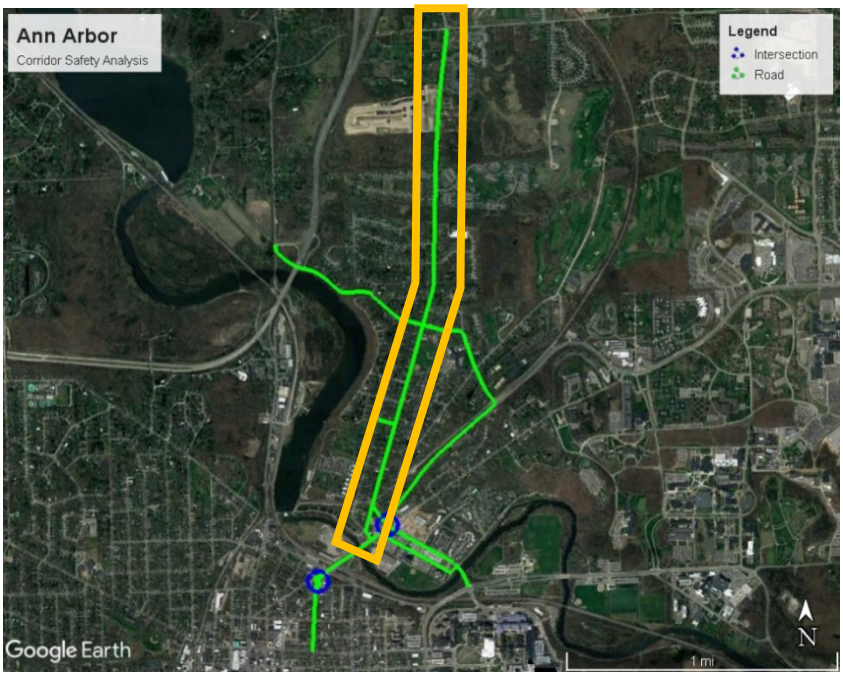
Appendix C

Ann Arbor
Lower Town Mobility Study

Corridor Crash Analysis

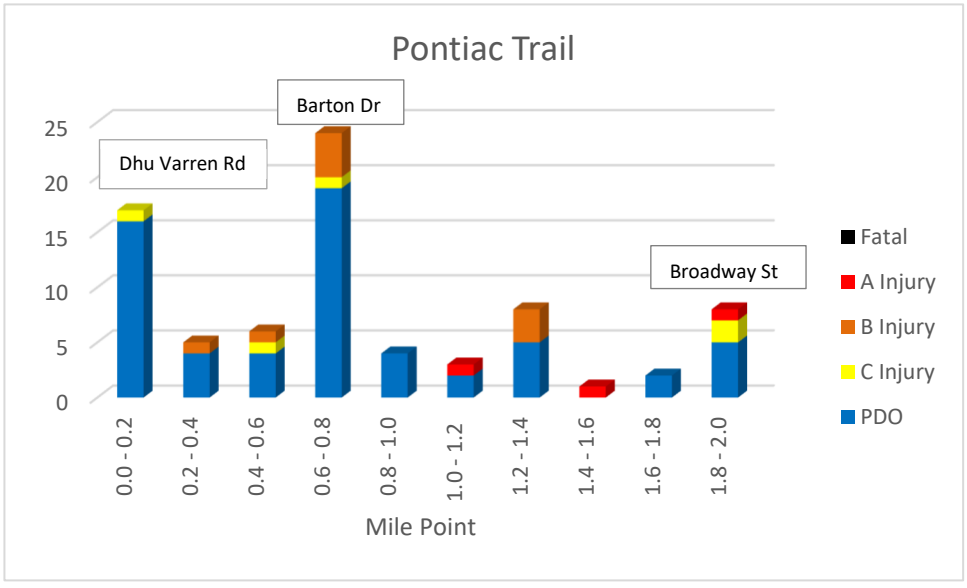
Pontiac Trail: Dhu Varren to Swift

Figure 2 – Pontiac Trail



Pontiac Trail is a two-way roadway, which runs approximately 2 miles from Dhu Varren Road to just short of Broadway Street. Pontiac Trail transitions into a one-way roadway after intersecting with Moore Street. Over the last 200' prior to reaching Broadway Street, the roadway becomes Swift Street. Pontiac Trail is under traffic signal control where it intersects with Barton Dr. The majority of the crashes were angle and rear end crashes with the concentrations (in decreasing order of frequency) occurring at the intersections with Barton, Moore, Dhu Varren and Taylor.

Table 6 – Crash Distributions for Pontiac Trail



There were no fatalities, 3 Type A, 9 Type B, and 5 Type C crashes with resulting injuries. The elevated number of crashes on Pontiac trail took place at mile points 0.0-0.2 and 0.6-0.8 which are located where Pontiac Trail intersects Dhu Varren Road and Barton Drive respectively. One of the type A injury was caused from single vehicle crashes where the driver fell asleep and stuck a tree. Another type A crash occurred in a head-on crash where a vehicle traveling south went into oncoming northbound traffic striking another car. The crash report for this event indicated that the weather condition was for snowy

Crash Analysis Report

Background

This Corridor Safety Analysis was performed as part of the Road Safety Audit (RSA) for multiple routes within Ann Arbor for the Lower Town Study. Routes selected for analysis included all or portions of Barton Drive, Plymouth Road, Pontiac Trail, Swift Street, Moore Street, Detroit Street, Broadway Street, High Street, Carey Street, Division Street, and Maiden Lane. These routes are highlighted in Figure 1. This analysis was completed for the RSA to assist the City of Ann Arbor in identifying high crash locations, recognizing correctable problems, and evaluating potential solutions. A total of **five** years of crash data, from January 1, 2014 through December 31, 2018 was obtained from the Traffic Improvement Association's (TIA) Crash Analysis Tool (TCAT) software. The TIA provided detailed traffic crash reports (UD-10) that were reviewed for crash types, and fatal or serious injury collisions (if any).

The analysis procedure consisted of identifying the location, type and severity of each crash. Additional information including weather and pavement conditions for each crash was then identified. Table 1, shown below, notes how the traffic crash analysis focused on certain predetermined traffic crash patterns and types. This information was then used by the RSA team as part of their process of identifying potential mitigation measures for the roads within the study area. This report contains recommendations for improvements to address the crash patterns identified herein. They may be redundant to those mitigations to be found in the RSA report.

Table 1 – Critical Crash Patterns and Issues Related

Crash Patterns	Issues to Evaluate
Head-On	Wrong way and left of center movements, loss of control
Head-On Left Turn	
Rear-end	Congestion, merge & diverge movements, horizontal alignment, lane width, signing, pavement markings
Angle	
Sideswipe	
Single Vehicle	Horizontal alignment, clear zone / safe recovery area
Nonmotorized – Crossing Rd	Countdown ped signals, pedestrian signal clearances, signing, pavement markings
Nonmotorized – In road/midblock	Sidewalk continuity, desire lines, signing, pavement markings
All	Total per year, trend over 5 years

Overview of Crash Data

There were 479 crashes in the 5-year study period, which represents 3% of the total amount of crashes that had occurred in Ann Arbor during this time frame. The crashes on the road segments under study did not involve any fatalities. However, 22 fatalities have occurred in the rest of Ann Arbor in the five years of the study period.

The annual crash distribution and severity of the study area can be seen in Table 3. The 479 crashes were relatively well distributed between 2014 and 2018, and do not indicate a trend of increasing (or decreasing) frequency. Type A injuries are defined as any injury that prevents the injured person from walking, driving, or normally continuing the activities which they were capable of performing prior to the crash, examples being severe lacerations or visibly broken limbs. Many times, this level of injury require the person to be transported by ambulance to a hospital or critical care unit. Type B injuries are any injuries that are evident at the scene of the crash but do not prevent the individual from operating normally, examples being a lump on the head or abrasions. Injuries at this level are occasionally transported by ambulance. Type C injuries are any that are claimed but not visible, examples being complaints of pain or nausea.

Figure 1 – Study Area with Evaluated Road Segments and Intersections Highlighted

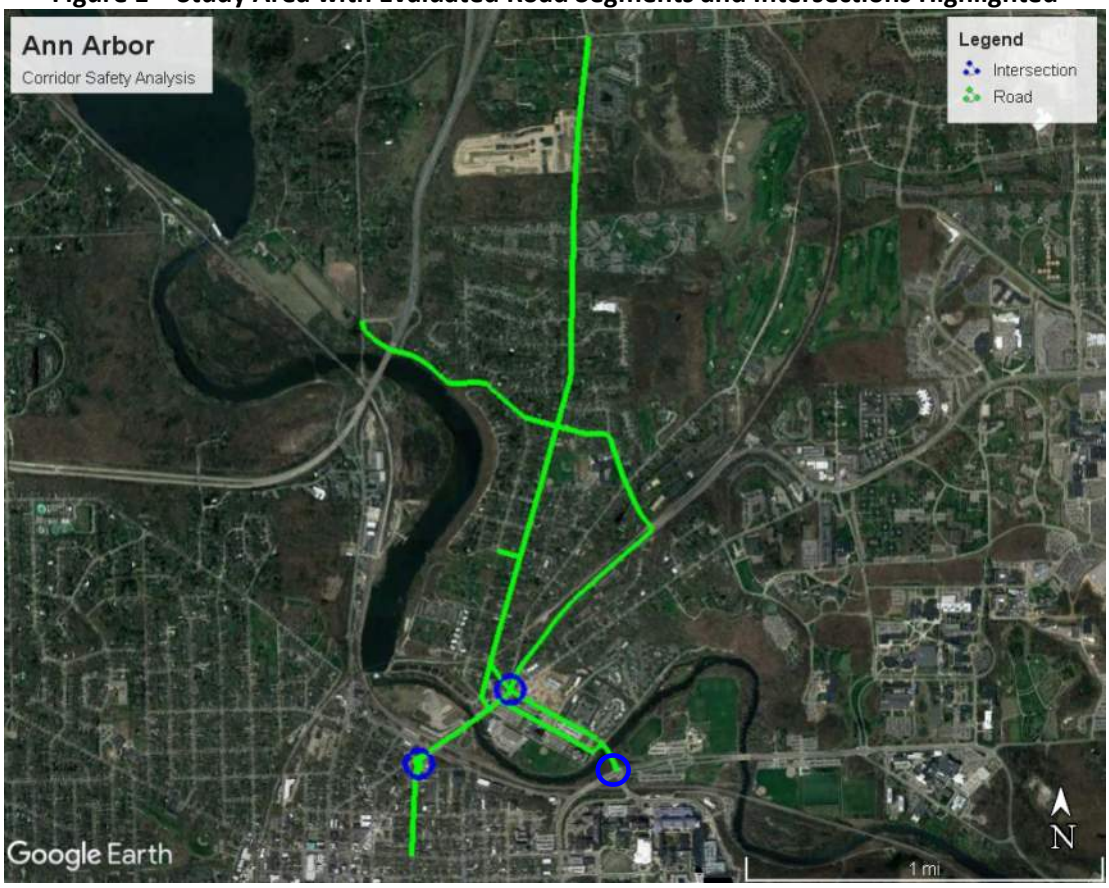


Table 2 –Critical Crash Patterns for the Study Routes (Years 2014 – 2018)

	Targeted Crash Patterns								5 Year Total for Study Area (All Crash Types)	5 Year Total for Ann Arbor
	Sideswipe	Head-on	Head-on Left-turn	Angle	Rear-end	Single Vehicle	Ped / Bike	Other		
All Crashes	83	9	13	93	189	71	14	7	479	15,577
	17.3%	1.9%	2.7%	19.4%	39.5%	14.8%	2.9%	1.5%		
Fatal	0	0	0	0	0	0	0	0	0	22
	0%	0%	0%	0%	0%	0%	0%	0%		
A Injury	0	1	0	0	0	4	2	0	7	151
	0%	14.3%	0%	0%	0%	57.1%	28.6%	0%		

Table 3 – Annual Crash Distribution and Severity for the Total of the Segments within the Study Area (Years 2014 – 2018)

	Injury Crash Year					
	2014	2015	2016	2017	2018	Total
Crashes	110	94	110	90	75	**479**
Type A Injury	1	1	1	2	2	**7**
Type B Injury	7	3	5	5	10	**30**
Type C Injury	15	13	7	14	9	**58**

Collisions Involving Non-Motorized Users

While crash data for roadway segments and intersections was evaluated for all typical crash patterns, a special look was undertaken to focus on those involving pedestrians and bicyclists. Specifically, a breakdown was performed to examine the severity, trends, and locations with such crashes. Table 4 is a restatement of Table 3, but just reporting data for pedestrians and bicyclists. Table 5 notes the roadway segments where collisions with pedestrians or bicyclist occurred.

Table 4 – Annual Crash Distribution and Severity for Ped (Bike) Crashes within the Study Area (Years 2014 – 2018)

Peds (Bikes)	Injury Crash Year					
	2014	2015	2016	2017	2018	Total
Crashes	2 (2)	0 (1)	0 (2)	0 (2)	2 (3)	**4 (10)**
Type A Injury	1 (0)	0 (0)	0 (0)	0 (0)	1 (0)	**2 (0)**
Type B Injury	1 (2)	0 (0)	0 (1)	0 (1)	0 (1)	**1 (5)**
Type C Injury	0 (0)	0 (0)	0 (0)	0 (0)	1 (1)	**1 (1)**

Table 5 – Location Distribution for Pedestrian and Bicycle Crashes within the Study Area (Years 2014 – 2018)

Roadways	Pedestrians	Bicyclists
N Division St	0	1
Fuller Rd	1	0
Glen St	0	1
High St	0	1
Maiden Ln	0	1
Pontiac St/Trail	2	3
Wall St	1	3

The individual discussions of roadway segments and intersection which follow will reiterate the various non-motorized crashes within the context of the other crash patterns.

Segments

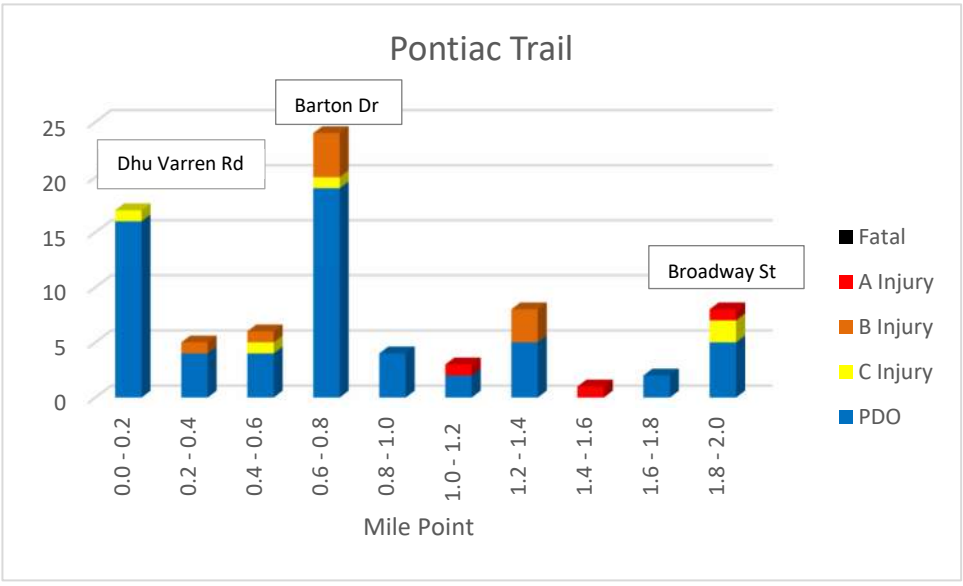
Crash data for each study route was analyzed independently. Crash data was organized by location with each study route divided into 0.2-mile long segments. The crash data within these segments were reviewed for patterns and areas of concern. A graphical representation of each study routes crash data can be found in the figures below. Analysis of segment crash data identified that there were a few locations of higher crash concentration on the study corridors. The most recurring crash patterns in this study are rear-ends, sideswipes, and single vehicle crashes.

Pontiac Trail: Dhu Varren to Swift

Figure 2 – Pontiac Trail

Pontiac Trail is a two-way roadway, which runs approximately 2 miles from Dhu Varren Road to just short of Broadway Street. Pontiac Trail transitions into a one-way roadway after intersecting with Moore Street. Over the last 200' prior to reaching Broadway Street, the roadway becomes Swift Street. Pontiac Trail is under traffic signal control where it intersects with Barton Dr. The majority of the crashes were angle and rear end crashes with the concentrations (in decreasing order of frequency) occurring at the intersections with Barton, Moore, Dhu Varren and Taylor.

Table 6 – Crash Distributions for Pontiac Trail

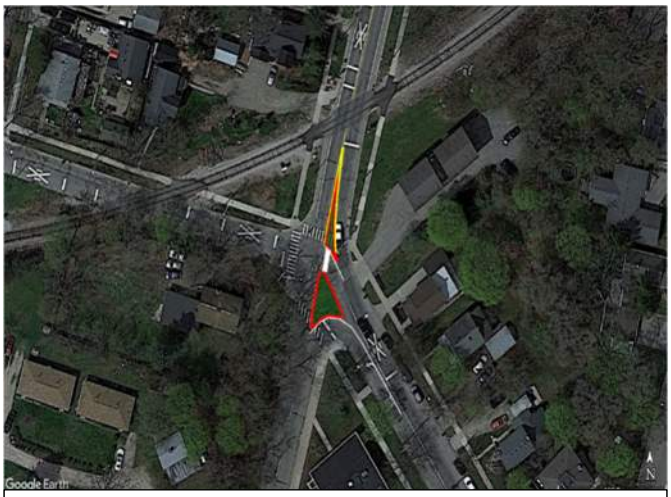


There were no fatalities, 3 Type A, 9 Type B, and 5 Type C crashes with resulting injuries. The elevated number of crashes on Pontiac trail took place at mile points 0.0-0.2 and 0.6-0.8 which are located where Pontiac Trail intersects Dhu Varren Road and Barton Drive respectively. One of the type A injury was caused from single vehicle crashes where the driver fell asleep and stuck a tree. Another type A crash occurred in a head-on crash where a vehicle traveling south went into oncoming northbound traffic striking another car. The crash report for this event indicated that the weather condition was for snowy

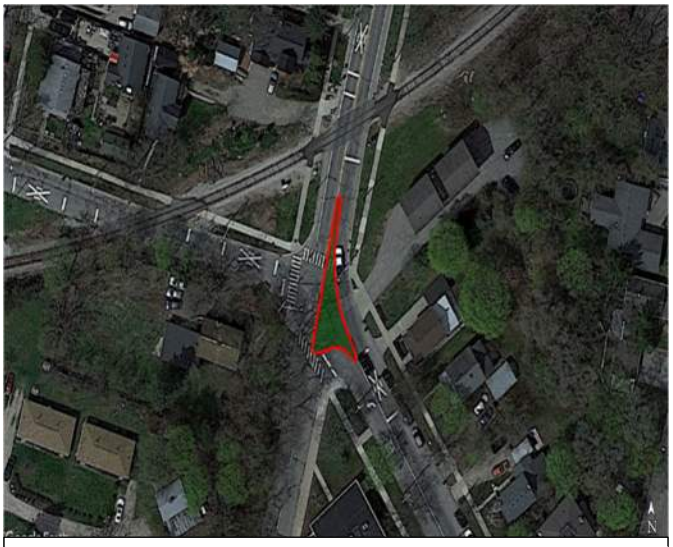
roads. The last occurred in a crash where the vehicle struck a pedestrian at a crosswalk 500 feet south of Arrowwood Trail due to failure to stop during a sleet storm at night. Furthermore, a type B injury crash occurred when a construction worker denied a driver access to Skydale Drive due to construction. The driver proceeded to drive aggressively past the construction worker causing a collision with the construction worker.

Potential crash mitigations involve improvements to the various intersections along the corridor. Pontiac Trail at Dhu Varren is a good candidate location for a single-lane roundabout. Utilizing Crash Modification Factors (CMF) from the Highway Safety Manual, it is anticipated that a roundabout at this intersection would reduce total crashes from an average of 2.3 per year to 1.3 per year, a 44% reduction. Pontiac Trail at Barton is currently operating under signal control. This traffic signal should be evaluated for updating its clearance intervals. Signal clearance intervals encompass yellow and all red intervals. When properly timed for the approach speed of vehicles and the width of the intersections, they help minimize the incidents of rear end and angle collisions. The intersection of Pontiac St / Moore St / Longshore Dr involved a special review during the Road Safety Audit (RSA), including the review of various reconfigurations of the intersection with the goal of reducing the complexity and in turn the number of conflict points for this area. These are shown here.

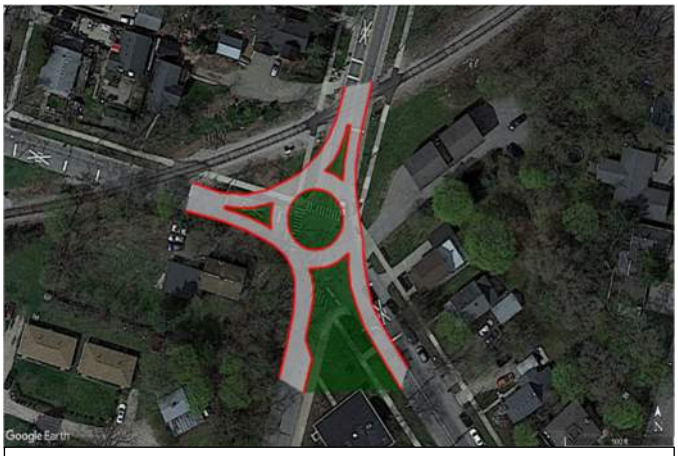
Short Term - Add pavement markings to better delineate vehicle paths through intersection.



Mid-Term Option A – Add new islands to intersection. Stop sign would be added for Moore Street to Longshore Drive movement. Traffic flashers would be removed.



Mid-Term Option B – Add new island to intersection. Treatment would simplify the intersection by allowing only two movements from Moore Street and require Longshore to be right in/out only. Would remove traffic flashers.



Long Term – Reconfigure intersection as one-lane roundabout. Maintains access for all existing movements. Would eliminate all flashers. Depicted is one with about 90' diameter.

Barton Drive: City Limit to Plymouth Rd

Figure 3 – Barton Dr

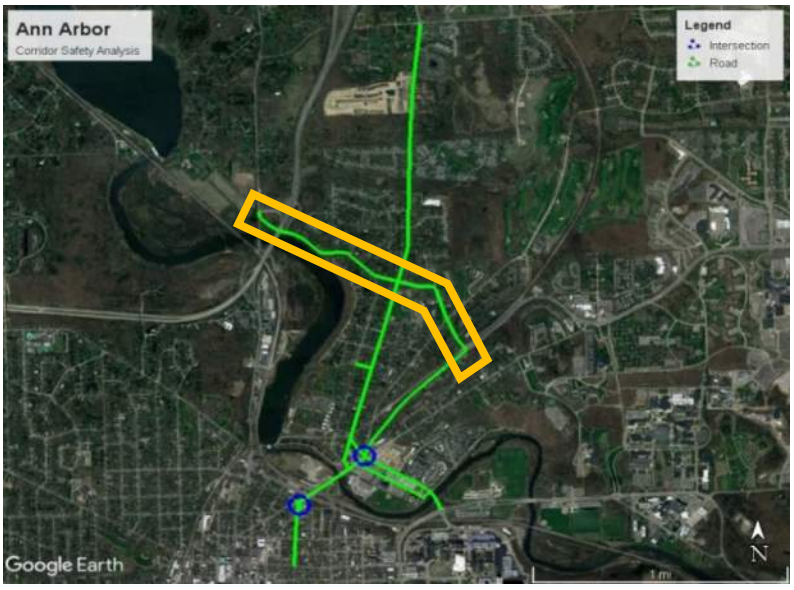
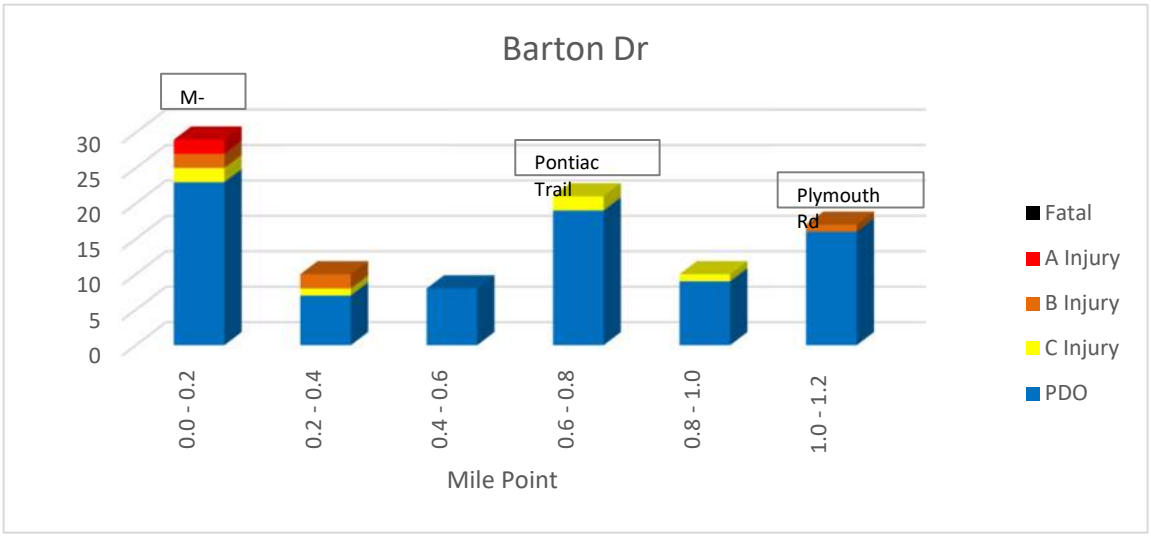


Table 7 – Crash Distributions for Barton Dr



Barton Drive intersects with M-14, Pontiac Trail and Plymouth Road. The intersection of Barton Drive and Pontiac Trial is traffic signal controlled. The majority of the crashes on this segment were rear end and single vehicle crashes.

The crashes that occurred were relatively well distributed along this corridor. There were no fatalities on this segment. Furthermore, no accidents involved pedestrians or bicyclists. However, two type A, five type B and six type C injuries took place on this segment. The two Type A crashes and one Type C were all southbound single vehicles which lost control in the curved transition from Whitmore Lake Rd to Barton Dr near the entrance to the Huron Bridge Park driveway. The other injury crashes were indicated to be in single vehicle crashes, rear end crashes and one head-on collision.

The curvilinear nature of portions of the roadway contribute to the poor sight distances (rear end collisions) and lack of a safe recovery area (single vehicle run off road crashes). There is no practical or cost effective way to redress the geometric shortcoming of the road within the existing road right of way. However, in the uncurbed portions, the lack of an effective shoulder could be corrected. If a 4' paved shoulder was to be provided on each side, it could double as on-street bike lanes. Providing a reasonable shoulder should be combined with vegetation control on the inside of the horizontal curves to improve sight lines for stopping distances.

Plymouth Road: Barton Dr to Broadway St

Figure 4 – Plymouth Rd

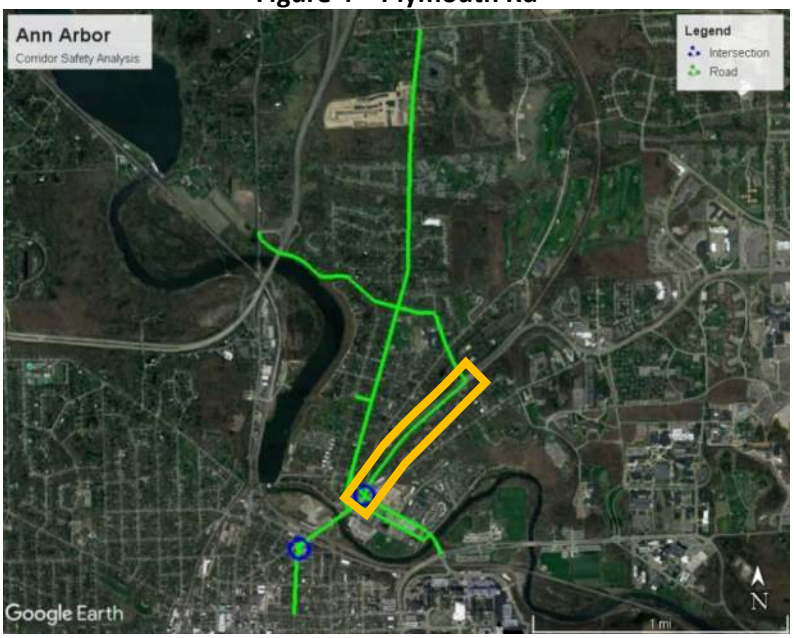
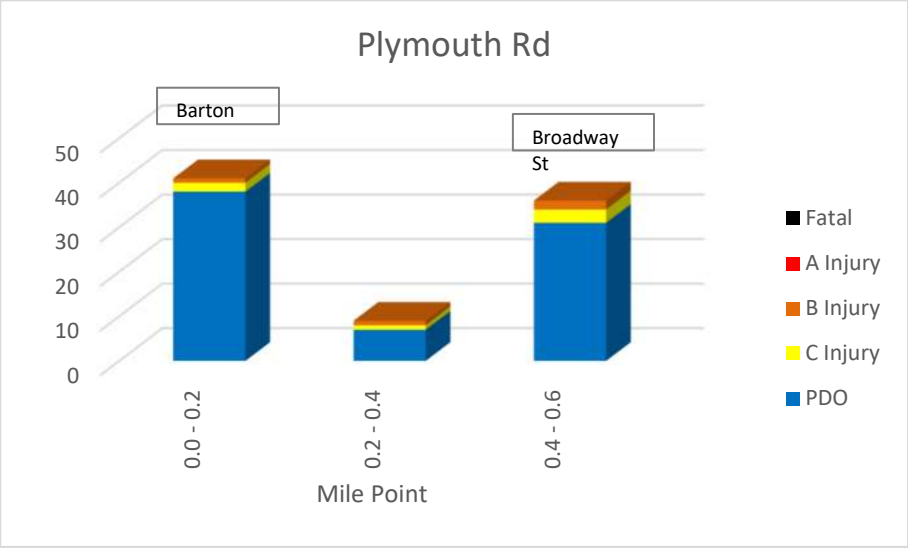


Table 8 – Crash Distributions for Plymouth Rd



Plymouth Road is a 5-lane wide roadway that has signalized intersections with Barton Drive and Broadway Street, the termini for the segment in this study. The segment covers the roadway up to Maiden Lane and is approximately 0.6 miles in length. Rear end crashes were the most common type of crashes, followed by side swipe crashes. However, the table does not include crashes at the Maiden Lane intersection, as those crashes have been pulled out and are discussed in the intersection crash data portion of this report. Please refer the section **Broadway Street at Moore Street/Maiden Lane**, beginning on page 12 below.

The majority of the crashes that occurred in this corridor were distributed close to major intersections. There were no fatalities or type A injuries that took place on this segment. Also, no accidents involving pedestrians or bicyclists took place during the study period. There were eight type C and four type B crashes that occurred between 2014 and 2018. Most injuries occurred in rear end crashes. One type B crash was an angle crash and one type C was in a head on crash.

Potential crash countermeasures for the signalized intersections of Pymouth at Barton and Plymouth at Broadway would be to evaluate them for proper clearance intervals, i.e. yellow and all-red periods.

Division Street: Broadway St to Catherine St

Figure 5 – Division St

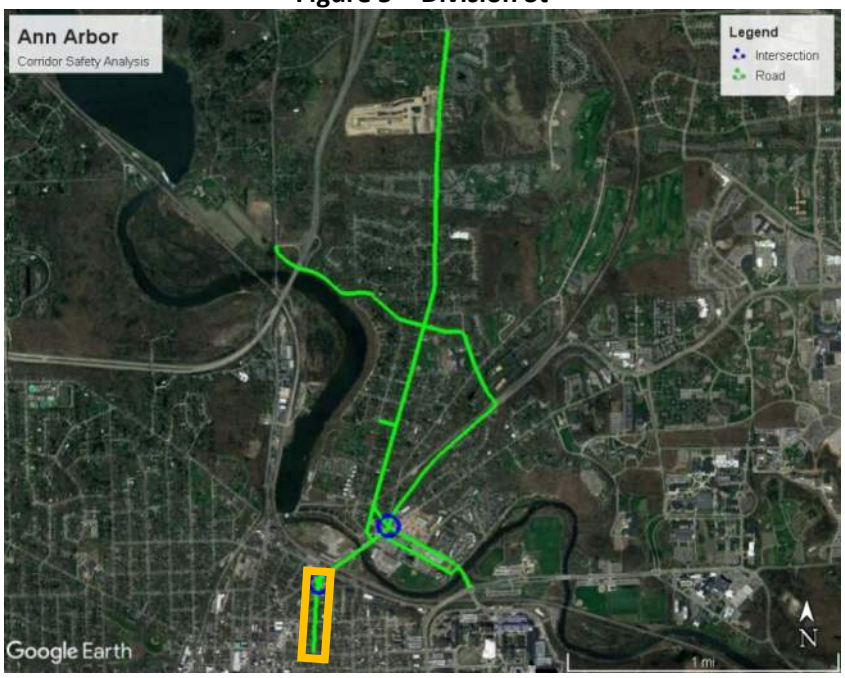


Table 9 – Crash Distributions for Division St

This segment of North Division Street is a little over 0.2 miles long and intersects with Catherine Street and East Kingsley Street. These intersections are under traffic signal control. The majority of the crashes on this segment were rear end and angle crashes. The table does not include crashes at the intersection with Broadway Street, as those crashes have been pulled out and are discussed in the intersection crash data section. Please refer to the section **Broadway/ Beakes/ Carey/ Division/ Summit** beginning on page 13 below.

There were no fatalities or Type A injuries that took place on this segment. No accidents involved pedestrians or bicyclists. The type B injury occurred in an angle crash when a vehicle traveling west on Catherine St went through a red light. Furthermore, the one type C crash occurred in a rear end crash on Division St at the Catherine St intersection.

Potential crash countermeasures for the signalized intersections would be to evaluate them for proper clearance intervals, i.e. yellow and all-red periods. Also, due to the unusual offset geometry at Catherine St, consider the use of a leading pedestrian interval (LPI).

Maiden Lane: Broadway St to Fuller Rd

Figure 6 – Maiden Ln

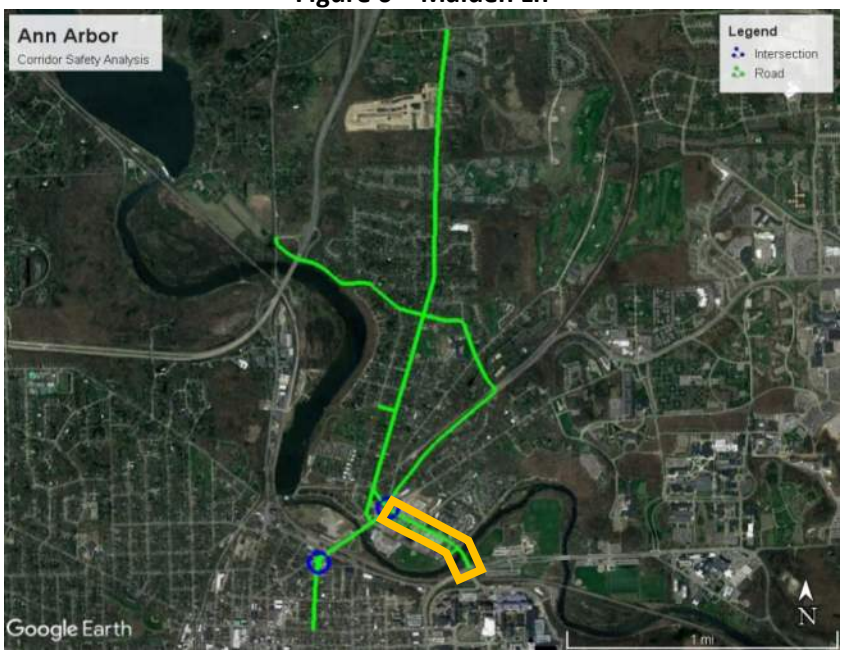
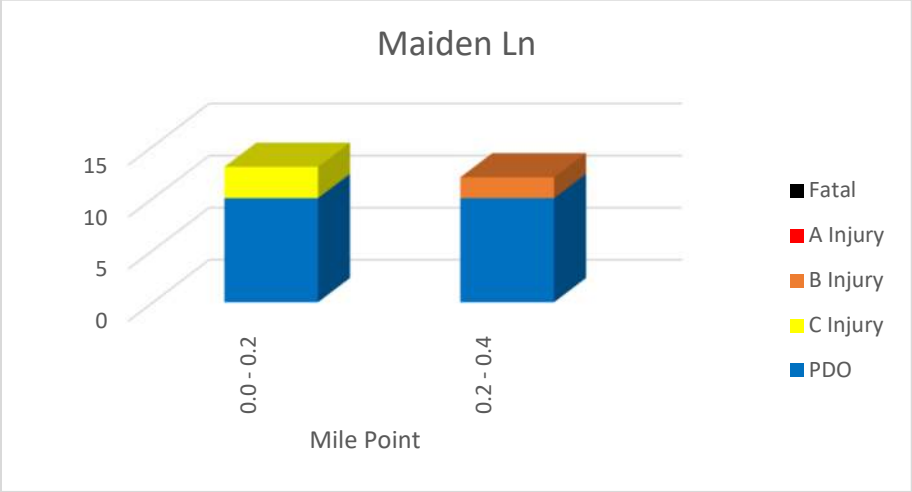


Table 10 – Maiden Ln



Maiden Lane is a three-lane roadway that has a signalized intersection Broadway Street and at Fuller Road. The table does not include crashes at the intersections with Broadway Street or with Fuller Rd, as those crashes have been pulled out and are discussed in the intersection crash data section.

The prominent crash type in this segment are rear end crashes, typically attributed to weather conditions and traffic congestion. There were no fatalities on this segment. However, there was one type A, there were two type B injuries and four type C injuries that took place on this segment. The type A involved a pedestrian crossing Wall St at Maiden Lane. The 80 year old driver from Ohio was looking left to turn right onto Maiden Ln and did not see the pedestrian enter the crosswalk from the drivers right. The others were all either rear end or angle related collisions. There was also one crash that involved a bicyclist but did not result in any injuries. A vehicle was backing up from Freesia Ct on to Maiden Ln when the vehicle struck a bicyclist. The police report cited the driver for causing the collision due to distractions while driving.

Based solely on the crash data, no crash mitigations were identified for this roadway. However, we also conducted a **Review of Pedestrian Crossings in Lower Town**. This is a separate report looking at existing and potential pedestrian crossing locations. From this evaluation, we found that one location, Maiden Lane at Island Drive, merited a Standard Plus pedestrian crossing design treatment. Given the traffic controls currently in place, this means that pedestrian warning signs (W11-2) should be added.

Broadway Street: Plymouth Rd to Beakes St

Figure 7 – Broadway St

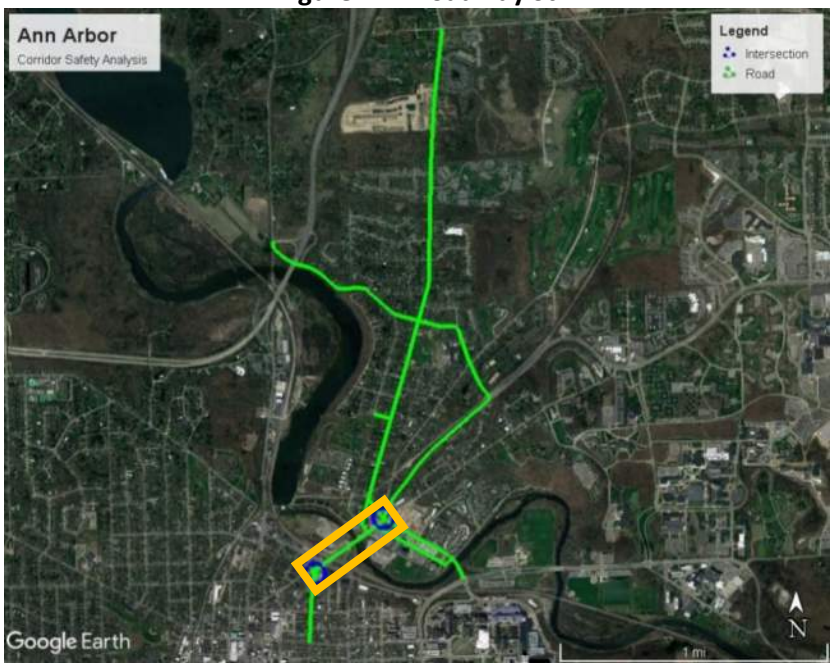
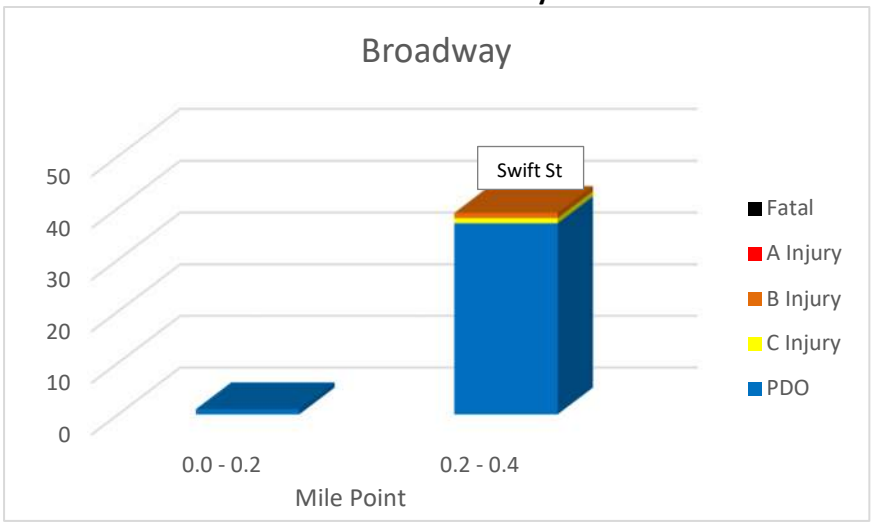


Table 11 – Broadway St



The Broadway Street corridor segment is approximately 0.4 mile and runs from Division Street to Maiden Lane. The table does not include crashes at the intersections with Division Street and Maiden Lane, as those crashes have been pulled out and are discussed in the intersection crash data section.

The majority of crashes here were rear end and side swipe crashes that occurred during the day and dry conditions. This route includes a parking lot for the train station in the area. Furthermore, there is a signalized intersection where Broadway Street meets Swift Street. A large number or crashes that occurred were near where the roadway intersects with Swift Street. There were no fatalities or type A injuries in this segment. However, there was one type C and one Type B injury that took place on this segment. No accidents involved pedestrians or bicyclists. Both injury crashes occurred in rear end crashes.

Potential crash countermeasures for the signalized intersection of Swift St would be to evaluate it for proper clearance intervals, i.e. yellow and all-red periods.

Intersections Crash Data

Three major intersections in this Lower Town study were identified as significant concerns that warranted their own focus. A summary of the intersection crash data can be seen below Table 2.

TABLE 12: Summary of Intersection Crash Data (2014-2018)

Lower Town – Intersection Study												
	Crash Type								Injuries			
Intersection	Side Swipe	Head On	Head On Left Turn	Angle	Rear End	Single Vehicle	Other	TOTAL	Fatal	A-Level (Incapacitating)	B-Level (Non-Incapacitating)	C-Level (Possible)
Broadway at Moore/Maiden	10	1	2	17	21	3	2	**56**	-	1	4	6
Broadway/Beakes/Carey/Division/Summit	20	1	1	9	27	14	1	**73**	-	1	2	7
Fuller Rd at Maiden Ln / E. Medical Center	31	-	-	8	84	7	5	**135**	-	-	1	19
TOTAL	30	2	3	26	48	17	3	**129**	0	2	6	13
% TOTAL	23.3%	1.6%	2.3%	20.2%	37.2%	13.2%	2.3%	100.0%	0.0%	1.8%	4.7%	10.1%

Broadway Street at Moore Street/Maiden Lane

In spite of the multiple street names, the intersection of Broadway St, Moore St and Maiden Lane is a conventional four-leg intersection with three approaches under traffic signal control. Moore St is one-way departing from the intersection. It experienced primarily rear end crashes followed by angle crashes. There were no fatalities but there were 1 type A, 4 type B and 6 type C injuries. No crashes involved pedestrians or bicyclists. The crashes were evenly distributed between the approaches.

The type A crash occurred when a vehicle disregarded a traffic signal traveling north through the intersection crashing into a moped heading west. Three type B occurred in angle crashes where vehicles attempted to complete turns and misjudged approaching vehicles distance. The other type B injury occurred when a motorcyclist abandoned his motorcycle to avoid a crash with another vehicle. The majority of the type C injuries occurred in rear end crashes.

Potential crash countermeasures for this signalized intersection would be to evaluate it for proper clearance intervals, i.e. yellow and all-red periods. This is also a good candidate for a roundabout. Utilizing Crash Modification Factors (CMF) from the Highway Safety Manual, it is anticipated that a roundabout at this intersection would reduce total crashes from an average of 11.2 per year to 9.1 per year, a 19% reduction. Given the volumes here, it would likely be two lanes for the Broadway and Plymouth approaches, but just one lane for Maiden Ln and Moore St. This roundabout option is illustrated here:

Convert intersection of Broadway St, Maiden Lane and Moore St to 2-lane roundabout. Moore St could change to 2-way traffic. Depicted is one with about 150' diameter.

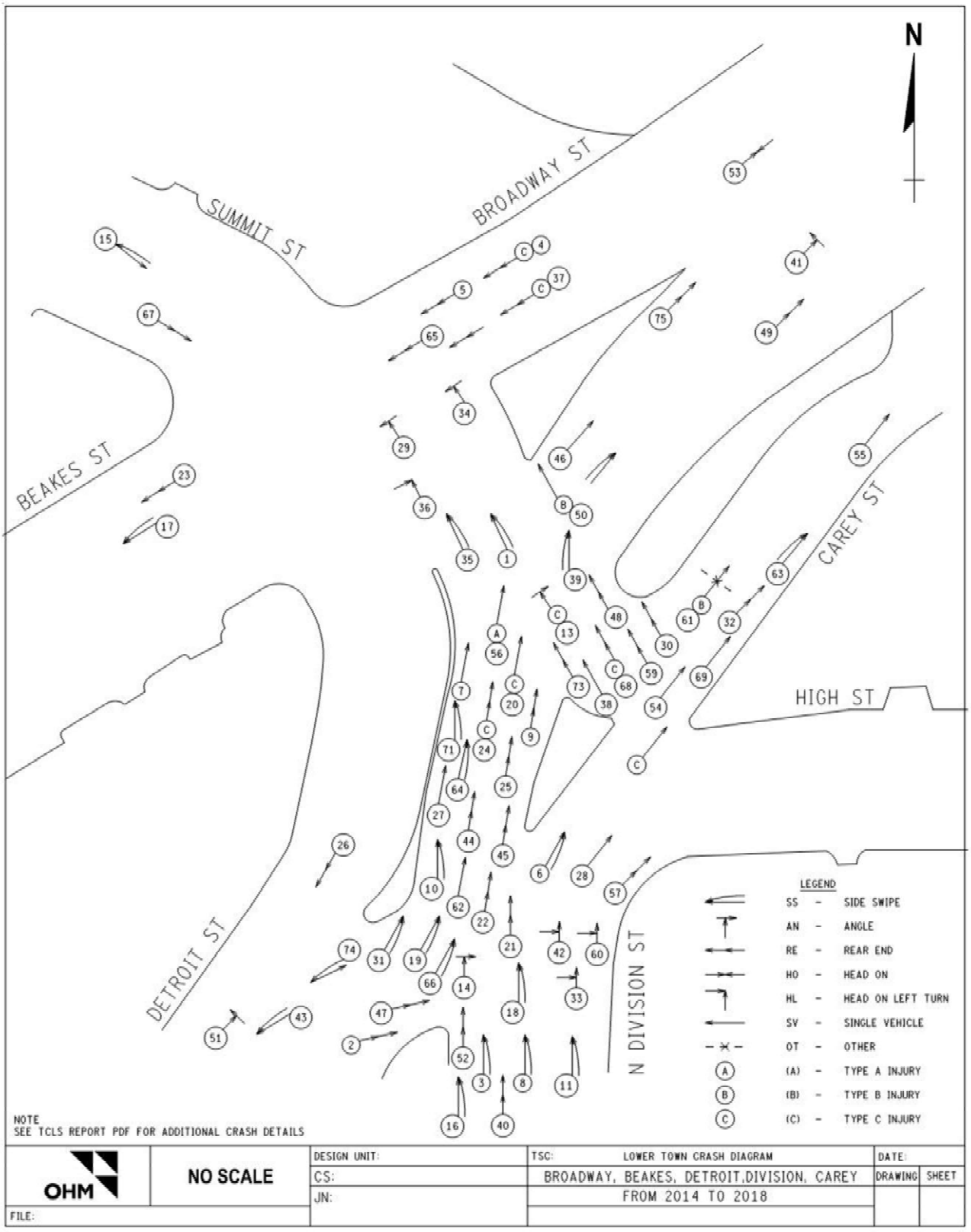
Broadway/Beakes/Carey/Division/Summit

This unique intersection has approaches from Broadway Street, Division Street, Carey Street, and Summit Street, and departures to Beakes Street, Detroit Street, and High Street. Given the complexity of the junction, it warranted a Crash Diagram (*Figure 8*) to display crash patterns.

The most prominent type of crashes during the study period was rear end crashes and side swipe crashes. These are typically attributed to vehicles stopping abruptly and/or failing to merge properly.

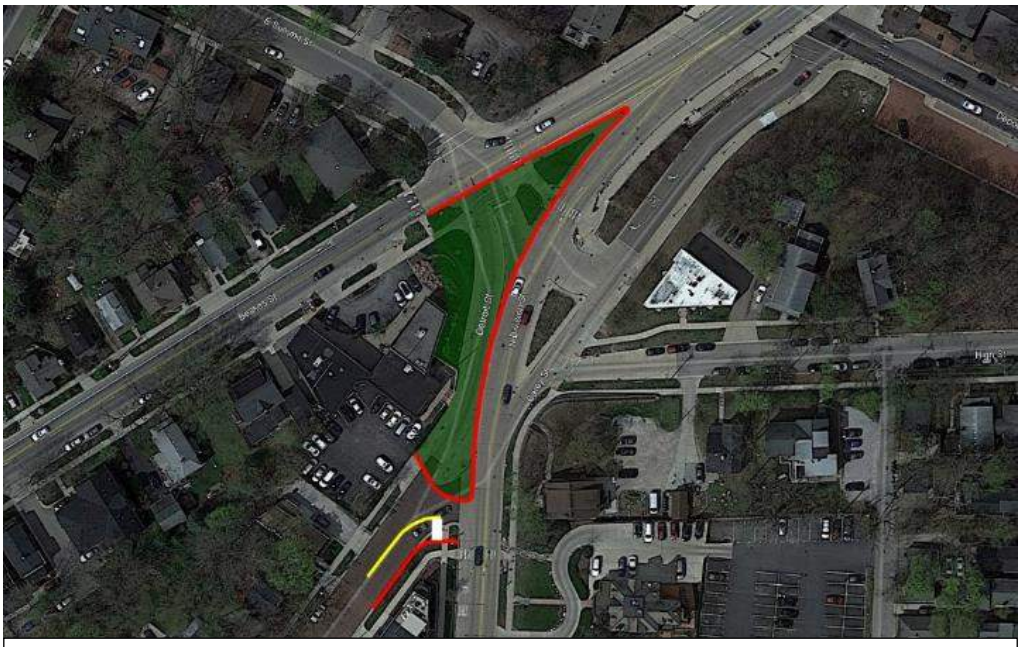
There were one type A, two type B, and seven type C injuries that occurred at this intersection. The type A injury occurred in a single vehicle crash due to the vehicle travelling at a high rate of speed along Division and colliding with a concrete barrier. Furthermore, alcohol was a factor in the crash as well. There were no crashes involving pedestrians that occurred in this area during the study period. However, two crashes at this intersection involved bicyclists. Both involved drivers who failed to yield to the bicyclists, and both were along Carey St. One involved Type B injury to the bicyclist, who was crossing Carey at the marked pedestrian crossing north of High St. The second bicycle collision was a Type C where a vehicle turned right from Carey to High, cutting off the bike from continuing north on Carey.

Figure 8 – Crash Diagram



Note: The number associated with each crash symbol is an identification reference to the specific details for that collision as reported in the data search printouts contained in this report's appendixes.

The complexity of the crash patterns is a reflection of the complexity of the geometry of this junction. Within the RSA report are several alternative geometric configurations that will reduce the complexity and in turn the number of conflict points for this area. These are replicated here.



Option A – Close access between Detroit / Division and Broadway / Summit. This would eliminate conflicts with pedestrians crossing Beakes St and Broadway St. Crosswalk would be moved south along Division to improve visibility around the retaining wall.

Option B – Variation on Option A. Would eliminate conflicts related to pedestrian crossings at Beakes St and Broadway St. Maintains access from Division St down to Depot St and to High St, but Depot St up to Broadway St. will be detoured.

Option C – Close northbound entrance to Carey St from Division St and southbound access to Detroit St from Broadway St/Summit St. Maintains access from Division to Summit. Left turns and thru movements would be channelized. Would maintain access to the Broadway Street bridge from Depot Street and to High Street from Division.

Fuller Road at Maiden Lane / E. Medical Center

The intersection of Fuller Rd, Maiden Lane and E. Medical Center is a conventional four-leg intersection under traffic signal control. It experienced primarily rear end crashes followed by same direction side swipe collisions. There were no fatalities or Type A injury crashes, but there were one Type B and 19 Type C injury collisions. There were two crashes with a bicyclist and one with a pedestrian. The crashes were evenly distributed between the approaches.

The Type B injury involved a bicyclist. The vehicle on Maiden Ln pulled across the crosswalk preparing to make a right turn on red to Fuller Rd as the bicyclist entered the crosswalk and struck the side of the vehicle. The second incident involving a bike involved a vehicle on E. Medical Center stopped several cars back from the queue of those waiting for the red signal. The bicyclist attempted to cross the street but lost control riding off the sidewalk and fell hitting the vehicle in its rear quarter panel. The bicyclist then rides off without exchanging information with the driver. Finally, the collision involving the pedestrian was a Type C. This crash occurred when a driver driving northbound on E. Medical Center approaching the intersection of Maiden Lane and Fuller Road made a left turn on a red traffic light from the incorrect lane while a pedestrian was crossing Fuller Road.

This intersection has been the subject of numerous safety and operations studies. The proposed alternative configurations have ranged from roundabouts to boulevards with indirect left turns. We do not have any further suggestions to offer for crash mitigation at this location.