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City Administrator Report to Mayor & City Council

2018.05.11, Edition No. 308

WEEKLY UPDATE:

- Grandview: At the last council meeting Jim was asked to provide the traffic data on Grandview and has provided the following: The traffic data data 2018.02.16 is the data collected within the last year specific to the project and the Grandview Corridor. Additionally, attached is traffic data available prior to the Bolton-Menk work done last year on Grandview.Specifically, this is the most recent DOT count from 2014 https://iowadot.gov/maps/msp/traffic/2014/cities/muscatine.pdf. There is also the attached information from the Comp Plan, which shows the 2010 DOT traffic count, and how much that traffic changed since the 1998 DOT traffic count.
- Dock: The dock formerly operated by the Meeker's and the associated fixtures have been transferred back to the City.
- Fire: Effective June 1, 2018 Captain Gary Ronzheimer will be promoted to Battalion Chief. Please help me in congratulating Gary on his promotion. Gary will assume Training and Operations as BC.
- In-Depth: If there is a particular topic or interest that you would like City staff to work into the in-depth meeting rotation, please send your ideas!
- Whicher Street and Street Matrix: Please see the attached copies of DPW Director Stineman's presentations from last night. Per Brian…The attached Whicher presentation has the detour routes that were requested. I don't have the alley matrix completely done yet and still need to have internal staff review it. I will have it to you by the end of next week.
- Refuse and recycling: Feel free to share Kevin's post about refuse and recycling pickup as there is no refuse collection on Memorial Day (May 28th), otherwise please see below.
  - Refuse, recycling collection schedule for Memorial Day Holiday is announced
  - MUSCATINE, Iowa – There will not be refuse or recycling collection on Memorial Day, Monday, May 28, according to Kristi Korpi, Solid Waste Manager for the City of Muscatine. In one of her final acts before retiring at the end of this week, Korpi released the collection schedule for the first holiday of the summer season.
  - Refuse collection for Monday (May 28) and Tuesday (May 29) will be collected on Tuesday (May 29). The regular collection schedule will resume on Wednesday (May 30). Route B recycling collection for that week will be delayed one day (Monday's collection on Tuesday, Tuesday on Wednesday, etc.). Regular recycling collection will resume on Monday (June 4).
  - The Transfer Station and Compost Site will be closed on Monday, May 28, and will resume normal operating hours on Tuesday, May 29. Transfer Station hours are 7 a.m.-3:30 p.m. Monday through Friday and 8 a.m.-12:00 p.m. on Saturday. Compost Site hours are 12-6 p.m. Sunday through Friday and 9 a.m. to 6 p.m. on Saturday.

BOLTON & MENK

Real People. Real Solutions.

Traffic Analysis

Grandview Avenue

Muscatine, IA

Submitted by:
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Certification

Traffic Analysis

for

Grandview Avenue

City of Muscatine, IA
BMI Project No. – A13.115171

March 21, 2018

I hereby certify that this engineering document was prepared by me or under my direct personal supervision and that I am a duly licensed Professional Engineer under that laws of the State of Iowa.

03/21/2018

Marcus H Januario — Date
License Number 23116

MY LICENSE RENEWAL DATE IS DECEMBER 31, 2018
Pages or sheets covered by this seal:
Pages 1 to 23, Appendix A to H

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Appendix

I. Executive Summary

The City of Muscatine is looking to reconstruct the Grandview Avenue Corridor through the City. The corridor stretches from the US 61/Dick Drake HWY on the southwest to Hershey Avenue in northeast but the study limits are from US 61/Dick Drake HWY to Pearl St, in the northeast, approximately 2.18 miles in length. For technical reasons, the corridor will be hereafter described as north-south with US 61 as the south end, and Mill Street as the north end. Grandview Avenue is also part of Iowa 92 and BUS US 61.

The City is interested in analyzing the traffic operations and safety to determine the appropriate roadway configuration. The roadway is currently a 2-lane section from US 61 to Oregon Street, after which a second northbound lane is added. A second southbound lane is added at Bleeker Street. From Bleeker Street, the corridor is a 4-lane section until the north end. Turning lanes exist at US 61, and Oregon Street/Warren Street. The city wants to review if a combination of a 2-lane and a 3-lane roadway would be appropriate to allow a complete streets project for improved bicycle and pedestrian circulation. The following summarizes the main outcomes of this study:

A. Access Management

On the eastbound approach of the intersection of Warren St/Oregon St with Grandview Avenue, the curb on the south is mountable with an open access from the back alley to Grandview Avenue (about 140 ft). This access should be reduced to a normal in/out access a 150 ft from Grandview Avenue to avoid conflicts with the eastbound queue of vehicles.

B. Safety

From the crash analysis completed, it was determined that none of the intersections analyzed have crash rates either equal to or higher than the statewide average for the same class of intersections. There were no fatal crashes but one major injury one-vehicle only crash occurred at the intersection of Warren St / Oregon St, involving an ill 64-year old driver stopped at a traffic signal. At both the intersections of US 61 / Dick Drake HWY and Warren St / Oregon St, the minor crashes account for 33% and 25% of the total intersection crashes, respectively. However, as crash frequencies are low and crash rates are almost half of the statewide average, at both locations, these two numbers become less significant. Rear end crash pattern and left turn crash patterns were identified at US 61 / Dick Drake HWY intersection. The rear end pattern is mostly caused by inadequate clearance and green times, inadequate stopping sight distance, or lack of stop warning signs. The left turn pattern is mostly caused by including inadequate clearance time, stopping sight distance, vertical alignment, and sight triangle. Both situations can be corrected during the design phase.

C. Operations

The existing traffic analysis shows that currently intersection delay is acceptable with LOS equal to or better than B and no limiting movement near capacity for all of the intersections analyzed.

The forecasted 2020 (construction year) traffic analysis shows that service levels provided by both the two-lane and three lane sections (Build scenario) along Grandview Avenue are equal to or better than B for all the intersections and are comparable with the ones provided under existing geometry and control (No Build scenario). The forecasted 2020 traffic analysis also shows that the service levels for the limiting movements are equal to or better than C, that the limiting movement delay and delays are acceptable for all the intersections and are comparable with the ones provided by the No Build scenario.

The forecasted 2040 (future year) traffic analysis shows that service levels provided by both the two-lane and three lane sections (Build scenario) along Grandview Avenue are equal to or better than C and comparable with the ones provided under existing geometry and control (No Build scenario).

The forecasted 2040 (future year) traffic analysis also shows, however, that the service level for the limiting movement (eastbound left movement) at Franklin St intersection is equal to E and that the limiting movement is near capacity with undesirable delay in the PM peak hour. However, this movement has only one vehicle in the PM peak hour and therefore, the result is overall insignificant. Additionally, drivers have historically adjusted to traffic conditions by taking alternate paths or changing their time schedules. At the remaining intersections, the service levels for the limiting movements are equal to or better than D, the limiting movement delay and delays are acceptable are comparable with the ones provided by the No Build scenario.

The travel times for all scenarios vary from 30 mph to 35 mph, on both directions, for current conditions and future scenarios, both Build and No Build. The average travel time in all scenarios is 3.9 ± 0.3 minutes, where the variation is insignificant.

The warrant analysis completed shows that currently signal warrants are met at the intersection of US 61 / Dick Drake HWY (2018), and Oregon (2040), which are already signalized. At the intersection of S Houser St / Sampson St, which is currently signalized, no warrants are met. However, this intersections is proposed to be reconstructed with a signal, mostly because Oregon St is the main access to the grain processing center, whose peak hour may not match the corridor peak hour and also because the random number of trucks, which may be high at times. All-way stop control warrants are met only at US 61 / Dick Drake HWY and Warren St / Oregon St intersections.

The conversion of Grandview Avenue from the current configuration to 2-lane section from the south end to S Houser St / Sampson St , and 3-lane section from S Houser St / Sampson St to the north end will not cause any negative impact on the traffic operations and safety of the corridor, with advantage of providing a complete streets project for improved bicycle and pedestrian circulation.

Operations analyses have shown the need to add left turn lanes at both north and southbound approaches at Musser St, Warren St/Oregon St, Bond St, and Franklin St, due to the 4-lane to 3-lane conversion. Southbound and northbound through lanes were eliminated at these same intersections but the shared thru/right lane was maintained. At Warren St intersection eastbound approach, the existing dedicated right turn lane was removed.

II. Introduction

The City of Muscatine is looking to reconstruct the Grandview Avenue Corridor through the City. The corridor stretches from the US 61/Dick Drake HWY on the southwest to Hershey Avenue in northeast but the study limits are from US 61/Dick Drake HWY to the transition of Green Street with Grandview Avenue (Mill Street), in the northeast, approximately 2.18 miles in length. For technical reasons, the corridor will be hereafter described as north-south with US 61 as the south end, and Mill Street as the north end. Grandview Avenue is also part of Iowa 92 and BUS US 61. See **Appendix A** for an overview of the Project Extents.

The following intersections along the University Avenue Corridor are included in the scope of the study:

- US 61 / Dick Drake HWY
- S Houser St / Sampson St
- Musser St
- Warren St / Oregon St
- Bond St
- Franklin St

The City is interested in analyzing the traffic operations and safety to determine the appropriate roadway configuration. The roadway is currently a 2-lane section from US 61 to White Street, after which a second northbound and southbound lanes are added to make the corridor a 4-lane section

until the north end. Turning lanes exist at US 61, and Oregon Street/Warren Street. The city wants to review if a combination of a 2-lane and a 3-lane roadway would be appropriate to allow a complete streets project for improved bicycle and pedestrian circulation. An overview of the 2-lane and the 3-lane section plus typical section can be found in **Appendix B**.

The intersections of Grandview Avenue at US 61, Sampson Street/S Houser Street, and Oregon Street/Warren Street are signalized. The remaining intersections are side-street stop-controlled. The inclusion of these streets in the study area will allow the study to determine the effect on the delay and queueing of potential 2-lane or 3-lane section (from 4-lane), and future growth on the system. The crash history will be analyzed to identify any issues and potential trends, if any.

The purpose of this traffic study is to identify potential transportation issues created as a result of changes to the roadway system and surrounding area and recommend solutions to mitigate the potential issues to provide a safer and efficient transportation facility for vehicular, pedestrian and bicycle traffic.

III. Data Collection

Thirteen-hour Turning Movement Counts for the intersections of Grandview Avenue at HWY 61/Dick Drake Hwy, Grandview Avenue at S Houser St/Sampson St, and Grandview Avenue at Musser Street were performed on November 28, 2017, while Thirteen-hour Turning Movement Counts for intersections of Grandview Avenue at Warren Street/Oregon Street, Grandview Avenue at Bond Street, and Grandview Avenue at Franklin Street were performed on November 30, 2017. AM Peak Hour and PM Peak Hour were determined to be 7:15-8:15 am and 3:30-4:30 pm respectively. The turning movement counts were not balanced as there are crossing streets and driveways between the locations where turning movement counts occurred. See **Appendix C** for Peak hour count information.

According to the Iowa DOT, the 2014 AADT is 3,950 vpd between US 61 and Houser Street intersections, and the 2013 AADT is 4,740 vpd form Houser Street to the north end of the corridor.

IV. Safety Review

A crash review was completed for each intersection in this study. The crash analysis was completed using the crash data available through the Iowa DOT Crash Mapping Analysis Tool for 2012 to 2016.

Summaries of crashes according to frequency and rate, severity, and type, for each intersection included in the study, are depicted in **Table 1** though **Table 3**. Intersection crash diagrams were created for each studied intersection and can be found in **Appendix D**.

Table 1: Crash Frequency and Rate

Intersection	Crash Frequency and Rate			
	Entering Volume	Number of Crashes	Crash Rate	Statewide Crash Rate*
US 61 / Dick Drake HWY	12,450	16	0.71	1.0
S Houser / Sampson St	6,465	1	0.09	0.7
Musser St	5,300	2	0.21	0.7
Warren St / Oregon St	10,350	6	0.32	0.8
Bond St	9,250	2	0.12	0.8
Franklin St	9,400	1	0.06	0.8
* Per Million Entering Vehicles				

None of the intersections have a crash rate either equal to or higher than the statewide average for its corresponding category. Therefore, no concerns were found regarding either crash rates or frequency.

Table 2: Crash Severity

Intersection	Crash Severity					
	Fatal	Major Injury	Minor Injury	Possible Injury	PDO	Total
US 61 / Dick Drake HWY	0	0	4	2	10	16
S Houser / Sampson St	0	0	0	0	1	1
Musser St	0	0	0	1	1	2
Warren St / Oregon St	0	1	1	1	3	6
Bond St	0	0	0	0	2	2
Franklin St	0	0	0	0	1	1

At the intersection of US 61 / Dick Drake HWY, the number of minor injuries is 25% of the total, which could be a concern. However, as the crash rate is less than half of the statewide average (1.0), that injury crash frequency is within the normal range. These minor crashes were 2 left turn, rear end, and right angle.

At the intersection of Warren St / Oregon St, the number of major and minor injury crashes is 33% of the total, which could be a concern. However, as the crash rate is less than half of the statewide average (0.8), that injury crash frequency is probably within the normal range. The major injury crash involved only an ill 64-year old driver stopped at a traffic signal heading west. No details were disclosed in the Crash Detail Report. The minor injury involved a driver going south and turning left, who ran the traffic signal and hit a driver going north.

The crash severity summary does not show any concerns at the remaining intersections.

Table 3: Crash Type

Intersection	Crash Type								
	Rear End	Right Angle	Sideswipe	Left Turn	Head On	Run Off Road	Collision with Animal	Other	Total
US 61 / Dick Drake HWY	5	3	3	4	0	1	0	0	16
S Houser / Sampson St	0	0	0	0	0	1	0	1	1
Musser St	1	0	0	0	0	1	0	0	2
Warren St / Oregon St	0	1	0	4	0	1	0	0	6
Bond St	0	1	1	0	0	0	0	0	2
Franklin St	0	1	0	0	0	0	0	0	1

The only concerns in terms of crash patterns is rear end at US 61 / Dick Drake HWY and left turns at US 61 / Dick Drake HWY and at Warren St / Oregon St.

Four out of the five rear end crashes at US 61 / Dick Drake HWY occurred on the southbound approach. This pattern is mostly caused by inadequate clearance and green times, inadequate stopping sight distance, or lack of advanced warning signs, which can be corrected during the design phase.

All four left turn crashes at US 61 / Dick Drake HWY occurred on the northbound approach, turning left to US 61. This pattern is mostly caused by including inadequate clearance time, stopping sight distance, vertical alignment, and sight triangle, which can be corrected during the design phase.

At Warren St / Oregon St, there were four left turn crashes but they do not represent a pattern as two of them involved vehicles turning southbound to east, one was turning westbound to south, and one was turning northbound to west.

No concerns were identified at the other intersections.

While the crash rates are below the statewide averages for the type of intersections, the number of crashes can be reduced with mitigation. The conversion of a 4 lane roadway to a 3-lane roadway has shown a potential 18% reduction in crashes, according to the available literature. The conversion of a signalized intersection into a roundabout has shown a potential 56% reduction in crash frequency, according to available literature. Additionally, route signage near the intersection could decrease the amount of crashes by reducing driver route hesitation. Crash mitigation countermeasures, as suggested in the previous paragraphs, can be implemented during the design phase.

V. Existing Conditions Review

The proposed study area is the Grandview Avenue Corridor in Muscatine, Iowa, extending from the US 61 on the south to Pearl Street on the north end. Grandview Avenue is also part of Iowa 92 and BUS US 61.

Grandview Avenue in the City of Muscatine is a 4-lane divided roadway with 2-lanes in each direction from the south city, limits where it is also HWY 61, to 700 ft north of the intersection with HWY 61/Dick Drake Hwy. At that point, it reduces width to a 2-lane roadway, with one lane in each direction to 350 ft south of the intersection at Warren St/Oregon St where it expands to a 4-lane undivided section, with two lanes in each direction. The roadway widths vary from 24 ft up to 68 ft. Some road sections have parking along one or both sides of the street, while other sections have no parking. The following provides the roadway information for each intersection.

1. Grandview Avenue at HWY 61/Dick Drake Hwy – this intersection is a 4-legged intersection with Grandview Ave extending north, Dick Drake Hwy extending east, Grandview Avenue/HWY 61 extending south, and HWY 61 extending west. HWY 61 west of the intersection is a 4-lane divided roadway with 2 lanes in each direction and a left turn lane approaching the intersection. It has a rural section that is 88-ft wide including 10-ft paved shoulders. Grandview Avenue is a 4-lane road with left turn lanes from each approach. It is a rural section that has a pavement width of 68-ft including 2-ft wide paved shoulders. There are also 8-ft wide granular shoulders. There is a painted median dividing the turn lane and the opposing through lane. Dick Drake Hwy is a 2-lane roadway with one lane in each direction and a left turn lane approaching the intersection. It is 42-ft wide edge of pavement to edge of pavement. The intersection is signalized. Speed limits are 45 mph north, south and west of the intersection, and 40 mph east of the intersection. Parking is not allowed on any of the roads connecting to this intersection.

2. Grandview Avenue at S Houser St/Sampson St – this intersection is a 4-legged intersection with Grandview Ave extending north/south, S Houser St extending west, and Sampson St extending east. Grandview Avenue is a 2-lane roadway. It has a rural section that is 32-ft wide including 4-ft wide paved shoulders. There are also 4-ft wide granular shoulders. S Houser St has an urban section measuring 32 ft back-of-curb to back-of-curb with one lane in each direction. Sampson St has an urban roadway section measuring 38 ft back-of-curb to back-of-curb with one lane in each direction, but narrows to 32 ft back-of-curb to back-of-curb 300 ft east of the intersection. There are "No Parking" signs posted along Grandview Avenue, but not along S Houser St or Sampson St. The intersection is signalized. Grandview Avenue has a posted speed limit of 35 MPH through the intersection, where it changes to 45 mph southwest of the intersection. S Houser St has a posted speed limit of 40 mph and Sampson St has a posted speed limit of 25 mph.

3. Grandview Avenue at Musser Street – this intersection is a 4-legged intersection with Grandview Ave extending north/south and Musser St extending east/west. Both roadways are 2-lane rural roadway section with one lane in each direction. Grandview Ave is 24-ft edge of pavement to edge of pavement with 6-ft wide granular shoulders. Musser St is 24-ft edge of pavement to edge of pavement with grass shoulders. There are "No Parking" signs posted along Grandview Avenue, but parking in permitted along Musser St. Grandview Avenue has a posted speed limit of 35 MPH through the intersection and Musser St has a posted speed limit of 25 mph. The intersection is side street stop controlled.

4. Grandview Avenue at Warren Street/Oregon Street – this intersection is a 4-legged intersection with Grandview Ave extending north/south, Warren St extending west and Oregon St extending east. Grandview Ave expands to a 4-lane undivided roadway approximately 350 ft south of the intersection with two lanes in each direction. It has an urban roadway section measuring 44 ft back-of-curb to back-of-curb. The southbound left lane is marked as a dedicated left turn lane. Warren St has an urban roadway section measuring 40 ft back-of-curb to back-of-curb. It is marked as 3 lanes with one lane heading west and two heading east. The two lanes heading east are a shared thru/left turn lane and a right turn lane. Oregon St has an urban roadway section measuring 48 ft back-of-curb to back-of-curb. It is a 4-lane undivided road with 2 lanes in each direction. The two lanes heading west are a shared thru/left turn lane and a right turn lane. The intersection is signalized. Parking is not allowed on the streets at this intersection. Grandview Avenue and Oregon St have posted speed limits of 35 mph and Warren St has a posted speed limit of 25 mph.

5. Grandview Avenue at Bond Street – this intersection is a 4-legged intersection with Grandview Ave extending north/south and Bond St extending west. There is a two-way driveway into a parking lot extending east from the intersection that is offset from Bond St 40 ft to the north. Grandview Ave is a 4-lane undivided roadway with two lanes in each direction. It has an urban roadway section measuring 44 ft back-of-curb to back-of-curb. Bond St has an urban roadway section measuring 26 ft back-of-curb to back-of-curb. It has 2 lanes with one lane in each direction. The intersection is side street stop controlled with Bond St stopping. No parking is allowed on Grandview Avenue. Bond St has parking allowed on both sides. Grandview Avenue has a posted speed limit of 35 mph and Bond St has a posted speed limit of 25 mph.

6. Grandview Avenue at Franklin Street – this intersection is a 4-legged intersection with Grandview Ave extending north/south and Franklin St extending east/west. Grandview Ave is a 4-lane undivided roadway with two lanes in each direction. It has an urban roadway section measuring 44 ft back-of-curb to back-of-curb. Franklin St has an urban roadway section measuring 36 ft back-of-curb to back-of-curb west of the intersection. Franklin Street is in disrepair to the east of the intersection. It has 2 lanes with one lane in each direction. The intersection is side street stop controlled with Franklin St stopping. No parking is allowed on

Grandview Avenue. Franklin St has parking allowed on both sides. Grandview Avenue has a posted speed limit of 35 MPH and Franklin St has a posted speed limit of 25 mph.

According to the Urban Area Federal Functional Classification map, provided by the Iowa DOT, Grandview Avenue, Dick Drake HWY and Oregon St are Minor Arterials, US 61 is Other Principal Arterial, and all the other streets are local roads. However, according to the City of Muscatine's Comprehensive Plan, Grandview Avenue and US 61 are Principal Arterials, Oregon St and Dick Drake HWY are Minor Arterials, S Houser St is a Collector, and all the other streets are Local Streets.

Grandview Avenue corridor is parallel to the Canadian Pacific Railroad tracks and the northern section of the road (north of Bond St) is also parallel to the Mississippi River shoreline. The railroad also crosses Grandview Avenue slightly north of the Day St intersection. On the north end of the corridor, Grandview Avenue turns into Green Street and connects with Hershey Avenue, which is an extension of the Mississippi Drive, currently under reconstruction.

See **Appendix A** for aerial of the project extents.

VI. Project Scenario Review

The project scenarios for this analysis include additions of some potential developments and redevelopments, lane reconfiguration and intersection control changes, and future growth.

A. POTENTIAL DEVELOPMENTS AND REDEVELOPMENTS

Some development and redevelopment between the existing conditions and the design year are expected to occur along the corridor within the project limits. One redevelopment is already expected to happen before the construction year. Other developments are expected to happen between the construction year and the design year. Some assumptions were made of areas that would be developed or redeveloped. A map with the locations of each potential development/redevelopment can be found in **Appendix E.**

There is one site considered for redevelopment before the construction year. The old Wholesale Food Outlet at the corner of Grandview Avenue and Warren Street/Oregon Street is being reopened

as a Dollar General. The building and the site will be reused with minimal changes. This is location A noted in **Appendix E**.

There are three potential development or redevelopment groupings for the design year, as follows:

1. The city owns approximately 10 acres of land southeast of the intersection of Hershey Avenue and Green Street. The site is currently vacant lots. While outside of the corridor study area, the traffic generated will impact the roadway and intersections in the corridor study area. The land is proposed as mixed use development with the intent being multi-story building having commercial on the main floor and apartment space above. A 3-story building with 2 stories of apartments was assumed. Historical data used to determine the footprint(s) of buildings on a site this size indicated 0.20 sf per sf of lot space. This gives approximately 87,000 sf of building footprint. While apartment sizes vary from location to location, a historical average of about 1150 sf per apartment was used to determine the number of apartments, which was found as being approximately 150 units. This is location B noted in **Appendix E**.

2. The currently developed commercial area on the north end of the project has potential for some redevelopment. By reconstructing the road and adding amenities to the area, there is potential to bring new investment to the area. Four properties currently unused or appearing vacant which could be redeveloped were identified. It was assumed half, or two, of these properties might be redeveloped within the 20 years from construction to the design year. The assumptions are one of the properties could be a general commercial and the other could be a high turnover sit down restaurant. The lots are all of similar size, so the general commercial was assumed at the corner of Grandview Avenue and Warren Street/Oregon Street. The restaurant was assumed on another lot to the north. This is location C noted in **Appendix E**.

3. The third potential area to experience development or redevelopment is the south end of the project where there are vacant lots that could be potentially developed. There are eight vacant lots directly adjacent to Grandview Avenue between HWY 61 and S Houser Street/Sampson Street. Since the location is farther from the city center, it was assumed two of the eight lots might be developed. The lot areas were reviewed and an approximate average size of 1.8 acres per lot was found. It was assumed the lots would be light industrial related to construction companies or small manufacturing companies. This is location D noted in **Appendix E**.

Trip generation was completed using the Trip Generation Manual, 8th Edition, Institute of Transportation Engineers, 2008. Trip generation rates were evaluated using data for Shopping Center (ITE 820), Mid-Rise Apartments (ITE 223), High-Turnover (Sit-Down) Restaurant (ITE 532), and General Light Industrial (ITE 110). The trip generation results are contained in **Appendix F**, and is also summarized in **Table 1** and **Table 2.**

Table 1: Trip Generation Summary Construction Year

Land Use	ITE Code	Proposed Size	AM Peak Hour		PM Peak Hour		Weekday	
			Entering	Exiting	Entering	Exiting	Entering	Exiting
Construction Year Redevelopment								
Shopping Center	820	19,800 SF	37	24	106	110	1186	1186
			AM Peak Hour total	61	PM Peak Hour total	216	Weekday total	2372

Table 2: Trip Generation Summary Design Year

Land Use	ITE Code	Proposed Size	AM Peak Hour		PM Peak Hour		Weekday	
			Entering	Exiting	Entering	Exiting	Entering	Exiting
Design Year Redevelopment - City Property								
Mid-Rise Apartment	223	150 Dwelling Units	16	34	36	26	517	517
Shopping Center	820	74,000 SF	79	50	259	264	2823	2761
Design Year Redevelopment - North Commercial Area								
High-Turnover (Sit-Down) Restaurant	532	5,500 SF	34	31	36	27	350	350
Shopping Center	820	6,000 SF	17	11	44	45	497	486
Design Year Redevelopment - South Industrial Area								
General Light Industrial	110	3.6 Acres	104	15	13	94	132	132
			AM Peak Hour total	391	PM Peak Hour total	844	Weekday total	8565

B. LANE CONFIGURATION

The City requested a review of the lane configuration in coordination and the incorporation of Complete Streets objectives, where applicable, in accordance with the City of Muscatine's Complete Street Policy. The proposed configuration must improve traffic flow and safety, and bicycle and pedestrian facilities along the corridor.

A concept created by Greening America's Communities with center turn lane, bike lanes and intersection revisions was utilized. The concept is subject to change as the development of the project progress to include input from the traffic study as well as input from a stakeholders group.

The City wants to evaluate the following lane configuration:

- Two-lane section from US 61 / Dick Drake HWY intersection to S Houser / Sampson St intersection
- Three-lane section from S Houser / Sampson St intersection to the north end (Pearl St intersection)

An overview of the 2-lane and the 3-lane section plus typical section can be found in **Appendix B**.

C. FUTURE YEAR GROWTH

The AADT Maps generated by the DOT were used to determine the potential growth on the system for the future. The growth rates were reviewed along the corridor within the study area, divided into three segments: US 61 / Dick Drake HWY through Houser St/Sampson St, Houser St / Sampson St through Bond St, and Bond St through Pearl St. As depicted in **Table 5**, in certain

periods, the annual growth rate was positive for some of the sections but the general annual growth rate from 1998 to 2014 was negative for all three segments. The traffic study prepared by Bolton & Menk for the Mississippi Drive used an annual growth rate of 1.0%. Therefore, for consistency and to be more conservative, a 1.0% annual growth rate was used in this study.

Table 5 – AADTs and Growth Rates on Grandview Avenue

		Roadway Section		
AADT Year	Annual Growth Rate	US 61 - Houser St	Houser St - Bond St	Bond St - PearlSt
1998		5500	6600	12650
	1998-2002	-0.029	-0.040	0.026
2002		4880	5600	14000
	2002-2006	0.002	0.007	-0.038
2006		4920	5760	12000
	2006-2010	-0.056	-0.051	-0.077
2010		3910	4680	8700
	2010-2014	0.003	0.003	--
2014		3950	4740	--
	1998-2014	-0.020	-0.020	-0.031

Turning Movement counts were updated for both opening and design year and can be found in **Appendix C.**

D. ALTERNATIVES ANALYZED

Two alternatives were analyzed, as follows:

I. No Build

The No Build alternative takes into consideration the traffic generated by the proposed developments and redevelopments with no roadway improvements, i.e., same lane configuration and intersection control.

II. Build

The Build Alternative takes into consideration the traffic generated by the proposed developments and redevelopments with roadway improvements, as follows:

- Reconstruction of Grandview Avenue as 2-lane section from US 61 / Dick Drake HWY intersection to S Houser / Sampson St intersection
- Reconstruction of the intersection of Grandview Avenue and S Houser / Sampson St as a 1-lane roundabout with slip lanes on both northbound east and eastbound-south directions.
- Reconstruction of Grandview Avenue as 3-lane section from S Houser / Sampson St intersection to the north end (Pearl St intersection)
- Addition of left turn lane at all intersections within the 3-lane roadway section
- Addition of turn lanes on the side street approaches if required by the traffic operation analysis to provide acceptable delays and LOS

VII. Operational Analysis

The traffic operations analysis for the intersections consider the following measures to determine the adequacy of the intersection design to meet acceptable operations: intersection delay/Level of Service (LOS) and volume-to-capacity ratios (V/C). An explanation of each of these measures is provided below:

A. LEVEL OF SERVICE AND DELAY

The operational analysis results are described as a Level of Service (LOS) ranging from A to F. These letters serve to describe a range of operating conditions for different types of facilities. Levels of Service are calculated based on the Highway Capacity Manual, 6th Edition, which defines the level of service, based on control delay. Control delay is the delay experienced by vehicles slowing down as they are approaching the intersection, the wait time at the intersection, and the time for the vehicle to speed up through the intersection and enter into the traffic stream. The average intersection control delay is a volume weighted average of delay experienced by all motorists entering the intersection on all intersection approaches. The control delay is modeled within the analysis software, Trafficware Synchro. Level of Service D is commonly taken as an acceptable design year LOS. The level of service and its associated intersection delays for signalized and unsignalized intersections, and V/C ratios are presented below. The delay threshold for unsignalized intersections is lower for each LOS compared to signalized intersections, which accounts for the fact that people expect a higher level of service when at a stop-controlled intersection.

Table 6: Level of Service Criteria

	Signalized Intersection	Unsignalized Intersection
LOS	**Control Delay per Vehicle (sec.)**	**Control Delay per Vehicle (sec.)**
A	≤ 10	≤ 10
B	>10 and ≤ 20	>10 and ≤ 15
C	>20 and ≤ 35	>15 and ≤ 25
D	>35 and ≤ 55	>25 and ≤ 35
E	>55 and ≤ 80	>35 and ≤ 50
F	>80	>50

Note: If V/C > 1.0, then LOS will be equal to F, independently of the delay.

Additional Measures of Effectiveness (MOEs) such as travel time, travel speed, queue lengths, and delay were used to evaluate either the intersections or the corridor operations.

The tabulations with all MOEs for the scenarios described can be found in **Appendix E.**

B. SCENARIOS

A total of five scenarios were prepared and evaluated, as follows:

- Existing Conditions (2018)
  Existing traffic volumes with existing lane configuration and intersection controls
- Construction Year (2020) No Build
  Existing traffic volumes plus developments with existing lane configuration and intersection controls
- Construction Year (2020) Build
  Existing traffic volumes plus developments with proposed lane configuration and intersection controls

- Future Year (2040) No Build
  Future Year traffic volumes plus developments with existing lane configuration and intersection controls
- Future Year (2040) Build
  Future Year traffic volumes plus developments with proposed lane configuration and intersection controls

A. SCENARIO 1: EXISTING CONDITIONS

A traffic operations analysis was conducted using the existing turning movement counts, existing lane configurations, and existing intersection controls, using Synchro and SimTraffic. **Table 7** includes a summary of the results of the analysis. The full table with the results of the analysis can be found in **Appendix G**.

Table 7 – Existing Conditions (2018) LOS and Queue Lengths per Intersection

Traffic Control Scenario	Peak Hour	Intersection Delay* - LOS		Maximum Delay - LOS**		Limiting Movement ***	Max Approach Queue			
							Direction		Average Queue (ft)	Max Queue (ft) ****
US 61	AM	10	B	20	C	SBL	EBT	US 61	50	125
	PM	16	B	23	C	NBL	NBL	Grandview Ave	125	250
S Houser St / Sampson St	AM	9	A	16	B	EBL	EBL/T	S Houser St	50	150
	PM	11	B	18	B	EBL	WBL/T	Sampson St	50	125
Musser St	AM	2	A	6	A	EBT	WBL/T/R	Musser St	50	75
	PM	3	A	8	A	EBT	EBL/T/R	Musser St	50	100
Warren St / Oregon St	AM	5	A	10	B	WBT	SBL	Grandview Ave	50	125
	PM	7	A	12	B	SBL	SBL	Grandview Ave	75	150
Bond St / Driveway	AM	1	A	8	A	WBL	NBL/T	Grandview Ave	25	75
	PM	1	A	3	A	EBR	EBL/T/R	Bond St	25	50
Franklin St	AM	1	A	10	B	EBT	EBL/T/R	Franklin St	25	50
	PM	1	A	14	B	EBT	SBL/T	Grandview Ave	25	50
* Delay in seconds per vehicle										
** Maximum delay and LOS on any specific approach and/or movement										
*** Limiting movement is the highest delay approach										
**** Max Queue refers to the 95th Percentile Queue (Passenger car stored length = 25 ft, Heavy vehicle stored length = 45 ft										
General Notes:										
- AM Peak Hour = 7:15 - 8:15										
- PM Peak Hour = 3:30 - 4:30										

The results show that:

- Intersection delay is acceptable at all of the intersections, which have overall LOS equal to or better than B.
- All movements at all intersections for both AM and PM peak hours have acceptable delays and LOS equal to or better than C.
- None of the limiting delays is near capacity during either the AM or the PM peak.

The travel time, delay per vehicle and average travel speeds for vehicles travelling between US 61 / Dick Drake HWY and Franklin Street were analyzed with exiting traffic volumes. **Table 8** shows the results of the analysis.

Table 8 – Existing Conditions Travel Time and Speed

Direction	Peak Hour	Travel Time (sec.)	Delay (sec./veh.)	Average Speed (mph)
Northbound	AM	238	33	33
	PM	244	38	32
Southbound	AM	215	31	35
	PM	234	45	32

Currently, the travel time along Grandview Avenue is about 3.6-4.0 minutes going either direction during both peak hours and the average speeds vary from 32 mph to 35 mph, for posted speeds of 35-45 mph. This speed accounts for delay at signals and higher speeds between the signals.

B. SCENARIO 2: CONSTRUCTION YEAR WITH EXISTING GEOMETRY

The forecasted 2020 traffic volumes were analyzed with current geometry and current intersection controls in Synchro/Simtraffic. **Table 9** depicts the results of the analysis.

Table 9: Construction Year (2020) and Existing Geometry and Controls

LOS and Queue Lengths per Intersection

Traffic Control Scenario	Peak Hour	Intersection Delay* - LOS		Maximum Delay - LOS**		Limiting Movement ***	Max Approach Queue			
							Direction		Average Queue (ft)	Max Queue (ft) ****
US 61	AM	10	B	16	B	SBT	EBT	US 61	50	125
	PM	18	B	29	C	NBL	NBL	Grandview Ave	150	350
S Houser St / Sampson St	AM	9	A	16	B	EBL	EBL/T	S Houser St	50	125
	PM	12	B	19	B	EBL	SBL/T/R	Grandview Ave	50	175
Musser St	AM	2	A	7	A	WBT	WBL/T/R	Musser St	25	75
	PM	3	A	9	A	EBL	EBL/T/R	Musser St	50	100
Warren St / Oregon St	AM	6	A	10	B	WBL	SBL	Grandview Ave	50	125
	PM	7	A	13	B	SBL	SBL	Grandview Ave	75	150
Bond St / Driveway	AM	1	A	6	A	WBL	NBL/T	Grandview Ave	25	50
	PM	1	A	3	A	NBL	NBL/T	Grandview Ave	25	50
Franklin St	AM	1	A	7	A	EBT	EBL/T/R	Franklin St	25	50
	PM	1	A	10	B	WBL	SBL/T	Grandview Ave	25	75

* Delay in seconds per vehicle

** Maximum delay and LOS on any specific approach and/or movement

*** Limiting movement is the highest delay approach

**** Max Queue refers to the 95th Percentile Queue (Passenger car stored length = 25 ft, Heavy vehicle stored length = 45 ft

The results show that:

- Intersection delay is acceptable at all of the intersections, which have overall LOS equal to or better than B.
- All movements at all intersections for both AM and PM peak hours have acceptable delays and LOS equal to or better than C.
- None of the limiting delays is near capacity during either the AM or the PM peak.

The travel time, delay per vehicle and average travel speeds for vehicles travelling between US 61 / Dick Drake HWY and Franklin Street were analyzed with exiting traffic volumes. **Table 10** shows the results of the analysis.

Table 10: Construction Year (2020) and Existing Geometry and Controls

Travel Time and Speed

Direction	Peak Hour	Travel Time (sec.)	Delay (sec./veh.)	Average Speed (mph)
Northbound	AM	235	33	33
	PM	252	43	31
Southbound	AM	218	34	34
	PM	238	48	31

In the construction year, with current geometry and intersection controls, the travel time along Grandview Avenue is about 3.6-4.2 minutes going either direction during both peak hours and the average speeds vary from 31 mph to 34 mph, for posted speeds of 35-45 mph. This speed accounts for delay at signals and higher speeds between the signals.

C. SCENARIO 3: CONSTRUCTION YEAR WITH ALTERNATE GEOMETRY

The forecasted 2020 traffic volumes were analyzed with alternate geometry and intersection controls in Synchro/Simtraffic. The intersection of Houser Street was analyzed as a one-lane roundabout and the lane configuration at the intersections north of Houser reflect the proposed roadway three-lane section. **Table 11** depicts the results of the analysis.

Table 11: Construction Year (2020) and Alternate Geometry and Controls

LOS and Queue Lengths per Intersection

Traffic Control Scenario	Peak Hour	Intersection Delay* - LOS		Maximum Delay - LOS**		Limiting Movement ***	Max Approach Queue			
							Direction		Average Queue (ft)	Max Queue (ft) ****
US 61	AM	10	B	17	B	SBT	EBT	Dick Drake HWY	50	150
	PM	17	B	26	C	NBL	NBL	Grandview Ave	150	325
S Houser St / Sampson St	AM	5	A	6	A	NBT	NBL/T	Grandview Ave	25	75
	PM	6	A	8	A	NBT	SBL/T/R	Grandview Ave	50	100
Musser St	AM	2	A	7	A	EBT	EBL/T/R	Musser St	50	75
	PM	3	A	9	A	WBT	WBL/T/R	Musser St	50	100
Warren St / Oregon St	AM	6	A	12	B	WBL	SBL	Grandview Ave	50	125
	PM	8	A	14	B	EBL	NBT/R	Grandview Ave	75	150
Bond St / Driveway	AM	1	A	14	B	EBL	EBL/T/R	Driveway	25	50
	PM	1	A	5	A	EBR	EBL/T/R	Driveway	25	50
Franklin St	AM	1	A	14	B	EBL	EBL/T/R	Franklin St	25	50
	PM	1	A	13	B	WBL	EBL/T/R	Franklin St	25	50

* Delay in seconds per vehicle

** Maximum delay and LOS on any specific approach and/or movement

*** Limiting movement is the highest delay approach

**** Max Queue refers to the 95th Percentile Queue (Passenger car stored length = 25 ft, Heavy vehicle stored length = 45 ft

The results show that:

- Intersection delay is acceptable at all of the intersections, which have overall LOS equal to or better than B.
- All movements at all intersections for both AM and PM peak hours have acceptable delays and LOS equal to or better than C.
- None of the limiting delays is near capacity during either the AM or the PM peak.
- The comparison with the 2018 No Build Scenario shows insignificant changes between the two.

The travel time, delay per vehicle and average travel speeds for vehicles travelling between US 61 and Franklin Street were analyzed with exiting traffic volumes. **Table 12** shows the results of the analysis.

Table 12: Construction Year (2020) and Alternate Geometry and Controls

Travel Time and Speed

Direction	Peak Hour	Travel Time (sec.)	Delay (sec./veh.)	Average Speed (mph)
Northbound	AM	239	31	33
	PM	221	32	34
Southbound	AM	252	41	31
	PM	239	44	31

In the construction year, with alternate geometry and intersection controls, the travel time along Grandview Avenue is about 3.7-4.2 minutes going either direction during both peak hours and the average speeds vary from 31 mph to 34 mph, for posted speeds of 35-45 mph. This speed accounts for delay at signals and higher speeds between the signals.

Comparing the MOEs between the 2018 No Build Scenario and 2018 Build Scenario shows insignificant changes between the two. Therefore, the proposed configuration has no adverse impact in the traffic flow along the Grandview Avenue corridor.

D. SCENARIO 4: FUTURE YEAR WITH CURRENT GEOMETRY

The forecasted 2040 traffic volumes were analyzed with current geometry and intersection controls in Synchro/Simtraffic, whose results are depicted in **Table 13**.

Table 13: Future Year (2040) and Current Geometry and Controls

LOS and Queue Lengths per Intersection

Traffic Control Scenario	Peak Hour	Intersection Delay* - LOS		Maximum Delay - LOS**		Limiting Movement ***	Max Approach Queue			
							Direction		Average Queue (ft)	Max Queue (ft) ****
US 61	AM	11	B	14	B	WBL	EBT	US 61	75	175
	PM	20	C	35	D	NBL	NBL	Grandview Ave	200	375
S Houser St / Sampson St	AM	10	B	18	B	EBT	EBL/T	S Houser St	75	175
	PM	14	B	20	C	EBL	NBL/T/R	Grandview Ave	100	225
Musser St	AM	3	A	8	A	WBT	WBL/T/R	Musser St	50	100
	PM	5	A	14	B	WBL	EBL/T/R	Musser St	50	125
Warren St / Oregon St	AM	7	A	12	B	SBL	SBL	Grandview Ave	75	150
	PM	9	A	18	B	WBL	WBR	Oregon St	100	200
Bond St / Driveway	AM	1	A	10	B	WBL	NBL/T	Grandview Ave	25	75
	PM	1	A	5	A	NBL	NBL/T	Grandview Ave	25	50
Franklin St	AM	1	A	14	B	WBL	SBL/T	Grandview Ave	25	75
	PM	1	A	24	C	EBT	SBL/T	Grandview Ave	25	100
* Delay in seconds per vehicle										
** Maximum delay and LOS on any specific approach and/or movement										
*** Limiting movement is the highest delay approach										
**** Max Queue refers to the 95th Percentile Queue (Passenger car stored length = 25 ft, Heavy vehicle stored length = 45 ft										

The results show that:

- Intersection delay is acceptable at all of the intersections, which have overall LOS equal to or better than C.
- All movements at all intersections for both AM and PM peak hours have acceptable delays and LOS equal to or better than D.

The travel time, delay per vehicle and average travel speeds for vehicles travelling between US 61 and Franklin Street were analyzed with exiting traffic volumes. **Table 14** shows the results of the analysis.

Table 14: Future Year (2040) and Current Geometry and Controls

Travel Time and Speed

Direction	Peak Hour	Travel Time (sec.)	Delay (sec./veh.)	Average Speed (mph)
Northbound	AM	243	39	32
	PM	253	51	31
Southbound	AM	217	33	35
	PM	245	55	30

In the future year (2040), with current geometry and intersection controls, the travel time along Grandview Avenue is about 3.6-4.2 minutes going either direction during both peak hours and the average speeds vary from 31 to 35 mph, for posted speeds of 35-45 mph. This speed accounts for delay at signals and higher speeds between the signals.

E. SCENARIO 5: FUTURE YEAR WITH ALTERNATE GEOMETRY

The forecasted 2040 traffic volumes were analyzed with alternate geometry and intersection controls in Synchro/Simtraffic, whose results are depicted in **Table 15**.

Table 15: Future Year (2040) and Alternate Geometry and Controls

LOS and Queue Lengths per Intersection

Traffic Control Scenario	Peak Hour	Intersection Delay* - LOS		Maximum Delay - LOS**		Limiting Movement ***	Max Approach Queue			
							Direction		Average Queue (ft)	Max Queue (ft) ****
US 61	AM	11	B	14	B	EBT	EBT	Dick Drake HWY	75	200
	PM	21	C	35	D	NBL	NBL	Grandview Ave	175	375
S Houser St / Sampson St	AM	6	A	9	A	NBL	NBL/T	Grandview Ave	25	100
	PM	8	A	10	B	NBT	NBL/T	Grandview Ave	50	150
Musser St	AM	3	A	9	A	WBT	WBL/T/R	Musser St	50	100
	PM	4	A	14	B	EBL	EBL/T/R	Musser St	50	100
Warren St / Oregon St	AM	8	A	15	B	SBL	SBL	Grandview Ave	75	175
	PM	12	B	21	C	EBL	WBR	Warren St	100	250
Bond St / Driveway	AM	1	A	7	A	EBL	EBL/T/R	Driveway	25	50
	PM	1	A	6	A	NBL	NBL	Grandview Ave	25	50
Franklin St	AM	1	A	13	B	WBL	WBL/T/R	Franklin St	25	75
	PM	2	A	43	E	EBL	WBL/T/R	Franklin St	25	100

* Delay in seconds per vehicle

** Maximum delay and LOS on any specific approach and/or movement

*** Limiting movement is the highest delay approach

**** Max Queue refers to the 95th Percentile Queue (Passenger car stored length = 25 ft, Heavy vehicle stored length = 45 ft

The results show that:

- Intersection delay is acceptable at all of the intersections, which have overall LOS equal to or better than C.
- Only the EBL movement at Franklin St during the PM peak hour has an unsatisfactory delay (37 sec.) and LOS (E), which may be acceptable as the overall intersection operates under a LOS equal to A during the PM peak hour. This movement has only one vehicle in the PM peak hour and therefore, the result is overall insignificant. Additionally, drivers have historically adjusted to traffic conditions by taking alternate paths or changing their time schedules. All other movements at all intersections for both AM and PM peak hours have acceptable delays and LOS equal to or better than D.
- The limiting delay is near capacity at the EBL movement of Franklin St intersection during the PM peak hour. None of the remaining limiting delays at each intersection are near capacity during either the AM or the PM peak. However, as explained in the previous paragraph, this result is overall insignificant. Additionally, the result is being caused by the additional trips generated by a potential development nearby, which there is no guarantee would happen. In the future, if the development happens, a Traffic Impact Study must be prepared which can limit either the size or the type, keeping delay and LOS at acceptable levels.

The travel time, delay per vehicle and average travel speeds for vehicles travelling between US 61 and Franklin Street were analyzed with exiting traffic volumes. **Table 16** shows the results of the analysis.

Table 16: Future Year (2040) and Alternate Geometry and Controls

Travel Time and Speed

Direction	Peak Hour	Travel Time (sec.)	Delay (sec./veh.)	Average Speed (mph)
Northbound	AM	246	38	32
	PM	255	49	31
Southbound	AM	219	29	34
	PM	246	51	30

In the future year (2040), with alternate geometry and intersection controls, the travel time along Grandview Avenue is about 3.7-4.3 minutes going either direction during both peak hours and the average speeds vary from 30 mph to 34 mph, for posted speeds of 35-45 mph. This speed accounts for delay at signals and higher speeds between the signals.

Comparing the MOEs between the 2040 No Build Scenario and 2040 Build Scenario shows insignificant changes between the two, except for the westbound left turn movement at Franklin St, with LOS equal to E and capacity near the limit. This is caused by the development being proposed on the east side of Grandview Avenue, between Bond St and Franklin St. Previous experience has demonstrated that drivers may adjust to this situation and improve operations by trying different paths or changing their work schedule.

F. INTERSECTION LANE CONFIGURATIONS

The analysis have shown the need to modify the lane configuration of some intersections to provide acceptable delays and LOS, as follows:

Table 17: Proposed Lane Configurations

Intersection	Approach			
	SB	WB	NB	EB
US 61/Dick Drake HWY	Same	Same	Same	Same
S Houser St/Sampson St	Same	Same	Same	Same
Musser St	1LT Lane Added	Same	1 LT Lane Added	Same
Warren St/Oregon St	Same	Same	1 LT and 1 Share TH/RT	1 Shared RT/TH/RT; Dedicated RT Lane Removed
Bond St	1 LT and 1 Shared Th/RT	Same	1 LT and 1 Share TH/RT	Same
Franklin St	1 LT and 1 Shared Th/RT	Same	1 LT and 1 Share TH/RT	Same

VIII. Warrant Analysis

A. Traffic Signal Warrant Analysis

The MUTCD states that the investigation of the need for a traffic control signal shall include an analysis of the applicable factors contained in the following traffic signal warrants:

- Warrant 1: Eight-Hour Vehicular Volume
- Warrant 2: Four-Hour Vehicular Volume
- Warrant 3: Peak Hour
- Warrant 4: Pedestrian Volume
- Warrant 5: School Crossing

- Warrant 6: Coordinated Signal System
- Warrant 7: Crash Experience
- Warrant 8: Roadway Network
- Warrant 9: Intersection Near a Grade Crossing

A traffic signal shall not be installed unless one or more of the warrants can be met.

Traffic signal warrant analyses were completed for some intersections along Grandview Avenue with the objective of determining whether or not the existing traffic signal is still warranted at signalized intersections and whether or not a new traffic signal is warranted at unsignalized intersections. Signal warrant analysis 1A, 1B, 2, 3, and 7 were prepared with the existing 2018 traffic volumes for the following intersections:

- US 61/Dick Drake HWY
- S Houser St/Sampson St
- Musser St
- Warren St/Oregon St
- Bond St/Driveway
- Franklin St

Signal warrant analysis 1A, 1B, 2, 3, and 7 were prepared with the forecast 2040 traffic volumes for the intersections of S Houser St/Sampson St and Warren St/Oregon St, as the warrants were not met for existing conditions at these intersections.

Table 17 shows the warrants met at each intersection with the existing 2018 and future 2040 traffic counts.

Table 17: Traffic Signal Warrant

Signal Warrant - 2018		
Intersection	Warrants Met - 2018	Warrants Met - 2040
US 61/Dick Drake HWY	1A, 2, 7	*
S Houser St/Sampson St	None	7
Musser St	None	*
Warren St/Oregon St	None	None
Bond St/Driveway	None	*
Franklin St	None	*
* Future year not analyzed		

The intersection of US 61/Dick Drake HWY, which is currently signalized, met two signal warrants for 2018. Warrants were not analyzed for 2040.

The intersection of S Houser St/Sampson St, which is currently signalized, did not meet any warrants for 2018 but met signal warrant 7 for 2040. This intersection is being proposed to be reconstructed as a roundabout.

The intersection of Warren St/Oregon St, which is currently signalized, did not meet any warrants for 2018 or 2040. This intersection is proposed to be reconstructed with a signal, mostly because Oregon St is the main access to the grain processing center, whose peak hour may not match the corridor peak hour and also because the random number of trucks, which may be high at times.

The remaining intersections, which are currently not signalized, did not meet any warrants, for 2018. Warrants were not analyzed for 2040.

The results of the traffic signal warrant analysis can be found in **Appendix H**.

B. All-Way Stop Warrant Analysis

All-Way Stop warrant analyses were completed for the same intersections where turning movements were collected. The analyses with the existing 2018 traffic volumes were prepared for the following intersections:

- US 61/Dick Drake HWY
- S Houser St/Sampson St
- Musser St
- Warren St/Oregon St
- Bond St/Driveway
- Franklin St

The analyses with the forecast 2040 traffic volumes were prepared for the intersections of S Houser St/Sampson St and Warren St/Oregon St. **Table 18** shows the warrants met at each intersection with the existing 2018 and future 2040 traffic counts.

Table 18: All-Way Stop Warrant

All Way Stop Control Warrant - 2018		
Intersection	Warrant Met - 2018	Warrant Met - 2040
US 61/Dick Drake HWY	Yes	*
S Houser St/Sampson St	No	No
Musser St	No	*
Warren St/Oregon St	Yes	Yes
Bond St/Driveway	No	*
Franklin St	No	*
* Future year not analyzed		

The intersection of US 61/Dick Drake HWY, which is currently signalized, met the warrant for 2018. Warrant was not analyzed for 2040.

The intersection of S Houser St/Sampson St, which is currently signalized, did not meet the warrant for either 2018 or 2040. This intersection is being proposed to be reconstructed as a roundabout.

The intersection of Warren St/Oregon St, which is currently signalized, met the warrant for both 2018 and 2040.

The remaining intersections, which are currently not signalized, did not meet any warrants for 2018. Warrant was not analyzed for 2040.

The results of the all-way stop warrant analysis can be found in **Appendix H.**

C. Justification

- Traffic signals are justified today at the intersections of US 61 / Dick Drake HWY and S Houser St / Sampson St
- Roundabout is deemed to be justified at the intersection of S Houser St / Sampson St, due to signal warrants and safety concerns
- A traffic signal is not justified at the intersection of Warren St / Oregon St, which is currently signalized, but an all-way stop control is justified.
- Neither traffic signals nor all-way stop control are justified at the intersections of Musser St, Bond St / Driveway, and Franklin St.

IX. Conclusions & Recommendations

The purpose of this traffic impact study is to identify potential transportation issues created as a result of changes to the roadway system and surrounding area and recommend solutions to mitigate the potential issues to provide a safer transportation facility for vehicular, pedestrian and bicycle traffic.

A. Access Management

On the eastbound approach of the intersection of Warren St/Oregon St with Grandview Avenue, the curb on the south is mountable with an open access from the back alley to Grandview Avenue (about 140 ft). This access should be reduced to a normal in/out access a 150 ft from Grandview Avenue to avoid conflicts with the eastbound queue of vehicles.

B. Safety

From the crash analysis completed, it was determined that none of the intersections analyzed have crash rates either equal to or higher than the statewide average for the same class of intersections. There were no fatal crashes but one major injury one-vehicle only crash occurred at the intersection of Warren St / Oregon St, involving an ill 64-year old driver stopped at a traffic signal. At both the intersections of US 61 / Dick Drake HWY and Warren St / Oregon St, the minor crashes account for 33% and 25% of the total intersection crashes, respectively. No immediate cause could be identified but substandard geometrics can be connected to unsafe conditions. During the design phase, geometry should be evaluated to identify if any substandard geometric exists and the corresponding countermeasures. Rear end crash pattern and left turn crash patterns were identified at US 61 / Dick Drake HWY intersection. Rear end crashes are mostly caused by inadequate clearance and green times, and inadequate stopping sight distance, while left turn crashes are mostly caused by including inadequate clearance time, stopping sight distance, vertical alignment, and sight triangle. Both patterns can be corrected during the design phase.

C. Operations

The existing traffic analysis shows that currently intersection delay is acceptable with LOS equal to or better than B and no limiting movement near capacity for all of the intersections analyzed.

The forecasted 2020 (construction year) traffic analysis shows that service levels provided by both the two-lane and three lane sections (Build scenario) along Grandview Avenue are equal to better than B for all the intersections and are comparable with the ones provided under existing geometry and control (No Build scenario). The forecasted 2020 traffic analysis also shows that the service levels for the limiting movements are equal to or better than C, that the limiting movement delay and delays are acceptable for all the intersections and are comparable with the ones provided by the No Build scenario.

The forecasted 2040 (future year) traffic analysis shows that service levels provided by both the two-lane and three lane sections (Build scenario) along Grandview Avenue are equal to or better than C and comparable with the ones provided under existing geometry and control (No Build scenario). The forecasted 2040 (future year) traffic analysis also shows, however, the EBL movement at Franklin St during the PM peak hour has an unsatisfactory delay (37 sec.) and LOS (E), which may be acceptable as the overall intersection operates under a LOS equal to A during the PM peak hour. This movement has only one vehicle in the PM peak hour and therefore, the result is overall insignificant. Additionally, drivers have historically adjusted to traffic conditions by taking alternate paths or changing their time schedules. All other movements at all intersections for both AM and PM peak hours have acceptable delays and LOS equal to or better than D.

The limiting delay is near capacity at the EBL movement of Franklin St intersection during the PM peak hour. None of the remaining limiting delays at each intersection are near capacity during either the AM or the PM peak.

The travel times for all scenarios vary from 31 mph to 35 mph, on both directions, for current conditions and future scenarios, both Build and No Build. The average travel time in all scenarios is 3.9 ± 0.3 minutes, where the variation is insignificant.

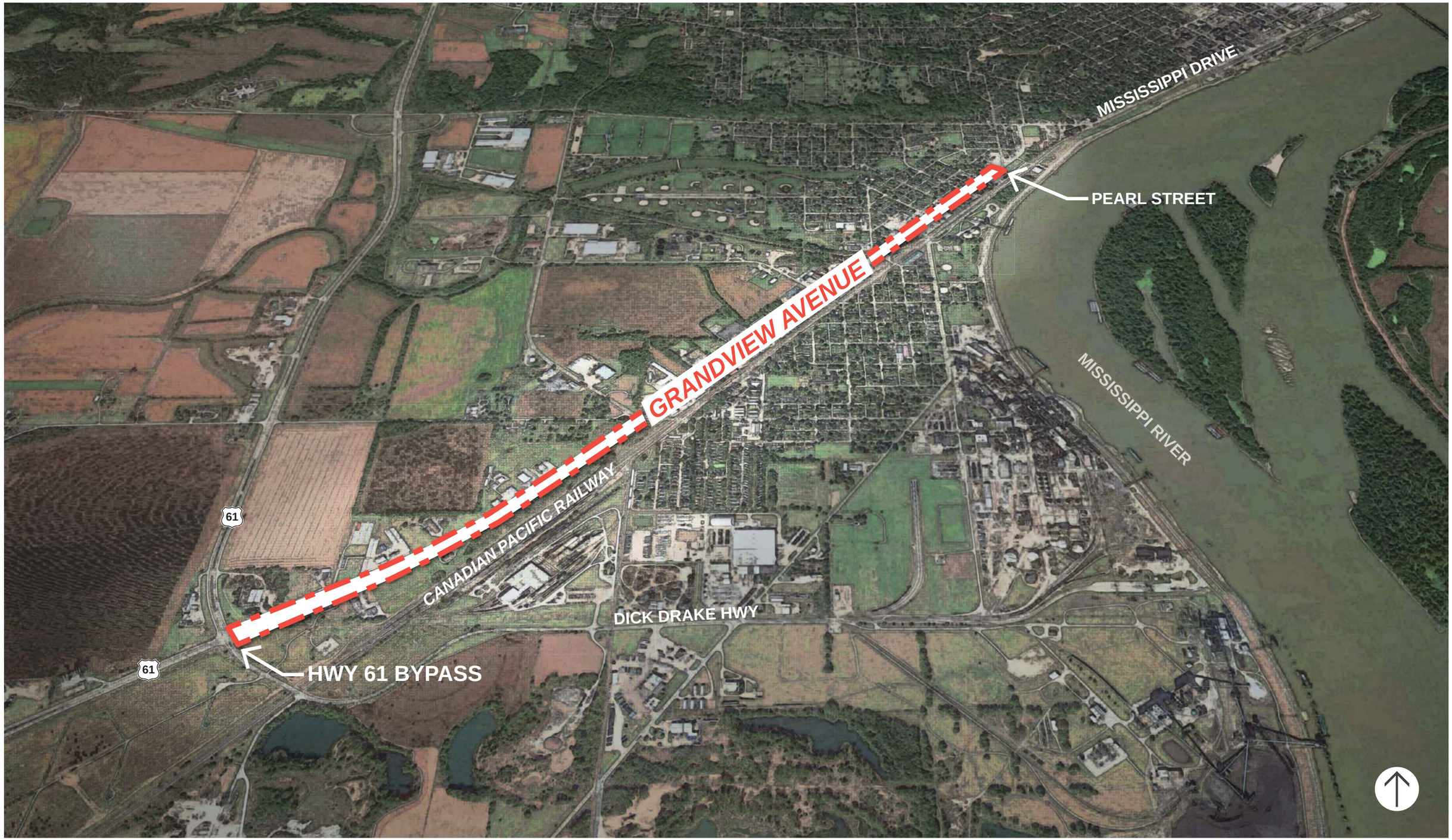
The warrant analysis completed shows that currently signal warrants are met at the intersection of US 61 / Dick Drake HWY (2018), and S Houser St/Sampson St (2040), which are already signalized. At the intersection of Warren St/Oregon St, which is currently signalized, no warrants are met. However, this intersection is proposed to be reconstructed with a signal, mostly because Oregon St is the main access to the grain processing center, whose peak hour may not match the corridor peak hour and also because the random number of trucks, which may be high at times. All-way stop control warrants are met only at US 61 / Dick Drake HWY and Warren St / Oregon St intersections.

The conversion of Grandview Avenue from the current configuration to 2-lane section from the south end to S Houser St / Sampson St , and 3-lane section from S Houser St / Sampson St to the north end will not cause any negative impact on the traffic operations and safety of the corridor, with advantage of providing a complete streets project for improved bicycle and pedestrian circulation.

Operations analyses have shown the need to add left turn lanes at both north and southbound approaches at Musser St, Warren St/Oregon St, Bond St, and Franklin St, due to the 4-lane to 3-lane conversion. Southbound and northbound through lanes were eliminated at these same intersections but the shared thru/right lane was maintained. At Warren St intersection, the existing dedicated eastbound right turn lanes was removed.

Appendix A: Project Extents

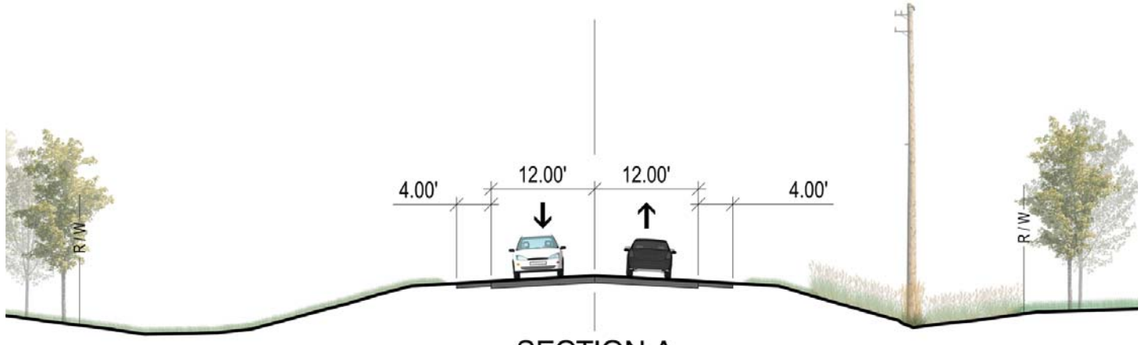
PROJECT EXTENTS



Appendix B: 2-Lane and 3-Lane Overview and Typical Sections

PROPOSED CONDITIONS

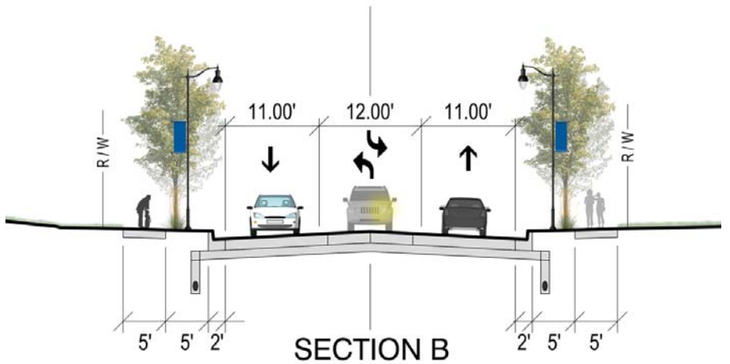
2-LANE ROAD TYPICAL SECTION



SECTION A

US 61 BYPASS to HOUSER ST

3-LANE ROAD TYPICAL SECTION



SECTION B

HOUSER ST to PEARL ST

Appendix C: Peak Hour Count Information

MUSCATINE

Grandview Avenue Reconstruction

City of Muscatine, Iowa

Existing Conditions

February 2018

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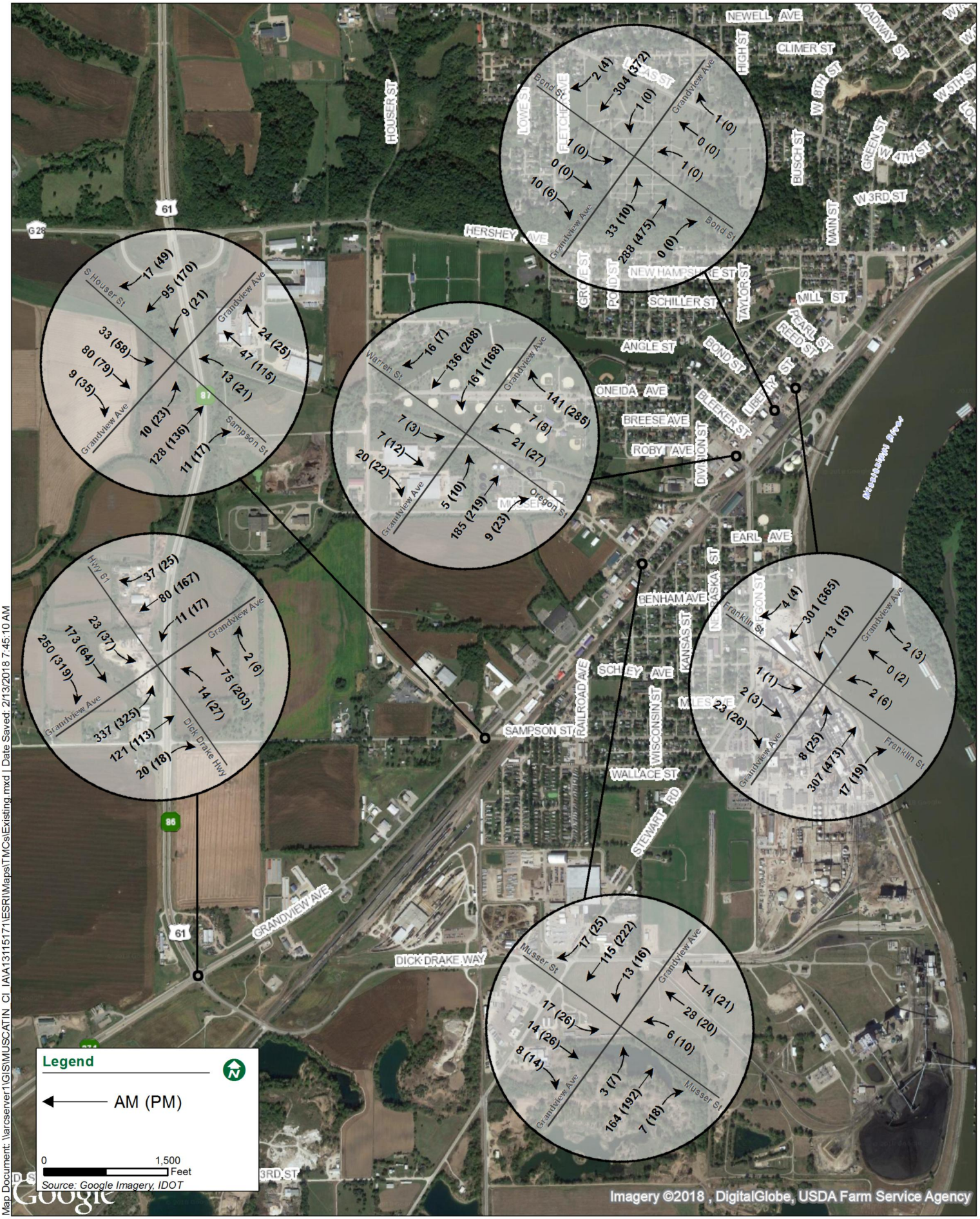

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Grandview Avenue Reconstruction

City of Muscatine, Iowa

Construction Year without Changes

February 2018

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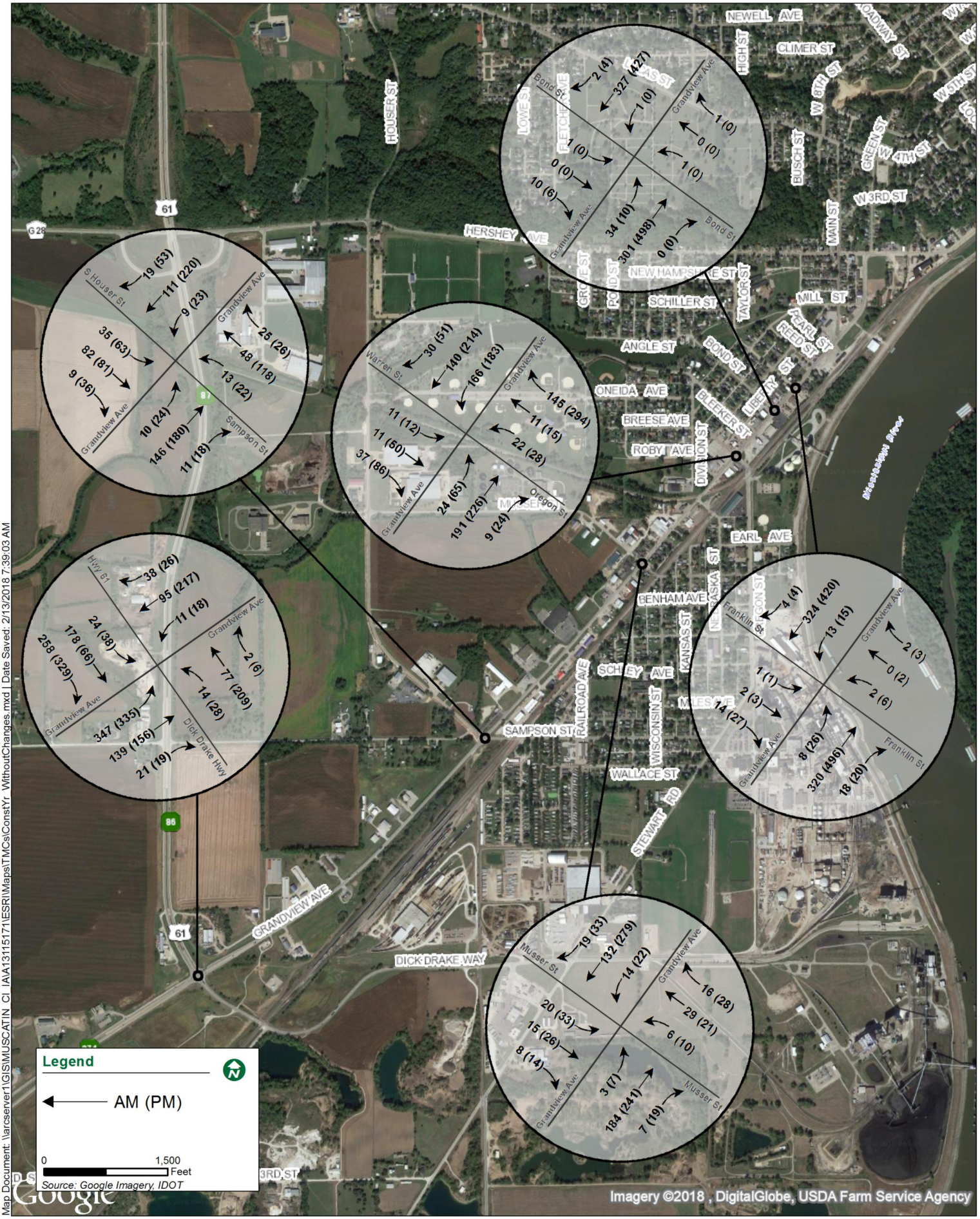

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Grandview Avenue Reconstruction

City of Muscatine, Iowa

Construction Year with Changes

February 2018

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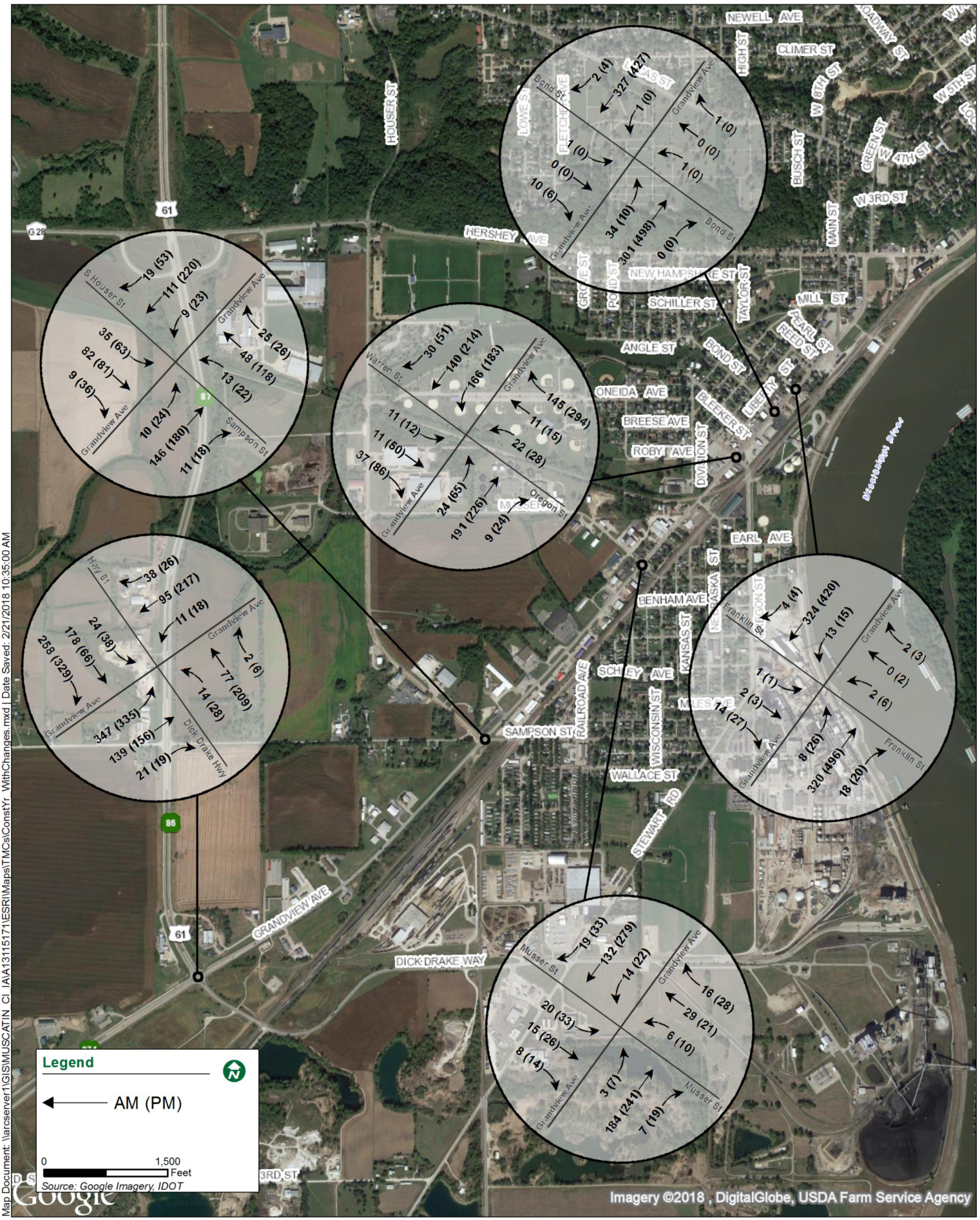

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Grandview Avenue Reconstruction

City of Muscatine, Iowa

Design Year without Changes

February 2018

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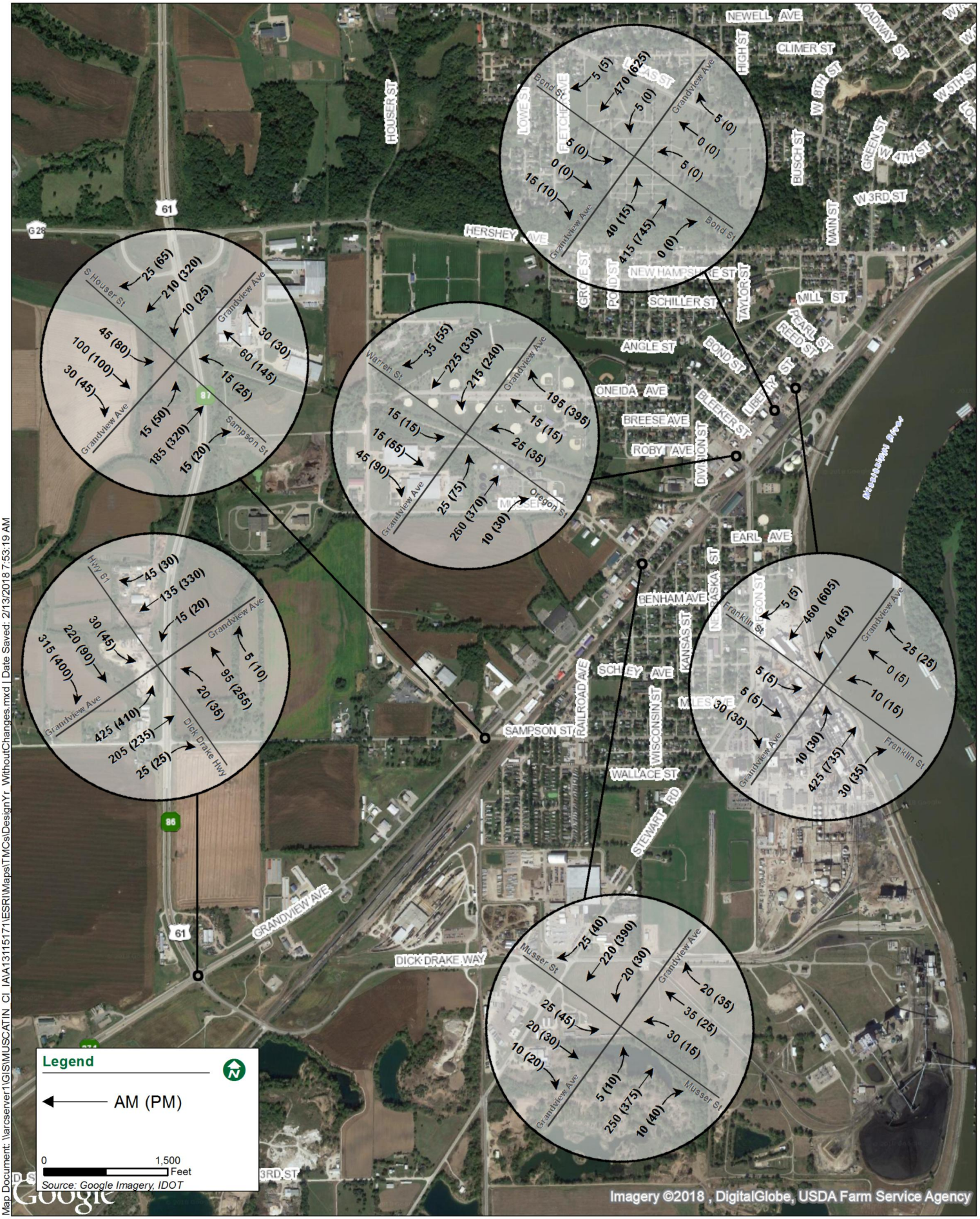

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Grandview Avenue Reconstruction

City of Muscatine, Iowa

Design Year with Changes

February 2018

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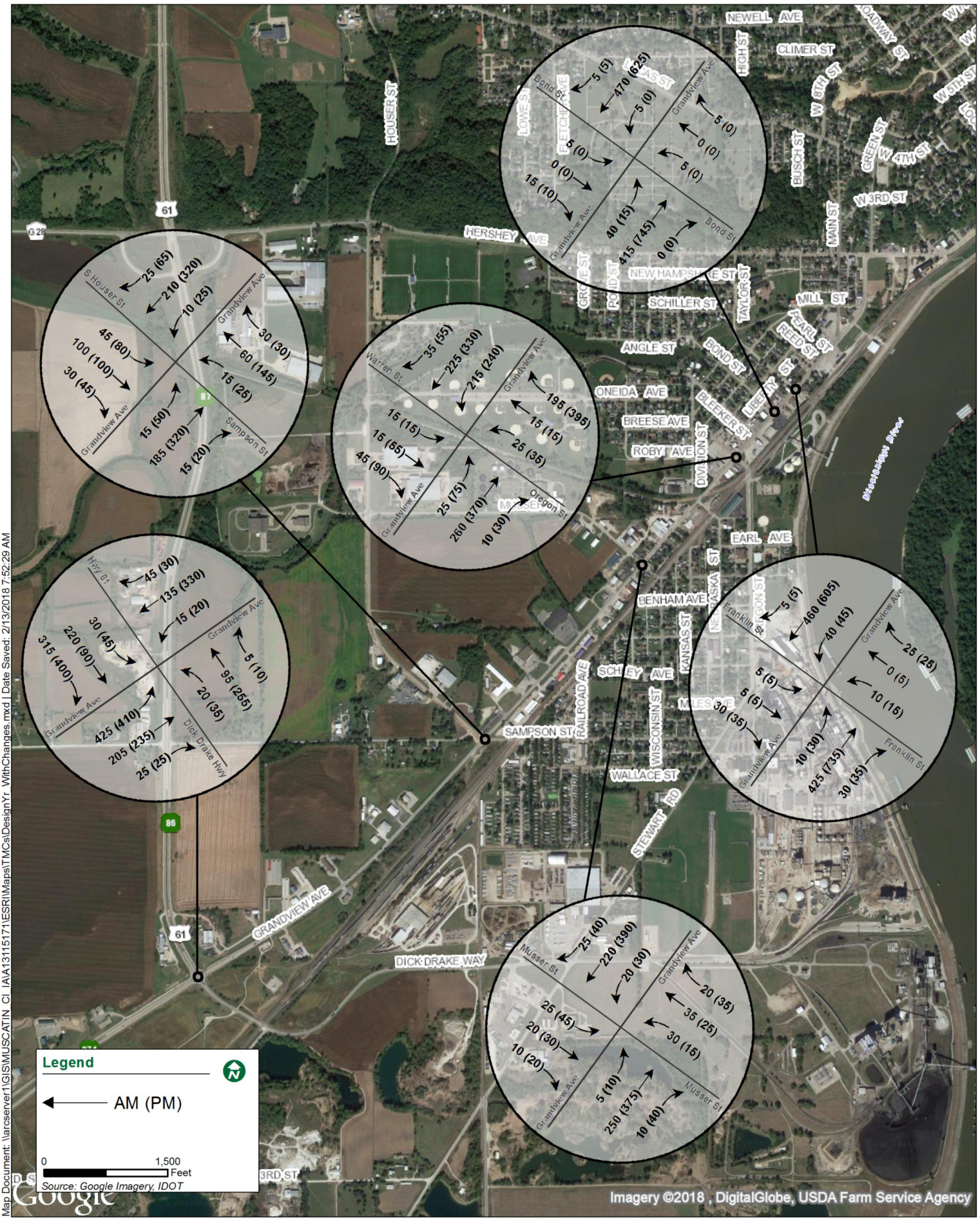

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Appendix D: Crash Diagrams

COLLISION DIAGRAM

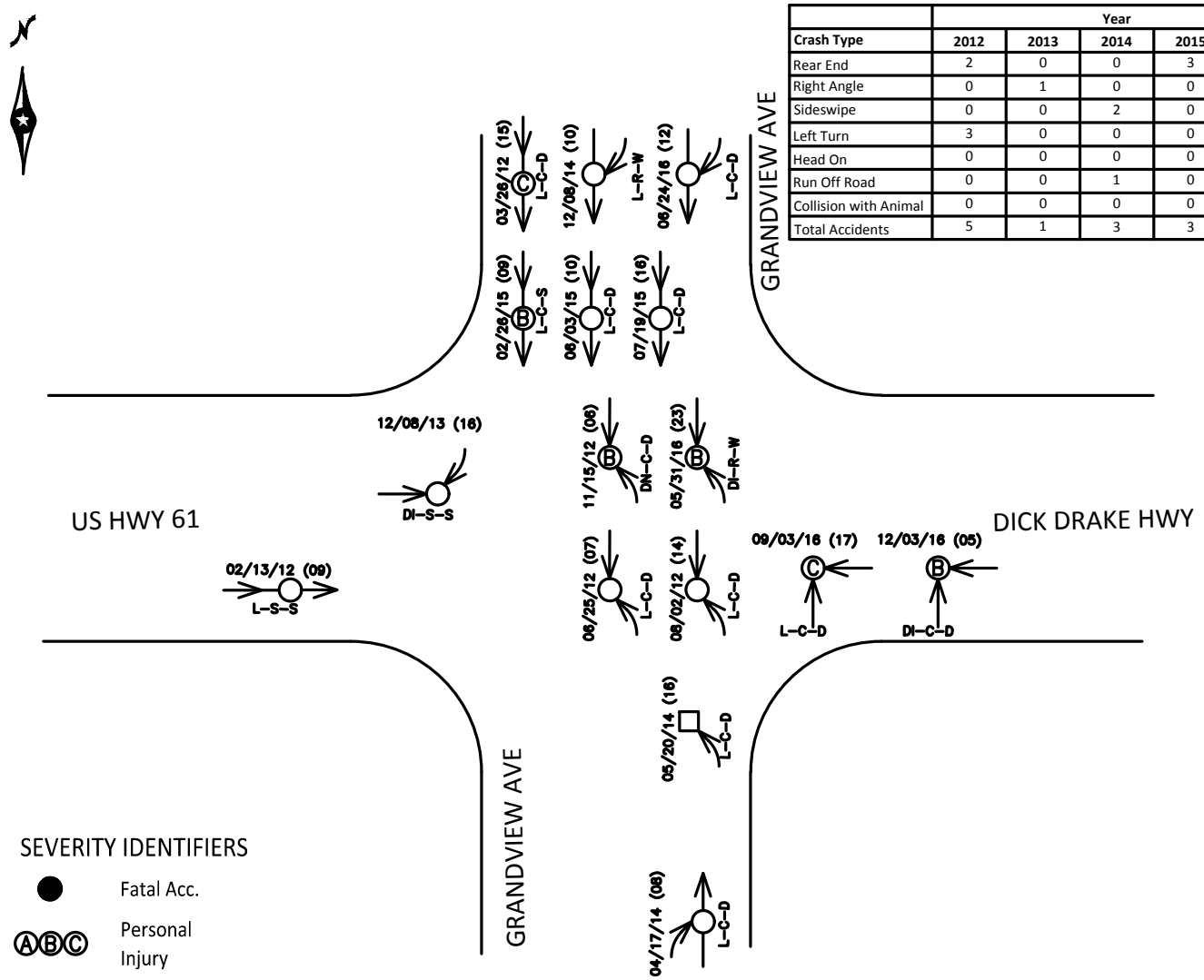
LOCATION: GRANDVIEW AVE AT US 61

TIME PERIOD: 01/01/2012 - 12/31/2016 DATE: 01/19/18

PREPARED BY: R.HAALAND

	Year				
Severity	**2012**	**2013**	**2014**	**2015**	**2016**
Fatal	0	0	0	0	0
Major Injury	0	0	0	0	0
Minor Injury	1	0	0	1	2
Poss/unkwn Injury	1	0	0	0	1
Property Damage	3	1	3	2	1
Total Accidents	5	1	3	3	4

	Year				
Crash Type	**2012**	**2013**	**2014**	**2015**	**2016**
Rear End	2	0	0	3	0
Right Angle	0	1	0	0	2
Sideswipe	0	0	2	0	1
Left Turn	3	0	0	0	1
Head On	0	0	0	0	0
Run Off Road	0	0	1	0	0
Collision with Animal	0	0	0	0	0
Total Accidents	5	1	3	3	4



SEVERITY IDENTIFIERS

- ● Fatal Acc.
- Ⓐ Ⓑ Ⓒ Personal Injury
- ○ Property Damage Acc.

KEY

- Motor Vehicle Backing Up
- Motor Vehicle Out of Control
- SIDESWIPE
- Rear End
- Right Angle
- Pedestrian
- B Bicycle/Moped
- M Motorcycle
- Left Turn
- Fixed Object

NOTES

[1] ADT = 12,450

[2] CR = 0.70

[3]

Light:	Weather:	Surface:
L= Daylight (1)	C= Clear or Cloudy (1 or 2)	D= Dry (1)
DN= Dawn (2)	R= Rain (3)	W= Wet (2)
DU= Dusk (3)	S= Snow or Sleet (4 or 5)	S= Snow or Ice (3 or 4)
DI= Dark, Lighted (4)	F= Fog, Smog, Smoke (6)	M= Muddy (5)
Do= Dark, Lights Off (5)	B= Blowing Sand/Dust (7)	DB= Debris (6)
D= Dark, Unlighted (6)	W= Severe Crosswinds (8)	O= Oily (7)
X= Unknown (99)	X= Other or Unknown (99)	X= Other or Unknown (99)

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INTERSECTION CONTROL EVALUATION

GRANDVIEW AVENUE

FIGURE 1: COLLISION DIAGRAM

Drawing name: H:\MUSCATIN_CI_IA\A131151711\2_Preliminary\C_Reports\Traffic Report\Crash Data\Crash Diagrams GrandView.dwg -- Printed: Feb 08, 2018 - 3:40pm

COLLISION DIAGRAM

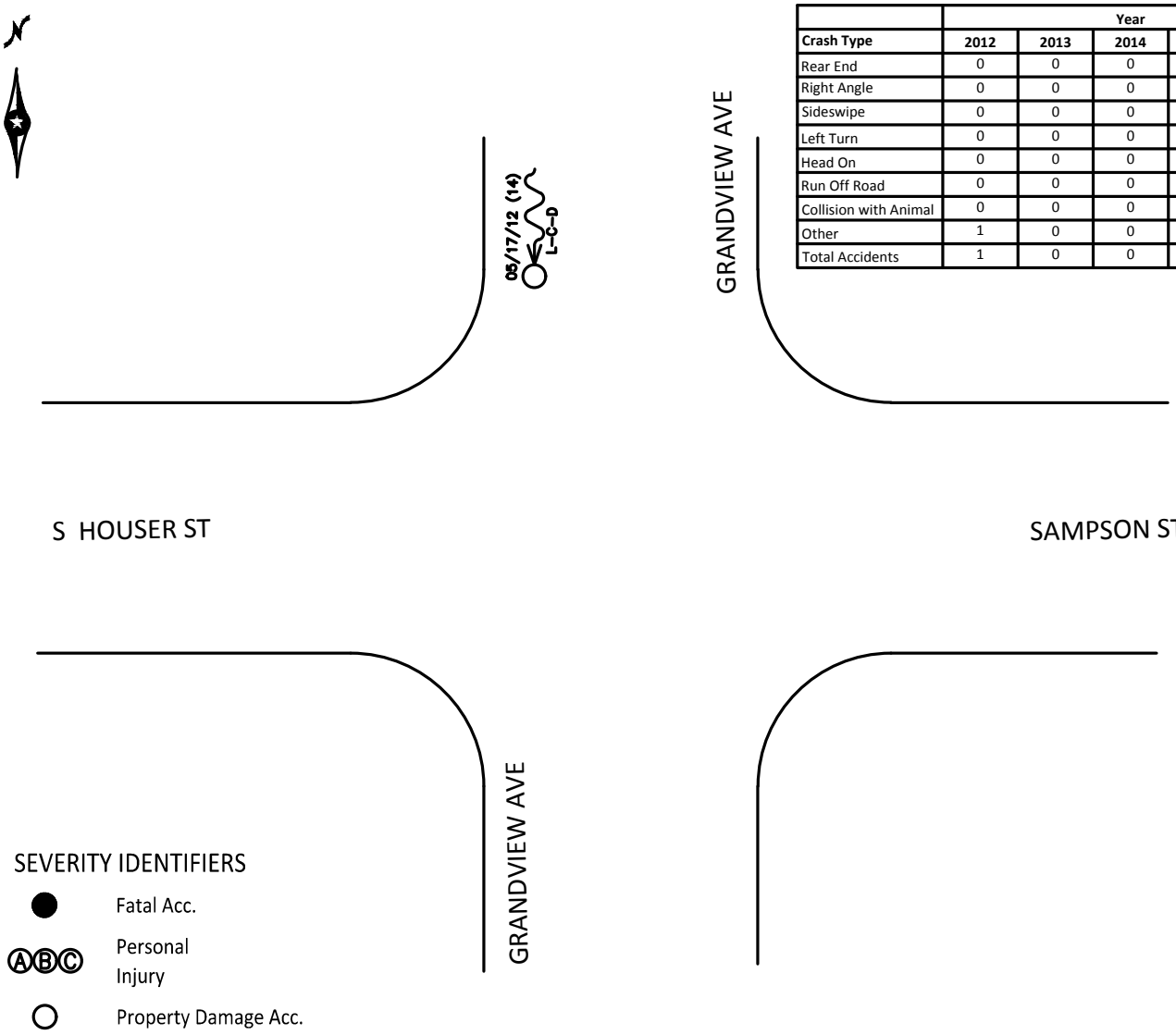
LOCATION: GRANDVIEW AVE AT S HOUSER ST

TIME PERIOD: 01/01/2012 - 12/31/2016 DATE: 01/19/18

PREPARED BY: R.HAALAND

	Year				
Severity	**2012**	**2013**	**2014**	**2015**	**2016**
Fatal	0	0	0	0	0
Major Injury	0	0	0	0	0
Minor Injury	0	0	0	0	0
Poss/unkwn Injury	0	0	0	0	0
Property Damage	1	0	0	0	0
Total Accidents	1	0	0	0	0

	Year				
Crash Type	**2012**	**2013**	**2014**	**2015**	**2016**
Rear End	0	0	0	0	0
Right Angle	0	0	0	0	0
Sideswipe	0	0	0	0	0
Left Turn	0	0	0	0	0
Head On	0	0	0	0	0
Run Off Road	0	0	0	0	0
Collision with Animal	0	0	0	0	0
Other	1	0	0	0	0
Total Accidents	1	0	0	0	0



SEVERITY IDENTIFIERS

- Fatal Acc.
- Personal Injury
- Property Damage Acc.

KEY

- Motor Vehicle Backing Up
- Motor Vehicle Out of Control
- SIDESWIPE
- Rear End
- Right Angle
- Pedestrian
- Bicycle/Moped
- Motorcycle
- Left Turn
- Fixed Object

NOTES

[1] ADT = 6,465

[2] CR = 0.08

[3]

Light:	Weather:	Surface:
L= Daylight (1)	C= Clear or Cloudy (1 or 2)	D= Dry (1)
DN= Dawn (2)	R= Rain (3)	W= Wet (2)
DU= Dusk (3)	S= Snow or Sleet (4 or 5)	S= Snow or Ice (3 or 4)
Dl= Dark, Lighted (4)	F= Fog, Smog, Smoke (6)	M= Muddy (5)
Do= Dark, Lights Off (5)	B= Blowing Sand/Dust (7)	DB= Debris (6)
D= Dark, Unlighted (6)	W= Severe Crosswinds (8)	O= Oily (7)
X= Unknown (99)	X= Other or Unknown (99)	X= Other or Unknown (99)

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INTERSECTION CONTROL EVALUATION

GRANDVIEW AVENUE

FIGURE 1: COLLISION DIAGRAM

COLLISION DIAGRAM

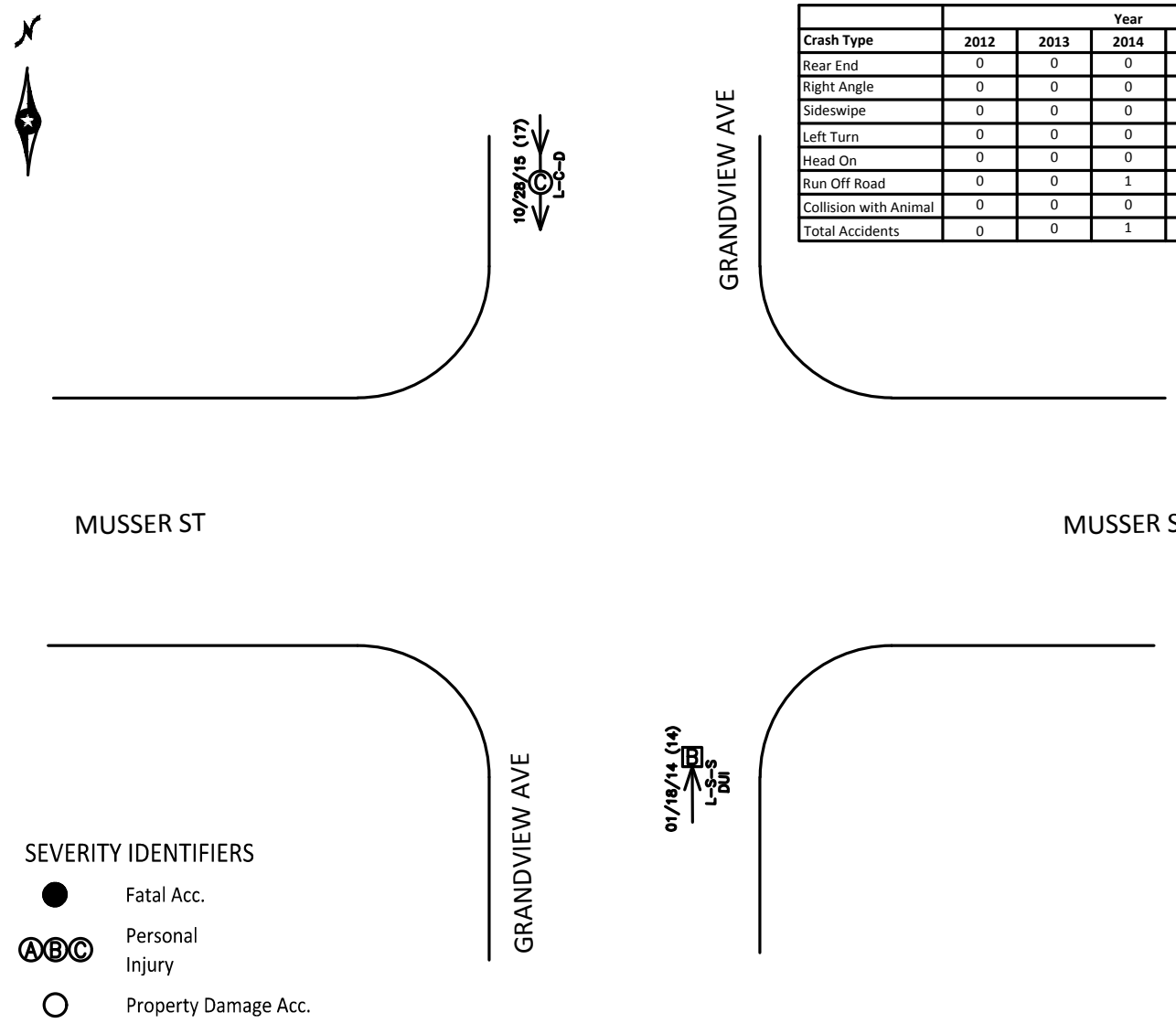
LOCATION: GRANDVIEW AVE AT MUSSER ST

TIME PERIOD: 01/01/2012 - 12/31/2016 DATE: 01/19/18

PREPARED BY: R.HAALAND

	Year				
Severity	**2012**	**2013**	**2014**	**2015**	**2016**
Fatal	0	0	0	0	0
Major Injury	0	0	0	0	0
Minor Injury	0	0	1	0	0
Poss/unkwn Injury	0	0	0	1	0
Property Damage	0	0	0	0	0
Total Accidents	0	0	1	1	0

	Year				
Crash Type	**2012**	**2013**	**2014**	**2015**	**2016**
Rear End	0	0	0	1	0
Right Angle	0	0	0	0	0
Sideswipe	0	0	0	0	0
Left Turn	0	0	0	0	0
Head On	0	0	0	0	0
Run Off Road	0	0	1	0	0
Collision with Animal	0	0	0	0	0
Total Accidents	0	0	1	1	0



KEY

- Motor Vehicle Backing Up
- Motor Vehicle Out of Control
- SIDESWIPE
- Rear End
- Right Angle
- Pedestrian
- B — Bicycle/Moped
- M — Motorcycle
- Left Turn
- Fixed Object

NOTES

[1] ADT = 5,300

[2] CR = 0.21

[3]

Light:
L= Daylight (1)
DN= Dawn (2)
DU= Dusk (3)
Dl= Dark, Lighted (4)
Do= Dark, Lights Off (5)
D= Dark, Unlighted (6)
X= Unknown (99)

Weather:
C= Clear or Cloudy (1 or 2)
R= Rain (3)
S= Snow or Sleet (4 or 5)
F= Fog, Smog, Smoke (6)
B= Blowing Sand/Dust (7)
W= Severe Crosswinds (8)
X= Other or Unknown (99)

Surface:
D= Dry (1)
W= Wet (2)
S= Snow or Ice (3 or 4)
M= Muddy (5)
DB= Debris (6)
O= Oily (7)
X= Other or Unknown (99)

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INTERSECTION CONTROL EVALUATION

GRANDVIEW AVENUE

FIGURE 1: COLLISION DIAGRAM

COLLISION DIAGRAM

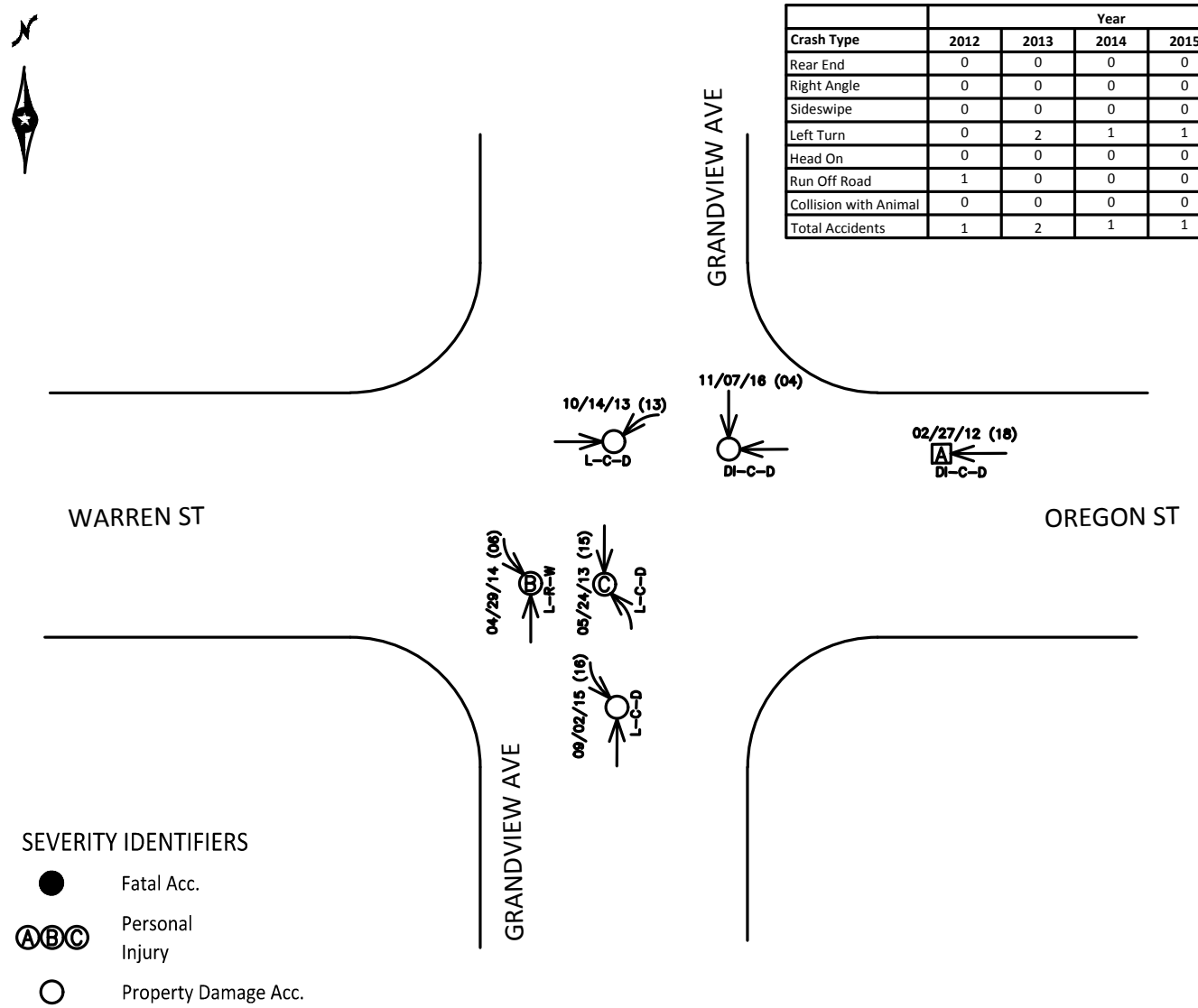
LOCATION: GRANDVIEW AVE AT WARREN ST

TIME PERIOD: 01/01/2012 - 12/31/2016 DATE: 01/19/18

PREPARED BY: R.HAALAND

	Year				
Severity	**2012**	**2013**	**2014**	**2015**	**2016**
Fatal	0	0	0	0	0
Major Injury	1	0	0	0	0
Minor Injury	0	0	1	0	0
Poss/unkwn Injury	0	1	0	0	0
Property Damage	0	1	0	1	1
Total Accidents	1	2	1	1	1

	Year				
Crash Type	**2012**	**2013**	**2014**	**2015**	**2016**
Rear End	0	0	0	0	0
Right Angle	0	0	0	0	1
Sideswipe	0	0	0	0	0
Left Turn	0	2	1	1	0
Head On	0	0	0	0	0
Run Off Road	1	0	0	0	0
Collision with Animal	0	0	0	0	0
Total Accidents	1	2	1	1	1



KEY

- Motor Vehicle Backing Up
- Motor Vehicle Out of Control
- SIDESWIPE
- Rear End
- Right Angle
- Pedestrian
- Bicycle/Moped
- Motorcycle
- Left Turn
- Fixed Object

NOTES

[1] ADT = 10,350

[2] CR = 0.32

[3]

Light:	Weather:	Surface:
L= Daylight (1)	C= Clear or Cloudy (1 or 2)	D= Dry (1)
DN= Dawn (2)	R= Rain (3)	W= Wet (2)
DU= Dusk (3)	S= Snow or Sleet (4 or 5)	S= Snow or Ice (3 or 4)
DI= Dark, Lighted (4)	F= Fog, Smog, Smoke (6)	M= Muddy (5)
Do= Dark, Lights Off (5)	B= Blowing Sand/Dust (7)	DB= Debris (6)
D= Dark, Unlighted (6)	W= Severe Crosswinds (8)	O= Oily (7)
X= Unknown (99)	X= Other or Unknown (99)	X= Other or Unknown (99)

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INTERSECTION CONTROL EVALUATION

GRANDVIEW AVENUE

FIGURE 1: COLLISION DIAGRAM

COLLISION DIAGRAM

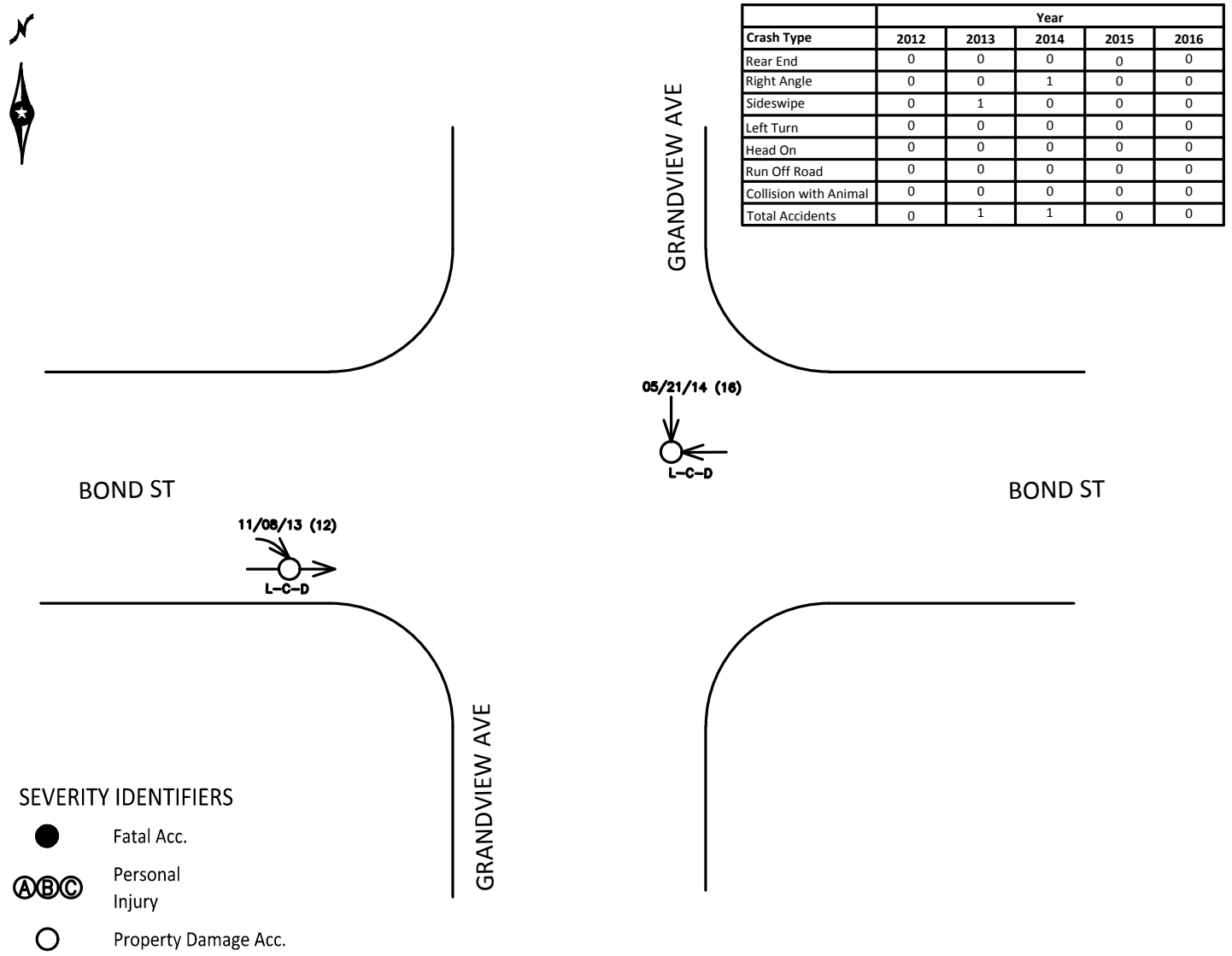
LOCATION: GRANDVIEW AVE AT BOND ST

TIME PERIOD: 01/01/2012 - 12/31/2016 DATE: 01/19/18

PREPARED BY: R.HAALAND

	Year				
Severity	**2012**	**2013**	**2014**	**2015**	**2016**
Fatal	0	0	0	0	0
Major Injury	0	0	0	0	0
Minor Injury	0	0	0	0	0
Poss/unkwn Injury	0	0	0	0	0
Property Damage	0	1	1	0	0
Total Accidents	0	1	1	0	0

	Year				
Crash Type	**2012**	**2013**	**2014**	**2015**	**2016**
Rear End	0	0	0	0	0
Right Angle	0	0	1	0	0
Sideswipe	0	1	0	0	0
Left Turn	0	0	0	0	0
Head On	0	0	0	0	0
Run Off Road	0	0	0	0	0
Collision with Animal	0	0	0	0	0
Total Accidents	0	1	1	0	0



SEVERITY IDENTIFIERS

- Fatal Acc.
- ABC Personal Injury
- Property Damage Acc.

KEY

- Motor Vehicle Backing Up
- Motor Vehicle Out of Control
- SIDESWIPE
- Rear End
- Right Angle
- Pedestrian
- B Bicycle/Moped
- M Motorcycle
- Left Turn
- Fixed Object

NOTES

[1] ADT = 9,250

[2] CR = 0.12

[3]

Light:	Weather:	Surface:
L= Daylight (1)	C= Clear or Cloudy (1 or 2)	D= Dry (1)
DN= Dawn (2)	R= Rain (3)	W= Wet (2)
DU= Dusk (3)	S= Snow or Sleet (4 or 5)	S= Snow or Ice (3 or 4)
Dl= Dark, Lighted (4)	F= Fog, Smog, Smoke (6)	M= Muddy (5)
Do= Dark, Lights Off (5)	B= Blowing Sand/Dust (7)	DB= Debris (6)
D= Dark, Unlighted (6)	W= Severe Crosswinds (8)	O= Oily (7)
X= Unknown (99)	X= Other or Unknown (99)	X= Other or Unknown (99)

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INTERSECTION CONTROL EVALUATION

GRANDVIEW AVENUE

FIGURE 1: COLLISION DIAGRAM

COLLISION DIAGRAM

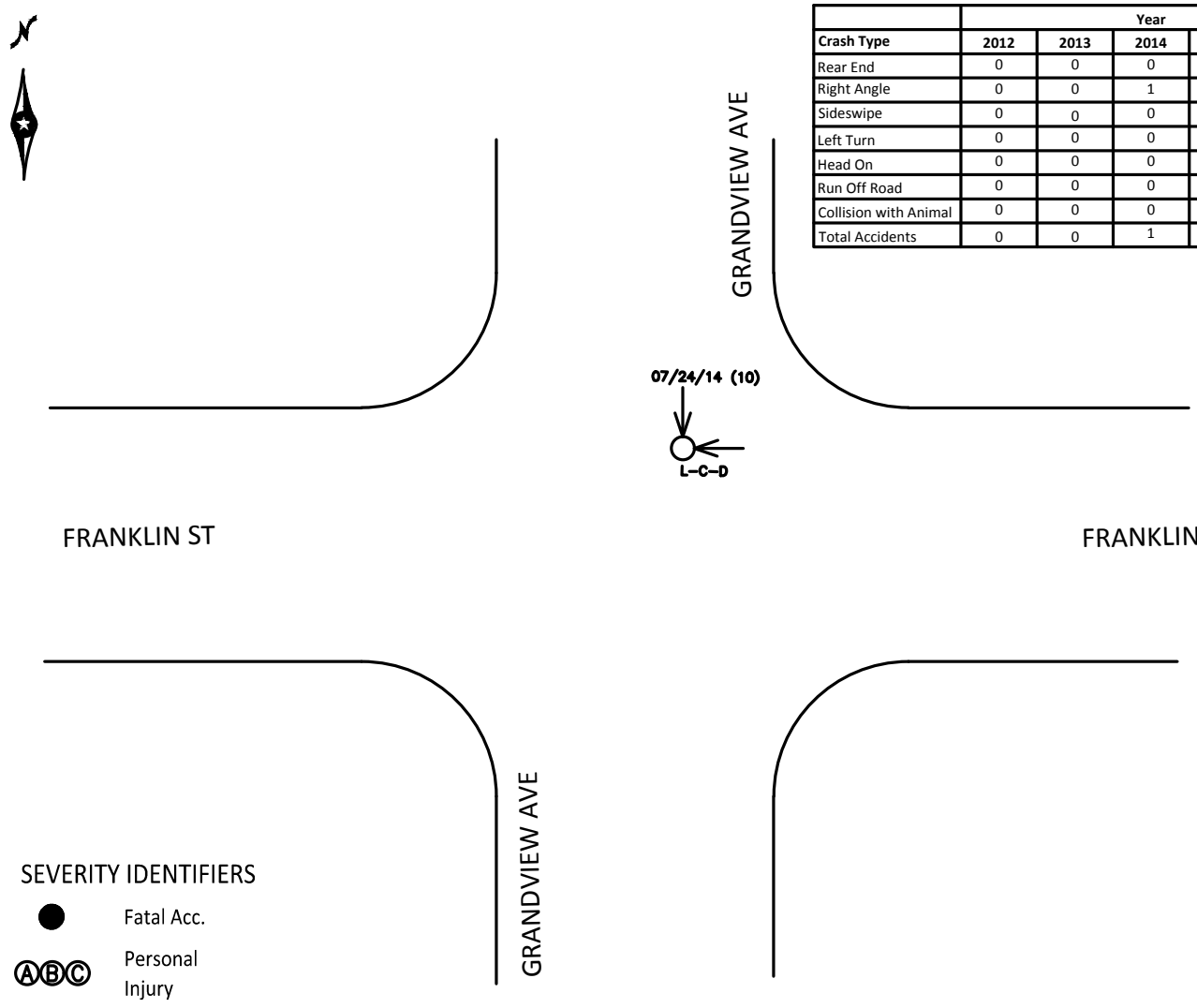
LOCATION: GRANDVIEW AVE AT MUSSER ST

TIME PERIOD: 01/01/2012 - 12/31/2016 DATE: 01/19/18

PREPARED BY: R.HAALAND

	Year				
Severity	**2012**	**2013**	**2014**	**2015**	**2016**
Fatal	0	0	0	0	0
Major Injury	0	0	0	0	0
Minor Injury	0	0	0	0	0
Poss/unkwn Injury	0	0	0	0	0
Property Damage	0	0	1	0	0
Total Accidents	0	0	1	0	0

	Year				
Crash Type	**2012**	**2013**	**2014**	**2015**	**2016**
Rear End	0	0	0	0	0
Right Angle	0	0	1	0	0
Sideswipe	0	0	0	0	0
Left Turn	0	0	0	0	0
Head On	0	0	0	0	0
Run Off Road	0	0	0	0	0
Collision with Animal	0	0	0	0	0
Total Accidents	0	0	1	0	0



KEY

- Motor Vehicle Backing Up
- Motor Vehicle Out of Control
- SIDESWIPE
- Rear End
- Right Angle
- Pedestrian
- B — Bicycle/Moped
- M — Motorcycle
- Left Turn
- Fixed Object

NOTES

[1] ADT = 9,400

[2] CR = 0.06

[3]

Light:
L= Daylight (1)
DN= Dawn (2)
DU= Dusk (3)
Dl= Dark, Lighted (4)
Do= Dark, Lights Off (5)
D= Dark, Unlighted (6)
X= Unknown (99)

Weather:
C= Clear or Cloudy (1 or 2)
R= Rain (3)
S= Snow or Sleet (4 or 5)
F= Fog, Smog, Smoke (6)
B= Blowing Sand/Dust (7)
W= Severe Crosswinds (8)
X= Other or Unknown (99)

Surface:
D= Dry (1)
W= Wet (2)
S= Snow or Ice (3 or 4)
M= Muddy (5)
DB= Debris (6)
O= Oily (7)
X= Other or Unknown (99)

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INTERSECTION CONTROL EVALUATION

GRANDVIEW AVENUE

FIGURE 1: COLLISION DIAGRAM

Appendix E: Potential Developments and Redevelopments

2-LANE SECTION DEVELOPMENT SITES

3-LANE SECTION DEVELOPMENT SITES

Appendix F: Trip Generation

Trip Generation 2020

Grandview Avenue, Muscatine, IA

Shopping Center				19.8 per 1000 SF		ITE Code	820	Internal-to-Internal Reduction					Pass-by		New Trips	
	Based on Screens Average Rate	Fitted Curve Equation	#	% enter	% exit	entering	exiting	entering	exiting	entering	exiting		entering	exiting	entering	exiting
AM	1	Ln(T) = 0.59 Ln(X)+2.32	60	61	39	37	23	0%	0%	37	24	0%	0	0	37	24
PM	3.73	Ln(T) = 0.67 Ln(X)+3.37	215	49	51	105	110	0%	0%	106	110	0%	0	0	106	110
Weekday	42.94	Ln(T) = 0.65 Ln(X)+5.83	2371	50	50	1186	1186	0%	0%	1186	1186	0%	0	0	1186	1186

						Pass-by		New Trips	
						entering	exiting	entering	exiting
AM	60	37	23		AM	0	0	37	24
PM	215	105	110		PM	0	0	106	110
Weekday	2371	1186	1186		Weekday	0	0	1186	1186

Trip Generation 2040 Mixed Use

Grandview Avenue, Muscatine, IA

Mixed use at north end

Mid-Rise Apartment 150 Dwelling Units ITE Code 223 Internal-to-Internal Reduction

Based on Dwelling Units

	Average Rate	Fitted Curve Equation	#	% enter	% exit	entering	exiting	entering	exiting	entering	exiting		Pass-by entering	Pass-by exiting	New Trips entering	New Trips exiting
AM	0.3	T = 0.41 X-13.06	49	31	69	15	34	0%	0%	16	34	0%	0	0	16	34
PM	0.39	T = 0.48 X-11.07	61	58	42	35	26	0%	0%	36	26	0%	0	0	36	26
Weekday*	6.65	T = 6.06 X+123.56	1033	50	50	517	517	0%	0%	517	517	0%	0	0	517	517

* Weekday trips based on land use 220 - Apartment because land use 223 - Mid-Rise Apartment does not include weekday calculations

Shopping Center 87 per 1000 SF ITE Code 820 Internal-to-Internal Reduction

Based on Screens

	Average Rate	Fitted Curve Equation	#	% enter	% exit	entering	exiting	entering	exiting	entering	exiting		Pass-by entering	Pass-by exiting	New Trips entering	New Trips exiting
AM	1	Ln(T) = 0.59 Ln(X)+2.32	142	61	39	87	55	9%	11%	79	50	0%	0	0	79	50
PM	3.73	Ln(T) = 0.67 Ln(X)+3.37	580	49	51	284	296	9%	11%	259	264	0%	0	0	259	264
Weekday	42.94	Ln(T) = 0.65 Ln(X)+5.83	6204	50	50	3102	3102	9%	11%	2823	2761	0%	0	0	2823	2761

	#	entering	exiting
AM	191	102	89
PM	641	320	321
Weekday	7237	3619	3619

	Pass-by entering	Pass-by exiting	New Trips entering	New Trips exiting
AM	0	0	95	84
PM	0	0	295	290
Weekday	0	0	3340	3278

Trip Generation 2040 Redevelopment

Grandview Avenue, Muscatine, IA

redevelopment

High-Turnover (Sit-Down) Restaurant 5.5 per 1000 SF ITE Code 532 Internal-to-Internal Reduction

Based on Dwelling Units

	Average Rate	Fitted Curve Equation	#	% enter	% exit	entering	exiting	entering	exiting	entering	exiting		Pass-by entering	Pass-by exiting	New Trips entering	New Trips exiting
AM	11.52	Not Given	64	52	48	33	31	0%	0%	34	31	0%	0	0	34	31
PM	11.15	Not Given	62	58	42	36	26	0%	0%	36	27	0%	0	0	36	27
Weekday*	127.15	Not Given	700	50	50	350	350	0%	0%	350	350	0%	0	0	350	350

* Weekday trips based on land use 220 - Apartment because land use 223 - Mid-Rise Apartment does not include weekday calculations

Shopping Center 6 per 1000 SF ITE Code 820 Internal-to-Internal Reduction

Based on Screens

	Average Rate	Fitted Curve Equation	#	% enter	% exit	entering	exiting	entering	exiting	entering	exiting		Pass-by entering	Pass-by exiting	New Trips entering	New Trips exiting
AM	1	Ln(T) = 0.59 Ln(X)+2.32	30	61	39	18	12	9%	11%	17	11	0%	0	0	17	11
PM	3.73	Ln(T) = 0.67 Ln(X)+3.37	97	49	51	48	49	9%	11%	44	45	0%	0	0	44	45
Weekday	42.94	Ln(T) = 0.65 Ln(X)+5.83	1091	50	50	546	546	9%	11%	497	486	0%	0	0	497	486

					Pass-by entering	Pass-by exiting	New Trips entering	New Trips exiting
AM	94	52	42	AM	0	0	51	42
PM	159	83	76	PM	0	0	80	72
Weekday	1791	896	896	Weekday	0	0	847	836

Trip Generation 2040 Industrial

Grandview Avenue, Muscatine, IA

south end

General Light Industrial 3.6 Acres ITE Code 110 Internal-to-Internal Reduction

	Based on Squarefoot Average Rate	Fitted Curve Equation	#	% enter	% exit	entering	exiting	entering	exiting	entering	exiting		Pass-by entering	Pass-by exiting	New Trips entering	New Trips exiting
AM	7.96	T = 3.76 X+117.88	118	88	12	104	14	0%	0%	104	15	0%	0	0	104	15
PM	8.77	T = 4.94 X+105.18	106	12	88	13	93	0%	0%	13	94	0%	0	0	13	94
Weekday	51.8	T = 42.22 X+263.11	264	50	50	132	132	0%	0%	132	132	0%	0	0	132	132

				Pass-by entering	Pass-by exiting	New Trips entering	New Trips exiting
AM	118	104	14	AM	0	0	104	15
PM	106	13	93	PM	0	0	13	94
Weekday	264	132	132	Weekday	0	0	132	132

Appendix G: Results of the Analysis

Table 1: Existing Conditions Traffic Operations Analysis - Muscatine, IA - Grandview Avenue

Intersection ID	Intersection	Peak Hour	Intersection Delay (1.)		Movement Delay (sec/veh)																																						Maximum Delay LOS (2.)		Limiting Movement (3.)	Max Approach Queue		
					NBL		NBL2	NBT		NBT2	NBR		NBR2	SBU	SBU2	SBL		SBL2	SBT		SBR		SBR2	EBU	EBU2	EBL		EBL2	EBT		EBT2	EBR		EBR2	WBU	WBU2	WBL		WBL2	WBT		WBT2	WBR					Direction	Average Queue (ft)	Max Queue (ft)
1	Grandview Avenue & HWY 61/Dick Drake Hwy	Existing Conditions AM Peak	10	B	13	B	-	14	B	-	2	A	-	-	-	20	C	-	17	B	4	A	-	-	-	12	B	-	11	B	-	4	A	-	-	-	11	B	-	10	B	-	2	A	20	C	SBL	EBT	50	125
	Signalized Intersection	Existing Conditions PM Peak	16	B	23	C	-	14	B	-	1	A	-	-	-	13	B	-	22	C	6	A	-	-	-	15	B	-	15	B	-	6	A	-	-	-	14	B	-	18	B	-	8	A	23	C	NBL	NBL	125	250
2	Grandview Avenue & S Houser St/Sampson St	Existing Conditions AM Peak	9	A	7	A	-	6	A	-	4	A	-	-	-	7	A	-	5	A	2	A	-	-	-	16	B	-	15	B	-	4	A	-	-	-	14	B	-	14	B	-	3	A	16	B	EBL	EBL/T	50	150
	Signalized Intersection	Existing Conditions PM Peak	11	B	10	B	-	8	A	-	5	A	-	-	-	10	B	-	8	A	5	A	-	-	-	18	B	-	16	B	-	5	A	-	-	-	13	B	-	15	B	-	5	A	18	B	EBL	WBL/T	50	125
3	Grandview Avenue & Musser St	Existing Conditions AM Peak	2	A	6	A	-	3	A	-	2	A	-	-	-	2	A	-	1	A	1	A	-	-	-	6	A	-	6	A	-	4	A	-	-	-	6	A	-	6	A	-	3	A	6	A	EBT	WBL/T/R	50	75
	Stop Controlled	Existing Conditions PM Peak	3	A	4	A	-	3	A	-	2	A	-	-	-	3	A	-	1	A	1	A	-	-	-	7	A	-	8	A	-	4	A	-	-	-	6	A	-	7	A	-	4	A	8	A	EBT	EBL/T/R	50	100
4	Grandview Avenue & Warren St/Oregon St	Existing Conditions AM Peak	5	A	5	A	-	4	A	-	3	A	-	-	-	9	A	-	4	A	2	A	-	-	-	6	A	-	10	B	-	3	A	-	-	-	9	A	-	10	B	-	4	A	10	B	WBT	SBL	50	125
	Signalized Intersection	Existing Conditions PM Peak	7	A	8	A	-	6	A	-	2	A	-	-	-	12	B	-	7	A	4	A	-	-	-	9	A	-	10	B	-	3	A	-	-	-	10	B	-	12	B	-	5	A	12	B	SBL	SBL	75	150
5	Grandview Avenue & Bond St/Driveway	Existing Conditions AM Peak	1	A	4	A	-	1	A	-	-		-	-	-	-		-	0	A	0	A	-	-	-	-		-	-		-	3	A	-	-	-	8	A	-	-		-	4	A	8	A	WBL	NBL/T	25	75
	Stop Controlled	Existing Conditions PM Peak	1	A	3	A	-	1	A	-	-		-	-	-	-		-	0	A	0	A	-	-	-	-		-	-		-	3	A	-	-	-	-		-	-		-	-		3	A	EBR	EBL/T/R	25	50
6	Grandview Avenue & Franklin St	Existing Conditions AM Peak	1	A	2	A	-	0	A	-	0	A	-	-	-	3	A	-	0	A	0	A	-	-	-	-		-	10	B	-	4	A	-	-	-	8	A	-	-		-	3	A	10	B	EBT	EBL/T/R	25	50
	Stop Controlled	Existing Conditions PM Peak	1	A	3	A	-	0	A	-	0	A	-	-	-	3	A	-	0	A	0	A	-	-	-	6	A	-	14	B	-	4	A	-	-	-	7	A	-	10	B	-	4	A	14	B	EBT	SBL/T	25	50

1. Delay in seconds per vehicle
2. Maximum delay and LOS on any approach and/or movement
3. Limiting Movement is the highest delay movement.

Table 2: Peak Hour Queues By Movement - Existing Conditions Geometry

Intersection ID	Intersection	Peak Hour	Queue Lengths																																			
			EBL		EBL/T		EBL/T/R		EBT		EBR		WBL		WBL/T		WBL/T/R		WBT/R		WBR		NBL		NBL/T		NBL/T/R		NBT		NBT/R		SBL		SBL/T		SBL/T/R		SBT		SBT/R	
			Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
1	Grandview Avenue & HWY 61/Dick Drake Hwy	Existing Conditions AM Peak	25	50	-	-	-	-	50	125	50	100	25	50	-	-	-	-	25	75	-	-	50	100	-	-	-	-	50	100	25	75	25	50	-	-	-	-	25	75	50	75
	Signalized Intersection	Existing Conditions PM Peak	25	75	-	-	-	-	50	75	75	125	25	75	-	-	-	-	75	200	-	-	125	250	-	-	-	-	50	125	25	25	25	50	-	-	-	-	50	100	50	100
2	Grandview Avenue & S Houser St/Sampson St	Existing Conditions AM Peak	-	-	50	150	-	-	-	-	25	50	-	-	25	75	-	-	-	-	25	50	-	-	-	-	25	75	-	-	-	-	-	-	-	-	25	75	-	-	-	-
	Signalized Intersection	Existing Conditions PM Peak	-	-	50	125	-	-	-	-	25	75	-	-	50	125	-	-	-	-	25	50	-	-	-	-	50	100	-	-	-	-	-	-	-	-	50	125	-	-	-	-
3	Grandview Avenue & Musser St	Existing Conditions AM Peak	-	-	-	-	25	75	-	-	-	-	-	-	-	-	50	75	-	-	-	-	-	-	-	-	25	25	-	-	-	-	-	-	-	-	25	50	-	-	-	-
	Stop Controlled	Existing Conditions PM Peak	-	-	-	-	50	100	-	-	-	-	-	-	-	-	25	75	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-
4	Grandview Avenue & Warren St/Oregon St	Existing Conditions AM Peak	-	-	25	50	-	-	-	-	25	50	-	-	25	75	-	-	-	-	50	75	-	-	50	75	-	-	-	-	25	75	50	125	-	-	-	-	-	-	25	75
	Signalized Intersection	Existing Conditions PM Peak	-	-	25	50	-	-	-	-	25	50	-	-	25	75	-	-	-	-	75	125	-	-	50	100	-	-	-	-	50	100	75	150	-	-	-	-	-	-	50	125
5	Grandview Avenue & Bond St/Driveway	Existing Conditions AM Peak	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	25	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Stop Controlled	Existing Conditions PM Peak	-	-	-	-	25	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Grandview Avenue & Franklin St	Existing Conditions AM Peak	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-
	Stop Controlled	Existing Conditions PM Peak	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	25	50	-	-	-	-	0	25	-	-	25	50	-	-	-	-	-	-

Table 1: Construction Year No Build Traffic Operations Analysis - Muscatine, IA - Grandview Avenue

Intersection ID	Intersection	Peak Hour	Intersection Delay (1.)		Movement Delay (sec/veh)																																				Maximum Delay LOS (2.)		Limiting Movement (3.)	Max Approach Queue		
					NBL		NBL2	NBT		NBT2	NBR		NBR2	SBU	SBU2	SBL		SBL2	SBT		SBR	SBR2	EBU	EBU2	EBL		EBL2	EBT		EBT2	EBR		EBR2	WBU	WBU2	WBL		WBL2	WBT		WBT2	WBR					Direction	Average Queue (ft)	Max Queue (ft)
1	Grandview Avenue & HWY 61/Dick Drake Hwy	Construction Year NB AM Peak	10	B	14	B	-	12	B	-	2	A	-	-	-	13	B	-	16	B	3	A	-	-	-	12	B	-	12	B	-	4	A	-	-	-	13	B	-	10	B	-	3	A	16	B	SBT	EBT	50	125
	Signalized Intersection	Construction Year NB PM Peak	18	B	29	C	-	15	B	-	2	A	-	-	-	15	B	-	21	C	9	A	-	-	-	16	B	-	17	B	-	7	A	-	-	-	18	B	-	19	B	-	8	A	29	C	NBL	NBL	150	350
2	Grandview Avenue & S Houser St/Sampson St	Construction Year NB AM Peak	9	A	7	A	-	6	A	-	5	A	-	-	-	9	A	-	6	A	3	A	-	-	-	16	B	-	16	B	-	4	A	-	-	-	13	B	-	14	B	-	4	A	16	B	EBL	EBL/T	50	125
	Signalized Intersection	Construction Year NB PM Peak	12	B	12	B	-	10	B	-	5	A	-	-	-	12	B	-	10	B	7	A	-	-	-	19	B	-	18	B	-	6	A	-	-	-	14	B	-	15	B	-	4	A	19	B	EBL	SBL/T/R	50	175
3	Grandview Avenue & Musser St	Construction Year NB AM Peak	2	A	3	A	-	3	A	-	3	A	-	-	-	3	A	-	1	A	1	A	-	-	-	6	A	-	6	A	-	3	A	-	-	-	5	A	-	7	A	-	3	A	7	A	WBT	WBL/T/R	25	75
	Stop Controlled	Construction Year NB PM Peak	3	A	6	A	-	4	A	-	3	A	-	-	-	4	A	-	2	A	1	A	-	-	-	9	A	-	8	A	-	5	A	-	-	-	7	A	-	8	A	-	5	A	9	A	EBL	EBL/T/R	50	100
4	Grandview Avenue & Warren St/Oregon St	Construction Year NB AM Peak	6	A	7	A	-	5	A	-	1	A	-	-	-	10	B	-	5	A	3	A	-	-	-	8	A	-	9	A	-	3	A	-	-	-	10	B	-	9	A	-	4	A	10	B	WBL	SBL	50	125
	Signalized Intersection	Construction Year NB PM Peak	7	A	12	B	-	7	A	-	3	A	-	-	-	13	B	-	7	A	4	A	-	-	-	9	A	-	10	B	-	3	A	-	-	-	11	B	-	11	B	-	5	A	13	B	SBL	SBL	75	150
5	Grandview Avenue & Bond St/Driveway	Construction Year NB AM Peak	1	A	4	A	-	1	A	-	-		-	-	-	-		-	0	A	0	A	-	-	-	6	A	-	-		-	3	A	-	-	-	6	A	-	-		-	2	A	6	A	WBL	NBL/T	25	50
	Stop Controlled	Construction Year NB PM Peak	1	A	3	A	-	1	A	-	-		-	-	-	-		-	0	A	0	A	-	-	-	-		-	-		-	3	A	-	-	-	-		-	-		-	-		3	A	NBL	NBL/T	25	50
6	Grandview Avenue & Franklin St	Construction Year NB AM Peak	1	A	3	A	-	0	A	-	0	A	-	-	-	3	A	-	0	A	0	A	-	-	-	4	A	-	7	A	-	3	A	-	-	-	5	A	-	-		-	4	A	7	A	EBT	EBL/T/R	25	50
	Stop Controlled	Construction Year NB PM Peak	1	A	3	A	-	0	A	-	0	A	-	-	-	3	A	-	0	A	0	A	-	-	-	7	A	-	10	B	-	4	A	-	-	-	10	B	-	9	A	-	3	A	10	B	WBL	SBL/T	25	75

1. Delay in seconds per vehicle
2. Maximum delay and LOS on any approach and/or movement
3. Limiting Movement is the highest delay movement.

Table 2: Peak Hour Queues By Movement - Construction Year No Build Geometry

Intersection ID	Intersection	Peak Hour	Queue Lengths																																			
			EBL		EBL/T		EBL/T/R		EBT		EBR		WBL		WBL/T		WBL/T/R		WBT/R		WBR		NBL		NBL/T		NBL/T/R		NBT		NBT/R		SBL		SBL/T		SBL/T/R		SBT		SBT/R	
			Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
1	Grandview Avenue & HWY 61/Dick Drake Hwy	Construction Year NB AM Peak	25	50	-	-	-	-	50	125	50	100	25	50	-	-	-	-	50	100	-	-	50	100	-	-	-	-	50	125	25	75	25	50	-	-	-	-	50	75	50	75
	Signalized Intersection	Construction Year NB PM Peak	25	75	-	-	-	-	50	75	75	150	25	75	-	-	-	-	100	200	-	-	150	350	-	-	-	-	50	200	25	75	25	50	-	-	-	-	75	125	75	125
2	Grandview Avenue & S Houser St/Sampson St	Construction Year NB AM Peak	-	-	50	125	-	-	-	-	25	50	-	-	25	100	-	-	-	-	25	50	-	-	-	-	25	100	-	-	-	-	-	-	-	-	25	100	-	-	-	-
	Signalized Intersection	Construction Year NB PM Peak	-	-	75	150	-	-	-	-	25	75	-	-	50	100	-	-	-	-	25	75	-	-	-	-	50	125	-	-	-	-	-	-	-	-	50	175	-	-	-	-
3	Grandview Avenue & Musser St	Construction Year NB AM Peak	-	-	-	-	25	75	-	-	-	-	-	-	-	-	25	75	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	50	-	-	-	-
	Stop Controlled	Construction Year NB PM Peak	-	-	-	-	50	100	-	-	-	-	-	-	-	-	50	75	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	75	-	-	-	-
4	Grandview Avenue & Warren St/Oregon St	Construction Year NB AM Peak	-	-	25	50	-	-	-	-	25	50	-	-	25	50	-	-	-	-	50	75	-	-	50	100	-	-	-	-	25	75	50	125	-	-	-	-	-	-	50	100
	Signalized Intersection	Construction Year NB PM Peak	-	-	25	75	-	-	-	-	50	75	-	-	25	75	-	-	-	-	75	125	-	-	50	125	-	-	-	-	50	100	75	150	-	-	-	-	-	-	50	150
5	Grandview Avenue & Bond St/Driveway	Construction Year NB AM Peak	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	25	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Stop Controlled	Construction Year NB PM Peak	-	-	-	-	25	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Grandview Avenue & Franklin St	Construction Year NB AM Peak	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-
	Stop Controlled	Construction Year NB PM Peak	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	75	-	-	-	-	-	-

Table 1: Construction Year Build Traffic Operations Analysis - Muscatine, IA - Grandview Avenue

Intersection ID	Intersection	Peak Hour	Intersection Delay (1.		Movement Delay (sec/veh)													
					NBL		NBT		NBR		SBL		SBT		SBR		EBL		EE
1	ndview Avenue & HWY 61/Dick Drake	n Year B AM I	10	B	14	B	12	B	2	A	13	B	17	B	4	A	13	B	11
	Signalized Intersection	n Year B PM I	17	B	26	C	15	B	2	A	14	B	22	C	8	A	15	B	14
2	andview Avenue & S Houser St/Sampson	n Year B AM I	5	A	5	A	6	A	5	A	5	A	5	A	4	A	3	A	5
	Stop Controlled	n Year B PM I	6	A	6	A	8	A	5	A	7	A	7	A	6	A	3	A	6
3	Grandview Avenue & Musser St	n Year B AM I	2	A	6	A	2	A	1	A	2	A	1	A	1	A	7	A	7
	Stop Controlled	n Year B PM I	3	A	3	A	3	A	1	A	3	A	1	A	1	A	8	A	9
4	Grandview Avenue & Warren St/Oregon	n Year B AM I	6	A	8	A	5	A	1	A	11	B	5	A	2	A	12	B	10
	Signalized Intersection	n Year B PM I	8	A	12	B	8	A	4	A	13	B	7	A	3	A	14	B	11
5	Grandview Avenue & Bond St/Driveway	n Year B AM I	1	A	4	A	1	A	-		3	A	0	A	0	A	14	B	-
	Stop Controlled	n Year B PM I	1	A	4	A	1	A	-		-		0	A	0	A	-		-
6	Grandview Avenue & Franklin St	n Year B AM I	1	A	3	A	1	A	0	A	2	A	1	A	0	A	14	B	6
	Stop Controlled	n Year B PM I	1	A	3	A	1	A	0	A	4	A	1	A	0	A	9	A	9

1. Delay in seconds per vehicle
2. Maximum delay and LOS on any approach and/or movement
3. Limiting Movement is the highest delay movement.

ɜT		EBR		WBL		WBT		WBR		Maximum Delay-LOS (2.)		ting Movemen	Max Approach Queue		
													Direction	erage Queue (	Max Queue (ft
B	4	A	13	B	11	B	2	A	17	B	SBT	EBT	50	150	
B	7	A	17	B	19	B	11	B	26	C	NBL	NBL	150	325	
A	2	A	2	A	3	A	2	A	6	A	NBT	NBL/T	25	75	
A	2	A	3	A	4	A	3	A	8	A	NBT	SBL/T/R	50	100	
A	3	A	5	A	6	A	3	A	7	A	EBT	EBL/T/R	50	75	
A	4	A	8	A	9	A	4	A	9	A	WBT	WBL/T/R	50	100	
B	4	A	12	B	11	B	4	A	12	B	WBL	SBL	50	125	
B	5	A	12	B	12	B	6	A	14	B	EBL	NBT/R	75	150	
-	5	A	4	A	-		3	A	14	B	EBL	EBL/T/R	25	50	
-	5	A	-		-		-		5	A	EBR	EBL/T/R	25	50	
A	4	A	6	A	-		3	A	14	B	EBL	EBL/T/R	25	50	
A	4	A	13	B	10	B	6	A	13	B	WBL	EBL/T/R	25	50	

Table 2: Peak Hour Queues By Movement - Construction Year Build Revised Geometry

Intersection ID	Intersection	Peak Hour	EBL		EBL/T		EBL/T/R		EBT		EBR		WBL		WBL/T		WBL/T/R		WB
			Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg
1	ndview Avenue & HWY 61/Dick Drake	n Year B AM F	25	50	-	-	-	-	50	150	50	100	25	50	-	-	-	-	50
	Signalized Intersection	n Year B PM F	25	75	-	-	-	-	25	100	75	125	25	100	-	-	-	-	100
2	andview Avenue & S Houser St/Sampson	n Year B AM F	-	-	25	50	-	-	-	-	-	-	-	-	-	-	25	50	-
	Stop Controlled	n Year B PM F	-	-	25	75	-	-	-	-	0	25	-	-	-	-	25	75	-
3	Grandview Avenue & Musser St	n Year B AM F	-	-	-	-	50	75	-	-	-	-	-	-	-	-	25	50	-
	Stop Controlled	n Year B PM F	-	-	-	-	50	75	-	-	-	-	-	-	-	-	50	100	-
4	Grandview Avenue & Warren St/Oregon	n Year B AM F	-	-	-	-	50	75	-	-	-	-	-	-	25	75	-	-	-
	Signalized Intersection	n Year B PM F	-	-	-	-	50	125	-	-	-	-	-	-	25	75	-	-	-
5	Grandview Avenue & Bond St/Driveway	n Year B AM F	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-
	Stop Controlled	n Year B PM F	-	-	-	-	25	50	-	-	-	-	-	-	-	-	-	-	-
6	Grandview Avenue & Franklin St	n Year B AM F	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-
	Stop Controlled	n Year B PM F	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-

Queue Lengths																				
T/R	WBR		NBL		NBL/T		NBT		NBT/R		NBR		SBL		SBL/T/R		SBT		SBT/R	
Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
100	-	-	50	100	-	-	50	100	25	50	-	-	25	50	-	-	50	75	50	75
175	-	-	150	325	-	-	50	125	25	75	-	-	25	50	-	-	75	125	75	125
-	-	-	-	-	25	75	-	-	-	-	-	-	-	-	25	50	-	-	-	-
-	-	-	-	-	25	75	-	-	-	-	0	25	-	-	50	100	-	-	-	-
-	-	-	25	25	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-
-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-
-	50	75	25	50	-	-	-	-	50	100	-	-	50	125	-	-	-	-	50	100
-	75	150	25	100	-	-	-	-	75	150	-	-	75	125	-	-	-	-	50	125
-	-	-	25	50	-	-	-	-	-	-	-	-	0	25	-	-	-	-	-	-
-	-	-	25	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	25	25	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-
-	-	-	25	50	-	-	-	-	0	25	-	-	25	50	-	-	-	-	-	-

Table 1: Design Year No Build Traffic Operations Analysis - Muscatine, IA - Grandview Avenue

Intersection ID	Intersection	Peak Hour	Intersection Delay (1.)		Movement Delay (sec/veh)																																								Maximum Delay-LOS (2.)		Limiting Movement (3.)	Max Approach Queue		
					NBL		NBL2	NBT		NBT2	NBR		NBR2	SBU	SBU2	SBL		SBL2	SBT		SBR		SBR2	EBU	EBU2	EBL		EBL2	EBT		EBT2	EBR		EBR2	WBU	WBU2	WBL		WBL2	WBT		WBT2	WBR					Direction	Average Queue (ft)	Max Queue (ft)
1	Grandview Avenue & HWY 61/Dick Drake Hwy	Future Year NB AM Peak	11	B	13	B	-	14	B	-	2	A	-	-	-	13	B	-	12	B	5	A	-	-	-	13	B	-	14	B	-	5	A	-	-	-	14	B	-	13	B	-	5	A	14	B	WBL	EBT	75	175
	Signalized Intersection	Future Year NB PM Peak	20	C	35	D	-	16	B	-	2	A	-	-	-	12	B	-	23	C	10	B	-	-	-	17	B	-	16	B	-	9	A	-	-	-	18	B	-	21	C	-	14	B	35	D	NBL	NBL	200	375
2	Grandview Avenue & S Houser St/Sampson St	Future Year NB AM Peak	10	B	12	B	-	8	A	-	6	A	-	-	-	9	A	-	7	A	4	A	-	-	-	16	B	-	18	B	-	6	A	-	-	-	16	B	-	14	B	-	4	A	18	B	EBT	EBL/T	75	175
	Signalized Intersection	Future Year NB PM Peak	14	B	17	B	-	14	B	-	11	B	-	-	-	14	B	-	13	B	9	A	-	-	-	20	C	-	18	B	-	6	A	-	-	-	16	B	-	16	B	-	6	A	20	C	EBL	NBL/T/R	100	225
3	Grandview Avenue & Musser St	Future Year NB AM Peak	3	A	4	A	-	4	A	-	3	A	-	-	-	3	A	-	1	A	1	A	-	-	-	8	A	-	8	A	-	4	A	-	-	-	7	A	-	8	A	-	5	A	8	A	WBT	WBL/T/R	50	100
	Stop Controlled	Future Year NB PM Peak	5	A	7	A	-	5	A	-	4	A	-	-	-	5	A	-	2	A	2	A	-	-	-	13	B	-	12	B	-	8	A	-	-	-	14	B	-	12	B	-	6	A	14	B	WBL	EBL/T/R	50	125
4	Grandview Avenue & Warren St/Oregon St	Future Year NB AM Peak	7	A	9	A	-	5	A	-	2	A	-	-	-	12	B	-	6	A	3	A	-	-	-	10	B	-	11	B	-	3	A	-	-	-	10	B	-	12	B	-	4	A	12	B	SBL	SBL	75	150
	Signalized Intersection	Future Year NB PM Peak	9	A	13	B	-	7	A	-	3	A	-	-	-	15	B	-	7	A	4	A	-	-	-	17	B	-	14	B	-	3	A	-	-	-	18	B	-	17	B	-	8	A	18	B	WBL	WBR	100	200
5	Grandview Avenue & Bond St/Driveway	Future Year NB AM Peak	1	A	5	A	-	1	A	-	-		-	-	-	3	A	-	0	A	0	A	-	-	-	9	A	-	-		-	4	A	-	-	-	10	B	-	-		-	2	A	10	B	WBL	NBL/T	25	75
	Stop Controlled	Future Year NB PM Peak	1	A	5	A	-	1	A	-	-		-	-	-	-		-	0	A	0	A	-	-	-	-		-	-		-	4	A	-	-	-	-		-	-		-	-		5	A	NBL	NBL/T	25	50
6	Grandview Avenue & Franklin St	Future Year NB AM Peak	1	A	3	A	-	0	A	-	0	A	-	-	-	4	A	-	1	A	0	A	-	-	-	5	A	-	9	A	-	4	A	-	-	-	14	B	-	-		-	3	A	14	B	WBL	SBL/T	25	75
	Stop Controlled	Future Year NB PM Peak	1	A	4	A	-	1	A	-	0	A	-	-	-	6	A	-	1	A	1	A	-	-	-	20	C	-	24	C	-	6	A	-	-	-	21	C	-	14	B	-	6	A	24	C	EBT	SBL/T	25	100

1. Delay in seconds per vehicle
2. Maximum delay and LOS on any approach and/or movement
3. Limiting Movement is the highest delay movement.

Table 2: Peak Hour Queues By Movement - Design Year No Build Geometry

Intersection ID	Intersection	Peak Hour	Queue Lengths																																			
			EBL		EBL/T		EBL/T/R		EBT		EBR		WBL		WBL/T		WBL/T/R		WBT/R		WBR		NBL		NBL/T		NBL/T/R		NBT		NBT/R		SBL		SBL/T		SBL/T/R		SBT		SBT/R	
			Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
1	Grandview Avenue & HWY 61/Dick Drake Hwy	Future Year NB AM Peak	25	50	-	-	-	-	75	175	50	125	25	50	-	-	-	-	50	125	-	-	50	100	-	-	-	-	75	150	25	75	25	50	-	-	-	-	50	100	50	100
	Signalized Intersection	Future Year NB PM Peak	25	75	-	-	-	-	50	125	100	175	25	100	-	-	-	-	125	225	-	-	200	375	-	-	-	-	75	175	25	100	25	50	-	-	-	-	75	150	75	150
2	Grandview Avenue & S Houser St/Sampson St	Future Year NB AM Peak	-	-	75	175	-	-	-	-	25	75	-	-	25	100	-	-	-	-	25	50	-	-	-	-	50	125	-	-	-	-	-	-	-	-	50	125	-	-	-	-
	Signalized Intersection	Future Year NB PM Peak	-	-	75	175	-	-	-	-	25	75	-	-	75	150	-	-	-	-	25	75	-	-	-	-	100	225	-	-	-	-	-	-	-	-	75	225	-	-	-	-
3	Grandview Avenue & Musser St	Future Year NB AM Peak	-	-	-	-	50	75	-	-	-	-	-	-	-	-	50	100	-	-	-	-	-	-	-	-	25	25	-	-	-	-	-	-	-	-	25	50	-	-	-	-
	Stop Controlled	Future Year NB PM Peak	-	-	-	-	50	125	-	-	-	-	-	-	-	-	50	75	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	125	-	-	-	-
4	Grandview Avenue & Warren St/Oregon St	Future Year NB AM Peak	-	-	25	50	-	-	-	-	25	75	-	-	25	75	-	-	-	-	50	100	-	-	50	125	-	-	-	-	50	100	75	150	-	-	-	-	-	-	50	125
	Signalized Intersection	Future Year NB PM Peak	-	-	50	100	-	-	-	-	50	75	-	-	50	100	-	-	-	-	100	200	-	-	75	125	-	-	-	-	50	125	75	175	-	-	-	-	-	-	75	175
5	Grandview Avenue & Bond St/Driveway	Future Year NB AM Peak	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	25	75	-	-	-	-	-	-	-	-	0	25	-	-	-	-	-	-
	Stop Controlled	Future Year NB PM Peak	-	-	-	-	25	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
6	Grandview Avenue & Franklin St	Future Year NB AM Peak	-	-	-	-	25	75	-	-	-	-	-	-	-	-	25	75	-	-	-	-	-	-	25	50	-	-	-	-	0	25	-	-	25	75	-	-	-	-	-	-
	Stop Controlled	Future Year NB PM Peak	-	-	-	-	25	75	-	-	-	-	-	-	-	-	25	100	-	-	-	-	-	-	25	75	-	-	-	-	25	25	-	-	25	100	-	-	-	-	-	-

Table 1: Design Year Build Traffic Operations Analysis - Muscatine, IA - Grandview Avenue

Intersection ID	Intersection	Peak Hour	Intersection Delay (1.		Movement Delay (sec/veh)													
					NBL		NBT		NBR		SBL		SBT		SBR		EBL		EE
1	ndview Avenue & HWY 61/Dick Drake	ar Build AM Pe	11	B	14	B	14	B	3	A	14	B	12	B	6	A	13	B	14
	Signalized Intersection	ar Build PM Pe	21	C	35	D	17	B	2	A	16	B	25	C	14	B	18	B	18
2	andview Avenue & S Houser St/Sampson	ar Build AM Pe	6	A	9	A	7	A	5	A	6	A	6	A	5	A	4	A	6
	Stop Controlled	ar Build PM Pe	8	A	8	A	10	B	8	A	7	A	9	A	7	A	4	A	6
3	Grandview Avenue & Musser St	ar Build AM Pe	3	A	4	A	2	A	2	A	3	A	1	A	1	A	9	A	8
	Stop Controlled	ar Build PM Pe	4	A	5	A	3	A	3	A	4	A	2	A	1	A	14	B	11
4	Grandview Avenue & Warren St/Oregon	ar Build AM Pe	8	A	9	A	6	A	2	A	15	B	6	A	3	A	13	B	13
	Signalized Intersection	ar Build PM Pe	12	B	16	B	9	A	4	A	21	C	8	A	5	A	21	C	17
5	Grandview Avenue & Bond St/Driveway	ar Build AM Pe	1	A	5	A	2	A	-		2	A	0	A	0	A	7	A	-
	Stop Controlled	ar Build PM Pe	1	A	6	A	2	A	-		-		1	A	0	A	-		-
6	Grandview Avenue & Franklin St	ar Build AM Pe	1	A	4	A	1	A	0	A	3	A	1	A	0	A	10	B	10
	Stop Controlled	ar Build PM Pe	2	A	5	A	1	A	0	A	6	A	1	A	1	A	43	E	30

1. Delay in seconds per vehicle
2. Maximum delay and LOS on any approach and/or movement
3. Limiting Movement is the highest delay movement.

ɜT		EBR		WBL		WBT		WBR		Maximum Delay-LOS (2.)		ting Movemen	Max Approach Queue		
													Direction	erage Queue (	Max Queue (ft
B	5	A	14	B	13	B	5	A	14	B	EBT	EBT	75	200
B	9	A	19	B	23	C	13	B	35	D	NBL	NBL	175	375
A	3	A	2	A	3	A	2	A	9	A	NBL	NBL/T	25	100
A	3	A	4	A	5	A	5	A	10	B	NBT	NBL/T	50	150
A	4	A	8	A	9	A	6	A	9	A	WBT	WBL/T/R	50	100
B	6	A	11	B	13	B	7	A	14	B	EBL	EBL/T/R	50	100
B	4	A	11	B	11	B	5	A	15	B	SBL	SBL	75	175
B	8	A	19	B	18	B	10	B	21	C	EBL	WBR	100	250
-	5	A	7	A	-		3	A	7	A	EBL	EBL/T/R	25	50
-	4	A	-		-		-		6	A	NBL	NBL	25	50
B	5	A	13	B	-		4	A	13	B	WBL	WBL/T/R	25	75
D	7	A	21	C	20	C	9	A	43	E	EBL	WBL/T/R	25	100

Table 2: Peak Hour Queues By Movement - Design Year Build Revised Geometry

Intersection ID	Intersection	Peak Hour	EBL		EBL/T		EBL/T/R		EBT		EBR		WBL		WBL/T		WBL/T/R		WB
			Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg
1	ndview Avenue & HWY 61/Dick Drake	ar Build AM Pe	25	100	-	-	-	-	75	200	50	100	25	50	-	-	-	-	50
	Signalized Intersection	ar Build PM Pe	50	75	-	-	-	-	50	125	100	175	50	150	-	-	-	-	125
2	andview Avenue & S Houser St/Sampson	ar Build AM Pe	-	-	25	75	-	-	-	-	-	-	-	-	-	-	25	50	-
	Stop Controlled	ar Build PM Pe	-	-	25	75	-	-	-	-	0	25	-	-	-	-	50	100	-
3	Grandview Avenue & Musser St	ar Build AM Pe	-	-	-	-	50	75	-	-	-	-	-	-	-	-	50	100	-
	Stop Controlled	ar Build PM Pe	-	-	-	-	50	100	-	-	-	-	-	-	-	-	50	100	-
4	Grandview Avenue & Warren St/Oregon	ar Build AM Pe	-	-	-	-	50	75	-	-	-	-	-	-	25	50	-	-	-
	Signalized Intersection	ar Build PM Pe	-	-	-	-	75	150	-	-	-	-	-	-	25	100	-	-	-
5	Grandview Avenue & Bond St/Driveway	ar Build AM Pe	-	-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-
	Stop Controlled	ar Build PM Pe	-	-	-	-	25	50	-	-	-	-	-	-	-	-	-	-	-
6	Grandview Avenue & Franklin St	ar Build AM Pe	-	-	-	-	25	75	-	-	-	-	-	-	-	-	25	75	-
	Stop Controlled	ar Build PM Pe	-	-	-	-	25	75	-	-	-	-	-	-	-	-	25	100	-

Queue Lengths																				
T/R	WBR		NBL		NBL/T		NBT		NBT/R		NBR		SBL		SBL/T/R		SBT		SBT/R	
Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max	Avg	Max
125	-	-	50	100	-	-	75	125	25	50	-	-	25	50	-	-	50	75	50	100
225	-	-	175	375	-	-	100	175	25	75	-	-	25	75	-	-	100	150	100	150
-	-	-	-	-	25	100	-	-	-	-	-	-	-	-	25	100	-	-	-	-
-	-	-	-	-	50	150	-	-	-	-	25	50	-	-	50	125	-	-	-	-
-	-	-	25	25	-	-	-	-	0	25	-	-	25	50	-	-	-	-	-	-
-	-	-	25	50	-	-	-	-	0	25	-	-	25	50	-	-	-	-	0	25
-	50	100	25	50	-	-	-	-	75	150	-	-	75	175	-	-	-	-	50	100
-	100	250	50	100	-	-	-	-	100	225	-	-	100	200	-	-	-	-	75	175
-	-	-	25	50	-	-	-	-	-	-	-	-	0	25	-	-	-	-	-	-
-	-	-	25	50	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
-	-	-	25	50	-	-	-	-	-	-	-	-	25	50	-	-	-	-	-	-
-	-	-	25	75	-	-	-	-	-	-	-	-	25	75	-	-	-	-	-	-

Appendix H: Warrant Analysis

EXISTING CONDITIONS
SIGNAL WARRANTS ANALYSIS
FOR
HWY 61 AT GRANDVIEW AVENUE
(MINOR APPROACH RT TRAFFIC REMOVED)

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
45	Major App1: Grandview Ave NB	2
45	Major App3: Grandview Ave SB	2
45	Minor App2: HWY 61 EB	2
40	Minor App4: Dick Drake Hwy WB	1

0.70 FACTOR USED? YES
POPULATION < 10,000? No
EXISTING SIGNAL ? Yes

THRESHOLDS 1A/1B: 335/503 111/55 83/41

HOUR	MAJOR APP. 1	MAJOR APP. 3	TOTAL 1+3	MAJOR 1A/1B	MINOR APP. 2	MINOR 2 1A/1B	MINOR APP. 4	MINOR 4 1A/1B	MET SAME 1A/1B
0:00 - 1:00			0	/		/		/	/
1:00 - 2:00			0	/		/		/	/
2:00 - 3:00			0	/		/		/	/
3:00 - 4:00			0	/		/		/	/
4:00 - 5:00			0	/		/		/	/
5:00 - 6:00			0	/		/		/	/
6:00 - 7:00	344	127	471	X/	255	X/X	84	X/X	X/
7:00 - 8:00	484	122	606	X/X	199	X/X	91	X/X	X/X
8:00 - 9:00	362	92	454	X/	135	X/X	97	X/X	X/
9:00 - 10:00	292	97	389	X/	107	/X	95	X/X	X/
10:00 - 11:00	302	83	385	X/	114	X/X	107	X/X	X/
11:00 - 12:00	312	124	436	X/	128	X/X	133	X/X	X/
12:00 - 13:00	332	118	450	X/	123	X/X	125	X/X	X/
13:00 - 14:00	356	145	501	X/	142	X/X	112	X/X	X/
14:00 - 15:00	355	133	488	X/	125	X/X	176	X/X	X/
15:00 - 16:00	435	174	609	X/X	98	/X	257	X/X	X/X
16:00 - 17:00	424	176	600	X/X	109	/X	192	X/X	X/X
17:00 - 18:00	313	158	471	X/	91	/X	157	X/X	X/
18:00 - 19:00	239	88	327	/	57	/X	49	/X	/
19:00 - 20:00			0	/		/		/	/
20:00 - 21:00			0	/		/		/	/
21:00 - 22:00			0	/		/		/	/
22:00 - 23:00			0	/		/		/	/
23:00 - 24:00			0	/		/		/	/

	Met (Hr)	Required (Hr)	
Warrant 1A	12	8	Satisfied
Warrant 1B	3	8	Not satisfied
Warrant 2	4	4	Satisfied
Warrant 3	0	1	Not satisfied
Warrant 7	12	8	Satisfied, check accident record

Four Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	360	440	590
400	310	390	530
500	260	340	460
600	215	290	390
700	180	245	330
800	150	205	280
900	125	170	235
1000	100	145	195
1100	85	120	165
1200	80	100	135
1300	80	83	115
1400	80	80	115
1500	80	80	115
1600	80	80	115
1700	80	80	115
1800	80	80	115

Peak Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
400	475	570	725
500	425	520	665
600	370	465	600
700	330	420	540
800	280	370	480
900	240	330	425
1000	204	285	375
1100	175	250	330
1200	150	220	285
1300	130	190	250
1400	115	160	220
1500	100	140	187
1600	100	115	165
1700	100	100	150
1800	100	100	150

Four Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
200	250	320	420
300	210	265	350
400	170	215	285
500	130	170	230
600	93	130	175
700	70	100	135
800	60	80	103
900	60	65	80
1000	60	60	80
1100	60	60	80
1200	60	60	80
1300	60	60	80
1400	60	60	80
1500	60	60	80
1600	60	60	80
1700	60	60	80
1800	60	60	80

Peak Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	320	380	500
400	270	335	435
500	225	285	370
600	180	240	315
700	145	200	260
800	115	160	215
900	90	135	175
1000	75	110	140
1100	75	95	115
1200	75	75	100
1300	75	75	100
1400	75	75	100
1500	75	75	100
1600	75	75	100
1700	75	75	100
1800	75	75	100

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
45	Major App1: Grandview Ave NB	2
45	Major App3: Grandview Ave SB	2
45	Minor App2: HWY 61 EB	2
40	Minor App4: Dick Drake Hwy WB	1

0.70 FACTOR USED? YES
POPULATION < 10,000? No
EXISTING SIGNAL ? Yes

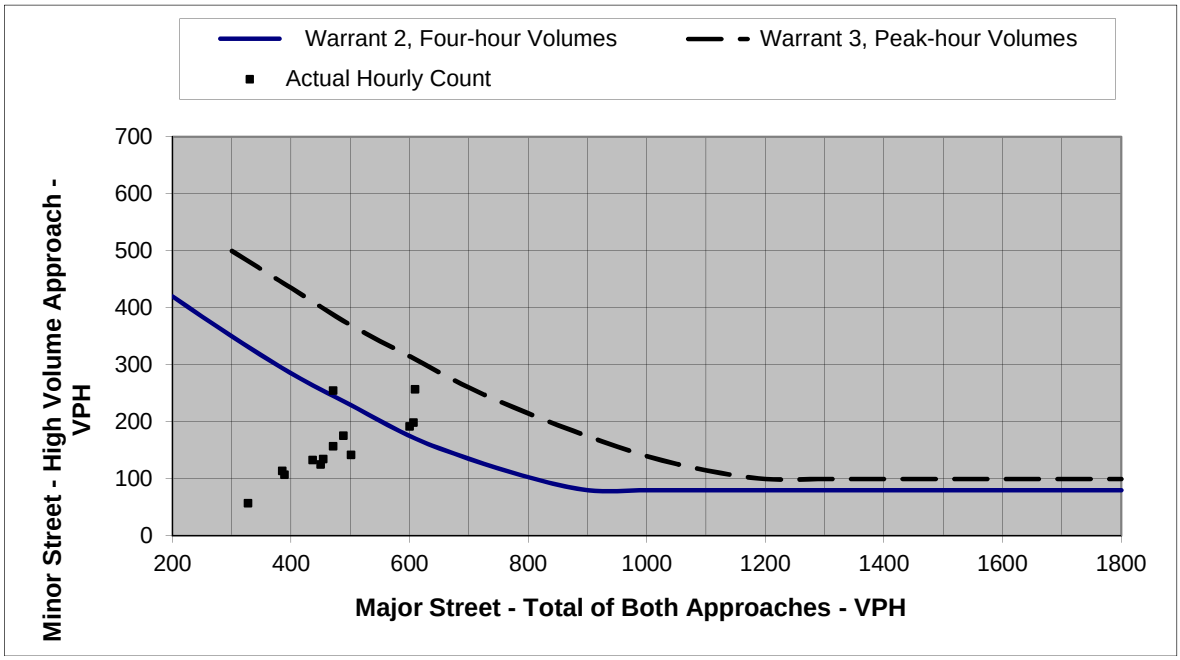


Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria			Actual Hourly Count	
Major	Warrant 2, I	Warrant 3, Pe	Major	Actual Hourly Count
200	420		0	0
300	350	500	0	0
400	285	435	0	0
500	230	370	0	0
600	175	315	0	0
700	135	260	0	0
800	103	215	471	255
900	80	175	606	199
1000	80	140	454	135
1100	80	115	389	107
1200	80	100	385	114
1300	80	100	436	133
1400	80	100	450	125
1500	80	100	501	142
1600	80	100	488	176
1700	80	100	609	257
1800	80	100	600	192
			471	157
			327	57
			0	0
			0	0
			0	0
			0	0
			0	0

ALL WAY STOP WARRANT

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017
OPERATOR: RJH

Speed	Approach Description	Lanes
45	Major App1: Grandview Ave NB	2
45	Major App3: Grandview Ave SB	2
45	Minor App2: HWY 61 EB	2
40	Minor App4: Dick Drake Hwy WB	1

0.70 FACTOR USED? Yes

					210	140	
HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR TOTAL Σ (APP. 1 & APP. 3)	MINOR TOTAL APP. 2 + APP. 4	WARRANT MET
0:00 - 1:00							
1:00 - 2:00							
2:00 - 3:00							
3:00 - 4:00							
4:00 - 5:00							
5:00 - 6:00							
6:00 - 7:00	344	127	255	84	471	339	X/X
7:00 - 8:00	484	122	199	91	606	290	X/X
8:00 - 9:00	362	92	135	97	454	232	X/X
9:00 - 10:00	292	97	107	95	389	202	X/X
10:00 - 11:00	302	83	114	107	385	221	X/X
11:00 - 12:00	312	124	128	133	436	261	X/X
12:00 - 13:00	332	118	123	125	450	248	X/X
13:00 - 14:00	356	145	142	112	501	254	X/X
14:00 - 15:00	355	133	125	176	488	301	X/X
15:00 - 16:00	435	174	98	257	609	355	X/X
16:00 - 17:00	424	176	109	192	600	301	X/X
17:00 - 18:00	313	158	91	157	471	248	X/X
18:00 - 19:00	239	88	57	49	327	106	X/
19:00 - 20:00							
20:00 - 21:00							
21:00 - 22:00							
22:00 - 23:00							
23:00 - 24:00							

	Met (Hr)	Required (Hr)	
Allway Stop Warrant:	**12**	8	**Satisfied**

REMARKS:

EXISTING CONDITIONS
SIGNAL WARRANTS ANALYSIS
FOR
HOUSER ST AT GRANDVIEW AVENUE
(MINOR APPROACH RT TRAFFIC REMOVED)

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	1
35	Major App3: Grandview Ave SB	1
40	Minor App2: S Houser St EB	1
25	Minor App4: Sampson St WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? Yes

THRESHOLDS 1A/1B: 400/600 120/60 120/60

HOUR	MAJOR APP. 1	MAJOR APP. 3	TOTAL 1+3	MAJOR 1A/1B	MINOR APP. 2	MINOR 2 1A/1B	MINOR APP. 4	MINOR 4 1A/1B	**MET SAME 1A/1B**
0:00 - 1:00			0	/		/		/	**/**
1:00 - 2:00			0	/		/		/	**/**
2:00 - 3:00			0	/		/		/	**/**
3:00 - 4:00			0	/		/		/	**/**
4:00 - 5:00			0	/		/		/	**/**
5:00 - 6:00			0	/		/		/	**/**
6:00 - 7:00	104	108	212	/	103	/X	54	/	**/**
7:00 - 8:00	144	119	263	/	107	/X	61	/X	**/**
8:00 - 9:00	110	106	216	/	77	/X	42	/	**/**
9:00 - 10:00	103	116	219	/	60	/X	26	/	**/**
10:00 - 11:00	123	101	224	/	61	/X	49	/	**/**
11:00 - 12:00	132	172	304	/	76	/X	65	/X	**/**
12:00 - 13:00	148	161	309	/	99	/X	53	/	**/**
13:00 - 14:00	128	172	300	/	83	/X	55	/	**/**
14:00 - 15:00	139	176	315	/	86	/X	79	/X	**/**
15:00 - 16:00	175	222	397	/	127	X/X	131	X/X	**/**
16:00 - 17:00	163	211	374	/	114	/X	106	/X	**/**
17:00 - 18:00	124	209	333	/	95	/X	72	/X	**/**
18:00 - 19:00	89	107	196	/	63	/X	28	/	**/**
19:00 - 20:00			0	/		/		/	**/**
20:00 - 21:00			0	/		/		/	**/**
21:00 - 22:00			0	/		/		/	**/**
22:00 - 23:00			0	/		/		/	**/**
23:00 - 24:00			0	/		/		/	**/**

	Met (Hr)	Required (Hr)	
Warrant 1A	0	8	Not satisfied
Warrant 1B	0	8	Not satisfied
Warrant 2	0	4	Not satisfied
Warrant 3	0	1	Not satisfied
Warrant 7	2	8	Not satisfied

Four Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	360	440	590
400	310	390	530
500	260	340	460
600	215	290	390
700	180	245	330
800	150	205	280
900	125	170	235
1000	100	145	195
1100	85	120	165
1200	80	100	135
1300	80	83	115
1400	80	80	115
1500	80	80	115
1600	80	80	115
1700	80	80	115
1800	80	80	115

Peak Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
400	475	570	725
500	425	520	665
600	370	465	600
700	330	420	540
800	280	370	480
900	240	330	425
1000	204	285	375
1100	175	250	330
1200	150	220	285
1300	130	190	250
1400	115	160	220
1500	100	140	187
1600	100	115	165
1700	100	100	150
1800	100	100	150

Four Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
200	250	320	420
300	210	265	350
400	170	215	285
500	130	170	230
600	93	130	175
700	70	100	135
800	60	80	103
900	60	65	80
1000	60	60	80
1100	60	60	80
1200	60	60	80
1300	60	60	80
1400	60	60	80
1500	60	60	80
1600	60	60	80
1700	60	60	80
1800	60	60	80

Peak Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	320	380	500
400	270	335	435
500	225	285	370
600	180	240	315
700	145	200	260
800	115	160	215
900	90	135	175
1000	75	110	140
1100	75	95	115
1200	75	75	100
1300	75	75	100
1400	75	75	100
1500	75	75	100
1600	75	75	100
1700	75	75	100
1800	75	75	100

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	1
35	Major App3: Grandview Ave SB	1
40	Minor App2: S Houser St EB	1
25	Minor App4: Sampson St WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? Yes

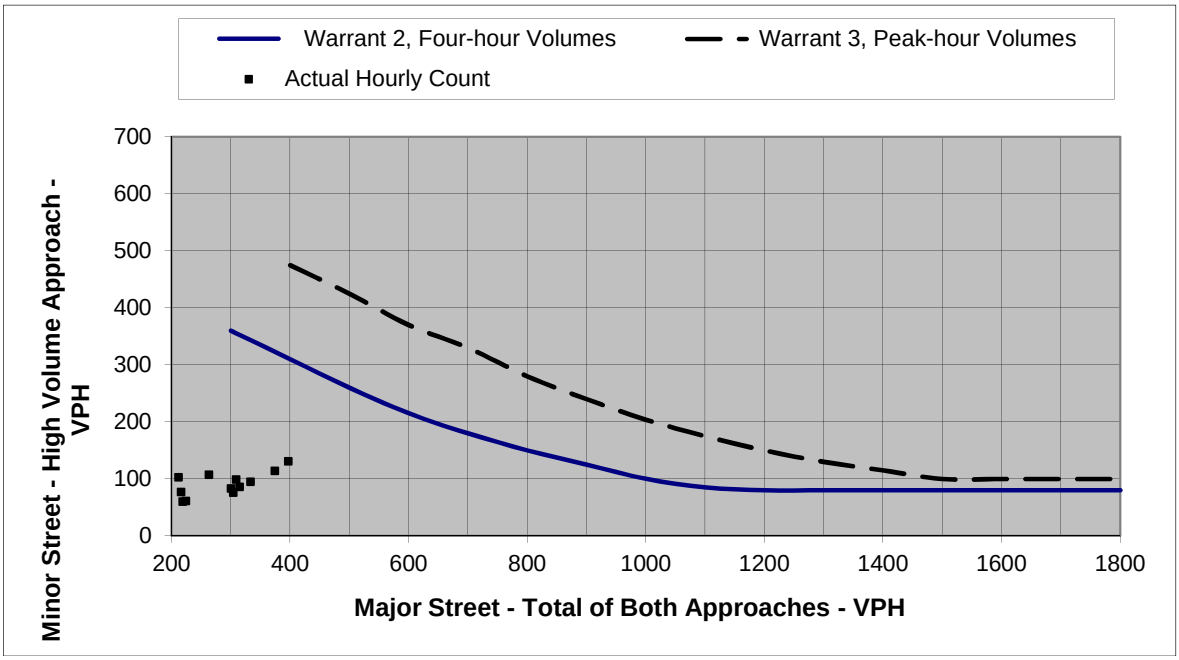


Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria			Actual Hourly Count	
Major	Warrant 2, I	Warrant 3, Pe	Major	Actual Hourly Count
200			0	0
300	360		0	0
400	310	475	0	0
500	260	425	0	0
600	215	370	0	0
700	180	330	0	0
800	150	280	212	103
900	125	240	263	107
1000	100	204	216	77
1100	85	175	219	60
1200	80	150	224	61
1300	80	130	304	76
1400	80	115	309	99
1500	80	100	300	83
1600	80	100	315	86
1700	80	100	397	131
1800	80	100	374	114
			333	95
			196	63
			0	0
			0	0
			0	0
			0	0
			0	0

ALL WAY STOP WARRANT

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017
OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	1
35	Major App3: Grandview Ave SB	1
40	Minor App2: S Houser St EB	1
25	Minor App4: Sampson St WB	1

0.70 FACTOR USED? No

					300	200	
HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR TOTAL Σ (APP. 1 & APP. 3)	MINOR TOTAL APP. 2 + APP. 4	WARRANT MET
0:00 - 1:00							
1:00 - 2:00							
2:00 - 3:00							
3:00 - 4:00							
4:00 - 5:00							
5:00 - 6:00							
6:00 - 7:00	104	108	103	54	212	157	/
7:00 - 8:00	144	119	107	61	263	168	/
8:00 - 9:00	110	106	77	42	216	119	/
9:00 - 10:00	103	116	60	26	219	86	/
10:00 - 11:00	123	101	61	49	224	110	/
11:00 - 12:00	132	172	76	65	304	141	X/
12:00 - 13:00	148	161	99	53	309	152	X/
13:00 - 14:00	128	172	83	55	300	138	X/
14:00 - 15:00	139	176	86	79	315	165	X/
15:00 - 16:00	175	222	127	131	397	258	X/X
16:00 - 17:00	163	211	114	106	374	220	X/X
17:00 - 18:00	124	209	95	72	333	167	X/
18:00 - 19:00	89	107	63	28	196	91	/
19:00 - 20:00							
20:00 - 21:00							
21:00 - 22:00							
22:00 - 23:00							
23:00 - 24:00							

	Met (Hr)	Required (Hr)	
Allway Stop Warrant:	2	8	Not satisfied

REMARKS:

EXISTING CONDITIONS
SIGNAL WARRANTS ANALYSIS
FOR
HOUSER ST AT GRANDVIEW AVENUE
(MINOR APPROACH RT TRAFFIC REMOVED)

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	1
35	Major App3: Grandview Ave SB	1
40	Minor App2: S Houser St EB	1
25	Minor App4: Sampson St WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? Yes

THRESHOLDS 1A/1B: 400/600 120/60 120/60

HOUR	MAJOR APP. 1	MAJOR APP. 3	TOTAL 1+3	MAJOR 1A/1B	MINOR APP. 2	MINOR 2 1A/1B	MINOR APP. 4	MINOR 4 1A/1B	MET SAME 1A/1B
0:00 - 1:00			0	/		/		/	/
1:00 - 2:00			0	/		/		/	/
2:00 - 3:00			0	/		/		/	/
3:00 - 4:00			0	/		/		/	/
4:00 - 5:00			0	/		/		/	/
5:00 - 6:00			0	/		/		/	/
6:00 - 7:00	192	200	392	/	134	X/X	68	/X	/
7:00 - 8:00	266	220	486	X/	139	X/X	76	/X	X/
8:00 - 9:00	204	196	400	X/	100	/X	53	/	/
9:00 - 10:00	191	215	406	X/	78	/X	33	/	/
10:00 - 11:00	228	187	415	X/	79	/X	61	/X	/
11:00 - 12:00	244	318	562	X/	99	/X	81	/X	/
12:00 - 13:00	274	298	572	X/	129	X/X	66	/X	X/
13:00 - 14:00	237	318	555	X/	108	/X	69	/X	/
14:00 - 15:00	257	326	583	X/	112	/X	99	/X	/
15:00 - 16:00	324	411	735	X/X	165	X/X	164	X/X	X/X
16:00 - 17:00	302	390	692	X/X	148	X/X	133	X/X	X/X
17:00 - 18:00	229	387	616	X/X	124	X/X	90	/X	X/X
18:00 - 19:00	165	198	363	/	82	/X	35	/	/
19:00 - 20:00			0	/		/		/	/
20:00 - 21:00			0	/		/		/	/
21:00 - 22:00			0	/		/		/	/
22:00 - 23:00			0	/		/		/	/
23:00 - 24:00			0	/		/		/	/

	Met (Hr)	Required (Hr)	
Warrant 1A	5	8	Not satisfied
Warrant 1B	3	8	Not satisfied
Warrant 2	0	4	Not satisfied
Warrant 3	0	1	Not satisfied
Warrant 7	**10**	8	**Satisfied, check accident record**

Four Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	360	440	590
400	310	390	530
500	260	340	460
600	215	290	390
700	180	245	330
800	150	205	280
900	125	170	235
1000	100	145	195
1100	85	120	165
1200	80	100	135
1300	80	83	115
1400	80	80	115
1500	80	80	115
1600	80	80	115
1700	80	80	115
1800	80	80	115

Peak Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
400	475	570	725
500	425	520	665
600	370	465	600
700	330	420	540
800	280	370	480
900	240	330	425
1000	204	285	375
1100	175	250	330
1200	150	220	285
1300	130	190	250
1400	115	160	220
1500	100	140	187
1600	100	115	165
1700	100	100	150
1800	100	100	150

Four Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
200	250	320	420
300	210	265	350
400	170	215	285
500	130	170	230
600	93	130	175
700	70	100	135
800	60	80	103
900	60	65	80
1000	60	60	80
1100	60	60	80
1200	60	60	80
1300	60	60	80
1400	60	60	80
1500	60	60	80
1600	60	60	80
1700	60	60	80
1800	60	60	80

Peak Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	320	380	500
400	270	335	435
500	225	285	370
600	180	240	315
700	145	200	260
800	115	160	215
900	90	135	175
1000	75	110	140
1100	75	95	115
1200	75	75	100
1300	75	75	100
1400	75	75	100
1500	75	75	100
1600	75	75	100
1700	75	75	100
1800	75	75	100

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	1
35	Major App3: Grandview Ave SB	1
40	Minor App2: S Houser St EB	1
25	Minor App4: Sampson St WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? Yes

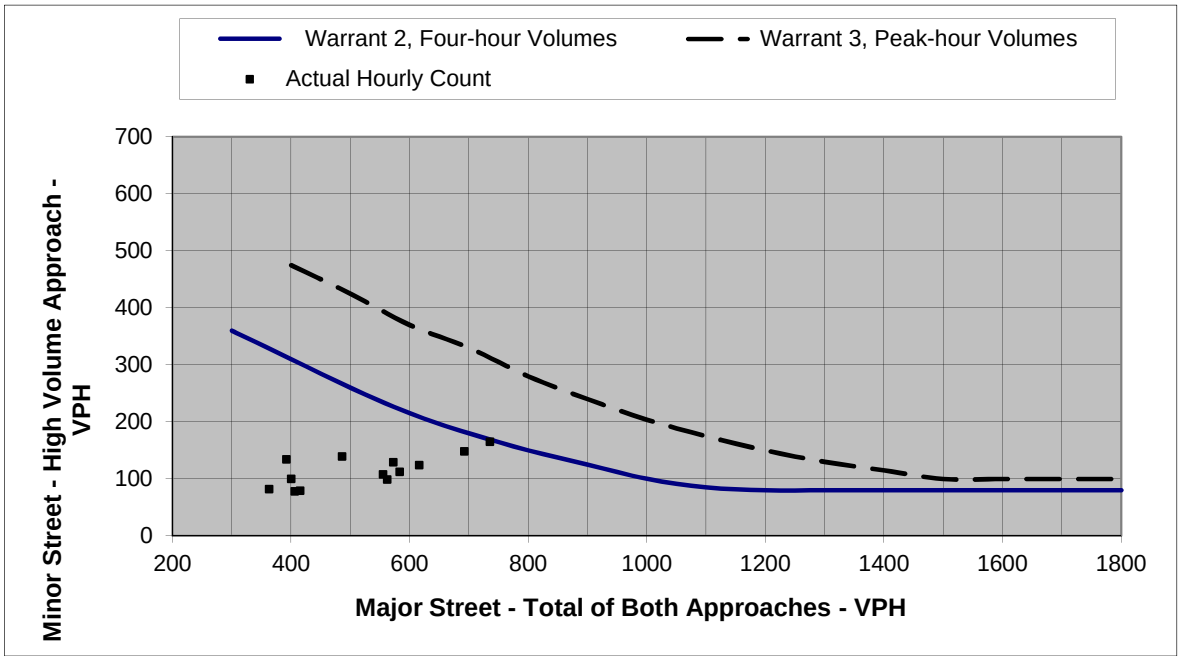


Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria			Actual Hourly Count	
Major	Warrant 2, I	Warrant 3, Pe	Major	Actual Hourly Count
200			0	0
300	360		0	0
400	310	475	0	0
500	260	425	0	0
600	215	370	0	0
700	180	330	0	0
800	150	280	392	134
900	125	240	486	139
1000	100	204	400	100
1100	85	175	406	78
1200	80	150	415	79
1300	80	130	562	99
1400	80	115	572	129
1500	80	100	555	108
1600	80	100	583	112
1700	80	100	735	165
1800	80	100	692	148
			616	124
			363	82
			0	0
			0	0
			0	0
			0	0
			0	0

ALL WAY STOP WARRANT

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017
OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	1
35	Major App3: Grandview Ave SB	1
40	Minor App2: S Houser St EB	1
25	Minor App4: Sampson St WB	1

0.70 FACTOR USED? No

					300	200	
HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR TOTAL Σ (APP. 1 & APP. 3)	MINOR TOTAL APP. 2 + APP. 4	WARRANT MET
0:00 - 1:00							
1:00 - 2:00							
2:00 - 3:00							
3:00 - 4:00							
4:00 - 5:00							
5:00 - 6:00							
6:00 - 7:00	192	200	134	68	392	202	X/X
7:00 - 8:00	266	220	139	76	486	215	X/X
8:00 - 9:00	204	196	100	53	400	153	X/
9:00 - 10:00	191	215	78	33	406	111	X/
10:00 - 11:00	228	187	79	61	415	140	X/
11:00 - 12:00	244	318	99	81	562	180	X/
12:00 - 13:00	274	298	129	66	572	195	X/
13:00 - 14:00	237	318	108	69	555	177	X/
14:00 - 15:00	257	326	112	99	583	211	X/X
15:00 - 16:00	324	411	165	164	735	329	X/X
16:00 - 17:00	302	390	148	133	692	281	X/X
17:00 - 18:00	229	387	124	90	616	214	X/X
18:00 - 19:00	165	198	82	35	363	117	X/
19:00 - 20:00							
20:00 - 21:00							
21:00 - 22:00							
22:00 - 23:00							
23:00 - 24:00							

	Met (Hr)	Required (Hr)	
Allway Stop Warrant:	6	8	Not satisfied

REMARKS:

EXISTING CONDITIONS
SIGNAL WARRANTS ANALYSIS
FOR
MUSSER ST AT GRANDVIEW AVENUE
(MINOR APPROACH RT TRAFFIC REMOVED)

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017
OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	1
35	Major App3: Grandview Ave SB	1
25	Minor App2: Musser St. EB	1
25	Minor App4: Musser St. WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? No

THRESHOLDS 1A/1B: 500/750 150/75 150/75

HOUR	MAJOR APP. 1	MAJOR APP. 3	TOTAL 1+3	MAJOR 1A/1B	MINOR APP. 2	MINOR 2 1A/1B	MINOR APP. 4	MINOR 4 1A/1B	**MET SAME 1A/1B**
0:00 - 1:00			0	/		/		/	**/**
1:00 - 2:00			0	/		/		/	**/**
2:00 - 3:00			0	/		/		/	**/**
3:00 - 4:00			0	/		/		/	**/**
4:00 - 5:00			0	/		/		/	**/**
5:00 - 6:00			0	/		/		/	**/**
6:00 - 7:00	93	132	225	/	12	/	9	/	**/**
7:00 - 8:00	159	149	308	/	25	/	29	/	**/**
8:00 - 9:00	126	125	251	/	41	/	33	/	**/**
9:00 - 10:00	112	133	245	/	26	/	19	/	**/**
10:00 - 11:00	124	127	251	/	30	/	13	/	**/**
11:00 - 12:00	167	208	375	/	42	/	22	/	**/**
12:00 - 13:00	185	201	386	/	56	/	18	/	**/**
13:00 - 14:00	151	189	340	/	42	/	17	/	**/**
14:00 - 15:00	187	218	405	/	39	/	25	/	**/**
15:00 - 16:00	215	254	469	/	53	/	36	/	**/**
16:00 - 17:00	193	248	441	/	39	/	24	/	**/**
17:00 - 18:00	180	226	406	/	37	/	9	/	**/**
18:00 - 19:00	100	119	219	/	17	/	11	/	**/**
19:00 - 20:00			0	/		/		/	**/**
20:00 - 21:00			0	/		/		/	**/**
21:00 - 22:00			0	/		/		/	**/**
22:00 - 23:00			0	/		/		/	**/**
23:00 - 24:00			0	/		/		/	**/**

	Met (Hr)	Required (Hr)	
Warrant 1A	0	8	Not satisfied
Warrant 1B	0	8	Not satisfied
Warrant 2	0	4	Not satisfied
Warrant 3	0	1	Not satisfied
Warrant 7	0	8	Not satisfied

Four Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	360	440	590
400	310	390	530
500	260	340	460
600	215	290	390
700	180	245	330
800	150	205	280
900	125	170	235
1000	100	145	195
1100	85	120	165
1200	80	100	135
1300	80	83	115
1400	80	80	115
1500	80	80	115
1600	80	80	115
1700	80	80	115
1800	80	80	115

Peak Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
400	475	570	725
500	425	520	665
600	370	465	600
700	330	420	540
800	280	370	480
900	240	330	425
1000	204	285	375
1100	175	250	330
1200	150	220	285
1300	130	190	250
1400	115	160	220
1500	100	140	187
1600	100	115	165
1700	100	100	150
1800	100	100	150

Four Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
200	250	320	420
300	210	265	350
400	170	215	285
500	130	170	230
600	93	130	175
700	70	100	135
800	60	80	103
900	60	65	80
1000	60	60	80
1100	60	60	80
1200	60	60	80
1300	60	60	80
1400	60	60	80
1500	60	60	80
1600	60	60	80
1700	60	60	80
1800	60	60	80

Peak Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	320	380	500
400	270	335	435
500	225	285	370
600	180	240	315
700	145	200	260
800	115	160	215
900	90	135	175
1000	75	110	140
1100	75	95	115
1200	75	75	100
1300	75	75	100
1400	75	75	100
1500	75	75	100
1600	75	75	100
1700	75	75	100
1800	75	75	100

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	1
35	Major App3: Grandview Ave SB	1
25	Minor App2: Musser St. EB	1
25	Minor App4: Musser St. WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? No

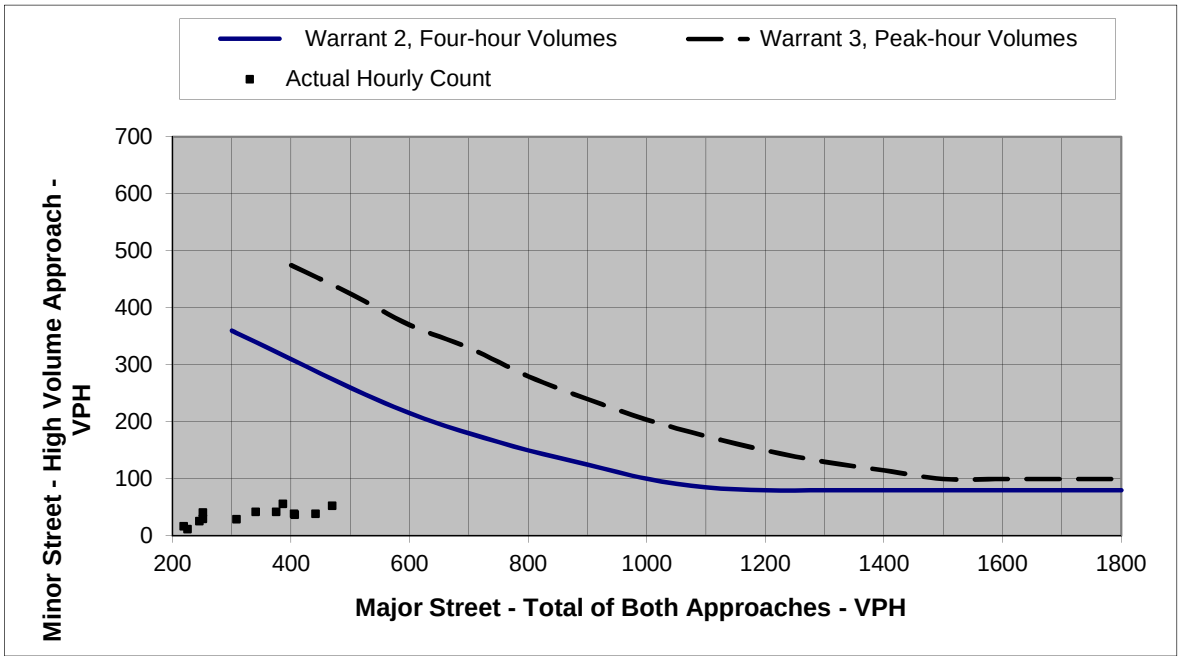


Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria			Actual Hourly Count	
Major	Warrant 2, I	Warrant 3, Pe	Major	Actual Hourly Count
200			0	0
300	360		0	0
400	310	475	0	0
500	260	425	0	0
600	215	370	0	0
700	180	330	0	0
800	150	280	225	12
900	125	240	308	29
1000	100	204	251	41
1100	85	175	245	26
1200	80	150	251	30
1300	80	130	375	42
1400	80	115	386	56
1500	80	100	340	42
1600	80	100	405	39
1700	80	100	469	53
1800	80	100	441	39
			406	37
			219	17
			0	0
			0	0
			0	0
			0	0
			0	0

ALL WAY STOP WARRANT

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	1
35	Major App3: Grandview Ave SB	1
25	Minor App2: Musser St. EB	1
25	Minor App4: Musser St. WB	1

0.70 FACTOR USED? No

					300	200	
HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR TOTAL Σ (APP. 1 & APP. 3)	MINOR TOTAL APP. 2 + APP. 4	WARRANT MET
0:00 - 1:00							
1:00 - 2:00							
2:00 - 3:00							
3:00 - 4:00							
4:00 - 5:00							
5:00 - 6:00							
6:00 - 7:00	93	132	12	9	225	21	/
7:00 - 8:00	159	149	25	29	308	54	X/
8:00 - 9:00	126	125	41	33	251	74	/
9:00 - 10:00	112	133	26	19	245	45	/
10:00 - 11:00	124	127	30	13	251	43	/
11:00 - 12:00	167	208	42	22	375	64	X/
12:00 - 13:00	185	201	56	18	386	74	X/
13:00 - 14:00	151	189	42	17	340	59	X/
14:00 - 15:00	187	218	39	25	405	64	X/
15:00 - 16:00	215	254	53	36	469	89	X/
16:00 - 17:00	193	248	39	24	441	63	X/
17:00 - 18:00	180	226	37	9	406	46	X/
18:00 - 19:00	100	119	17	11	219	28	/
19:00 - 20:00							
20:00 - 21:00							
21:00 - 22:00							
22:00 - 23:00							
23:00 - 24:00							

	Met (Hr)	Required (Hr)	
Allway Stop Warrant:	0	8	Not satisfied

REMARKS:

EXISTING CONDITIONS
SIGNAL WARRANTS ANALYSIS
FOR
WARREN ST AT GRANDVIEW AVENUE
(MINOR APPROACH RT TRAFFIC REMOVED)

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	2
35	Major App3: Grandview Ave SB	2
25	Minor App2: Warren St. EB	1
35	Minor App4: Oregon St. WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? Yes

THRESHOLDS 1A/1B: 480/720 120/60 120/60

HOUR	MAJOR APP. 1	MAJOR APP. 3	TOTAL 1+3	MAJOR 1A/1B	MINOR APP. 2	MINOR 2 1A/1B	MINOR APP. 4	MINOR 4 1A/1B	**MET SAME 1A/1B**
0:00 - 1:00			0	/		/		/	**/**
1:00 - 2:00			0	/		/		/	**/**
2:00 - 3:00			0	/		/		/	**/**
3:00 - 4:00			0	/		/		/	**/**
4:00 - 5:00			0	/		/		/	**/**
5:00 - 6:00			0	/		/		/	**/**
6:00 - 7:00	100	367	467	/	23	/	8	/	**/**
7:00 - 8:00	168	310	478	/	11	/	27	/	**/**
8:00 - 9:00	184	254	438	/	15	/	17	/	**/**
9:00 - 10:00	124	221	345	/	20	/	28	/	**/**
10:00 - 11:00	147	205	352	/	13	/	30	/	**/**
11:00 - 12:00	205	272	477	/	18	/	35	/	**/**
12:00 - 13:00	219	344	563	X/	20	/	45	/	**/**
13:00 - 14:00	173	307	480	X/	23	/	36	/	**/**
14:00 - 15:00	204	370	574	X/	9	/	41	/	**/**
15:00 - 16:00	230	360	590	X/	29	/	31	/	**/**
16:00 - 17:00	256	386	642	X/	20	/	35	/	**/**
17:00 - 18:00	180	337	517	X/	14	/	20	/	**/**
18:00 - 19:00	146	254	400	/	15	/	17	/	**/**
19:00 - 20:00			0	/		/		/	**/**
20:00 - 21:00			0	/		/		/	**/**
21:00 - 22:00			0	/		/		/	**/**
22:00 - 23:00			0	/		/		/	**/**
23:00 - 24:00			0	/		/		/	**/**

	Met (Hr)	Required (Hr)	
Warrant 1A	0	8	Not satisfied
Warrant 1B	0	8	Not satisfied
Warrant 2	0	4	Not satisfied
Warrant 3	0	1	Not satisfied
Warrant 7	0	8	Not satisfied

Four Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	360	440	590
400	310	390	530
500	260	340	460
600	215	290	390
700	180	245	330
800	150	205	280
900	125	170	235
1000	100	145	195
1100	85	120	165
1200	80	100	135
1300	80	83	115
1400	80	80	115
1500	80	80	115
1600	80	80	115
1700	80	80	115
1800	80	80	115

Peak Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
400	475	570	725
500	425	520	665
600	370	465	600
700	330	420	540
800	280	370	480
900	240	330	425
1000	204	285	375
1100	175	250	330
1200	150	220	285
1300	130	190	250
1400	115	160	220
1500	100	140	187
1600	100	115	165
1700	100	100	150
1800	100	100	150

Four Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
200	250	320	420
300	210	265	350
400	170	215	285
500	130	170	230
600	93	130	175
700	70	100	135
800	60	80	103
900	60	65	80
1000	60	60	80
1100	60	60	80
1200	60	60	80
1300	60	60	80
1400	60	60	80
1500	60	60	80
1600	60	60	80
1700	60	60	80
1800	60	60	80

Peak Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	320	380	500
400	270	335	435
500	225	285	370
600	180	240	315
700	145	200	260
800	115	160	215
900	90	135	175
1000	75	110	140
1100	75	95	115
1200	75	75	100
1300	75	75	100
1400	75	75	100
1500	75	75	100
1600	75	75	100
1700	75	75	100
1800	75	75	100

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	2
35	Major App3: Grandview Ave SB	2
25	Minor App2: Warren St. EB	1
35	Minor App4: Oregon St. WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? Yes

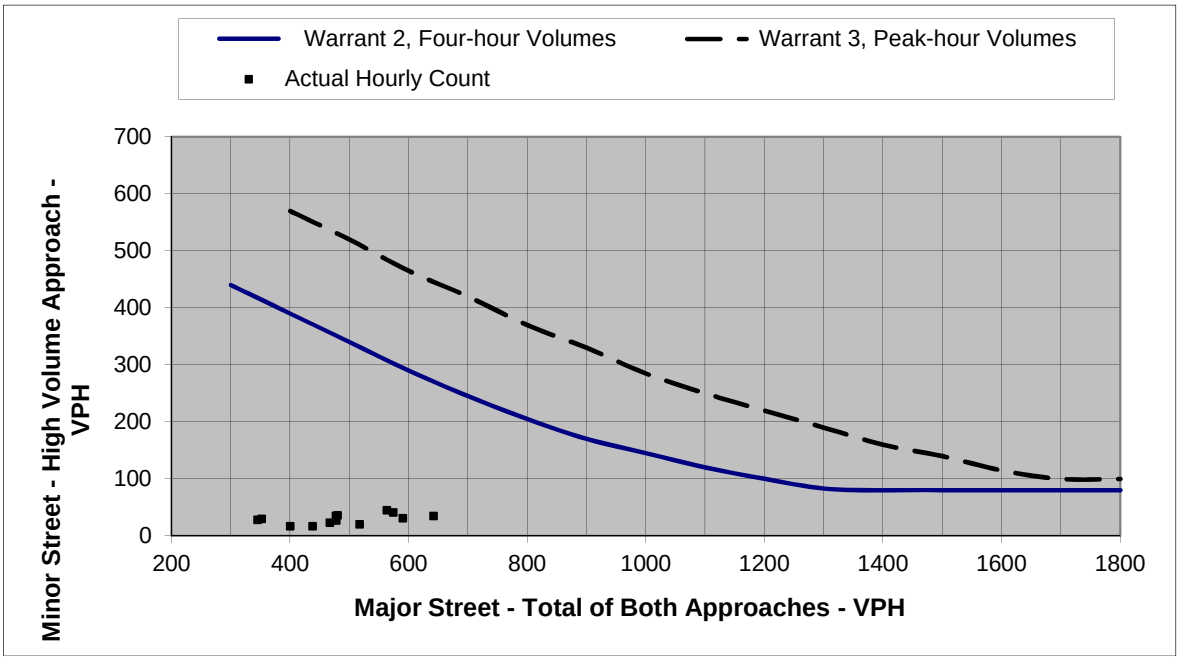


Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria			Actual Hourly Count	
Major	Warrant 2, I	Warrant 3, Pe	Major	Actual Hourly Count
200			0	0
300	440		0	0
400	390	570	0	0
500	340	520	0	0
600	290	465	0	0
700	245	420	0	0
800	205	370	467	23
900	170	330	478	27
1000	145	285	438	17
1100	120	250	345	28
1200	100	220	352	30
1300	83	190	477	35
1400	80	160	563	45
1500	80	140	480	36
1600	80	115	574	41
1700	80	100	590	31
1800	80	100	642	35
			517	20
			400	17
			0	0
			0	0
			0	0
			0	0
			0	0

ALL WAY STOP WARRANT

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017
OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	2
35	Major App3: Grandview Ave SB	2
25	Minor App2: Warren St. EB	1
35	Minor App4: Oregon St. WB	1

0.70 FACTOR USED? No

					300	200	
HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR TOTAL Σ (APP. 1 & APP. 3)	MINOR TOTAL APP. 2 + APP. 4	WARRANT MET
0:00 - 1:00							
1:00 - 2:00							
2:00 - 3:00							
3:00 - 4:00							
4:00 - 5:00							
5:00 - 6:00							
6:00 - 7:00	100	367	41	100	467	141	X/
7:00 - 8:00	168	310	26	178	478	204	X/X
8:00 - 9:00	184	254	36	119	438	155	X/
9:00 - 10:00	124	221	32	134	345	166	X/
10:00 - 11:00	147	205	30	143	352	173	X/
11:00 - 12:00	205	272	43	200	477	243	X/X
12:00 - 13:00	219	344	46	211	563	257	X/X
13:00 - 14:00	173	307	49	159	480	208	X/X
14:00 - 15:00	204	370	36	253	574	289	X/X
15:00 - 16:00	230	360	46	380	590	426	X/X
16:00 - 17:00	256	386	41	283	642	324	X/X
17:00 - 18:00	180	337	34	225	517	259	X/X
18:00 - 19:00	146	254	24	147	400	171	X/
19:00 - 20:00							
20:00 - 21:00							
21:00 - 22:00							
22:00 - 23:00							
23:00 - 24:00							

	Met (Hr)	Required (Hr)	
Allway Stop Warrant:	**8**	8	**Satisfied**

REMARKS:

EXISTING CONDITIONS
SIGNAL WARRANTS ANALYSIS
FOR
WARREN ST AT GRANDVIEW AVENUE
(MINOR APPROACH RT TRAFFIC REMOVED)

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	2
35	Major App3: Grandview Ave SB	2
25	Minor App2: Warren St. EB	1
35	Minor App4: Oregon St. WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? Yes

THRESHOLDS 1A/1B: 480/720 120/60 120/60

HOUR	MAJOR APP. 1	MAJOR APP. 3	TOTAL 1+3	MAJOR 1A/1B	MINOR APP. 2	MINOR 2 1A/1B	MINOR APP. 4	MINOR 4 1A/1B	**MET SAME 1A/1B**
0:00 - 1:00			0	/		/		/	**/**
1:00 - 2:00			0	/		/		/	**/**
2:00 - 3:00			0	/		/		/	**/**
3:00 - 4:00			0	/		/		/	**/**
4:00 - 5:00			0	/		/		/	**/**
5:00 - 6:00			0	/		/		/	**/**
6:00 - 7:00	170	587	757	X/X	46	/	11	/	**/**
7:00 - 8:00	286	496	782	X/X	22	/	38	/	**/**
8:00 - 9:00	313	406	719	X/	30	/	24	/	**/**
9:00 - 10:00	211	354	565	X/	40	/	39	/	**/**
10:00 - 11:00	250	328	578	X/	26	/	42	/	**/**
11:00 - 12:00	349	435	784	X/X	36	/	49	/	**/**
12:00 - 13:00	372	550	922	X/X	40	/	63	/X	**/X**
13:00 - 14:00	294	491	785	X/X	46	/	50	/	**/**
14:00 - 15:00	347	592	939	X/X	18	/	57	/	**/**
15:00 - 16:00	391	576	967	X/X	58	/	43	/	**/**
16:00 - 17:00	435	618	1053	X/X	40	/	49	/	**/**
17:00 - 18:00	306	539	845	X/X	28	/	28	/	**/**
18:00 - 19:00	248	406	654	X/	30	/	24	/	**/**
19:00 - 20:00			0	/		/		/	**/**
20:00 - 21:00			0	/		/		/	**/**
21:00 - 22:00			0	/		/		/	**/**
22:00 - 23:00			0	/		/		/	**/**
23:00 - 24:00			0	/		/		/	**/**

	Met (Hr)	Required (Hr)	
Warrant 1A	0	8	Not satisfied
Warrant 1B	1	8	Not satisfied
Warrant 2	0	4	Not satisfied
Warrant 3	0	1	Not satisfied
Warrant 7	**6**	8	Not satisfied

Four Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	360	440	590
400	310	390	530
500	260	340	460
600	215	290	390
700	180	245	330
800	150	205	280
900	125	170	235
1000	100	145	195
1100	85	120	165
1200	80	100	135
1300	80	83	115
1400	80	80	115
1500	80	80	115
1600	80	80	115
1700	80	80	115
1800	80	80	115

Peak Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
400	475	570	725
500	425	520	665
600	370	465	600
700	330	420	540
800	280	370	480
900	240	330	425
1000	204	285	375
1100	175	250	330
1200	150	220	285
1300	130	190	250
1400	115	160	220
1500	100	140	187
1600	100	115	165
1700	100	100	150
1800	100	100	150

Four Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
200	250	320	420
300	210	265	350
400	170	215	285
500	130	170	230
600	93	130	175
700	70	100	135
800	60	80	103
900	60	65	80
1000	60	60	80
1100	60	60	80
1200	60	60	80
1300	60	60	80
1400	60	60	80
1500	60	60	80
1600	60	60	80
1700	60	60	80
1800	60	60	80

Peak Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	320	380	500
400	270	335	435
500	225	285	370
600	180	240	315
700	145	200	260
800	115	160	215
900	90	135	175
1000	75	110	140
1100	75	95	115
1200	75	75	100
1300	75	75	100
1400	75	75	100
1500	75	75	100
1600	75	75	100
1700	75	75	100
1800	75	75	100

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	2
35	Major App3: Grandview Ave SB	2
25	Minor App2: Warren St. EB	1
35	Minor App4: Oregon St. WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? Yes

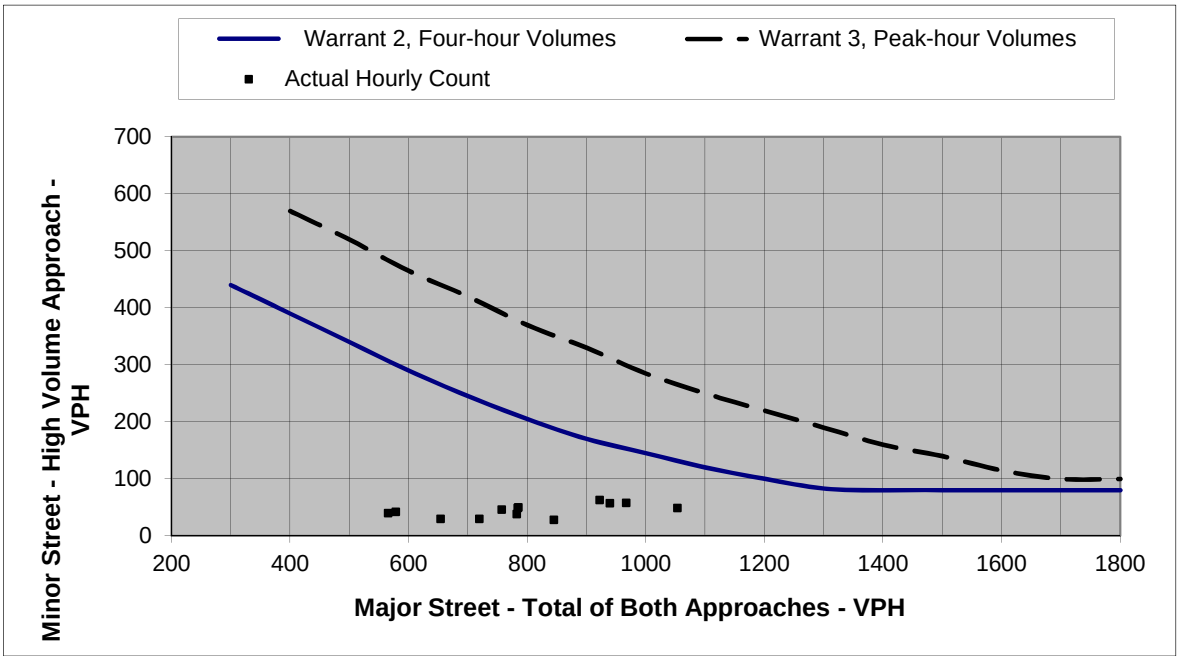


Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria			Actual Hourly Count	
Major	Warrant 2, I	Warrant 3, Pe	Major	Actual Hourly Count
200			0	0
300	440		0	0
400	390	570	0	0
500	340	520	0	0
600	290	465	0	0
700	245	420	0	0
800	205	370	757	46
900	170	330	782	38
1000	145	285	719	30
1100	120	250	565	40
1200	100	220	578	42
1300	83	190	784	49
1400	80	160	922	63
1500	80	140	785	50
1600	80	115	939	57
1700	80	100	967	58
1800	80	100	1053	49
			845	28
			654	30
			0	0
			0	0
			0	0
			0	0
			0	0

ALL WAY STOP WARRANT

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	2
35	Major App3: Grandview Ave SB	2
25	Minor App2: Warren St. EB	1
35	Minor App4: Oregon St. WB	1

0.70 FACTOR USED? No

					300	200	
HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR TOTAL Σ (APP. 1 & APP. 3)	MINOR TOTAL APP. 2 + APP. 4	WARRANT MET
0:00 - 1:00							
1:00 - 2:00							
2:00 - 3:00							
3:00 - 4:00							
4:00 - 5:00							
5:00 - 6:00							
6:00 - 7:00	170	587	82	140	757	222	X/X
7:00 - 8:00	286	496	52	249	782	301	X/X
8:00 - 9:00	313	406	72	167	719	239	X/X
9:00 - 10:00	211	354	64	188	565	252	X/X
10:00 - 11:00	250	328	60	200	578	260	X/X
11:00 - 12:00	349	435	86	280	784	366	X/X
12:00 - 13:00	372	550	92	295	922	387	X/X
13:00 - 14:00	294	491	98	223	785	321	X/X
14:00 - 15:00	347	592	72	354	939	426	X/X
15:00 - 16:00	391	576	92	532	967	624	X/X
16:00 - 17:00	435	618	82	396	1053	478	X/X
17:00 - 18:00	306	539	68	315	845	383	X/X
18:00 - 19:00	248	406	48	206	654	254	X/X
19:00 - 20:00							
20:00 - 21:00							
21:00 - 22:00							
22:00 - 23:00							
23:00 - 24:00							

	Met (Hr)	Required (Hr)	
Allway Stop Warrant:	**13**	8	**Satisfied**

REMARKS:

EXISTING CONDITIONS
SIGNAL WARRANTS ANALYSIS
FOR
BOND ST AT GRANDVIEW AVENUE
(MINOR APPROACH RT TRAFFIC REMOVED)

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	2
35	Major App3: Grandview Ave SB	2
25	Minor App2: Bond St. EB	1
25	Minor App4: Bond St. WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? No

THRESHOLDS 1A/1B: 600/900 150/75 150/75

HOUR	MAJOR APP. 1	MAJOR APP. 3	TOTAL 1+3	MAJOR 1A/1B	MINOR APP. 2	MINOR 2 1A/1B	MINOR APP. 4	MINOR 4 1A/1B	**MET SAME 1A/1B**
0:00 - 1:00			0	/		/		/	**/**
1:00 - 2:00			0	/		/		/	**/**
2:00 - 3:00			0	/		/		/	**/**
3:00 - 4:00			0	/		/		/	**/**
4:00 - 5:00			0	/		/		/	**/**
5:00 - 6:00			0	/		/		/	**/**
6:00 - 7:00	175	361	536	/	1	/	0	/	**/**
7:00 - 8:00	303	310	613	X/	4	/	2	/	**/**
8:00 - 9:00	269	267	536	/	2	/	1	/	**/**
9:00 - 10:00	219	222	441	/	3	/	3	/	**/**
10:00 - 11:00	236	212	448	/	8	/	4	/	**/**
11:00 - 12:00	345	293	638	X/	9	/	10	/	**/**
12:00 - 13:00	373	363	736	X/	8	/	6	/	**/**
13:00 - 14:00	280	327	607	X/	3	/	8	/	**/**
14:00 - 15:00	393	368	761	X/	5	/	6	/	**/**
15:00 - 16:00	552	358	910	X/X	3	/	9	/	**/**
16:00 - 17:00	504	395	899	X/	10	/	6	/	**/**
17:00 - 18:00	370	305	675	X/	9	/	5	/	**/**
18:00 - 19:00	281	256	537	/	8	/	8	/	**/**
19:00 - 20:00			0	/		/		/	**/**
20:00 - 21:00			0	/		/		/	**/**
21:00 - 22:00			0	/		/		/	**/**
22:00 - 23:00			0	/		/		/	**/**
23:00 - 24:00			0	/		/		/	**/**

	Met (Hr)	Required (Hr)	
Warrant 1A	0	8	Not satisfied
Warrant 1B	0	8	Not satisfied
Warrant 2	0	4	Not satisfied
Warrant 3	0	1	Not satisfied
Warrant 7	0	8	Not satisfied

Four Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	360	440	590
400	310	390	530
500	260	340	460
600	215	290	390
700	180	245	330
800	150	205	280
900	125	170	235
1000	100	145	195
1100	85	120	165
1200	80	100	135
1300	80	83	115
1400	80	80	115
1500	80	80	115
1600	80	80	115
1700	80	80	115
1800	80	80	115

Peak Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
400	475	570	725
500	425	520	665
600	370	465	600
700	330	420	540
800	280	370	480
900	240	330	425
1000	204	285	375
1100	175	250	330
1200	150	220	285
1300	130	190	250
1400	115	160	220
1500	100	140	187
1600	100	115	165
1700	100	100	150
1800	100	100	150

Four Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
200	250	320	420
300	210	265	350
400	170	215	285
500	130	170	230
600	93	130	175
700	70	100	135
800	60	80	103
900	60	65	80
1000	60	60	80
1100	60	60	80
1200	60	60	80
1300	60	60	80
1400	60	60	80
1500	60	60	80
1600	60	60	80
1700	60	60	80
1800	60	60	80

Peak Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	320	380	500
400	270	335	435
500	225	285	370
600	180	240	315
700	145	200	260
800	115	160	215
900	90	135	175
1000	75	110	140
1100	75	95	115
1200	75	75	100
1300	75	75	100
1400	75	75	100
1500	75	75	100
1600	75	75	100
1700	75	75	100
1800	75	75	100

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	2
35	Major App3: Grandview Ave SB	2
25	Minor App2: Bond St. EB	1
25	Minor App4: Bond St. WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? No

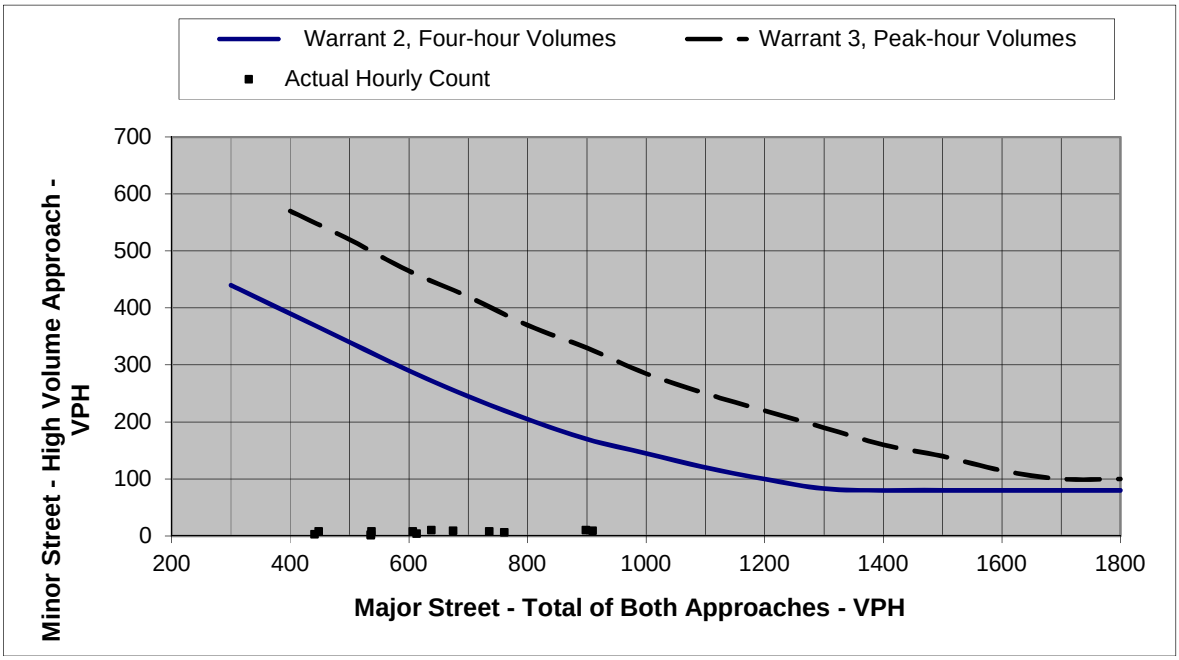


Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria			Actual Hourly Count	
Major	Warrant 2, I	Warrant 3, Pe	Major	Actual Hourly Count
200			0	0
300	440		0	0
400	390	570	0	0
500	340	520	0	0
600	290	465	0	0
700	245	420	0	0
800	205	370	536	1
900	170	330	613	4
1000	145	285	536	2
1100	120	250	441	3
1200	100	220	448	8
1300	83	190	638	10
1400	80	160	736	8
1500	80	140	607	8
1600	80	115	761	6
1700	80	100	910	9
1800	80	100	899	10
			675	9
			537	8
			0	0
			0	0
			0	0
			0	0
			0	0

ALL WAY STOP WARRANT

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	2
35	Major App3: Grandview Ave SB	2
25	Minor App2: Bond St. EB	1
25	Minor App4: Bond St. WB	1

0.70 FACTOR USED? No

					300	200	
HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR TOTAL Σ (APP. 1 & APP. 3)	MINOR TOTAL APP. 2 + APP. 4	WARRANT MET
0:00 - 1:00							
1:00 - 2:00							
2:00 - 3:00							
3:00 - 4:00							
4:00 - 5:00							
5:00 - 6:00							
6:00 - 7:00	175	361	1	0	536	1	X/
7:00 - 8:00	303	310	4	2	613	6	X/
8:00 - 9:00	269	267	2	1	536	3	X/
9:00 - 10:00	219	222	3	3	441	6	X/
10:00 - 11:00	236	212	8	4	448	12	X/
11:00 - 12:00	345	293	9	10	638	19	X/
12:00 - 13:00	373	363	8	6	736	14	X/
13:00 - 14:00	280	327	3	8	607	11	X/
14:00 - 15:00	393	368	5	6	761	11	X/
15:00 - 16:00	552	358	3	9	910	12	X/
16:00 - 17:00	504	395	10	6	899	16	X/
17:00 - 18:00	370	305	9	5	675	14	X/
18:00 - 19:00	281	256	8	8	537	16	X/
19:00 - 20:00							
20:00 - 21:00							
21:00 - 22:00							
22:00 - 23:00							
23:00 - 24:00							

	Met (Hr)	Required (Hr)	
Allway Stop Warrant:	0	8	Not satisfied

REMARKS:

EXISTING CONDITIONS
SIGNAL WARRANTS ANALYSIS
FOR
FRANKLIN ST AT GRANDVIEW AVENUE
(MINOR APPROACH RT TRAFFIC REMOVED)

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	2
35	Major App3: Grandview Ave SB	2
25	Minor App2: Franklin St. EB	1
25	Minor App4: Franklin St. WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? Yes

THRESHOLDS 1A/1B: 480/720 120/60 120/60

HOUR	MAJOR APP. 1	MAJOR APP. 3	TOTAL 1+3	MAJOR 1A/1B	MINOR APP. 2	MINOR 2 1A/1B	MINOR APP. 4	MINOR 4 1A/1B	MET SAME 1A/1B
0:00 - 1:00			0	/		/		/	/
1:00 - 2:00			0	/		/		/	/
2:00 - 3:00			0	/		/		/	/
3:00 - 4:00			0	/		/		/	/
4:00 - 5:00			0	/		/		/	/
5:00 - 6:00			0	/		/		/	/
6:00 - 7:00	167	350	517	X/	2	/	0	/	/
7:00 - 8:00	291	301	592	X/	0	/	1	/	/
8:00 - 9:00	265	252	517	X/	1	/	0	/	/
9:00 - 10:00	202	213	415	/	0	/	0	/	/
10:00 - 11:00	230	199	429	/	0	/	0	/	/
11:00 - 12:00	319	267	586	X/	0	/	0	/	/
12:00 - 13:00	347	338	685	X/	3	/	0	/	/
13:00 - 14:00	268	313	581	X/	1	/	0	/	/
14:00 - 15:00	364	348	712	X/	1	/	1	/	/
15:00 - 16:00	518	344	862	X/X	1	/	0	/	/
16:00 - 17:00	473	381	854	X/X	1	/	1	/	/
17:00 - 18:00	366	325	691	X/	0	/	0	/	/
18:00 - 19:00	269	248	517	X/	3	/	0	/	/
19:00 - 20:00			0	/		/		/	/
20:00 - 21:00			0	/		/		/	/
21:00 - 22:00			0	/		/		/	/
22:00 - 23:00			0	/		/		/	/
23:00 - 24:00			0	/		/		/	/

	Met (Hr)	Required (Hr)	
Warrant 1A	0	8	Not satisfied
Warrant 1B	0	8	Not satisfied
Warrant 2	0	4	Not satisfied
Warrant 3	0	1	Not satisfied
Warrant 7	0	8	Not satisfied

Four Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	360	440	590
400	310	390	530
500	260	340	460
600	215	290	390
700	180	245	330
800	150	205	280
900	125	170	235
1000	100	145	195
1100	85	120	165
1200	80	100	135
1300	80	83	115
1400	80	80	115
1500	80	80	115
1600	80	80	115
1700	80	80	115
1800	80	80	115

Peak Hour Warrant

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
400	475	570	725
500	425	520	665
600	370	465	600
700	330	420	540
800	280	370	480
900	240	330	425
1000	204	285	375
1100	175	250	330
1200	150	220	285
1300	130	190	250
1400	115	160	220
1500	100	140	187
1600	100	115	165
1700	100	100	150
1800	100	100	150

Four Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
200	250	320	420
300	210	265	350
400	170	215	285
500	130	170	230
600	93	130	175
700	70	100	135
800	60	80	103
900	60	65	80
1000	60	60	80
1100	60	60	80
1200	60	60	80
1300	60	60	80
1400	60	60	80
1500	60	60	80
1600	60	60	80
1700	60	60	80
1800	60	60	80

Peak Hour Warrant Factored

	Minor App		
Major App	1 & 1	2 & 1	2 & 2
300	320	380	500
400	270	335	435
500	225	285	370
600	180	240	315
700	145	200	260
800	115	160	215
900	90	135	175
1000	75	110	140
1100	75	95	115
1200	75	75	100
1300	75	75	100
1400	75	75	100
1500	75	75	100
1600	75	75	100
1700	75	75	100
1800	75	75	100

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017

OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	2
35	Major App3: Grandview Ave SB	2
25	Minor App2: Franklin St. EB	1
25	Minor App4: Franklin St. WB	1

0.70 FACTOR USED? No
POPULATION < 10,000? No
EXISTING SIGNAL ? Yes

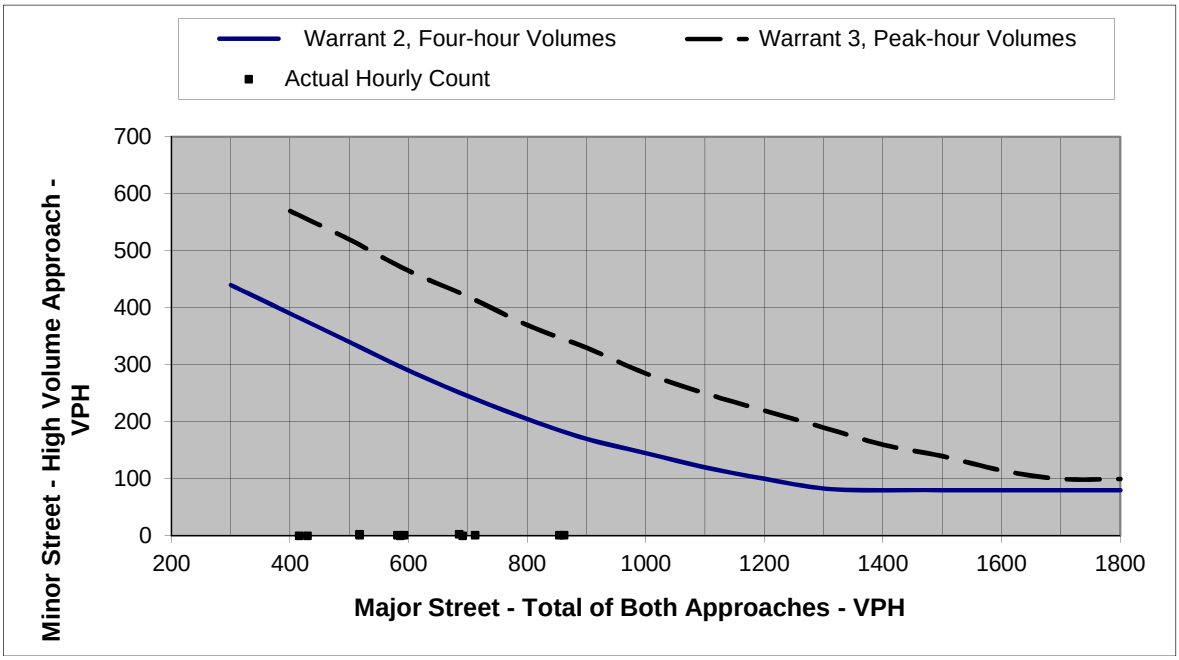


Figure 1. Four Hour and Peak Hour Warrant Analysis

Note: For data points outside the graph range, check the minor street volume against the lower thresholds

Warrant Criteria			Actual Hourly Count	
Major	Warrant 2, I	Warrant 3, Pe	Major	Actual Hourly Count
200			0	0
300	440		0	0
400	390	570	0	0
500	340	520	0	0
600	290	465	0	0
700	245	420	0	0
800	205	370	517	2
900	170	330	592	1
1000	145	285	517	1
1100	120	250	415	0
1200	100	220	429	0
1300	83	190	586	0
1400	80	160	685	3
1500	80	140	581	1
1600	80	115	712	1
1700	80	100	862	1
1800	80	100	854	1
			691	0
			517	3
			0	0
			0	0
			0	0
			0	0
			0	0

ALL WAY STOP WARRANT

LOCATION: Muscatine
COUNTY:
REF. POINT:
DATE: 11/28/2017
OPERATOR: RJH

Speed	Approach Description	Lanes
35	Major App1: Grandview Ave NB	2
35	Major App3: Grandview Ave SB	2
25	Minor App2: Franklin St. EB	1
25	Minor App4: Franklin St. WB	1

0.70 FACTOR USED? No

					300	200	
HOUR	MAJOR APP. 1	MAJOR APP. 3	MINOR APP. 2	MINOR APP. 4	MAJOR TOTAL Σ (APP. 1 & APP. 3)	MINOR TOTAL APP. 2 + APP. 4	WARRANT MET
0:00 - 1:00							
1:00 - 2:00							
2:00 - 3:00							
3:00 - 4:00							
4:00 - 5:00							
5:00 - 6:00							
6:00 - 7:00	167	350	2	0	517	2	X/
7:00 - 8:00	291	301	0	1	592	1	X/
8:00 - 9:00	265	252	1	0	517	1	X/
9:00 - 10:00	202	213	0	0	415	0	X/
10:00 - 11:00	230	199	0	0	429	0	X/
11:00 - 12:00	319	267	0	0	586	0	X/
12:00 - 13:00	347	338	3	0	685	3	X/
13:00 - 14:00	268	313	1	0	581	1	X/
14:00 - 15:00	364	348	1	1	712	2	X/
15:00 - 16:00	518	344	1	0	862	1	X/
16:00 - 17:00	473	381	1	1	854	2	X/
17:00 - 18:00	366	325	0	0	691	0	X/
18:00 - 19:00	269	248	3	0	517	3	X/
19:00 - 20:00							
20:00 - 21:00							
21:00 - 22:00							
22:00 - 23:00							
23:00 - 24:00							

	Met (Hr)	Required (Hr)	
Allway Stop Warrant:	0	8	Not satisfied

REMARKS:

Street Prioritization Matrix

Council In-depth Session

May 10, 2018

Identify Potential Projects

- Review prior fiscal years' unfunded projects
- Review latest dTIMS Pavement Evaluation Report.
- Review the Bi-State Regional Commission – Long Range Transportation Plan.
- Review staff (police, fire, streets, etc.) reported problems.
- Review Customer Service Requests.
- Review Council requests and citizen complaints.
- Consolidate lists into one list.

Confirm list of projects

- Public Works Director prepares a list of projects to be considered.
- Street division staff go out to each location and verify the onsite conditions
- Street Manager and Director verify the projects to be prioritized.
- Projects are separated into the appropriate programs.
- The programs are:
    - Street Reconstruction
    - Full Depth Patching Program
    - Street Resurfacing Program
    - Alley Reconstruction and Resurfacing Program (coming soon)
- Street Manager measures areas to be repaired for cost estimate
- A final project list is prepared.

Evaluation of Projects

- Staff evaluates projects based on the following factors:
  - Future Utility Work Planned
  - Ease of Construction
  - Traffic Counts
  - Pavement Condition
  - Staff Assessment
  - Remaining Life of Pavement
  - Cost of Construction
- The evaluations are put on a spreadsheet and tabulated
- The projects are then ranked within their grouping and a final priority list is developed.

Street Rating Factors

	Points	Definitions
Future Utility Work Planned		
Work Scheduled current year	0	This factor is used when utility work is planned on the street section. Work will wait until after the utility work has been completed.
Work Scheduled following year	2	
No Work Scheduled	10	
Ease of Construction		
Less than one week to complete	8 to 10	Ease of construction is defined as how quickly a project can be completed. The more quickly a project can be done to faster another project can be started. Therefore more points should be given to those projects that take less time.
One to two weeks to complete	5 to 7	
Two weeks to one month to complete	2 to 4	
More than one month to complete	0 to 1	
Traffic Counts		
9,000 or more vehicles per day	9 to 10	Points will be given based upon the number of vehicles per day. It is in the best interest of the community to maintain and repair streets with higher usage.
7,000 to 8,999 vehicles per day	7 to 8	
5,000 to 6,999 vehicles per day	5 to 6	
3,000 to 4,999 vehicles per day	3 to 4	
1,000 to 2,999 vehicles per day	1 to 2	
Less than 1,000 vehicles per day	0	
Pavement Condition		
PCI Index lower than 20	2 to 4	The lower the pavement condition index the worse the condition of the street. However, streets below 20 should no longer be repaired and should be moved to the reconstruction list. Streets above 60 will be put in the preventive maintenance program. Streets between 21 and 60 will be considered for repairs.
PCI Index between 21 and 40	8 to 10	
PCI Index between 41 and 60	5 to 7	
PCI Index between 61 and 80	1 to 3	
PCI Index between 81 and 100	0	
Staff Assessment		
Critical to Repair	10	Public Works Street Department Staff deal with city streets daily, their knowledge of the system is important and their input should be considered. Staff have the ability to rank street repairs based on their assessment of how urgent repairs are needed.
High need to repair	8 to 9	
Moderate need to repair	6 to 7	
Some need to repair	2 to 5	
Low need to repair	0 to 1	
Remaining Life of Pavement		
Less than 2 years	10	An estimate on the remaining life of the pavement assuming no improvements are made. The shorter the projected lifespan the higher the number of points given.
3 to 5 years	5 to 9	
6 or more years	0 to 4	
Cost of Construction		
Project costs less than $15K	9 to 10	Cost of construction is an important factor when considering the city's limited resources. A lot of small projects can be completed for every large one built. More points are to be given to the smaller projects.
Project cost between $16K to $99K	7 to 8	
Project cost between $100K to $200K	5 to 6	
Project cost between $201K to $399K	3 to 4	
Project cost more than $400K	0 to 2	

Project Fund Allocation F.Y. 2019 ≈ $1 Million

- This year planning to only repair concrete streets
- $100,000 for railroad crossing repair at Dick Drake Way
- $100,000 for alley resurfacing
- $800,000 for full depth concrete patching

Proposed FY 18-19 Full-Depth Patch Streets

Street Name	Location Address or from: to:	Ward	Cost Estimate	Pavement Type	Future Utility Work Planned	Ease of Construction	Traffic Counts	Pavement Condition	Staff Evaluation	Remaining Life of Pavement	Cost of Construction	**Point Ranking**
Fulliam Ave	Buell to Roscoe	1&2	$92,840.50	PCC	10	6	4	8	9	10	7	**54**
Stewart Road	Wallace to Dick Drake Way	4	$86,708.00	PCC	10	8	4	4	8	10	7	**51**
Fulliam Ave	Kindler to Devitt	1	$54,175.50	PCC	10	3	4	10	9	6	7	**49**
Fulliam Ave	Houser to Green Acres	1	$180,000.00	PCC	10	2	5	8	9	10	5	**49**
Houser	Musser to Grandview	1 & 4	$257,008.50	PCC	10	2	7	4	9	10	4	**46**
Houser	Hershey to Musser	4	$260,000.00	PCC	10	2	7	4	9	10	4	**46**
Division	Evans to Warren	4	$146,567.00	PCC	10	4	0	8	8	10	5	**45**
Park Ave West	Hwy 38 & Peachtree	5	$58,981.00	PCC	10	3	1	4	9	10	8	**45**
Logan Street	Pinefield to Newell Ave	4	$124,036.00	PCC	10	3	1	7	8	10	6	**45**
2nd Avenue	Cleveland to Lake Park	5	$74,077.00	PCC	10	2	1	6	8	10	7	**44**
Green Acres Drive	Fulliam to dead end	1	$157,329.00	PCC	10	3	0	7	5	10	5	**40**
Surrey Ct	Spinning Wheel area	1	$103,548.00	PCC	10	3	0	4	3	10	7	**37**
Logan Street	Fulliam to Cedar	1		PCC	10	0	3	8	0	10	0	**31**
Sterling Woods Ct	at Stonebrook Drive	1		PCC	10	4	0	4	0	10	0	**28**
Pearlview	Fulliam to dead end	1		PCC	10	0	0	7	0	10	0	**27**
Meadow Lane	Fulliam to dead end	1		PCC	10	0	0	6	0	10	0	**26**
American Ave	Devitt to Siegel	1		PCC	10	0	0	6	0	10	0	**26**
Whicher	8th to E. of Quince	2		PCC	10	1	0	7	0	10	0	**28**
Glenwood Lane	Bidwell to dead end	3		PCC	10	0	0	6	0	10	0	**26**
Dolliver	Dawson to Lucas	1		PCC	10	0	0	6	0	10	0	**26**
Oneida	Division to Park entrance	4		PCC	10	0	0	6	0	10	0	**26**
Mill Street	Green to Busch	4		PCC	10	10	0	1	0	0	0	**21**
Sunrise Circle	Sunset Dr. to Robin Rd.	3		PCC	10	0	0	4	0	10	0	**24**
University Drive	HWY 61 to HWY 22	5		PCC	10	0	5	1	0	5	0	**21**
Roscoe Avenue	Fulliam to 8th	2		PCC	2	0	1	7	0	10	0	**20**
Spinnining Wheel Ct.		1		PCC	10	0	0		0		0	**10**
Roscoe Avenue	11th to Van Horne	2		PCC	10	0	0		0		0	**10**
Roscoe Avenue	Van Horne to 8th	2		PCC	2	0	0		0		0	**2**
Ford Avenue	Frontage Rd. to Jody	5		PCC	10	0	0		0		0	**10**
												0

CURRENT TOTAL **$1,595,270.50**

Proposed FY 18-19 Full-Depth Patch
Streets

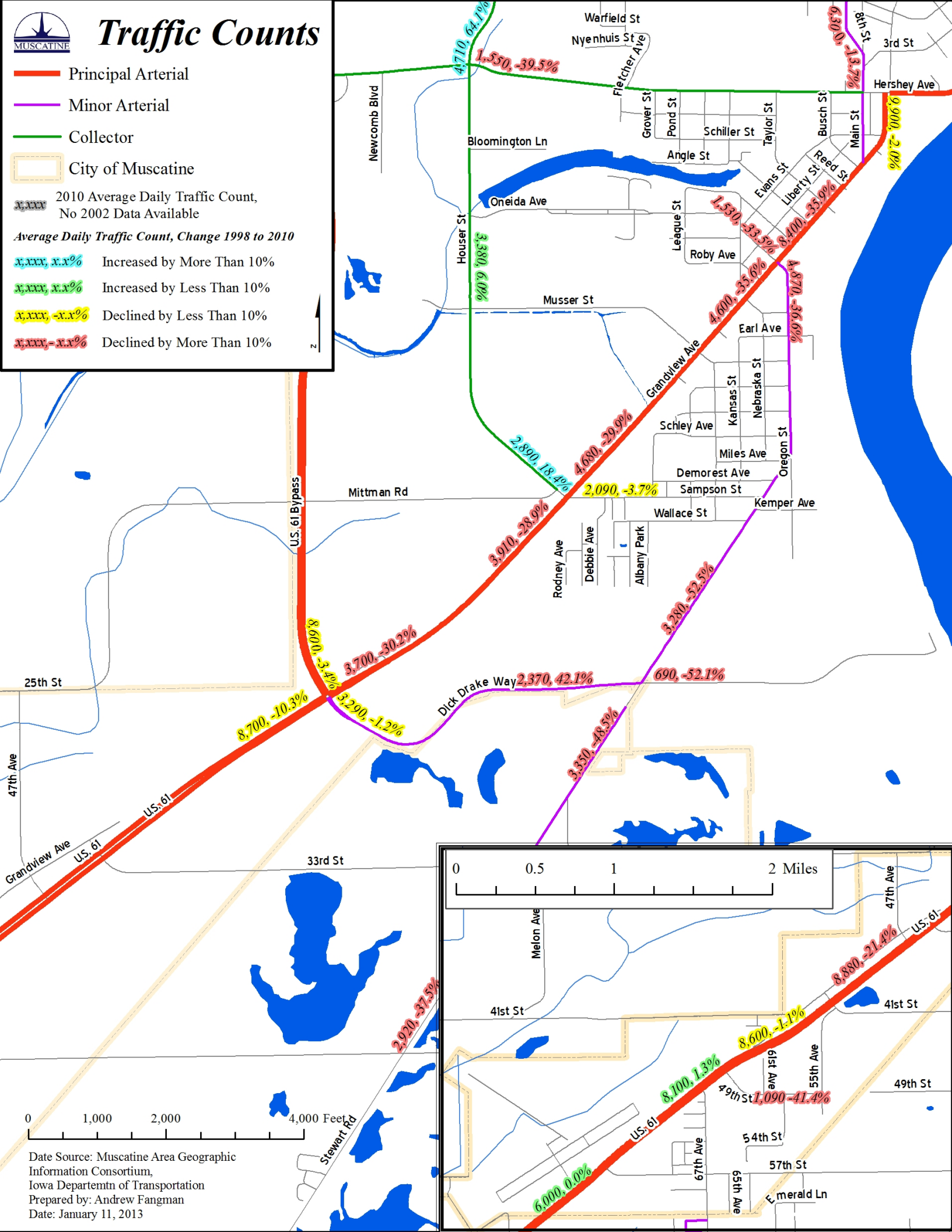
Street Name	Location Address or from: to:	Ward	Cost Estimate	Pavement Type	Future Utility Work Planned	Ease of Construction	Traffic Counts	Pavement Condition	Staff Evaluation	Remaining Life of Pavement	Cost of Construction	**Point Ranking**	Running Cost Total
Fulliam Ave	Buell to Roscoe	1&2	$92,840.50	PCC	10	6	4	8	9	10	7	**54**	$92,840.50
Stewart Road	Wallace to Dick Drake Way	4	$86,708.00	PCC	10	8	4	4	8	10	7	**51**	$179,548.50
Fulliam Ave	Kindler to Devitt	1	$54,175.50	PCC	10	3	4	10	9	6	7	**49**	$233,724.00
Fulliam Ave	Houser to Green Acres	1	$180,000.00	PCC	10	2	5	8	9	10	5	**49**	$413,724.00
Houser	Musser to Grandview	1 & 4	$257,008.50	PCC	10	2	7	4	9	10	4	**46**	$670,732.50
Houser	Hershey to Musser	4	$260,000.00	PCC	10	2	7	4	9	10	4	**46**	$930,732.50
Division	Evans to Warren	4	$146,567.00	PCC	10	4	0	8	8	10	5	**45**	$1,077,299.50
Park Ave West	Hwy 38 & Peachtree	5	$58,981.00	PCC	10	3	1	4	9	10	8	**45**	$1,136,280.50
Logan Street	Pinefield to Newell Ave	4	$124,036.00	PCC	10	3	1	7	8	10	6	**45**	$1,260,316.50
2nd Avenue	Cleveland to Lake Park	5	$74,077.00	PCC	10	2	1	6	8	10	7	**44**	$1,334,393.50
Green Acres Drive	Fulliam to dead end	1	$157,329.00	PCC	10	3	0	7	5	10	5	**40**	$1,491,722.50
Surrey Ct	Spinning Wheel area	1	$103,548.00	PCC	10	3	0	4	3	10	7	**37**	$1,595,270.50

Proposed FY 18-19 Full-Depth Patch
Streets

Street Name	Location Address or from: to:	Ward	Cost Estimate	Pavement Type	Future Utility Work Planned	Ease of Construction	Traffic Counts	Pavement Condition	Staff Evaluation	Remaining Life of Pavement	Cost of Construction	**Point Ranking**	Running Cost Total
Fulliam Ave	Buell to Roscoe	1&2	$92,840.50	PCC	10	6	4	8	9	10	7	**54**	$92,840.50
Stewart Road	Wallace to Dick Drake Way	4	$86,708.00	PCC	10	8	4	4	8	10	7	**51**	$179,548.50
Fulliam Ave	Kindler to Devitt	1	$54,175.50	PCC	10	3	4	10	9	6	7	**49**	$233,724.00
Fulliam Ave	Houser to Green Acres	1	$180,000.00	PCC	10	2	5	8	9	10	5	**49**	$413,724.00
Houser	Musser to Grandview	1 & 4	$257,008.50	PCC	10	2	7	4	9	10	4	**46**	$670,732.50
Houser	Hershey to Musser	4	$260,000.00	PCC	10	2	7	4	9	10	4	**46**	$930,732.50
Division	Evans to Warren	4	$146,567.00	PCC	10	4	0	8	8	10	5	**45**	$1,077,299.50
Park Ave West	Hwy 38 & Peachtree	5	$58,981.00	PCC	10	3	1	4	9	10	8	**45**	$1,136,280.50
Logan Street	Pinefield to Newell Ave	4	$124,036.00	PCC	10	3	1	7	8	10	6	**45**	$1,260,316.50
2nd Avenue	Cleveland to Lake Park	5	$74,077.00	PCC	10	2	1	6	8	10	7	**44**	$1,334,393.50
Green Acres Drive	Fulliam to dead end	1	$157,329.00	PCC	10	3	0	7	5	10	5	**40**	$1,491,722.50
Surrey Ct	Spinning Wheel area	1	$103,548.00	PCC	10	3	0	4	3	10	7	**37**	$1,595,270.50

Proposed FY 18-19 Full-Depth Patch
Streets

Street Name	Location Address or from: to:	Ward	Cost Estimate	Pavement Type	Future Utility Work Planned	Ease of Construction	Traffic Counts	Pavement Condition	Staff Evaluation	Remaining Life of Pavement	Cost of Construction	**Point Ranking**	Running Cost Total
Fulliam Ave	Buell to Roscoe	1&2	$92,840.50	PCC	10	6	4	8	9	10	7	**54**	$92,840.50
Stewart Road	Wallace to Dick Drake Way	4	$86,708.00	PCC	10	8	4	4	8	10	7	**51**	$179,548.50
Fulliam Ave	Kindler to Devitt	1	$54,175.50	PCC	10	3	4	10	9	6	7	**49**	
Fulliam Ave	Houser to Green Acres	1	$180,000.00	PCC	10	2	5	8	9	10	5	**49**	
Houser	Musser to Grandview	1 & 4	$257,008.50	PCC	10	2	7	4	9	10	4	**46**	
Houser	Hershey to Musser	4	$260,000.00	PCC	10	2	7	4	9	10	4	**46**	$439,548.50
Park Ave West	Hwy 38 & Peachtree	5	$58,981.00	PCC	10	3	1	4	9	10	8	**45**	$498,529.50
Division	Evans to Warren	4	$146,567.00	PCC	10	4	0	8	8	10	5	**45**	$645,096.50
Logan Street	Pinefield to Newell Ave	4	$124,036.00	PCC	10	3	1	7	8	10	6	**45**	$769,132.50
2nd Avenue	Cleveland to Lake Park	5	$74,077.00	PCC	10	2	1	6	8	10	7	**44**	$843,209.50
Green Acres Drive	Fulliam to dead end	1	$157,329.00	PCC	10	3	0	7	5	10	5	**40**	$1,000,538.50
Surrey Ct	Spinning Wheel area	1	$103,548.00	PCC	10	3	0	4	3	10	7	**37**	$1,104,086.50



Date Source: Muscatine Area Geographic Information Consortium,
Iowa Departemtn of Transportation
Prepared by: Andrew Fangman
Date: January 11, 2013

Whicher Street

Council In-depth

May 10, 2018

Neighborhood Meeting Held 4/24/18

- 21 Non-city staff signed in
- 10 Whicher addresses
- 1 Valley address
- 2 Lucas addresses
- 1 8th Street address

Staff Proposal

- Stabilize the fill area
- Add compacted fill to remove the “roller coaster”
- Address stormwater runoff
- Address traffic speed with signage
- Re-pave and open roadway

Public Input

- No!
- Concerns
  - “Racetrack”
  - Safety because of past history
  - Landfill stability
  - Children play here
  - Stormwater
  - Traffic control

Staff Input

- A closed road has no value to the public
- Best option for detour during West Hill work
  - Street widths and on-street parking issues on others
- Access for public safety vehicles
- Why provide a “private park” to residents?
- We have time to evaluate this and make a sound decision, just don’t want to spend the time and money if not going to be approved.

Options

- Spend money on more evaluation, survey and draft plan
- Abandon project and leave alone
- Sell right of way behind 939 Whicher to adjacent owners


Whicher St
W 8th St
Quince St
Valley St
Wilson St
Cherry Ln
Whicher St
Green St
Cherry St
Lucas St
Main St
George St
W 4th St
2,311,077.094 526,596.946 Feet
MUSCOM; MAGIC
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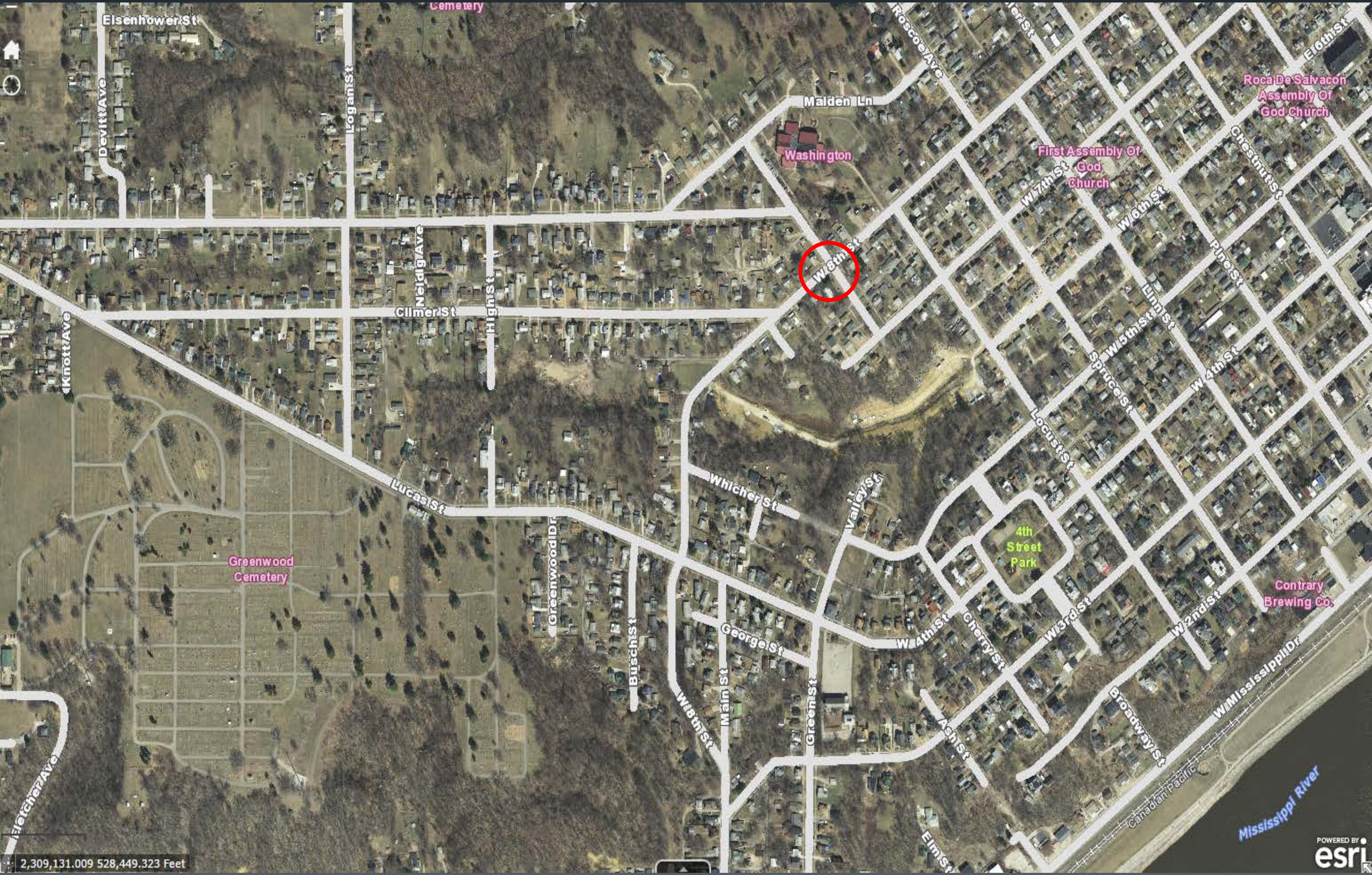
Detour Discussion (if wanted)



Eisenhower St
Cemetery
Malden Ln
Washington
Roscoe Ave
Roca De Salvacon Assembly Of God Church
First Assembly Of God Church
W 7th St
W 6th St
Chestnut St
Pine St
W 8th St
Climer St
Neidig Ave
High St
Logan St
Devitt Ave
Knott Ave
Linn St
W 5th St
Spruce St
W 4th St
Locust St
Whicher St
Valley St
Lucas St
4th Street Park
Greenwood Cemetery
Greenwood Dr
Busch St
George St
W 4th St
Cherry St
W 3rd St
W 2nd St
Contrary Brewing Co.
W Mississippi Dr
W 8th St
Main St
Green St
Ash St
Broadway St
Canadian Pacific
Mississippi River
Elm St
Fletcher Ave
2,309,131.009 528,449.323 Feet
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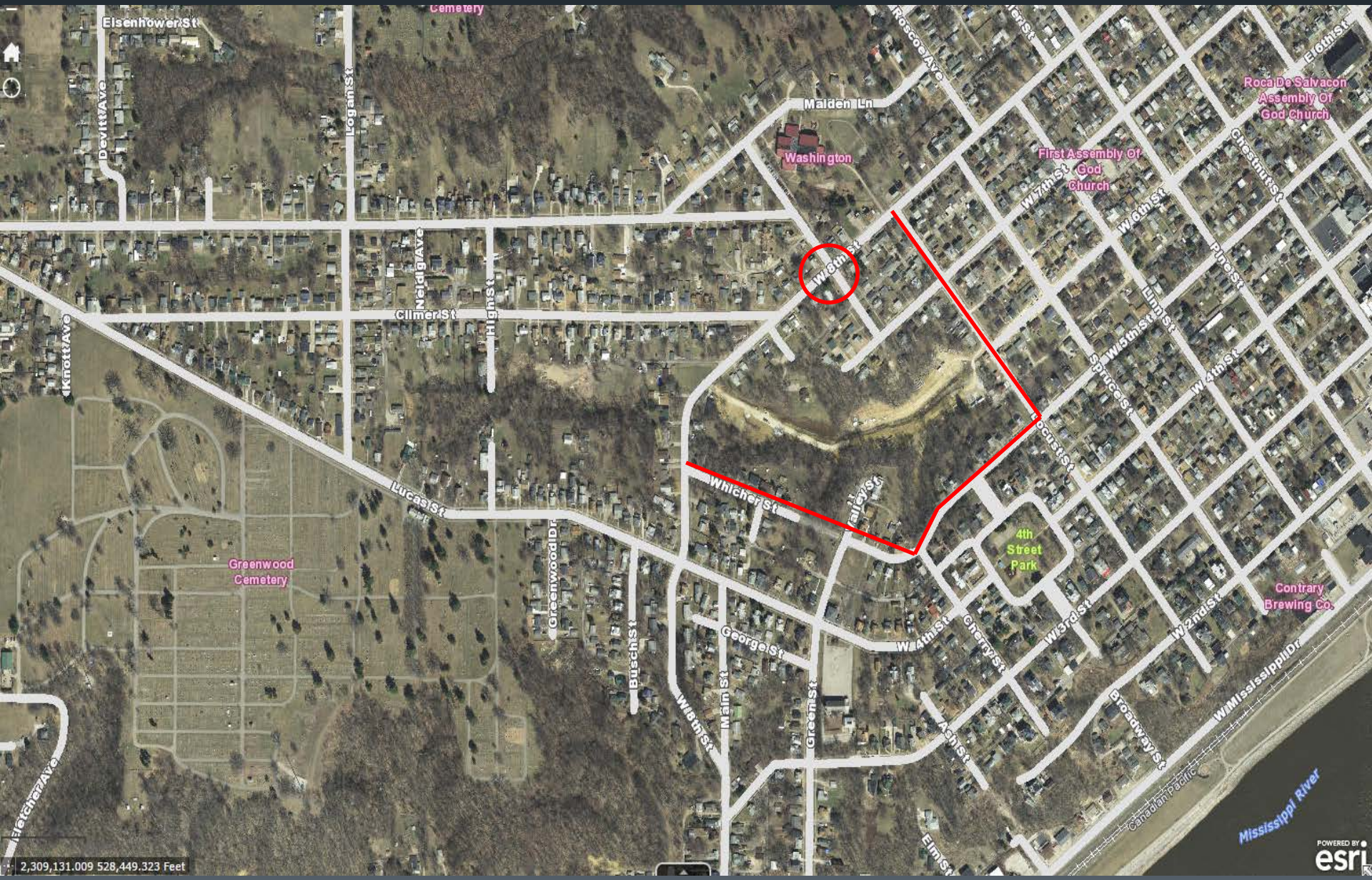
Detour 1: Locust to 5th to Whicher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Contrary Brewing Co.
Greenwood Cemetery
Greenwood Dr
Busch St
George St
W 4th St
Cherry St
W 3rd St
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Wash St
Ash St
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W Mississippi Dr
Canadian Pacific
Mississippi River
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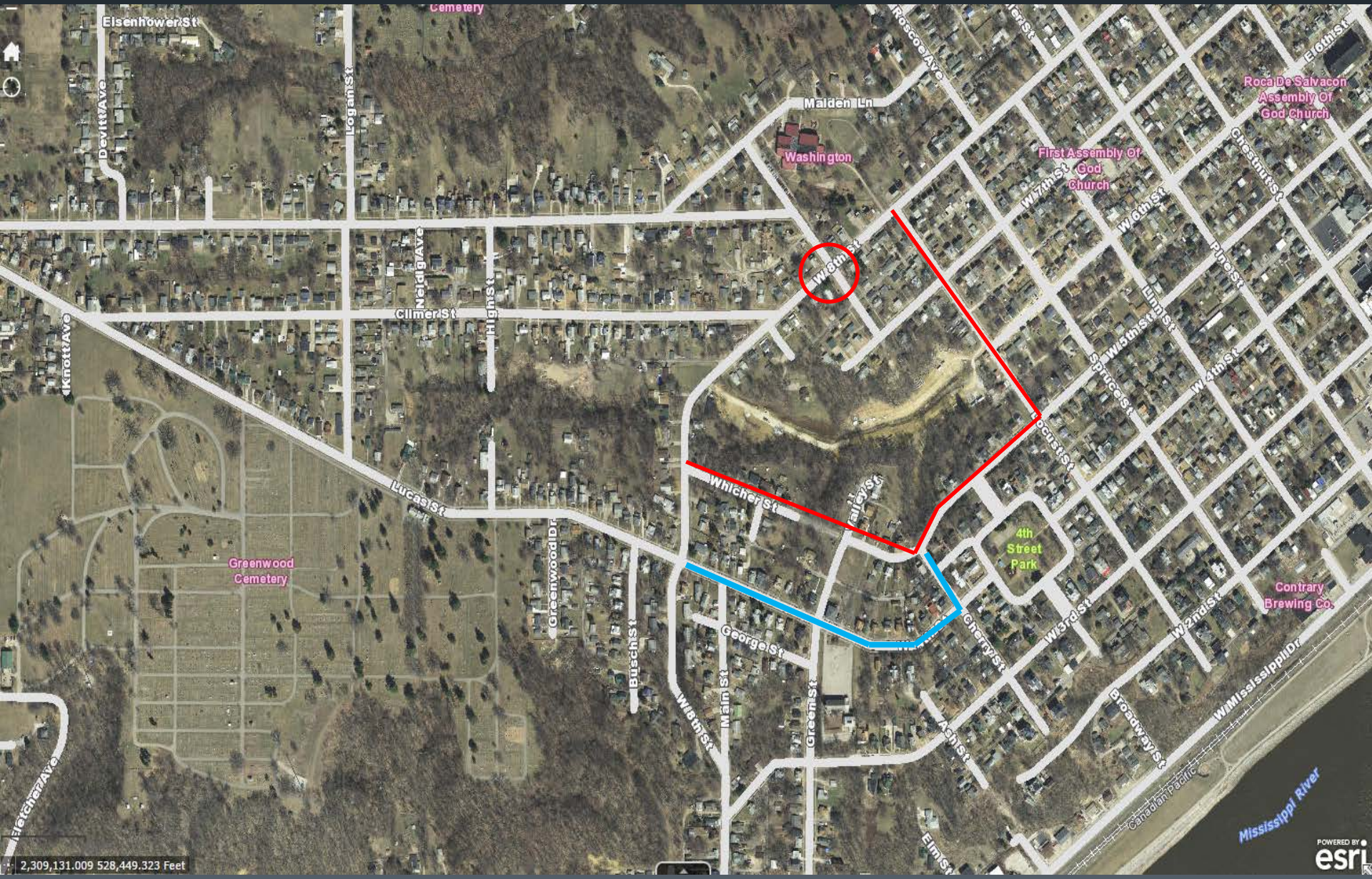
Detour 2: Locust to 5th to Cherry to 4th to Lucas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W Mississippi Dr
Broadway St
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Elm St
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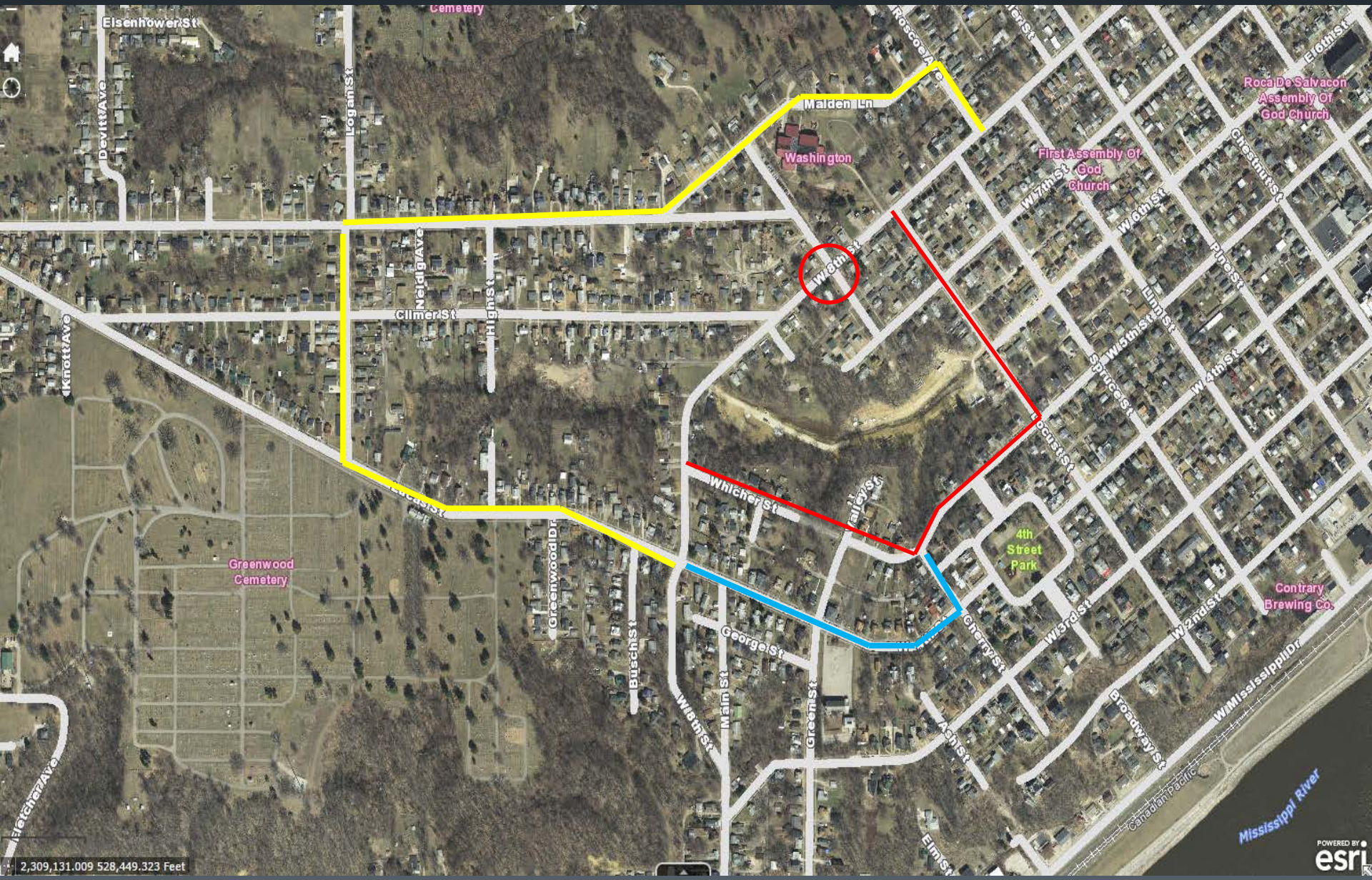
Detour 3: Roscoe to Maiden Lane to Newell to Logan to Lucas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