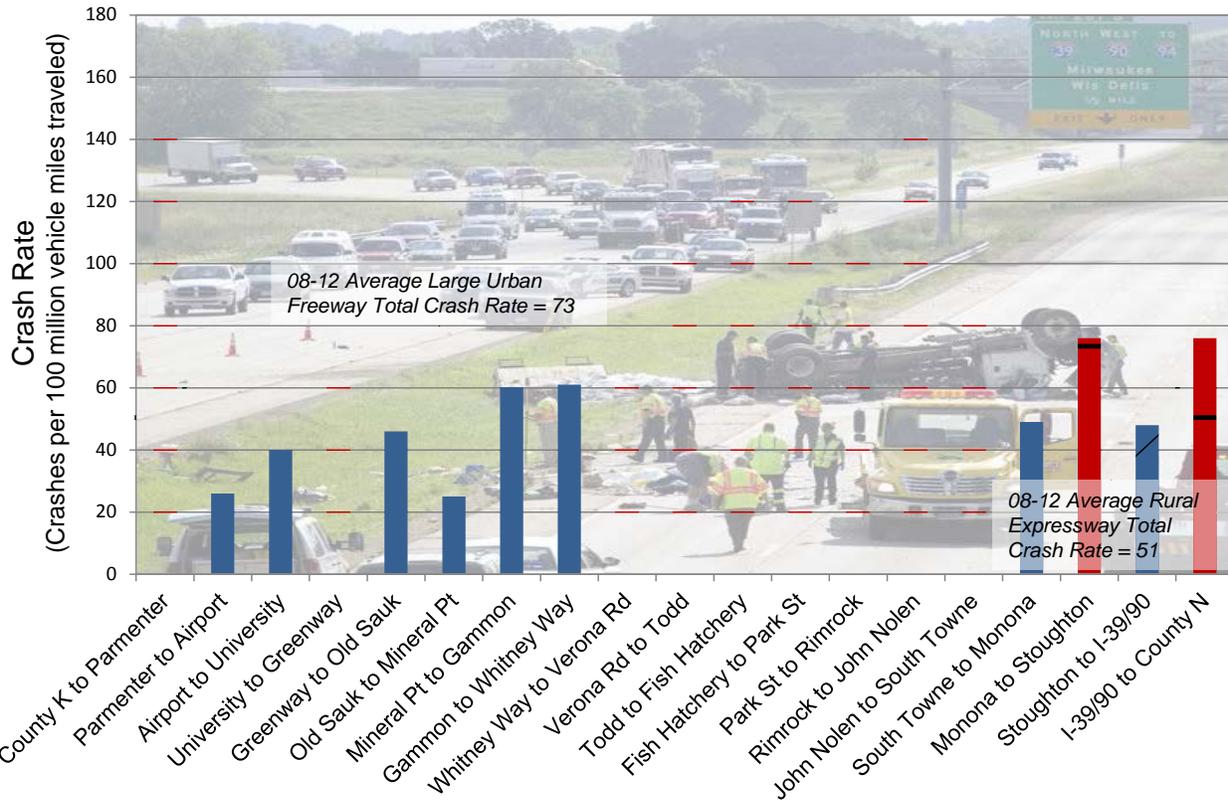


Figure 6.03-4 Beltline Total Crash Rates (2008-2012) vs. Statewide Average Crash Rates

Segment	Total Crash Rate (Crashes per HMVMT)	Statewide Crash Rate (Crashes per HMVMT)	Total Crash Rate vs. Statewide Average	Total Number of Crashes
County K to Parmenter	143	73.3	2.79	72
Parmenter to Airport	26		0.35	15
Airport to US 14/University	40		0.55	24
US 14/University to Greenway	75		1.02	31
Greenway to Old Sauk	46		0.62	42
Old Sauk to Mineral Point	25		0.34	28
Mineral Point to Gammon	60		0.82	80
Gammon to Whitney Way	61		0.84	125
Whitney Way to Verona	76		1.03	146
Verona to Todd	113		1.55	385
Todd to Fish Hatchery	123		1.68	216
Fish Hatchery to Park	127		1.73	190
Park to Rimrock	111		1.52	205
Rimrock to John Nolen	156		2.13	128
John Nolen to South Towne	82		1.12	147
South Towne to Monona	49		0.66	164
Monona to Stoughton	76		1.03	138
Stoughton to I-39/90	48		0.66	106
I-39/90 to County N	76	51.1	1.48	101
Approaching Statewide Crash Rate (>0.70)				
Over Statewide Crash Rate				

Table 6.03-1 Beltline Total Crash Rates (2008-2012) vs. Statewide Average Crash Rates

B. Comparison to Madison Beltline Operational Needs Assessment Report

The crash data referenced in this subsection of the report uses the exact same limits, US 14/University Avenue to County N, as the previous Madison Beltline Operational Needs Assessment to be able to make a direct comparison between the 2000-2004 crashes and the 2008-2012 crashes.

1. Total Number and Frequency of Crashes

The crash analysis indicates that over a crash a day and between 2 and 3 injury crashes per week occurred along the Beltline from US 14/University Avenue to County N between 2008 and 2012. From 2000 to 2004 there were over 1.5 crashes per day and between 4 and 5 injury crashes per week. The number of fatal crashes from 2008 to 2012 was 7 as opposed to 10 fatal crashes from 2000 to 2004. Table 6.03-2 shows a comparison of the total number of crashes and crash frequencies between study years.

	Total Crashes		Injury Crashes		Fatal Crashes	
	2000-2004	2008-2012	2000-2004	2008-2012	2000-2004	2008-2012
Total	3,046	2,297	1,108	634	10	7
Per Year	609	459	222	127	2	1.4
Per Week	11.7	8.8	4.3	2.4	0.2	0.1
Per Day	1.7	1.3	0.6	0.3	0.0	0.0

Table 6.03-2 Total Crashes and Frequency Historical Trends (US 14/University Avenue to County N)

2. Daily Traffic Volumes

The 2000-2004 average daily traffic volumes used in the Madison Beltline Operational Needs Assessment report crash analysis are directly compared to the 2008-2012 average daily traffic volumes used for the Beltline PEL crash analysis in Table 6.03-3.

Of the 17 locations compared along the Beltline, 14 of the daily traffic volumes increased since 2005, with 6 locations increasing by 10 percent or greater. Three locations showed decreasing daily traffic volume trends between the two time frames, ranging from a decline of 3 to 7 percent in daily traffic volumes.

Madison Beltline Segment	2000-2004 AADT	2008-2012 AADT	Difference	Percent Difference
University Ave to Greenway Blvd	48,000	45,380	-2,620	-5%
Greenway Blvd to Old Sauk Rd	49,800	48,140	-1,660	-3%
Old Sauk Rd to Mineral Point Rd	63,300	65,330	+2,030	+3%
Mineral Point Rd to Gammon Rd	52,900	60,450	+7,550	+14%
Gammon Rd to Whitney Way	68,800	74,280	+5,480	+8%
Whitney Way to Verona Rd	92,600	92,620	+20	+0%
Verona Rd to Seminole Hwy	105,500	111,330	+5,830	+6%
Seminole Hwy to Todd Dr	111,100	128,220	+17,120	+15%
Todd Dr to Fish Hatchery Rd	110,100	121,100	+11,000	+10%
Fish Hatchery Rd to Park St	118,000	128,000	+10,000	+8%
Park St to Rimrock Rd	117,300	125,150	+7,850	+7%
Rimrock Rd to John Nolen Dr	110,700	102,920	-7,780	-7%
John Nolen Dr to South Towne Dr	119,400	124,000	+4,600	+4%
South Towne Dr to Monona Dr	105,400	123,230	+17,830	+17%
Monona Dr to Stoughton Rd	101,800	116,050	+14,250	+14%
Stoughton Rd to I-39/90	70,200	78,200	+8,000	+11%
I-39/90 to County N	14,800	15,300	+500	+3%
<i>Average</i>	<i>85,900</i>	<i>91,700</i>	<i>+5,800</i>	<i>+7%</i>

Table 6.03-3 Daily Traffic Volumes Trends

3. Corridor Crash Rates

The individual segments analyzed from US 14/University Avenue to County N are listed in order from highest crash rate to lowest crash rate for each study in Table 6.03-4.

In general, overall crash rates have decreased along the Beltline from the 2000-2004 time frame to the 2008-2012 time frame. Contributing factors to this appear to be increasing traffic volumes along the Beltline, fewer number of crashes, and improvement projects since and during the 2000-2004 time frame.

Total Crash Rate Rank	2000-2004 Crash Analysis		2008-2012 Crash Analysis		Ranking Change (2000-2004 to 2008-2012)
	Segment	Total Crash Rate (crashes per HMVMT)	Segment	Total Crash Rate (crashes per HMVMT)	
1	Verona to Seminole	349	Rimrock to John Nolen	156	+3
2	Fish Hatchery to Park	246	Seminole to Todd	135	+1
3	Seminole to Todd	188	Fish Hatchery to Park	127	-1
4	Rimrock to John Nolen	170	Todd to Fish Hatchery	123	+10
5	Mineral Point to Gammon	156	Park to Rimrock	111	+2
6	Monona to Stoughton	124	John Nolen to Broadway	82	+10
7	Park to Rimrock	118	I-39/90 to County N	77	+3
8	University to Greenway	112	Whitney Way to Verona	76	+3
9	Gammon to Whitney Way	99	Monona to Stoughton	76	-3
10	I-39/90 to County N	92	University to Greenway	75	-2
11	Whitney Way to Verona	87	Gammon to Whitney Way	61	-2
12	Broadway to Monona	83	Mineral Point to Gammon	60	-7
13	Greenway to Old Sauk	70	Verona to Seminole	60	-12
14	Todd to Fish Hatchery	64	Broadway to Monona	49	-2
15	Old Sauk to Mineral Point	61	Stoughton to I-39/90	48	+2
16	John Nolen to Broadway	45	Greenway to Old Sauk	46	-3
17	Stoughton to I-39/90	42	Old Sauk to Mineral Point	25	-2

Table 6.03-4 Beltline Total Crash Rate Comparisons (2000-2004 vs. 2008-2012)

4. Construction Improvements

There are construction efforts that probably have had a positive effect on the Beltline crash rates since the 2000-2004 time frame.

One example of an improvement of crash rates is with the addition of an eastbound auxiliary lane from Seminole Highway to Todd Drive in 2006. The 2000-2004 crash rate between Seminole Highway to Todd Drive of 188 crashes per HMVMT fell to 135 crashes per HMVMT for 2008-2012, nearly a 30 percent reduction in the overall number of crashes. The 2000-2004 injury+fatal crash rate between Seminole Highway to Todd Drive of 66 crashes per HMVMT fell to 34 crashes per HMVMT for 2008-2012, a 50 percent reduction in the number of fatal and injury crashes.

C. Highest Segment Crash Rates

The Beltline segments with 2008-2012 total crash rates over the Wisconsin statewide average crash rates are listed in Table 6.03-5. Eleven segments are above the statewide average crash rate for their respective class of roadway.

Segment	Total Crash Rate vs. Statewide Average	Total Crash Rate (Crashes per HMVMT)	Total # of Crashes	Total Crash Rate Rank
County K to Parmenter	2.79	143	72	2
Rimrock to John Nolen	2.13	156	132	1
Fish Hatchery to Park	1.73	127	196	3
Todd to Fish Hatchery	1.68	123	220	4
Verona to Todd	1.55	113	396	5
Park to Rimrock	1.52	111	216	6
I-39/90 to North Star	1.48	76	97	9
John Nolen to Broadway	1.12	82	151	7
Whitney Way to Verona	1.03	76	159	8
Monona to Stoughton	1.03	76	141	10
University to Greenway	1.02	75	31	11

Table 6.03-5 Beltline Segments over Statewide Average Total Crash Rates

Additional information for all segments can be found in Appendix E. The Beltline segments over the statewide total crash rate are further discussed below:

1. County K to Parmenter

A total of 72 crashes occurred along this approximately 1.10-mile-long segment from 2008-2012. This included 25 injury crashes. One fatal crash occurred along the segment during this time frame.

The fatal crash occurred at the Beltline/County K signalized intersection and involved a driver traveling eastbound that ran a red light and struck a southbound vehicle. Weather, alcohol, and lack of safety equipment did not appear to be contributing factors to this crash.

The 2008-2012 total crash rate for this segment is 143 crashes per HMVMT, the injury crash rate is 50 injury crashes per HMVMT, and the fatal injury crash rate is 2 crashes per HMVMT. Directionality and prominent characteristics of the crashes that occurred in this segment are shown in Table 6.03-6.

Crash Characteristics		Number of Crashes	Percent of Directional Crashes
Eastbound Crashes		20	
Time Period	AM (6-10)	7	35%
Manner of Collision	Rear-End	7	35%
	Angle	7	35%
Road Conditions	Wet	2	10%
Other Factors	Intersection Related	17	85%
Westbound Crashes		49	
Time Period	Midday (10 AM-2 PM)	18	37%
	PM (2-6)	18	37%
Manner of Collision	Rear-End	35	71%
	Angle	8	16%
Road Conditions	Wet	12	24%
	Snowy	3	6%
Other Factors	Intersection Related	36	73%

Table 6.03-6 County K to Parmenter Crashes

2. County MM/Rimrock Road to John Nolen Drive

A total of 132 crashes occurred along this approximately 0.5-mile-long segment from 2008-2012. This included 32 injury crashes. No fatal crashes occurred along the segment during the analysis period.

The 2008-2012 total crash rate for this segment is 156 crashes per HMVMT, and the injury crash rate is 38 injury crashes per HMVMT. Directionality and prominent characteristics of the crashes that occurred in this segment are shown in Table 6.03-7.

Crash Characteristics		Number of Crashes	Percent of Directional Crashes
Eastbound Crashes		90	
Highest Crash Time Period	PM (2-6)	57	63%
Manner of Collision	Rear-End	54	60%
	Sideswipe	16	18%
	Fixed Object	16	18%
Road Conditions	Wet	7	8%
	Snowy	8	9%
Westbound Crashes		42	
Highest Crash Time Period	AM (6-10)	15	36%
	PM (2-6)	14	33%
Manner of Collision	Rear-End	26	62%
	Sideswipe	4	10%
	Fixed Object	10	24%
Road Conditions	Wet	6	14%
	Snowy	7	17%

Table 6.03-7 County MM/Rimrock Road to John Nolen Drive Crashes

3. County D/Fish Hatchery Road to Park Street

A total of 196 crashes occurred along this approximately 0.7-mile-long segment from 2008-2012. This included 59 injury crashes. One fatal crash occurred along the segment during this time frame.

The fatal crash occurred approximately 1,000 feet west of the Park Street overpass. This was an eastbound rear-end accident that involved a vehicle being completely stopped for an object in the roadway and the following vehicle colliding with the stopped vehicle at around 60 miles per hour.

The 2008-2012 total crash rate for this segment is 127 crashes per HMVMT, the injury crash rate is 38 injury crashes per HMVMT, and the fatal injury crash rate is 0.6 crashes per HMVMT. Directionality and prominent characteristics of the crashes that occurred in this segment are shown in Table 6.03-8.

Crash Characteristics		Number of Crashes	Percent of Directional Crashes
Eastbound Crashes		64	
Highest Crash Time Period	PM (2-6)	27	42%
Manner of Collision	Rear-End	34	53%
	Sideswipe	8	13%
	Fixed Object	8	13%
Road Conditions	Wet	11	17%
	Snowy	9	14%
Westbound Crashes		132	
Highest Crash Time Period	AM (6-10)	35	27%
	PM (2-6)	52	39%
Manner of Collision	Rear-End	78	59%
	Sideswipe	17	13%
	Fixed Object	23	17%
Road Conditions	Wet	19	14%
	Snowy	13	10%

Table 6.03-8 County D/Fish Hatchery Road to Park Street Crashes

4. Todd Drive to County D/Fish Hatchery Road

A total of 220 crashes occurred along this approximately 0.8-mile-long segment from 2008-2012. This included 69 injury crashes. One fatal crash occurred along the segment during this time frame.

The fatal crash occurred approximately 300 feet west of the County D/Fish Hatchery Road overpass on the westbound Beltline. This crash involved a pedestrian crossing the Beltline, where the pedestrian action in the police report was described as “darting into the road.”

The 2008-2012 total crash rate for this segment is 123 crashes per HMVMT, the injury crash rate is 39 injury crashes per HMVMT, and the fatal injury crash rate is 0.6 crashes per HMVMT. Directionality and prominent characteristics of the crashes that occurred in this segment are shown in Table 6.03-9.

Crash Characteristics		Number of Crashes	Percent of Directional Crashes
Eastbound Crashes		119	
Highest Crash Time Period	PM (2-6)	63	53%
Manner of Collision	Rear-End	73	61%
	Sideswipe	16	13%
	Fixed Object	22	18%
Road Conditions	Wet	21	18%
	Snowy	8	7%
Other Factors	Alcohol-Related	4	3%
Westbound Crashes		101	
Highest Crash Time Period	AM (6-10)	23	23%
	PM (2-6)	45	45%
Manner of Collision	Rear-End	60	59%
	Sideswipe	18	18%
	Fixed Object	13	13%
Road Conditions	Wet	16	16%
	Snowy	6	6%
Other Factors	Alcohol-Related	8	8%

Table 6.03-9 Todd Drive to County D/Fish Hatchery Road Crashes

5. Verona Road to Todd Drive

A total of 396 crashes occurred along this approximately 1.6-mile-long segment from 2008-2012. This included 99 injury crashes. No fatal crashes occurred along the segment during the analysis period.

The 2008-2012 total crash rate for this segment is 113 crashes per HMVMT and the injury crash rate is 28 injury crashes per HMVMT. Directionality and prominent characteristics of the crashes that occurred in this segment are shown in Table 6.03-10.

Crash Characteristics		Number of Crashes	Percent of Directional Crashes
Eastbound Crashes		211	
Highest Crash Time Period	AM (6-10)	40	19%
	PM (2-6)	121	57%
Manner of Collision	Rear-End	140	66%
	Sideswipe	27	13%
	Fixed Object	30	14%
Road Conditions	Wet	44	21%
	Snowy	15	7%
Westbound Crashes		185	
Highest Crash Time Period	AM (6-10)	41	19%
	PM (2-6)	80	38%
Manner of Collision	Rear-End	113	61%
	Sideswipe	29	16%
	Fixed Object	31	17%
Road Conditions	Wet	34	18%
	Snowy	25	14%

Table 6.03-10 Verona Road to Todd Drive Crashes

6. Park Street to Rimrock Road

A total of 216 crashes occurred along this approximately 0.9-mile-long segment from 2008-2012. This included 58 injury crashes. No fatal crashes occurred along the segment during the analysis period.

The 2008-2012 total crash rate for this segment is 111 crashes per HMVMT, and the injury crash rate is 30 injury crashes per HMVMT. Directionality and prominent characteristics of the crashes that occurred in this segment are shown in Table 6.03-11.

Crash Characteristics		Number of Crashes	Percent of Directional Crashes
Eastbound Crashes		116	
Highest Crash Time Period	AM (6-10)	17	15%
	PM (2-6)	63	54%
Manner of Collision	Rear-End	68	59%
	Sideswipe	21	18%
	Fixed Object	18	16%
Road Conditions	Wet	11	9%
	Snowy	11	9%
Westbound Crashes		100	
Highest Crash Time Period	AM (6-10)	23	23%
	PM (2-6)	47	47%
Manner of Collision	Rear-End	65	65%
	Sideswipe	16	16%
	Fixed Object	16	16%
Road Conditions	Wet	9	9%
	Snowy	9	9%

Table 6.03-11 Park Street to Rimrock Road Crashes

7. I-39/90 to North Star Road

A total of 97 crashes occurred along this approximately 4.6-mile-long segment from 2008-2012. This included 39 injury crashes. Two fatal crashes occurred along the segment during this time frame.

The two fatal crashes occurred at the Beltline/Long Drive intersection, and each involved a northbound left-turning vehicle crossing with an eastbound through vehicle. One of the fatalities included a motorcyclist who was not wearing a helmet.

The 2008-2012 total crash rate for this segment is 76 crashes per HMVMT, the injury crash rate is 30 injury crashes per HMVMT, and the fatal injury crash rate is 1.6 crashes per HMVMT. Directionality and prominent characteristics of the crashes that occurred in this segment are shown in Table 6.03-12.

Crash Characteristics		Number of Crashes	Percent of Directional Crashes
Eastbound Crashes		60	
Highest Crash Time Period	PM (2-6)	22	37%
	Evening (6-10)	15	25%
Manner of Collision	Angle	35	58%
	Rear-End	6	10%
	Fixed Object	8	13%
Road Conditions	Wet	5	8%
	Snowy	3	5%
Other Factors	Alcohol Related	5	8%
	Intersection Related	38	63%
Westbound Crashes		37	
Highest Crash Time Period	AM (6-10)	10	27%
	PM (2-6)	13	35%
Manner of Collision	Angle	6	16%
	Rear-End	7	19%
	Fixed Object	9	24%
Road Conditions	Wet	6	16%
	Snowy	4	11%
Other Factors	Alcohol Related	5	14%
	Intersection Related	7	19%

Table 6.03-12 I-39/90 to North Star Road Crashes

8. John Nolen Drive to Broadway/South Towne Drive

A total of 151 crashes occurred along this approximately 0.8-mile-long segment 2008-2012. This included 43 injury crashes. No fatal crashes occurred along the segment during the analysis period.

The 2008-2012 total crash rate for this segment is 82 crashes per HMVMT, and the injury crash rate is 24 injury crashes per HMVMT. Directionality and prominent characteristics of the crashes that occurred in this segment are shown in Table 6.03-13.

Crash Characteristics		Number of Crashes	Percent of Directional Crashes
Eastbound Crashes		77	
Highest Crash Time Period	Midday (10 AM-2 PM)	17	22%
	PM (2-6)	32	42%
Manner of Collision	Rear-End	33	43%
	Sideswipe	11	14%
	Fixed Object	24	31%
Road Conditions	Wet	9	12%
	Snowy	12	16%
Westbound Crashes		74	
Highest Crash Time Period	AM (6-10)	21	28%
	PM (2-6)	27	36%
Manner of Collision	Rear-End	36	49%
	Sideswipe	14	19%
	Fixed Object	15	20%
Road Conditions	Wet	7	9%
	Snowy	13	18%

Table 6.03-13 John Nolen Drive to Broadway/South Towne Drive Crashes

9. Whitney Way to Verona Road

A total of 159 crashes occurred along this approximately 1.2-mile-long segment from 2008-2012. This included 35 injury crashes. No fatal crashes occurred along the segment during the analysis period.

The 2008-2012 total crash rate for this segment is 76 crashes per HMVMT, and the injury crash rate is 17 injury crashes per HMVMT. Directionality and prominent characteristics of the crashes that occurred in this segment are shown in Table 6.03-14.

Crash Characteristics		Number of Crashes	Percent of Directional Crashes
Eastbound Crashes		87	
Highest Crash Time Period	AM (6-10)	15	17%
	PM (2-6)	42	48%
Manner of Collision	Rear-End	66	76%
	Sideswipe	9	10%
	Fixed Object	10	11%
Road Conditions	Wet	17	20%
	Snowy	11	13%
Westbound Crashes		72	
Highest Crash Time Period	AM (6-10)	25	35%
	PM (2-6)	18	25%
Manner of Collision	Rear-End	30	42%
	Sideswipe	15	21%
	Fixed Object	21	29%
Road Conditions	Wet	14	19%
	Snowy	12	17%

Table 6.03-14 Whitney Way to Verona Road

10. Monona Drive to US 51/Stoughton Road

A total of 141 crashes occurred along this approximately 0.9-mile-long segment from 2008-2012. This included 26 injury crashes. No fatal crashes occurred along the segment during the analysis period.

The 2008-2012 total crash rate for this segment is 76 crashes per HMVMT, and the injury crash rate is 14 injury crashes per HMVMT. Directionality and prominent characteristics of the crashes that occurred in this segment are shown in Table 6.03-15.

Crash Characteristics		Number of Crashes	Percent of Directional Crashes
Eastbound Crashes		49	
Highest Crash Time Period	AM (6-10)	16	33%
	PM (2-6)	14	29%
Manner of Collision	Rear-End	19	39%
	Sideswipe	12	24%
	Fixed Object	12	24%
Road Conditions	Wet	5	10%
	Snowy	5	10%
Westbound Crashes		92	
Highest Crash Time Period	AM (6-10)	53	58%
	PM (2-6)	16	17%
Manner of Collision	Rear-End	58	63%
	Sideswipe	10	11%
	Fixed Object	15	16%
Road Conditions	Wet	13	14%
	Snowy	8	9%

Table 6.03-15 Monona Drive to US 51/Stoughton Road Crashes

11. US 14/University Avenue to Greenway Boulevard

A total of 31 crashes occurred along this approximately 0.5-mile-long segment from 2008-2012. This included 8 injury crashes. One fatal crash occurred along the segment during this time frame.

The fatal crash involved a motorcyclist that lost control on the westbound on-ramp to the Beltline from US 14/University Avenue. Alcohol or weather conditions did not appear to be contributing factors to the crash; however, the motorcyclist was not wearing a helmet.

The 2008-2012 total crash rate for this segment is 75 crashes per HMVMT, the injury crash rate is 19 injury crashes per HMVMT, and the fatal injury crash rate is 2.4 crashes per HMVMT. Directionality and prominent characteristics of the crashes that occurred in this segment are shown in Table 6.03-16.

Crash Characteristics		Number of Crashes	Percent of Directional Crashes
Eastbound Crashes		23	
Highest Crash Time Period	AM (6-10)	11	48%
Manner of Collision	Angle	4	17%
	Fixed Object	15	65%
Road Conditions	Wet	1	4%
	Snowy	4	17%
Other Factors	Dark Lighting	11	48%
Westbound Crashes		8	
Highest Crash Time Period	AM (6-10)	3	38%
Manner of Collision	Angle	2	25%
	Fixed Object	4	50%
Road Conditions	Wet	1	13%
	Snowy	3	38%
Other Factors	Dark Lighting	4	50%

Table 6.03-16 US 14/University Avenue to Greenway Boulevard Crashes

6.04 INTERSECTION CRASH ANALYSIS

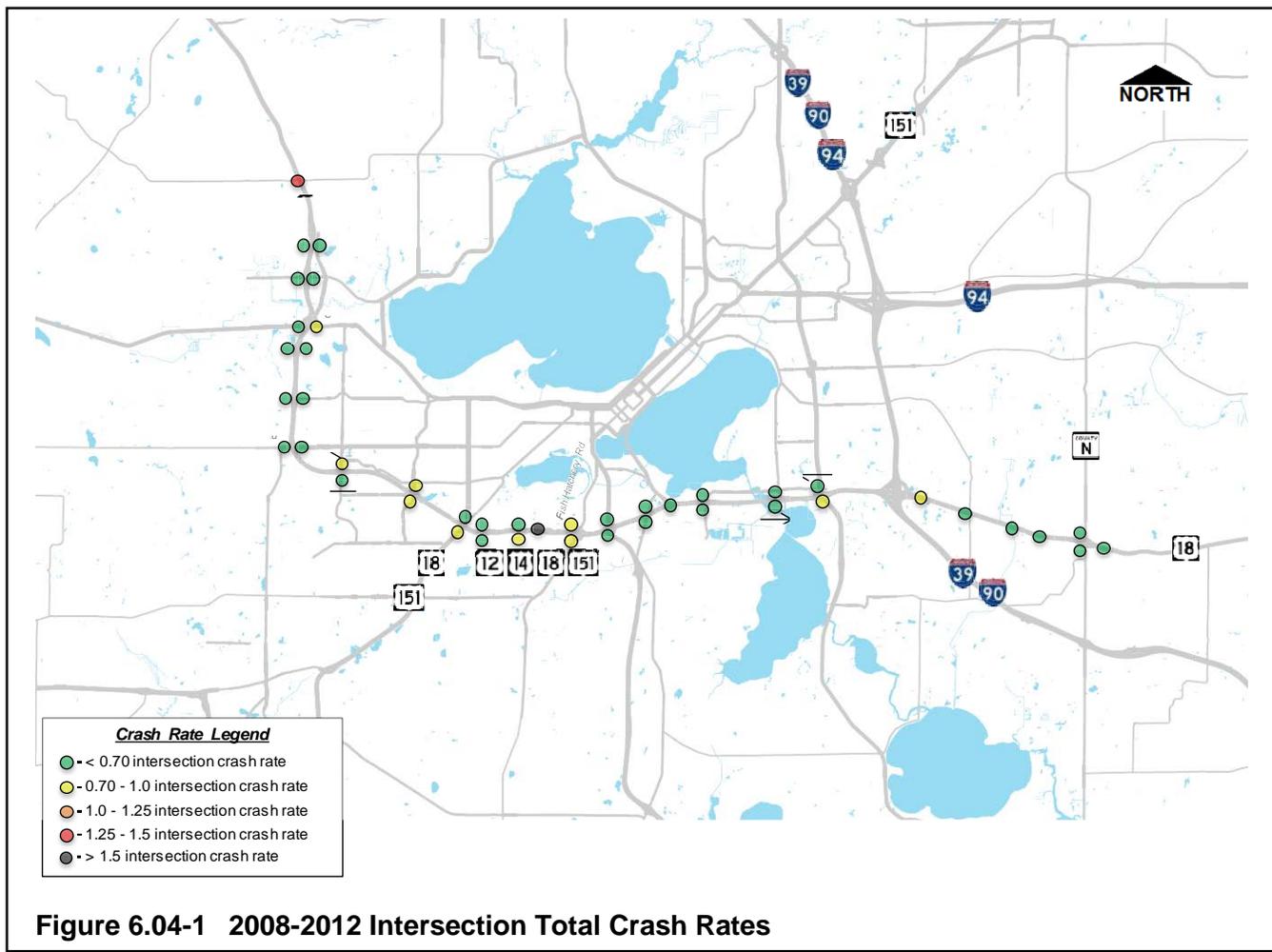
A. Results

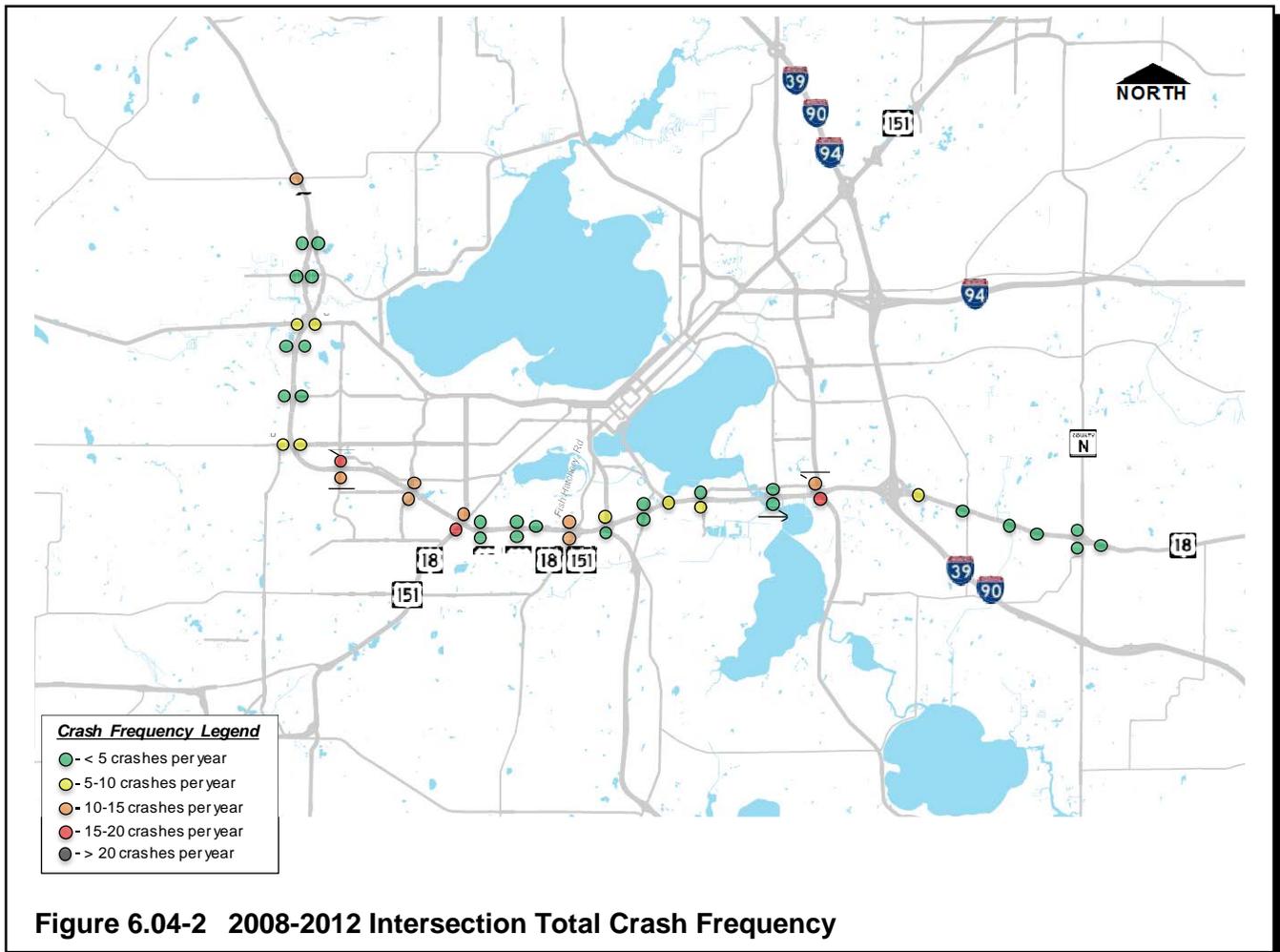
The study looked at ramp terminal intersections, adjacent intersections (typically one major intersection outside of the ramp terminal intersections), and at-grade intersections on US 12 and US 12/18. Based on the initial crash analysis, one of the intersections analyzed was above the threshold for evaluation of 1.5 crashes per MEV. Four intersections are approaching this threshold for evaluation, with a crash rate over 1.0 crashes per MEV. Table 6.04-1 shows a breakdown of where the intersection crashes occurred.

Location	Total Crashes	Injury Crashes	Fatal Crashes
Beltline At-Grade Intersections	117	51	3
Interchange Ramp Terminals	1,124	320	1
Adjacent Side Streets	1,229	381	0
Total	2,470	752	4

Table 6.04-1 Location of Intersection Crashes

Figures 6.04-1 and 6.04-2 show the intersection total crash rates and total crash frequencies, respectively, for the Beltline at-grade intersections and interchange ramp terminals for the corridor.





A complete breakdown showing the number of crashes, severity of crashes, entering volumes, and intersection crash rates for each intersection analyzed is located in Appendix F. The following subsections discuss bicycle, pedestrian, and roundabout crashes.

1. Bicycle and Pedestrian crashes

Of the 88 intersections analyzed, 21 intersections had at least one crash involving a pedestrian or a bicyclist. A total of 31 intersection crashes occurred involving a pedestrian or bicyclist. Intersections that involved 2 or more pedestrian and bicycle crashes from 2008-2012 include the following:

- a. Park Street and Badger Road—Four pedestrians crashes.
- b. Old Sauk Road and Junction Road—Three bicycle crashes.
- c. Whitney Way and Odana Road—Two pedestrian crashes and one bicycle crash.

- d. County D/Fish Hatchery Road and Beltline Eastbound Ramp Terminal—Two bicycle crashes.
 - e. County MM/Rimrock Road and John Nolen Road—Two bicycle crashes.
 - f. South Towne Drive/Broadway and Beltline Westbound Ramp Terminal—One pedestrian crash and one bicycle crash.
2. Roundabouts

Two roundabout-controlled intersections are located within the Beltline PEL study corridor. These are the intersections of South Towne Drive/Industrial Drive and Discover Drive/Parmenter Street.

The South Towne Drive/Industrial Drive roundabout is a dual-lane roundabout with pedestrian crossings on each leg of the intersection. This roundabout is discussed later in this report in the “Top 10 Highest Intersection Crash Rates” section. A summary of the crash rate results indicates that this roundabout has one of the highest overall intersection crash rates (1.32 crashes per MEV) of the intersections analyzed; however, it also is among the lowest in terms of total injury intersection crash rates (0.17 injury crashes per MEV).

The Discovery Drive/Parmenter Street roundabout is a single-lane roundabout with turning lanes and pedestrian crossings on each leg of the intersection. The overall crash rate (0.71 crashes per MEV) for the Discovery Drive/Parmenter Street roundabout ranks 24th among the intersections analyzed and, like the South Towne Drive/Industrial Drive roundabout, has a total injury intersection crash rate (0.08 injury crashes per MEV) among the lowest of the intersections analyzed.

B. Comparison to Madison Beltline Operational Needs Assessment

The Madison Beltline Operational Needs Assessment identified the Todd Drive eastbound ramp terminal intersection and the US 14/University Avenue westbound ramp terminal intersection as the two intersections with the highest overall crash rates.

From 2000-2004, the Todd Drive eastbound ramp terminal had an overall crash rate of 1.93 crashes per MEV and the US 14/University Avenue westbound ramp terminal had an overall crash rate of 1.84 crashes per MEV. From 2008-2012, these two intersections had overall crash rates of 0.76 crashes per MEV and 0.80 crashes per MEV, respectively. The overall crash rates have gone down at these two intersections since 2000-2004; however, they are still relatively high compared to the rest of the intersections analyzed.

C. Top 10 Highest Intersection Crash Rates

The top 10 highest 2008-2012 total crash rates for intersections in the study area are listed in Table 6.04-2.

Intersection	Total Crash Rate Rank	Total Crash Rate (Crashes per MEV)	Total Number of Crashes	Total Number of Injury Crashes	Total Number of Fatal Crashes
Frontage / Todd Drive WB Exit	1	1.51	14	2	0
Beltline / County K	2	1.36	58	22	1
Park St / Badger Rd	3	1.33	97	37	0
South Towne Dr / Industrial Dr	4	1.32	40	5	0
University Ave / Parmenter St	5	1.05	58	18	0
Gammon Rd / Watts Rd	6	0.97	97	34	0
Fish Hatchery Rd / WB Ramps	7	0.96	70	19	0
Beltline / Long Dr	8	0.95	38	18	2
Whitney Way / WB Ramps	9	0.95	74	30	0
Fish Hatchery Rd / EB Ramps	10	0.93	65	26	0

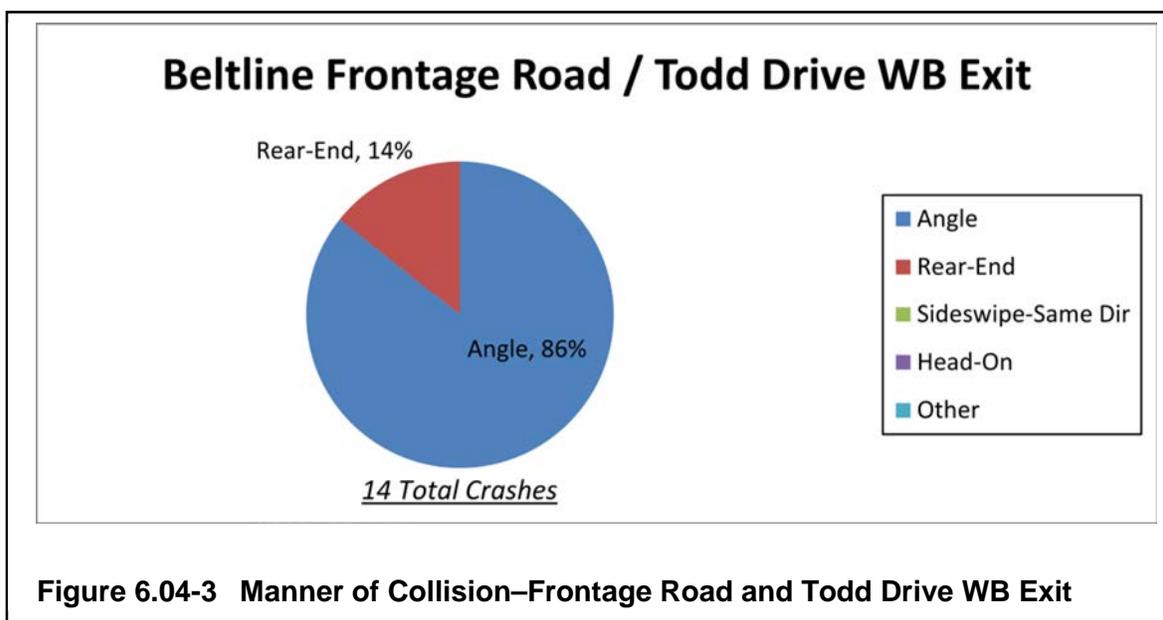
Table 6.04-2 Top 10 Total Crash Rates for Intersections

The intersections with crash rates at or above 1.0 crash per MEV are discussed further.

1. Beltline Frontage Road and Todd Drive Westbound Exit Ramp

The Beltline Frontage Road/Todd Drive westbound exit ramp terminal intersection had a total of 14 crashes occur between 2008 and 2012, including 2 injury crashes. This resulted in a total crash rate of 1.51 crashes per MEV, the highest among the intersections analyzed as part of the Madison Beltline PEL. A low injury crash rate of 0.22 injury crashes per MEV was experienced at this signal-controlled intersection.

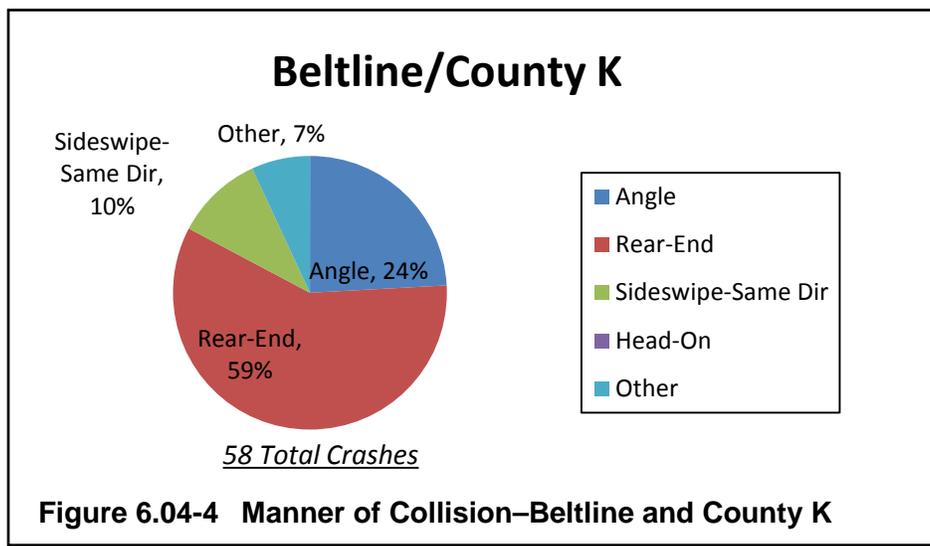
Angle crashes accounted for approximately 86 percent of the total crashes at this signal-controlled intersection. Figure 6.04-3 shows a breakdown of the types of crashes that occurred at the Beltline Frontage Road/Todd Drive westbound exit ramp terminal intersection.



2. Beltline/County K

The Beltline/County K intersection had a total of 58 crashes occur between 2008 and 2012, including 22 injury crashes and 1 fatal crash. This resulted in a total crash rate of 1.36 crashes per MEV, the second highest among the intersections analyzed as part of the Madison Beltline PEL. An injury crash rate of 0.52 injury crashes per MEV ranked highest among the intersections analyzed. The fatal crash that occurred at this intersection is described in Section 6.03-C.

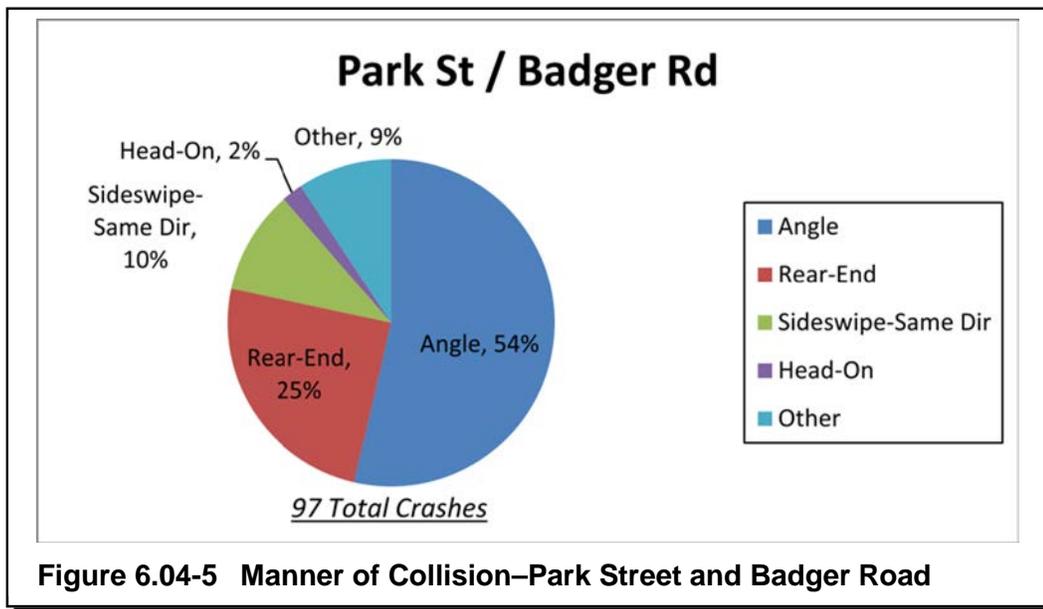
Nearly 60 percent (34 total) of the crashes that occurred at this signal-controlled intersection were rear-end crashes. Of the rear-end crashes, 19 of the 34, or 56 percent, occurred in the westbound direction on the Beltline. This indicates that traffic congestion at the signal and the transition to an expressway from the Beltline freeway may be a contributing factor to the high intersection crash rate. Figure 6.04-4 shows a breakdown of the types of crashes that occurred at the Beltline/County K intersection.



3. Park Street/Badger Road

The Park Street/Badger Road intersection had a total of 97 crashes occur between 2008 and 2012, including 37 injury crashes. This resulted in a total crash rate of 1.33 crashes per MEV, the third highest among the intersections analyzed as part of the Madison Beltline PEL. An injury crash rate of 0.51 injury crashes per MEV was experienced at this signal-controlled intersection, resulting in the second highest injury crash rate among intersections analyzed.

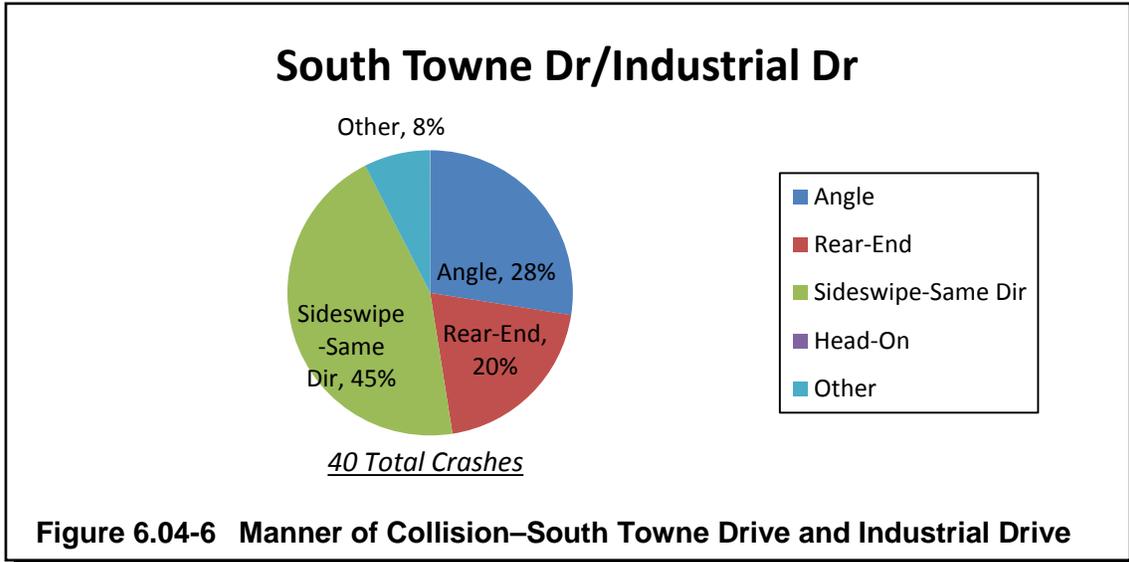
Nearly 55 percent of the crashes that occurred at this signal-controlled intersection were angle crashes and 25 percent of the crashes were rear-end collisions. Twenty-one percent, or 20 of the 97 crashes, were reported as hit-and-run. Figure 6.04-5 shows a breakdown of the types of crashes that occurred at the Park Street/Badger Road intersection.



4. South Towne Drive/Industrial Drive

The South Towne Drive/Industrial Drive intersection had a total of 40 crashes occur between 2008 and 2012, including 5 injury crashes. This resulted in a total crash rate of 1.32 crashes per MEV, the fourth highest among the intersections analyzed as part of the Madison Beltline PEL. A low-injury crash rate of 0.17 injury crashes per MEV was experienced at this roundabout-controlled intersection.

Of the 40 crashes that occurred at this roundabout, sideswipe crashes were the most common types of crashes, which accounted for 18, or 45 percent, of the total crashes. Of the 5 injury crashes, 4 were reported as Type C (possible injury) and 1 was reported as Type A (incapacitating injury). Figure 6.04-6 shows a breakdown of the types of crashes that occurred at the South Towne Drive/Industrial Drive intersection.



5. University Avenue/Parmenter Street

The University Avenue/Parmenter Street intersection had a total of 58 crashes occur between 2008 and 2012, including 18 injury crashes. This resulted in a total crash rate of 1.05 crashes per MEV, the fifth highest among the intersections analyzed as part of the Madison Beltline PEL. An injury crash rate of 0.33 injury crashes per MEV was experienced at this signal-controlled intersection, resulting in the eighth highest injury crash rate among intersections analyzed.

Nearly 60 percent (33 total) of the crashes that occurred at this signal-controlled intersection were angle crashes. Figure 6.04-7 shows a breakdown of the types of crashes that occurred at the University Avenue/Parmenter Street intersection.

