



Alternatives Development Report

Twin Ports Interchange Reconstruction Project

SP 6982-322 and SP 6980-60

City of Duluth

St. Louis County, Minnesota

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1 Report Purpose

This report has been prepared in support of the Twin Ports Interchange (TPI) Reconstruction Project environmental process. This report describes the alternatives development, evaluation, and decision-making since March 2017.

2 Project Description

2.1 Background

When the I-35/I-535/US 53 interchange was originally constructed, the northbound (NB) I-35 to NB US 53 movement was not included. MnDOT added it in 1972 based on local input. The I-35/US 53 connection has an unusual configuration because of its location relative to railroads, the Lincoln Park neighborhood, the St. Louis Bay, steep topography, and the in-place infrastructure (see Figure 1).

There are seven non-redundant bridges in the I-35/I-535/US 53 interchange. In 2008, the Minnesota Legislature directed MnDOT to replace or retrofit all fracture critical (non-redundant) bridges on the state's trunk highway system. In 2009, MnDOT began studying the I-35/I-535/US 53 interchange after the state's 20-year bridge planning process indicated that major rehabilitations and/or replacement would be required by the mid to late 2020s.

An initial interchange planning study was completed in 2011 that identified three basic alternatives: take no action, maintain the existing interchange, or replace the interchange with new geometrics. This study did not define a preferred alternative but set the stage for further stakeholder involvement and discussion. MnDOT initiated a more in-depth analysis of potential alternatives in late 2016.

2.2 Purpose and Need

2.2.1 Project Purpose

The purpose of the project is to improve the functionality (structural and geometric deficiencies) of the I-35/I-535/US 53 interchange, US 53 approach to the I-35/I-535/US 53 interchange, and I-535/Garfield Avenue interchange to improve the flow of traffic and freight between the Port of Duluth-Superior and local, regional, and international destinations.

2.2.2 Project Needs

The project has three primary needs:

- The infrastructure included in the TPI Reconstruction Project has structural deficiencies, including seven non-redundant and 14 weight restricted bridges, that need to be addressed to accommodate oversize and overweight (OSOW) loads and meet legislative directive
- The I-35/I-535/US 53 interchange has geometric deficiencies, including two left exits, five blind merges, and short weave distances, that need to be addressed to improve safety and mobility
- Weight restrictions prevent access to the I-35/I-535/US 53 and I-535/Garfield Avenue interchanges for the majority of freight loads

These needs are discussed in the following sections.

Structural Deficiencies

The TPI Reconstruction Project has a substantial amount of bridge structure as shown in Table 1. Of the 35 bridges in the TPI Reconstruction Project, 14 are weight restricted (see Appendix H). Due to the

weight restrictions on these bridges, OSOW freight cannot directly reach an interstate and trucks transporting these loads must navigate city streets.

Table 1: Bridges Included in the TPI Reconstruction Project

Location	Existing Bridges	Proposed Bridges
I-35 Bridges		
I-35 NB – I-535 SB	69801B, ¹ 69801C, ² 69801D ¹	69902
I-53 SB – I-535 SB	69801F, ² 69801H ¹	69901
I-535 NB – I-35 NB	69825 ²	69905
I-35 SB – I-535 SB	69824 ²	69904
I-535 NB – I-35 SB	69801J, ² 69801K, ² 69801L ¹	69903
I-35/US 53 Connection	69801G ¹	PENDING
I-35 SB Ramp	69801M	PENDING
I-35 Ramps	69801A, 69801E, 69801I, ¹ 69801N ³	Fill
I-35 SB Mainline	69881, 69881A, 69881B, 69881N	Fill
I-35 NB Mainline	69882, 69882A, 69882B, 69882N	Fill
Total Number of Bridges	24 (16 ramps plus 8 mainline bridges)	7
US 53 Bridges		
US 53	69802, 69802A, 69802B, 69802C, 69802D, 69802E	PENDING
Total Number of Bridges	6	5
27th Avenue W Interchange		
27th Avenue W	69834	69834 ⁴
Total Number of Bridges	1	1
I-535/Garfield Avenue Interchange		
I-535/Garfield Avenue	69808, 69808A, ¹ 69809 ¹	Same if rehab; new numbers if replaced
I-535 over railroad	69810	69810 ⁴
Total Number of Bridges	4	4
Creek Structures		
Coffee Creek	Double 4-foot by 6-foot brick tunnel	TBD
Miller Creek	10-foot by 6-foot box culvert to Michigan Street, 60-inch reinforced concrete pipe at I-35, 72-inch metal pipe to St. Louis Bay	TBD

¹ Weight restricted

² Non-redundant and weight restricted

³ Non-redundant

⁴ The bridge will be rehabilitated so the bridge number will remain the same.

I-35 Bridges

There is a total of 24 bridges within the main I-35/I-535 interchange. These 24 bridges include all of the non-redundant bridges as well as 12 of the 14 weight restricted bridges in the project area. Nearly 2,200 linear feet of mainline I-35 is on bridge structure due to poor subsoil and high water table.

US 53 Bridges

The US 53 bridges are deteriorating to the point of potentially becoming weight restricted. The US 53 leg of the TPI Reconstruction Project consists of six concrete box girder bridges constructed in 1972 (see Table 1). One US 53 mainline bridge is in poor condition (with a National Bridge Inventory (NBI) rating of 4) due to several shear cracks near an abutment and throughout the length of the concrete box girders near the piers. These cracks are a major concern for the future capacity of this bridge. This bridge also has cracking of the bottom and sides of the box girder near the abutment, which is causing significant spalling and delamination. Two associated bridges on the 21st Avenue West ramps have similar issues and are in fair condition (NBI ratings of 5). The other US 53 mainline bridge is in a similarly deteriorated condition and has an NBI rating of 5. The deck has map cracking on the surface and cracking and delamination with rust staining on the bottom side or top of the interior of the box girder.

The main US 53 Bridge (69802), along with the ramp bridges (69802A, 69802B, 69802C, 69802D, and 69802E) will be load-rated in the summer of 2018. The need for the load rating is based on growing shear cracks in the webs of the cast-in-place concrete box structures at several locations throughout the bridge. Additionally, there has been increasing deterioration at several locations that needs to be further studied to determine if any short-term repairs are needed prior to full replacement of these bridges with the TPI Reconstruction Project. This deterioration may be impacting the load capacity of these bridges prior to using them for staging and super-load evaluation. Finally, the existing rating is outdated and the new rating will be developed using LRFD. This methodology will provide for a more consistent method of evaluating future loads and any temporary strengthening needs, based on an updated evaluation with respect to the current condition and ongoing deterioration.

I-535/Garfield Avenue Interchange

The I-535/Garfield Avenue interchange includes Bridge 69808, which carries I-535 over Garfield Avenue, along with Bridges 69808A and 69809 that are ramp bridges that provide local access to Garfield Avenue. The bridges were modified in a previous repair project in the early 1990s and are currently being studied in detail to investigate potential rehabilitation alternatives compared with replacement in-kind. These bridges are continuous steel beam type structures, but include variable depth beams with hinges located within the spans. The complex framing of the gore areas within these bridges, where the ramp bridges frame into the main bridge, require detailed and time-consuming analysis to determine potential rehabilitation alternatives. A preliminary bridge rating investigation is underway that will lead to a better understanding of the potential for rehabilitation of the superstructure. The determination of rehabilitation of the beams or complete replacement of the beams on the existing piers is currently being evaluated, along with complete replacement of these bridges.

The piling that supports the piers and abutments of these bridges were constructed with pile driving equipment that is much lighter and delivered less energy to drive the foundation piles than that used for current modern pile driving operations. The pile hammer used for the original construction is not within the range required for conversion to Load and Resistance Factor Design (LRFD) pile capacities. A separate contract is currently underway to drive additional test piles near adjacent piers of the existing bridges to gather LRFD pile capacities that will be used in further assessment of the piles capacities that may be used in conjunction with the rehabilitation alternatives. The pile load test data will also be useful for determination of re-using the existing piles, together with additional piles that may need to be added to new bridge footings for the case of the complete bridge replacement alternative.

I-535 Over BNSF Railway Spur Track

I-535 spans over a BNSF Railway spur track on Bridge 69810. This bridge is a continuous steel beam type bridge that is planned to be rehabilitated with the TPI Reconstruction Project. Preliminary analysis indicates that the beams at the outer edges of the bridge deck could be modified by adding additional steel bracing (diaphragms) at the piers to provide lateral support to the fascia beams that will increase the bridge capacity to carry LRFD HL-93 Design Loads and MnDOT LRFD Permit Vehicles. OSOW loads particular to the Port of Duluth-Superior will also be included in further study of rehabilitation needs. Further investigation into pier cap strengthening and other repair needs are also included in the ongoing rehabilitation study that is underway for Bridge 69810.

27th Avenue W Over I-35

Bridge 69834 is a continuous steel beam bridge that may be rehabilitated with the TPI Reconstruction Project. The bridge deck needs to be replaced and may reuse the existing steel beams and existing substructures. The new bridge deck may be reconfigured to accommodate a pedestrian access. Piers will likely require modification to support the pier caps with the addition of pier walls cast between the existing columns. Rehabilitation recommendations are currently under development and will be considered with an evaluation of bridge replacement costs.

Geometric Deficiencies

The I-35/I-535/US 53 interchange has the fourth highest crash rate in the state,⁵ and these crashes are directly related to the geometric deficiencies of the roadway (i.e., short weaves, blind merges, left exits, and non-typical signal placement).

MnDOT conducted an online survey from November 13 to December 11, 2017 to better understand how people use the interchange and what their priorities are for the TPI Reconstruction Project. When asked what the highest priority or greatest need is when reconstructing the interchanges, of the 881 respondents, 71 percent answered removal of blind entrance and exit ramps. There was also an open-ended survey question that asked for additional thoughts and ideas for improvements. Of the 371 comments received in response to this question, 57 percent were related to the need to fix existing geometric deficiencies and specifically eliminating the blind merges and left exits. One respondent noted, “The merge from southbound I-35 to northbound Hwy 53 is particularly hairy – I've had more than one close-call due to lack of visibility at that merge.”

The I-35/I-535/US 53 interchange has 2.08 crashes per million entering vehicles (MEV), and there were 275 crashes in the project area between 2011-2015.

Freight Mobility

During 2015 and 2016, there were over 1,300 OSOW single use permits issued to and from the Port, averaging about two to three OSOW loads per day that were diverted to local streets. Movement of these cargos through the local street system is costly to shippers; on average, it adds an estimated three hours for each move. Local businesses and residents are impacted by the traffic congestion caused by these loads, and overweight loads also shorten the life span of the City's and County's infrastructure. Utilities and local agencies are involved to assist with moving utilities and signal poles from the alternate routes, which also impacts local businesses and residents.

⁵ 2011-2015 5-year interchange crash data comparing 654 interchanges from MnDOT's Office of Traffic Safety and Technology.

2.2.3 Additional Considerations

Other factors that have been considered during development of the project alternatives include the following:

- The project must be constructed while maintaining traffic flow on and access to the interstates and truck routes
- The existing infrastructure includes more than 750,000 square feet of bridge surface area, most of which was built in 1969 and requires frequent closures for inspection and maintenance
- Reducing OSOW impact on local streets

These additional considerations are discussed in the following sections. This project also provides the opportunity to improve management of stormwater runoff from the bridges and around the project area and minimize overall environmental impacts.

Maintenance of Traffic

During construction of the I-35/I-535/US 53 interchange, a minimum of one through lane in each direction must be maintained during regular daytime hours (7:00 am to 7:00 pm) and local access must be maintained during normal business hours. The Western Lake Superior Sanitary District (WLSSD) has just one route to enter and leave the site, which is via 27th Avenue W. The WLSSD has on average 126 trucks entering and leaving the facility on a typical day.⁶ Most of these trucks deliver supplies required for daily operations to effectively manage the water treatment, or are delivering waste to the recycling/transfer station and yard waste site. There are three other properties located south of 27th Avenue W that also depend on 27th Avenue W as their only access.

Bridge Maintenance

The bridges within the TPI Reconstruction Project were constructed in the late 1960s and the early 1970s. Because of the age of the infrastructure, increased maintenance activities are critical and required to sustain this transportation system link. Ramp closures and lane restrictions are required to conduct bridge inspections and routine maintenance due to the minimal width of the in-place bridges. The shoulder width on these bridges does not allow the inspection or maintenance vehicles access to the bridges while maintaining traffic. Bridge width standards have since changed to provide a safe area for maintenance vehicles. The maintenance needs ultimately result in delays and rerouting of vehicular traffic. As the system continues to age the maintenance timeline will only increase.

Inspections are currently conducted every other year, with maintenance activities occurring frequently on some portions of the interchange. The non-redundant bridges require annual inspections and have required maintenance every four years. Emergency repairs have required the closure of an interchange component about once a year due to rapidly accelerating deterioration. Opportunities to reduce the amount of bridge surface area should be considered.

Local Streets

By improving the geometric and structural deficiencies, the intent is that the majority of OSOW loads accessing the port will be able to do so via the I-35/I-535/US 53 and I-535/Garfield Avenue interchanges. In order to achieve the maximum impact on the number of loads that can be shifted back to the interstate, the design must consider the range of load widths, lengths, and heights that are being rerouted to local streets.

⁶ Per data from WLSSD. Assumes 250 working days per year.

2.3 Project Components

The TPI Reconstruction Project has three main components as illustrated in Figure 1. The alternatives evaluated for these components are discussed in Section 3.

Figure 1: Project Components



3 Alternatives Evaluated

3.1 Component 1: I-35/I-535/US 53 Interchange

I-35 separates the industrial lakeshore from the business district between 27th and Garfield Avenues, with US 53 providing access to the business/residential area to the west, and 27th and Garfield serving access to the east industrial areas.

3.1.1 Concepts Evaluated

Numerous concepts have been developed to address these issues with the I-35/I-535/US 53 interchange. At a design workshop in March 2017, 10 initial concepts were presented and evaluated qualitatively based on the following criteria:

- Would the concept improve traffic mobility?
- Would the concept improve geometric and structural deficiencies?
- Would the concept meet the project purpose and need?
- Are there any major issues with constructability of the concept?
- Are there any major environmental or community impacts associated with the concept?

Based on this high-level evaluation, elements of some concepts were combined to create new concepts, and other concepts were further refined. In the end, 15 concepts were considered resulting in many concepts being eliminated based on feasibility, potential constructability, or not addressing needs as well as other concepts. The outcome of this process resulted in four concepts being carried forward for public input: Concepts B, C, I, and O.

The design of Concepts B, C, I, and O was advanced further (see concept layouts in Appendix A). The two main differentiators among Concepts B, C, I, and O were the number of traffic signals and if all movements would be maintained between I-35, I-535, and US 53. Concept B would include three traffic signals and maintain all movements. Concepts C and I would include one traffic signal (similar to the existing condition) and would maintain all movements. Concept O would not have any traffic signals but would eliminate the NB I-35 to NB US 53 movement.

After additional technical analysis and stakeholder input, Concept C was identified as the recommended alternative for the following reasons:

- Concept O:
 - Would require a substantial right-of-way impact on Lower Michigan Street north of US 53
 - Would eliminate the direct I-35 NB to US 53 NB movement
 - Had little public support primarily due to the lost movement between southbound (SB) I-35 and NB US 53, and the complexity of the interchange
- Concept I:
 - Would have more complex bridges
 - Would be the most expensive alternative
 - Had little public support because other concepts met the needs with simpler bridges
- Concept B:
 - Would include three traffic signals
 - Would have the highest vehicle-hours of delay
 - Had little public support primarily due to the added traffic signals

- Concept C:
 - Would relocate the traffic signal to an expected location
 - Would maintain all traffic movements
 - Would minimize the amount of bridge structure
 - Had broad public support because it met project needs with less bridge structure

Refinement of Bridge Pier Locations with Railroad

The main I-35/I-535/US 53 interchange that spans over I-35 and the adjacent BNSF railroad includes several curved steel beam type bridges that are planned to be replaced with the TPI Reconstruction Project. A detailed listing of the bridges included is provided in Table 1. Several of these bridges are non-redundant. New bridges that span over the BNSF rail yard are currently being evaluated in consultation with BNSF Railway to evaluate construction impacts on BNSF operations, and placement of piers within the BNSF Railway facility.

Initial discussions with BNSF included requirements to maintain two active tracks with sufficient space to allow for an additional track and maintenance road to be added in the future parallel to I-35. The requirement for maintaining rail operations during construction also included consideration that a temporary shoo-fly track alignment may be required to replace the Miller Creek and Coffee Creek culverts that pass under the BNSF tracks. It is proposed to combine Miller and Coffee Creeks on the west side of I-35 and construct one new structure under the interchange to outlet to the lake. Various shoo-fly track alignments are under evaluation that maintain rail operations with temporary shoo-fly track alignments that are necessary to permit replacement of the Miller Creek box culvert, and also maintain connectivity with the existing rail yard facility, while also providing sufficient offset from the existing bridge piers to enable removal of existing bridges and existing bridge piers.

Recent coordination efforts with BNSF have led to two alternatives that are currently being evaluated – RR Portal Concept 1 and RR Portal Concept 2.

RR Portal Concept 1 evolved from discussion with BNSF regarding pier removal during demolition of the existing bridges. The excavations required adjacent to the existing tracks would require sheet piling to stabilize the railroad tracks during pier footing removal operations. The piers for the new bridges could be positioned adjacent to the existing piers to permit removal of the existing pier footings but also utilize the same railroad portal for the reconstructed bridges. This portal would also require space for the addition of a third railroad track and maintenance road along the track for future potential railroad expansion needs. It was noted that the current portal converges under Garfield Avenue Bridge 69803. Note that this bridge is to remain and is not included within the TPI Reconstruction Project. This concept includes two BNSF tracks on the east side of new piers, with allowance for the addition of a third track and maintenance road on the west side of the new piers, which are in line with existing piers that will be removed. This concept is still under evaluation.

RR Portal Concept 2 evolved from study of the proposed bridges that could be arranged with piers that span over the same two BNSF tracks, but allow for the placement of an additional track and maintenance within a new un-obstructed railroad corridor by repositioning the new piers to the outside of the portal. This pier arrangement allows for clear unobstructed space for BNSF operations since the piers for the new bridges are positioned on each side of the railroad portal, accommodating the two BNSF tracks, along with the space to add an adjacent track and maintenance road within the portal. This concept effectively eliminates conflicts within the BNSF rail portal.

Both RR Portal Concept 1 and RR Portal Concept 2 are still under evaluation by BNSF, but most recent discussions have resulted in perception that RR Portal Concept 2 may offer more advantages to future rail operations since pier placement flanks the entire portal. Track re-alignment is likely required with both concepts to maintain rail operations due to the need to remove existing bridges and replace the Miller Creek culvert with a new bridge or culvert. The use of temporary track closure windows is also under

discussion to better understand the extent of time that may be permitted to complete removals and reconstruction operations during brief track closure windows.

Bridge Super-Load Design Criteria

The Port of Duluth-Superior includes a high concentration of oversize and overweight (OSOW) freight that is transported by heavy freight haulers within the state and region, that are currently restricted to operate on routes that can accommodate Oversize-Overweight Permits. Many of the bridges within the existing interchange are load restricted (see Table 1) and cannot accommodate OSOW loads. The high concentration of OSOW freight originating from the port utilizes Garfield Avenue to cross over I-35 on Garfield Avenue (Bridge 69803) and weave through local streets within Duluth to obtain access to routes that can accommodate OSOW freight. Bridge 69803 was designed in the early 1980s with a special super-load such that heavy freight from the port could be transported over I-35 and gain access to the interstate system via local roads.

A goal of the TPI Reconstruction Project is to accommodate the majority of the OSOW freight being delivered from the port through the reconstructed interchange. Development of Preliminary Bridge Plans for the TPI Reconstruction Project will include further study of the OSOW data particular to the Port of Duluth-Superior to consider special design criteria that could be included for the design of the bridges to help ensure that the majority of the OSOW freight can be accommodated directly onto the I-35/I-535/US 53 system.

Permit load data requests will be evaluated to consider load configurations in various load classifications, vertical clearance requirements, and load distribution considerations for development of TPI super-load design criteria. The super-load design vehicle study will be in accordance with the reliability based principals of AASHTO LRFD code requirements and include characteristics such as frequency, weight variation, traffic pattern, and appropriate load factors and multi-presence factors. The analysis will include evaluation of current MnDOT LRFD single trip permit vehicles compared with the OSOW freight data, together with the current LRFD Manual for Bridge Evaluation to determine any modifications that should be made due to the high volume of OSOW loads.

Accommodation of additional vertical clearance requirements will also be made for particular connections, with study of adjacent height restrictions beyond the TPI corridor. The current vertical clearance standard of 16'-6" may also be modified at select locations within the TPI corridor. Note that some loads originating from the port include transport loads exceeding 17'-0". With a high volume of wind turbines originating to and from the Port of Duluth-Superior, there is a need to carefully consider various classifications of OSOW freight so that a major improvement to accommodate OSOW freight is achieved upon completion of the TPI Reconstruction Project.

Since it will be impractical to set the design criteria to accommodate all OSOW loads (some that include up to 23' for vertical clearance), a statistical analysis approach will be used for evaluation and development of the TPI super-load design criteria.

3.1.2 Recommended Concept C Description

The following provides a more detailed description of the improvements and design details that will be considered as part of the project for evaluation of potential environmental impacts.

Structural Improvements

The existing 24 bridges within the I-35/I-535/US 53 interchange (see Attachment E) will be replaced with six new bridges as outlined below. Where feasible, elevated structures were eliminated and replaced with light-weight fill and retaining walls, primarily on mainline I-35.

- Bridge 69905 will replace Bridge 69825 and Bridge 69904 will replace Bridge 69824, which are the northbound and southbound ramps from and to I-535
- Bridge 69903 will replace Bridges 69801J, K, and L for the NB I-535 ramp to SB I-35

- Bridge 69902 will replace Bridges 69801B, C, and D for the NB I-35 ramp to SB I-535
- Bridges 69801F, H, and I will be replaced by Bridge 69906 and a fill section
- The mainline bridges (69881; 69881A, B, and N; 69882; 69882A, B, and N) will be replaced by fill section between retaining walls and a portion of Bridges 69801M and 69881A will be replaced by a new bridge (bridge number pending)
- Bridge 69834 at 27th Avenue W will be rehabilitated

Geometric Improvements

The geometric improvements that will be made to the I-35/I-535/US 53 interchange are summarized in Table 2. The current lane and ramp configuration on SB I-35 requires traffic merging from Mesaba Avenue heading to eastbound I-535 to change lanes twice to access the left exit only lane, conflicting with I-35 through traffic and traffic wanting to use the right-hand exit for US 53, resulting in substantial slowing of traffic flow on the I-35 mainline. Over 4,300 vehicles make this maneuver every day in approximately 1,000 feet, creating a dangerous weaving area.

The proposed project moves the eastbound I-535 exit to a more traditional right exit ramp. This change from left to right exit ramp vastly improves the weaving movement for Mesaba Avenue traffic heading to I-535 by eliminating the double lane change to the left-hand exit. With the proposed project, Mesaba Avenue can stay in the auxiliary lane exit to US 53 and simply merge with traffic from I-35 exiting onto the I-535 eastbound ramp.

Table 2: I-35/I-535/US 53 Geometric Improvements

Location	Existing Issue	Improvement
Exit from NB I-35 to NB US 53	Left exit	Replace with right exit
Exit from SB I-35 to SB I-535	Left exit	Replace with right exit
SB I-35 ramp to NB US 53 and NB I-535 ramp to NB US 53	Blind merge	Extend merge distance by 1,000 feet by maintaining dedicated lanes for each ramp
NB I-35 ramp to SB I-535 and SB US 53 ramp to SB I-535	Blind merge	Extend merge distance by 550 feet
SB US 53 ramp with NB I-35 mainline prior to NB I-535 entrance	Blind merge	Extend merge distance by 600 feet
SB US 53 ramp to SB I-35 merge and NB I-535 to SB I-35	Blind merge and short weave	Change combined ramp merge to independent merge for each ramp, which extends weaving distance by 200 feet
NB/SB US 53	Unexpected traffic signal	Shift signal to end of NB I-35 exit ramp on tangent, which is a more anticipated location

Table 3 illustrates the estimated crash reduction with the TPI Reconstruction Project. Crashes are anticipated to be reduced by more than 30 percent, or 400 fewer crashes over 20 years. From 2011 to 2015, the average crash rate for an urban freeway interchange was 1.15 crashes per MEV. The proposed project will address current design deficiencies, and it is anticipated that crashes will trend toward the average crash rate for urban freeway interchanges. If the crash rate meets the average of 1.15 crashes/MEV, the reduction in crashes at the locations listed in Table 3 would be over 40 percent.

Table 3: Crash Count Analysis

Location	Crashes in 2020		Crashes in 2040	
	No Build	Build	No Build	Build
SB US 53 Ramp to SB I-35	14	11	16	12
SB I-35 Ramp to US 53 and Junction with I-535 NB and I-35 NB Entrance Ramps	8	5	9	6
I-35 SB from TH 194 to I-535 SB Exit Ramp to US 53 Off-Ramp	7	5	8	6
Traffic Signal I-35 NB Ramp to US 53 NB/US 53 SB to I-535	6	2	7	2
I-535 NB Ramp to I-35 NB	6	4	6	4
I-35 NB from 27 th Avenue W to US 53/I-535 Exit	3	2	3	2
NB I-35 and SB US 53 Ramps to I-535	4	3	4	3
I-35 Mainline	7	6	8	6
Other Ramps	5	4	6	5
TOTAL	60	42	67	46

Other Considerations

- Creek realignment options
 - Miller and Coffee Creeks are designated trout streams that outlet to the bay within close proximity to each other after crossing in separate culverts under I-35. Given their proximity, they are being considered to be combined into a common culvert or bridge in addition to the alternative of maintaining their respective crossing locations.
 - If combined, Miller and Coffee Creeks would merge before crossing under I-35. This will allow cost effective crossing (one location versus two) and less impact to rail operations during construction. Also provides opportunity for some creek channel improvements. Soil contamination in the realigned channel area will be investigated in preliminary design and if possible to relocate, addressed in design. The minimum structure width is estimated at 50 feet and a height of 6 feet, and more than 300 feet long, thus a bridge may be considered for this crossing. The proposed alignment is shown in Appendix A.
 - If combining the creeks is not feasible, the default option would be to design independent culverts for each creek after confirming appropriate pipe sizes. This determination is dependent on contaminants and DNR and COE input.
- Cross City Trail realignment
 - The Cross City Trail currently runs along Michigan and Lower Michigan Streets under a Limited Use Permit (LUP) from MnDOT. It could be realigned by others through the creek realignment area to take advantage of existing green space. This green space is owned by MnDOT, which it would make available for trail use via a Limited Use Permit if the City chooses to move the segment of the trail between 22nd and 24th Avenues West.
- Temporary railroad track realignment
 - A temporary BNSF track alignment shift (shoo-fly) will be required in the Miller and Coffee Creek area to facilitate the staged construction of the new Miller and Coffee Creek structure(s) to avoid impacts to BNSF track operations during construction.

- Stormwater management locations
 - Two pond locations have been identified within the MnDOT right-of-way as shown in Appendix G. These ponds will be sized to treat the additional impervious surfaced added by the project.

3.2 Component 2: US 53 Reconstruction

US 53 runs through the Lincoln Park neighborhood and business district which includes small single-family homes, an apartment high rise, and a mix of older service business and newer small businesses.

3.2.1 Concepts Evaluated

The part of US 53 within the TPI Reconstruction Project consists of six concrete box girder bridges constructed in 1972 (see Table 1). One US 53 mainline bridge is in poor condition (with a National Bridge Inventory (NBI) rating of 4) due to several shear cracks near an abutment and throughout the length of the concrete box girders near the piers. These cracks are a major concern for the future capacity of this bridge. This bridge also has cracking of the bottom and sides of the box girder near the abutment, which is causing significant spalling and delamination. Two associated bridges on the 21st Avenue West ramps have similar issues and are in fair condition (NBI ratings of 5). The other US 53 mainline bridge is in a similarly deteriorated condition and has an NBI rating of 5. The deck has map cracking on the surface and cracking and delamination with rust staining on the bottom side or top of the interior of the box girder.

The main US 53 Bridge (69802), along with the ramp bridges (69802A, 69802B, 69802C, 69802D, and 69802E) will be load-rated in the summer of 2018. The need for the load rating is based on growing shear cracks in the webs of the cast-in-place concrete box structures at several locations throughout the bridge. Additionally, there has been increasing deterioration at several locations that needs to be further studied to determine if any short-term repairs are needed prior to full replacement of these bridges with the TPI Reconstruction Project. It is also important to understand how the deterioration may be impacting the load capacity of these bridges prior to using them for staging and super-load evaluation. Finally, the existing rating is outdated and the new rating will be developed using LRFD. This methodology will provide for a more consistent method of evaluating future loads and any temporary strengthening needs, based on an updated evaluation with respect to the current condition and ongoing deterioration.

Initially, three options for replacing the US 53 bridges were considered: reconstructing the bridges as is, putting US 53 at-grade at West Superior Street, and replacing the existing bridges with fill.

The at-grade intersection at Superior Street option (see Figure 2 and Figure 3) was developed to increase access to businesses in the Lincoln Park neighborhood. It would have seven percent grades in both directions and would remove existing street crossings under US 53 at Michigan Street, W 1st Street, and 21st Avenue W (see layout in Appendix C). Public feedback received indicated that residents and business owners were concerned about introducing high traffic volumes into the neighborhood and restricting access across US 53, as well as introducing another signal on US 53, pedestrian movements and eliminating parking spaces under the bridge. For these reasons, this alternative was eliminated from further consideration.

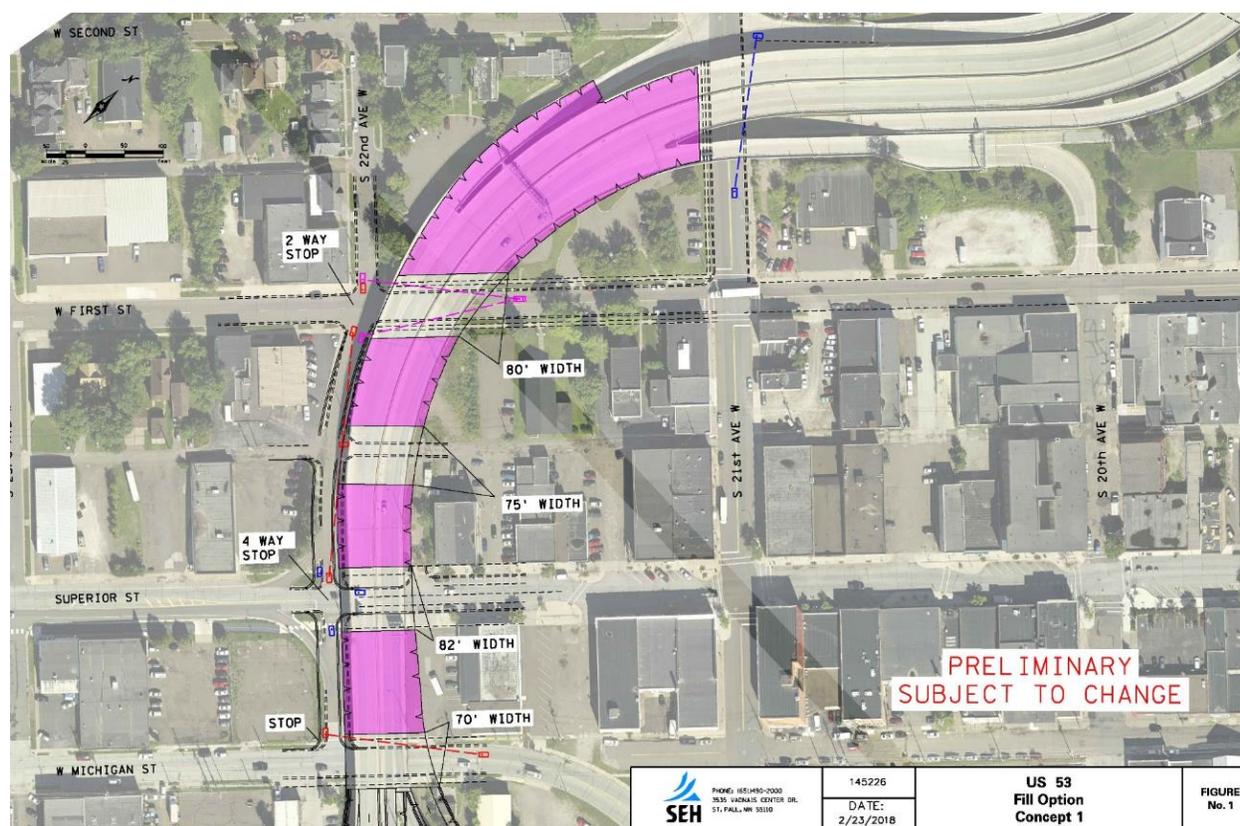
Figure 2: US 53 At-Grade Option – View 1



Figure 3: US 53 At-Grade Option – View 2



Figure 4: US 53 Initial Fill Option



The initial fill option was developed during the value engineering workshop to address community concerns about the safety and aesthetics of the areas under the existing US 53 bridges, attempt to reduce infrastructure and maintenance costs, and to minimize closures during construction. This option initially included four sections of fill between Michigan Street and 21st Avenue W as shown in pink on Figure 4. Existing street crossings under US 53 would remain open. Based on input from the neighborhood and area businesses regarding concern that the initial fill concept would isolate the neighborhood, a number of modifications to the number and location of the fill sections has been evaluated. The fill sections between Michigan and Superior Streets and between Superior and First Streets were identified by local business as potentially blocking visibility. There was also a concern from residents that walls on both sides of street would create a “tunnel effect” and would not allow escape from anyone in a threatening situation. The alleyway between Superior and First was also identified as an important access point, thus these two fill sections have been dropped. The area between 21st and 19th Avenues was also identified as an important open space amenity to the neighborhood that it wanted to remain (including the residents of the adjacent high-rise buildings).⁷ The segment between 1st and 21st is planned to be fill with some reconfiguration of parking on the adjacent parcels. Refinements to the extent of fill sections will be determined during final design and formed by additional public input using visualizations that illustrate the options.

21st Avenue Ramp

A secondary design consideration for the US 53 bridges was reconfiguring the ramp from NB US 53 to 21st Avenue W (see Appendix B). Although the current directional signage indicates that the exit is for 21st Avenue W, the existing northbound off-ramp exits at 20th Avenue W. This design option was eliminated

⁷ The local neighborhood operates a skate park under the bridge.

from consideration because it would require a substandard weave distance from NB I-35 to NB US 53. Four lanes would be required in this situation. The distance was only 100' in length which is greatly diminished from standard values. There was also supporting evidence that many crashes occur in this segment today and having such a short weaving distance would not address, and perhaps worsen, the existing crash problem.

3.2.2 Recommended Concept Description

Structural Improvements

The six concrete box girder bridges will be replaced with five pre-stressed concrete beam bridges and one fill section between 1st Street and 21st Avenue W. Standard bridge clearances will be maintained over Michigan, Superior, and 1st Streets and 20th and 21st Avenues. Pier and/or abutment wall placement will be outside the street right-of-way, similar to existing condition, to minimize permanent impact on local street traffic.

Geometric Improvements

By maintaining separate traffic lanes for the SB I-35 ramp and NB I-535 ramp to NB US 53, the blind merge is eliminated and the weaving distance has been extended to approximately 1,000 feet (nose to nose), allowing ample time and distance for traffic to merge from these routes. In addition, the US 53 mainline profile will be designed to improve a small, existing grade break that lies between Piedmont Avenue and the existing US 53 structure over 20th Avenue W. The profile will be improved with a 260-foot vertical curve between the two grades (approximately 6 to 8 percent) to smooth out the break and make it less distinct.

Other Considerations

- There are a few utilities (water, gas) that cross under the US 53 corridor within 1st, Superior, and Michigan Streets that may need to be reconstructed or relocated during the creek relocation or bridge reconstruction. As noted under Component 1, Coffee Creek may be relocated where it crosses under I-35. Similarly, the segment of the creek that follows US 53 between First and Michigan Avenues will need to be relocated to facilitate bridge construction. Building a new bridge over the 125 year-old tunnel structure was not considered feasible due to difficulty to ensure integrity of the tunnel during construction around it, and the limitations it would create for future access for tunnel maintenance. Coffee Creek follows a stone/brick arch pipe along roughly the centerline of US 53 between 1st Street W and Michigan Street W (approximately three blocks). The tunnel structure was built in 1894 according to city records. Coffee Creek is a designated trout stream. Maintaining the creek/storm tunnel under the existing reconstructed bridges is a concern due to age, maintenance access, and construction impacts. The new alignment is planned within 22nd Avenue West
- Right-of-way will need to be acquired from north of US 53 and west of I-35. In order to avoid a substandard radius on the SB I-35 to NB US 53 movement. If this parcel is not acquired, a design exception would be needed. This parcel is privately owned and has a small storage building.

3.3 Component 3: I-535/Garfield Avenue Interchange

The area surrounding this interchange is a commercial/industrial area with I-535 following the BNSF rail yard on the south side, and Port business and operations on the north side of Rice's Point. I-535 extends from the interchange to the east across the bay into Superior WI via the Blatnik bridge.

3.3.1 Concepts Evaluated

The I-535/Garfield Avenue interchange is the primary access point for the Port of Duluth-Superior, including the Clure Public Terminal, the Duluth Intermodal Terminal, and other growing freight-related

businesses along Garfield Avenue. This interchange was constructed in 1969, and it has geometric deficiencies that lead to recurring congestion and crashes that lead to non-recurring congestion. It also has weight restricted bridges that restrict access to I-535, I-35, and US 53 for oversize/overweight loads to and from the Port of Duluth-Superior (see Table 1).

There were three approaches to this interchange under consideration: reconstructing the bridges in place, rehabilitating the bridges in place, or reconfiguring the interchange.

Four options were initially developed for reconfiguring the interchange. Two of the four extended outside of MnDOT's right-of-way and were quickly eliminated from further consideration based on discussions with BNSF. The two remaining reconfiguration concepts, Concepts 1 and 2, are contained within the existing right-of-way but changed the location of the existing portals for the railroad. The layouts for these concepts are included in Appendix C. Concept 1 applies a traditional diamond-type interchange to reduce the sweeping curved ramps. This concept would have increased the grade from I-535 to the Blatnik Bridge, making it difficult for trucks accelerating from this interchange and would also have provided stop locations in a currently free flowing interchange. Concept 2 applies a buttonhook design to reduce tight curves with less additional bridge area. For this concept, the decision distance from NB I-535 would have been very short. Concepts 1 and 2 have also been eliminated based on railroad concerns. Therefore, these bridges will be reconstructed in the current configuration with some widened ramps to facilitate maintenance. Analysis of the existing structures will determine whether rehabilitation is an option or if new structures will be built.

3.3.2 Recommended Concept Description

Structural Improvements

The I-535/Garfield Avenue interchange includes Bridge 69808, which carries I-535 over Garfield Avenue, along with Bridges 69808A and 69809 that are ramp bridges that provide local access to Garfield Avenue. The bridges were modified in a previous repair project in the early 1990s and are currently being studied in detail to investigate potential rehabilitation alternatives compared with replacement in-kind. These bridges are continuous steel beam type structures but include variable depth beams with hinges located within the spans. The complex framing of the gore areas within these bridges, where the ramp bridges frame into the main bridge, require detailed and time-consuming analysis for determination of potential rehabilitation alternatives. A preliminary bridge rating investigation is underway that will lead to a better understanding of the potential for rehabilitation of the superstructure. The determination of rehabilitation of the beams or complete replacement of the beams on the existing piers is currently being evaluated, along with complete replacement of these bridges.

The piling that supports the piers and abutments of these bridges were constructed with pile driving equipment that is much lighter and delivered less energy to drive the foundation piles than that used for current modern pile driving operations. The pile hammer used for the original construction is not within the range required for conversion to LRFD pile capacities. A separate contract is currently underway to drive additional test piles near adjacent piers of the existing bridges to gather LRFD pile capacities that will be used in further assessment of the piles capacities that may be used in conjunction with the rehabilitation alternatives. The pile load test data will also be useful for determination of re-using the existing piles, together with additional piles that may need to be added to new bridge footings for the case of the complete bridge replacement alternative.

I-535 spans over a BNSF spur track on Bridge 69810. This bridge is a continuous steel beam type bridge that is planned to be rehabilitated with the TPI Reconstruction Project. Preliminary analysis indicates that the beams at the outer edges of the bridge deck could be modified by adding additional steel bracing (diaphragms) at the piers to provide lateral support to the fascia beams that will increase the bridge capacity to carry AASHTO LRFD HL-93 Design Loads and MnDOT LRFD Permit Vehicles. OSOW loads will also be included in further study of rehabilitation needs. Further investigation into pier cap

strengthening and other repair needs are also included in the ongoing rehabilitation study that is underway for Bridge 69810.

Geometric Improvements

There are existing horizontal sight distance issues and vertical clearance deficiencies at this interchange. There are also existing sight distance restrictions on ramps at this interchange and roadway width issues on northbound and southbound Garfield Avenue that result in any maintenance or broken-down vehicles blocking most of the road section and impacting traffic flow. With the pavement and bridge rehabilitation, the existing vertical deficiencies will be corrected to maintain a minimum 40 mph vertical design speed on all ramps. Minor roadway widening on Garfield Avenue will occur to maintain a minimum 22-foot width (curb face to curb face) to allow vehicles to get around obstructions.

Other Considerations

- Stormwater management
 - Given the interchange bridges will be constructed essentially in kind, minor changes in impervious surface will result, thus no new stormwater management is expected for this component. However, improved drainage and treatment around the structures will be evaluated in the Categorical Exclusion.

3.4 Other Improvements Considered

3.4.1 Concepts Evaluated

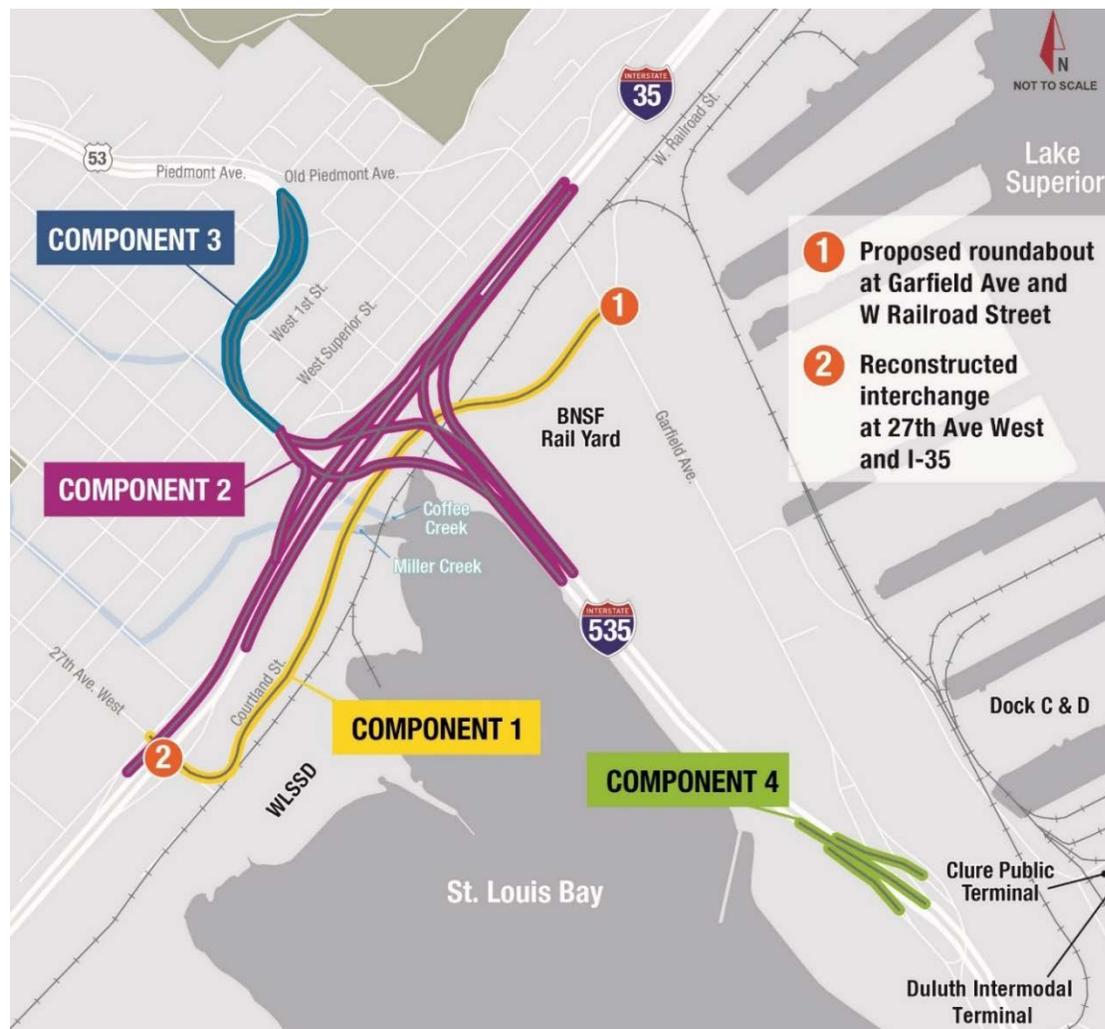
Courtland Street Connection

As MnDOT began evaluating the need for the TPI Reconstruction Project, several project partners identified the need for a local street connection between the 27th Avenue West interchange and Garfield Avenue/Railroad Street, parallel to I-35. This connection would serve oversize/overweight loads and local and tourist traffic, acting as an alternate route for I-35 during present and future construction and peak traffic events. It would also provide benefits during construction, maintaining access to parcels that would otherwise be landlocked and providing a reliever route for local traffic to divert from the I-35 mainline. There was also an interest in providing a pedestrian trail connection under I-35 near 19th Avenue West to link the Cross City Trail to the Lakes Trail to the proposed Courtland Street Connection road.

Initially, one concept was developed that would extend the existing Courtland Street north under the I-35/I-535/US 53 interchange bridges, across the BNSF rail yard, and tie in to Garfield Avenue at Railroad Street (see Component 1 on Figure 5 and the layout in Appendix D). This concept was shared with BNSF, who raised concerns about the road severing an area of land they have slated for potential future expansion. To address BNSF's concern, 10 new concepts were developed. These concepts presented options for shifting Courtland Street closer to I-35 and tying in to Railroad Street instead of Garfield Avenue. BNSF was also very concerned with safety issues of adding any sort of pedestrian traffic across its' yard and tracks.

These 10 concepts were narrowed down to four (Concepts G, F, H, and P) as MnDOT worked to address BNSF's concerns and contamination that was identified in the rail yard (see layouts in Appendix D). At a meeting with BNSF on February 1, 2018, all four concepts were eliminated from further consideration as they all crossed through known high risk contamination and archaeologically sensitive areas and/or were not supported by BNSF due to impacts to their tracks or rail yard.

Figure 5: Project Components with Courtland Street Connection



Railroad Street Connection

After the Courtland Street connection was found to be not feasible, MnDOT identified a route on the west side of I-35 that could also provide an alternate parallel route to I-35 and enhance local access between the Lincoln Park neighborhood and downtown Duluth (see Appendix E). This route could follow 27th Avenue W to Michigan Street/Lower Michigan Street until W Superior Street where there would be a new roundabout that would allow for easy turning for vehicles that want to access Railroad Street via the existing Garfield Avenue overpass. Additionally, the 27th Avenue West bridge over I-35 would be restriped to three lanes, but no other improvements would be made to the roadway between 27th Avenue West and just south of the roundabout. The proposed improvements are shown on a layout in Appendix E.

An additional option was considered that added a fourth leg to the roundabout that crossed over I-35 and touched down at Railroad Street, where vehicles could turn left and continue to the downtown area or turn right get to Garfield Avenue and the port terminals. The estimated cost of a bridge over I-35 (\$10 million) has resulted in this option being dropped.

3.4.2 Proposed Traffic Mitigation

Improvements

Pavement improvements will be implemented on 27th Avenue West, Garfield Avenue and Railroad Street. These improvements will generally consist of pavement repair and restriping of lanes. At the intersections of 27th Avenue/Michigan Street and Garfield Avenue and Railroad Street minor intersection improvements will also be made to provide for clearer channelization of traffic. No pavement widening is required for any of these improvements, with all work essentially being conducted within the existing curb line.

Other Considerations

A number of open space areas within the right of way or near the project were initially identified as potential locations for construction staging. Some of these areas have been eliminated as potential staging areas due to known contamination issues, potential cultural resource issues, and/or ownership concerns. A short list of sites that may be considered for laydown areas is shown in Appendix J. These areas will be further discussed in the Categorical Exclusion with the assumption that no grading, vegetation removal or construction will occur on the parcels. Activities in these areas is expected to be limited to storage of construction materials and equipment, and construction access,

4 Public Engagement

4.1 Stakeholder Meetings and Public Open House

In October 2017, a series of stakeholder meetings was held to review and solicit input on concepts, provide an overview of the funding process and possible construction schedule, and ask for help in distributing open house notices to local organizations. Meetings were held with the following stakeholder groups:

- City of Duluth
- City of Superior
- Lincoln Park businesses
- Lincoln Park residents
- Lincoln Park warehouse/wholesale businesses
- Port and industry
- Railroad Street and Courtland Street businesses
- Tourism

An open house was then held on November 13, 2017 to provide an update on the project and receive input on the proposed interchange concepts from the general public.

A summary of the comments received at the stakeholder meetings and public open house is provided in Appendix F.

4.2 Travel Survey

An online survey was posted on the project website between November 13 and December 11, 2017, and 881 responses were received. This survey asked questions about frequency of travel through the TPI, purpose of travel through TPI, experience with congestion, and priorities for the reconstruction project. A summary of the results is provided in Appendix F.

4.3 Monthly Update Meetings

MnDOT began holding monthly update meetings in January 2018 to provide the public with regular project updates and receive feedback as the project continues to evolve. Two identical sessions are held

at different times of day to reach a broader audience. The presentations from these meetings are posted on the project website.⁸

4.4 Stakeholder Advisory Committee

A stakeholder advisory committee was formed in early 2018 to advise MnDOT on interchange design refinements and bring forward community input on local elements that will be integrated into the project. The advisory committee includes representatives from the following stakeholder groups:

- Lincoln Park Business Association
- Housing & Redevelopment Authority of Duluth
- Visit Duluth
- Garfield Avenue businesses
- Duluth Seaway Port Authority
- Duluth Superior Transportation Association
- Wisconsin Department of Transportation
- Superior Business Improvement District
- Superior Chamber of Commerce
- City of Duluth
- Ecolibrium 3
- Duluth Entertainment Convention Center
- Western Lake Superior Sanitary District
- Duluth Bikes
- Duluth Transit Authority
- Duluth-Superior Metropolitan Interstate Council
- Lincoln Park residents

4.5 Railroad Coordination

BNSF owns, operates, and leases much of the rail that parallels I-35 and I-535, and extends through the rail yard on Rice's Point. MnDOT initiated conversations with BNSF regarding the potential concepts being considered and listen to any concerns it may have. Three meetings have been held to date, with another scheduled for late July 2018. The first two meetings focused on the potential for an extension of Courtland Street across the rail yard. BNSF outlined its primary concerns as:

- Rail operations are important – Courtland Street cannot impede upon existing operations
- Maintain green space – BNSF desired to maintain the integrity and marketability of the parcels immediately adjacent to Garfield Avenue
- Environmental – The property has long been used for rail operations with known contamination risks that should be avoided when possible
- Planned improvements – Courtland Street concepts would need to accommodate planned improvements with the rail yard such as a profile increase to reduce flooding risks, an additional track, and a maintenance road
- Pedestrian access/safety – Safety is a paramount concern of BNSF including restricting access to the public

After the second meeting it was clear that none of the Courtland Street concepts would fit the needs of BNSF or would require impacting areas with substantial contamination issues. Therefore, focus shifted to the I-35 ramp bridges over the tracks, pier placement, and construction staging. Additionally, temporary shoo-fly track alignments were discussed at subsequent meetings to allow for reconstructing the creeks

⁸ <http://www.dot.state.mn.us/d1/projects/twin-ports-interchange/meetings.html>

under existing tracks and bridges over the tracks with minimal interruption to rail operations. Discussion is ongoing to define agreeable terms and conditions for construction.

5 Next Steps

Once the project definition is finalized, design will advance and environmental documentation will be completed. Construction for the Local Street Improvements is currently scheduled to begin in the summer of 2019 with the interchange component construction beginning in 2020 and lasting three to four years.

Figure 6: Project Schedule

