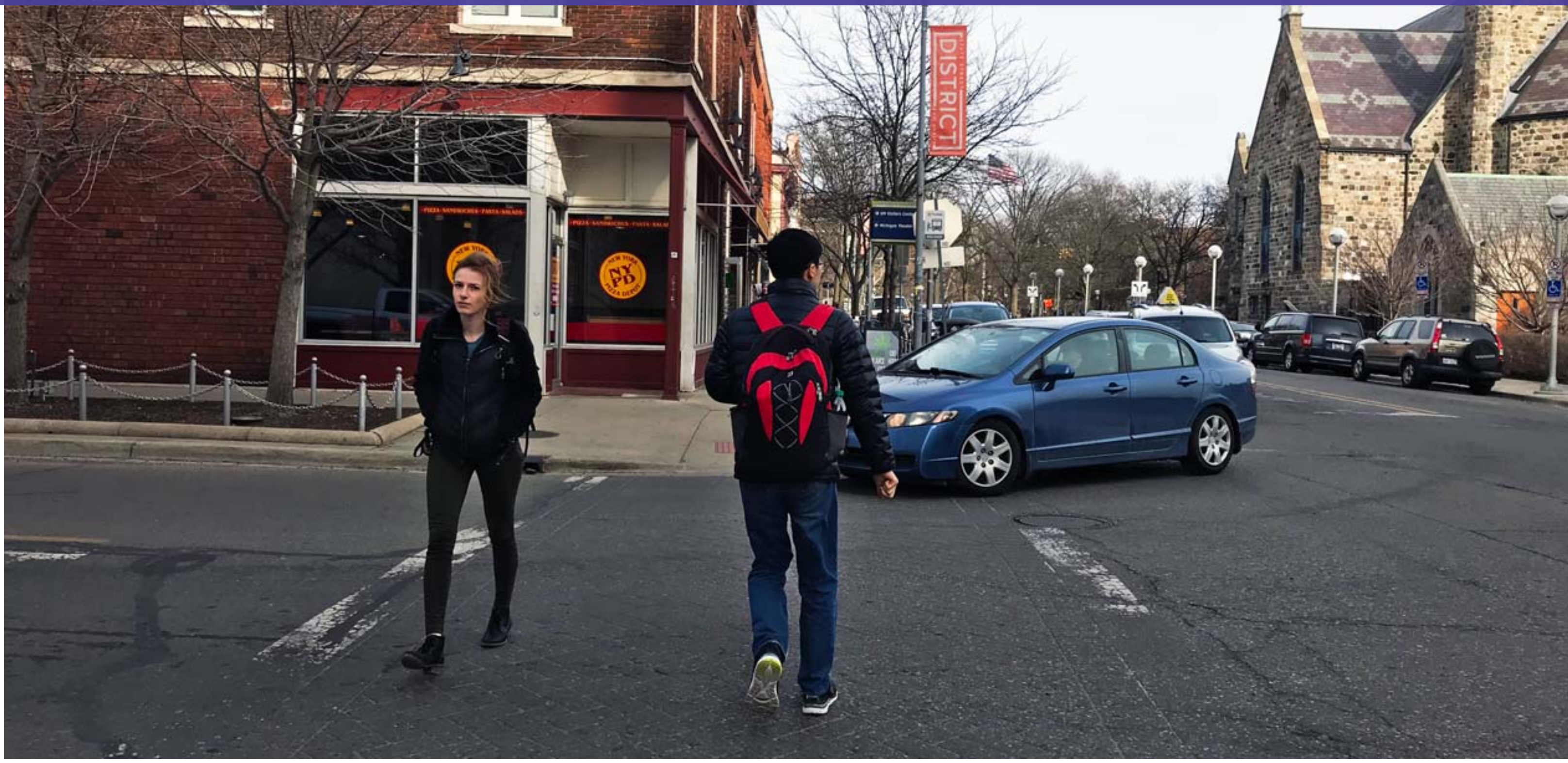
FIRST, ASHLEY, AND WILLIAM STREETS

TRANSPORTATION FEASIBILITY STUDY

submitted to: Ann Arbor Downtown Development Authority

submitted by: Toole Design Group

with: SmithGroupJJR
Wade Trim



SMITHGROUPJJR TooleDesignGroup WADETRIM

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Toole Design Group (TDG) has prepared this report to present the operational analysis for the two-way restoration of First Street and Ashley Street, and the addition of a protected bicycle facility on William Street in Ann Arbor, Michigan. TDG is working with the larger project team consisting of SmithGroupJJR and Wade Trim. This report includes a description of the study area and existing conditions, the proposed design alternative, and transportation analyses for bicyclists, pedestrians, and drivers.

Project History and Goals

In 2015, the City of Ann Arbor and the Downtown Development Authority (DDA) collaborated to create the Ann Arbor Downtown Street Design Manual. This Manual set shared goals, design parameters, and specifications for downtown street projects. This Manual, together with the City of Ann Arbor's Non-motorized Transportation Plan (updated in 2013), assisted the DDA in prioritizing First Street, Ashley Street, and William Street for improvements. All three streets were identified as having a functional emphasis on bicycles, with a small section of Ashley having an emphasis on pedestrians. Figure 1 below demonstrates this.

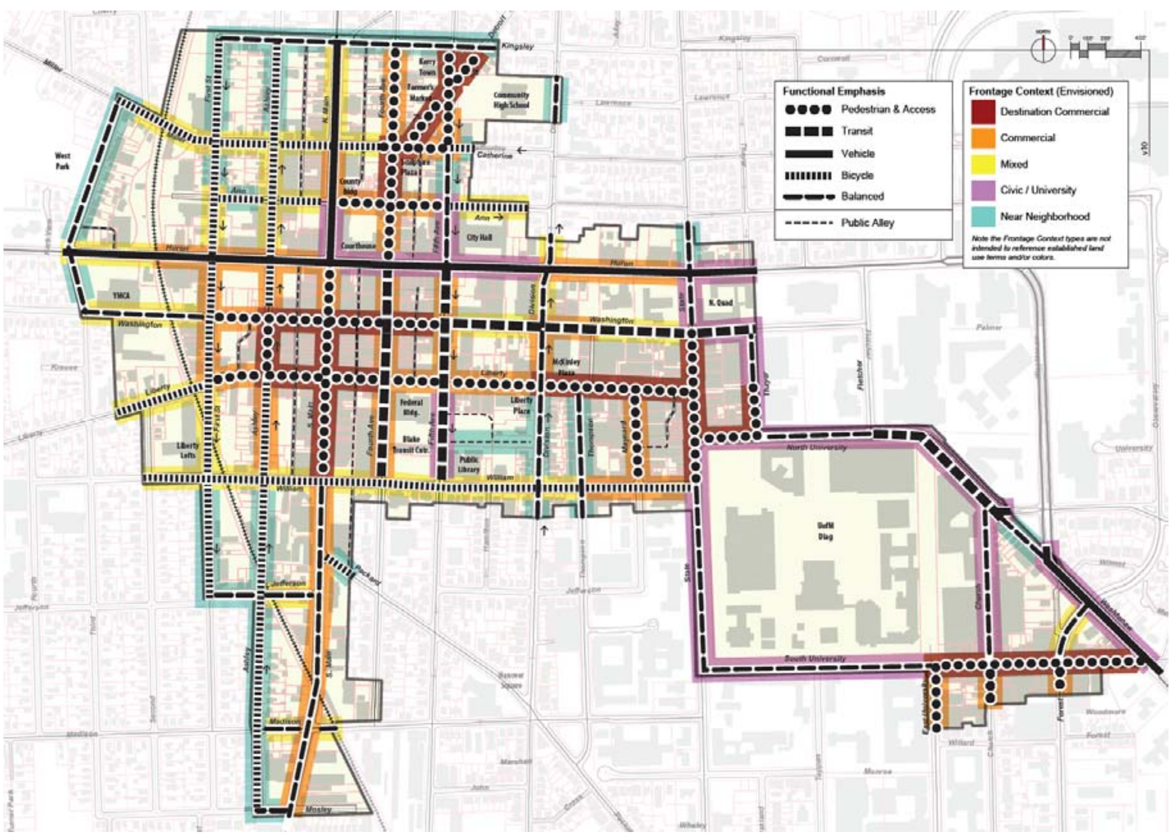


Figure 1 Functional Emphasis and Frontage Context for Downtown Ann Arbor

The goal of this project is to determine the feasibility of restoring First Street and Ashley Street to two-way traffic operations and installing protected bicycle lanes on William Street.

First and Ashley Streets were converted to one-way streets in the late 1960's as part of the failed Packard-Beakes Bypass, as shown in Figure 2. The one-way conversions were the first step in the project, and while the bypass did not move forward, the one-way configuration remains today. The DDA views two-way traffic restoration on these streets as an opportunity to transform the streets and adjacent property/land uses, supporting a higher quality of place making. The restoration of wo-way traffic will better connect First and Ashley Streets to the adjacent commercial and residential neighborhoods, improve the walking and bicycling experience, and encourage vibrant commercial and development activity that engages the sidewalk. The Treeline Project (Allen Creek Urban Trail) will connect to First Street within the project area and must be incorporated into the design to ensure the success of the two-way restoration project.

William Street lacks a strong identity and varies in width and number of vehicle travel lanes, generally creating an uninviting environment for bicyclists and pedestrians. There is minimal on-street parking or street furniture in the center of William Street to provide separation for pedestrians from moving vehicles, adding to the uninviting nature of the sidewalks. The DDA seeks to transform William Street to provide a safe and desirable bicycle route for residents, workers, and visitors, connecting nearby residential neighborhoods and the University of Michigan campus to the downtown area. This will encourage bicycling, increase commercial activity, and send a clear message that Ann Arbor is a bike-friendly city. Additionally, Ann Arbor set a Vision Zero goal of zero traffic-related fatalities by

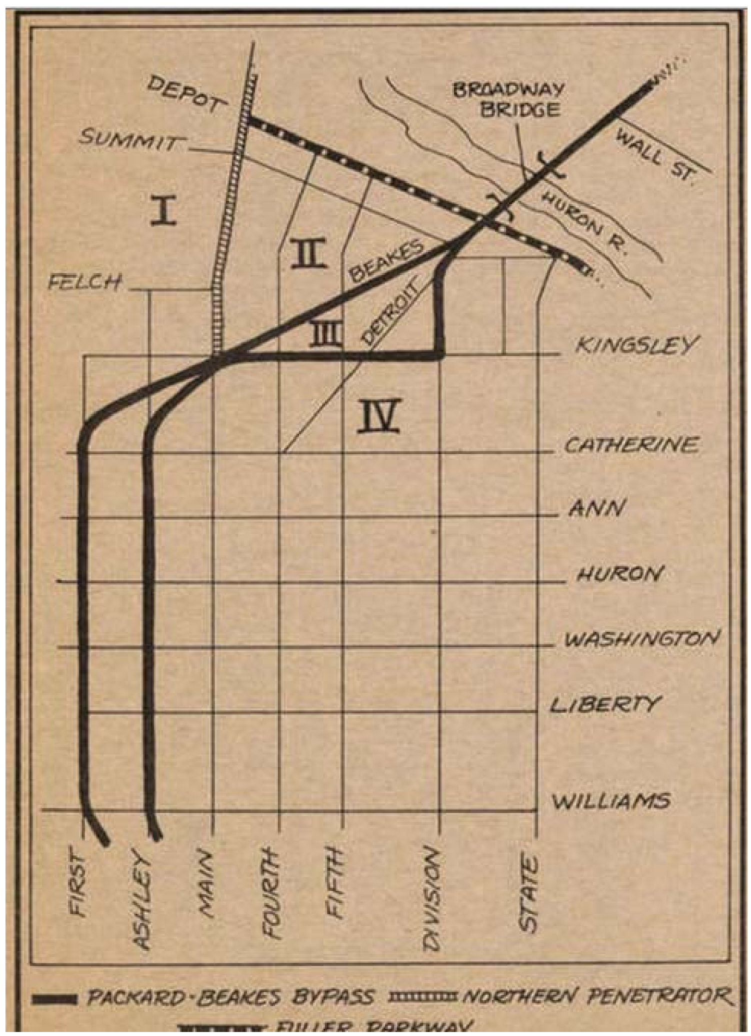


Figure 2 Packard-Beakes Bypass (Source: https://localwiki.org/ann-arbor/Packard-Beakes_Bypass)

2025. This project directly supports the objectives of the Street Design Manual, Vision Zero, and the Transportation Commissions' initiative on safety by incorporating proven safety countermeasures for all roadway users.

Study Area

The study area encompasses First Street from West Kingsley Street to Madison Street, Ashley Street from West Kingsley Street to Madison Street, and the entirety of William Street (4th Street to State Street). The study area also includes the intersection of Kingsley Street, Main Street, and Beakes Street. Figure 3 presents the study area.

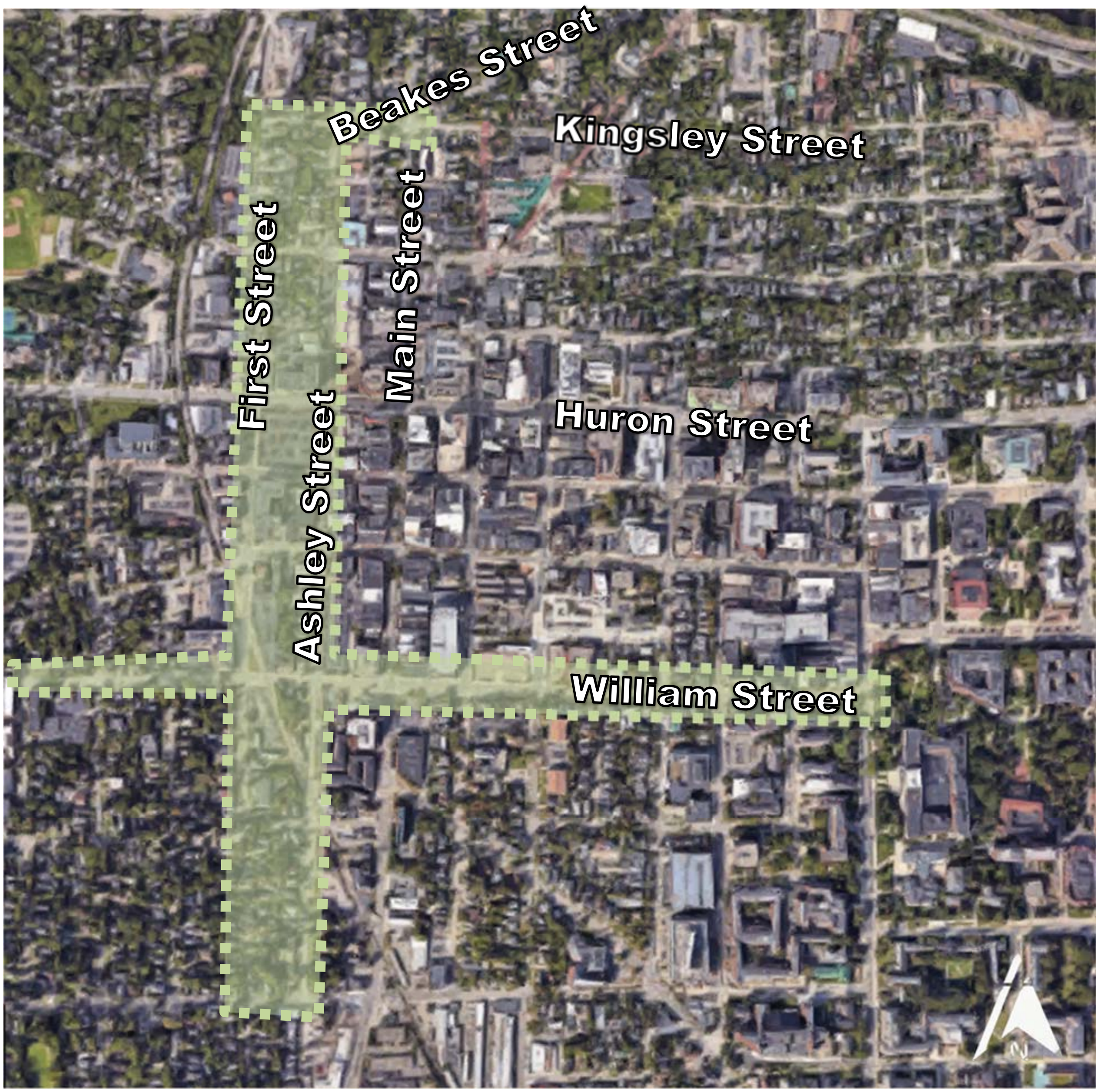


Figure 3 First, Ashley, and William Streets Study Area

Existing Conditions

The following section describes the existing conditions along the project corridors and at key intersections with regards to the driver, pedestrian, and bicyclist experience, in addition to the safety of all users within the study area.

First Street

First Street is currently a one-way street operating in the southbound direction and is classified as a major collector under the City's jurisdiction. As shown in Figure 1, the surrounding land use consists of residential to the north and south, and a combination of commercial and mixed use within the core. Typically, First Street consists of two vehicle travel lanes, a bicycle lane on the eastern side (left of vehicle travel direction), and on-street parking on the western side of the street, as shown in Figure 4 and Figure 5. Sidewalks are present on both sides of the street.

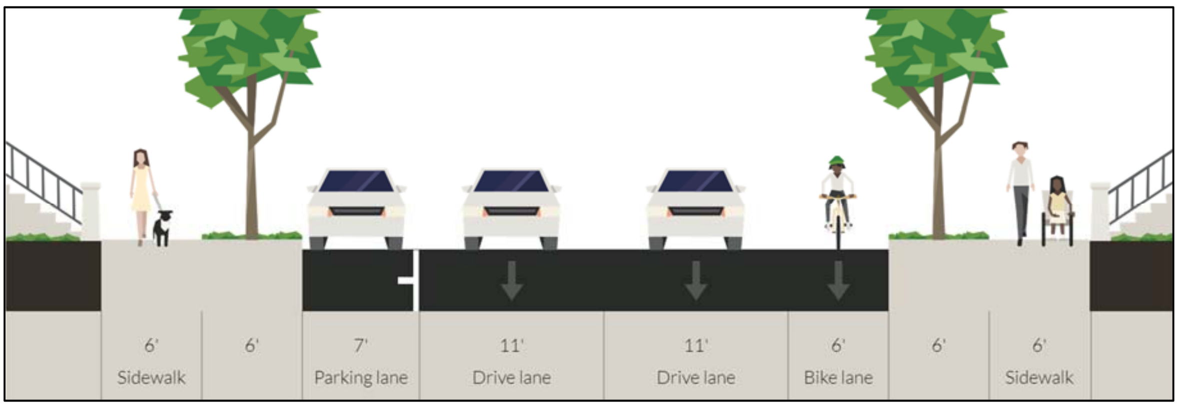


Figure 4 First Street Typical Cross Section – Existing

Figure 5 Street View of First Street

Ashley Street

Ashley Street is currently a one-way street operating in the northbound direction and is classified as a major collector under the City's jurisdiction. The surrounding land use consists of residential to the north and south, and a combination of commercial and mixed use within the core. Typically, Ashley Street consists of two vehicle travel lanes with parking provided on both sides of the street, as shown in Figures 6 and 7. There is a bicycle lane on the eastern side (right of vehicle direction) in sections where current width allows. Sidewalks are present on both sides of the street.

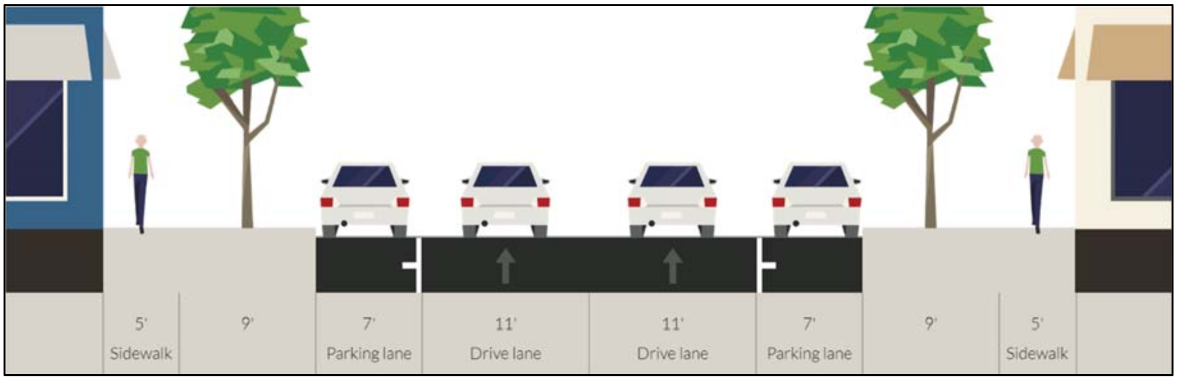


Figure 6 Ashley Street Typical Cross Section – Existing

Figure 7 Street View of Ashley Street

William Street

William Street is a two-way street running in the general east-west direction and is classified as a major collector under the City's jurisdiction. The surrounding land use consists of residential to the west, mixed use at the center, and commercial to the east. William Street terminates at the University of Michigan campus to the east. The cross section varies greatly between two and four vehicle travel lanes, with on-street parking provided intermittently along the roadway. Typically, two travel lanes are provided within the residential area and the commercial area. Sidewalks are present on both sides of the street, however there are currently no bicycle facilities on William Street. The cross section between Ashley Street and Main Street is shown in Figure 5. Additional photos of William Street are presented in Figures 9 through 11.

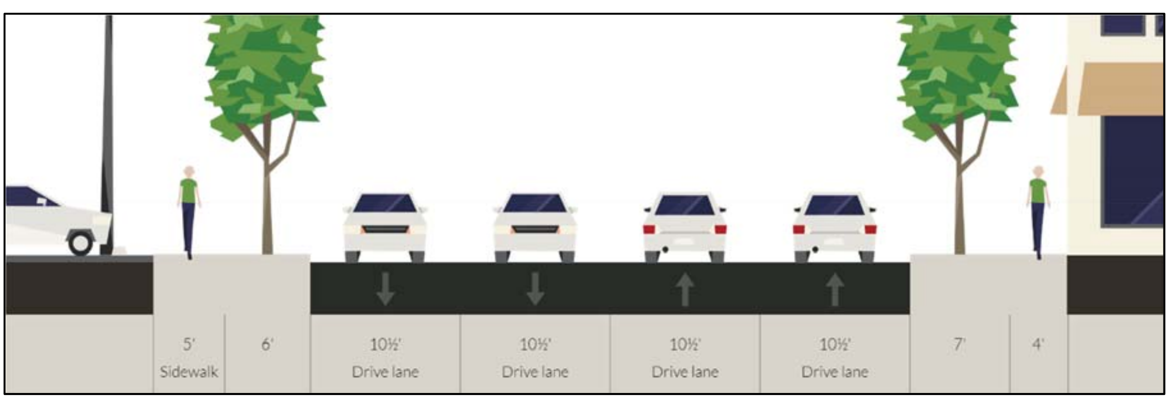


Figure 8 William Street Cross Section between Ashley St and Main St - Existing

Figure 9 Commercial section of William Street to the east

Figure 10 Mixed-use section of William Street

Figure 11 Residential section of William Street to the west

Key Intersections

There are 28 intersections located within the study area, shown in Figure 12. Of these intersections, four are all-way stop controlled, and nine are stop-controlled on the minor approach only. The signalized intersections are concentrated on First and Ashley Streets, north of William Street, and on William Street, east of Ashley Street. These areas tend to have more retail and commercial land uses, whereas the southern and western portions of the study area tend to be more residential.

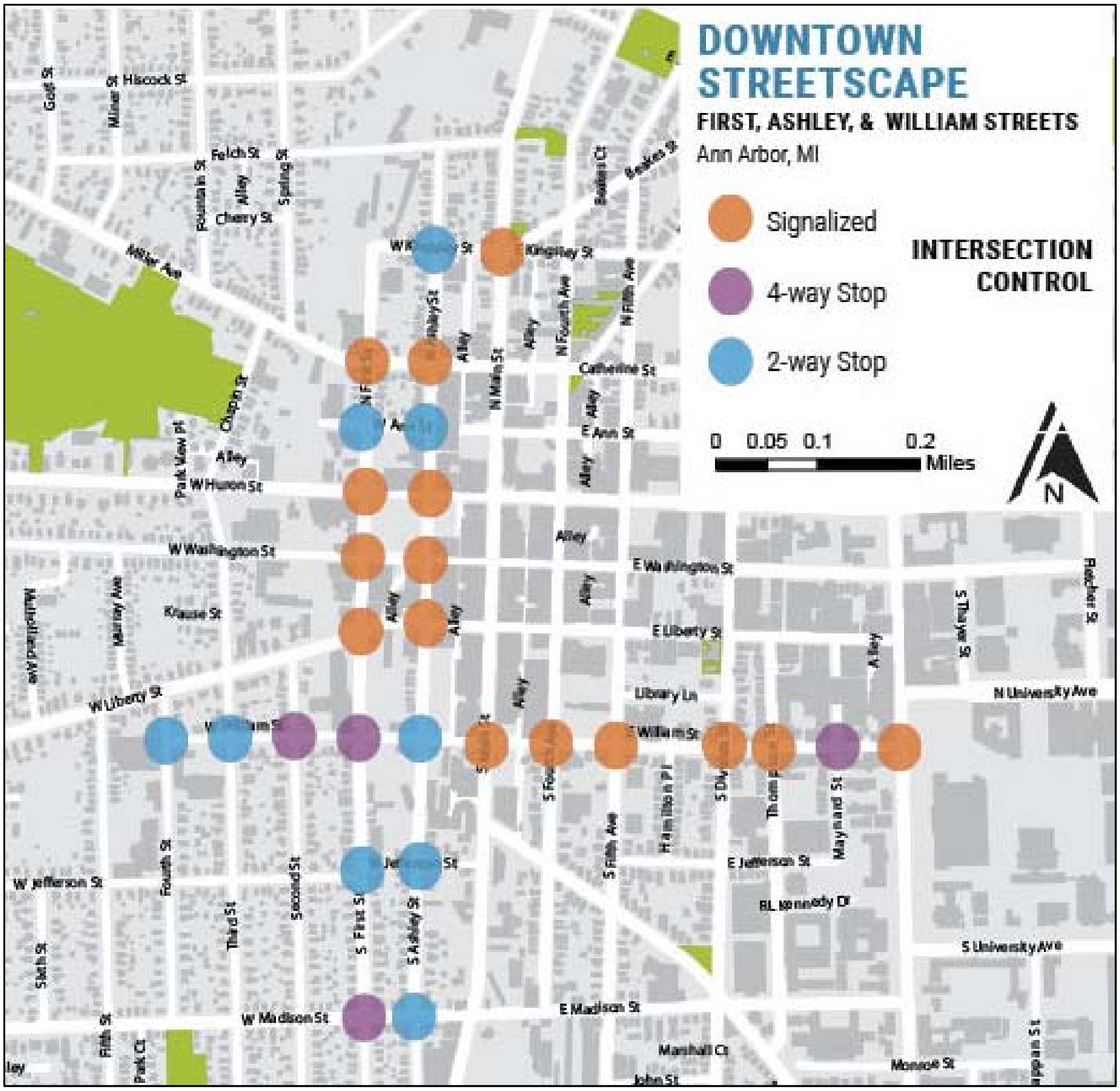


Figure 12 Study Area Existing Intersection Traffic Control

Crash History

Crash data for the study area were obtained from the Ann Arbor Transportation Improvement Association's Traffic Crash Analysis Tool (TCAT) for the most recent complete five-year period available (2013 through 2017). Figure 13 shows the concentrations of these crashes, while Figure 14 shows the number of injury crashes at the intersections. Note that this analysis is limited to reported crashes only, therefore unreported crashes and near misses are not accounted for.

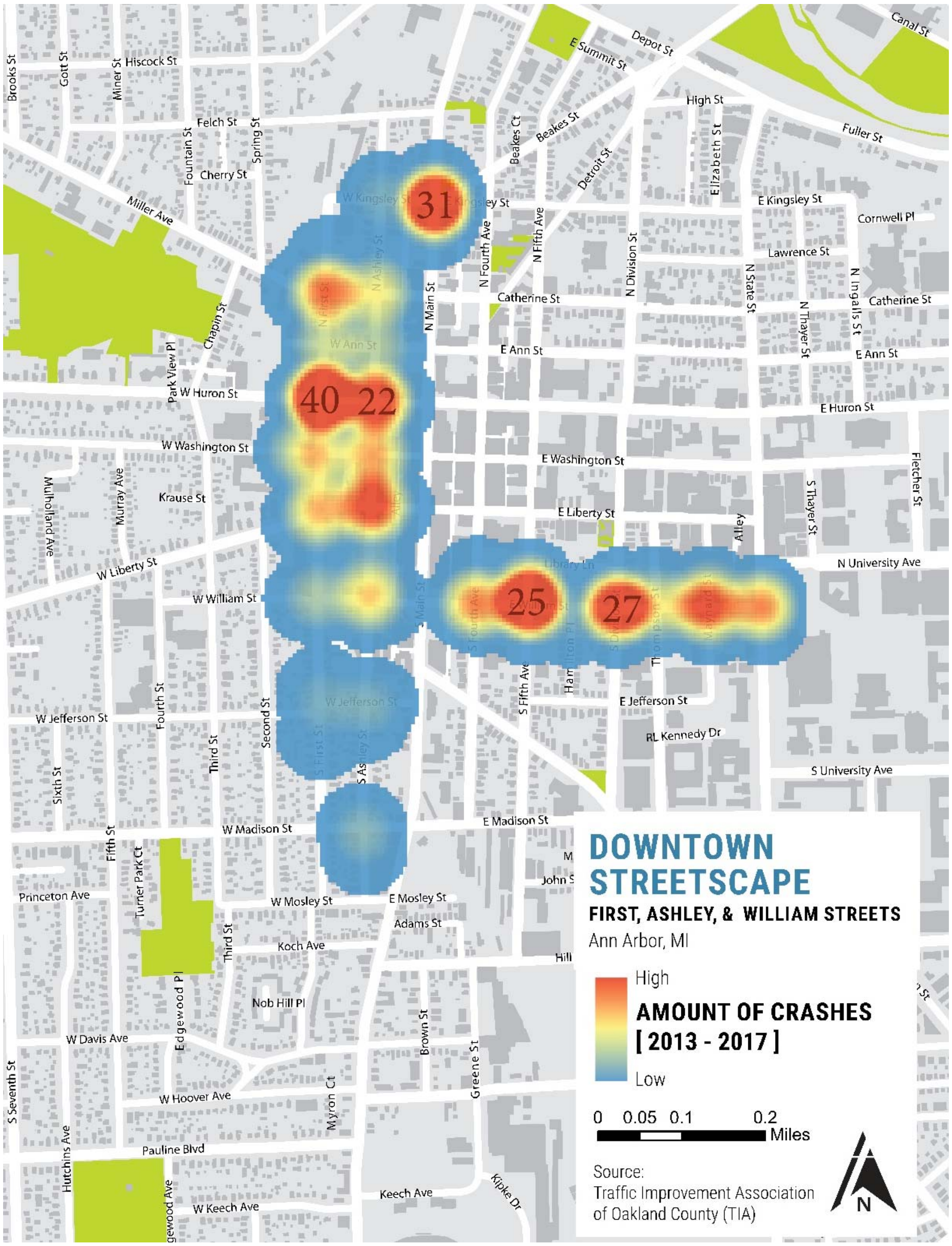


Figure 13 Study area crash heat map

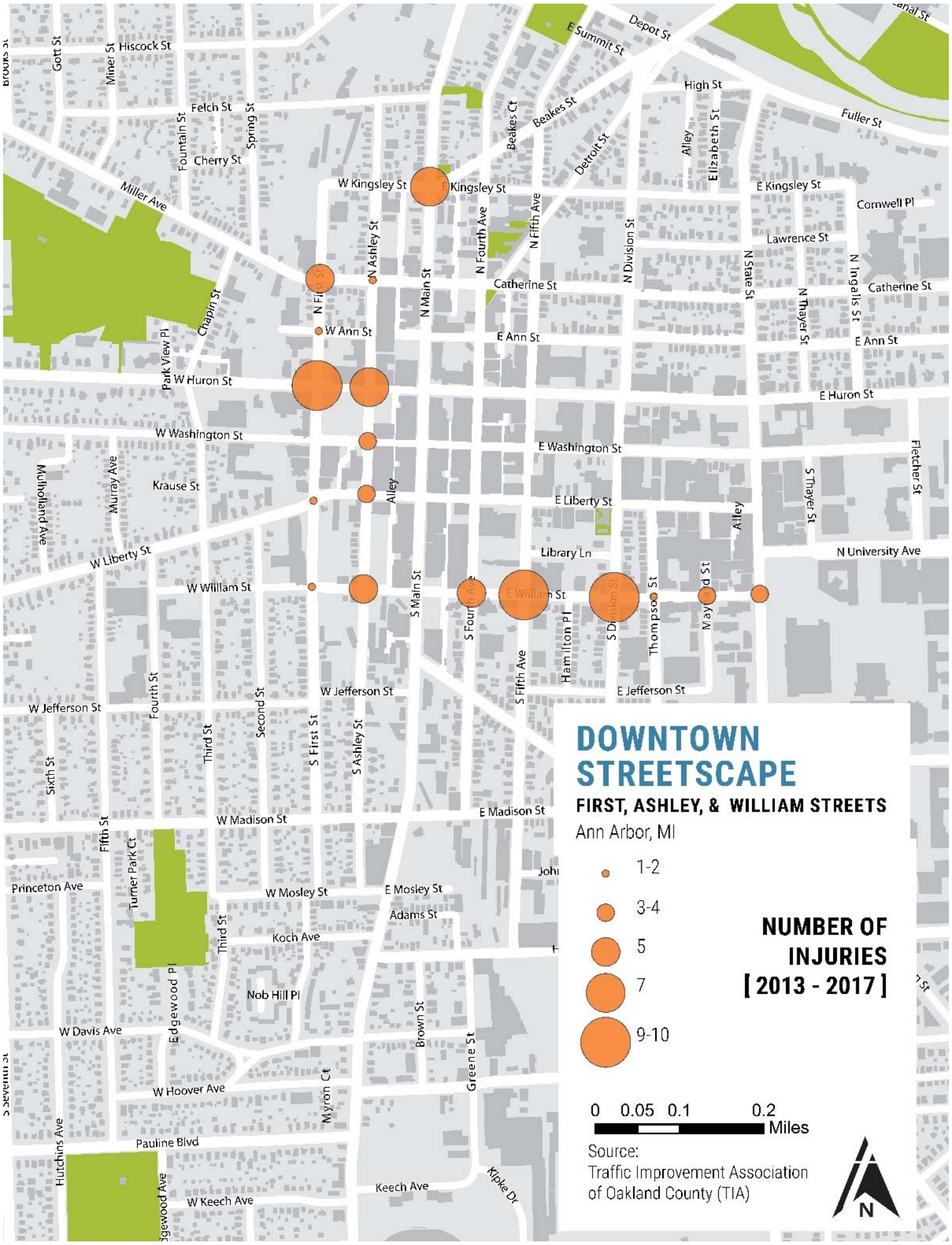


Figure 14 Number of injuries at intersections

Within the study area, a total of 650 crashes occurred between 2013 and 2017. Of these crashes, 43 (7%) involved vulnerable roadway users (pedestrians and bicyclists).

The intersection of First Street at Huron Street had the most crashes of any intersection within the study area with 40 crashes. Of the 40 crashes, 21 (53%) were angle crashes, while nine (23%) were rear-end crashes and five (13%) involved vulnerable roadway users.

On First Street, 84 crashes occurred at midblock locations. Of these 84 crashes, 29 (35%) were sideswipe crashes and 26 (31%) were rear-end crashes. There were 21 reported crashes at the intersection of First Street and Miller Street, six of which resulted in injury (29%). This rate of injury occurrence is similar to the national average[1] of approximately 29%.

Table 1 First Street Collision Summary

	First Street at:					
	Huron Street	Miller Street	Liberty Street	Other intersections and driveways	Midblock Locations	**Total**
2013	6	3	1	7	19	**36**
2014	4	2	3	2	13	**24**
2015	12	6	4	7	19	**48**
2016	12	4	1	2	20	**39**
2017	6	6	3	3	13	**31**
Total	**40**	**21**	**12**	**21**	**84**	**178**

Table 2 First Street Collision Type and Severity

	First Street at:					
	Huron Street	Miller Street	Liberty Street	Other intersections and driveways	Midblock Locations	**Total**
Collision Type						
Angle	21	13	4	7	10	**55**
Rear End	9	3	1	6	26	**45**
Sideswipe	1	1	5	5	29	**41**
Single Vehicle	4	2	1	1	15	**23**
Other/Unknown	5	2	1	2	4	**14**
Total	**40**	**21**	**12**	**21**	**84**	**178**
Vulnerable Users						
Bicyclist Involved	1	3	0	1	1	**6**
Pedestrian Involved	4	0	0	0	1	**5**
Total	**5**	**3**	**0**	**1**	**2**	**11**
Severity						
Fatality	0	0	0	0	0	**0**
Incapacitating Injury	1	1	0	0	0	**2**
Non- incapacitating Injury	4	1	0	2	2	**9**
Possible Injury	1	4	0	1	5	**11**
Property Damage Only	34	15	12	18	77	**156**
Total	**40**	**21**	**12**	**21**	**84**	**178**
Percent Injury	**15%**	**29%**	**0%**	**14%**	**8%**	**12%**

[1] *Traffic Safety Facts Research Note*; U.S. Department of Transportation National Highway Traffic Safety Administration (NHTSA); December 2014.

The intersection of Ashley Street at Huron Street had the most crashes of any intersection on Ashley Street with 22 crashes. Of the 22 crashes, nine (41%) were angle crashes, four (18%) were rear-end crashes, and three (14%) involved vulnerable roadway users.

On Ashley Street, 83 crashes did not occur at an intersection. Of the 83 crashes, 28 (34%) were sideswipe crashes and 17 (20%) were rear-end crashes.

Table 3 Ashley Street Collision Summary

	Ashley Street at:						
	Huron Street	Miller Street	Liberty Street	William Street	Other intersections and driveways	Midblock Locations	**Total**
2013	8	3	3	2	7	13	**36**
2014	3	1	2	3	6	23	**38**
2015	3	3	2	3	7	15	**33**
2016	5	2	4	4	5	20	**40**
2017	3	4	3	0	4	12	**26**
Total	**22**	**13**	**14**	**12**	**29**	**83**	**173**

Table 4 Ashley Street Collision Type and Severity

	Ashley Street at:						
	Huron Street	Miller Street	Liberty Street	William Street	Other intersections and driveways	Midblock Locations	**Total**
Collision Type							
Angle	9	10	9	6	12	13	**59**
Rear End	4	0	1	1	3	17	**26**
Sideswipe	2	0	3	1	5	28	**42**
Single Vehicle	2	1	1	3	2	8	**17**
Other/Unknown	2	2	0	1	7	17	**29**
Total	**22**	**13**	**14**	**12**	**29**	**83**	**173**
Vulnerable Users							
Bicyclist Involved	0	0	1	1	0	0	**2**
Pedestrian Involved	3	1	0	1	3	4	**12**
Total	**3**	**1**	**1**	**2**	**3**	**4**	**14**
Severity							
Fatality	0	0	0	0	0	0	**0**
Incapacitating Injury	1	0	0	0	1	0	**2**
Non- incapacitating Injury	2	1	0	2	3	2	**10**
Possible Injury	1	1	1	1	2	6	**12**
Property Damage Only	18	11	13	9	23	75	**155**
Total	**22**	**13**	**14**	**12**	**29**	**83**	**173**
Percent Injury	**18%**	**15%**	**7%**	**25%**	**21%**	**10%**	**14%**

The William Street corridor had the most crashes of all three corridors with 236 crashes, not including crashes which occurred at the intersections of First Street and Ashley Street. The intersection of Division Street at William Street had the most crashes of any intersection on William Street with 27 crashes. Of the 27 crashes, 20 (74%) were angle crashes, three (11%) were sideswipe crashes, and two (7%) involved vulnerable roadway users.

On William Street, 136 crashes did not occur at an intersection. Of the 136 crashes, 64 (48%) were sideswipe crashes and 25 (18%) were rear-end crashes. The intersections of William Street at Fifth Avenue and at Division Street had injury occurrence rates of 36% and 33%, respectively. These rates of injury occurrence are higher than the national average of 29%.

Table 5 William Street Collision Summary

	William Street at:						
	Fourth Avenue	Fifth Avenue	Division Street	State Street	Other intersections and driveways	Midblock Locations	**Total**
2013	2	4	6	2	7	27	**48**
2014	4	5	6	2	6	34	**57**
2015	3	3	4	3	8	29	**50**
2016	4	6	8	1	3	22	**44**
2017	2	7	3	0	1	24	**37**
Total	**15**	**25**	**27**	**8**	**25**	**136**	**236**

Table 6 William Street Collision Type and Severity

	William Street at:						
	Fourth Avenue	Fifth Avenue	Division Street	State Street	Other intersections and driveways	Midblock Locations	**Total**
Collision Type							
Angle	8	15	20	1	6	14	**64**
Rear End	2	1	1	4	3	25	**36**
Sideswipe	2	7	3	1	11	64	**88**
Single Vehicle	1	1	2	0	3	7	**14**
Other/Unknown	2	1	1	2	2	26	**34**
Total	**15**	**25**	**27**	**8**	**25**	**136**	**236**
Vulnerable Users							
Bicyclist Involved	0	0	0	0	0	2	**2**
Pedestrian Involved	2	1	2	1	3	3	**12**
Total	**2**	**1**	**2**	**1**	**3**	**5**	**14**
Severity							
Fatality	0	0	0	0	0	0	**0**
Incapacitating Injury	0	0	0	0	0	0	**0**
Non- incapacitating Injury	2	3	3	0	3	3	**14**
Possible Injury	2	6	6	1	1	9	**25**
Property Damage Only	11	16	18	7	21	124	**197**
Total	**15**	**25**	**27**	**8**	**25**	**136**	**236**
Percent Injury	**27%**	**36%**	**33%**	**13%**	**16%**	**9%**	**17%**

The intersection of Kingsley Street, Main Street, and Beakes Street had a total of 63 crashes occur within 150’ of the intersection. Approximately half of the collisions occurred within the intersection itself, while the other half occurred on the approach to the intersection. Of the 31 crashes occurring within the intersection, 13 (42%) were rear-end crashes, and 11 (35%) were angle crashes. Of the 32 crashes occurring on the immediate approach to the intersection, 24 (75%) were rear-end crashes and four (13%) involved vulnerable roadway users. There were 13 reported crashes on the approaches where injuries occurred, for an injury occurrence rate of 41%.

Table 7 Kingsley Street, Main Street, and Beakes Street Collision Summary

	Within Intersection	On the Approach	**Total**
2013	7	9	**16**
2014	4	4	**8**
2015	8	4	**12**
2016	9	7	**16**
2017	3	8	**11**
Total	**31**	**32**	**63**

Table 8 Kingsley Street, Main Street, and Beakes Street Collision Type and Severity

	Within Intersection	On the Approach	**Total**
Collision Type			
Angle	11	0	**11**
Rear End	13	24	**37**
Sideswipe	3	3	**6**
Single Vehicle	2	3	**5**
Other/Unknown	2	2	**4**
Total	**31**	**32**	**63**
Vulnerable Users			
Bicyclist Involved	0	0	**0**
Pedestrian Involved	0	4	**4**
Total	**0**	**4**	**4**
Severity			
Fatality	0	0	**0**
Incapacitating Injury	0	0	**0**
Non- incapacitating Injury	3	7	**10**
Possible Injury	2	6	**8**
Property Damage Only	26	19	**45**
Total	**31**	**32**	**63**
Percent Injury	**16%**	**41%**	**29%**

During overnight hours (midnight to 6:30 AM) all signalized intersections within the study area are under flashing operations. The main approach traffic signal indications display a flashing yellow, while the minor approach signal indications display a flashing red. Of the crashes that occurred within signalized intersections in the study area, 16% occurred during flashing operations. Of the crashes occurring during flashing operations, 15% resulted in injury. The intersection of Ashley Street at Miller Avenue had the highest percent of crashes occurring during this time period (38%), while William Street at Division Street had the second highest and First Street at Huron Street had the third highest (26% and 20%, respectively).

Table 9 Crashes occurring during overnight flashing operations

		Crashes occurring during overnight flashing operations	Total crashes occurring at the intersection	Percent crashes during flashing operations
First Street at:	Miller Avenue	2	21	**10%**
	Huron Street	8	40	**20%**
	Liberty Street	2	12	**17%**
	Washington Street	1	6	**17%**
Ashley Street at:	Miller Avenue	5	13	**38%**
	Huron Street	3	22	**14%**
	Liberty Street	2	12	**14%**
	Washington Street	0	9	**0%**
William Street at:	Fourth Avenue	1	15	**7%**
	Fifth Avenue	3	25	**12%**
	Division Street	7	27	**26%**
	Thompson Street	0	6	**0%**
	State Street	0	8	**0%**
Main Street at:	Kingsley Street/Beakes Street	5	31	**16%**
	Total	**39**	**247**	**16%**

Current Mode Split

Data was obtained to determine the existing mode split both within the study area and within Ann Arbor via the 2016 American Community Survey 5-Year Estimates[2]. The means of transportation to work is shown in Table 10.

Within the study area, the primary mode of transportation to work is walking (41%), followed by driving (37%), then utilizing public transportation (11%). When expanded to Ann Arbor, driving is the primary mode (62%), with walking being the second most utilized (15%). Figure 15 displays the mode splits graphically.

[2] Census Tracts 4001, 4002, 4003, 4005, 4006, 4007, and 4008 were included in the study area.

Table 10 Commute Mode Split Census Data

Mode	Study Area	Ann Arbor
Walk	41%	15%
Vehicle	37%	62%
Public Transportation	11%	11%
Work at Home	11%	7%
Bicycle	5%	5%
Other	1%	1%

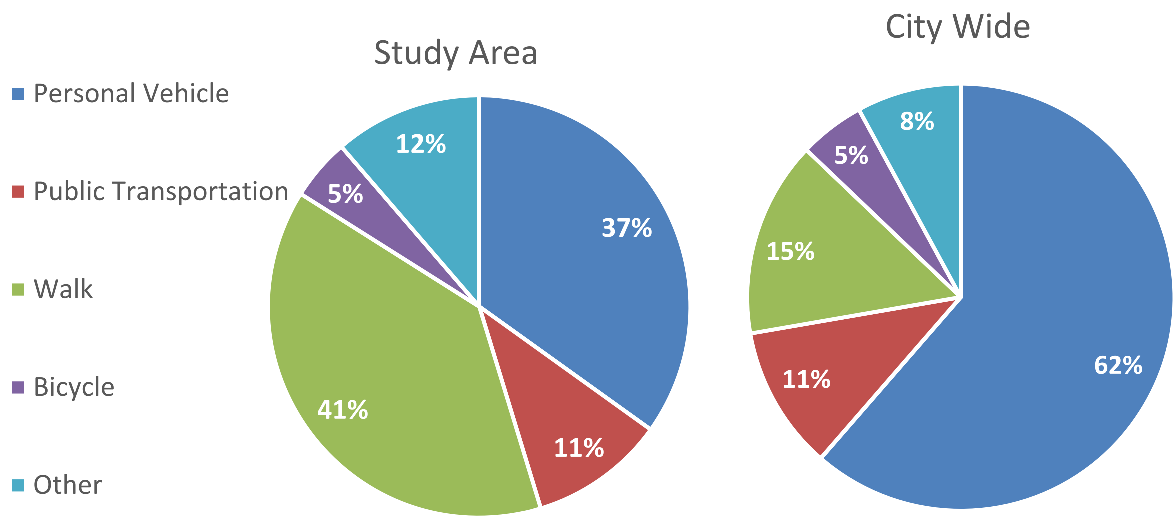


Figure 15 Study area and Ann Arbor mode split

Transportation Data Collection

Existing traffic volumes within the study area were developed by conducting manual turning movement counts (TMCs) and obtaining 168-hour Automatic Traffic Recorder (ATR) counts in December of 2017 and March of 2018, respectively. Existing vehicular, pedestrian, and bicyclist volumes were obtained through TMCs, performed at all study area intersections on Thursday, December 7, 2017. Count data was collected during the weekday morning period (7:00AM-9:00AM), weekday midday (11:00AM-1:00PM), and the weekday evening (3:00PM-6:00PM). Average Daily Traffic (ADT) volumes counts were collected via ATRs for a 168-hour period at two locations along each of the study area roadways; First and Ashley Streets north of Ann Street, First and Ashley Streets south of William Street, William Street west of First Street, and William Street east of Hamilton Place. These data were collected to inform design decisions, specifically related to the desire for bicycle accommodations within the study area and the conversion of First and Ashley Streets to two-way traffic. Figure 16 below shows the ATR and TMC collection locations.

Figure 16 Study Area Count Locations

Bicyclist Environment

Bicycling is a viable means of mobility throughout the City of Ann Arbor, with bicyclist volume and activity being notable throughout downtown. Bicyclists were reported to mostly ride with vehicle traffic in the road, though less confident riders were noted on the sidewalks. Pictures of these occurrences are shown in Figures 17 and 18.

In the Ann Arbor Downtown Street Design Manual, all three project roadways were identified to have a strong bicyclist emphasis, with sections of Ashley Street also emphasizing pedestrians.

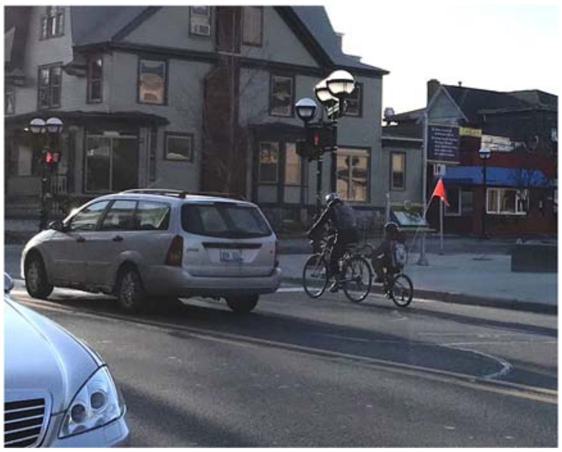


Figure 17 Bicyclists riding in the street with traffic

Figure 18 Bicyclist riding on the sidewalk

Pedestrian Environment

Pedestrian activity is a prominent feature within the study area, particularly close to the University of Michigan campus. This area is highly active with people walking between where they live, work, play, study, and connect to transit along the corridor. Concrete sidewalks with curbing are provided along both sides of the three study area roadways. However, high speeds were measured along all three the corridors. Figure 19 shows the relationship between higher speeds and the increased likelihood of fatal or serious injury if a pedestrian is struck. Pedestrians' perceived safety also affects sidewalk utilization. High vehicle speeds, especially with little or no physical barrier, are a deterrent to pedestrian activity. Corridor speeds are summarized later in this report. Addressing high vehicle speeds and providing a human-scaled streetscape offer opportunities to improve the pedestrian experience along throughout the study area. Figures 20 and 21 illustrate the current lack of human-scaled streetscape and the proximity to high-speed vehicle traffic.

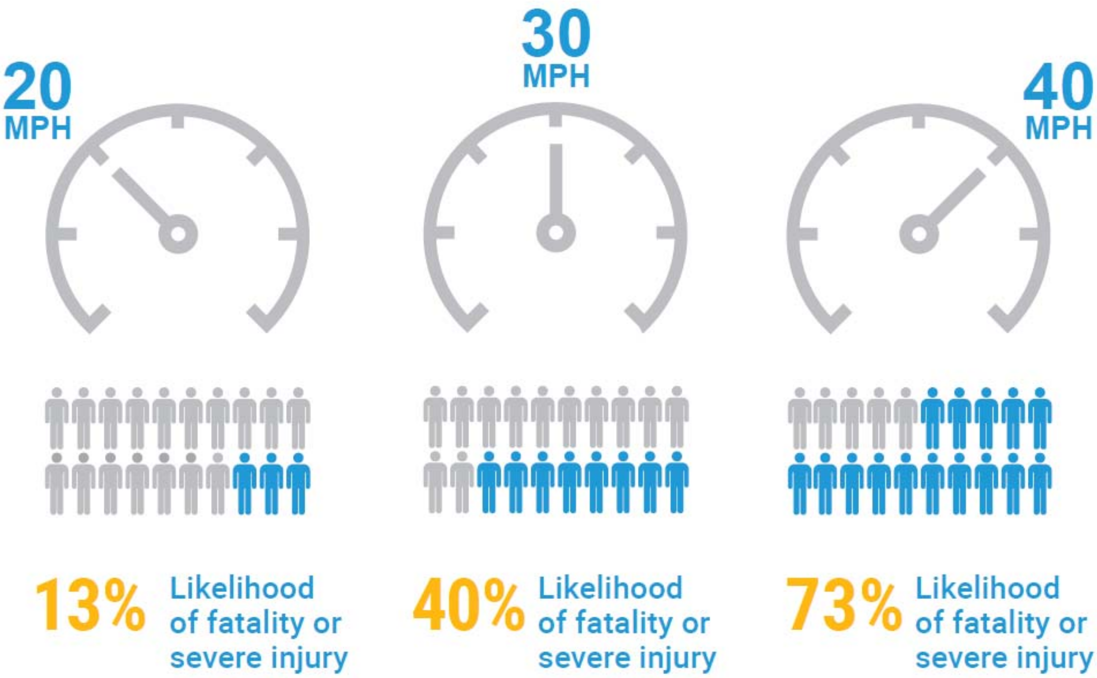


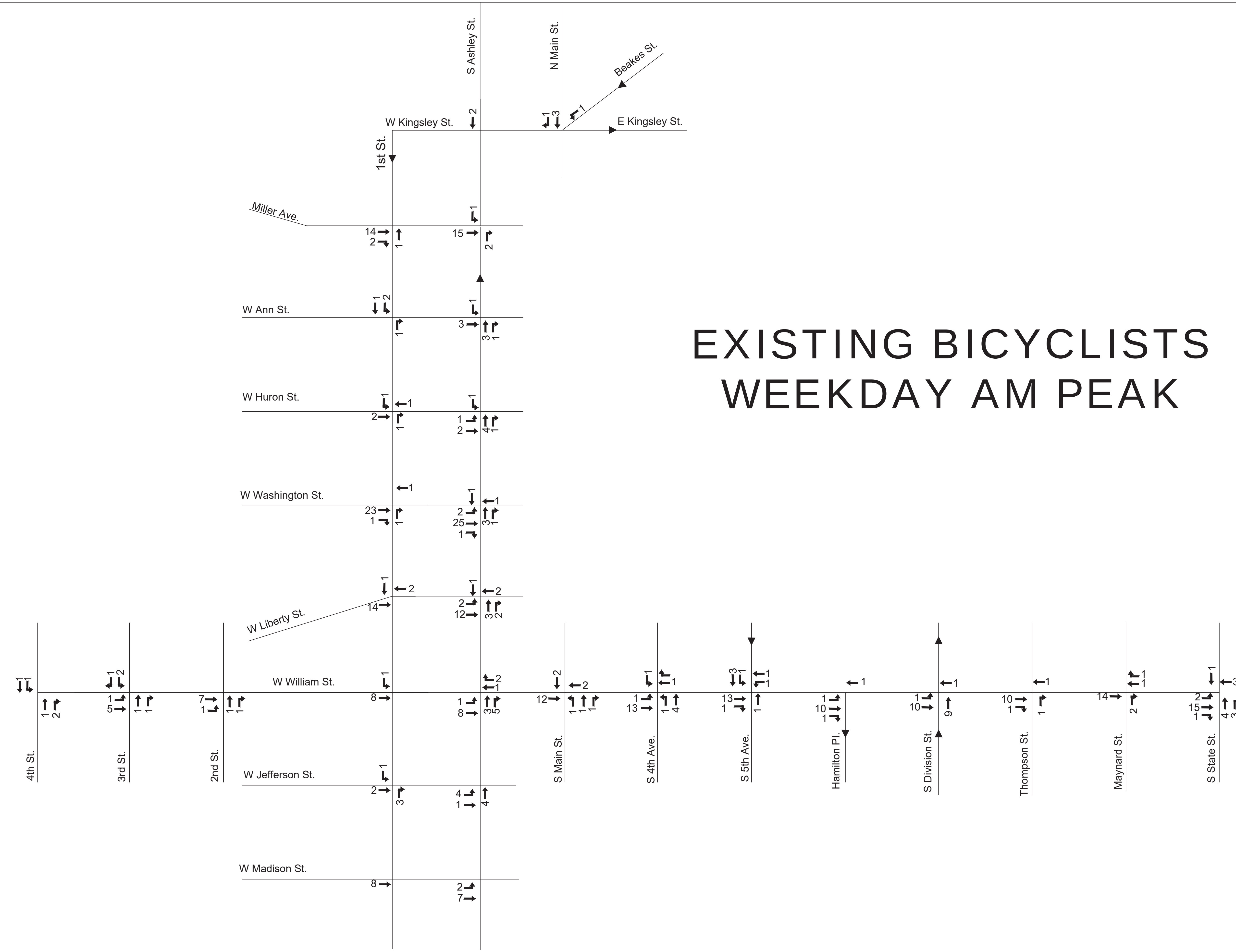
Figure 19 Likelihood of fatality or severe injury with regards to vehicle speed (Source: Tefft, Brian C. Impact speed and a pedestrian's risk of severe injury or death. Accident Analysis & Prevention. 50. 2013)

Figure 20 Pedestrians waiting to cross the street

Figure 21 Lack of human-scale streetscape on William Street

The bicycle turning movement volumes at the study area intersections are depicted graphically in Figures 22 through 24 for the weekday morning, midday, and evening, respectively. Figures 25, 26 and 27 graphically depict the existing weekday morning, midday, and evening peak hour pedestrian volumes, respectively.

EXISTING BICYCLISTS WEEKDAY AM PEAK



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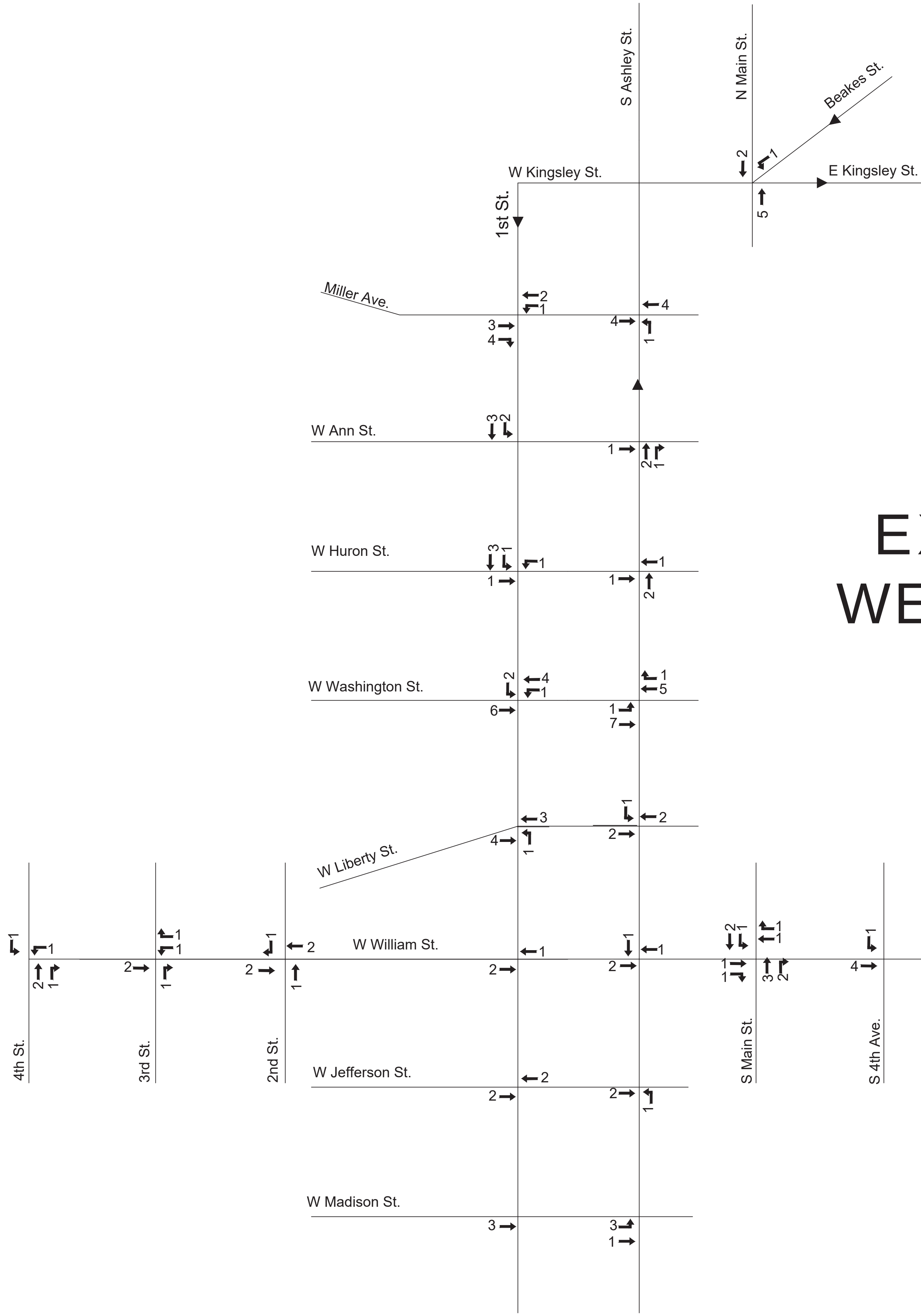
ANN ARBOR TRAFFIC COUNTS

PREPARED: HS
CHECKED: TD
DATE
7/13/2018

N

SHEET NAME
EXISTING BICYCLISTS WEEKDAY AM PEAK
FIGURE NUMBER
22



EXISTING BICYCLISTS WEEKDAY MIDDAY PEAK

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ANN ARBOR TRAFFIC COUNTS

PREPARED: HS

CHECKED: TD

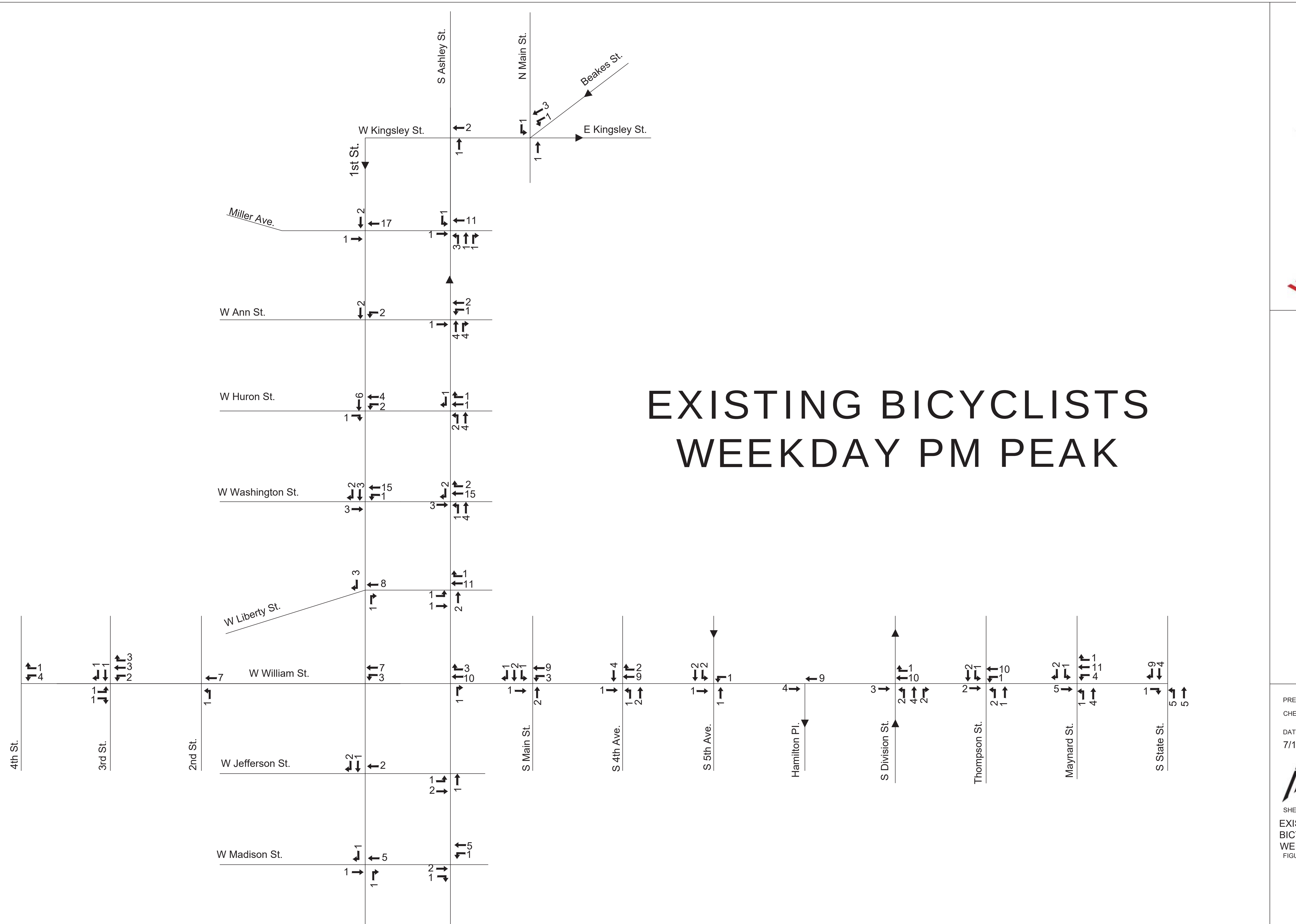
DATE 7/13/2018

N

SHEET NAME EXISTING BICYCLISTS WEEKDAY MIDDAY PEAK

FIGURE NUMBER 23

EXISTING BICYCLISTS
WEEKDAY PM PEAK



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ANN ARBOR
TRAFFIC COUNTS

PREPARED: HS
CHECKED: TD

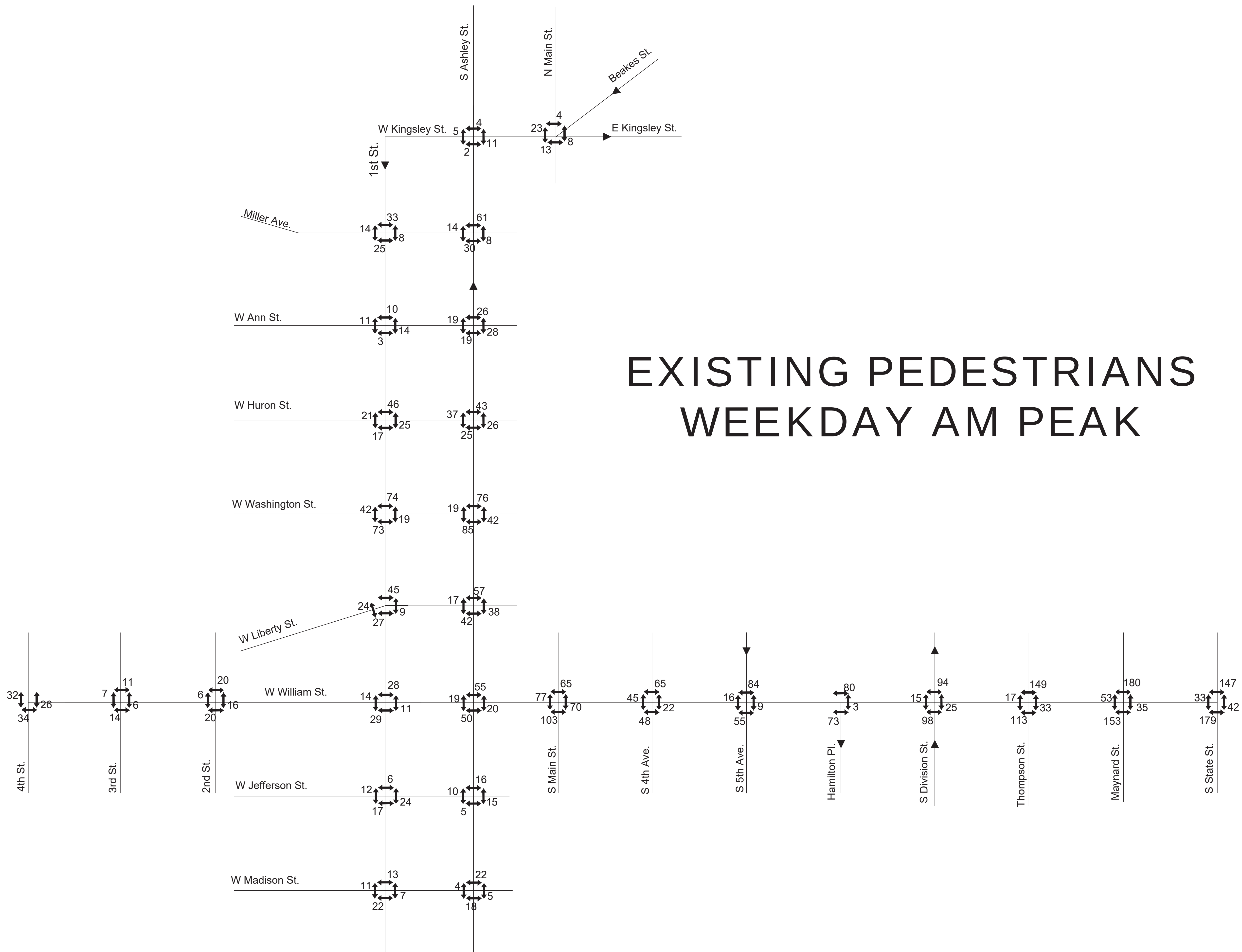
DATE
7/13/2018

N

SHEET NAME
EXISTING BICYCLISTS WEEKDAY PM PEAK

FIGURE NUMBER
24

EXISTING PEDESTRIANS
WEEKDAY AM PEAK



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TRAFFIC COUNTS

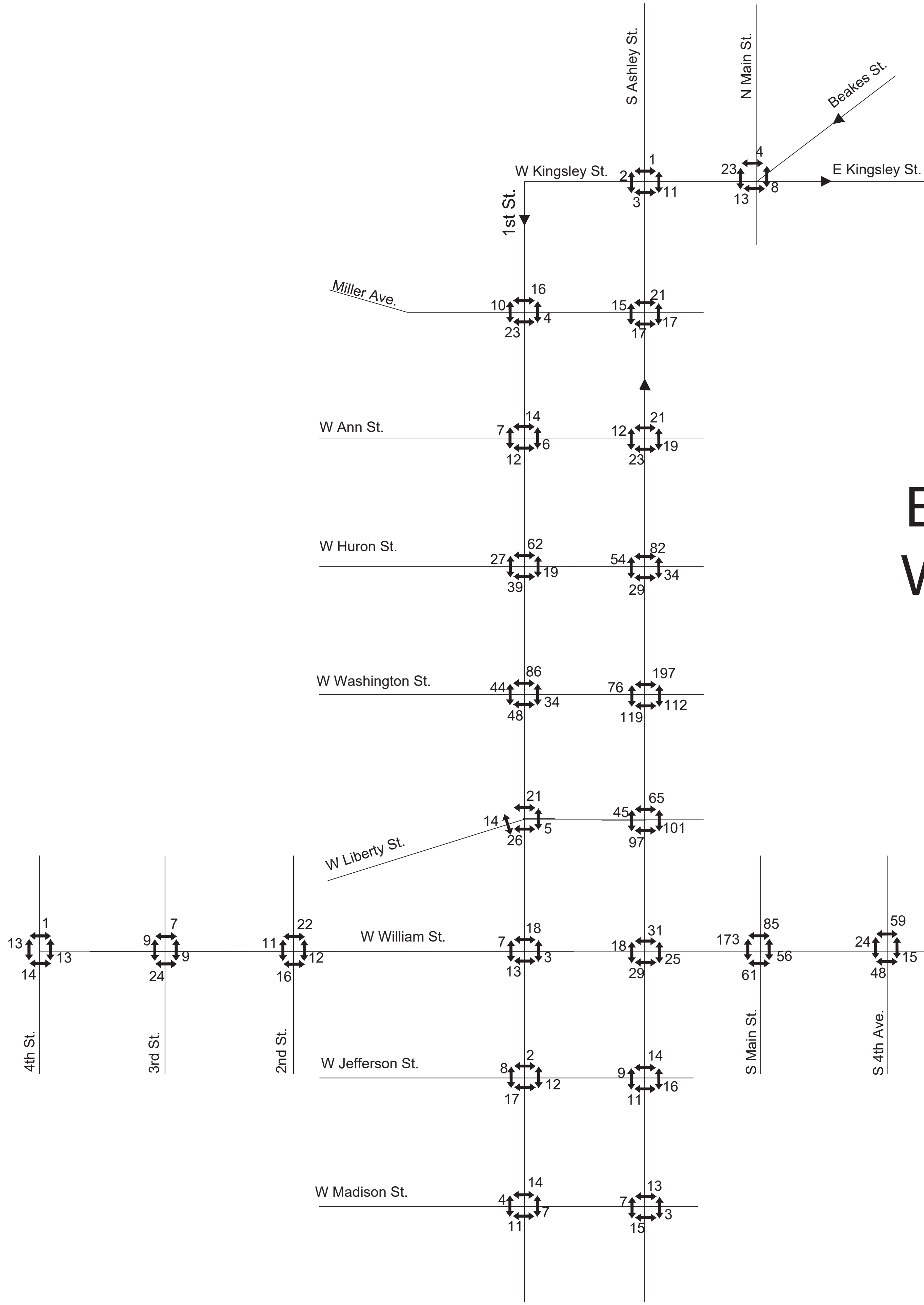
PREPARED: HS
CHECKED: TD

DATE
7/13/2018

N

SHEET NAME
EXISTING
PEDESTRIAN
WEEKDAY AM PEAK

FIGURE NUMBER
25



EXISTING PEDESTRIANS
WEEKDAY MIDDAY PEAK

ToolеDesignGroup

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ANN ARBOR
TRAFFIC COUNTS

PREPARED: HS
CHECKED: TD

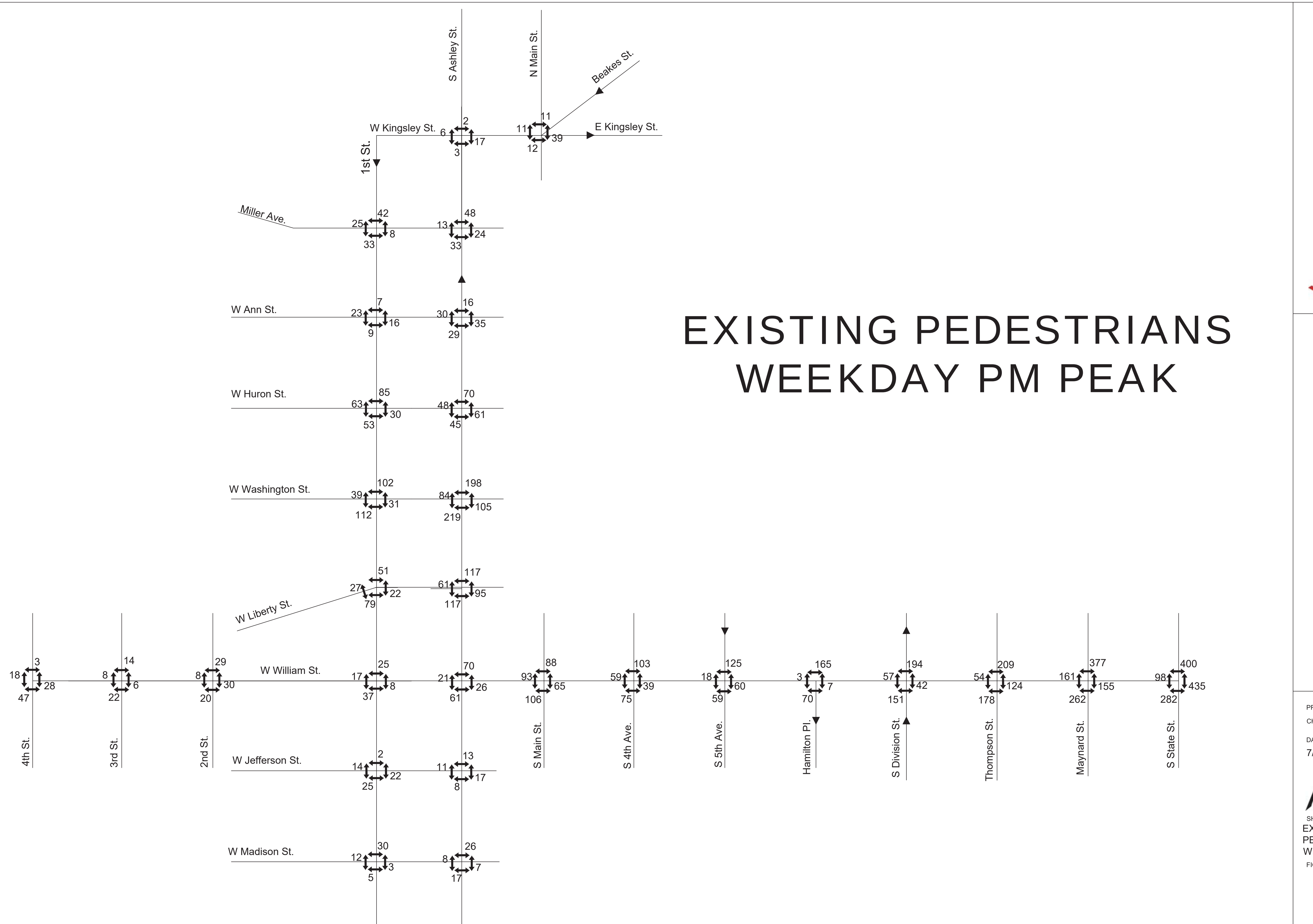
DATE
7/13/2018

N

SHEET NAME
EXISTING PEDESTRIAN WEEKDAY MIDDAY PEAK

FIGURE NUMBER
26

EXISTING PEDESTRIANS
WEEKDAY PM PEAK



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ANN ARBOR
TRAFFIC COUNTS

PREPARED: HS
CHECKED: TD
DATE
7/13/2018

N

SHEET NAME
EXISTING PEDESTRIAN WEEKDAY PM PEAK

FIGURE NUMBER
27

Public Transit Environment

The study corridors are currently serviced by The Ride Bus Routes 5, 6, 24, 25, 28B, 29, and 32 B/C. Table 11 describes the connectivity that the existing bus routes provide. Figure 28 presents the overall existing bus routes on First Street, Ashley Street, and William Street. Additionally, the Blake Transit Center is located between 4th Avenue and 5th Avenue, as shown in the figure below. Despite the location of the Blake Transit Center, there are only three bus stops on William Street, the only bus stops on the project corridors. These bus stops are designated by signs only; there are no bus shelters on William Street. With the proposed restoration of First Street and Ashley Street to two-way operations, it is recommended that Route 32 be consolidated onto First Street or Ashley Street. This reduces confusion for transit riders, as the bus follows the same route for incoming and outgoing routes.

Table 11 Bus Connections Through the Study Area

The Ride Service	**Connections**	
Route 5	Blake Transit Center (Ann Arbor)	Ypsilanti Transit Center (Ypsilanti)
Route 6	Blake Transit Center (Ann Arbor)	Ypsilanti Transit Center (Ypsilanti)
Route 24	Blake Transit Center (Ann Arbor)	Washtenaw Community College
Route 25	Blake Transit Center (Ann Arbor)	Oak Valley/Meijer
Route 28B	Blake Transit Center (Ann Arbor)	Westgate Shopping Center
Route 29	Blake Transit Center (Ann Arbor)	Scio Ridge
Route 32B/C	Skyline HS/Miller Rd P&R Lot	U-M Hospital

Figure 28 Bus routes through the study area

Vehicular Environment

Table 12 summarizes the 2018 daily traffic volumes and speeds at the ATR installation locations. While the median speeds along all three corridors were measured at or below the statutory speed limit of 25 mph, 85th percentile speeds where much higher along First and Ashley Streets. Over the course of the data collection period, the number of drivers travelling over the speed limit ranged from 33% to 57% on First and Ashley Streets. On Ashley Street, north of Ann Street, 103 drivers were measured travelling over 40 mph over the 168-hour collection period. As shown previously, if a pedestrian is struck by a vehicle driving 40 mph, there is a 73% chance of serious or fatal injury. Figure 29 summarizes the 2018 average daily traffic (ADT) volumes along the study area corridors at the ATR installation locations during a typical weekday day. Figures 30 through 32 present the existing vehicular turning movements for the weekday morning, midday, and evening peak hours, respectively. The raw count and speed data are included in the Attachments.

Table 12 Study area traffic volumes and speed summary

	Weekday Average (vpd*)	Saturday Daily (vpd)	Median Speed (mph)	85th percentile speed (mph)	% of vehicles over the speed limit (25 mph)	Total number of vehicles over 40 mph
First St north of Ann St (SB)	5,954	4,587	23	29	42%	45
Ashley St north of Ann St (NB)	2,946	2,058	22	28	33%	103
First St south of William St (SB)	2,248	1,778	25	29	57%	7
Ashley St south of William St (NB)	1,626	1,110	22	28	37%	4
William St west of First St	**2,147**	**1,609**	-	-	-	-
William St west of First St (EB)	330	237	15	19	0%	0
William St west of First St (WB)	1,817	1,372	9	20	3%	0
William St east of Hamilton Pl	**5,108**	**5,080**	-	-	-	-
William St east of Hamilton Pl (EB)	1,932	1,928	17	23	7%	4
William St east of Hamilton Pl (WB)	3,176	3,152	12	22	6%	1

*vehicles per day

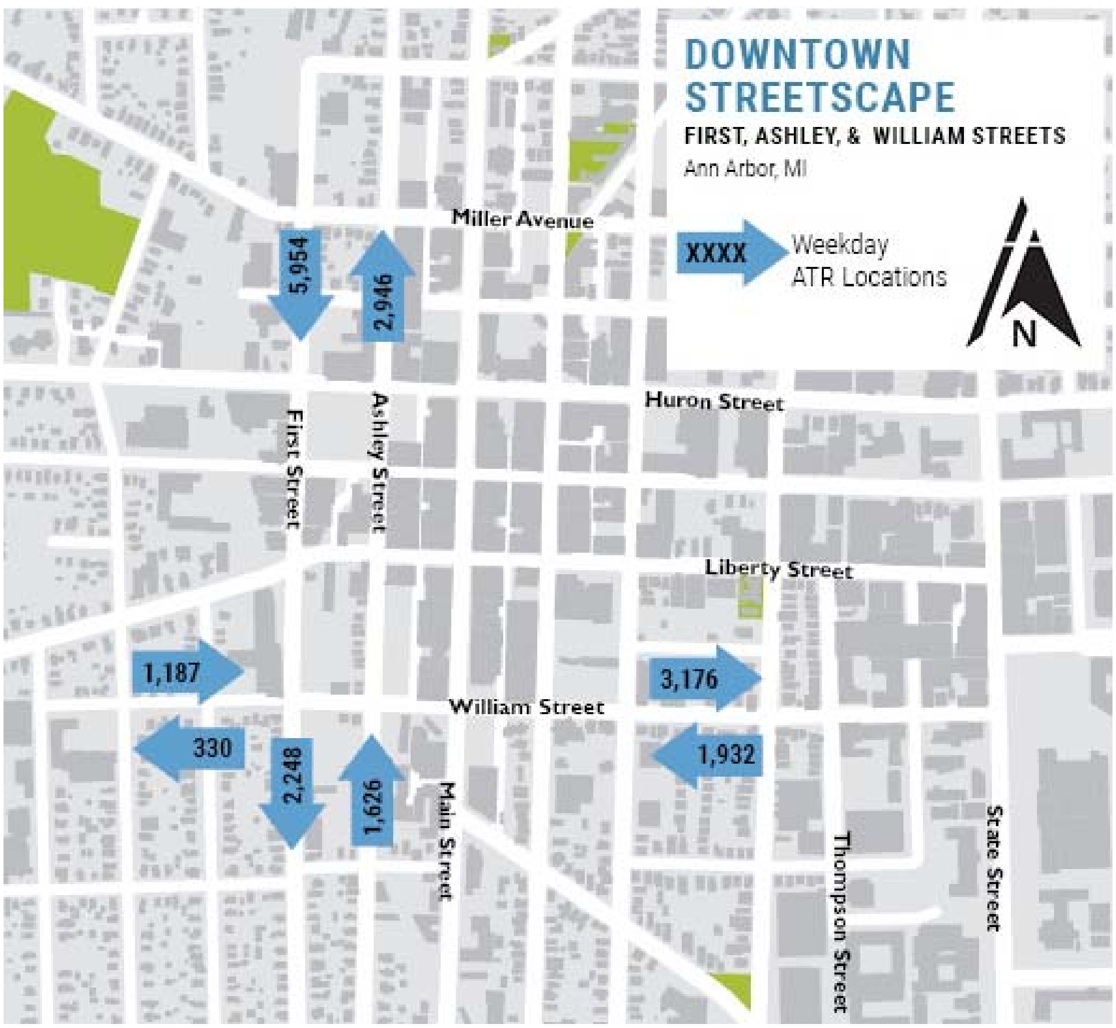
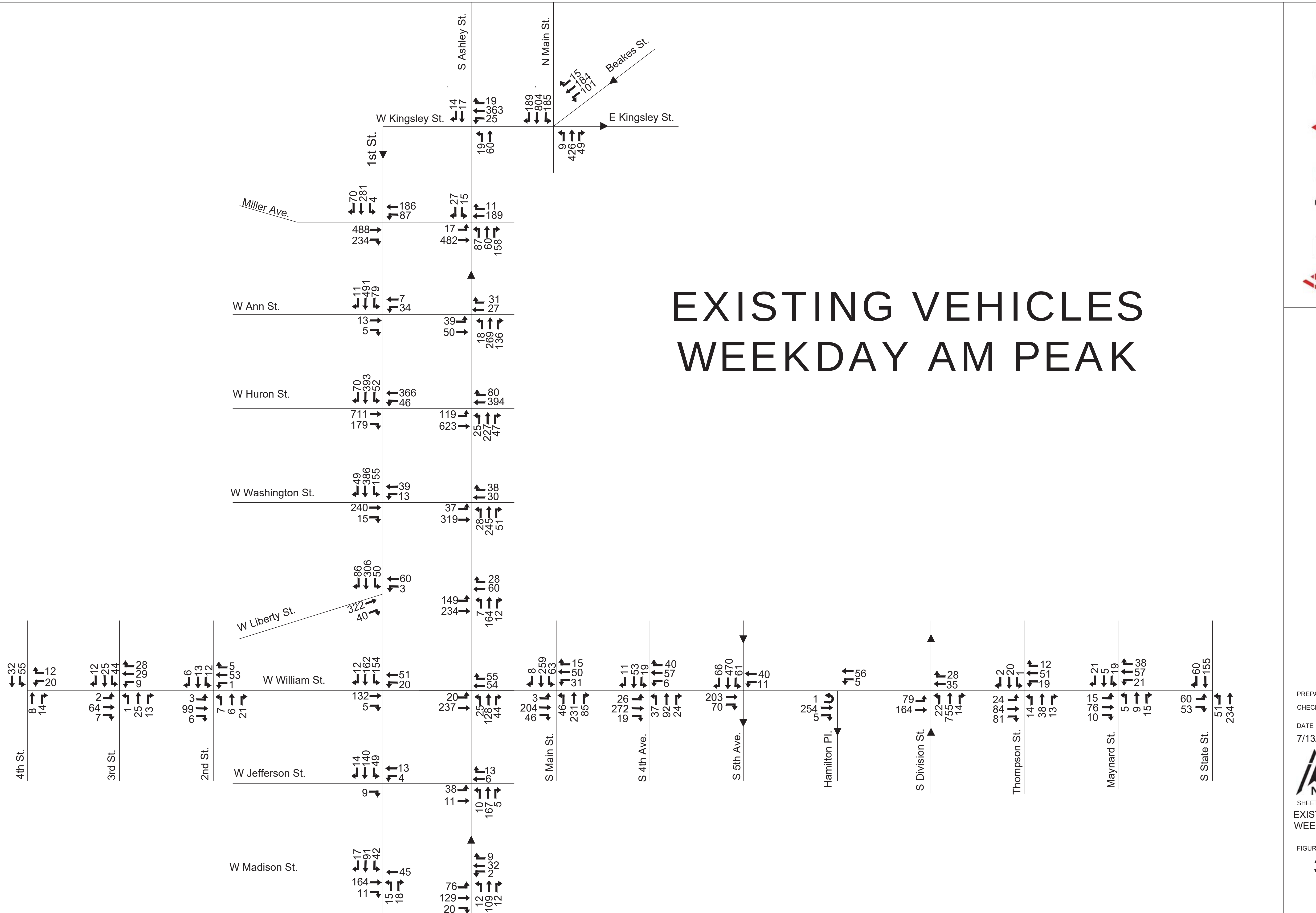


Figure 29 Typical weekday daily traffic volumes

EXISTING VEHICLES
WEEKDAY AM PEAK



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ANN ARBOR
TRAFFIC COUNTS

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CHECKED: TD

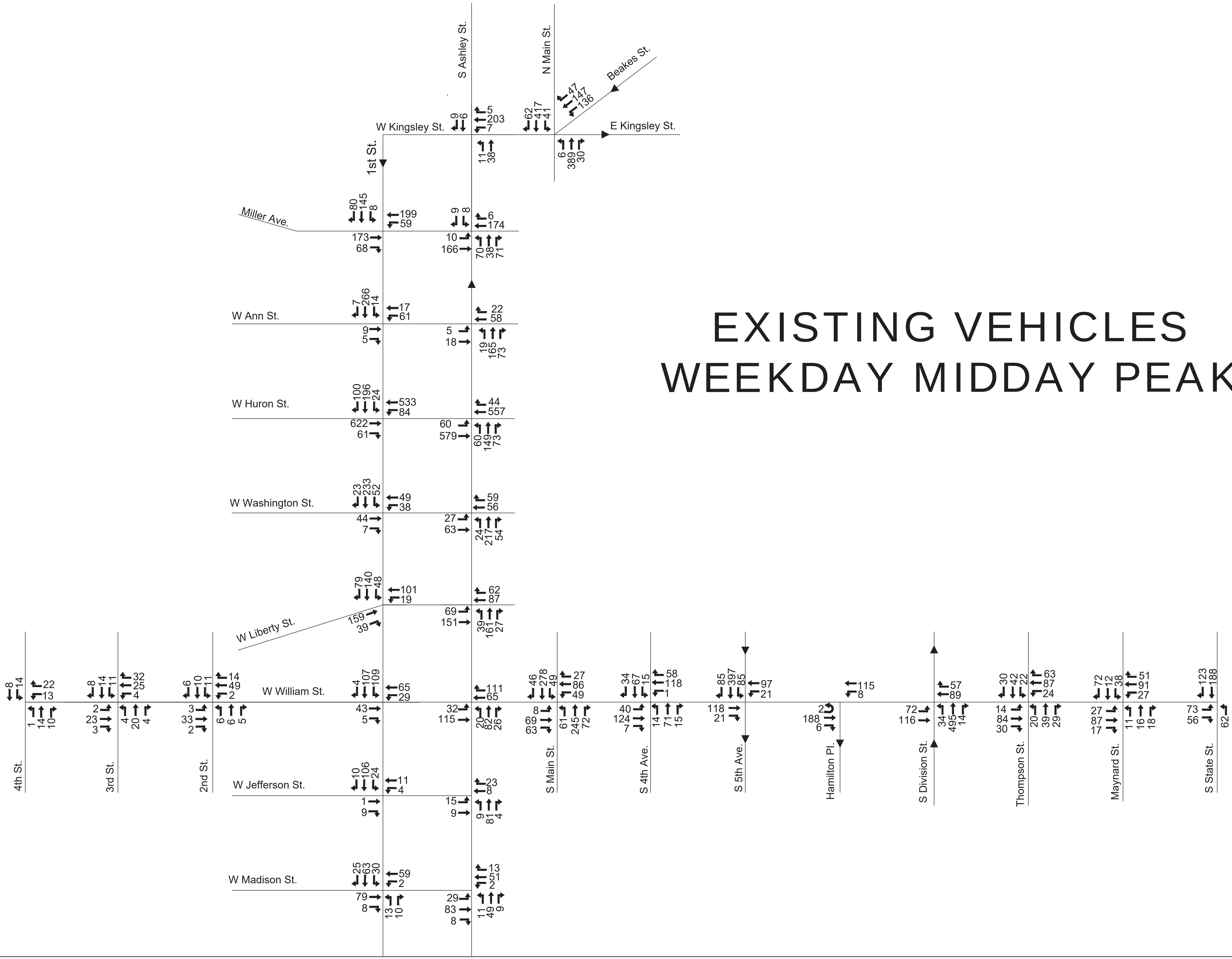
DATE
7/13/2018

N

SHEET NAME
EXISTING VEHICLES
WEEKDAY AM PEAK

FIGURE NUMBER
30

EXISTING VEHICLES
WEEKDAY MIDDAY PEAK



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ANN ARBOR TRAFFIC COUNTS

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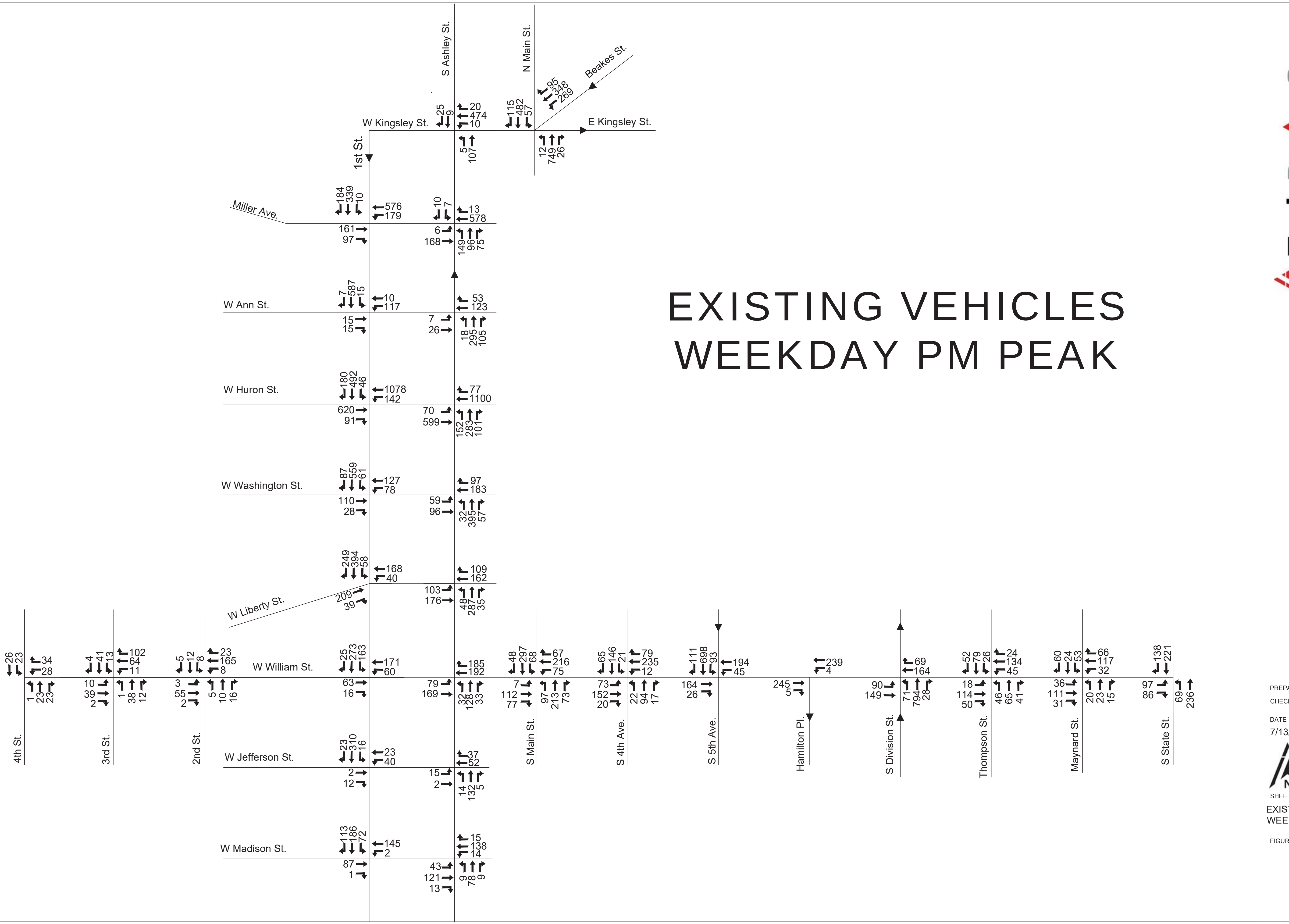
CHECKED: TD
DATE
7/13/2018

N

SHEET NAME
EXISTING VEHICLES WEEKDAY MIDDAY PEAK

FIGURE NUMBER
31

EXISTING VEHICLES
WEEKDAY PM PEAK



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N

SHEET NAME
EXISTING VEHICLES
WEEKDAY PM PEAK

FIGURE NUMBER
32

StreetLight Origin-Destination Data

Existing origin-destination (O-D) characteristics of vehicular trips on First and Ashley Streets were developed by collecting GPS data (via StreetLight Data, Inc.) and turning movement counts (TMCs). GPS data were collected over a one-year period from December 2016 through November 2017 and TMCs were measured in December 2017. O-D data were utilized to determine vehicle traffic patterns for vehicles traveling around First and Ashley Streets and to project how these patterns may be re-routed if First and Ashley Streets became two-way roadways. The raw data results are included in the Attachments. Entry/exit capture point locations are identified in Figure 33 below. The existing O-D data results, separated by peak hour, are summarized in Tables 13 through 15 below.

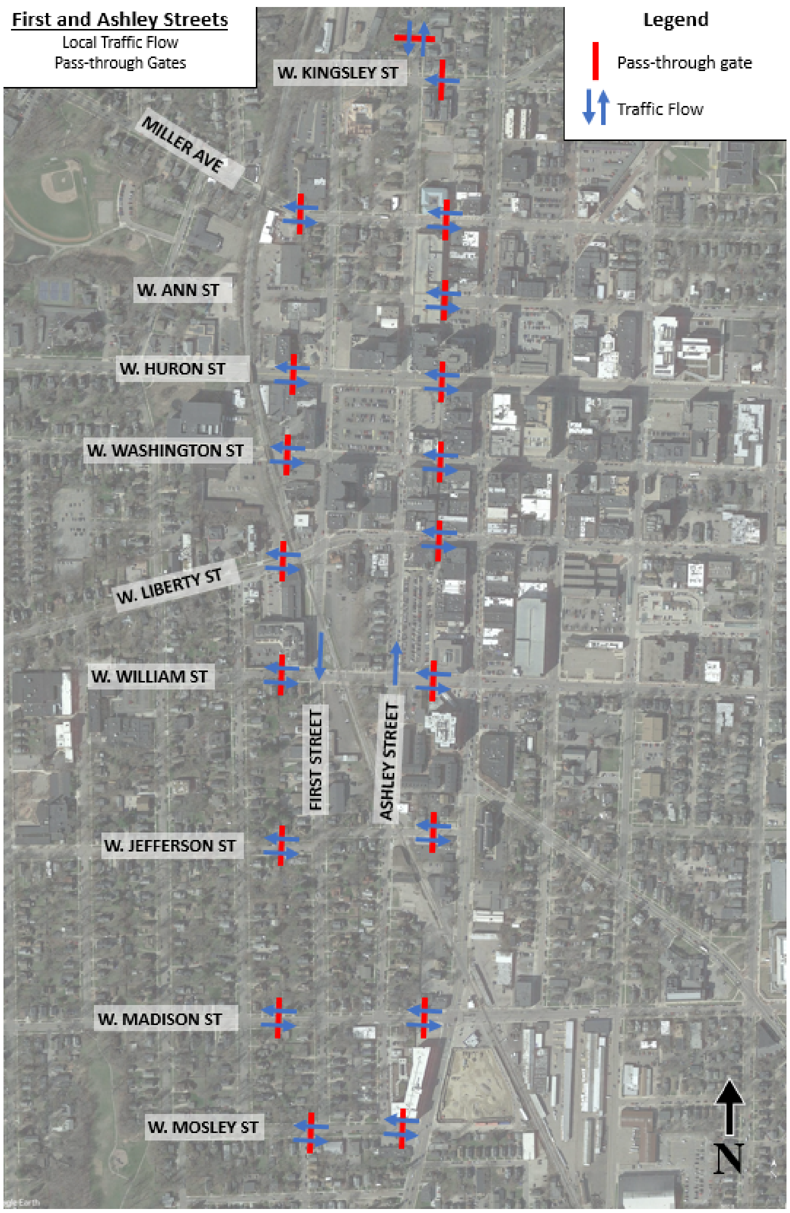


Figure 33 First Street and Ashley Street entry/exit gate collection locations

Table 13 Weekday AM Peak Period Origin Destination Data Summary

Leave Network Through Roadway capture point

Enter Network Through Roadway Capture Point	Mosley Street (West)	Mosley Street (East)	Madison Street (West)	Madison Street (East)	Jefferson Street (West)	Jefferson Street (East)	William Street (West)	William Street (East)	Liberty Street (West)	Liberty Street (East)	Washington Street (West)	Washington Street (East)	Huron Street (West)	Huron Street (East)	Ann Street (West)	Ann Street (East)	Miller Ave (West)	Miller Ave (East)	Kingsley Street	Ashley Street
Mosley Street (West)	-	75%	0%	9%	0%	0%	0%	8%	0%	0%	0%	0%	8%	0%	0%	0%	0%	0%	0%	0%
Mosley Street (East)	45%	-	2%	0%	0%	0%	0%	2%	0%	2%	4%	2%	7%	12%	0%	2%	10%	12%	0%	0%
Madison Street (West)	0%	2%	-	89%	0%	0%	1%	4%	0%	0%	0%	1%	1%	0%	0%	0%	1%	1%	0%	0%
Madison Street (East)	0%	9%	75%	-	0%	0%	0%	0%	0%	3%	0%	1%	0%	11%	0%	0%	0%	1%	0%	0%
Jefferson Street (West)	0%	0%	0%	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Jefferson Street (East)	0%	0%	14%	0%	14%	-	0%	13%	0%	13%	0%	0%	0%	32%	0%	0%	14%	0%	0%	0%
William Street (West)	0%	2%	0%	0%	0%	0%	-	94%	0%	0%	0%	0%	0%	4%	0%	0%	0%	0%	0%	0%
William Street (East)	0%	8%	3%	7%	0%	0%	43%	-	11%	11%	3%	0%	3%	0%	0%	0%	3%	8%	0%	0%
Liberty Street (West)	0%	0%	0%	0%	0%	0%	0%	2%	-	56%	1%	7%	1%	27%	0%	1%	1%	3%	0%	1%
Liberty Street (East)	0%	4%	2%	0%	0%	0%	0%	0%	72%	-	0%	5%	5%	4%	0%	0%	2%	4%	0%	2%
Washington Street (West)	0%	0%	1%	0%	0%	0%	0%	3%	1%	1%	-	76%	1%	16%	0%	0%	1%	1%	0%	0%
Washington Street (East)	0%	0%	0%	5%	0%	6%	0%	5%	0%	5%	43%	-	13%	13%	0%	0%	5%	5%	0%	0%
Huron Street (West)	0%	0%	0%	0%	0%	0%	0%	0%	1%	1%	0%	1%	-	96%	0%	0%	0%	1%	0%	0%
Huron Street (East)	0%	0%	0%	0%	0%	0%	0%	0%	4%	1%	4%	0%	80%	-	0%	1%	5%	5%	0%	0%
Ann Street (West)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%
Ann Street (East)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	26%	0%	0%	-	11%	63%	0%	0%
Miller Ave (West)	0%	1%	0%	0%	0%	0%	0%	3%	0%	6%	1%	1%	1%	16%	0%	4%	-	67%	0%	0%
Miller Ave (East)	0%	1%	0%	0%	0%	0%	0%	7%	1%	1%	1%	1%	5%	4%	0%	0%	78%	-	0%	1%
Kingsley Street	0%	4%	1%	0%	0%	0%	0%	1%	25%	3%	12%	0%	25%	13%	0%	0%	12%	1%	-	3%
Ashley Street	0%	0%	0%	34%	0%	0%	0%	33%	0%	0%	0%	0%	0%	0%	0%	0%	0%	33%	0%	-

Table 14 Weekday MD Peak Period Origin Destination Data Summary

Leave Network Through Roadway Capture Point

Enter Network Through Roadway Capture Point

	Mosley Street (West)	Mosley Street (East)	Madison Street (West)	Madison Street (East)	Jefferson Street (West)	Jefferson Street (East)	William Street (West)	William Street (East)	Liberty Street (West)	Liberty Street (East)	Washington Street (West)	Washington Street (East)	Huron Street (West)	Huron Street (East)	Ann Street (West)	Ann Street (East)	Miller Ave (West)	Miller Ave (East)	Kingsley Street	Ashley Street
Mosley Street (West)	-	81%	0%	0%	0%	0%	0%	0%	0%	19%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Mosley Street (East)	39%	-	14%	4%	0%	3%	0%	7%	0%	3%	0%	0%	0%	10%	0%	0%	15%	4%	0%	1%
Madison Street (West)	0%	0%	-	84%	0%	1%	0%	7%	0%	0%	0%	1%	0%	2%	0%	0%	4%	1%	0%	0%
Madison Street (East)	1%	9%	73%	-	0%	0%	05	2%	3%	5%	0%	0%	1%	3%	0%	0%	3%	0%	0%	0%
Jefferson Street (West)	0%	0%	0%	100%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Jefferson Street (East)	0%	0%	0%	0%	17%	-	0%	0%	0%	0%	0%	0%	17%	0%	0%	0%	49%	17%	0%	0%
William Street (West)	0%	2%	0%	0%	0%	0%	-	94%	0%	0%	0%	0%	2%	2%	0%	0%	0%	0%	0%	0%
William Street (East)	0%	0%	2%	1%	2%	0%	54%	-	2%	7%	3%	2%	5%	5%	0%	1%	12%	2%	0%	2%
Liberty Street (West)	0%	0%	0%	1%	0%	1%	0%	1%	-	63%	0%	3%	0%	24%	0%	1%	1%	4%	0%	1%
Liberty Street (East)	0%	3%	0%	0%	0%	0%	1%	1%	65%	-	1%	4%	11%	3%	0%	0%	7%	3%	0%	1%
Washington Street (West)	0%	3%	0%	6%	0%	0%	1%	4%	3%	1%	-	46%	1%	31%	0%	2%	1%	1%	0%	0%
Washington Street (East)	0%	0%	2%	0%	0%	0%	0%	6%	17%	0%	36%	-	21%	2%	0%	2%	8%	4%	0%	2%
Huron Street (West)	0%	0%	0%	1%	0%	0%	0%	1%	1%	0%	0%	1%	-	92%	0%	1%	1%	2%	0%	1%
Huron Street (East)	0%	0%	0%	0%	0%	0%	1%	1%	4%	1%	4%	2%	81%	-	0%	0%	4%	2%	0%	0%
Ann Street (West)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%
Ann Street (East)	0%	0%	0%	0%	0%	0%	0%	0%	25%	0%	0%	5%	40%	10%	0%	-	10%	10%	0%	0%
Miller Ave (West)	0%	2%	0%	2%	0%	0%	0%	2%	1%	1%	2%	0%	2%	17%	0%	1%	-	69%	0%	1%
Miller Ave (East)	0%	0%	0%	0%	0%	0%	0%	0%	7%	1%	1%	0%	9%	1%	0%	0%	81%	-	0%	0%
Kingsley Street	1%	3%	1%	1%	0%	0%	0%	1%	37%	2%	3%	1%	26%	4%	0%	0%	15%	2%	-	3%
Ashley Street	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	50%	0%	0%	0%	50%	0%	-

Table 15 Weekday PM Peak Period Origin Destination Data Summary

Leave Network Through Roadway Capture Point

Enter Network Through Roadway Capture Point

	Mosley Street (West)	Mosley Street (East)	Madison Street (West)	Madison Street (East)	Jefferson Street (West)	Jefferson Street (East)	William Street (West)	William Street (East)	Liberty Street (West)	Liberty Street (East)	Washington Street (West)	Washington Street (East)	Huron Street (West)	Huron Street (East)	Ann Street (West)	Ann Street (East)	Miller Ave (West)	Miller Ave (East)	Kingsley Street	Ashley Street
Mosley Street (West)	-	89%	3%	3%	0%	0%	0%	0%	0%	2%	0%	3%	0%	0%	0%	0%	0%	0%	0%	0%
Mosley Street (East)	20%	-	9%	4%	0%	1%	1%	3%	2%	6%	11%	0%	1%	21%	0%	0%	7%	10%	0%	4%
Madison Street (West)	1%	6%	-	80%	0%	0%	0%	3%	1%	3%	0%	0%	1%	2%	0%	0%	1%	2%	0%	0%
Madison Street (East)	1%	6%	83%	-	0%	1%	1%	1%	1%	0%	0%	0%	1%	3%	0%	0%	0%	1%	0%	1%
Jefferson Street (West)	0%	100%	0%	0%	-	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%
Jefferson Street (East)	0%	17%	2%	0%	41%	-	2%	0%	2%	0%	0%	2%	5%	10%	0%	0%	9%	0%	0%	10%
William Street (West)	0%	8%	0%	3%	1%	0%	-	79%	0%	5%	1%	1%	1%	0%	0%	0%	1%	0%	0%	0%
William Street (East)	0%	1%	25%	0%	1%	0%	43%	-	4%	3%	1%	1%	5%	3%	0%	0%	7%	4%	0%	2%
Liberty Street (West)	0%	1%	0%	1%	0%	0%	0%	2%	-	50%	0%	6%	1%	21%	0%	0%	4%	9%	0%	5%
Liberty Street (East)	0%	2%	0%	1%	0%	0%	0%	1%	74%	-	0%	2%	8%	4%	0%	1%	6%	0%	0%	1%
Washington Street (West)	0%	6%	0%	2%	0%	1%	0%	7%	5%	2%	-	57%	1%	12%	0%	1%	2%	3%	0%	1%
Washington Street (East)	0%	2%	1%	1%	0%	0%	1%	3%	24%	1%	44%	-	9%	8%	0%	0%	4%	2%	0%	0%
Huron Street (West)	0%	1%	0%	0%	0%	0%	0%	0%	0%	1%	0%	1%	-	93%	0%	1%	2%	1%	0%	0%
Huron Street (East)	0%	1%	0%	0%	0%	0%	0%	0%	8%	1%	1%	1%	82%	-	0%	0%	5%	1%	0%	0%
Ann Street (West)	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	-	0%	0%	0%	0%	0%
Ann Street (East)	0%	4%	0%	0%	0%	0%	0%	0%	9%	4%	4%	4%	42%	8%	0%	-	21%	4%	0%	0%
Miller Ave (West)	0%	1%	0%	1%	0%	0%	0%	2%	1%	1%	1%	0%	1%	13%	0%	1%	-	77%	0%	1%
Miller Ave (East)	0%	1%	0%	0%	0%	0%	0%	0%	6%	1%	1%	0%	5%	2%	0%	0%	83%	-	0%	1%
Kingsley Street	0%	1%	0%	1%	0%	0%	0%	1%	31%	1%	5%	0%	33%	4%	0%	0%	17%	1%	-	3%
Ashley Street	0%	10%	0%	0%	0%	0%	0%	23%	23%	0%	0%	0%	10%	24%	0%	0%	0%	10%	0%	-

In addition to the O-D gate study, a zone study was performed utilizing GPS data. The zone study allows for a broader look at where drivers start their trip and where they end their trip. These zones are shown in Figure 34 and 35, below.

Figure 34 O-D Zone Downtown Ann Arbor

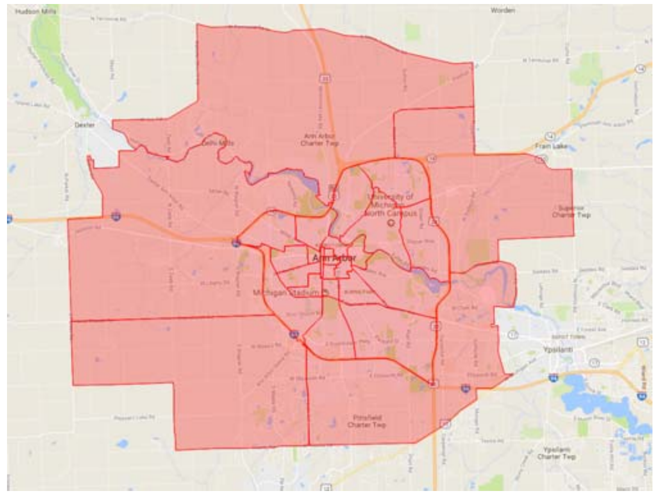


Figure 35 O-D Zones Ann Arbor

As shown in Figure 36, 45% of the trips captured within the First & Ashley Street Zone are primary trips, meaning the trip either started or ended within the study area. Conversely, 55% of all trips captured within the study area are pass-through trips, or trips that neither start nor end in the study area.

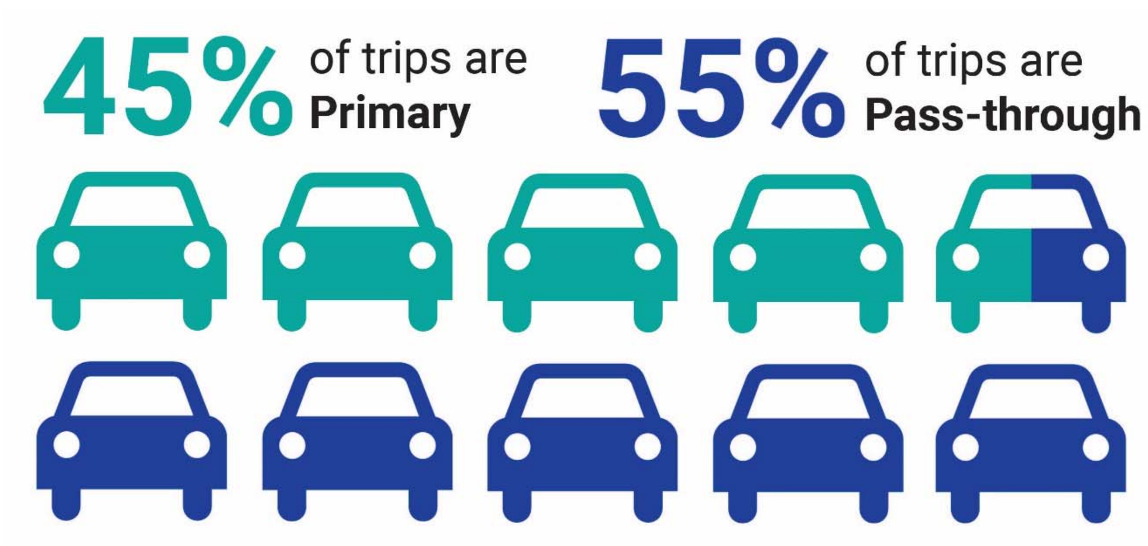


Figure 36 Primary and Pass-through trips in the study area

The O-D zone study also tracks the length of the vehicle trip. Of all vehicle trips captured in the Ann Arbor area, 31% were less than three miles long, as shown in Figure 37. Trips less than three miles long are considered viable options to be converted to walking trips or certain types of bicycling trips. According to the 2009 National Household Travel Survey, the average walking trip was 0.70 miles and the average bicycling trip was 2.26 miles[3]. Given the cohesive fabric and context of Ann Arbor's active downtown streets, longer trips may be attainable to convert an active trip, with the presence of enhanced walking and bicycling facilities. Additionally, 27% of vehicle trips captured in this study were between three and five miles long. Typically, people who commute to work by bicycle are willing to travel up to five miles to do so.

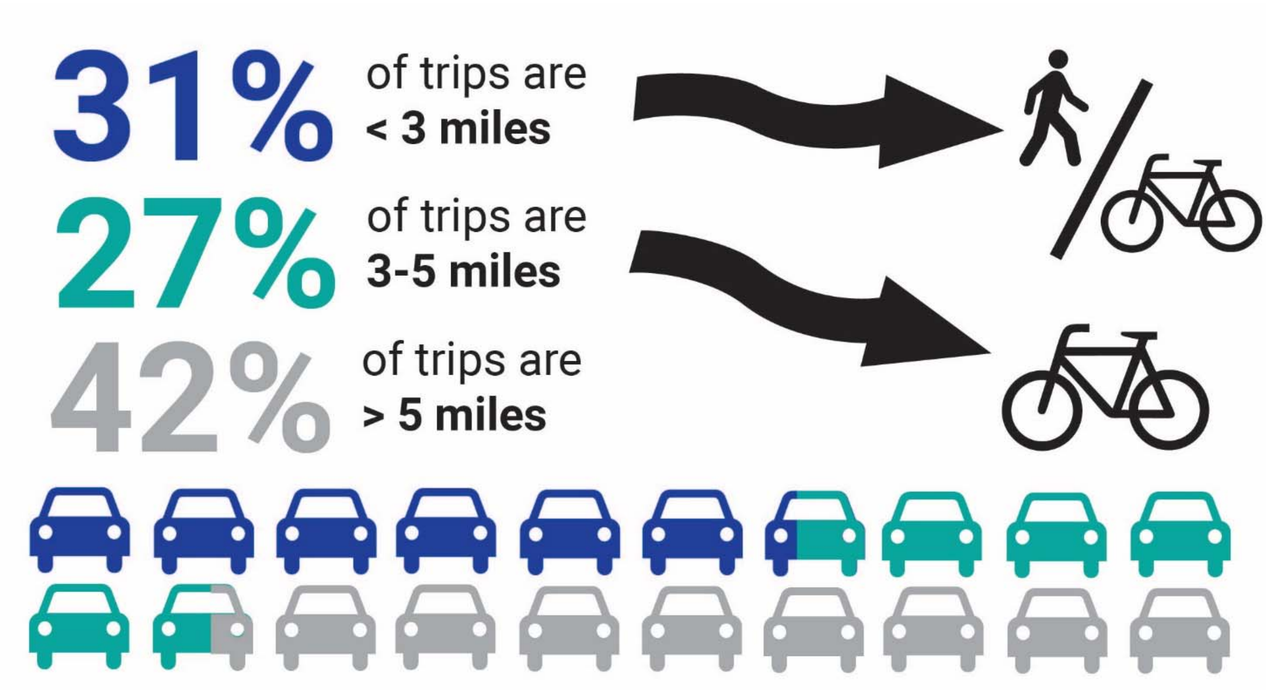


Figure 37 Length of vehicle trips captured within the study area zones

When accounting only for primary trips in the First & Ashley Streets zone, the percent of trips under three miles rose to 46%, shown in Figure 38. This means that 46% of the trips within the First Street and Ashley Street study area could potentially be converted to walking or bicycling trips.

[3] *Federal Highway Administration, 2009 National Household Travel Survey (NHTS)*

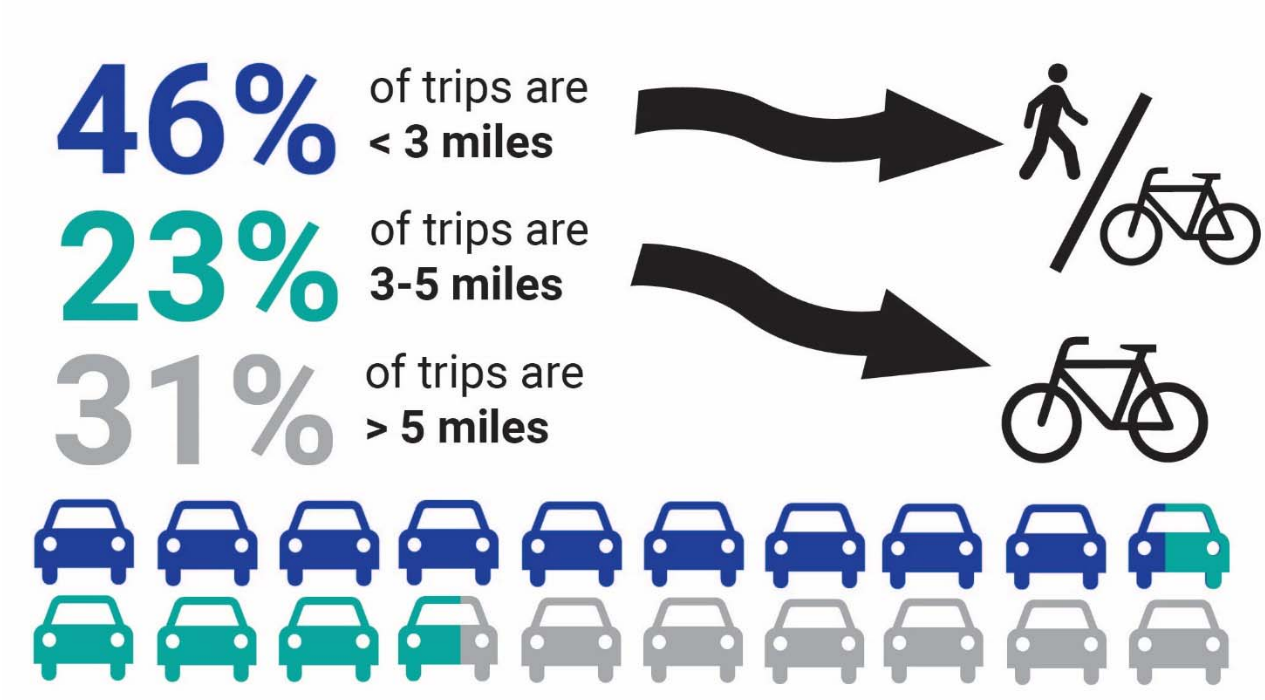


Figure 38 Length of vehicle trips within the First & Ashley Streets Zone

Existing Signal Operations

All signalized intersections within the study area operate on a two-phase cycle, running on maximum recall. Where applicable, the eastbound and westbound movements run simultaneously, then the northbound and southbound movements run simultaneously. All turning movements are permissive. Signals are typically coordinated along the east-west corridors. All signal heads are located on span wires. The City of Ann Arbor manages their signals through a central computer system.

Pedestrian phasing runs concurrently on automatic recall. Two intersections, William Street at Main Street and William Street at State Street, have Leading Pedestrian Intervals (LPIs) of four and three seconds, respectively.

Proposed Design

The proposed design for First Street and Ashley Street generally involves restoring both streets to two-way operations, as well as Kingsley Street between First Street and Main Street. As First Street aligns with the anticipated Treeline Trail for a block between William Street and Liberty Street, a two-way protected bicycle facility is proposed on First Street to facilitate connections. Typically, both First Street and Ashley Street will have two vehicle travel lanes, one lane in each direction. The proposed William Street design involves maintaining two vehicular travel lanes and adding a two-way protected bicycle facility. Two-way facilities are proposed on First Street and William Street as they are wide enough to be plowed with standard equipment and require only one buffer zone. A single buffer area requires less flexposts or planters to purchase and maintain and preserves more width for other roadway uses, such as on-street parking.

All signalized intersections on the corridors will include four-second LPIs, as well as prohibit vehicles from making turns on a red-light indication.

Roadways

In addition to restoring two-way vehicle traffic on First Street, parking is generally preserved on the western side of the street, with a protected two-way bicycle facility proposed on the eastern side, show in Figure 39. In addition to restoring two-way vehicle traffic on Ashley Street, parking and loading zones are generally preserved or expanded on both sides of the street, shown in Figure 40.

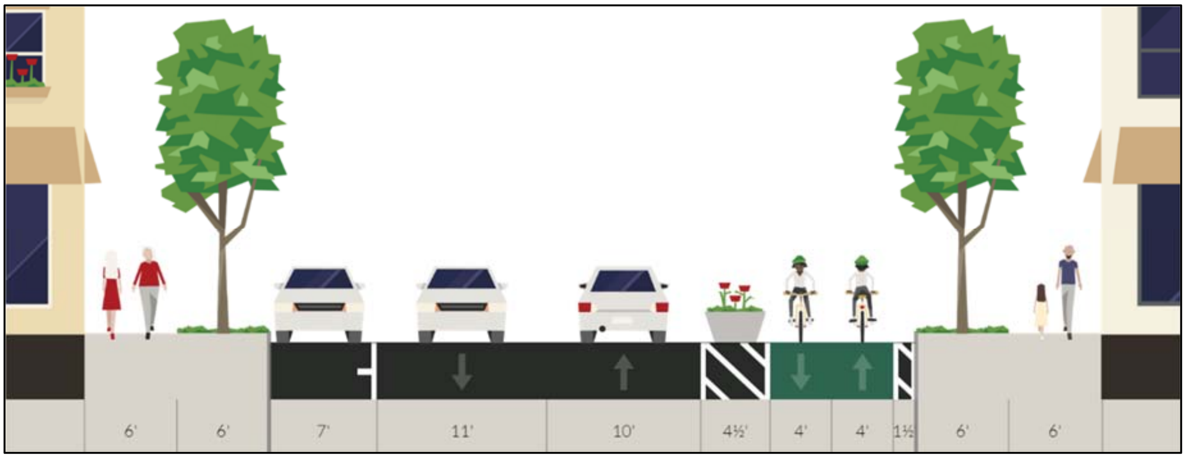


Figure 39 First Street Typical Cross Section, north of William Street – Proposed Design

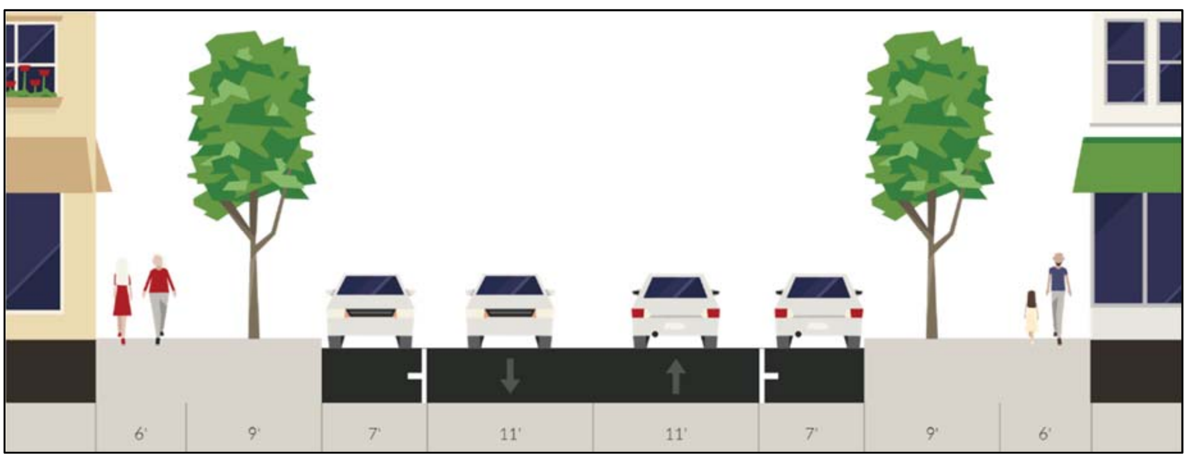


Figure 40 Ashley Street Typical Cross Section, north of William Street – Proposed Design

South of William Street on both First Street and Ashley Street, the corridors are more residential in nature. Due to the low vehicle volumes and slower vehicle speeds, a yield street with advisory bicycle lanes is proposed without a centerline marked, shown in Figure 41. With this treatment, vehicles will share the middle lane, yielding to bicyclists by pulling to the side to pass an oncoming vehicle in the opposite direction. An existing example from Minnesota is shown in Figure 42. Additional traffic calming measures may be implemented to ensure slow vehicle speeds as necessitated by the residential surroundings.

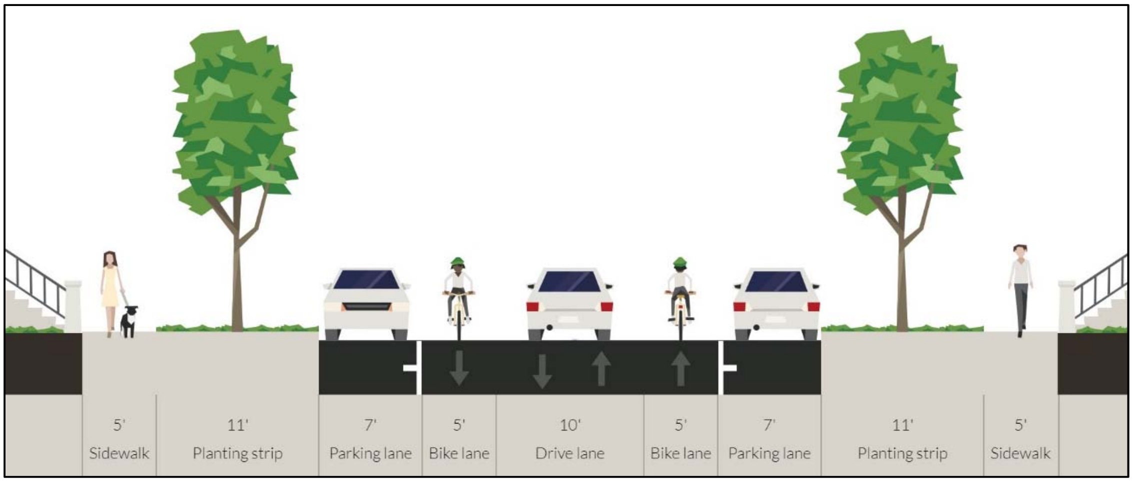


Figure 41 Ashley and First Street Typical Cross Section, south of William Street – Proposed

Figure 42 Advisory Bicycle Lanes in Minneapolis, Minnesota

The proposed design for William Street narrows the roadway to two vehicle travel lanes, one lane in each direction, to accommodate a protected two-way bicycle facility on the northern side of the road from First Street to State Street. Additional parking or transit amenities may be added in the unused space, shown in Figures 43 and 44. A rendering of a floating bus stop is shown in Figure 45.

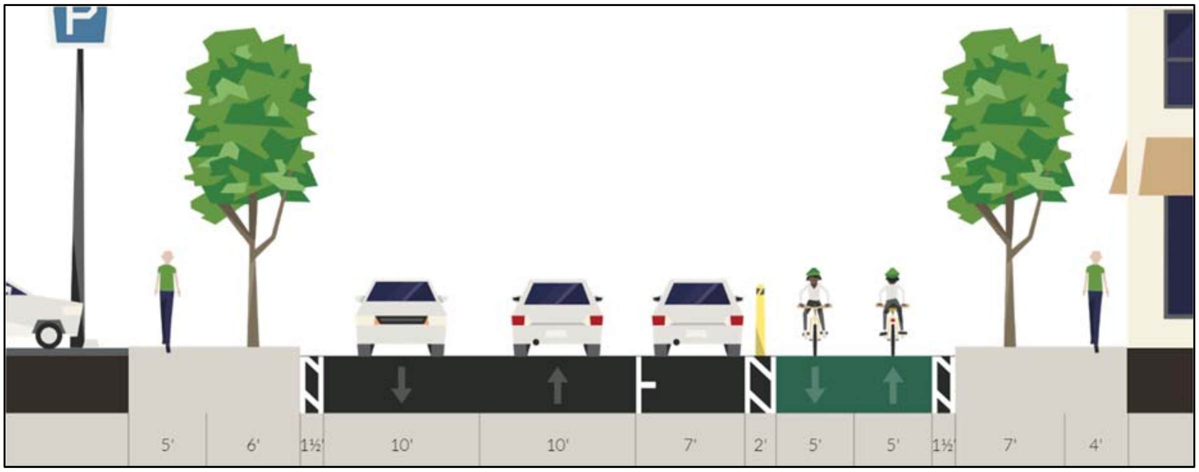


Figure 43 William Street Cross Section between Ashley Street and Main Street – Proposed with Parking

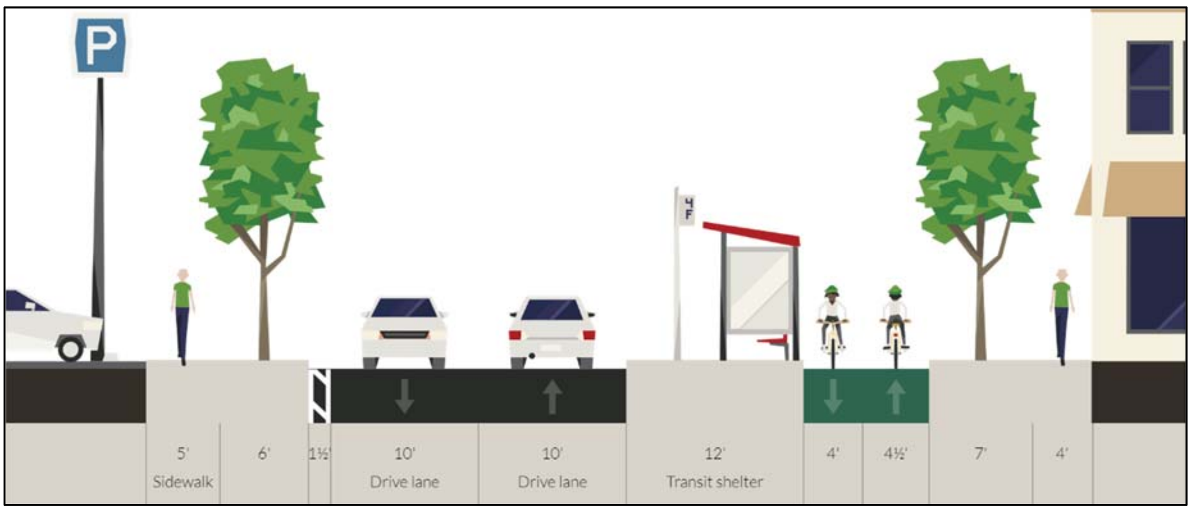


Figure 44 William Street Cross Section between Ashley Street and Main Street – Proposed with Floating Bus Stop

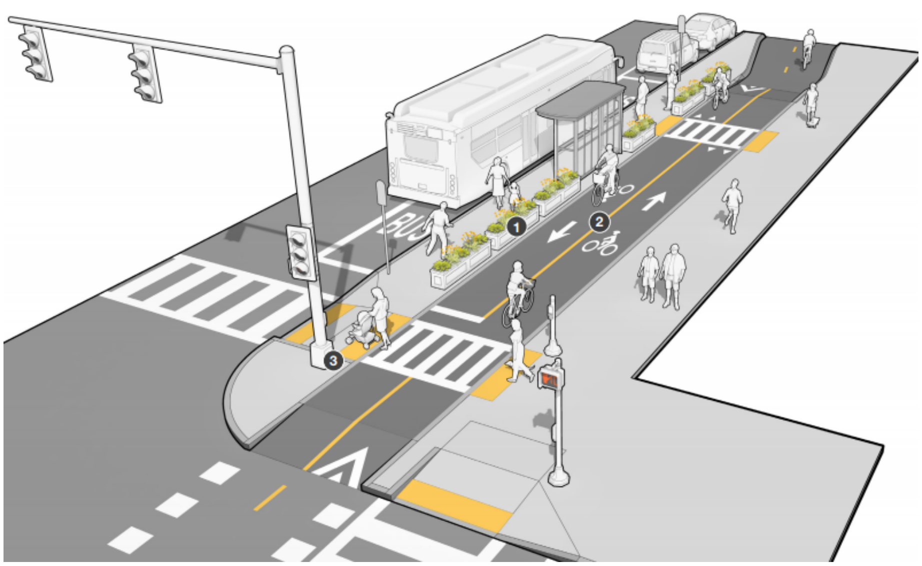


Figure 45 Floating bus stop with two-way bicycle facility (Source: MassDOT Separated Bike Lane Design Guide)

West of First Street, the William Street corridor is residential in nature with lower traffic volumes and slower vehicle speeds. For this section of William Street, advisory bicycle lanes with traffic calming measures are proposed.

Key Intersections

The majority of intersections within the study area are proposed to have one lane approaching the intersection on the study corridors, with the intersecting side streets maintaining the existing lane assignments. The exceptions are noted below.

Main Street and Kingsley Street/Beakes Street

At the intersection of Main Street and Kingsley Street/Beakes Street, the proposed design for Kingsley Street eastbound includes a dedicated left-turn lane. This is proposed due to anticipated turning volumes and to enhance sight distance. In addition to a dedicated left-turn lane, a lagging left-turn phase is also proposed for the Kingsley Street eastbound left and the Beakes Street southwest bound left.

Huron Street at First Street and at Ashley Street

Huron Street is a major vehicular corridor within Ann Arbor and is currently undergoing a redesign. As part of the proposed design at the intersections with First Street and Ashley Street, dedicated left-turn lanes are planned to accommodate vehicles turning northbound onto First Street or southbound onto Ashley Street with the proposed two-way conversion. In addition to dedicated left-turn lanes, a lagging left-turn phase is also proposed for the Huron Street approaches. The protected turning phase will increase safety for drivers and pedestrians as turning vehicles will not be required to find gaps in two lanes of oncoming traffic and pedestrians in the crosswalk when executing a left turn.

William Street at Main Street and 4th Avenue

William Street will generally consist of two vehicle travel lanes. Dedicated left-turn lanes are proposed for William Street westbound at Main Street and William Street eastbound at 4th Avenue to accommodate heavier left-turn movements, as well as maintain existing bus service.

William Street at First Street

William Street at First Street is an all-way stop-controlled intersection that is proposed to be the terminus of both two-way separated bicycle facilities along First Street and William Street. This is a critical transition point not only from one two-way facility to another, but also from the two-way facilities to the advisory bicycle lanes. Additional detail of the proposed treatment intersection layout is available in the concept designs, with an example rendering provided as Figure 46.

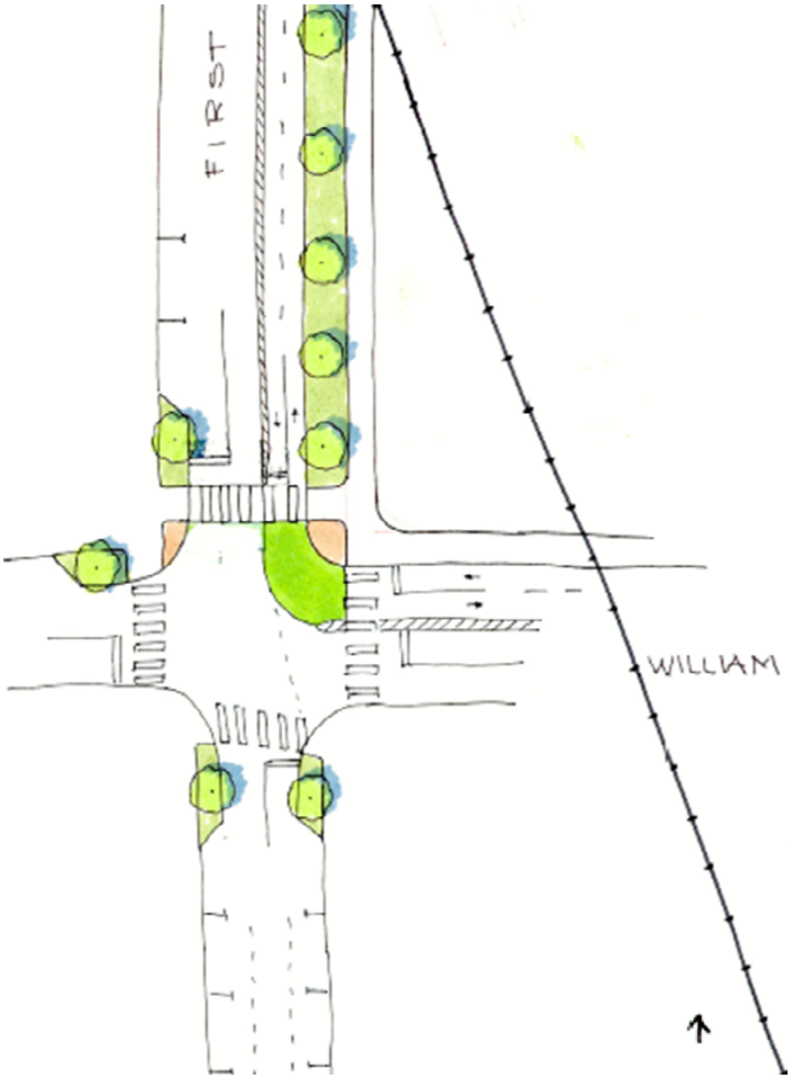


Figure 46 William Street at First Street Concept

All-way stop control

Under proposed conditions, multiple intersections are converted to all-way stop control. The majority are proposed to be converted from signalized intersections, however there are three that are currently under two-way stop control.

- Washington Street at First Street (currently signalized)
- Washington Street at Ashley Street (currently signalized)
- Liberty Street at First Street (currently signalized)
- Liberty Street at Ashley Street (currently signalized)
- William Street at Thompson Street (currently signalized
- Ashley Street at William Street (currently 2-way STOP)
- Ann Street at Ashley Street (currently 2-way STOP)
- First Street at Jefferson Street (currently 2-way STOP)

Future traffic volumes

To determine the feasibility of the proposed design, particularly for the two-way restoration of First Street and Ashley Street, estimated future vehicle traffic volumes were developed utilizing existing traffic volumes and the O-D gate study travel patterns. The methodology includes:

- StreetLight O-D data were obtained and entered onto a street network (in Attachments).
- The number of vehicles entering through each gate was held constant.
- Vehicles were then placed onto the street network using the data presented on the O-D PDF as a percent of total vehicles entering.
- It was assumed vehicles entering from the east and existing to the east would travel on Ashley Street. Likewise, vehicles entering from the west and exiting to the west would travel on First Street. If vehicles entering from the west and existed to the east (and vice versa), it was assumed that 50% of the trips would occur on Ashley Street, and 50% would occur on First Street.
- Once all the vehicles from all the gates had been entered onto the street network, the new network was then balanced to ensure the number of vehicle exiting through the gates were held constant as well.

Once the existing volumes were redistributed onto the proposed two-way network, a background growth rate of 0.3% per year over 20 years was applied. This number was obtained by consulting with the Washtenaw Area Transportation Study (WATS) model. The exception is through volumes on Huron Street. A parallel study for the Huron Street redesign is underway, where a growth rate of 1.5% per year is being applied. This growth rate was carried through to this project for consistency. Furthermore, the expected additional vehicle trips from the proposed expansion of the Ann Ashley Garage were estimated and added to the network. The estimated trip distribution for the garage is in the Attachments. A formal Transportation Impact Assessment is currently being performed. Once that study is complete, the future trips may be updated as necessary.

Figure 47 graphically depicts the estimated change in average weekday daily traffic volumes for First Street and Ashley Street. To better inform analysis, and to provide examples of comparable streets, future ADT were estimated using existing ADT, estimated turning movements, and peak hour factor. The estimated future ADT is as follows, with comparable local streets listed for reference:

- Ashley Street (north of Ann Street) – 5,595 vpd
  - First Street, north of Ann Street *(ADT of 5,954 in 2018)*
  - 4th Avenue, south of Huron Street *(ADT of 5,820 in 2005)*
- Ashley Street (south of William Street) – 2,291 vpd
  - Arborview Boulevard, east of Paul Street *(ADT of 1,310 in 2006)*
  - First Street, south of William Street *(ADT of 2,394 in 2018)*
- First Street (north of Ann Street) – 3,451 vpd
  - Summit Street, west of Wildt Street *(ADT of 4,380 in 2005)*

    - Ashley Street, north of Ann Street *(ADT of 3,314 in 2018)*
- First Street (south of William Street) – 1,820 vpd
    - Arborview Boulevard, east of Paul Street *(ADT of 1,310 in 2006)*
    - Ashley Street, south of William Street *(ADT of 1,780 in 2018)*

The anticipated 2037 turning movements for the proposed design for weekday morning, midday, and evening peak hours are shown in Figures 48 through 50.

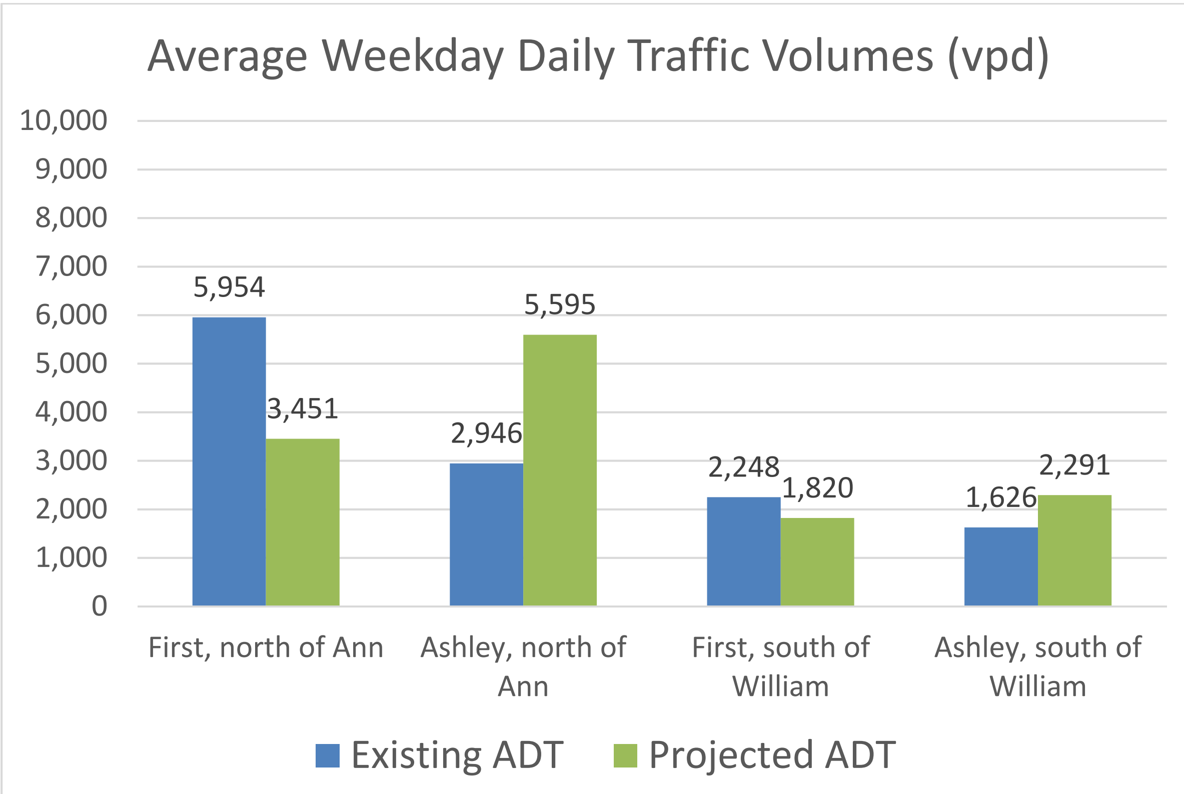
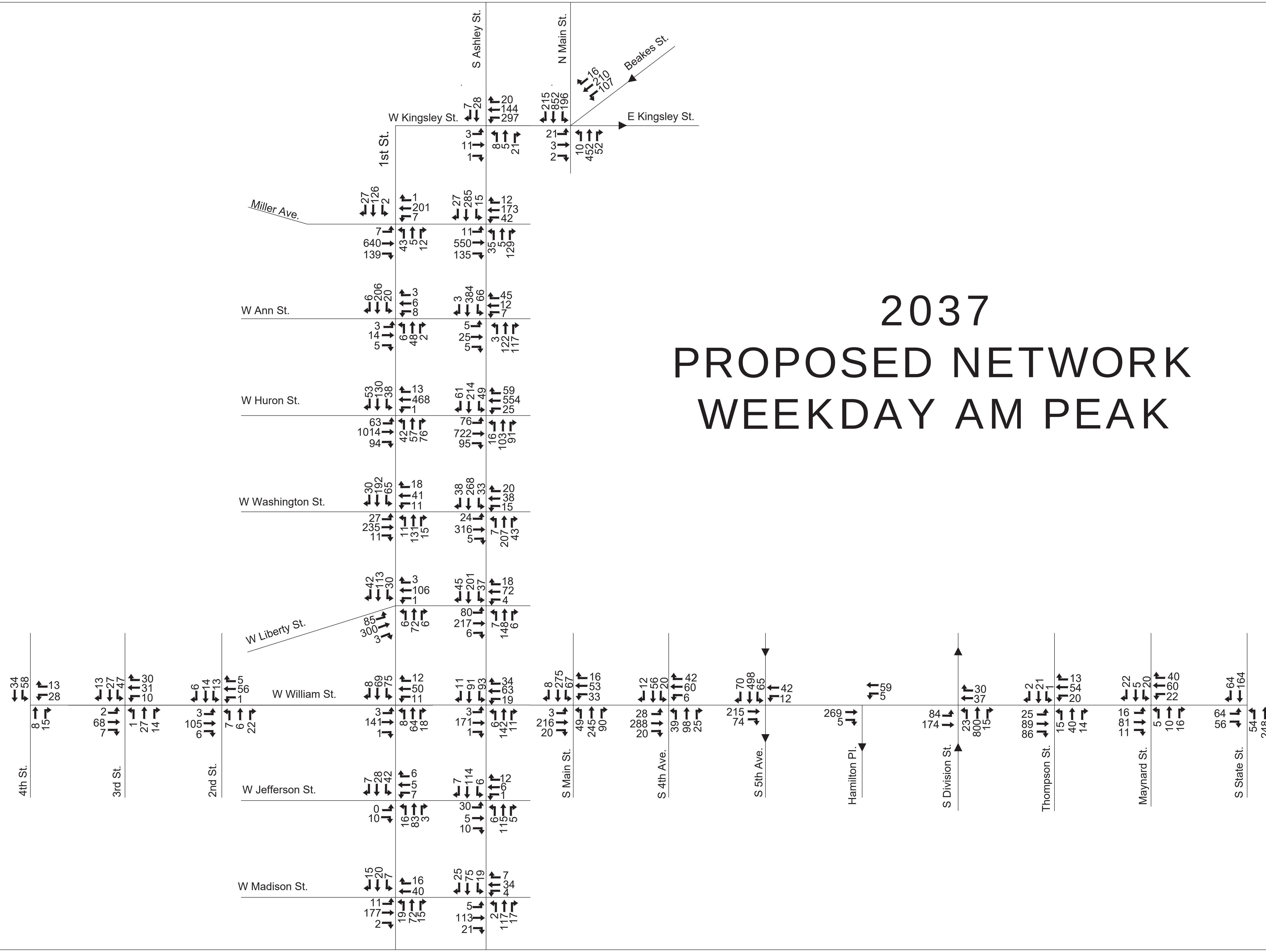


Figure 47 Average Weekday Daily Traffic Volumes

For reference, Huron Street closest to the study area had an ADT of around 20,000 vpd in 2016[4]. Main Street between Kingsley Street and Miller Street was measured to have an ADT of just under 17,000 vpd in 2016[3]. The measured volumes and estimated volumes on the study corridors are approximately one-third of the daily volume on these streets or less.

[4] https://maps.semcog.org/TrafficVolume/

2037
PROPOSED NETWORK
WEEKDAY AM PEAK



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ANN ARBOR
TRAFFIC COUNTS

PREPARED: HS
CHECKED: TD
DATE
7/13/2018

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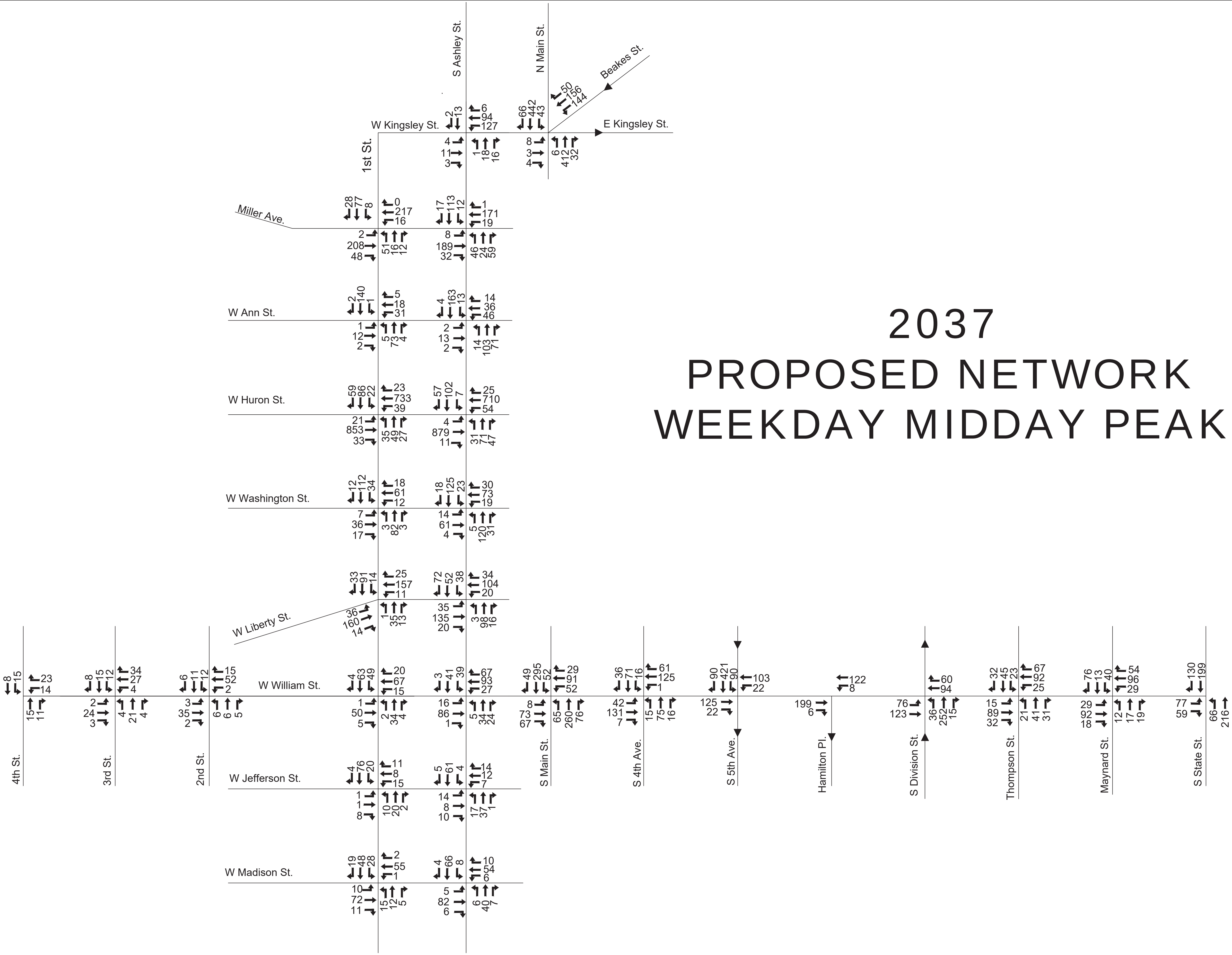
SHEET NAME
PROPOSED NETWORK
WEEKDAY AM PEAK

FIGURE NUMBER
48

2037 PROPOSED NETWORK WEEKDAY MIDDAY PEAK



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TRAFFIC COUNTS

PREPARED: HS
CHECKED: TD
DATE
7/13/2018

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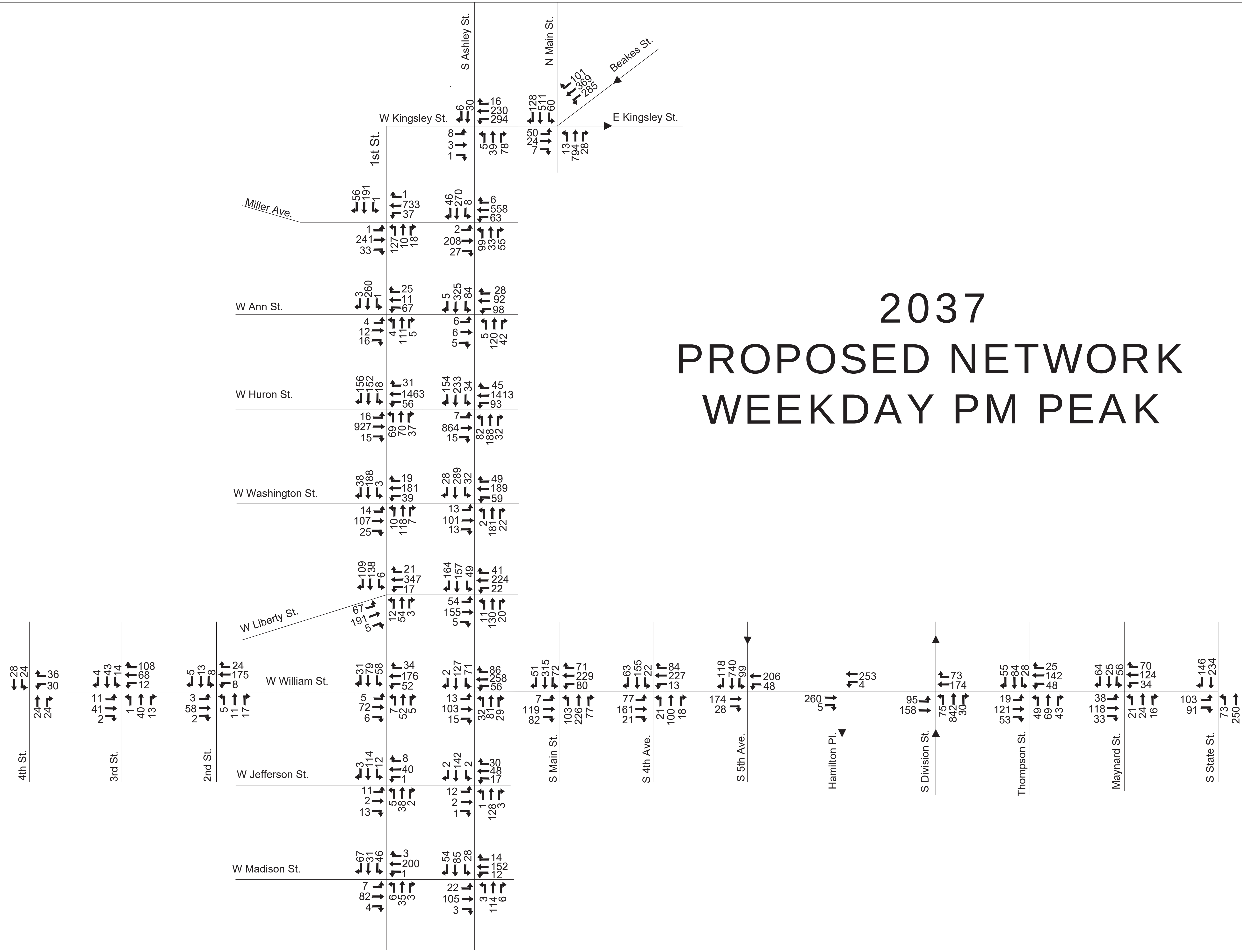
SHEET NAME
PROPOSED NETWORK WEEKDAY MIDDAY PEAK

FIGURE NUMBER
49

2037
PROPOSED NETWORK
WEEKDAY PM PEAK



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PREPARED: HS
CHECKED: TD

DATE
7/13/2018

SHEET NAME
PROPOSED NETWORK
WEEKDAY PM PEAK

FIGURE NUMBER
50

Equipment changes

All signalized intersections on First Street and Ashley Street will require additional signal head indications in the new direction of vehicle travel, for the intersections that maintain signalized control. Furthermore, there are two locations where the railroad tracks cross project area corridors: First Street between Liberty Road and William Street, and Ashley Street just north of Jefferson Street. Additional grade crossing flashers may be needed in the new direction of vehicle travel if not already present. No Turn on Red signs (R10-11b) will need to be added to all approaches of the signalized intersections. Additionally, signs associated with one-way streets (e.g., One Way and Do Not Enter signs) will need to be removed.

With the proposed two-way bicycle facilities on William Street and First Street, bicycle signals may be installed. However, under current MUTCD guidelines, vehicles cannot turn across a bicycle facility when bicycles are shown a green indication. This means that all vehicular traffic must stop when the bicycle signal is illuminated. This increases delay for all users, as bicyclists must also be held while vehicles are moving. An exemption to this rule may be applied for through a Request To Experiment (RTE), several of which are currently underway around the country. Applying for a RTE can be a lengthy process and requires studying the effects of permissive vehicle turns over bicycle facilities. Bicycles signals require an upfront cost, as well as periodic maintenance, similar to a pedestrian or vehicular signal. Given the current volume of bicyclists along the corridors, it is recommended that signs be installed to instruct bicyclists to use the pedestrian signal. Bicycle signals may be revisited at a later date, as needed.

Safety Analysis of Proposed Design

Table 16 outlines the recommendations throughout the study area and references crash modification factors (CMFs) or researched results where available. All CMFs were obtained from the Crash Modification Factors Clearinghouse[5].

Additionally, reducing the number of travel lanes is cited by the FHWA as a countermeasure for reducing mean vehicular speeds between 2 and 4 miles per hour[6]. FHWA also cites the benefits of converting one-way streets to two-way streets as a means of slowing down traffic due to "friction," especially on residential streets without a marked center line. Two-way streets also allow for better local access[7].

[5] http://www.cmfclearinghouse.org/

[6] https://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/eng_ctm_spd_14.pdf

[7] https://safety.fhwa.dot.gov/saferjourney1/library/countermeasures/13.htm

Table 16 Safety Issues and Proposed Recommendations

Safety Issue	*Recommendation*	*Location of Improvement*	*Crash Modification Factor (CMF) or Research Results*
Turning vehicle conflicts	Restrict parking to increase visibility between turning drivers, pedestrians, and bicyclists.	Throughout	0.44 CMF for fatal crashes when increasing sight distance[i]
	Daylight corners.	Throughout	33% crash reduction[ii]; 40% increase in yield rateS[iii]
	Prohibit turns on red lights.	Signalized intersections	1.69 CMF for vehicle/bicycle and vehicle/pedestrian when ALLOWING turns on red[iv] 1.6 CMF for right turn injury crashes when ALLOWING turns on red[v]
Bicyclist accommodations	Installation of colored bicycle lanes at intersections	Throughout	0.61 CMF for vehicle/bicycle crashes[vi]
	Provide separated bicycle lanes.	First Street and William Street	0.65 CMF for vehicle/bicycle crashes[vii], 0.41 CMF for vehicle/bicycle injury crashes[viii]
Signal operations	Add Leading Pedestrian Intervals to signalized intersections.	Throughout	0.41 CMF for vehicle/pedestrian[ix]
	Permitted/protected left-turn operations	Huron Street at First Street and Ashley Street	0.84 CMF for left turn crashes when converting from permissive to permissive protected[x]
Traffic Control	Convert two-way stop to all-way stop controlled intersections	Multiple intersections	68% reduction in total crashes, a 77% reduction in injury crashes, and a 75% reduction in angle, head on, and turning movement crash types[xi]
Lane Geometry	Designate left turn lane.	William Street WB at Main Street, William Street EB at 4th Ave	0.67 CMF for all crash types[xii]
	Reduce number of travel lanes.	William Street	0.71 CMF for all crash types when converting from 4-lanes to 2-lanes[xiii]

Reducing the number of travel lanes in the same direction also eliminates the multiple-threat phenomenon, particularly at uncontrolled crossings. This occurs on multi-lane roads when one vehicle stops for a pedestrian in the crosswalk, but the second vehicle approaches the crosswalk and the driver's view of the pedestrian is obstructed by the first vehicle, resulting in a crash, seen in Figure 51. By reducing the number of travel lanes on William Street, and restoring First Street and Ashley Street to one-lane in each direction, this multiple-threat is eliminated.

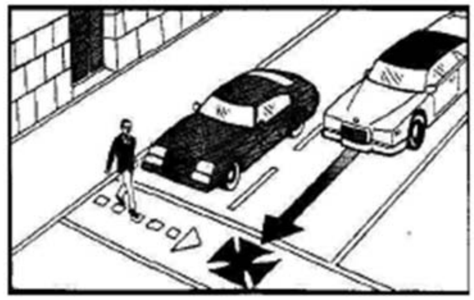

Figure 51 Multiple-threat pedestrian crash illustration (FHWA)

Additional Improvements

Additional improvements for future consideration within the study area will require further public outreach, design, and operational analyses. While these improvements are valuable, and recommended for further consideration, they are considered outside the scope of work for this study. Additional improvements may include shortening the cycle length for signalized intersections. The models show most signalized intersections in the study area desire a shorter cycle length, or have a shorter natural cycle length. Shorter cycle lengths can decrease delay for all roadways users and result in a more consistent vehicular speed along the corridor. Shorter cycle lengths may also encourage city streets to function as a complete network, rather than a series of major corridors.[8] However, the current cycle length of 80-90 seconds throughout the study area is within the frame of acceptable time for urban signals. The removal of the flashing operations at night is also recommended outside the scope of this project.

Once the design is finalized, the pedestrian clearance times can also be updated to more accurately reflect the new crosswalk length.

User Conditions and Operations

The following sections analyze the changes to conditions and operations of the proposed design for pedestrians, bicyclists, and motorists.

Pedestrian Operations

To better accommodate pedestrians at the intersections within the study area, LPIs were added to all signalized intersections except for the Kingsley Street, Main Street, and Beakes Street intersection, due to context. LPIs allow pedestrians to begin walking before concurrent vehicle movements receive a green indication. The goal of LPIs is to improve safety by giving pedestrians a chance to begin crossing and establish themselves in the street before vehicles start turning across the crosswalk. As a result, turning vehicles experience less conflicts with pedestrians during concurrent crossings. Additionally, prohibiting right turns on red for vehicles will improve

[8] https://nacto.org/publication/urban-street-design-guide/intersection-design-elements/traffic-signals/signal-cycle-lengths/

safety for pedestrians. Qualitatively, pedestrians will enjoy a better walking experience with anticipated slower vehicular speeds, as well as being 'protected' from vehicular travel lanes either by the new separated bicycle lanes or parked vehicles. Furthermore, while not discussed in detail in this feasibility memorandum, streetscape improvements will also occur as part of this project. If all-way stops replace the signalized locations, pedestrians will no longer experience delay at the intersections.

Bicyclist Operations

Bicycle Level of Traffic Stress (LTS) is a planning tool used to quantify the level of stress a bicyclist is likely to experience while riding in different types of environments, including streets and paths. The analysis correlates stress with the physical and operational characteristics of roadways and crossings. It is based on the premise that a person's level of stress on a bicycle decreases as separation from motor vehicles increases and as traffic volume and speed decrease. In turn, the lower the level of stress on a route, the more likely people are to bicycle there. LTS analysis scores road segments based on vehicular speed, volume, curbside use, and bicycle facility width/separation. The result is a numerical traffic stress ranking for every block, from the lowest stress (LTS 1) to the highest stress (LTS 4). LTS 1 segments are suitable for almost all people to bike on, including children, whereas the LTS 4 segments require riding near and negotiating with moderate to high-speed traffic. The lower the LTS, the more likely that roadway is to attract bicyclists who normally would not ride due to real or perceived safety concerns and comfort level. The analysis is based on leading research for low-stress bicycling and network connectivity.[9] By creating low-stress facilities, the number of potential bicycle riders increases dramatically from 16% of the population to 72%, as shown in Figure 52. The 'Interested but Concerned' population, which is estimated to account for more than half of the general population, typically only ride on low stress (LTS 1) or moderately low stress (LTS 2) facilities. If a segment of a roadway is rated LTS 3 or above, they may avoid the entire roadway or opt for a different mode of travel.

[9] Furth, P.G., M.C. Mekuria and H. Nixon. "Network Connectivity for Low-Stress Bicycling." *Transportation Research Record 2587* (2016): pp. 41–49.

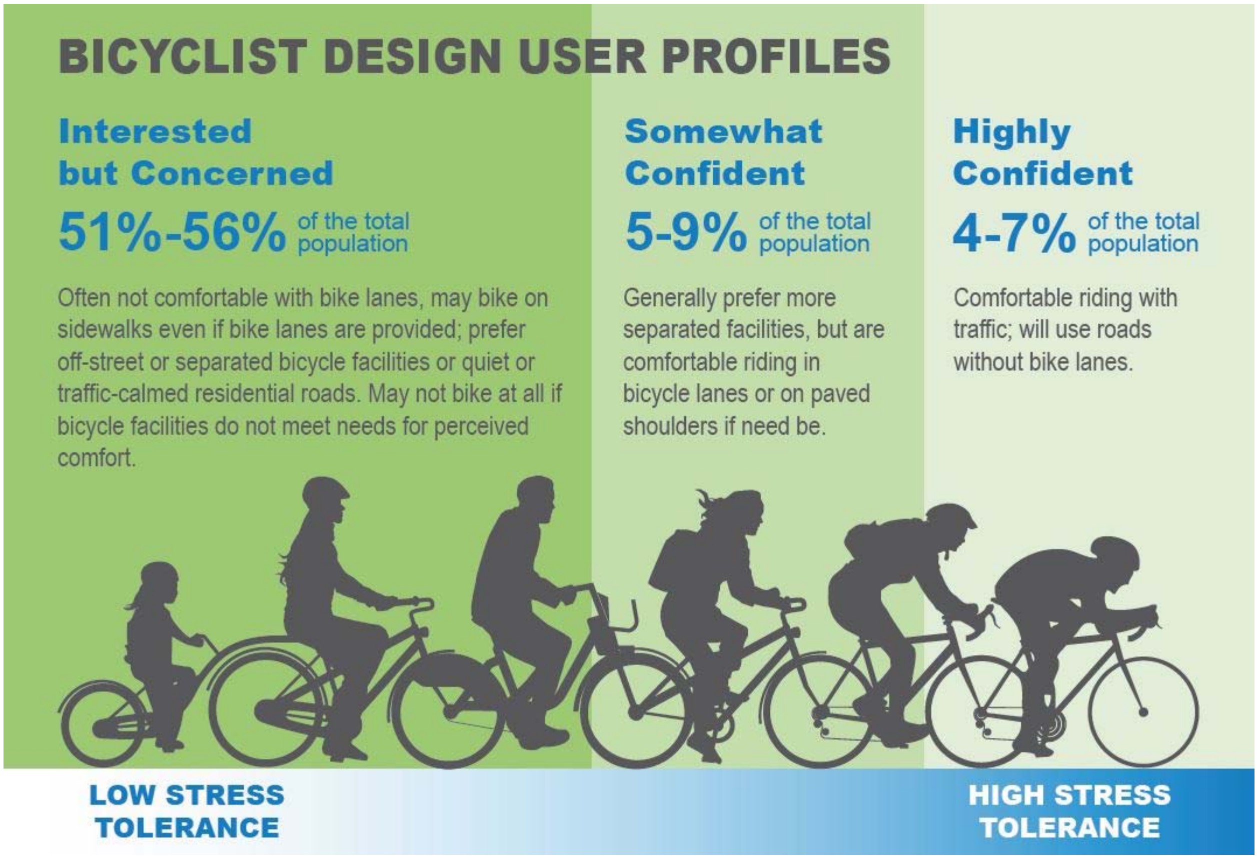

Figure 52 Bicyclist design user profiles (Source: MassDOT guide)

A LTS analysis was conducted for all streets within the project study area including:

- First and Ashley Streets between Kingsley Street and Madison Street; and
- William Street in its entirety (4^{th} Street to State Street).

The LTS analysis evaluated existing conditions and proposed conditions for the project. The analysis made use of existing data collected for the project including ADT, operational speeds, and the presence and quality of dedicated bike infrastructure. The following tables specify how the LTS was calculated for each road segment based on their unique features.

Table 17: LTS Analysis Criteria for Mixed Traffic Conditions (No Bike Infrastructure)

Number of lanes	Effective ADT*	Prevailing Speed						
		< 20 mph	25 mph	30 mph	35 mph	40 mph	45 mph	50+mph
Unmarked 2-way street (no centerline)	0-750	LTS 1	LTS 1	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	751-1500	LTS 1	LTS 1	LTS 2	LTS 3	LTS 3	LTS 4	LTS 4
	1501-3000	LTS 2	LTS 2	LTS 2	LTS 3	LTS 4	LTS 4	LTS 4
	3000+	LTS 2	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
1 thru lane per direction (1-way, 1-lane street, or 2-way street with centerline)	0-750	LTS 1	LTS 1	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	751-1500	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 4	LTS 4
	1501+	LTS 2	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4	LTS 4
2 thru lanes per direction	0-8000	LTS 3	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4
	8001+	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4	LTS 4	LTS 4
3+ thru lanes per direction	any ADT	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4	LTS 4	LTS 4

* Effective ADT = ADT for two-way roads; Effective ADT = 1.67*ADT for one-way roads

Table 18: LTS Analysis Criteria for Bike Lanes and Shoulders Not Adjacent to Parking Lane

Number of lanes	Bike lane width	Prevailing Speed					
		< 25 mph	30 mph	35 mph	40 mph	45 mph	50+ mph
1 thru lane per direction, or unlaned	6+ ft	LTS 1	LTS 1	LTS 2	LTS 3	LTS 3	LTS 3
	4 or 5 ft	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 4
2 thru lanes per direction	6+ ft	LTS 2	LTS 2	LTS 2	LTS 3	LTS 3	LTS 3
	4 or 5 ft	LTS 2	LTS 2	LTS 2	LTS 3	LTS 4	LTS 4
3+ lanes per direction	any width	LTS 3	LTS 3	LTS 3	LTS 4	LTS 4	LTS 4

1. If bike lane / shoulder is frequently blocked, use mixed traffic criteria.
2. Qualifying bike lane / shoulder should extend at least 4 ft from a curb and at least 3.5 ft from a pavement edge or discontinuous gutter pan seam
3. Bike lane width includes any marked buffer next to the bike lane.

Table 19: LTS Analysis Criteria for Bike Lanes Adjacent to Parking Lane

Number of lanes	Bike + Pkg lane width	Prevailing Speed		
		< 25 mph	30 mph	35 mph
1 lane per direction	15+ ft	LTS 1	LTS 2	LTS 3
	12-14 ft	LTS 2	LTS 2	LTS 3
2 lanes per direction (2-way)	15+ ft	LTS 2	LTS 3	LTS 3
2-3 lanes per direction (1-way)		LTS 2	LTS 3	LTS 3
other multilane		LTS 3	LTS 3	LTS 3

1. If bike lane is frequently blocked, use mixed traffic criteria.
2. Qualifying bike lane must have reach (bike lane width + parking lane width) > 12 ft.
3. Bike lane width includes any marked buffer next to the bike lane.

Existing Level of Traffic Stress

Due to the relatively low traffic volumes and speeds within the study area, the bicycle level of traffic stress currently ranges between LTS 2 (moderately low stress) and LTS 3 (moderately high stress). A description for the factors contributing to the existing LTS assignment for each segment of the project area is provided below and illustrated in Figure 53.

Ashley Street

Ashley Street is a one-way, northbound street that generally carries two lanes of motor vehicle traffic. Standard bike lanes of approximately five feet are provided along Ashley Street between William Street and Miller Avenue with the remainder of the corridor operating under mixed traffic conditions. With the exception of one block (Ann Street to Miller Avenue), the existing bike lanes on Ashley Street are primarily adjacent to an approximately eight-foot wide on-street parallel parking lane. South of William Street, no bike facilities are provided and people biking and driving share the space within the street. The northernmost block of the corridor (Miller Avenue to W Kingsley Street) operates in both directions with no bike facilities provided.

As previously stated, there is a significant difference in ADT along two distinct segments of Ashley Street. North of William Street, an ADT of just under 3,000 vpd was observed. South of William Street, the ADT was significantly lower (1,626 vpd). Speed data collected showed a consistent 85th percentile speed of 28 mph along the full stretch of the corridor.

Based on these conditions, the LTS for the corridor is primarily LTS 3 with a single block (W Ann Street to Miller Avenue) categorized as LTS 2.

First Street

First Street is a one-way, southbound street that generally carries two lanes of motor vehicle traffic. Standard bike lanes, approximately five feet wide, are provided between Miller Avenue and W Liberty Road with the remainder of the corridor operating under mixed traffic conditions. The existing bike lanes on First Street are not adjacent to parking. South of William Street and north of Miller Avenue, no bike facilities are provided and people biking and driving share the space within the street. Speed data collected showed fairly consistent 85th percentile speeds of 29-30 mph along the full stretch of First Street.

Based on these condition, the LTS for the corridor is primarily LTS 3, with the portion of the corridor with bike lanes receiving a score of LTS 2.

William Street

William Street is a two-way east/west connector that generally carries between one and two travel lanes per direction throughout the study area. There are no existing bike facilities provided along any portion of William Street. Traffic volumes on William Street vary significantly on the eastern and western portions of the corridor; west of First Street, the corridor experiences traffic volumes of approximately 2,150 vpd, while east of First Street, traffic volumes are significantly higher at approximately 5,100 vpd. 85th percentile speeds along William Street are relatively low.

West of First Street, 85th percentile speeds of 20 mph were observed, and east of First Street with speeds of 23 mph were observed.

Based on these condition, the LTS for William Street varies between LTS 2 and LTS 3. The variability in the LTS scores is primarily the result of changes in the lane configurations on the street, with segments of the street with three or four travel lanes receiving higher-stress scores.

Functionally, all roadways can be classified as LTS 3, as the LTS 2 segments are not long enough to attract the 'interested but concerned' category of bicycle riders. These riders will simply avoid these streets, ride on the sidewalks, or simply use other means of transportation.

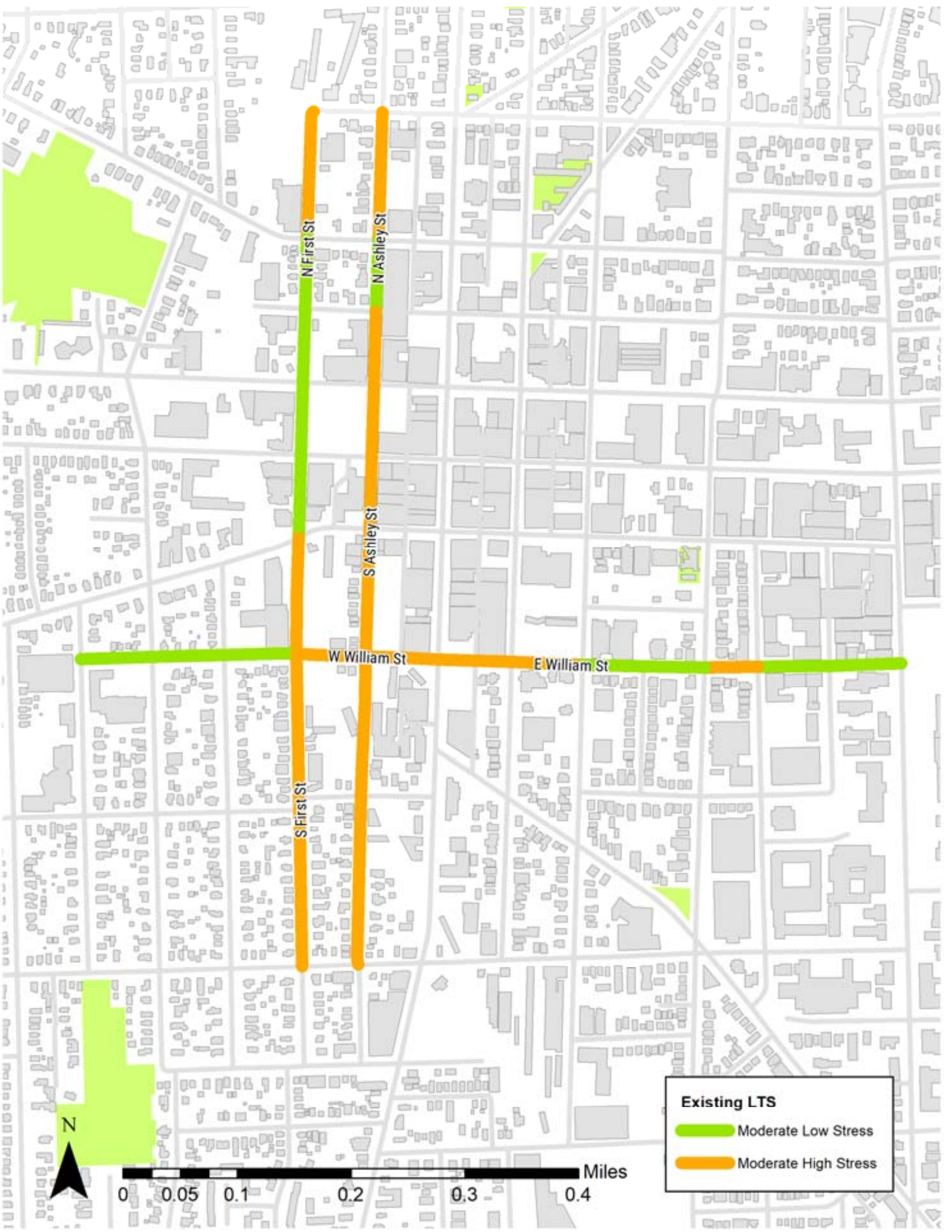

Figure 53: Existing Bicycle Level of Traffic Stress

Proposed Level of Traffic Stress

An analysis was completed to estimate the future LTS based on the proposed conditions for each segment of the project area. Because designs for the project are currently conceptual, discretion was used to determine the expected LTS in scenarios where design details have a significant impact on the overall level of comfort a person biking experiences. These assumptions included:

- Successful traffic calming on First Street and Ashley Street to reduce traffic speeds from the observed average of 28 mph to an average under 25 mph.
- Based on preliminary traffic analysis and on-site observations, the conversion of Ashley and First streets from one-way to two-way operations is not expected to have significant impacts on the traffic volumes on the streets. For segments where ADT factors into the calculation of LTS (mixed traffic conditions), the existing, observed ADT and future projected ADT resulted in the same LTS results.
- Design detail assumptions included the following:
    - No centerline will be painted on First and Ashley streets once they have been converted to two-way operations
    - No centerline will be painted on William Street west of First Street
    - The combined width of the proposed separated bike lanes and buffers will meet or exceed 6 feet (12 feet for two-way separated facilities).

A description for the factors contributing to the estimated LTS assignment for each segment of the project area is provided below and illustrated in Figure 54.

Ashley Street

The proposed conditions on Ashley Street will provide one motor vehicle travel lane in each direction. North of William Street, people biking will share the travel lane with people driving. The mixed traffic conditions coupled with estimated daily traffic volumes of under 6,000 vpd and average speeds of around 25 mph designates this segment as LTS 3.

South of William Street, the proposed conditions will provide one motor vehicle travel lane in each direction. Along this segment, significant traffic calming features are proposed to mitigate traffic speeds and provide a calmer experience for people biking. Advisory bicycle lanes are also provided. Given the proposed traffic calming elements and estimated traffic volumes under 3,000 vpd, this segment receives LTS 2.

First Street

The proposed conditions on First Street will provide one motor vehicle lane in each direction. North of William Street, the proposed design includes a two-way separated bicycle facility. The buffered bicycle facilities coupled with low speeds designates this segment at LTS 1.

South of William Street, the proposed conditions will provide one motor vehicle travel lane in each direction. Along this segment, significant traffic calming features are proposed to mitigate traffic speeds and provide a calmer experience for people biking. Advisory bicycle lanes are also provided. This segment receives a LTS 2 given the proposed traffic calming elements and estimated traffic volumes under 2,000 vpd.

William Street

The proposed conditions on William Street will provide one motor vehicle lane in each direction, with the exception of a left turn lane between Main Street and Fourth Avenue. East of First Street, the proposed design includes a two-way separated bicycle facility. This segment receives a LTS 1 given the buffered bicycle facilities coupled with low speeds.

West of First Street, the proposed conditions will maintain one motor vehicle travel lane in each direction. Along this segment, significant traffic calming features are proposed to mitigate traffic speeds and provide a calmer experience for people biking. Advisory bicycle lanes are also provided. This segment receives a LTS 2 given the proposed traffic calming elements and estimated traffic volumes just over 2,000 vpd.

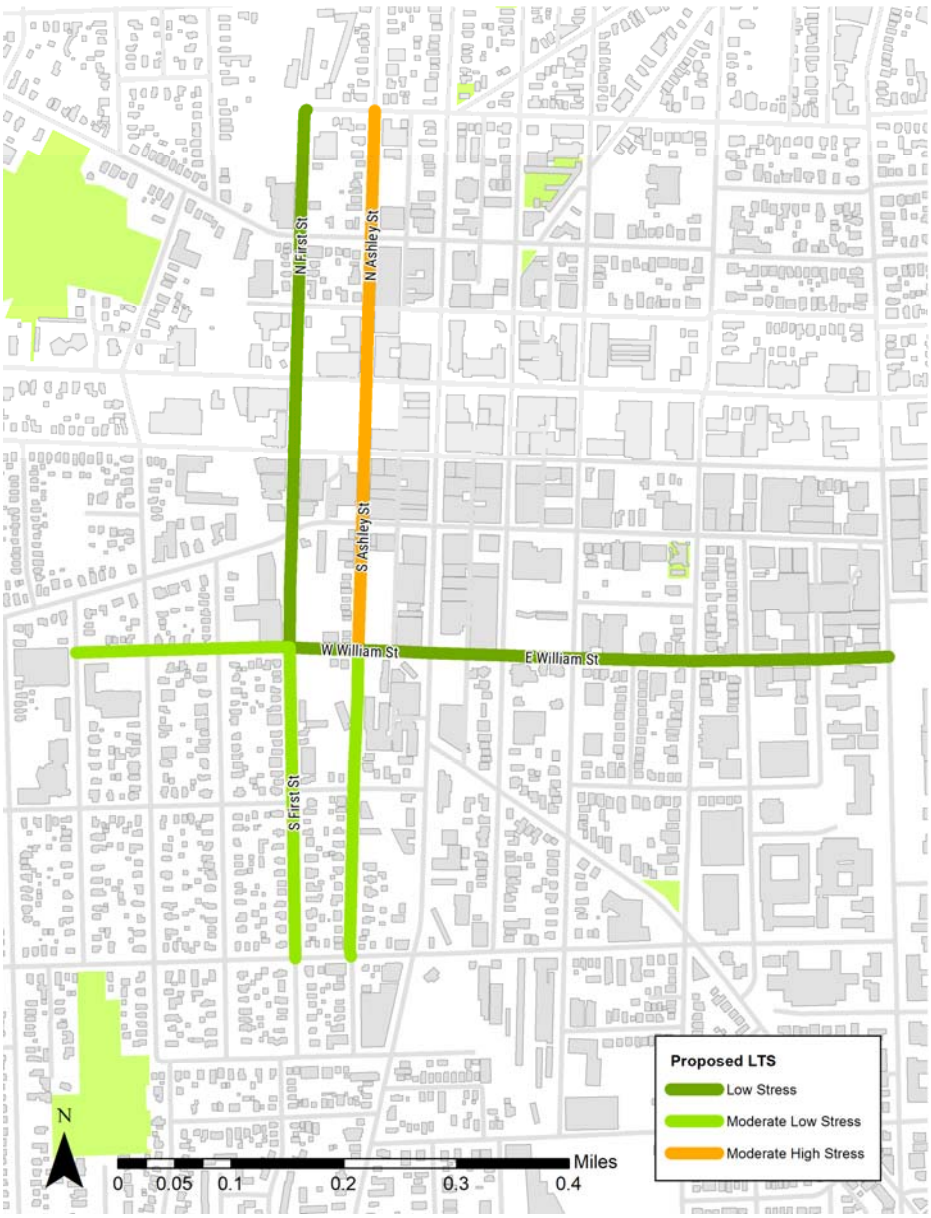

Figure 54 Proposed Bicycle Level of Traffic Stress

Vehicular Operations

Intersection capacity analyses were conducted for the study area intersections based on the traffic volumes, intersection geometry, and traffic control, during the weekday morning, midday, and evening peak hours. Four scenarios were analyzed: 2017 existing conditions, 2037 no-build conditions, 2037 conditions with the proposed design changes, and 2017 conditions with the proposed design changes. The 2037 no-build condition incorporates the aforementioned vehicular growth rate and the anticipated additional Ann Ashley Garage trips onto the existing network and signal timings. The 2037 build condition incorporates the anticipated two-way vehicular volume distribution and the additional Ann Ashley Garage trips onto the proposed roadway network, with added LPIs and signal retiming to better accommodate the added direction of travel on First Street and Ashley Street, as well as the reduction in travel lanes on William Street. Due to the added LPIs, the number of pedestrian and bicyclist conflicts in the 2037 build condition model were reduced by 25%, as pedestrians will cross during this time without conflict. For all models (apart from 2017 existing conditions), Huron Street during the midday time period was modeled with only one lane in each direction to be consistent with the ongoing Huron Street project.

It should be noted that these models can be interpreted as very conservative. Per Michigan Department of Transportation standards, individual intersection peak hours were used, as opposed to a network peak hour. This essentially models the worst-case scenario, in which the peak hour for every intersection occurs at the same time. Similarly, peak hour factors were applied by approach, as opposed to by intersection. This has the same effect as using individual intersection peak hours instead of a network wide peak hour. It assumes the heaviest traffic volume from each approach occurs at the same time, creating a worst-case scenario. Moreover, when creating the turning movement network, vehicular volumes were balanced to within 10% of the neighboring intersections. When this balancing occurs, vehicles are added to the network, further adding to the conservative nature of the models.

The future models also did not account for any change in mode split. As stated in previous sections, the primary mode of commuting within the study area is on foot. With anticipated improvements to walking and bicycling facilities, both within this project and outside of this project, the number of vehicular trips may decline or stagnate, while the number of walking, bicycling, and transit trips may increase. With anticipated development predicted within the downtown area, an increase in the number of short trips, which are more likely to be made by walking or bicycling, are to be expected. This may be particularly true with the relaunch of ArborBike, the Ann Arbor Bike Share Program, in 2018.

Level of Service Analysis

The latest version of *Synchro* was used to model traffic conditions at the study area intersections. The capacity analysis methodology is based on the concepts and procedures in the *Highway Capacity Manual* (HCM).[10] Capacity analyses provides an indication of how well an intersection

[10] *Highway Capacity Manual 2000*, Transportation Research Board; Washington, D.C.; 2000.

processes the vehicular demand placed upon it. A primary result of capacity analysis is the assignment of levels of service (LOS) to traffic facilities under various traffic flow conditions. The concept of LOS is defined as a qualitative measure describing operational conditions within a traffic.

Six levels of service are defined for each type of facility. They are given letter designations from A to F. Thresholds for vehicular LOS criteria for unsignalized and signalized intersections are shown in Table 20.

Table 20 Vehicle Level of Service (LOS) Criteria

Level of Service	**Unsignalized Intersection Average Control Delay Ranges (Seconds)**	**Signalized Intersection Average Control Delay Ranges (Seconds)**
A	≤10	≤10
B	>10 and ≤15	>10 and ≤20
C	>15 and ≤25	>20 and ≤35
D	>25 and ≤35	>35 and ≤55
E	>35 and ≤50	>55 and ≤80
F	>50 or v/c>1.0	>80

Source: *Highway Capacity Manual 2000*, Transportation Research Board; Washington, D.C.; 2000.

Figures 55 through 57 demonstrate the overall the LOS under existing morning, midday, and evening peak hour conditions, respectively, at all intersections within the study area. Notably, there are no intersections that experience a LOS lower than a D under proposed Build conditions, while the majority of intersections experience LOS A or B for all time periods studied. Detailed summary tables are provided within the Attachments.

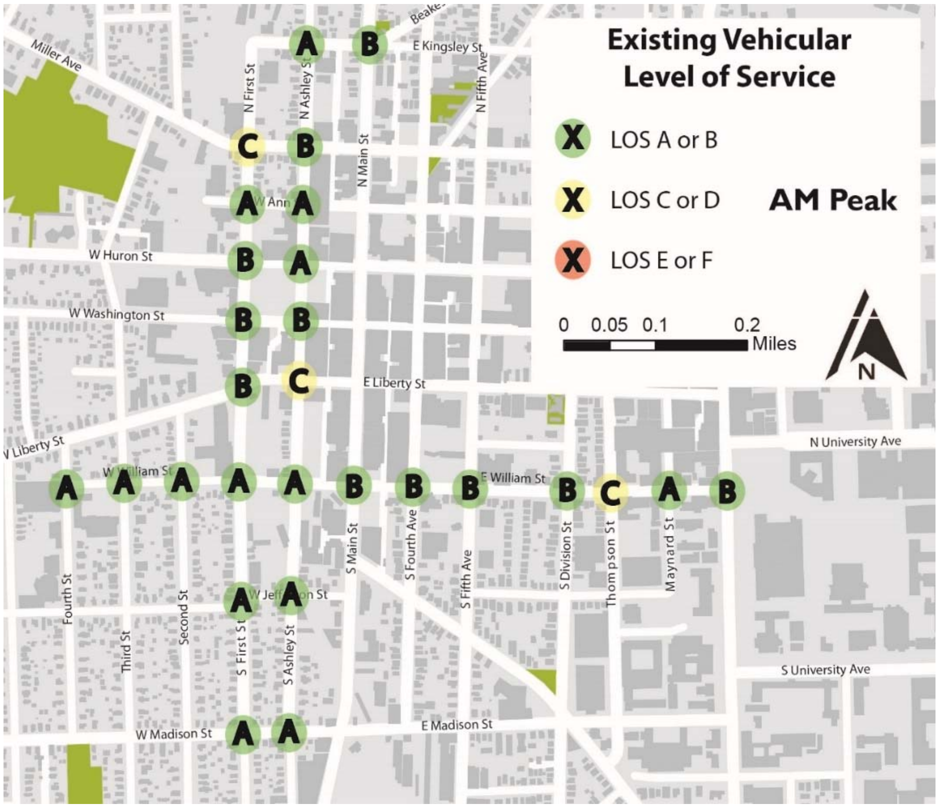

Figure 55 Existing Vehicle Level of Service, Morning Peak Hour

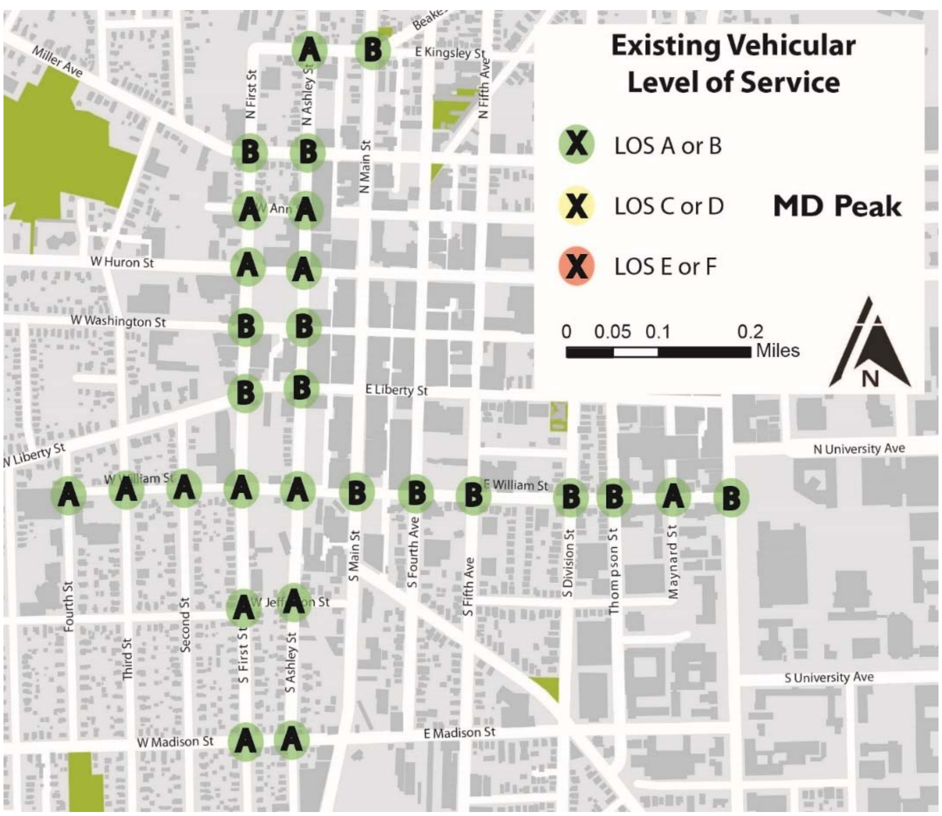

Figure 56 Existing Vehicle Level of Service, Midday Peak Hour

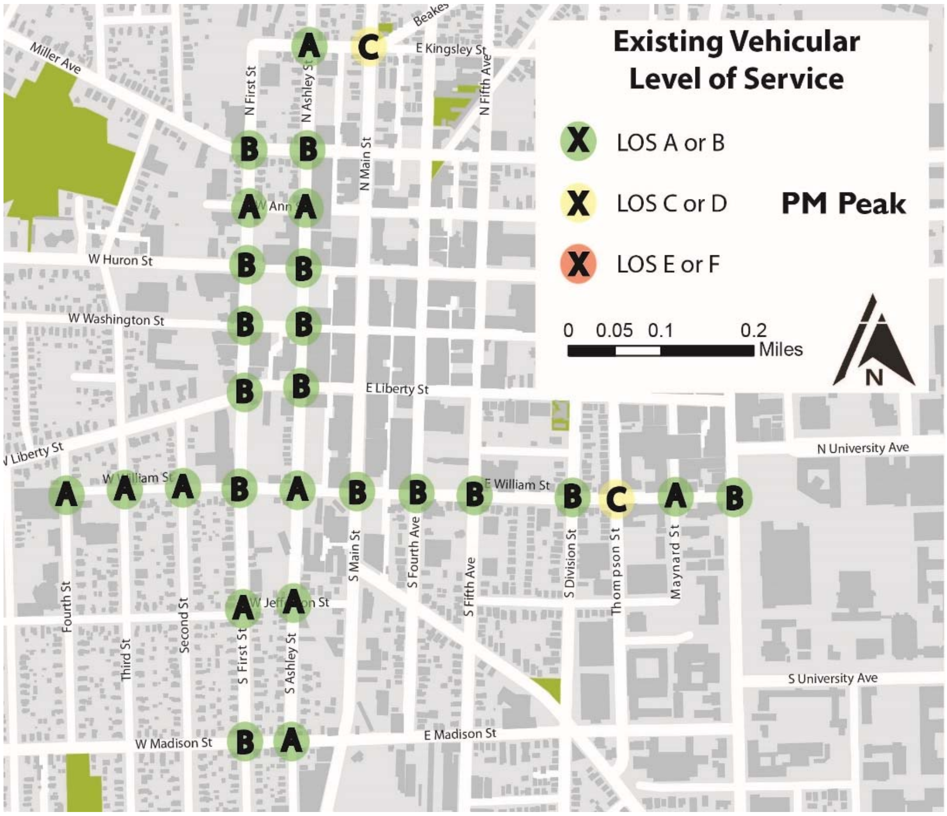

Figure 57 Existing Vehicle Level of Service, Evening Peak Hour

Figures 58 through 60 show the morning, midday, and evening peak hour intersection LOS, respectively, for the 2017 Build condition. Detailed summary tables are located in the Attachments. The peaks remain relatively unchanged at the intersection level, with the exception of Huron Street due to the additional left-turn phase. Under this scenario, all signalized intersections receive LOS D or better.

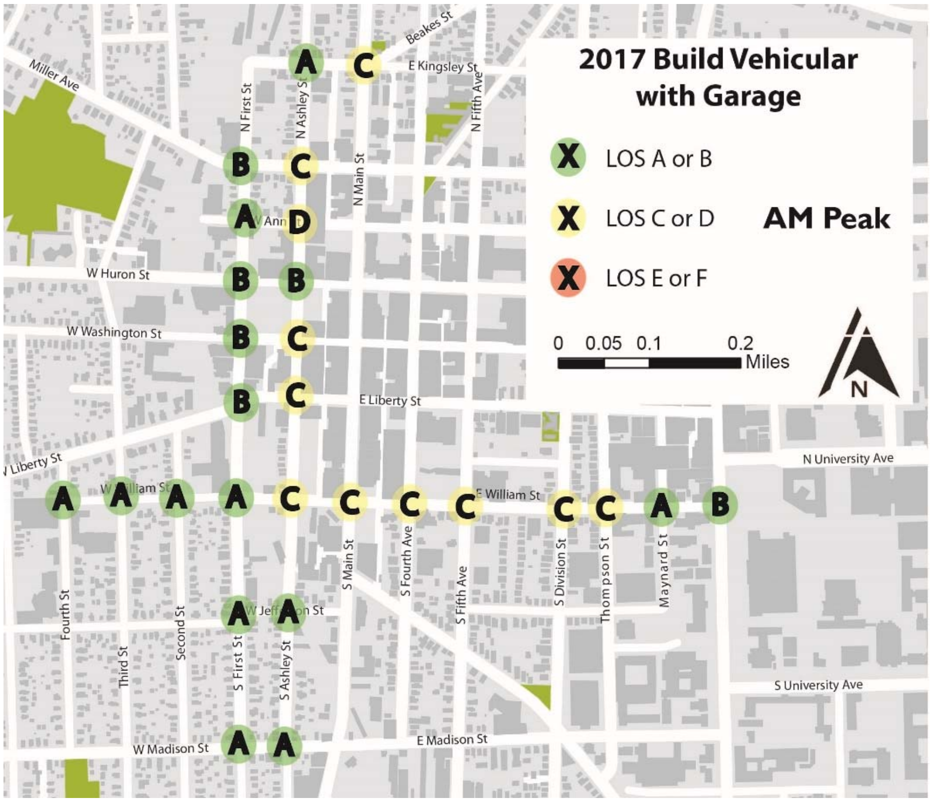

Figure 58 2017 Volumes on Build Scenario Vehicular LOS with Additional Garage Trips, Morning Peak Hour

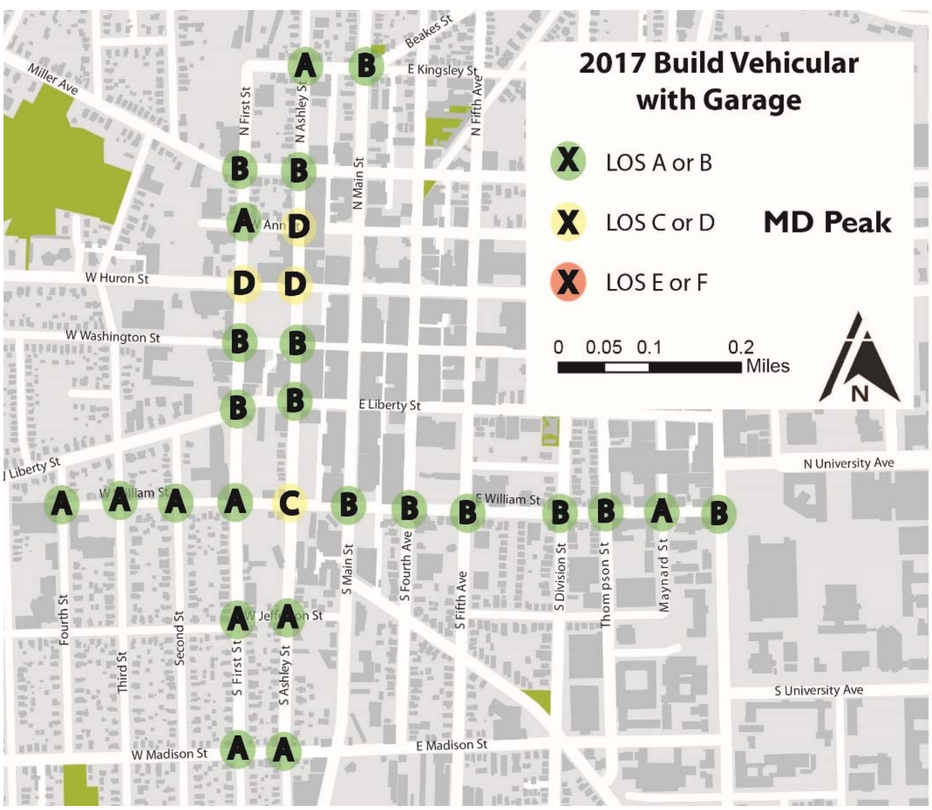

Figure 59 2017 Volumes on Build Scenario Vehicular LOS with Additional Garage Trips, Midday Peak Hour

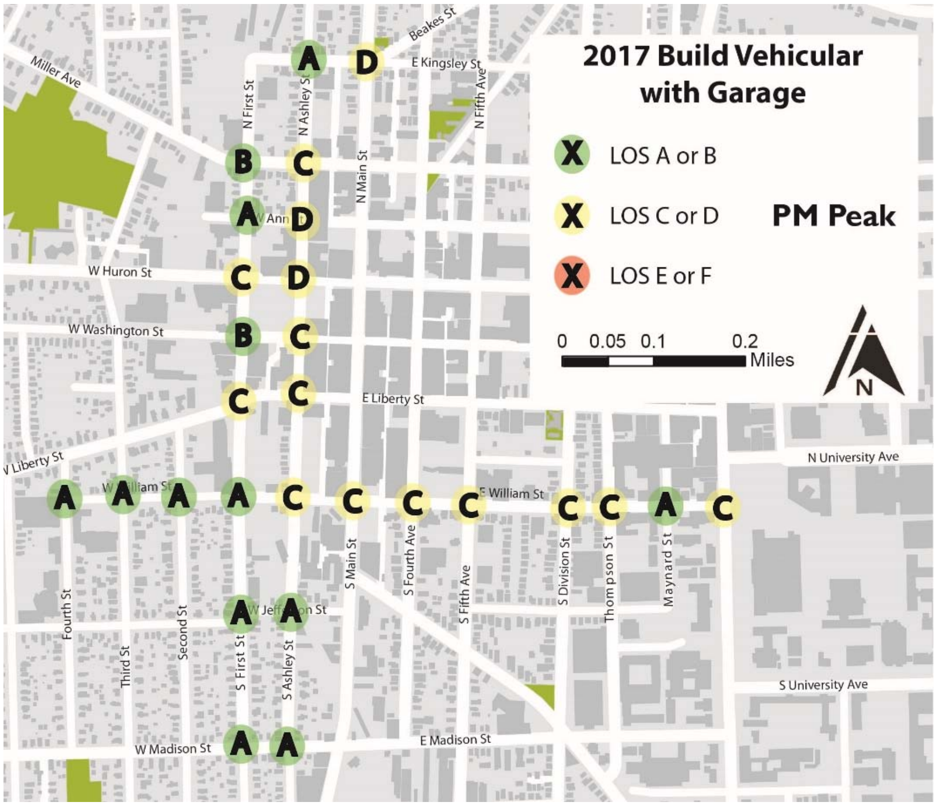

Figure 60 2017 Volumes on Build Scenario Vehicular LOS with Additional Garage Trips, Evening Peak Hour

Figures 61 through 63 show the morning, midday, and evening peak hour intersection LOS, respectively, for the 2037 No Build condition. Total intersection LOS remains relatively unchanged between the existing and no build conditions. However, when looking at approach metrics, a few stand out. The Huron Street eastbound left turn only lane at Ashley Street receives LOS F, with a delay of over 100 seconds. Similarly, the Miller Avenue westbound left turn only lane at 1st Street also receives LOS F and delay of 94 seconds under no build conditions. Detailed summary tables are located in the Attachments.

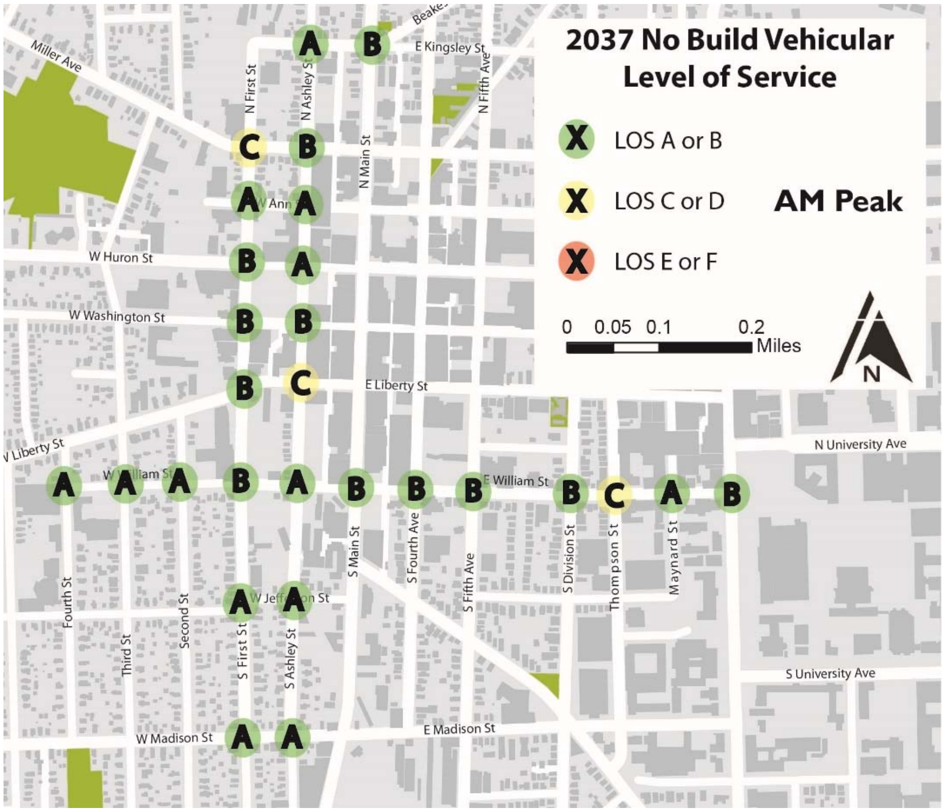

Figure 61 2037 No Build Vehicular LOS, Morning Peak Hour

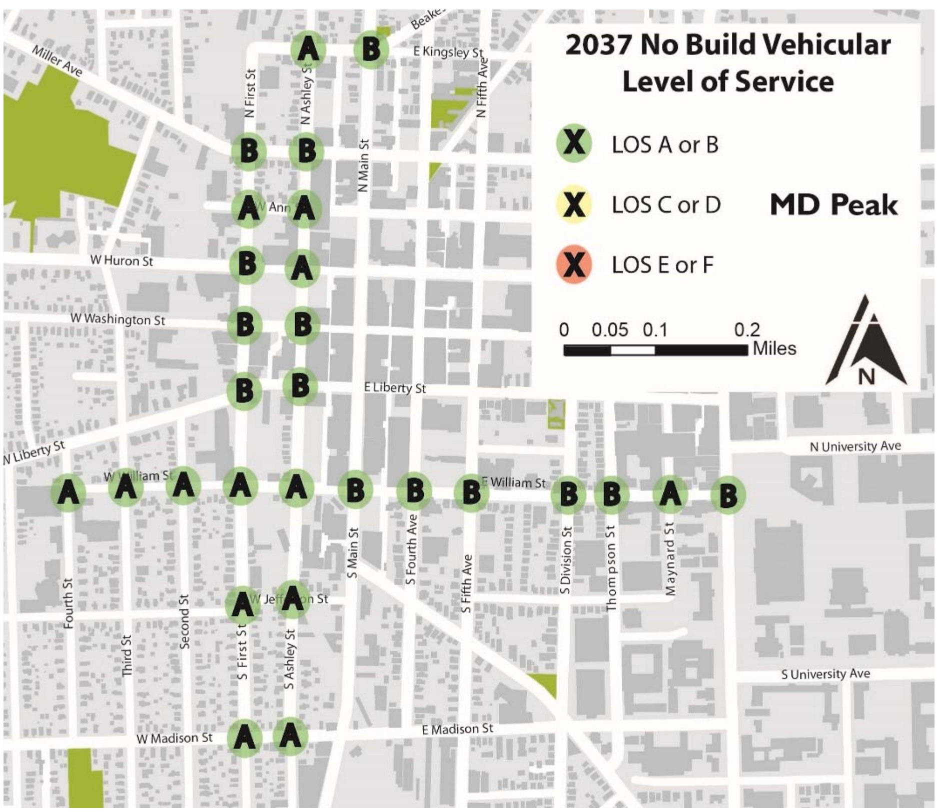

Figure 62 2037 No Build Vehicular LOS, Midday Peak Hour

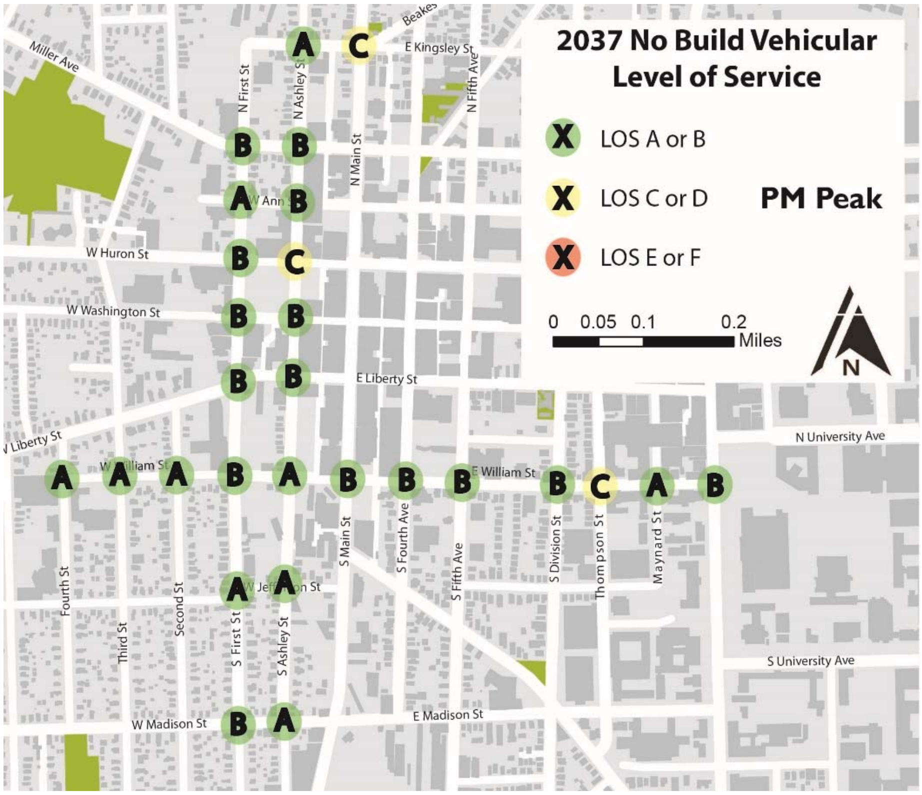

Figure 63 2037 No Build Vehicular LOS, Evening Peak Hour

Figures 64 through 66 show the morning, midday, and evening peak hour intersection LOS, respectively, for the 2037 Build condition. Detailed summary tables are located in the Attachments. The morning and midday peaks remain relatively unchanged at the intersection level, with the exception of the Huron Street intersections. This is most likely due to the conservative growth in vehicle volume over 20 years, the use of parking during the off-peak hours on Huron Street, and the additional left-turn phase. During the evening peak hour, the greatest change in intersection LOS occur along Ashley Street, particularly at the intersections of Ann Street and Huron Street.

For the Huron Street at Ashley Street intersection, the approach with the longest delay is the Huron Street westbound approach. The average queue length for the build scenario is 563 feet with the block being approximately 310 feet long. However, in the no build scenario, the average queue length is 429 feet, also exceeding the length of the block. This is likely due to the conservative 1.5% annual growth applied to the Huron Street approaches. Additionally, the model estimated a transfer of vehicle trips from First Street to Ashley Street. This, combined with the additional time needed for the LPIs, decreased the total split time for the Huron Street phase by approximately 11 seconds.

The intersection of Ashley Street at Ann Street is estimated to receive LOS E during the evening peak hour in the 2037 build condition model. This is most likely due to the estimated increase in left turns from the Ann Street westbound approach, growing volumes out 20 years, as well as the additional trips exiting the garage during this one-hour time period. Future trips from this garage may happen outside of the peak period, particularly as a wider range of employee types use it. Currently, most users are government employees with fairly inflexible daily schedules. It should be noted that this is assuming no change to the entrances and exits of the Ann Ashley garage, as well as a naïve, preliminary traffic study of the garage. It should be noted that overall LOS for a two-way stop controlled intersection is metered by the minor approaches of Ann Street, and vehicles on Ashley Street will not experience this delay.

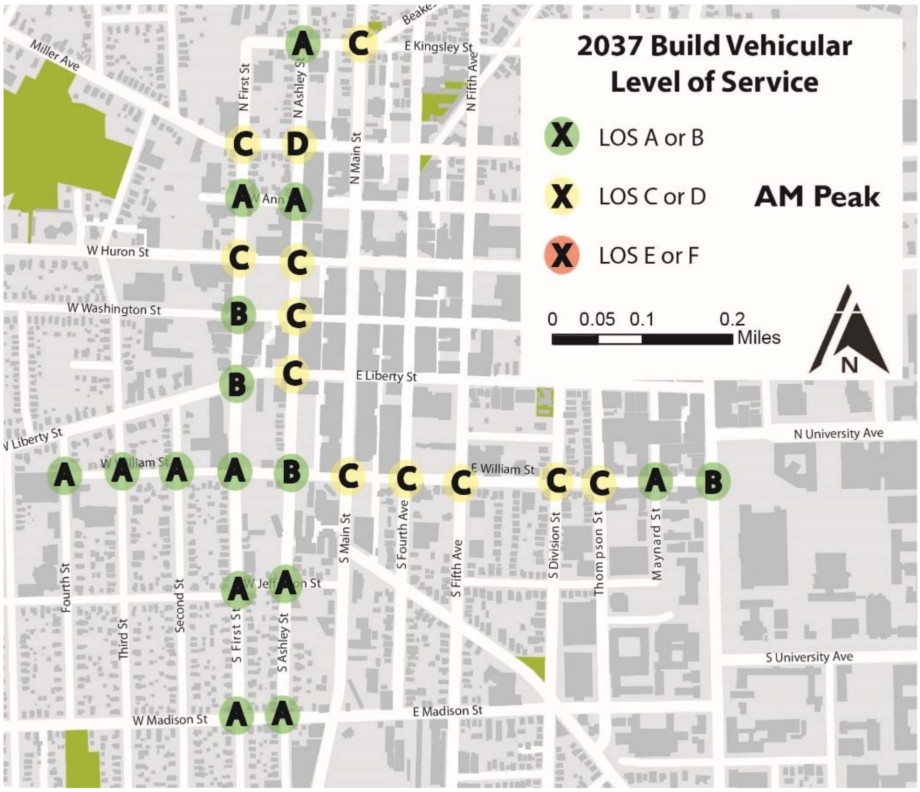

Figure 64 2037 Build Vehicular LOS, Morning Peak Hour

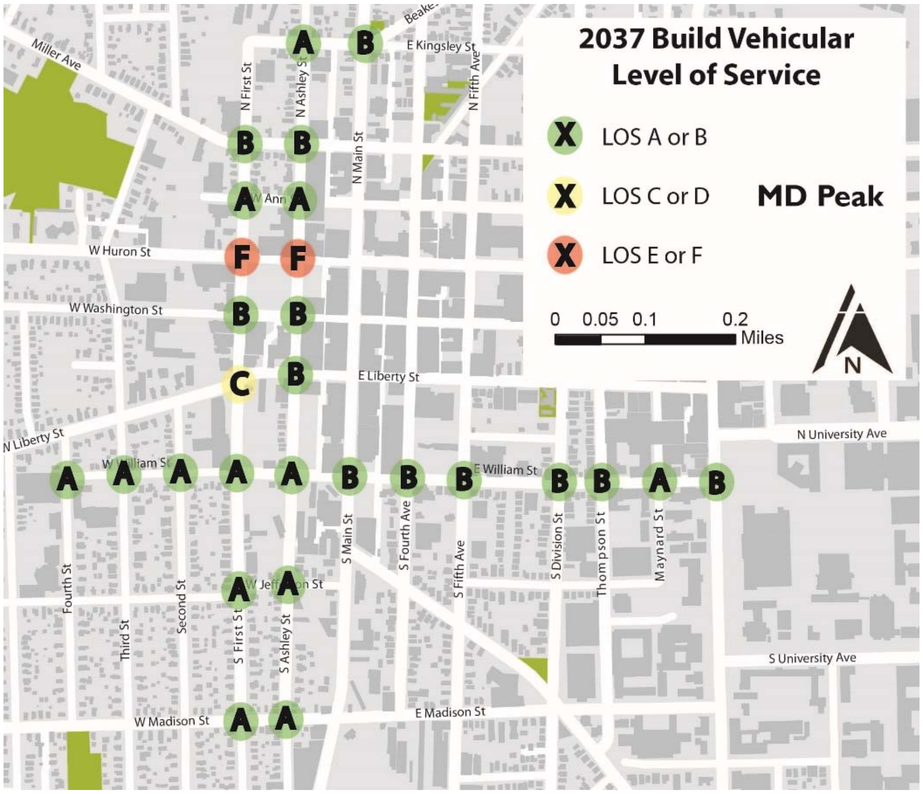

Figure 65 2037 Build Vehicular LOS, Midday Peak Hour

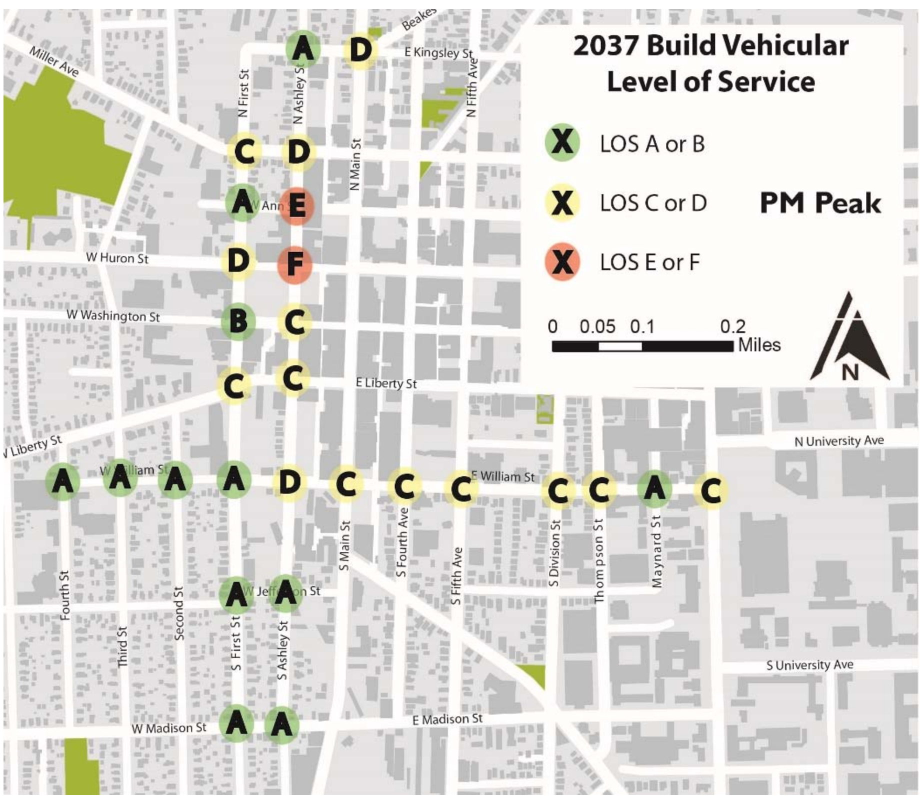

Figure 66 2037 Build Vehicular LOS, Evening Peak Hour

To further analyze the study area, select intersections were run as all-way stop controlled. This scenario, shown in Figure 67, maintains the 20 years of vehicular growth and analyzes the conversion of select intersections under all-way stop-control. Under this scenario, all intersections receive LOS D or better, with the exception of the Ashley Street at Huron Street intersection receiving LOS F, and the Ashley Street and Ann Street intersection receives LOS C. While it is not recommended that this intersection be converted to an all-way stop at this time as it is not currently warranted, it is an option that may be revisited once the additional levels to the garage have been completed.

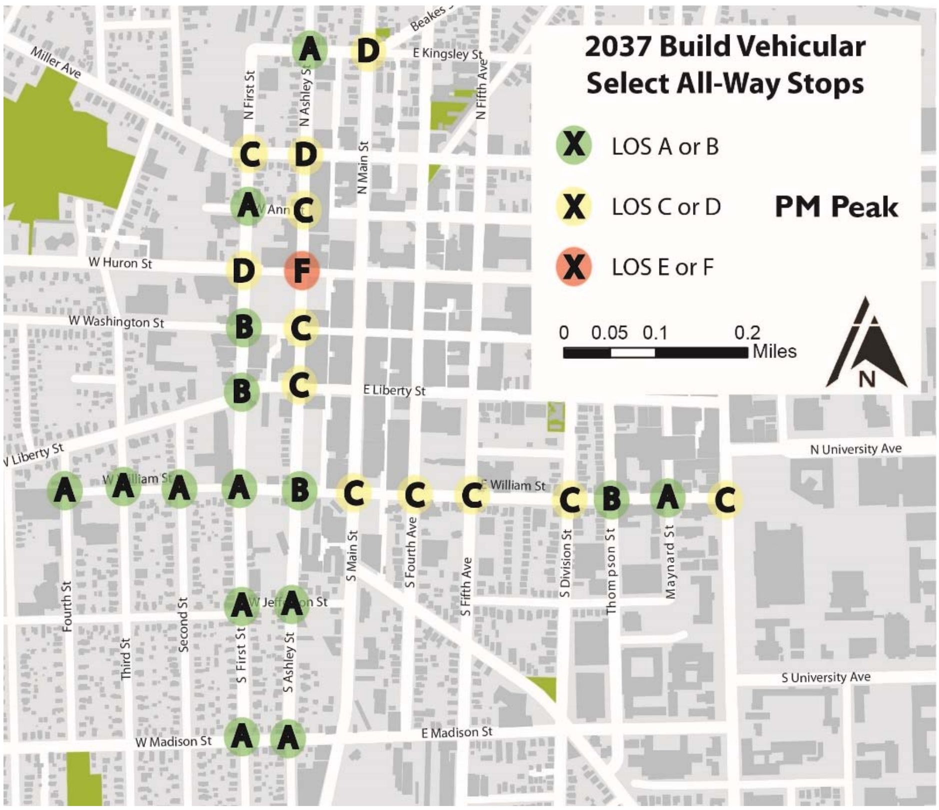

Figure 67 2037 Build Vehicular LOS with No Additional Garage Trips, Evening Peak Hour

Measures of Effectiveness Analysis

In order to assist Ann Arbor residents and decision makers with fully understanding the proposed changes on First Street, Ashley Street, and William Street, additional Measures of Effectiveness (MOE) were analyzed. LOS is a qualitative measure of traffic service; however, it can be difficult to envision how the change of an intersection from LOS B to LOS C will affect an individual. Additional MOEs analyzed include average travel time per vehicle (minutes/vehicle) and average speed along the corridor. A full report of MOEs are located in the Attachments.

During the evening peak hour, the total travel time per vehicle is projected to increase under the proposed design, under 2017 Build conditions. When traveling the entire length of First Street, the travel time is projected to increase 1.12 minutes per vehicle. However, based on the OD data collected, only approximately 1% of vehicles on First Street travel the entire length and will notice the increase in this magnitude. When traveling the entire length of Ashley Street, the travel time is projected to increase 1.75 minutes per vehicle. However, based on the OD data collected, only approximately 15% of vehicles travel the entire length of Ashley Street. When traveling the entire length of William Street, the travel time is projected to increase 0.10 minutes per vehicle.

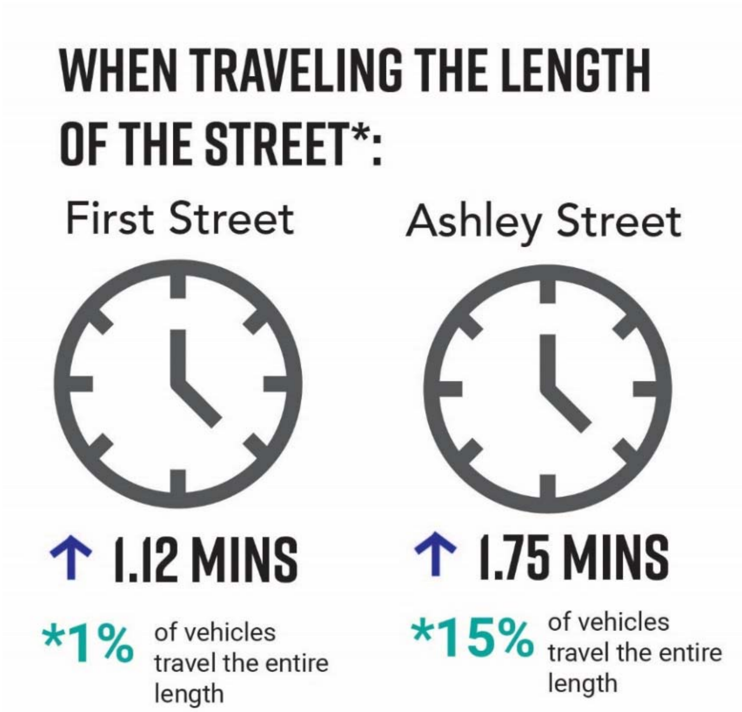

Figure 68 Change in travel time on First Street and Ashley Street during the evening peak hour

Average speed was also calculated for the existing conditions and proposed design. The average speed along all corridors decreased during all time periods studied. One of the greatest decreases was on First Street during the evening peak hour. The average speed on First Street is projected to decrease from 13 mph to 9 mph.

Figure 69 Estimated change in average speed along the study corridors during the evening peak hour

Conclusion

The proposed design for First Street, Ashley Street, and William Street, which includes restoring First Street and Ashley Street to two-way vehicle traffic, the addition of LPIs and protected bicycle facilities, as well as the removal of underutilized vehicular travel lanes on William Street, is anticipated to improve safety and access for all users while providing more comfortable facilities for bicyclists and pedestrians. The proposed two-way restoration of First Street and Ashley Street, and the repurposing of travel lanes on William Street, is anticipated to have minor impacts to vehicular delay and level of service during the morning and midday peak hours, with larger impacts concentrated to a few intersections during the evening peak hour. Despite the moderate impacts in LOS on Ashley Street, the proposed conditions are only expected to increase the travel time per vehicle by 1.75 minutes when traveling the entire length of the corridor. As stated previously, the models used to analyze the scenarios for vehicular traffic are conservative and do not necessarily reflect future scenarios accurately, but more likely represent 'worst-case' scenarios.

Next steps for the First Street, Ashley Street, and William Street Streetscape Project include a detailed design and beginning the Engineering Phase.

Attachments

Level of Service Tables

Census Tracts Map and Data

Raw Count Data

O-D Networks

Ann Ashley Garage Trip Distribution

Preliminary Warrant Analysis

Synchro Reports

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[i] Rodegerdts, L. A., Nevers, B., and Robinson, B., "Signalized Intersections: Informational Guide." FHWA-HRT-04-091, (2004).

[ii] Safety Treatments, https://www.sfmta.com/sites/default/files/projects/2015/Lombard%20Street%20Safety%20Project%20Plans_Updated.pdf

[iii] Johnson, R., Pedestrian Safety Impacts of Curb Extensions: A Case Study, 2005.

[iv] American Association of State Highway and Transportation Officials. Highway Safety Manual. Washington, DC, 2010.

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