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Draft Memorandum

SRF No. 013 8265

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City of Duluth

From: Brian Johnson, PE, Principal
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Date: December 2, 2013

Subject: Superior Street Reconstruction Traffic Study
Duluth, Minnesota

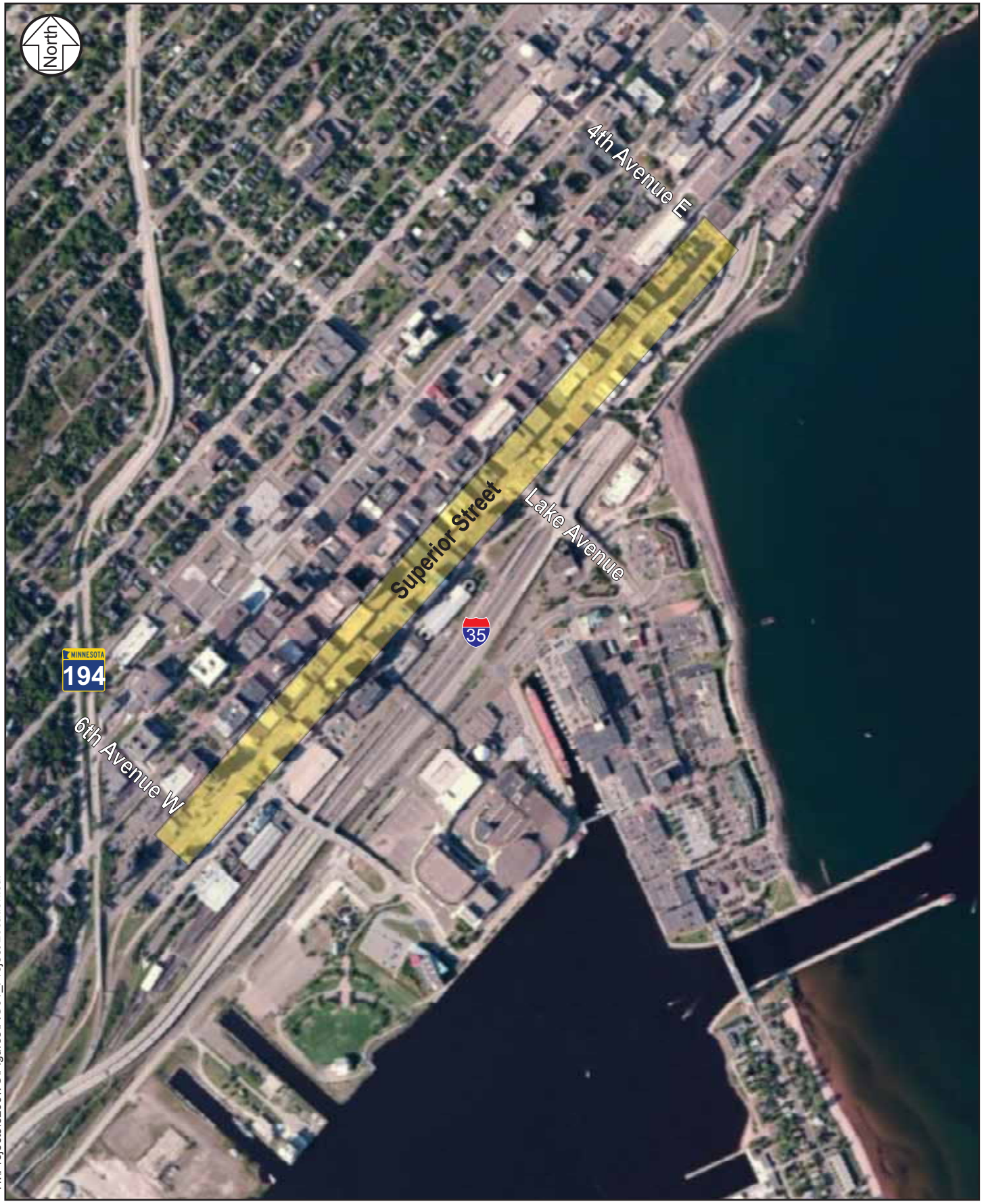
Introduction

As requested, SRF Consulting Group, Inc. has completed a traffic study for a segment of Superior Street in downtown Duluth, Minnesota. Superior Street between 6th Avenue W to 4th Avenue E is anticipated to be reconstructed starting in the year 2015 (see Figure 1). Superior Street not only functions as a corridor for passenger vehicles, but also includes busses, delivery trucks, bicycles, and pedestrians. The objective of this study is to evaluate the existing conditions along Superior Street, develop future traffic forecasts, evaluate operations along the corridor, and recommend potential geometric and/or traffic control modifications. The following assumptions, conclusions, and recommendations are offered for your consideration.

Existing Conditions

The existing conditions were reviewed along the study segment of Superior Street to establish a baseline to which future operations can be compared. The evaluation included data collection and operations analysis at the following study intersections:

- Superior Street W/6th Avenue W
- Superior Street W/5th Avenue W
- Superior Street W/4th Avenue W
- Superior Street W/3rd Avenue W
- Superior Street W/2nd Avenue W
- Superior Street W/1st Avenue W
- Superior Street /Lake Avenue
- Superior Street E/1st Avenue E
- Superior Street E/2nd Avenue E
- Superior Street E/3rd Avenue E
- Superior Street E/Michigan Street
- Superior Street E/4th Avenue E



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00138265
November 2013

Project Location

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Duluth, MN

Figure 1

Data Collection

Year 2012 annual average daily traffic (AADT) volumes were provided by the Minnesota Department of Transportation (MnDOT) within the study area. In addition to the daily traffic volumes, weekday a.m. and p.m. peak hour intersection turning movement and pedestrian counts were collected by SRF at the previously identified study intersections. These counts were collected during the week of October 21, 2013.

Field observations were also conducted to identify roadway characteristics within the study area (i.e. roadway geometry, posted speed limits, and intersection control types). The posted speed limit throughout the study area is 30 miles per hour (mph). The existing geometry layout, traffic control, and volumes are shown in Figure 2.

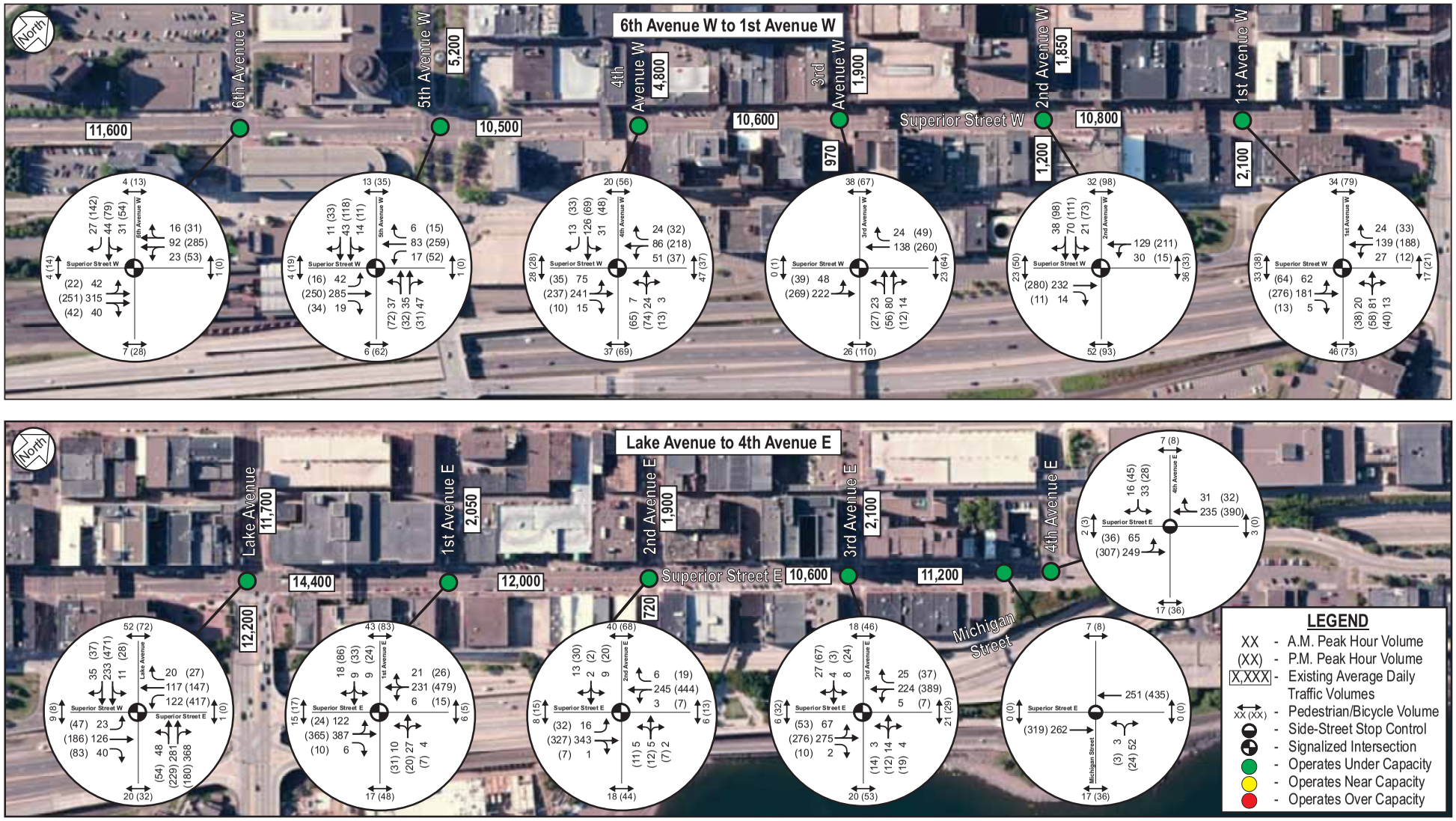
Intersection Operations Analysis

An intersection operations analysis was conducted to determine how traffic is currently operating within the study area. All intersections were analyzed using a combination of Synchro/SimTraffic software and the Highway Capacity Manual (HCM). Operations analysis results identify a Level of Service (LOS) which indicates how well an intersection is operating based on the average delay per vehicle. Intersections are given a ranking from LOS A through LOS F (see Table 1). LOS A indicates the best traffic operations, while LOS F indicates an intersection where demand exceeds capacity. In general, overall intersection LOS A through D is considered acceptable by MnDOT standards.

Table 1. Level of Service Criteria for Signalized and Unsignalized Intersections

LOS Designation	Signalized Intersection Average Delay/Vehicle (seconds)	Unsignalized Intersection Average Delay/Vehicle (seconds)
A	<10	<10
B	10-20	10-15
C	20-35	15-25
D	35-55	25-35
E	55-80	35-50
F	80<	50<

For side-street stop controlled intersections, special emphasis is given to providing an estimate for the level of service of the side-street approach. Traffic operations at an unsignalized intersection with side-street stop control can be described in two ways. First, consideration is given to the overall intersection level of service. This takes into account the total number of vehicles entering the intersection and the capability of the intersection to support those volumes.



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November 2013

Existing Conditions

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Duluth, MN

Figure 2

Second, it is important to consider the delay on the minor approach. Since the mainline does not have to stop, the majority of delay is attributed to the side-street approaches. It is typical of intersections with higher mainline traffic volumes to experience high levels of delay (i.e., poor levels of service) on the side-street approaches, but an acceptable overall intersection level of service during peak hour conditions.

Results of the existing operations analysis summarized in Table 2 indicate that all of the study intersections operate at an acceptable overall LOS C or better during the a.m. and p.m. peak hours with the current traffic control and geometric layout.

Although the study intersections operate at an acceptable overall level of service, westbound 95th percentile queues of approximately 400 feet were observed in the traffic simulation model and verified in the field at the Superior Street/Lake Avenue intersection during the p.m. peak hour. This queue is the result of the limited westbound left-turn lane storage (100 feet), and high left-turn volume. These queues also extend into the westbound through lane, resulting in additional impacts. No other significant delay or queuing issues were identified at the remaining study intersections. Existing operations are summarized in Figure 2.

Table 2. Existing Conditions – Intersection Capacity Analysis Results

Intersection	Level of Service (LOS)	
	A.M. Peak Hour	P.M. Peak Hour
Superior Street W/6th Avenue W	A	A
Superior Street W/5th Avenue W	B	B
Superior Street W/4th Avenue W	B	B
Superior Street W/3rd Avenue W	B	B
Superior Street W/2nd Avenue W	B	B
Superior Street E/1st Avenue W	B	B
Superior Street/Lake Avenue	C	C
Superior Street E/1st Avenue E	A	B
Superior Street E/2nd Avenue E	A	A
Superior Street E/3rd Avenue E	A	A
Superior Street E/Michigan Street(1)	A/A	A/A
Superior Street E/4th Avenue E(1)	A/A	A/A

(1) Indicates an unsignalized intersection with side-street stop control, where the overall LOS is shown followed by the worst approach LOS.

To mitigate the existing queuing issue of the Superior Street/Lake Avenue intersection, the westbound left-turn lane should be extended. However, for purposes of this study, no mitigation was assumed as part of the existing operations to illustrate how operations can be expected to change under future conditions.

Future Conditions

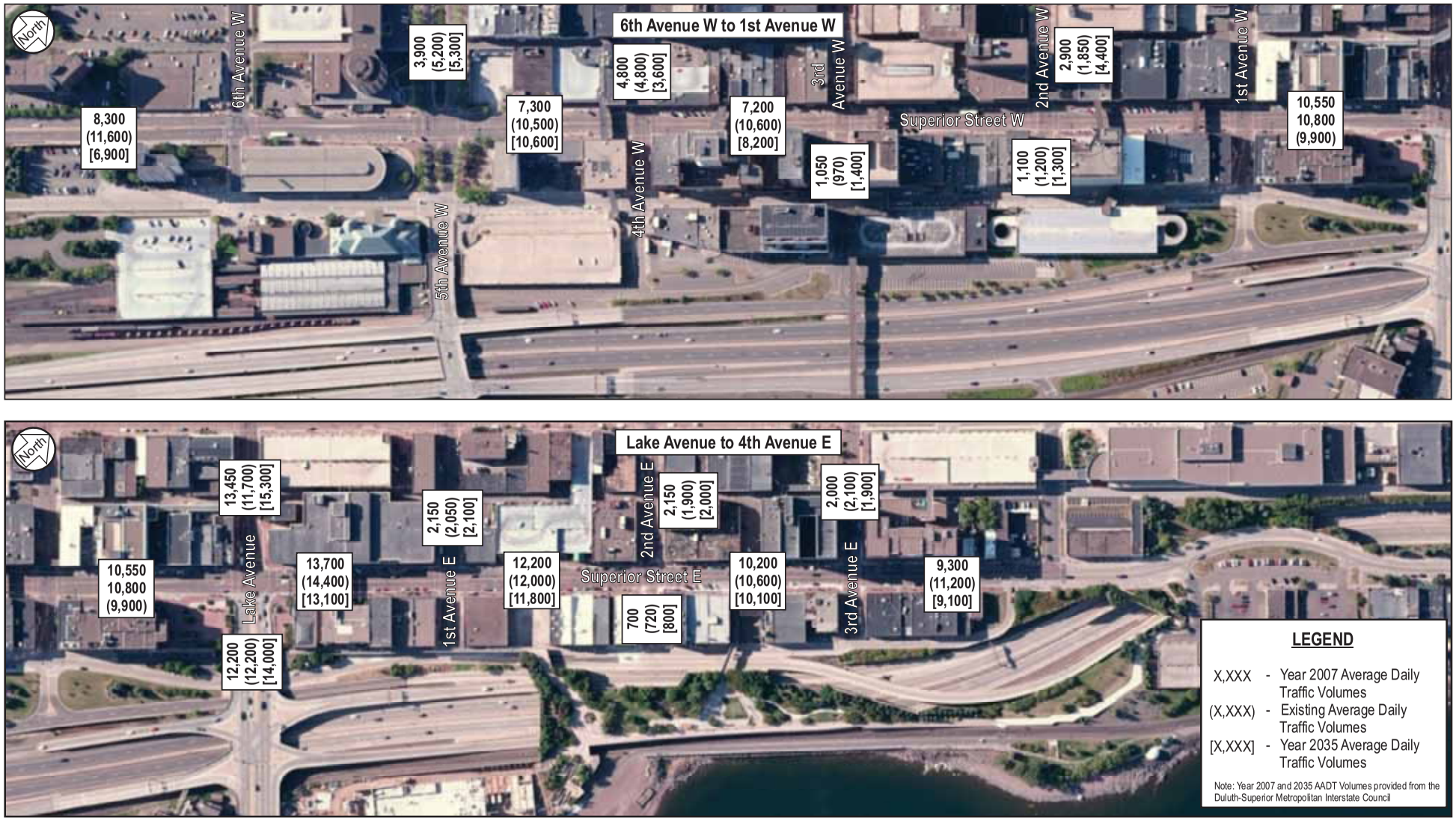
Traffic Forecasts

For purposes of this study, two future year forecasts were developed; one for the year of opening (assume 2017) and the other for 20-year forecast year (2035). For comparative purposes, daily traffic volumes for year 2007 and for forecast year 2035, shown in Figure 3, were provided by the Duluth-Superior Metropolitan Interstate Council. These traffic volumes were reviewed to determine an annual growth rate along Superior Street. Based on this review, a one-half percent annual growth rate was identified. This growth rate was applied to the existing a.m. and p.m. peak hour turning movement volumes to develop future year forecasts.

Year 2017 Intersection Capacity Analysis

To determine if the existing roadway network can accommodate the year 2017 traffic forecasts, shown in Figure 4, a detailed traffic operations analysis was completed. The study intersections were once again analyzed using the Synchro/SimTraffic software and the HCM. Results of the year 2017 operations analysis, shown in Table 3, indicate that all of the study intersections are expected to operate at an acceptable overall LOS C or better during the a.m. and p.m. peak hours with the existing traffic controls and geometric layout.

The westbound queuing issue identified under existing p.m. peak hour conditions at the Superior Street/Lake Avenue intersection is expected to continue under year 2017 conditions and extend approximately an additional 50 feet. No other significant delays or queuing issues are expected. Year 2017 operations are summarized in Figure 4.



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Average Daily Traffic Volumes

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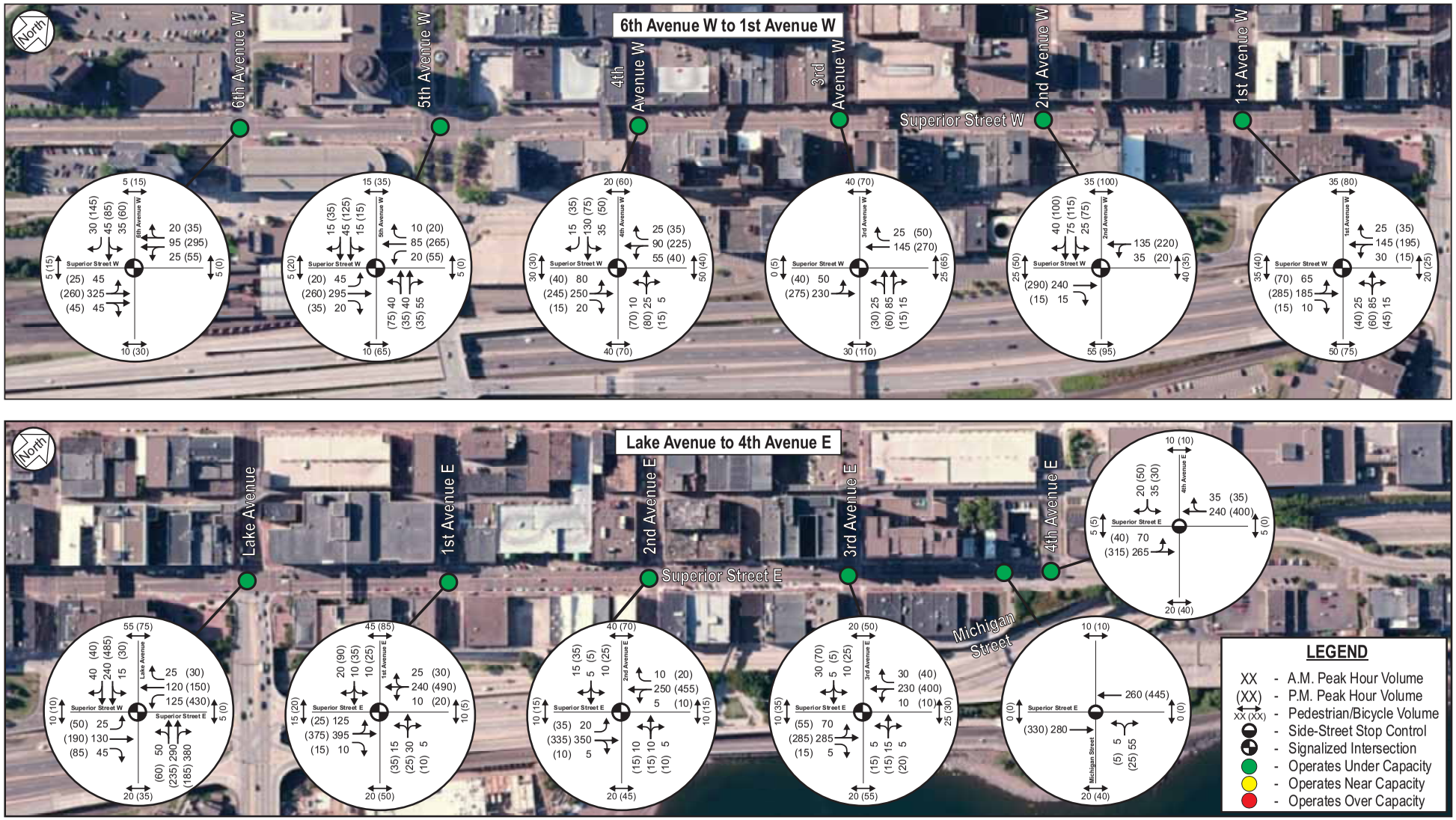
Duluth, MN

Figure 3



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November 2013

Year 2017 Conditions

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Duluth, MN

Figure 4

Table 3. Year 2017 – Intersection Capacity Analysis Results

Intersection	Level of Service (LOS)	
	A.M. Peak Hour	P.M. Peak Hour
Superior Street W/6th Avenue W	A	A
Superior Street W/5th Avenue W	B	B
Superior Street W/4th Avenue W	B	B
Superior Street W/3rd Avenue W	B	B
Superior Street W/2nd Avenue W	B	B
Superior Street E/1st Avenue W	B	B
Superior Street/Lake Avenue	C	C
Superior Street E/1st Avenue E	A	B
Superior Street E/2nd Avenue E	A	A
Superior Street E/3rd Avenue E	A	A
Superior Street E/Michigan Street(1)	A/A	A/A
Superior Street E/4th Avenue E(1)	A/A	A/A

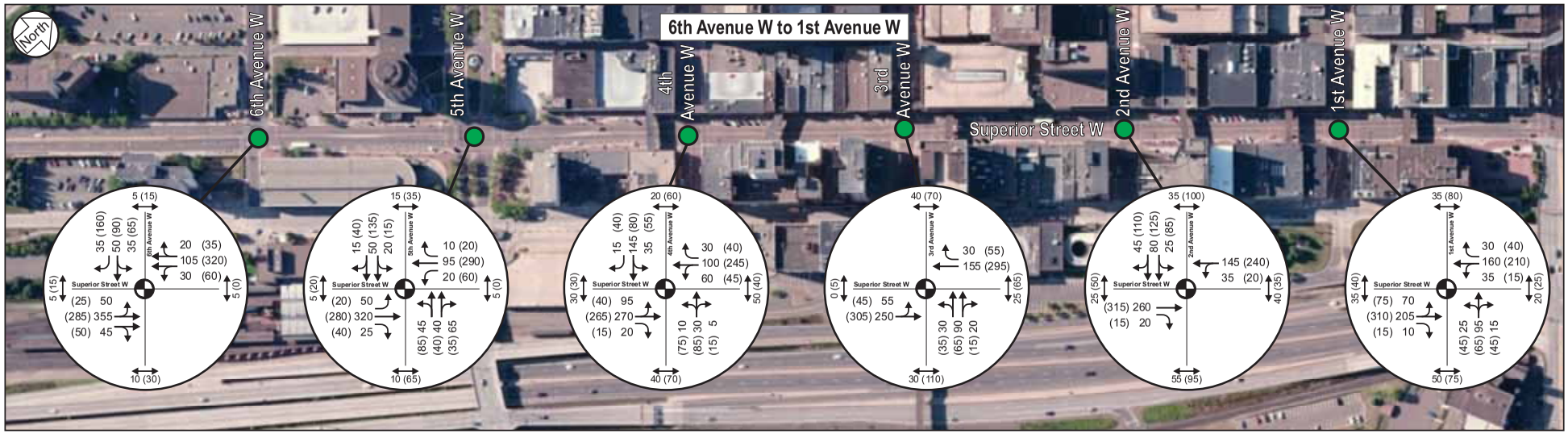
(1) Indicates an unsignalized intersection with side-street stop control, where the overall LOS is shown followed by the worst approach LOS.

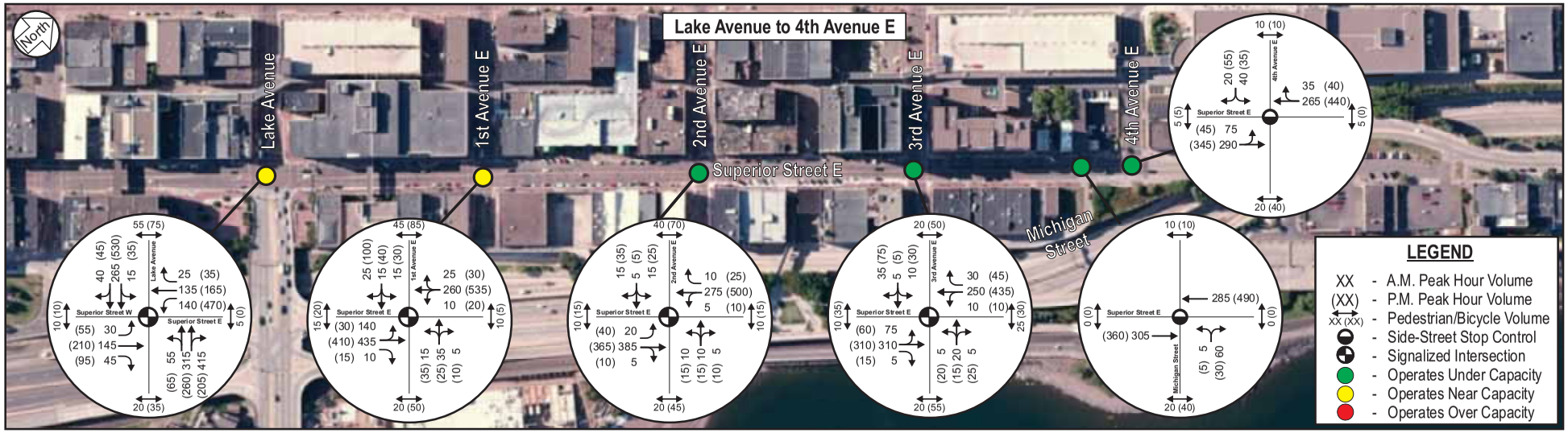
Year 2035 Intersection Capacity Analysis

To determine if the existing roadway network can accommodate the year 2035 traffic forecasts, shown in Figure 5, a detailed traffic operations analysis was completed with optimized signal timing. The study intersections were once again analyzed using the Synchro/SimTraffic software and the HCM. Results of the year 2035 intersection operations analysis, shown in Table 4, indicate that all of the study intersections are expected to operate at an acceptable overall LOS D or better during the a.m. and p.m. peak hours with the existing traffic controls and geometric layout.

The westbound queuing issue identified under both existing and year 2017 p.m. peak hour conditions at the Superior Street/Lake Avenue intersection is expected to continue under year 2035 conditions. The westbound queue is expected to extend approximately 500 feet, which will impact all approaches of the 1st Avenue E intersection, and impede overall intersection operations. No other significant delays or queuing issues are expected, using these baseline assumptions. Year 2035 operations are summarized in Figure 5.

To mitigate the queuing issue, several signal phasing and geometric alternatives were evaluated. Two alternative options were identified to improve the intersection queuing and delay issues. The first option is to extend the westbound left-turn lane, a minimum of 100 feet, and modify the signal phasing to include a westbound left-turn lagging phase. The second option would be to extend the westbound left-turn lane the entire length of the block.





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November 2013

Year 2035 Conditions

Superior Street Reconstruction Traffic Study
Duluth, MN

Figure 5

To accommodate either of these two alternatives, there would likely be impacts to existing angled parking spaces on the north side of Superior Street between Lake Avenue and 1st Avenue E and a potential modification of existing curb lines. With the recommended turn lane improvement, all study intersections are expected to operate at LOS C or better under future year 2035 conditions.

Table 4. Year 2035 – Intersection Capacity Analysis Results without Improvements

Intersection	Level of Service (LOS)	
	A.M. Peak Hour	P.M. Peak Hour
Superior Street W/6th Avenue W	A	A
Superior Street W/5th Avenue W	B	B
Superior Street W/4th Avenue W	B	B
Superior Street W/3rd Avenue W	B	B
Superior Street W/2nd Avenue W	B	B
Superior Street E/1st Avenue W	B	B
Superior Street/Lake Avenue	C	D
Superior Street E/1st Avenue E	B	D(2)
Superior Street E/2nd Avenue E	A	A
Superior Street E/3rd Avenue E	A	B
Superior Street E/Michigan Street(1)	A/A	A/A
Superior Street E/4th Avenue E(1)	A/A	A/A

(1) Indicates an unsignalized intersection with side-street stop control, where the overall LOS is shown followed by the worst approach LOS.

(2) LOS impacted by queues from Lake Avenue intersection

Other Considerations

The Multi-Modal Transit Terminal Traffic Analysis completed by SRF in April, 2012 recommended improvements along Superior Street that were not included in this traffic analysis but should be considered in future designs.

The 425 Corporate Tower Traffic Study completed by SRF in July, 2013 noted traffic and access considerations inherent to the proposed site that were not included in this traffic analysis but should be considered in future designs. It should also be noted that that study used a different growth rate because it was considering an earlier forecast year.

Summary and Conclusions

The following conclusions and recommendations are offered for consideration:

Existing Conditions

- All study intersections currently operate at an acceptable overall LOS C or better during the a.m. and p.m. peak hours with the existing traffic controls and geometric layout.
    - Queues of approximately 400 feet occur on the westbound approach to the Superior Street/Lake Avenue intersection during the p.m. peak hour.

Year 2017 Conditions

- All of the study intersections are expected to continue to operate at an acceptable overall LOS C or better during the a.m. and p.m. peak hours with existing intersection controls and geometry in year 2017.
    - The queuing issues on the westbound approach to the Superior Street/Lake Avenue intersection identified under the existing conditions during the p.m. peak hour are expected to continue under year 2017 conditions and extend approximately an additional 50 feet.

Year 2035 Conditions

- All of the study intersections are expected to continue to operate at an acceptable overall LOS D or better during the a.m. and p.m. peak hours with existing intersection controls and geometry in year 2035.
    - The westbound queuing issue identified under both existing and year 2017 p.m. peak hour conditions at the Superior Street/Lake Avenue intersection is expected to continue under year 2035 conditions. The westbound queue is expected to extend approximately 500 feet, which will impact all approaches of the 1st Avenue E intersection, and impede overall intersection operations.
- It is recommended that the westbound left-turn phase be modified to a lagging phase at the Superior Street/Lake Avenue intersection.
    - A minimum of 100 feet of additional westbound left-turn lane storage is necessary to allow for efficient traffic operations. However, extending the westbound left-turn lane the entire length of the block would ensure that the westbound left-turning queue would not impede westbound through and right-turning vehicles at the Superior Street/Lake Avenue intersection.
    - To accommodate these turn lane improvements, impacts to existing on-street parking and curb lines should be further evaluated.

- Various signal phasing combinations were evaluated, including split phasing, for the Superior Street/Lake Avenue intersection, however they were determined to not improve operations without extending the westbound left-turn lane.