I-90 Austin Corridor Study

July 2017

DEPARTMENT OF TRANSPORTATION

SEH

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1.0 Study Purpose and Process

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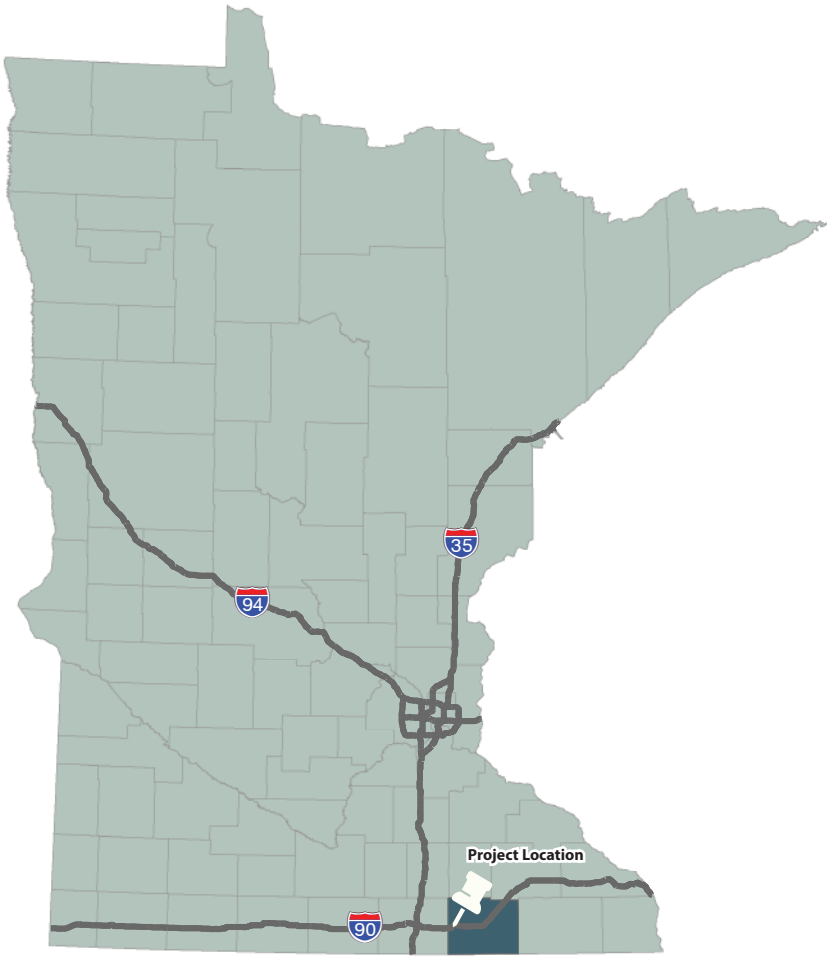
1.1 Study Purpose

I-90 through Austin was constructed in the late 1950s and was the first section of I-90 constructed in Minnesota. The bridges and interchanges which are the focus of this study are all at least 50 years old and as a result need to be programmed for either rehabilitation or replacement in the coming years. MnDOT has anticipated this need and has begun planning for a series of improvements to occur between 2021 and 2025.

Given the age of the infrastructure, the close proximity of the interchanges, and the relative uncertainty regarding the amount and timing of funding, MnDOT determined it would be prudent to conduct this planning study to comprehensively address the needs along the I-90 corridor through Austin and set the framework for an efficient and effective approach to implement the necessary improvements within the existing constrained funding plan.

The purpose of this planning study is to:

- Identify the existing and forecast traffic conditions and issues
- Document the condition of existing bridges and determine the relative need for replacement or rehabilitation
- Develop and evaluate improvement concepts as appropriate at each study area interchange
- Prepare a preferred concept improvement plan for the study area and document the study results for use in future stages of project development



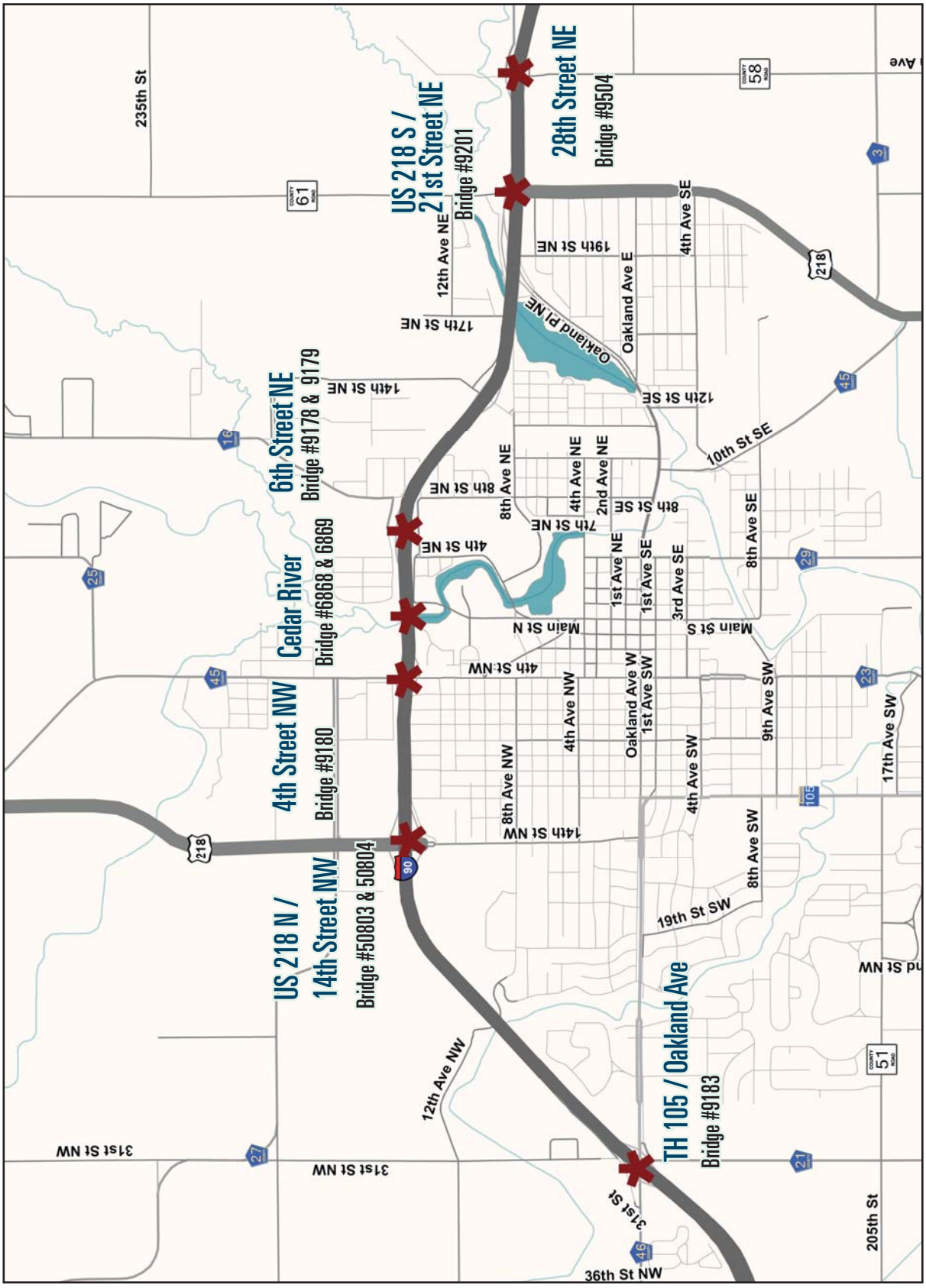
The primary focus of this study is a series of interchanges and bridges along the I-90 corridor through the Austin area. The interchanges and bridges include:

- Bridge #9183
  (TH 105/Oakland Avenue interchange)
- Bridges #50803 and #50804
  (TH 218 North/14th Street NW interchange)
- Bridge #9180 (4th Street NW interchange)
- Bridges #6868 and #6869 over the Cedar River
- Bridges #9178 and #9179
  (6th Street NE interchange)
- Bridge #9201
  (TH 218 South/21st Street NE interchange)
- Bridge #9504 (28th Street NE interchange)

The study area and the study locations identified above are shown in Figure 1 on the following page.

Study Area

Figure 1



The central goal of the process was to develop recommendations for future improvements at each of the study locations. The study focused on assessing the condition of the bridges and included traffic operations and safety analyses to determine whether it is more prudent to rehabilitate or replace each of the bridges. Pedestrian and bicyclist accommodations were another key consideration.

A secondary goal of the study was to determine whether there were other operational and safety issues along the I-90 study corridor not directly linked to the bridge and interchange locations identified above. Though outside the core purpose of this study, it was important for this process to document other issues that could be further addressed in future studies.

1.2 Study Process

The I-90 Austin Corridor Study planning process kicked off in November 2015 and included five key elements: Stakeholder Involvement, Data Collection, Needs Identification, Concept Development & Evaluation, and Recommendations. The overall study process was led by the I-90 Austin Corridor Study Project Management Team (PMT) consisting of staff from MnDOT District 6, MnDOT Bridge Office, the City of Austin, and Short Elliott Hendrickson (study consultant). Each study element is summarized below and discussed in detail in subsequent sections of this report.

Stakeholder Involvement

MnDOT recognizes the vital role stakeholder engagement serves in the development, evolution, and implementation of transportation projects. For the I-90 Austin Corridor Study, MnDOT wanted to engage a cross-section of community and business interests to assist in the process of identifying issues and priorities, generating improvement concepts, evaluating the concepts, and ultimately providing feedback on the study's technical recommendations.

In response to this priority, a Stakeholder Group was assembled consisting of community and business interests. The Group was engaged throughout the process and played a vital role in helping to develop the study recommendations.

Data Collection

During this phase of the study process the consultant team collected a substantial amount of new data including I-90 mainline tube counts and turning movement counts at numerous intersections. Other data compiled included historical traffic counts, crash statistics, and bridge condition information. Site visits were also conducted to review existing operations, verify traffic control and intersection geometry, and conduct visual inspections of each study area bridge.

Needs Identification

Following the data collection activities, the process centered on identifying the key study area issues and needs. An existing traffic conditions assessment was conducted followed by a future no-build traffic conditions analysis. Collectively, the existing and forecast information provided the basis for identifying the key issues and needs in the study area illustrated in Figure 1.

Concept Development and Evaluation

During the Concept Development and Evaluation Phase a series of sub-areas were identified that became the focus for developing and evaluating potential infrastructure improvements. In certain sub-areas, multiple concepts were developed and evaluated. The concept layouts reflected a range of capacity and safety improvements as well as pedestrian and bicyclist enhancements. Ultimately, the identified concepts were evaluated against a set of technical criteria and to a preferred recommendation for each of the study locations was identified.

Recommendations

The information developed and refined during the Conceptual Development and Evaluation Phase along with feedback received from the Stakeholder Group was used to finalize the study recommendations and prepare planning level cost estimates. The recommendations from this study process and presented in this study report are expected to be utilized by MnDOT to set the stage for more detailed analysis as subsequent stages of project development are initiated.

2.0 Stakeholder Involvement

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2.1 Stakeholder Group

MnDOT recognizes the vital role stakeholder engagement serves in the development, evolution, and implementation of transportation projects. For the I-90 Austin Corridor Study, MnDOT wanted to engage a cross-section of community and business interests to assist in the process of identifying issues and priorities, generating improvement concepts, evaluating the concepts, and ultimately providing feedback on the study's technical recommendations.

At the onset of the study process a Stakeholder Group was assembled consisting of community and business interests. The group membership was established based on input provided from City of Austin staff. Each of the Group's members and their affiliation is provided below:

- Geoff Baker – Macfarland Truck Lines
- Craig Clark – City of Austin, City Administrator
- Paul Eickhoff – Hormel Foods Corporate Services Senior Engineer
- Jon Erichson – Housing and Redevelopment Executive Director
- Sandy Forstner – Chamber of Commerce Executive Director
- John Gray – Vision 2020 Gateway to Austin Committee
- Mike Hanson – Mower County Engineer
- Chris Hiniker – SEH Project Manager
- Jai Kalsy – MnDOT Project Manager
- Steve Kime – Vision 2020 Bike/Walk Committee Chair
- Steven Lang – City of Austin, Public Works Director
- Joe Maccani – Hormel Foods Manager of Corporate Properties
- Greg Paulson – MnDOT Assistant District Engineer
- Chuck Peterson – Hormel Foods Shipping Manager
- Larry Rehaume – Hormel Foods Plant Manager
- Nancy Schnable – Convention and Visitors Bureau Executive Director
- AJ Shute – Hormel Livestock Manager

The Stakeholder Group's role was to: represent the broader interests of the greater Austin community; review and provide feedback on the technical information developed through the study process; and communicate issues, ideas, and opportunities to the entire Group. The Stakeholder Group met three times at key phases of the study process. The first meeting was held early in the process. This meeting focused on communicating the study goals, scope, and schedule and to solicit key issues and concerns from the Group members. The second meeting was held after the range of preliminary improvement concepts were developed. The Group was asked to provide feedback on the concepts and offer additional ideas for potential consideration. The third meeting was held toward the end of the study process. MnDOT presented the results of the technical evaluation process as well as the preliminary improvement recommendations.

At the end of the study process, MnDOT indicated to the Group that stakeholder engagement will be a continuing priority as individual improvement projects are programmed and project development activities are initiated.

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3.0 Data Collection & Needs Identification

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3.1 Study Area

As noted in Section 1, the primary focus of this study is a series of interchanges and bridges along the I-90 corridor extending from the TH 105/Oakdale Avenue Interchange on the west, to the 28th Street NE interchange on the east. In order to provide a clear understanding of the study area scope, the interchanges and bridges included in the study scope are described in detail below. It should be noted that the 11th Drive NE interchange was not included in this study because it is already scheduled for reconstruction in 2017.

TH 105/Oakland Avenue Interchange - Bridge #9183

The existing interchange, see Figure 2, is a diamond type configuration with stop control at the ramp intersection approaches. The bridge has two traffic lanes and narrow shoulders with no pedestrian facilities. The westbound I-90 off-ramp has separate left and right turn lanes, while the eastbound I-90 off-ramp is a single lane approach with enough space for a right turning vehicle to maneuver around a queued left turning vehicle.

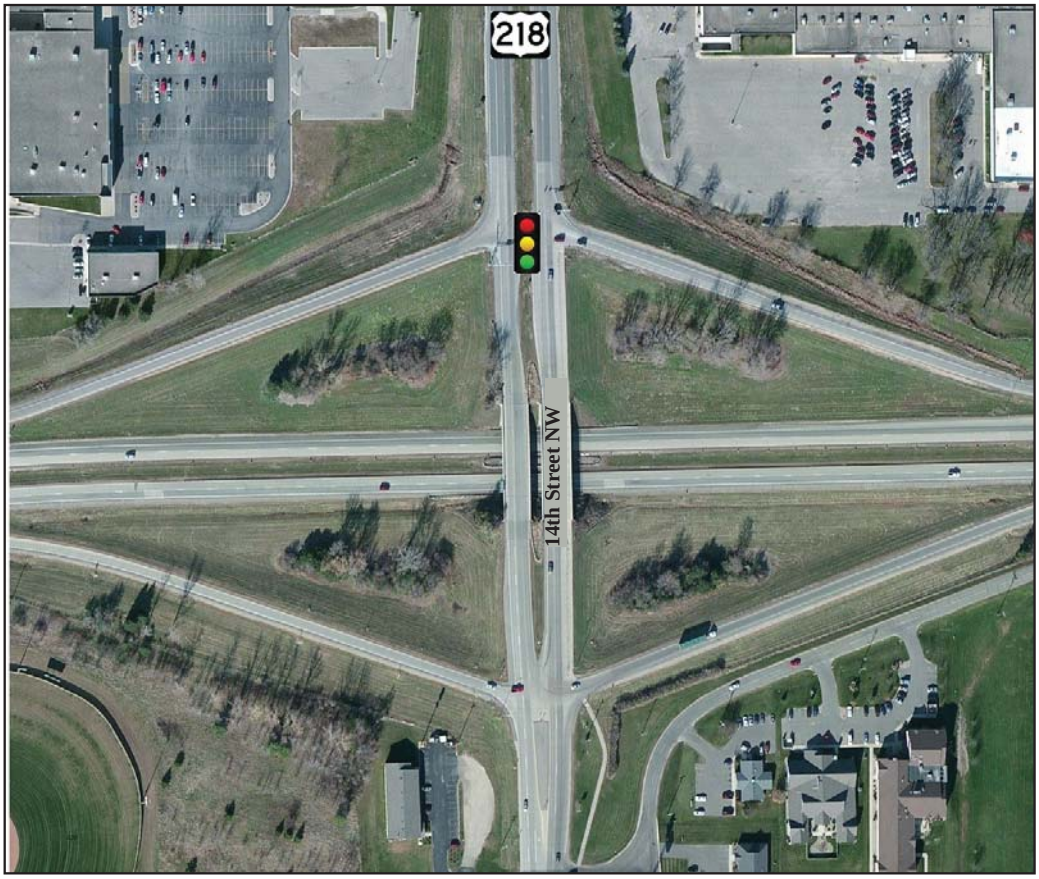
Figure 2. TH 105/Oakland Avenue Interchange - Bridge #9183

US 218 North/14th Street NW Interchange - Bridge #50803 and 50804

The existing interchange, see Figure 3, is a diamond type configuration with a traffic signal at the north ramp intersection. The south ramp intersection includes stop control for the eastbound I-90 off-ramp approach. US 218/14th Street NW traffic travels over I-90 on two bridges that carry two lanes in each direction plus left turn lanes.

In addition, the northbound bridge has an existing raised sidewalk while the southbound bridge has no sidewalk and a very narrow outside shoulder. The westbound I-90 off-ramp has separate left and right turn lanes at the signal, while the eastbound I-90 off-ramp is a single lane approach with enough space for a right turning vehicle to maneuver around a queued left turning vehicle.

Figure 3. US 218 North/14th Street NW Interchange - Bridge #50803 and 50804

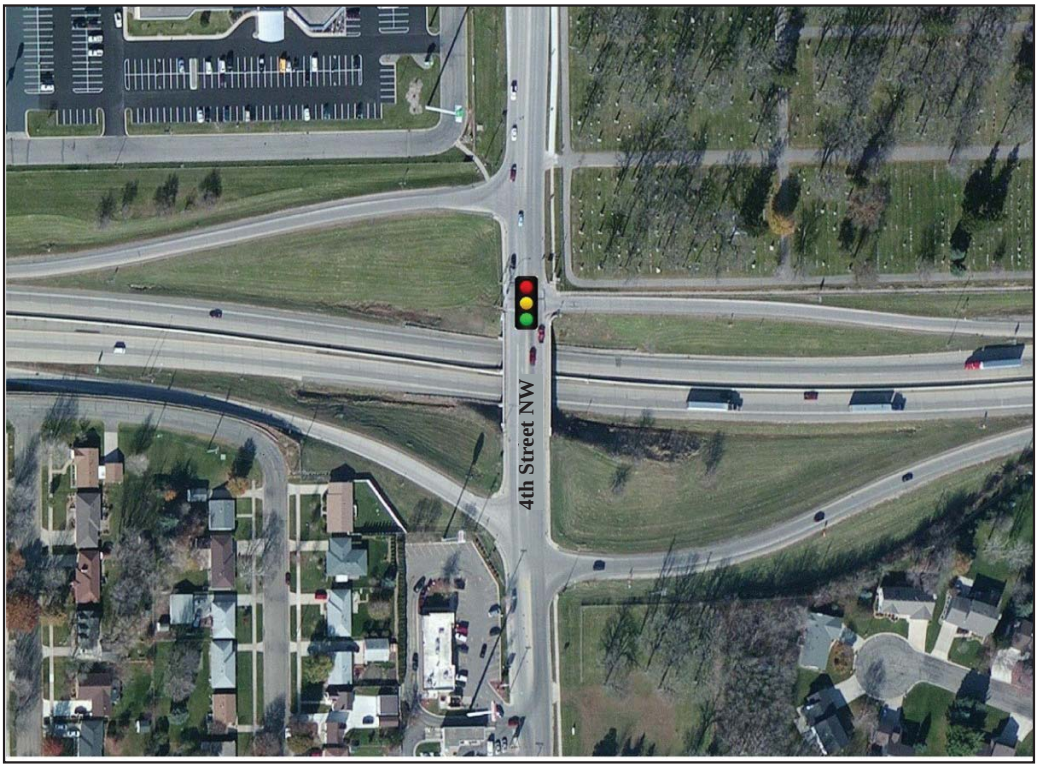


4th Street NW Interchange - Bridge #9180

The existing interchange, see Figure 4, is a diamond type configuration with a traffic signal for the westbound I-90 off-ramp. The eastbound I-90 off-ramp approach operates under stop control. The westbound I-90 on-ramp is offset from the westbound I-90 off-ramp and is uncontrolled.

The existing bridge includes one through lane in each direction on the outside and a left turn lane in each direction on the inside between the ramp terminal intersections. There is a narrow sidewalk provided for pedestrians on both sides of the bridge. The eastbound I-90 off-ramp has separate left and right turn lanes, while the westbound I-90 off-ramp is a single lane approach with enough space for a right turning vehicle to maneuver around a queued left turning vehicle.

Figure 4. 4th Street NW Interchange - Bridge #9180



Cedar River Bridges - Bridge #6868 and 6869

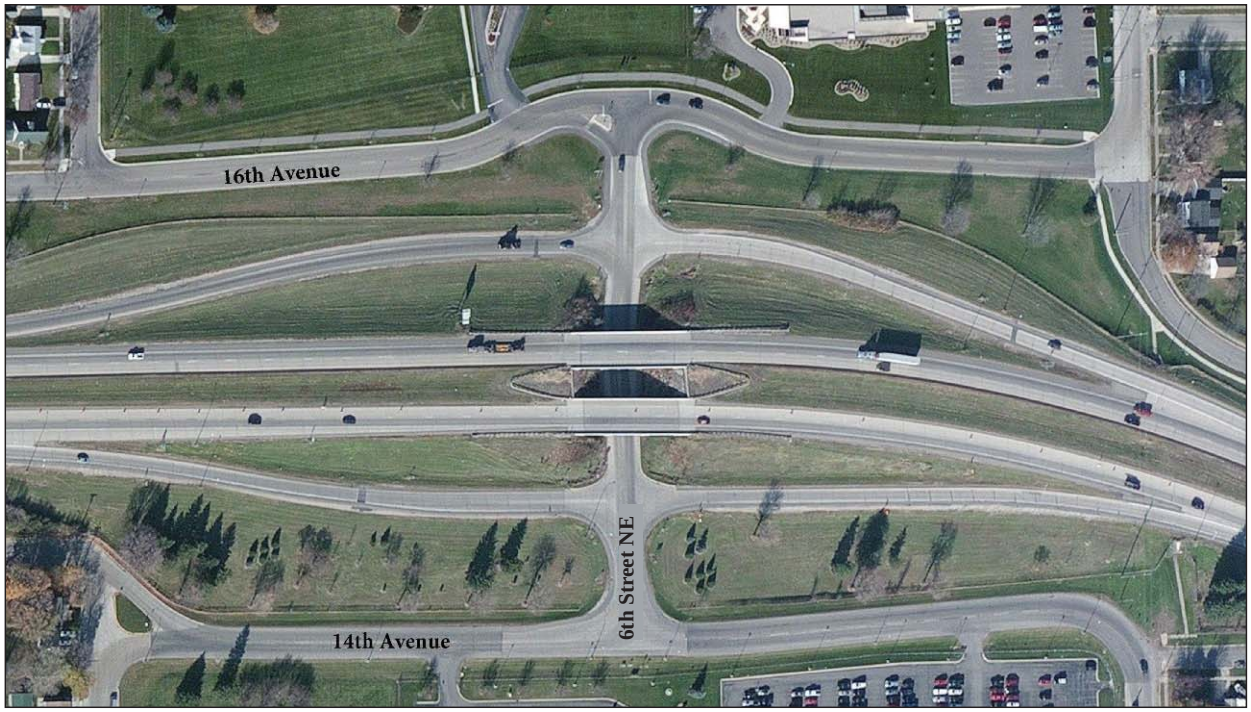
The Cedar River flows under I-90 immediately east of the 4th Street NW interchange (see Figure 5). There are two bridges, one carries eastbound I-90 traffic lanes and the other carries westbound I-90 traffic lanes.

Figure 5. Cedar River Bridges - Bridge #6868 and 6869

6th Street NE Interchange - Bridge #9178 and 9179

The existing interchange, see Figure 6, is a diamond type configuration with the ramp approaches at 6th Street NE operating under stop control. I-90 has two bridge structures over 6th Street NE with bridge piers directly abutting the roadway and there are no pedestrian facilities. Both I-90 off-ramps have separate left and right turn lanes. Sight lines from the ramp approaches looking towards the bridges are substandard due to the bridge pier placement.

Figure 6. 6th Street NE Interchange - Bridge 9178 and 9179

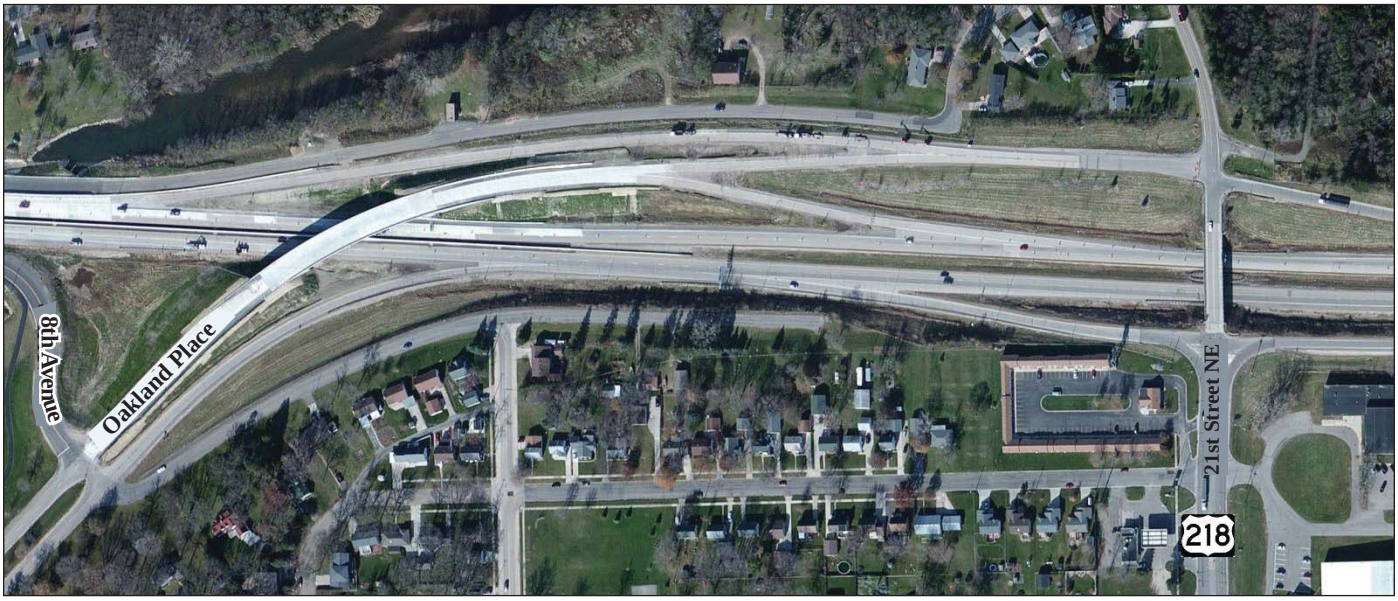


US 218 South/21st Street NE/Oakland Place Interchange - Bridge #9201

The existing interchange, see Figure 7, is a diamond type configuration with the ramp approaches operating under stop control. The Oakland Place westbound ramp is connected to the 21st Street NE interchange via a slip ramp as shown in Figure 7. The existing 21st Street NE bridge has two lanes with no turn lanes or pedestrian facilities. The eastbound I-90 off-ramp has separate left and right turn lanes, while the westbound I-90 off-ramp is a single lane approach with enough space for a right turning vehicle to maneuver around a queued left turning vehicle.

Oakland Place is located immediately west of the US 218 South/21st Street NE interchange. The I-90 eastbound entrance ramp from Oakland Place merges onto I-90 prior to the 21st Street exit ramp, creating a short weaving section. To westbound Oakland Place, vehicles can exit westbound I-90 directly or from the 21st Street NE slip ramp connection. The intersection of Oakland Place and 8th Avenue essentially operates as a ramp terminal intersection for I-90 traffic.

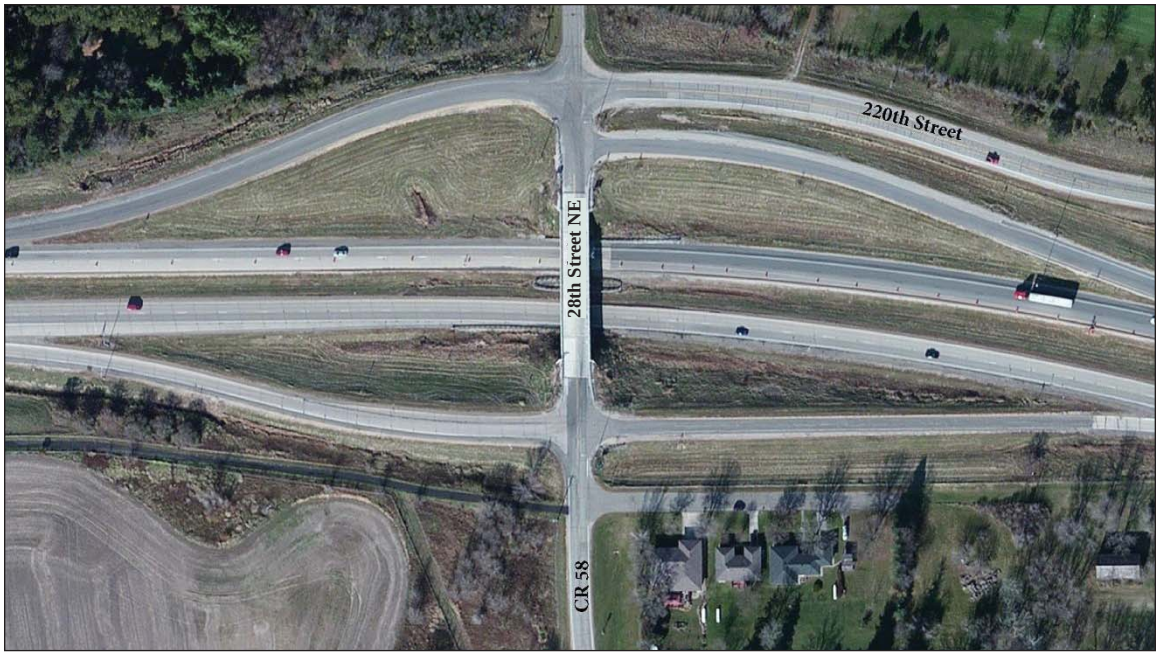
Figure 7. US 218 South/21st Street NE/Oakland Place Interchange - Bridge #9201



28th Street NE Interchange - Bridge #9504

The existing interchange, see Figure 8, is a diamond type configuration with the ramp approaches operating under stop control. The existing bridge has two lanes with no turn lanes or pedestrian facilities. The eastbound I-90 off-ramp has separate left and right turn lanes, while the westbound I-90 off-ramp is a single lane approach with enough space for a right turning vehicle to maneuver around a queued left turning vehicle. The I-90 westbound on-ramp is offset from the I-90 westbound off-ramp and shares an intersection with 220th Street.

Figure 8. 28th Street NE Interchange - Bridge #9504



3.2 Data Collection

At the onset of the study process a substantial amount of data collection was conducted to provide the information needed to complete the traffic analysis tasks, assist with identifying issues, and help with defining and evaluating potential improvement concepts. The data collected included the following:

- Intersection turning movements
- I-90 mainline tube counts
- Available crash data
- Bridge condition statistics
- Field inspection of study area bridges

Detailed documentation of the data collection efforts as well as the subsequent traffic analyses are provided in the *Existing and Forecast Traffic Conditions Technical Memorandum*, dated January 2016. This document is available upon request from MnDOT.

3.3 Needs Identification

As noted above, the collected traffic and bridge data served as a basis for conducting a comprehensive traffic analysis and completing an assessment of bridge conditions in the study area. The results of this analysis highlighted the primary needs that would in turn set the stage for identifying and evaluating potential improvement concepts. The remainder of this section presents the results of the traffic analysis and bridge condition assessment.

Existing and Forecasted Traffic Operations and Safety Analysis

The comprehensive traffic analysis, which is detailed in the above referenced technical memorandum, included the following components: a freeway system plan, crash history, existing traffic conditions, and future traffic conditions. Each component is described below.

Freeway System Plan

The freeway system plan assessed major design features of the I-90 corridor to be able to isolate issues that contribute to traffic congestion and safety issues. The primary design features considered included:

- **Basic Number of Lanes -** The basic number of lanes is defined as a minimum number of lanes designated and maintained over a significant length of a corridor, regardless of changes in traffic volumes and lane-balance. An assessment of basic lane needs is an indicator of minimum capacity requirements. I-90 meets the basic lane needs for the current traffic conditions. The existing demands are well below the basic capacity of the freeway lanes provided, with all demands below the capacity of a single freeway lane.

- **Lane Balance -** The concept of lane balance is intended to smooth traffic flow through and beyond interchanges. Lane balance is satisfied along I-90 through the project area and all entrance ramp merges fully satisfy established criteria. In addition, all exit ramp diverges meet the criteria when including the exception for closely spaced interchanges.

- **Route Continuity –** This evaluation is used to determine if any forced lane changes are required to continue along a highway. A forced lane change occurs when either an established through lane is dropped or when an auxiliary lane is added to the left side of the roadway and the through traffic must change lanes in order to continue. Route continuity is maintained for both eastbound and westbound I-90 through the project area as each direction has two continuous lanes for the entire stretch of roadway.

- **Interchange Spacing -** In urban areas, the minimum recommended interchange spacing is one mile. There are seven interchanges in the five-mile study segment through the Austin area which exceeds current interchange spacing standards. The only current spacing that meets the criteria is the 1.7 miles between the TH 105/Oakland Avenue and US 218 North/14th Street NW interchanges. All other interchanges have spacing that ranges between 0.3 miles to 0.7 miles. This close interchange spacing results in multiple locations where spacing between entrance and exit ramps of adjacent interchanges is below standards. In total, there are ten entrances to exit ramp segments on I-90 below the 1,500-foot minimum recommended standard. Three of these ten segments are less than 400 feet.

- **Interchange Type -** Uniformity of interchange types along a freeway corridor has the potential to reduce congestion and safety problems. Uniformity allows drivers to anticipate lane changing, merging, and exiting maneuvers between interchanges. Through the study area I-90 has good interchange uniformity with the exception of the Oakland Place interchange which is a partial access semi-directional interchange adjacent to the 21st Street NE diamond interchange.

Crash History

The crash assessment was based on data covering the years 2005 through 2014 obtained from MnDOT. During this 10-year period there were a total of 438 crashes along the five-mile segment of I-90, including the study intersections included in the analysis. More specifically, there were 195 crashes at the study intersections and 243 along I-90.

The type and severity of the crashes were reviewed and crash and severity rates were calculated for each intersection and freeway segment. The rates were compared to the calculated critical rates for each intersection or segment.

Crash rates at intersections are expressed as number of crashes per million entering vehicles at the intersection. Crash rates along highway segments are expressed as number of crashes per million vehicle miles traveled. In addition, crash severity comprises five separate types including fatal, incapacitating injury (Severity A), non-incapacitating injury (Severity B), possible injury (Severity C), and property damage crash.

The critical crash rate is a statistical value that is unique to each intersection or segment based on vehicle exposure and the MnDOT statewide average crash rate for similar type facilities. An intersection or segment with a crash or severity rate higher than the critical rates indicates a sustained crash problem. The following sections expand on both intersection and freeway crash history.

Intersection Crashes

Based on the data, there have been four incapacitating injury crashes (Severity A) at the intersections and there have been no fatal crashes. The majority of the intersections are below the calculated critical rates, however the following intersections have crash rates that are above the critical rates:

- Westbound I-90 off-ramp at 4th Street NW
- Eastbound I-90 off-ramp at 21st Street NW
- Westbound I-90 off-ramp at 21st Street NW
- Oakland Place at 8th Avenue

At westbound I-90 and 4th Street, the two closely spaced, offset ramp intersections create driver confusion and assignment of right-of-way issues that result in a high number of left turn related crashes.

At 21st Street, both ramp terminal intersections have a high percentage of left turn related crashes. The narrow bridge width, continuous bridge railing and guard railing create limited sight lines for the two off ramp approaches. Some of the westbound ramp crashes to 21st Street involved through vehicles trying to bypass a left turning vehicle in the single ramp approach lane.

At Oakland Place, there is a high percentage of right-angle crashes that are likely due to higher than posted speeds along Oakland Place due to the proximity to the freeway system.

Freeway Crashes

Based on the 10-year data, one fatality occurred along westbound I-90, but there were no incapacitating injury crashes (Severity A). Evaluating the 10-year data indicates a crash rate in both directions of I-90 above the critical crash rates.

The assessment shows crashes along eastbound I-90 included a high number of single vehicle type collisions; of the 120 crashes, 84 were single vehicle and 37 percent involved poor weather conditions. Four of the existing weaving segments and one exit ramp location all have a sustained crash problem based on the critical rate being exceeded.

The areas of concern that are above the critical rates include:

- 14th Street to 4th Street (weaving)
- 4th Street to 6th Street (weaving)
- Oakland Avenue to 21st Street (weaving)
- 21st Street to 28th Street (weaving)
- Oakland Avenue/TH 105 Exit Ramp

The majority of the crashes that occurred within the eastbound weaving segments are single vehicle ran-off-road crashes or crashes coded as "other/unknown". While the majority involve only a single vehicle, the cause of the crash is difficult to interpret based on the crash data as they could be the result of vehicle interaction in the weaving segments. Approximately 37 percent of the crashes in the four weaving segments were either rear-end or side-swipe collision.

Crashes along westbound I-90 included a high number of single vehicle type collisions; of the 123 total crashes, 86 were single vehicle and 43 percent involved poor weather conditions. The highest concentration of crashes was between the 11th Drive NE exit ramp and the 6th Street NE entrance ramp where 46 crashes occurred. This segment of roadway has closely spaced ramps, two high speed curves, and also transitions from an urban freeway design (concrete barrier in median) to a rural freeway design (grass median). The 46 crashes are spread out over 1 mile in length, which is why the critical rate is not surpassed. However, the actual crash rates are within about 15 percent or less of the critical rate, so the 11th Drive NE exit ramp and 6th street NE entrance ramps are approaching the critical, and are also above the statewide averages. None of these crashes were impacted by the railroad bridge.

The only segment that is impacted by the narrow bridge is the weaving segment between 11th Drive entrance and 6th Street exit where eighteen crashes occurred over the approximate 1500-foot length; this segment includes all of the tapers and guardrails between the painted ramp gores. Fourteen of the eighteen crashes involved single vehicle crashes. Road conditions (e.g. ice/slush or wet pavement) and unsafe speeds were contributing factors in those fourteen crashes.

Existing Conditions

This section summarizes the existing freeway operations and intersection operations evaluated for the project area. In summary, the I-90 mainline and the majority of the ramp terminal intersections operate with acceptable conditions throughout the project area.

Heavy Vehicles

I-90 is an Interregional Corridor (IRC) that connects regional trade centers in Minnesota and surrounding states and carries a high volume of truck traffic. MnDOT's Heavy Commercial Annual Average Daily Traffic (HCAADT) ranges between 5 percent and 14 percent of the total daily traffic volume. The 48-hour counts collected in November 2015 as part of this project indicated that approximately 13 percent to 16 percent of the daily traffic demands are heavy vehicles. Based on the turning movement data, all of the interchanges between 14th Street NW and 21st Street NE have significant truck demands that range up to 24 percent of the total ramp traffic during the peak hour. The 11th Drive NE interchange experiences the highest truck demands which is consistent with it being designated as the main access to the Hormel Plant.

Freeway Operations

Freeway traffic operations analyses were conducted to determine the level of service (LOS) along I-90 through the project area. LOS is a qualitative rating system used to describe the efficiency of traffic operations at an intersection designated by an A through F grading system. LOS A represents the best operating conditions (no congestion), and LOS F represents the worst operating conditions (severe congestion). For the study intersections it was assumed that LOS D or better represents acceptable operating conditions.

Based on evaluation methodologies in the Highway Capacity Manual, the analysis concluded that all freeway mainline segments, ramp merge/diverge connections, and weaving segments would operate at a LOS B or better through the 2045 forecast year. Due to the relatively low peak period traffic demands, the analysis does not result in any operational problems along the corridor.

Intersection Operations

Intersection traffic operations analyses were conducted to determine the LOS, delay, and queuing information for the AM and PM peak hour conditions.

The analysis indicated that all intersections have acceptable LOS. The only exception is the eastbound I-90 exit ramp to 14th Street NW which operates with an undesirable LOS E; however the queue does not impact freeway operations.

The only intersection queuing problem occurred at the westbound I-90 off-ramp/on-ramp at 4th Street NW. These intersections are offset with less than 100 feet of vehicle storage between the two intersections. The westbound off-ramp is signalized while the westbound on-ramp is uncontrolled. Queuing for southbound 4th Street NW at the traffic signal spills through the uncontrolled on-ramp intersection which blocks northbound vehicles from accessing the I-90 on-ramp. This can then spill the northbound left turn queue into the traffic signal and disrupt operations and safety at the I-90 off-ramp intersection.

Future Traffic Conditions

A key part of the study process was assessing future traffic conditions in order to understand key operational and safety issues that are anticipated within the forecast period. The expected timeline for implementing improvements is 2021-2025; as a result, the year 2045 was set as the planning period forecast year. This information provides the basis for developing and evaluating potential improvement concepts.

Traffic forecasts for I-90 and the intersecting roadways were developed using a regression analysis of historical AADT data. Historical AADT data for the project was obtained from MnDOT for the 20-year period of 1994 to 2014. The growth rates derived from the daily traffic forecasts were utilized to factor the AM and PM peak hour turning movement and freeway data to develop the 2045 traffic demands. For the purposes of this study, the minimum growth rate was 1percent per year based on a number of factors; all growth higher than 1percent per year was maintained. Based on the resulting traffic forecasts, operations analyses were completed for study area intersections and the I-90 mainline.

2045 Intersection Operations

The majority of intersections have acceptable LOS. The exceptions are the eastbound I-90 exit ramp to 14th Street NW and the eastbound I-90 exit ramp to 4th Street NW. Both of these intersections have severe delays on the ramp approach to the stop sign; the 14th Street NW ramp has delays of over 10 minutes per vehicle which would likely result in traffic rerouting and might introduce issues associated with existing I-90 traffic slowing down on the I-90 mainline as it approaches the queue at the off-ramp. In addition, the analysis indicates that the existing queuing at 4th Street NW between the westbound I-90 off-ramp and westbound I-90 on-ramp gets substantially worse with the increased traffic demands.

2045 Freeway Operations

A freeway traffic operations analyses were conducted to determine the LOS along I-90 through the project area with the forecasted 2045 demands. Given modest growth anticipated in the project area, all of the freeway analysis resulted in LOS B or better.

SUMMARY OF TRAFFIC ANALYSIS FINDINGS

The following key findings have been compiled from the traffic analysis described above:

- I-90 through the study area does not meet current interchange spacing guidelines.
- By 2045 the eastbound exit ramp intersections at both 14th Street NW and 4th Street NW will have significant operational problems in the PM peak periods assuming the existing geometry and traffic control.
- By 2045, queuing for the eastbound off-ramp to 14th Street NW will begin to impact freeway operations and create increased safety issues.
- By 2045, the offset ramp intersection for westbound I-90 at 4th Street NW will have increased queuing problems that will create major operational and safety concerns.
- While intersection ramp terminal operations are acceptable at most of the interchanges, safety is a major concern based on the historical crash data. Four intersections are above the critical rates indicating a sustained crash problem.
- While freeway operations along I-90 are acceptable through 2045, safety is a major concern based on the historical crash data and substandard designs. A more detailed evaluation indicated crash hot spots along eastbound I-90 including areas where ramp spacing is substandard. While westbound I-90 does not have any critical rates exceeded, it does have a few high crash frequency locations that are approaching the critical crash rates.

Bridge Condition Assessment

The study process involved completing a condition assessment for each bridge included in the project scope. The assessment included researching available records, completing a field review, and coordinating with MnDOT District 6 bridge staff and MnDOT Bridge Office staff. The process concluded with a prioritized list indicating which bridges should be priorities for replacement as opposed to rehabilitation. The ranked bridge replacement listing follows:

1. Cedar River Bridges - Bridge #6868 and 6869

- Replacement is a priority due to river scour, poor substructures, and poor deck conditions.
- Because of scour conditions, piers need to be replaced; therefore, rehabilitation is not an option.

2. 4th Street NW Bridge - Bridge #9180

- The existing bridge is functionally obsolete, which means it does not meet some or all of existing design standards related to shoulder width, sight distance, pedestrian/bicyclist accommodations, and vertical or horizontal clearances.
- Replacement is recommended due to poor substructures, poor deck condition, inadequate geometry, and poor substandard vertical clearance.
- Because of higher traffic volumes, inadequate pedestrian/bicyclist accommodations, and poor interchange functionality a total replacement is recommended.

3. US 218 South/21st Street NE Bridge - Bridge #9201

- The existing bridge is functionally obsolete.
- Replacement is preferred due to steel girder fatigue, spalling substructures, poor deck condition, poor deck geometry, and substandard vertical clearance.
- The existing bridge is a replacement priority over the 28th Street NE bridge due to it being a Trunk Highway bridge with higher traffic volumes.

4. 28th Street NE Bridge - Bridge #9504

- The existing bridge is functionally obsolete.
- If adequate funding was available, replacement would best address steel girder fatigue, steel corrosion, spalling substructures, poor deck geometry, and substandard vertical clearance.
- Existing bridge would need to be replaced with a wider structure in order to fully accommodate the Shooting Star Trail which will cross I-90 at this location.

5. TH 105/Oakland Avenue Bridge - Bridge #9183

- Replacement would address steel girder fatigue, spalling substructures, poor deck geometry, and substandard vertical clearance.
- Given overall condition and relatively lower traffic volumes this bridge is a lower replacement priority.

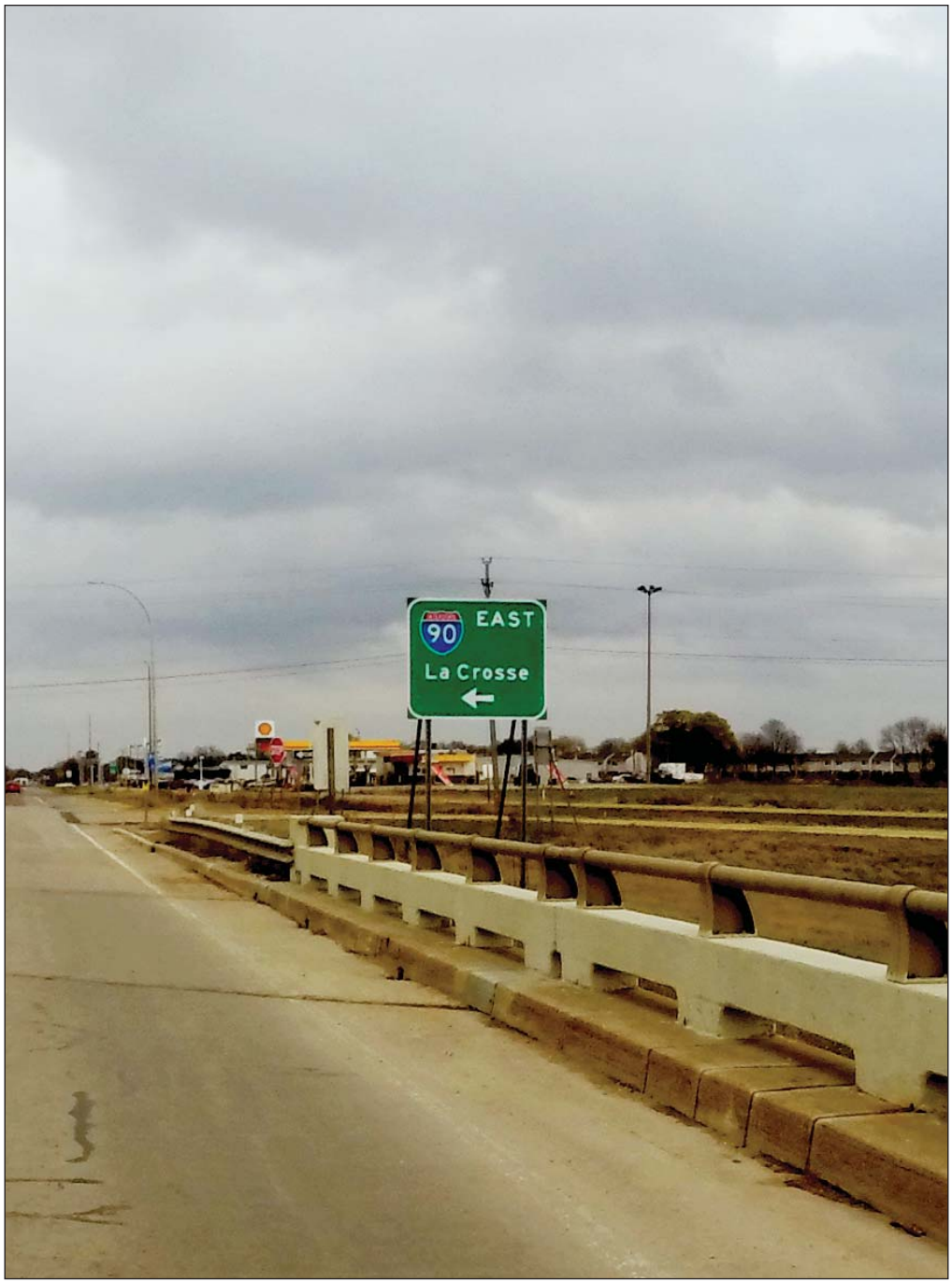
6. US 218 North/14th Street NW Bridges - Bridge #50803 and 50804

- The southbound (west) bridge is functionally obsolete.
- If adequate funding was available replacement would address spalling substructures, poor deck condition, and overweight truck issues.
- Given overall condition these bridges are a lower replacement priority.
- *Following completion of the technical analysis conducted for this study and assembling the Draft Corridor Study Report, MnDOT conducted additional investigations of Bridges 50803 and 50804. These inspections identified additional issues. as a result, MnDOT determined that replacement of both bridges is a priority.*

7. 6th Street NE Bridges - Bridge #9178 and 9179

- Given overall condition these bridges are a lower replacement priority.

4.0 Concept Development & Evaluation



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The needs identified through the traffic operations and safety analysis along with the information generated from the bridge condition assessment provided the basis for determining the potential scope and scale of improvement concepts at each of the study locations. The data also provided the framework for establishing the technical evaluation criteria against which the improvement concepts would be assessed.

This section has been structured to present the alternatives development process for each interchange in the study area. As noted in the text, in some cases, subareas were established to address potential improvements not directly tied to an interchange location.

4.1 Alternatives Development Process

The process for developing improvement concepts was defined and driven by the study area issues and needs detailed in Section 3.0. Input from the Stakeholder Group was essential in helping establish the relative priority of some of the needs and issues identified. This input was especially helpful in facilitating the alternatives evaluation process described later in this section. The improvement concepts are presented west to east through the study area beginning with the TH 105/Oakland Avenue Interchange.

TH 105/Oakland Avenue Interchange

Key Issues

The primary issues at the TH 105/Oakland Avenue interchange identified through the technical analysis and Stakeholder Group input included the following:

- Bridge is experiencing steel girder fatigue, steel corrosion, and concrete spalling.
- Existing geometry and clearances are substandard.
- Sight distance issues for westbound I-90 exiting traffic at TH 105.
- No pedestrian or bicyclist accommodations. Austin staff indicated there is pedestrian demand from residential development west of I-90.

Improvement Concepts

Based on this information, two base concepts were developed for consideration. One concept assumed bridge replacement (see Figure 9) and the second assumed bridge rehabilitation (see Figure 10).

The bridge replacement concept indicated in Figure 9 includes a designated sidewalk on the south side of the bridge and provides space at the ramp terminals for left and right turn lanes. In addition, the wider replacement bridge would improve existing sight distance issues. The improvements illustrated in Figure 10 include rehabilitating the existing bridge to address the bridge condition issues and reconfiguring use on the bridge deck to provide a 4 to 6-foot shoulder on the south side to improve conditions for pedestrians and bicyclists.

Figure 9. TH 105/Oakland Avenue Interchange Bridge Replacement Concept

Figure 10. TH 105/Oakland Avenue Interchange Bridge Rehabilitation Concept

US 218 North/14th Street NW Interchange

Key Issues

The primary issues identified through the technical analysis and Stakeholder Group input at the US 218 North/14th Street NW interchange included the following:

- Primary condition issues include spalling substructures, poor deck condition, and overweight truck issues
- Bridges are functionally obsolete
- No pedestrian or bicyclist accommodations on southbound bridge

Improvement Concepts

Based on this information, four concepts were developed for consideration. The first two concepts assumed retaining the existing interchange configuration (Figure 11).

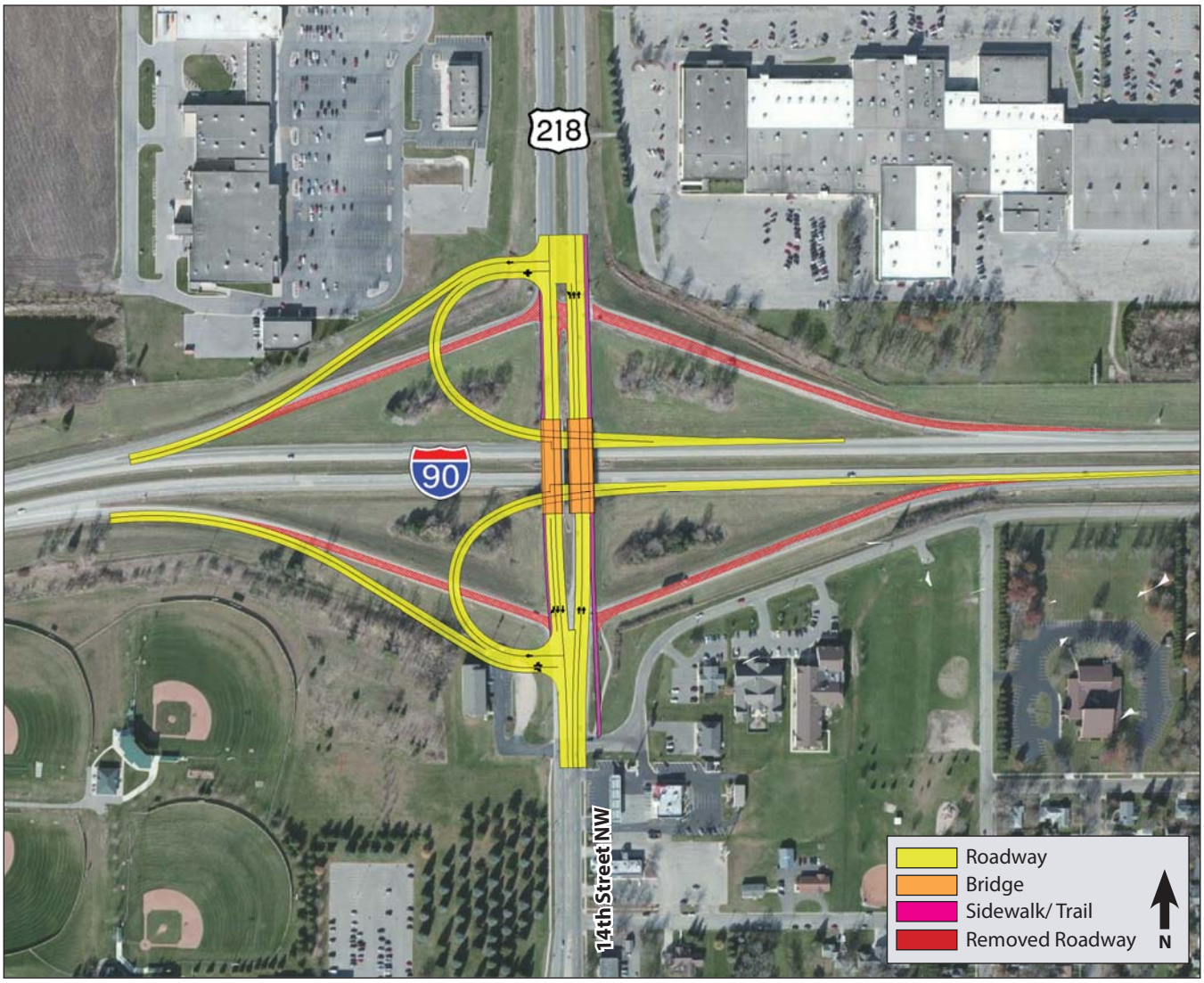
The rehabilitation concept assumes rehabilitating both bridges. The existing raised 8-foot sidewalk on the northbound bridge would be widened to 10 feet. In addition, the eastbound I-90 off-ramp would be widened to provide space for separate left and right turn lanes.

The replacement concept assumes two new bridges along with the eastbound I-90 off-ramp widening. the new northbound bridge would include a 10-foot trail and the southbound bridge would include a six-foot wide outside shoulder.

Figure 11. US 218 North/14th Street NW Interchange Rehabilitation and Replacement Concepts

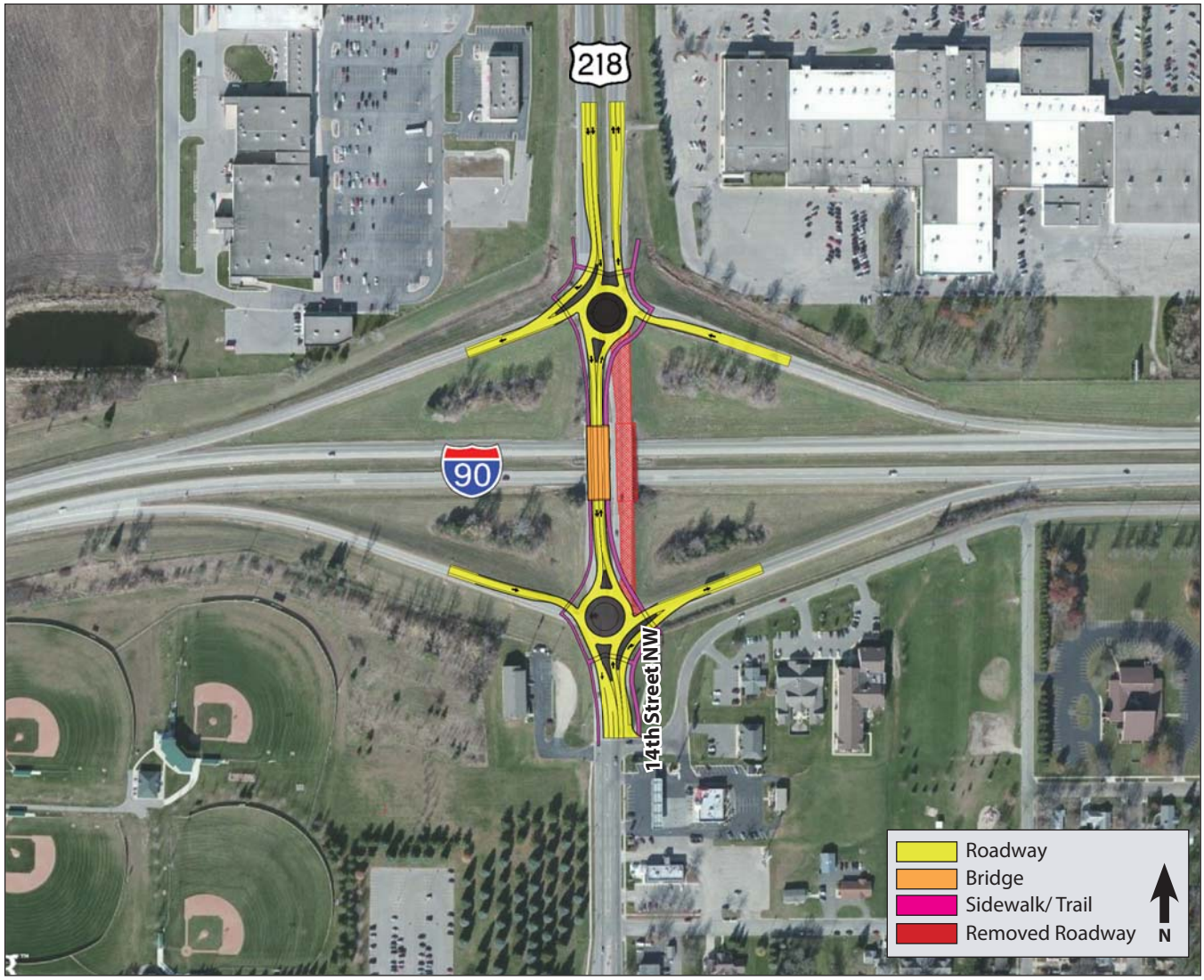
The third concept (see Figure 12) assumed reconstructing the interchange to a folded-diamond configuration. This concept addresses the identified issues and also improves the substandard weaving distance on I-90 between the US 218 North/14th Street NW and 4th Street NW interchanges.

Figure 12. US 218 North/14th Street NW Interchange Folded Diamond Concept



The fourth concept includes reconfiguring the existing interchange to a roundabout design (Figure 13). This concept would address all of the identified issues.

Figure 13. US 218 North/14th Street NW Interchange Roundabout Concept



4th Street NW Interchange

Key Issues

The primary issues identified through the technical analysis and Stakeholder Group input at the 4th Street NW interchange included the following:

- Primary condition issues include poor substructures, poor deck, inadequate geometry, and poor vertical clearance
- Bridge is functionally obsolete
- Traffic operational and safety issues, especially at the north ramp terminal intersection
- The I-90 westbound off-ramp and on-ramp intersections are offset resulting in traffic queues through intersections, safety issues, and travel delay
- Substandard pedestrian and bicyclist accommodations

Improvement Concepts

Four concepts were developed for consideration. The first assumed maintaining much of the existing interchange configuration (Figure 14). This concept includes realigning the interchange ramps to remove the off-set intersection at the north ramps and the skewed intersection at the south ramps. The concept addresses all the identified traffic, bridge condition, and functionality issues. Given the pedestrian and bicyclist demand at this location the concept includes sidewalks/trails on both sides of the bridge. The concept might require some right-of-way acquisition in the northwest and southwest quadrants. The potential of right-of-way impacts would be determined in future design phases.

Figure 14. 4th Street NW Interchange Reconstructed Diamond Concept

Similar to the diamond interchange in Figure 14, the partial diamond concept illustrated in Figure 15 addresses all the identified traffic, bridge condition, and functionality issues. Given the pedestrian and bicyclist demand at this location the concept includes sidewalks/trails on both sides of the bridge. The primary difference from the diamond concept is this design assumes removal of the northwest interchange ramp that provides access to westbound I-90. Removing this ramp would simplify traffic operations but require traffic destined to westbound I-90 to access the freeway via the US 218 North/14th Street NW interchange ½ mile to the west.

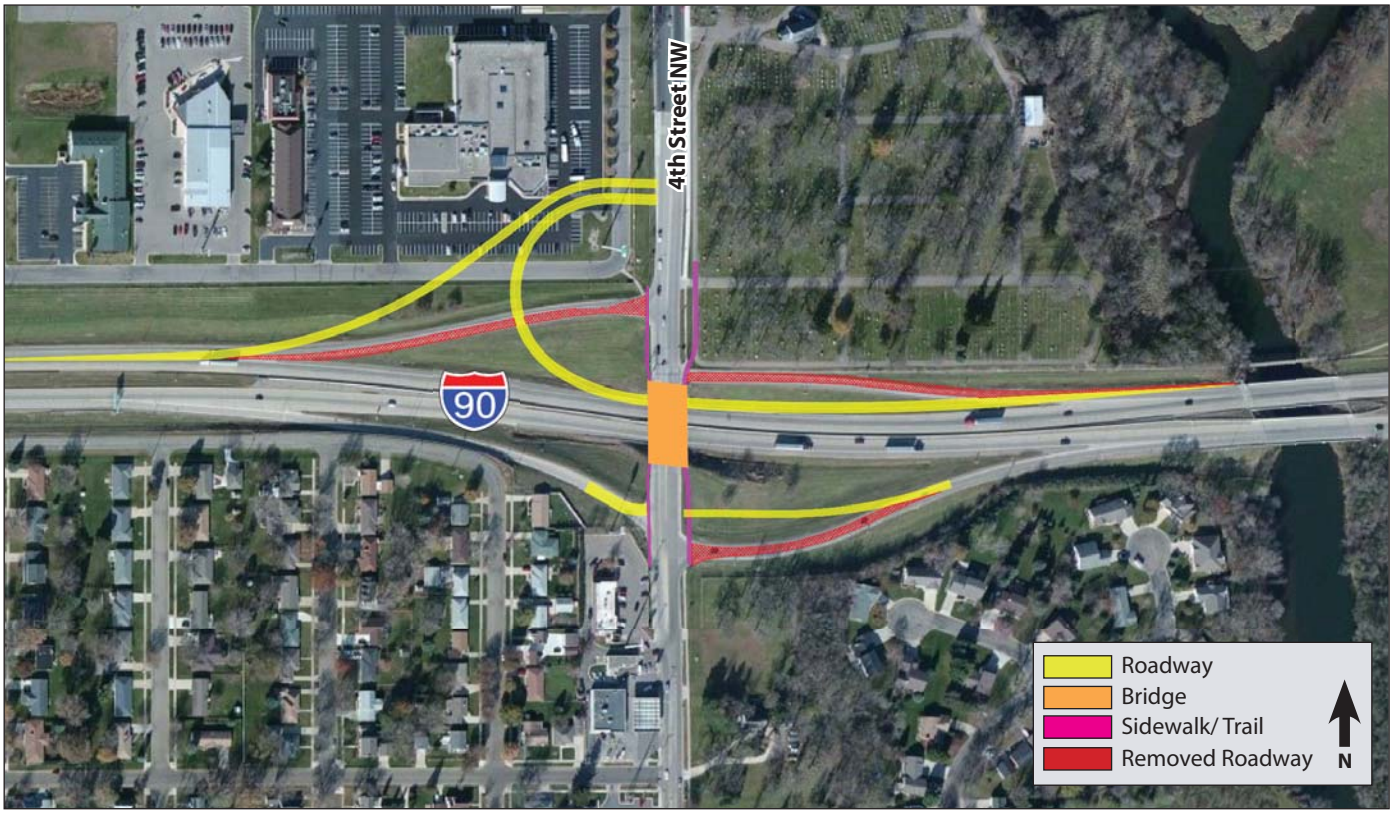
Figure 15. 4th Street NW Interchange Partial Diamond Concept

The roundabout concept illustrated in Figure 16 includes realigning the interchange ramps and combining them into a single elongated roundabout that would require two bridges over I-90 given the space constraints. The concept addresses all the identified traffic, bridge condition, and functionality issues. The concept includes sidewalks/trails on both sides of the bridge.

Figure 16. 4th Street NW Interchange Roundabout Concept

The concept illustrated in Figure 17 includes a folded loop in the northwest quadrant of the interchange to accommodate exiting westbound I-90 traffic. Similar to the other concepts, this design addresses all the identified traffic, bridge condition, and functionality issues.

Figure 17. 4th Street NW Interchange Folded Loop Concept



14th Street NW to 4th Street NW Frontage Road Link

It was noted earlier in this report that through the process of assessing study area issues and developing potential improvement concepts that some "subareas" outside the immediate study area interchanges were identified that warranted consideration. The segment of I-90 between 14th Street NW and 4th Street NW was one of these locations. This segment was of particular interest because the two interchanges are only ½ mile apart and the weaving distance between the respective interchange ramps are substandard. Understanding these challenges, a concept was developed that provided for a continuous frontage road link between 14th Street NW and 4th Street NW (see Figure 18). This concept would allow the removal of the I-90 eastbound off-ramp at 4th Street NW, thereby eliminating the most problematic traffic weaving issue in this portion of the study area.

Figure 18. 14th Street NW to 4th Street NW Frontage Road Concept

6th Street NE Interchange

Key Issues

The primary issues identified through the technical analysis and Stakeholder Group input at the 4th Street NW interchange included the following:

- Sight distance issues for exiting I-90 traffic at 6th Street NE given the location of the I-90 bridge piers
- Substandard pedestrian and bicyclist accommodations

Improvement Concept

The only concept developed at 6th Street NE assumed rehabilitating the existing eastbound and westbound I-90 bridges (see Figure 19). No improvements are proposed beyond rehabilitating the two bridges because the traffic analysis and safety assessment did not indicate any major issues and the bridges are in relatively good condition.

Figure 19. 6th Street NE Interchange Rehabilitation Concept

US 218 South/21st Street NE and 28th Street NE Interchange Area

As the alternatives identification process was initiated in the eastern end of the study area, it became evident given the close proximity of Oakland Place, 21st Street NE, and 28th Street NE that improvement concepts should be developed that account for the operational relationship between the interchanges. With this in mind, the alternatives development process focused on the following:

- Identify concepts that could "connect" 21st Street NE and 28th Street NE
- Identify concepts that address 21st Street NE and 28th Street NE as "stand-alone" interchanges
- Identify concepts that address the close proximity of Oakland Place to 21st Street NE and associated traffic issues on Oakland Place

Key Issues

The primary issues identified through the technical analysis and Stakeholder Group input in the US 218 South/21st Street NE and 28th Street NE interchange area included the following:

- Condition issues at both the 21st Street NE and 28th Street NE bridges include poor substructures, poor deck, inadequate geometry, and substandard vertical clearance
- Both bridges are functionally obsolete
- Both bridges have substandard pedestrian and bicyclist accommodations
- Traffic safety issues at the 21st Street NE interchange, likely due to poor site lines across the narrow bridge for both ramp approaches.
- Highly substandard weaving conditions that result in traffic safety issues between Oakland Place and 21st Street NE as well as between 21st Street NE and 28th Street NE
- Traffic safety issues at the Oakland Place/8th Avenue intersection

Improvement Concepts

The initial concepts that were developed addressed the potential to connect the 21st Street NE and 28th Street NE interchanges to reduce the number of ramps that connect to I-90 and in turn create weaving issues between entering and exiting I-90 traffic.

Concepts Connecting 21st Street NE and 28th Street NE

One-Way Pair Frontage Road Interchange

Figure 20 illustrates the concept of establishing a one-way pair frontage road system linking 21st Street NE and 28th Street NE. In this concept, all ramps at 28th Street NE would be removed and traffic would be redirected via the one-way frontage roads to the 21st Street NE interchange.

This concept would remove the substandard weaving condition between the two interchanges and retain full access to I-90 at the US 218 South/21st Street NE interchange which has substantially higher traffic demand than 28th Street NE.

Figure 20. 21st Street NE and 28th Street NE Interchanges: One-way Frontage Road Concept

Split-Diamond Interchange

A second concept for connecting 21st Street NE and 28th Street NE was developed that would create a "split-diamond" design. This concept would remove the I-90 eastbound on-ramp and westbound off-ramp at 21st Street NE and the westbound on-ramp and eastbound off-ramp at 28th Street NE (see Figure 21).

Similar to the one-way pair concept, this design would remove the substandard weaving condition between the two interchanges.

After developing improvement concepts that would connect the 21st Street NE and 28th Street NE interchanges, efforts focused on identifying concepts that would retain full access at each location.

Figure 21. 21st Street NE and 28th Street NE Interchanges: Split-Diamond Interchange Concept

21st Street NE Interchange Concepts

At 21st Street NE the concepts include either replacing or rehabilitating the existing bridge. Figure 22 illustrates the bridge replacement concept at 21st Street NE and Figure 23 illustrates the rehabilitation concept.

The bridge replacement concept depicted in Figure 22 includes a designated sidewalk on the west side of the bridge and provides space at the ramp terminals for left and right turn lanes. The improvements illustrated in Figure 23 include rehabilitating the existing bridge to address the bridge condition issues and reconfiguring use on the bridge deck to provide an approximate 6-foot shoulder on the west side for pedestrians and bicyclists.

Figure 22. 21st Street NE Interchange Bridge Replacement Concept

Figure 23. 21st Street NE Interchange Bridge Rehabilitation Concept

28th Street NE Interchange Concepts

Similar to the 21st Street NE interchange, the 28th Street NE improvement concepts include either replacing or rehabilitating the existing bridge. Figure 24 illustrates the bridge replacement concept at 28th Street NE and Figure 25 illustrates the rehabilitation concept.

The bridge replacement concept depicted in Figure 24 includes a 12-foot designated trail. This provision is to accommodate the planned extension of the Shooting Star Trail across I-90. The improvements illustrated in Figure 25 include rehabilitating the existing bridge to address the bridge condition issues and reconfiguring use on the bridge deck to provide an approximate 6-foot shoulder on the west side for pedestrians and bicyclists (including Shooting Star Trail users).

Figure 24. 28th Street NE Interchange Bridge Replacement Concept

Figure 25. 28th Street NE Interchange Bridge Rehabilitation Concept

Oakland Place Sub-Area

As noted previously the close proximity of the Oakland Place interchange to the 21st Street NE interchange results in a very short weaving distance (approximately 300 feet) for traffic entering I-90 eastbound from Oakland Place and exiting eastbound I-90 at 21st Street NE. In addition, the traffic operations and safety analysis indicated a crash rate above the critical rate at the Oakland Place/8th Avenue intersection. Given these conditions, concepts to address the issues in the Oakland Place interchange area were developed.

In order to address the short weaving distance between Oakland Place and 21st Street NE a concept was developed that redirected eastbound Oakland Place traffic through the 21st Street intersection prior to accessing I-90 eastbound. This concept would remove a very substandard weaving section along eastbound I-90 and provide more deceleration length for traffic exiting I-90 to 21st Street. The additional traffic through the 21st Street ramp terminal intersection does not create any adverse operational problems at the ramp terminal intersection. However, the design would significantly change traffic demands near the new Oakland Place and 19th Street intersection.

Figure 26 illustrates this reconfiguration concept.

This concept originally included the concept of removing the westbound I-90 off-ramp to Oakland Place. This idea was removed from consideration because it offered little benefit and would divert more traffic through to the north ramp intersection at the 21st Street NE interchange.

Figure 26. Oakland Place Interchange Reconfiguration Concept

The referenced safety issue at the Oakland Place/8th Avenue intersection, located immediately south of I-90, was assessed to determine concepts for mitigating the documented crash history. Two potential improvement concepts were developed, both of which involved modifying the existing median crossing for 8th Avenue.

Figure 27 illustrates a ¾ access intersection concept.

In this design 8th Avenue traffic is prohibited from crossing over or turning left onto Oakland Place. This design significantly reduces the number of traffic conflict points at the intersection.

The second intersection concept involves closing the existing median opening at 8th Avenue (see Figure 28). This "right-in/right-out" design eliminates all 8th Avenue traffic that currently crosses over and turns left onto Oakland Place. In addition northbound Oakland Place traffic could not access westbound 8th Avenue and southbound Oakland Place traffic could not access eastbound 8th Avenue.

Figure 27. Oakland Place/8th Avenue ¾ Access Intersection Concept

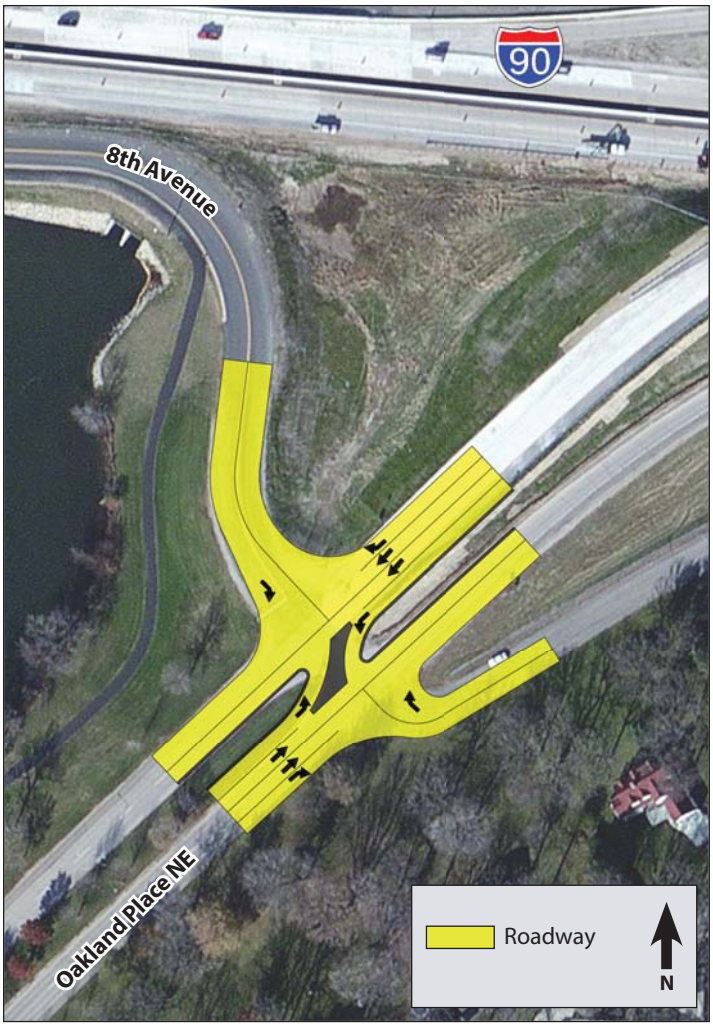
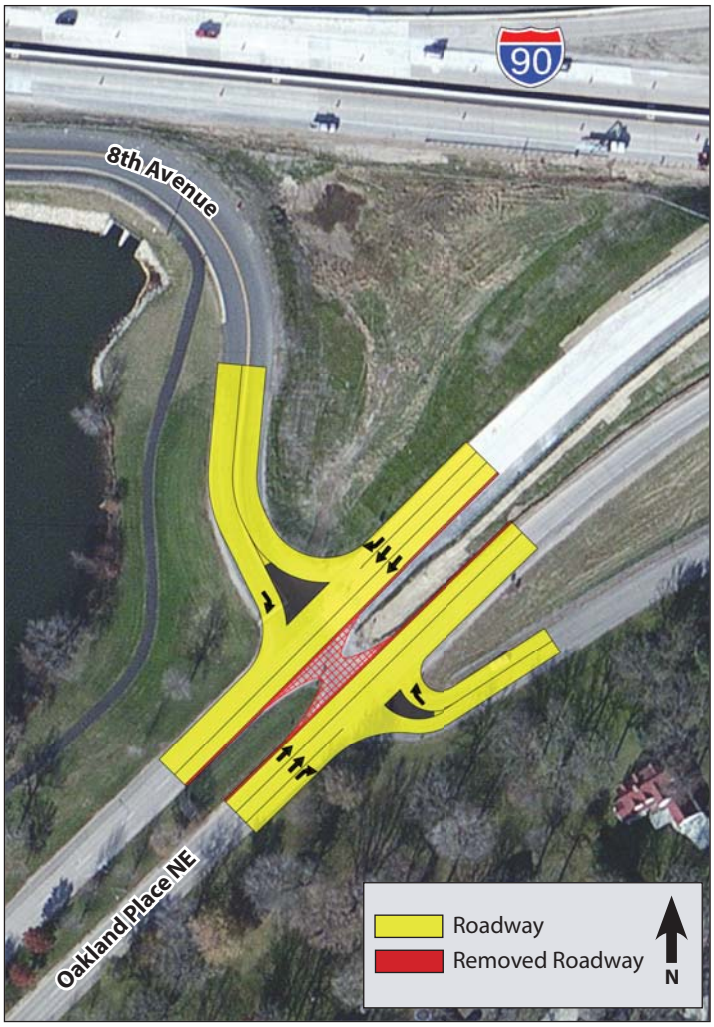


Figure 28. Oakland Place/8th Avenue Right-in/Right-out Concept



Stakeholder Group Input and Review

Following the development of the improvement concepts, the various concepts were presented to the Stakeholder Group to gather feedback prior to conducting the technical evaluation process. A summary of the provided input is summarized by location below:

Oakland Avenue/TH 105 Interchange

- Constructing a new bridge would be preferable to better address sight distance issues
- Improved pedestrian and bicyclist accommodations are needed

US 218 North/14th Street NW Interchange

- Concerns regarding truck movements on loop ramps (folded diamond concept)
- Concerns about truck movements through roundabouts
- Mixed input regarding need for pedestrian and bicyclist accommodations on both bridges
- Would like a traffic signal at south ramp intersection

14th Street NW to 4th Street NW Frontage Road

- Concerns about increasing traffic on an existing residential street
- Concerns about increasing traffic noise

4th Street NW Interchange

- This location has the most substantial traffic issues and is a key hub for visitors
- Regardless of the concept selected, need to minimize construction period delays and closures
- Roundabout concept appears to be very expensive
- Concerned about loss of freeway access with the partial diamond concept

6th Street NE Interchange

- The sight distance issues are a safety concern
- Need to improve lighting

US 218 South/21st Street NE and 28th Street NE Interchange Area

- 8th Avenue is used by Hormel delivery trucks although they are directed to 11th Drive NE
- Consider restricting access at 8th Avenue
- The northbound left turn lane from 21st Street NE to westbound I-90 is very tight
- Widening the 28th Street NE bridge would be preferred in order to accommodate the Shooting Star Trail crossing I-90

The feedback provided by the Stakeholder Group was carried into the evaluation process discussed in Section 4.2.

4.2 Concept Evaluation Process

The process for evaluating the range of improvement concepts presented in the previous section was completed in two phases. Phase 1 included a qualitative "feasibility" screening conducted by the Project Management Team (PMT). This screening considered the general feasibility and constructibility of the initial concepts with the goal of eliminating concepts that were significantly more expensive or introduced the potential for significant issues. Phase 2 included developing technical criteria to apply to the remaining concepts to assist in determining the technical merits of each concept.

Phase 1 Screening-Initial Feasibility

The initial screening focused on the following locations with multiple design concepts:

- US 218 North/14th Street NW Interchange
- 4th Street NW Interchange (including the 14th Street NW to 4th Street NW Frontage Road Concept)
- 21st Street NE and 28th Street NE Interchange Area

US 218 North/14th Street NW Interchange

Four concepts were identified at US 218 North/14th Street NW. They included retaining the existing interchange and either rehabilitating or replacing the two bridges, reconstructing as a folded diamond interchange, and reconstructing with roundabout intersections on 14th Street NW. The PMT concluded that given the trade-off in benefits and challenges with each concept, each should be carried forward for more detailed evaluation.

4th Street NW Interchange

Four improvement concepts were developed for the 4th Street NW interchange. They included: 1) reconstructed diamond design, 2) partial diamond, 3) a diamond design with roundabout intersections on 4th Street NW, and 4) a diamond concept with a loop in the northwest interchange quadrant.

In reviewing the four concepts, the PMT concluded that the roundabout intersection should be removed from further consideration because of extraordinary construction costs and that the diamond with a loop design should be screened because of substantial right-of-way impacts.

US 218/14th Street NW to 4th Street NW Frontage Road

This concept was included in the initial feasibility assessment because it directly affects the options at 14th Street NW and 4th Street NW, given it would require closing the I-90 eastbound on-ramp at 14th Street NW and the I-90 eastbound off-ramp at 4th Street NW. In reviewing this concept the PMT concluded it should not be carried forward into the detailed technical evaluation because it would substantially increase traffic volumes on an existing residential street, impact neighborhood traffic circulation, and impact access at the 14th Street NW and 4th Street NW interchanges.

21st Street NE and 28th Street NE Interchange Area

The PMT assessed the range of concepts in this portion of the study area and concluded that both the one-way pair and split diamond had to be removed from further consideration because both would require new roadways within the runway protection zone (RPZ) for the Austin Airport. Federal Aviation Administration (FAA) rules prohibit new roadways within RPZs except for extraordinary circumstances. Given there are reasonable concepts that avoid the RPZ, the one-way pair and split diamond concepts would not be approved by the FAA. Furthermore, both concepts would require construction within the Hormel Nature Center and there are specific federal laws that prohibit new roadways within parklands unless no other reasonable and prudent alternative exists.

As noted at the beginning of this report, the purpose of this study was to assess specific interchanges and bridges within the study area which have been identified by MnDOT for some level of improvement beginning in 2021. Given the concepts developed at the Oakland Place Interchange and Oakland Place/8th Avenue intersection are outside the scope of what MnDOT has planned for funding, the PMT concluded they should be set aside for potential consideration by MnDOT and/or the City of Austin in future studies. It is important to note that even though these concepts will not be advanced as recommendations in this study report, the analysis completed as part of the process did conclude there would be safety and operational benefits associated with the improvements.

Phase 2 Screening-Technical Evaluation

The second screening phase was based on a set of evaluating criteria defined by the PMT (see Table A).

At the onset of the Phase 2 screening process it was decided to defer the decision on whether to rehabilitate or replace bridges until the remainder of the technical screening was complete and the number of design concepts was reduced to one at each interchange location. This direction enabled the technical evaluation to focus on identifying a preferred design concept at each study location and set the stage for making the final decision on whether to rehabilitate or replace bridges based on anticipated funding and implementation priorities.

The study locations that included multiple design concepts entering the Phase 2 screening included US 218 North/14th Street NW, 4th Street NW, and the Oakland Place interchange area. Moving into the Phase 2 evaluation, the goal was to identify a single preferred design concept at each of these locations.

The technical analysis proceeded with the focus on assembling the data to address each of the evaluation criteria listed in Table A. The technical information was compiled into an evaluation matrix for those locations with multiple design concepts to provide an assessment of how the concepts compared to each other.

The evaluation matrix is presented in Table B.

Table A. Technical Evaluation Criteria

1. Traffic Safety (year 2045 conditions)
   - Estimated annual crashes
   - Percent crash reduction
   - Total intersection conflict points
   - Number of access points eliminated

2. Traffic Mobility (year 2045) conditions
   - Level of service
   - Total travel delay

3. Construction cost (year 2016 dollars)

4. Right-of-way impacts
   - Total acquisitions
   - Partial acquisitions

5. Pedestrian and bicyclist accommodations (compared to existing conditions)

Phase 2 Screening-Conclusions

The results of the Phase 2 screening process are summarized by study location below.

US 218 North/14th Street NW Interchange

The analysis concluded that compared to Concept 3 and 4, Concepts 1 and 2 have lower construction costs, less construction period traffic impacts, and no right-of-way impacts. Concept 1 does not provide the same level of pedestrian and bicyclist accommodations as Concepts 2, 3 or 4.

Technical Finding – Advance Concepts 1 and 2

4th Street NW Interchange

The Phase 2 evaluation concluded there are no substantial differences between Concept 1 (diamond) and Concept 2 (partial diamond). However, based on input from the Stakeholder Group, there were significant concerns about the adverse impacts associated with closing the access to westbound I-90 as assumed with Concept 2.

Technical Finding – Advance Concept 1 (Diamond Interchange Concept)

Table B. Technical Evaluation of Study Locations With Multiple Design Concepts

			US 218 North/14th Street NW Bridges 50803 & 50804			4th Street NE Bridge 9180	
		Concept 1- Rehabilitation	Concept 2- Replacement	Concept 3- Folded Diamond	Concept 4- Roundabout	Concept 1- Diamond	Concept 2- Partial Diamond
Criteria							
Safety (Year 4045)	**Annual Crash Estimation**	5.6	5.6	7.6	7.6	8.2	8.2
	Pct. Crash Reduction	+8%	+8%	+46%	+46%	20%	20%
	Total Conflict Points	26	26	18	16	26	17
	Access Points	0	0	0	0	0	0
Mobility (Year 4045)	**LOS (AM/PM)**	B/A	B/A	A/A	A/B	B/B	A/A
	Total Delay	<10 sec	<10 sec	<7 sec	<15 sec	< 15 sec	<10 sec
Construction Costs (2016)		$1,830,000	$5,600,000	$9,000,000-$11,000,000	$4,500,000-$5,500,000	$9,460,000	$7,900,000-$9,000,000
Construction Traffic Impacts		Low	Low	Medium	Medium	High	High
ROW- Total Acquisitions (parcels)	**Residential**	0	0	0	0	0	0
	Commercial	0	0	1	0	0	0
	Undeveloped	0	0	0	0	0	0
ROW- Partial Acquisitions (parcels)	**Residential**	0	0	0	0	0	0
	Commercial	0	0	1	1	2	2
	Undeveloped	0	0	1	0	0	0
Pedestrian and Bicycle Accommodations		Widen existing 8-foot raised sidewalk on east bridge to 10-feet.	Provides 10-foot trail on east bridge. Outside shoulder on west bridge would be 6-feet wide compared to 2-foot shoulder on existing bridge (Concept 1)	Adds sidewalk on west bridge. Removes ramp intersection conflicts on east bridge.	Provides sidewalk on west side and trail on east side of new bridge.	Provides sidewalk on west side of bridge and trail on east side of bridge.	Same as Concept 1 and further improves safety by removing NW ramp.

5.0 Recommendations

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5.1 Recommended Concepts

The two-phased evaluation process documented in the previous section generated technical information which led to the identification of concepts to carry forward for further consideration. The purpose of this section is to present the process used to assess the remaining concepts and identify the recommended improvement concept at each study location.

The following improvement concepts remained based on the conclusions of the Phase 1 and Phase 2 assessments:

Oakland Avenue/TH 105 Interchange
1. Bridge replacement
2. Bridge rehabilitation

US 218 North/14th Street NW Interchange
1. Rehabilitate existing bridges and widen eastbound I-90 off-ramp
2. Replace existing bridges and widen eastbound I-90 off-ramp.

4th Street NW
1. Replace bridge and construct new diamond interchange

Cedar River Bridges
1. Replace bridges

6th Street NE Interchange
1. Replace bridges
2. Rehabilitate bridges

US 218 South/21st Street NE Interchange
1. Bridge replacement
2. Bridge rehabilitation

28th Street NE Interchange
1. Bridge replacement
2. Bridge rehabilitation

As noted in Section 4, the evaluation process was structured to focus on identifying a preferred concept design at each study location. With the preferred concepts identified, the final step was to determine which bridges are recommended for replacement and which for rehabilitation. Though replacement is generally preferred over rehabilitation because it provides a longer term solution, MnDOT has limited financial resources so the final recommendations will need to include a mix of replacement projects (generally more expensive) and rehabilitation projects (generally less expensive).

The decision whether to replace or rehabilitate existing bridges has already been made for two of the seven study locations listed above; 4th Street NW (replace) and the Cedar River Bridges (replace).

- The preferred design concept at 4th Street NW requires bridge replacement in order to accommodate the additional traffic lanes over I-90. Rehabilitation was not a feasible option given the existing bridges condition and no practical means to widen the bridge to accommodate the required additional traffic lanes.

- Regarding the Cedar River Bridges, as noted in Section 4, based on bridge condition data the District Bridge Engineer and the Consultant Bridge Engineer concluded the existing bridges need to be replaced.

To make the replacement or rehabilitation decision at the five remaining locations, (Oakland Place/TH 105, US 218 North/14th Street NW, 6th Street NE, US 218 South/21st Street NE, and 28th Street NE), the PMT considered the following factors:

- Anticipated funding available for all improvements in the study area
- Replacement cost
- Rehabilitation cost
- Difference in cost between replacement and rehabilitation
- Existing bridge condition (are there locations where replacement is a higher priority)
- Traffic volume served

Table C summarizes the estimated replacement and rehabilitation construction costs. The table indicates rehabilitation costs between $450,000 and $810,000 and replacement costs from $2,630,000 to $3,550,000.

Table C. Replacement and Rehabilitation Construction Cost Comparison

		Oakland Place/ TH 105 Interchange	US 218 North / 14th Street NW	6th Street NE Interchange	US 218 South / 21st St NE Interchange	28th St NE Interchange
Construction Costs	Rehabilitation	$630,000	$1,830,000	$810,000	$450,000	$475,000
	Replacement	$3,550,000	$5,600,000	$2,630,000	$2,590,000	$2,670,0000

After reviewing all the factors listed above, the PMT concluded the following at each of the four remaining locations:

Oakland Place/TH 105 Interchange — Assume rehabilitation given the bridge ranked 5th (out of the seven) in replacement priority, rehabilitation costs are less than one-fifth the replacement costs, and Oakland Place has relatively light traffic volumes.

US 218 North / 14th Street NW — Assume replacement given spring 2107 bridge condition inspections conducted by MnDOT indicated both bridges have more substantial issues than originally understood at the beginning of this study process.

6th Street NE Interchange — Assume rehabilitation given the bridges ranked 7th (out of the seven) in replacement priority and rehabilitation costs are less than one-third the replacement costs.

US 218 South/21st Street NE Interchange — Assume replacement given the bridge ranked 3rd (out of seven) in replacement priority, US 218 South carries relatively higher traffic volumes, and the interchange connects an interstate freeway with a US highway.

28th Street NE Interchange — Assume replacement given the bridge ranked 4th (out of the seven) in replacement priority and a wider bridge is required to fully accommodate the Shooting Star Trail.

5.2 Summary of Recommendations and Implementation Priorities

To assist in defining the implementation sequence for the recommended projects, MnDOT requested input from City of Austin staff to better understand the City's relative priorities. The City indicated that the 4th Street NW interchange is their number one priority, followed by 28th Street NE, 21st Street NE, 14th Street NW, Oakland Avenue, and 6th Street NE.

After considering the City input, the PMT established an implementation priority ranking list. It is important to note that the implementation priorities identified through this study process reflect priorities based on bridge condition, traffic issues, and stakeholder preferences. These recommendations are subject to change given uncertainty in funding levels and timing as well as other unanticipated factors that could arise following completion of this study.

Table D provides a summary of the preliminary study recommendations, including implementation priority.

Table D. Preliminary Study Recommendations

	Design Concept	Replace or Rehabilitate Existing Bridges	Cost ($2016)	Implementation Priority
Oakland Avenue/ TH 105 Interchange - Bridge #9183	Retain existing diamond	Rehabilitate	$630,000	6
US 218 North/14th Street NW - Bridge #50803 and 50804	Retain existing diamond with widened I-90 eastbound off-ramp	Replace	$5,600,000	5
4th Street NW - Bridge # 9180	Tight-diamond	Replace	$9,500,000	2
Cedar River Bridges - Bridge #6868 and 6869	NA	Replace	$5,100,000	1
6th Street NE - Bridge #9178 and 9179	Retain existing diamond	Rehabilitate	$810,000	7
US 218 South/21st Street NE - Bridge #9201	Retain existing diamond	Replace	$2,590,000	3
28th Street NE - Bridge #9504	Retain existing diamond	Replace	$2,670,000	4

The recommendations outlined in Table D were presented to the Stakeholder Group for review and input. The Stakeholder Group inquired about the ability to incorporate recommendations from the I-90/Austin Visual Quality Manual (VQM) completed by MnDOT in January 2016. The VQM, which was developed in close coordination with the City of Austin and other local stakeholders, generated a series of ideas for aesthetic enhancements along the I-90 corridor through Austin. MnDOT indicated some of the aesthetic recommendations in the VQM could be more difficult to incorporate into bridges recommended for rehabilitation as opposed to replacement. However, it is anticipated that some of the VQM recommendations could be applied. The actual aesthetic elements applied at each location will be dependent on funding commitments and will be determined during future project development phases.

The Stakeholder Group members also emphasized the importance of minimizing construction duration and related detours. They encouraged attempting to package projects together to reduce the total amount of time that construction activities will be occurring during the 2021 to 2025 timeframe. The Group concurred with the proposed implementation priority defined by the PMT. However it was noted that even though Oakland Avenue/TH 105 is the 6th priority, providing some improvements for pedestrian and bicyclists is very important at that location given observations of existing demand, and that this interchange is a likely location for the future Blazing Star Trail that is planned to extend from Albert Lea to Austin to cross I-90.

Based on input from the Stakeholder Group no changes were made to the preliminary recommendations listed in Table D. Figure 29 combines all the improvements onto a study area-wide map. This graphic provides additional context regarding the close proximity of many of the recommendations.

5.3 Additional Study Findings

As documented in Section 4, a series of improvement concepts were developed in an attempt to address traffic safety issues identified at the Oakland Place interchange. One concept included redirecting eastbound Oakland Place traffic destined to I-90 through the 21st Street NE interchange. This design modification would eliminate a substandard weaving condition for Oakland Place traffic entering eastbound I-90 and eastbound I-90 traffic exiting at 21st Street NE (see Figure 26). In addition, two intersection modification concepts were developed to address the documented crash history at the Oakland Place/8th Avenue intersection (see Figures 27 and 28). Even though these concepts are not being advanced as recommendations in this study report, the analysis did conclude there would be safety and operational benefits associated with the improvements.

Figure 29. Recommended Improvement Concepts

5.4 Risk Assessment

As noted at the beginning of this report, the purpose of this corridor study was to address the needs along the I-90 corridor through Austin and set the framework for an approach to implement the necessary improvements within a constrained funding plan. This process represents a proactive effort by MnDOT to assess issues along the entire I-90 corridor in Austin in advance of proceeding with project development activities at individual interchange and bridge locations. Understanding the preliminary nature of these study recommendations and the uncertainties related to funding, it is important to acknowledge and document risks that need to be managed as this study process concludes.

Risk 1 - Funding

MnDOT has identified funding for improvements along I-90 in Austin for the years 2021 to 2025. There is significant risk that the amount of funding currently planned could change over the coming years. In addition, the years in which funding becomes available could also change. These factors make it difficult to determine whether the recommendations included in this report will be able to be implemented in the priority order noted in Table D.

To mitigate this risk, MnDOT will need to revisit the study recommendations annually and make adjustments as necessary to best match projects with the available funding.

Risk 2 - 4th Street Interchange Cost

The recommended tight-diamond interchange at 4th Street NW has an estimated 2016 construction cost of $9,500,000. This estimate is approximately double the funding currently identified in MnDOT's preliminary funding plan. As a result, significant additional funding will be required to be able to proceed with project development. Because of the funding shortfall, this improvement which is identified as the second implementation priority could be delayed until additional funding is secured.

To mitigate this risk, MnDOT should work with the City of Austin to identify potential funding opportunities.

Risk 3 - Bridge Condition Changes

Section 3 of this report provides a list of bridge replacement priorities. The potential exists that the current replacement priorities could change over the coming years if the condition of any bridge(s) deteriorate faster or slower than currently anticipated. These developments could in turn result in the need to modify the current implementation priorities.

To mitigate this risk, MnDOT should regularly review the condition of the study area bridges to determine whether unanticipated changes in bridge conditions are occurring.

Risk 4 – "Project Packaging" Could Lead to Changes in Current Implementation Priorities

As the recommendations were identified and implementation priorities were being considered, the PMT discussed concepts for "packaging" various improvements to potentially save money and/or reduce construction-related impacts. Some of the packaging scenarios relate to the proximity of improvements and construction staging concepts, while others result from the potential to save money by letting two or more projects simultaneously to gain efficiencies.

To mitigate this risk, MnDOT should continue to investigate opportunities to package multiple improvements with the objective to save money and reduce traffic and business access issues associated with construction activities. Implementation priorities should be adjusted accordingly and communicated to the City of Austin.

What's Next?

This report defines a series of recommendations related to interchange and bridge improvements along I-90 through the City of Austin. These recommendations in turn provide a framework for MnDOT to initiate more detailed project development activities in the coming years as funding levels and timing become more clear. These efforts will provide substantial opportunity for the public and other stakeholders to be engaged and provide input as the concepts presented in this report are refined and designed.