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MnDOT District 6

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Date: June 30, 2014

Subject: Winona Street and 4th Street Intersection Concerns Memo

Introduction

As requested, SRF has prepared this memo which documents design elements related to the Winona Street and 4th Street intersection near the Winona Bridge, focusing on the operation and safety of southbound motorists entering the intersection from the bridge.

As stated in the *Intersection Control Evaluation (ICE) for Winona Street at 4th Street* (SRF, April 2014), there are currently multiple safety and operations issues at the Winona Street and 4th Street intersection. The subject intersection presently operates under three-way stop control, which is a non-typical form of intersection control. Motorists currently coming from the bridge are not required to stop, while motorists on all other approaches have a stop condition. This situation can generate driver confusion over right-of-way, which may result in safety and operational issues.

Though the current configuration operates at an acceptable level, three-way stop control is not a conventional choice of intersection control at new or reconstructed intersections. On public roadways, the most common forms of multi-way stop control are two-way and all-way stop control, while three-way stop control is most commonly used in shopping mall parking lots and private developments. Additionally, the proposed geometric design will provide additional approach lanes at the intersection, causing concern that three-way stop control could lead to even more driver confusion and accidents. Therefore, three-way stop control would not represent a viable intersection control alternative for the reconstructed Winona Street/4th Street intersection.

Based on the findings of the ICE, traffic signal control was recommended at the intersection. Installation of a traffic signal at the subject intersection was determined to create a net public benefit at this location by being able to provide safe gaps for turning vehicles, increase pedestrian safety at the intersection, and better accommodate heavy vehicle movements.

Geometric Considerations

The existing Winona Street/4th Street intersection has some geometric deficiencies. As the intersection is currently designed, certain truck turning maneuvers are difficult to complete without impacting adjacent travel lanes. This has a significant impact to safety and operations. In addition, the current intersection has a limited landing area length. The landing area is defined as the area between opposing cross traffic and the location where the grade exceeds 2%.

The geometric design of the new intersection will be compliant with State and Federal design standards and will address the existing issues with truck turning maneuvers. Special emphasis will be made to provide a safe intersection design for all users, including pedestrians, bicyclists, and motorists (including trucks).

During preliminary design, the profile of proposed southbound TH 43 on the Winona Bridge was constrained by several factors, including:

- The Coast Guard clearance envelope over the Mississippi River
- The vertical clearance over 3rd Street
- The avoidance of right-of-way impacts to the YMCA property

As a result, the approach profile grade was increased from 4.5% to 5.0%. The increase in profile grade was mitigated by providing a more generous landing area, increasing sight distance at the intersection, and providing additional guide signing in advance of the intersection. In addition, the proposed landing area was maximized by using a post tensioned slab bridge over 3rd Street to maintain adequate clearance.

Profile curves were developed to allow for the appropriate sight distance for the design speed. The geometric changes take into account truck turning movements and stopping sight distance. A southbound truck driver should have adequate visibility to react to a traffic signal downstream.

The revised intersection will provide left and right turn bays for the southbound approach, which is a significant capacity improvement from the current single shared left-through-right turn lane configuration.

Safety Considerations

As stated in the ICE, the Minnesota Department of Transportation (MnDOT) provided crash data for the five-year period from January 1, 2003 through December 31, 2007 for the intersection of Winona Street and 4th Street. Based on this data, 17 crashes occurred at this intersection during the analysis period. The breakdown of the crashes is as follows:

- 6 right-angle
- 4 left-turn
- 3 sideswipe
- 1 rear-end
- 1 right-turn
- 2 other/uncategorized

As stated previously, the non-typical three-way stop control at this intersection can create driver confusion over right-of-way, which may result in safety and operational issues. Since three-way stops are uncommon, there really is not a basis of comparison for the crash data at this intersection.

Improper or unjustified traffic control signals can result in increases in rear-end collisions. However, the proposed signal at the Winona Street and 4th Street intersection was determined to operate at an acceptable level of service in the ICE, which used Synchro/SimTraffic modeling software to assess operations. In part because of this analysis, the ICE deemed a signal at this location as justified. A traffic signal should provide for the orderly movement of traffic at the intersection, and also reduce the frequency and severity of certain types of crashes, especially right-angle collisions.

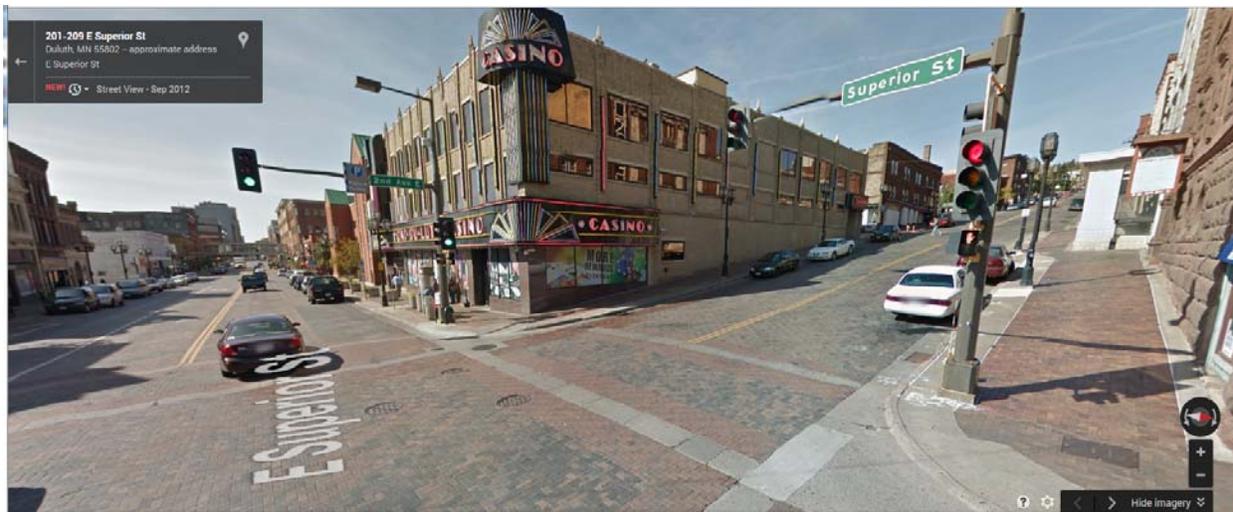
Traffic Considerations

The operations analysis within the ICE shows a traffic signal should operate at an acceptable level of service on opening day of the project. A well-timed traffic signal at Winona Street and 4th Street should efficiently assign right-of-way to the various traffic movements at the intersection based on vehicular demand. For example, if southbound traffic volumes are the heaviest movements at the intersection during peak hours, then southbound traffic should be provided with a bulk of the green time in order to satisfy traffic demands.

The preliminary design called for overhead guide signs on the southbound approach to clearly denote to drivers which lane they should be in in order to remain straight on Winona Street, turn left onto eastbound TH 43, or right onto westbound 4th Street. This signing should help mitigate driver confusion and provide the most efficient operations possible.

A number of signalized intersections with steep approach grades exist in Minnesota. The grades are a design consideration, but they are not necessarily a deterrent from installing a signal if an engineering study deems signalization as the preferred intersection control alternative. For example, several signals in downtown Duluth along Superior Street have steep grades comparable to the

Winona Street/4th Street intersection (see picture below of Superior Street and 2nd Avenue E). A designer must keep in mind sight distance and phasing when designing signals at intersections like these, but a signal can operate safely and efficiently at such locations despite steep grades. Agencies should keep in mind the importance of maintenance activities along the approaches of such intersections. Snow and ice removal are vital to maintaining adequate stopping conditions along steep grade roads approaching signals.



Source: Google Maps

Recommendations

Even though visibility is sufficient along the southbound approach to provide stopping sight distance to drivers, Signal Ahead (W3-3) signs should be installed along the southbound approach of the intersection to provide advanced warning for the signal at Winona Street and 4th Street. This will help to provide additional emphasis to the signal.

Additional warning could be provided by installing advanced warning flashers for the southbound approach. This would consist of installing “Prepare to Stop When Flashing” (W3-X4) signs upstream of the Signal Ahead signs. The “Prepare to Stop When Flashing” signs could be installed with warning beacons that would be interconnected with the traffic control signal system. When the southbound approach is red or about to turn red, the warning beacons would flash and provide additional notice to drivers that they will likely have to stop. This could provide a more active approach to warning southbound drivers (especially trucks) that they will be required to stop at the upcoming signal.