

Record of Meeting

SRF No. 11648

Location: SRF Consulting Group – Great Plains Conference Room

Client: Fargo-Moorhead Metro COG

Date: 1/8/2020

Subject: SRC Meeting #6

Attendees: Michael Maddox (Metro COG), Cindy Gray (Metro Cog), Kristie Leshovsky (City of Moorhead), Jonathan Atkins (City of Moorhead), Mary Safgren (MnDOT), Tom Lundberg (MnDOT), Bryan Christensen (MnDOT), David Leonard (MSUM), Derrick LaPoint (DMI), Lori VanBeek (MATBUS), Leif Garnass (SRF), Chris Dahl (SRF)

Purpose of Meeting:

Update the SRC on the study progress, discuss draft report and schedule for study completion, and begin discussions on Round 3 of engagement. Meeting materials are attached.

Summary of Meeting:

1. Schedule Update
 - a. Updated study schedule was reviewed by the SRC. Need to consider moving the City Council update to 3/9, which would still allow it to take place before the Metro COG TTC meeting scheduled for 3/12. **Action Item:** SRF to review schedule with Metro COG and determine if updates are needed regarding the City Council update.
 - b. SRF to present study findings to MnDOT management prior to issuing the findings to the public in Round 3 engagement. **Action Item:** SRF and MnDOT to coordinate date/time for meeting with MnDOT management. This meeting will be a Skype meeting.
 - c. Downtown Moorhead Inc. is planning engagement for their master plan study the week of 2/6. Consider having information available at this event.
 - d. MnDOT is planning to complete the environmental documentation (non-programmatic) for the 11th Street grade-separation in Spring 2020.
2. Draft Study Report
 - a. SRF led discussion on the outline and contents of the working copy of the draft report. The group offered the following input:
 1. Increase use of graphics where applicable.

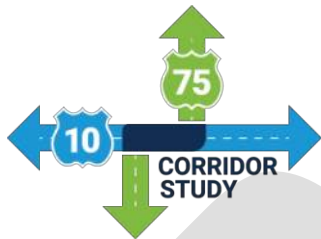
2. Expand on the non-technical discussion regarding purpose and need. Focus on “what are we trying to get out of this study.”
 3. Expand on how “vision” aligns with and addresses the purpose and need.
 4. Expand on how other studies and projects are integrated into the draft report. Tie together the “big picture.”
 5. For the 11th Street grade-separation, ensure this study documents that the grade-separation influence is a “snapshot in time” relative to status and how it influences the overall visions of the corridors.
 6. Expand on the integration of the 12th Avenue study recently completed. SRF can work with Metro COG to obtain any needed electronic files.
 7. Expand on pavement need in purpose and need, where applicable.
 8. Ensure study documentation (including graphics) clearly define limits of the future planned projects.
 9. Expand on the recommendation to use adjacent corridors for ped/bike routes.
 10. Review recommendations from MnDOT’s ped/bike unit and integrate into study where applicable. Follow-up with MnDOT to discuss what’s not moving forward.
 11. Add language that findings from this study can be used in NEPA to help tell the story regarding what alternatives were reviewed and not recommended to be carried forward. This study will identify locally recommended visions for the corridors.
 12. Include engagement summaries that have already been developed.
 13. Expand on surveys that were completed and their findings.
 14. Include language that the concepts are planning level only and are not to be taken as engineering drawings. SRF to confirm language with Metro COG.
 15. No aesthetics manual has been developed for the 2025-2026 reconstruction projects.
 16. Drawings should correlate to the typical shown. It was suggested to show plan and typical views on same graphic, one above and one below.
 17. Make sure drawings are legible and ADA accessible.
 18. Body of report should focus on “major” changes resulting from the corridor visions.
 19. Revise typical sections to be more illustrative in nature.
 20. Include discussion on the traffic signal warrants analysis where new traffic signals are being proposed.
- b. Discussion on Downtown focus area alternatives:
- i. Recommendation for 3-lane roadway with on-street parking on Center Avenue between 8th Street and 11th Street is supported by the future vision of development for this area. Conversion to a 3-lane will take place following the jurisdictional transfer of US 10/75 to Main Avenue to the City of Moorhead.

- ii. There is a strong desire for a 3-lane roadway on Main Avenue from the River to 8th Street. While traffic operations indicate potential issues, the SRC wants to include pros/cons/risks of doing the conversion. Larger area transportation changes could reduce traffic levels along this stretch, but true traffic demand won't be able to be determined until traffic "balances out" following current construction projects that are influencing traffic volumes.
 - iii. Study needs to include recommendations for access restrictions in downtown.
 - iv. Need to include transit stops in drawings and further discussion on impacts to transit, including potential options for changes to bus stops.
 - v. SRC agreed a 3-lane roadway on 8th Street between Center and Main Avenue would be challenging due the short intersection spacing.
- c. Discussion on US 10 East focus area alternatives:
- i. Four options are being considered for maintaining the truck inspection site, which is a desire of the State Patrol. Consensus was not obtained for a preferred option, additional vetting is necessary.
 - ii. Need to assume future grade-separation for peds/bikes crossing US 10/75 at or east of 1st Avenue/21st Street.
- d. US 75 South Focus Area Alternatives
- i. Need to include drawings of all options for the 2nd Avenue intersection as consensus was not obtained, additional vetting is necessary. This includes having an option that restricts all movements except the northbound left-turn.
 - ii. A traffic signal is being proposed at the 4th Avenue intersection. Need to confirm if/when traffic signal control would be warranted.
 - iii. Need to include further discussion on City's traffic count findings at 2nd Avenue.
- e. MnDOT's pedestrian and bicycle unit provided their report published in December 2019 that included recommendations for the US 10/75 corridors. Snow removal is typically a concern with various ped/bike recommendations and needs to be considered as part of this study. **Action Item:** SRF to review recommendations and develop plan for how to incorporate recommendations (or reject certain elements) and follow-up with MnDOT to coordinate the plan.
3. Draft Intersection Control Evaluation (ICE) Reports
- a. Discussion on the draft ICE findings for the 8th Street (US 75)/20th Avenue and US 10/75 intersections were included as part of the draft report discussion. Draft reports will be provided along with the overall study report.
4. Public & Stakeholder Engagement
- a. Round 3 engagement was discussed. The current plan is to conduct a public open house to "inform" the public regarding the study recommendations; comments and input will be documented, though. **Action Item:** SRF to review current approach and recommend any modifications.

- b. Need to determine best way to advertise event to maximize exposure. **Action Item:** SRF to develop a plan to advertise the open house, including using preexisting email lists. SRF to confirm the required “notice” lead time documented in Metro COG’s engagement plan.
- c. Other potential tools were discussed, such as Pop-Up meetings and a social media blitz (also need to link to social media for all agencies). This worked well for Round 2 engagement. **Action Item:** SRF to develop plan and share on-line video used on another project.

Actions Needed:

Actions Needed	Responsibility	Status
Review schedule and determine if updates are needed regarding the City Council update.	SRF/Metro COG	In progress
Coordinate date/time for meeting with MnDOT management. This meeting will be a Skype meeting.	SRF/MnDOT	Complete
Review recommendations and develop plan for how to incorporate recommendations (or reject certain elements) and follow-up with MnDOT to coordinate the plan.	SRF/MnDOT	In progress
Review current engagement approach and recommend any modifications.	SRF	In progress
Develop a plan to advertise the open house, including using preexisting email lists. Confirm the required “notice” lead time documented in Metro COG’s engagement plan.	SRF	In progress
Share on line video used on another project.	SRF	Complete
Revise Draft report and submit to SRC for review	SRF	In progress



US 10 / US 75 Corridor Study Moorhead, MN

January 6, 2020

Fargo-Moorhead Council of Governments (Metro COG) and its partners, the Minnesota Department of Transportation (MnDOT), City of Moorhead, Downtown Moorhead, Inc. and MATBUS, completed a study of the US 10 and US 75 corridors in Moorhead. The purpose of the study was to develop context-sensitive solutions for the corridors that balance the needs of the City of Moorhead with area stakeholders and users. Ultimately, the study developed corridor visions along US 10 and US 75 that enhance the corridor environment for all users, guide future studies, and set the framework for MnDOT's 2025-2026 reconstruction project.



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Report prepared by:



Study partners:



Study Review Committee (SRC):

Michael Maddox – Metro COG
Mary Safgren – MnDOT District 4
Justin Knopf – MnDOT District 4
Kristie Leshovsky – City of Moorhead
Jonathan Atkins – City of Moorhead
Lori VanBeek – MATBUS
Derrick LaPoint – Downtown Moorhead, Inc.
David Leonard – Minnesota State University Moorhead
Leif Garnass – SRF Consulting Group
Chris Dahl – SRF Consulting Group

About the Study

Highlights:

- Study partners included Fargo-Moorhead Metro COG, MnDOT, City of Moorhead, Downtown Moorhead, Inc., and MATBUS.
- Purpose of the study was to develop context-sensitive solutions for the corridors that balance the needs of the City of Moorhead with area stakeholders and users.
- Study was conducted in three phases with a focus on working with various stakeholders and providing numerous opportunities for community input.
- Land uses that serve the US 10 and US 75 corridors vary significantly. Three focus areas (Downtown, US 75 South, and US 10 East) were defined to ensure the right users were being prioritized based on the characteristics of each area.
- Visions along US 10 and US 75 will guide future studies and set the framework for MnDOT's 2025-2026 reconstruction project.

Fargo-Moorhead Council of Governments (Metro COG) and its partners, the Minnesota Department of Transportation (MnDOT), City of Moorhead, Downtown Moorhead, Inc. and MATBUS, completed a study of the US 10 and US 75 corridors in Moorhead. The purpose of the study was to develop context-sensitive solutions for the corridors that balance the needs of the City of Moorhead with area stakeholders and users. Ultimately, the study developed corridor visions along US 10 and US 75 that enhance the corridor environment for all users, guide future studies, and set the framework for MnDOT's 2025-2026 reconstruction project.

These corridors were studied in 2013 and subsequent roadway rehabilitation and pedestrian and bicycle improvement projects were completed. As the nature of development and redevelopment with more mixed commercial and residential uses has changed in Moorhead with a focus on promoting an environment where residents work, live, and play, developing visions with community input that balance the needs of all users will inform MnDOT as they plan for the full reconstruction of both US 10 and US 75.

Prior to the reconstruction project, it is anticipated jurisdictional transfer of US 10 and US 75 from the existing jurisdiction along 8th Street (between Main Avenue and Center Avenue) and along Center Avenue (between 8th Street and 11th Street) to a future jurisdiction along Main Avenue (between 8th Street and 11th Street) and along 11th Street (between Main Avenue and Center Avenue) will occur. This transfer is expected to occur regardless of if or when 11th Street has grade-separated railroad crossings between Main Avenue and Center Avenue (BNSF KO Subdivision) and between Center Avenue and 1st Avenue (BNSF Prosper Subdivision).

Study Goals

This study looked at balancing the needs of motorized and non-motorized traffic with business access, while considering the effects of changes on Main Avenue in downtown Fargo and what it means for traffic traveling across the Red River through downtown Moorhead. Community and stakeholder input were key in informing the future visions of the corridors. The study was guided by the following goals in which the recommended vision:

- Provides roadways that fit land use (i.e., appropriate access and design).
- Accommodates appropriate users (i.e., complete streets).
- Creates an environment to stimulate growth.
- Provides flexibility for near and long-term transportation needs.
- Improves "Gateway" feel for US 10 and US 75 corridors.
- Develops and executes a project that meets the needs for 30+ years.

Focus Areas

Land uses that serve the US 10 and US 75 corridors vary significantly. As a result, a “one size fits all” approach will not accomplish the goals of the study. Thus, three focus areas were defined based on the type of land uses that exist today and what is being considered in the future. The purpose of identifying the focus areas was to ensure the right users were being prioritized based on the characteristics of each area. Figure 1 depicts the following focus areas identified for this study:

- **Downtown** – Central business district with commercial and residential uses.
- **US 75 South of Downtown** – Residential and institutional uses.
- **US 10 East of Downtown** – Commercial and industrial uses.

Further details regarding the characteristics, needs, priorities and visions for the three focus areas are included in later sections of this report.

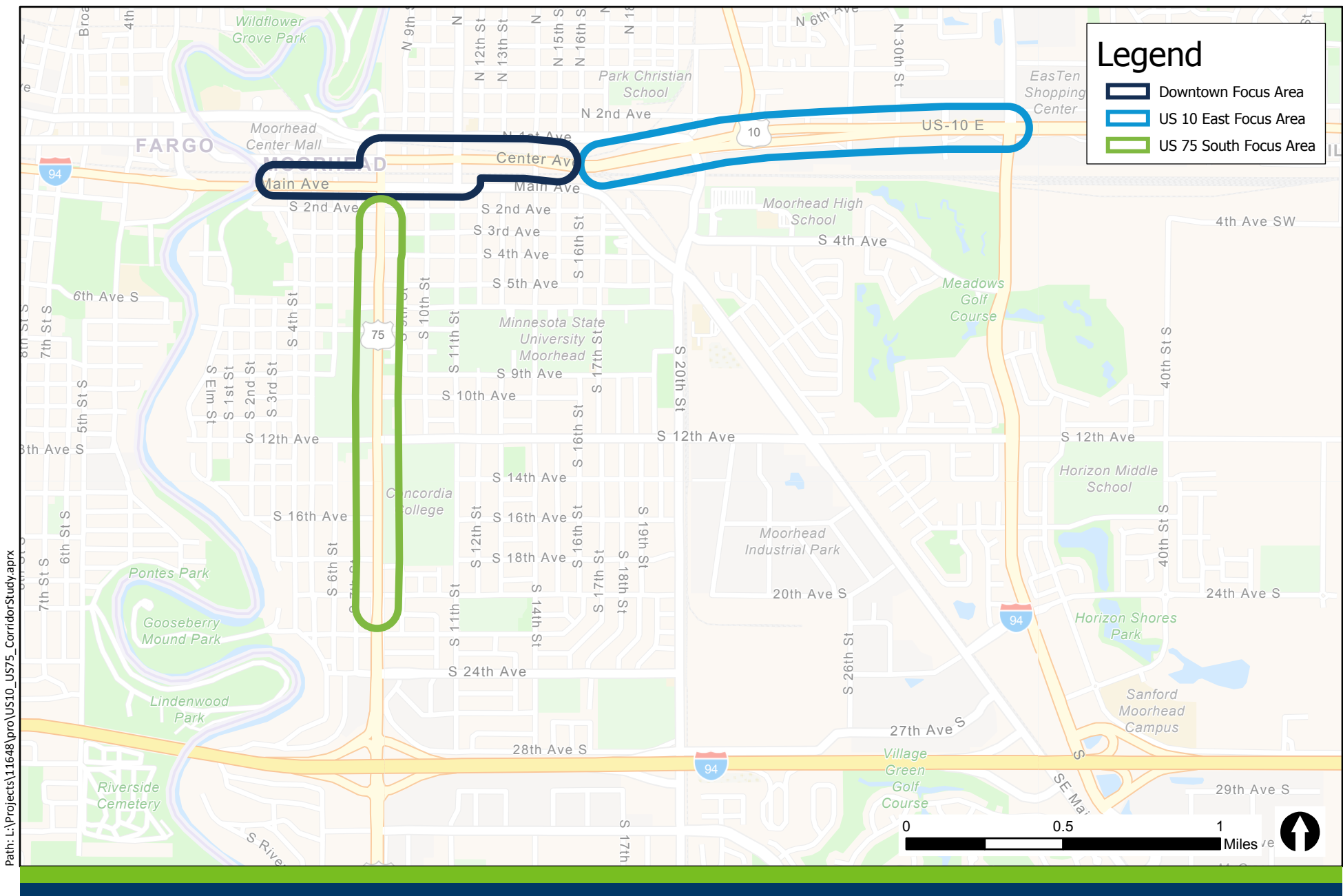
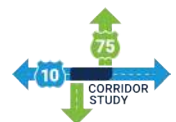


Figure 1: Focus Areas

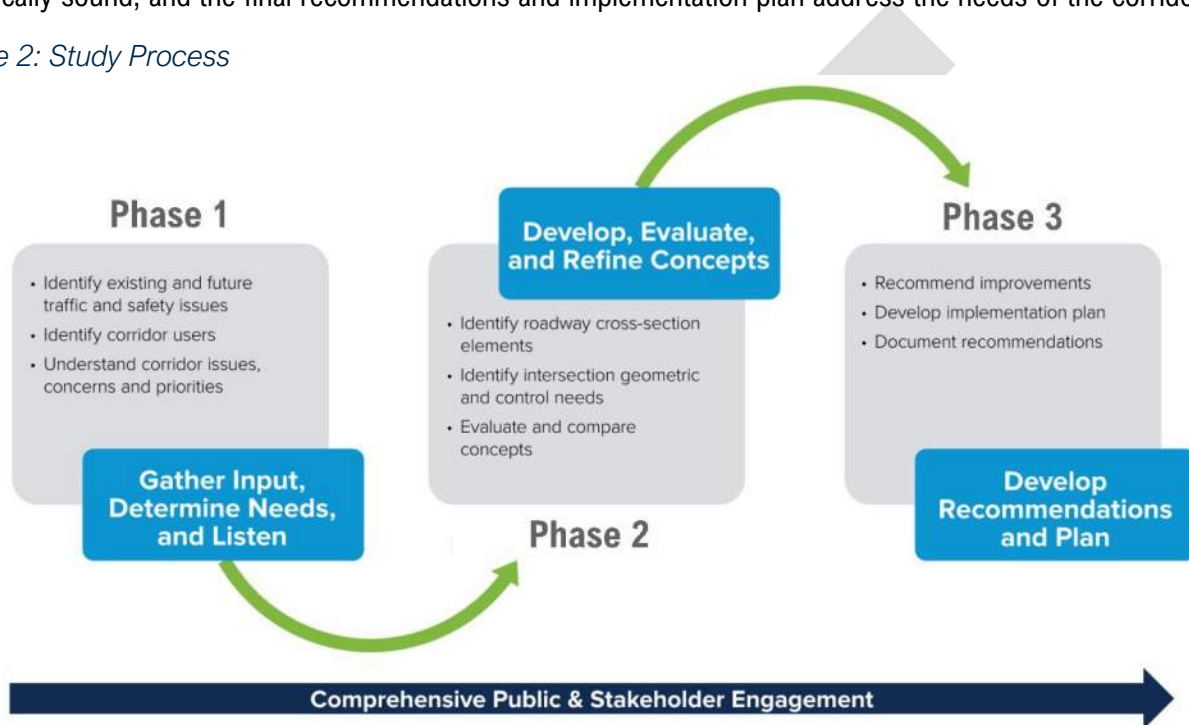
US 10 / US 75 Corridor Study



Study Process

The study was conducted in three phases as illustrated in Figure 2 with a focus on working with various stakeholders and providing numerous opportunities for community input. Guidance and decision-making were led by a Study Review Committee (SRC) consisting of the study partners of Metro COG, the City of Moorhead, Downtown Moorhead, Inc., MnDOT and MATBUS. The SRC played a key role in ensuring data needs were accommodated, issues were heard and vetted, that alternatives developed are feasible and the evaluation was technically sound, and the final recommendations and implementation plan address the needs of the corridors.

Figure 2: Study Process



Phase 1 included developing the purpose and need for the project along with the identification of issues and priorities. This included reviewing previous area studies, collecting traffic counts and conducting an evaluation of the area's crash history and land use and development plan. An important outcome of this phase was to develop an understanding on how both US 10 and US 75 function today and what future changes may influence the corridors. Engagement in this phase focused on gathering input, determining needs and listening. Ultimately, this initial phase set the foundation for understanding corridor issues, concerns and priorities.

Phase 2 included identifying potential roadway cross-sectional elements that could fit within the existing right of way, intersection control alternatives at key intersections, pedestrian and bicycle enhancements, and geometric and access alternatives along both corridors. Alternatives were evaluated and compared to determine their effectiveness in meeting the purpose and need of the project. Potential environmental risks were also identified. Engagement in this phase focused on gathering the community's support for the range of alternatives as well as general input regarding their suggestions for improvement.

Phase 3 included development of the recommended corridor visions along with an implementation plan to phase-in the reconstruction of the corridors. Engagement in this phase focused on education of the study outcomes, feedback on how the community's input was used to inform the visions and next steps.

Understanding Existing Conditions

Highlights:

- Existing traffic operational issues were identified at the Center Avenue (US 10)/30th Street, 8th Street (US 75)/2nd Avenue, and 8th Street (US 75)/4th Avenue intersections.
- Existing safety issues were identified at the Center Avenue (US 10)/34th Street and 8th Street (US 75)/2nd Avenue intersections. Safety issues were also identified along Main Avenue (US 10) from the River to 9th Street and along Center Avenue (US 10) from 21st Street/1st Avenue to 34th Street.
- All study segments except Center Avenue (US 10/75) from 14th Street to 21st Street/1st Avenue exceed the standard with respect to access density (i.e., number of access points per mile).
- There is an existing gap in the pedestrian/bicycle network along Center Avenue (US 10/75) between the 11th Street and 21st Street/1st Avenue intersections. Shared use trails are provided along 8th Street (US 75) south of 12th Avenue on the east side of the road and along Center Avenue (US 10) east of 28th Street.
- MATBUS transit routes operate along or across the US 10 and US 75 study corridors.
- Land uses along the corridors vary. Main Avenue (US 10/75) includes low- and high-density residential, low-density office, service, light industrial and commercial land uses. BNSF's KO and Prosper Subdivisions line the north and south sides of Main Avenue/Center Avenue (US 10/75). East of downtown there are commercial land uses. South of downtown includes low- to mid-density residential and institutional land uses, and downtown office, service and commercial uses.
- Pavement condition ratings and the "year of need" for improvement were reviewed. Year of need for Main Avenue (US 10) is 2021. Year of need for Center Avenue (US 10) is 2026. Year of need for 8th Street (US 75) ranges from 2022-2026.
- Existing utilities (i.e., lighting, drainage/storm sewer, sanitary sewer, watermain, and private utilities) were documented.
- Preliminary archaeological, cultural, and historic resources near the US 10 and US 75 corridors were documented.

To set the foundation for the purpose and need of the project, an understanding of the existing conditions was needed. This included reviewing previous studies and projects completed (and those currently in progress); evaluating the traffic, safety and access functionality of the corridors, including the influence of freight rail operations; reviewing pedestrian and bicycle facilities, transit considerations, and land use; understanding existing roadway design characteristics and utilities; and, understanding historical resources that will need to be considered as the reconstruction project develops. Details for this section of the report are documented in technical memorandums located in Appendix A and Appendix B.

Study Area History

Previous studies for the corridors led to improvements phased-in over time. In 2013, the US 10 (Red River to Hwy 336), US 75 (20th Avenue to US 10) and Center Avenue (Red River to 8th Street) Corridor Studies were completed. This current study builds on the previous studies with updated data, analysis, concepts, and public and stakeholder engagement to be reflective of the current study goals that will inform MnDOT's 2025-2026 reconstruction project. Since the completion of the 2013 study, the following projects have been completed (or are in progress) impacting travel patterns for the study corridors:

- Fargo 1st Avenue/NP Avenue One-Way to Two-Way Conversion – Modified/Constructed in 2013
- CIMS/Main Avenue Intersection and Pedestrian Improvements – Constructed in 2015
- 12th Avenue/15th Avenue Toll Bridge Transferred – Occurred in February 2015
- I-95/US 75 Diverging Diamond Interchange (DDI) – Constructed in 2016
- Fargo Main Avenue Reconstruction – Constructed in 2019
- Center Avenue Restriping (City plans to restripe Center Avenue between the River and 8th Street to a three-lane facility) – Constructed in 2019

- SE Main Avenue/20th Street/21st Street Underpass – Currently under construction
- Moorhead Grade Separation Study (Year 2014) – Planning study identified 11th Street as the locally preferred location for grade-separating multimodal traffic and the railroad.
- 12th Avenue South Corridor Study – Identified multimodal improvements to the 12th Avenue/US 75 (8th Street) intersection.

Traffic, Safety, and Access

Traffic Analysis

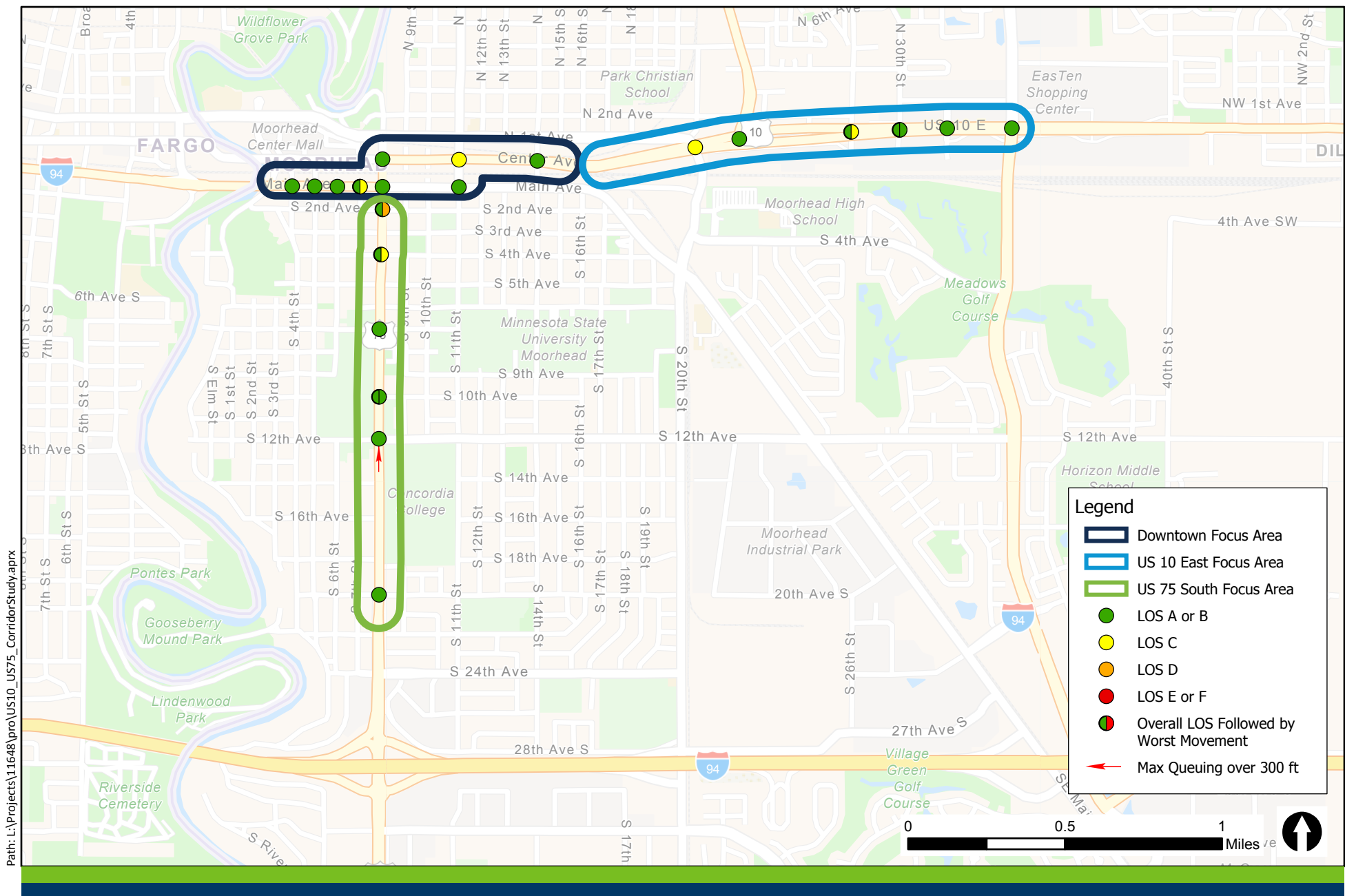
To support the traffic analysis, data for pedestrians, bicyclists, passenger vehicles and transit vehicles/trucks for peak periods (7:00 to 9:00 a.m. and 4:00 to 6:00 p.m.) were collected at intersections not directly impacted by current construction activities or where recent count data was not available. The data was supplemented by counts provided by the City of Moorhead that were previously collected. Short duration counts were also collected to estimate low-volume public or private driveway traffic volumes and patterns.

PTV VISSIM (Version 11.00-02) was used for the analysis since it is an effective tool to analyze how pedestrian and train activity influence traffic operations. Results identify a Level of Service (LOS) which indicates the quality of traffic flow through an intersection. Intersections are given a ranking from LOS A through LOS F based on average delay per vehicle. LOS A indicates the best traffic operation, with vehicles experiencing minimal delays. LOS F indicates an intersection where demand exceeds capacity, or a breakdown of traffic flow. An overall LOS A through D is generally considered acceptable by drivers in the Fargo-Moorhead Area.

For side-street stop-controlled intersections, special emphasis is given to providing an estimate for the level of service of the side-street approach. First, consideration is given to the overall intersection level of service, which considers the total number of vehicles entering the intersection and the ability of the intersection to support these volumes. Second, it is important to consider the delay on the minor approach since the mainline does not have to stop, thus most of the delay is attributed to the side-street approaches. It is typical of intersections with higher mainline traffic volumes to experience high levels of delay (i.e., poor levels of service) on the side-street approaches, but an acceptable overall intersection level of service.

Results of the existing a.m. and p.m. peak hour traffic analysis are illustrated in Figure 3 and Figure 4, respectively. The following operational and queuing issues should be noted:

- **Center Avenue (US 10)/30th Street** – Poor operations are experienced during the p.m. peak hour where the northbound and southbound left-turn and thru movements operate at LOS F. It was observed that a majority of vehicles making these movements do not utilize the intersection as a two-stage crossing. This intersection (unlike the 24th Street, 26th Street, and 28th Street intersections) is not signed as a two-stage crossing (i.e., there is no yield sign in center median). This creates a long crossing distance (approximately 125 feet) for northbound and southbound vehicles making left-turn and thru movements. With this challenge vehicles were observed to reverse or turn around to avoid making the left-turn or thru movement.
- **8th Street (US 75)/2nd Avenue** – The westbound approach operates at LOS E during the p.m. peak hour. Overall, eastbound and westbound left-turn and thru movements are difficult to make during the peak hours. Further, there are existing sight distance issues for the westbound left-turn movement causing vehicles to make aggressive movements.
- **8th Street (US 75)/4th Avenue** – Eastbound and westbound left-turn and thru movements are difficult to make, and the roadway alignment has a reverse curve at the intersection, which is atypical.

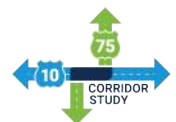


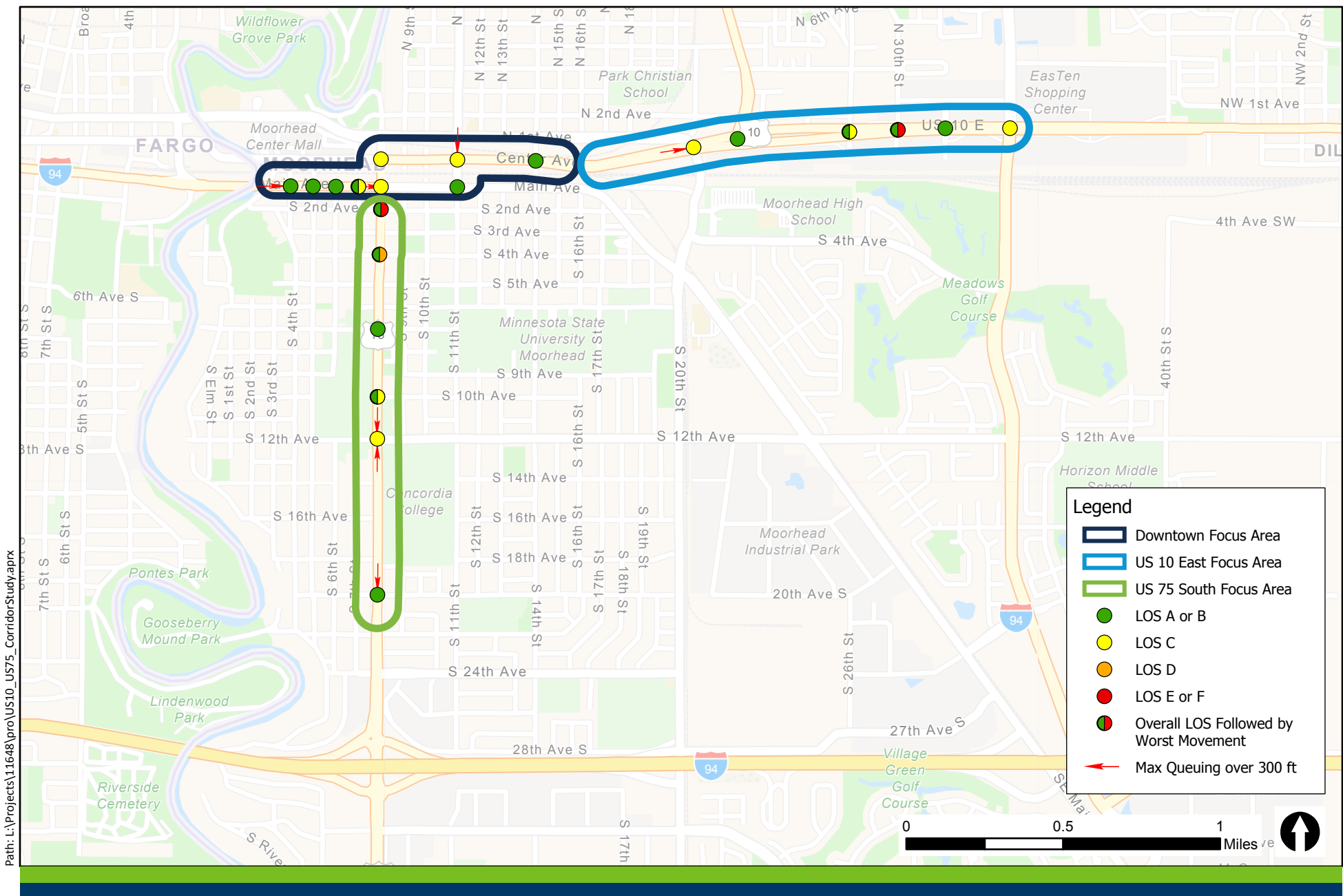
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Figure 3: Existing A.M. Peak Hour Traffic Operations

US 10 / US 75 Corridor Study



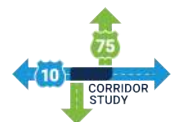


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Figure 4: Existing P.M. Peak Hour Traffic Operations

US 10 / US 75 Corridor Study



Additionally, two BNSF railroad subdivision lines run east/west through downtown Moorhead and they were included in the analysis. The KO line operates between Center Avenue and Main Avenue and the Prosper line operates between 1st Avenue and Center Avenue. Locations where the subdivision lines cross study roadways have flashing light and gate signal systems, are within locomotive-horn Quiet Zones, and have advance pre-emption systems with the adjacent roadway and intersection traffic signal system. Generally during train events, queuing will extend into the adjacent intersections. Once the train event ends (i.e., the gate arms raise), most vehicles can clear in one signal cycle, with a portion of vehicles taking two cycles to clear. Trains along the Prosper Line were observed to travel through the study area for up to 13 minutes. During train events, vehicles were observed to re-route through the study area to avoid the train.

Safety Analysis

Crash history was reviewed based on data from January 1, 2013 through December 31, 2017 (see Figure 5). This included reviewing the specific types of crashes that occur at the intersections and along the corridors. Calculated crash rates (i.e., the number of crashes per vehicles entering the intersection for segment) were compared to typical Minnesota crash rates for locations with similar characteristics. A higher than typical crash rate does not necessarily indicate a significant crash problem, so the critical crash rates were also calculated to determine the statistical significance of the crash rates. If the crash rate is below the critical crash rate, crashes that occurred are typically due to the random nature of crashes and not to a geometric design or traffic control issue. Safety issues were identified at the following locations:

- **Center Avenue (US 10)/34th Street** – 64 crashes were with the majority being rear-end (24 crashes) or angle (25 crashes) type collisions. 11 of the crashes occurred on days when there was snow/slush on the roadway and no severe crashes were reported.
- **8th Street (US 75)/2nd Avenue** – 16 crashes were reported with 11 being angle type collisions and none being severe. Sight distance issues on the westbound approach may be contributing to the crash issue.
- **Main Avenue (US 10) from the River to 9th Street** – 71 crashes were reported with 70 being noted as intersection related. Most of the crashes were rear end (26 crashes) or angle (21 crashes) type collisions with one injury crash. 17 occurred on days when there was snow/slush on the roadway.
- **Center Avenue (US 10) from 21st Street/1st Avenue to 34th Street** – 152 crashes were reported with 148 being noted as intersection related and none being severe. Most of the crashes were rear end (53 crashes) or angle (60 crashes) type collisions. 26 of the crashes occurred on days when there was snow/slush on the roadway.

Access Analysis

The frequency of access points can impact safety (i.e., introduce unnecessary conflict points) and reduce the amount of traffic a roadway can carry. Roadways are classified based on their function and the types of land uses they serve, and the number of access points permitted is based on this classification. Per MnDOT's access spacing guidelines, "it is MnDOT's preference to permit public street connections rather than driveways in urban/urbanizing areas. Where possible, MnDOT should work with local agencies to encourage the development of a supporting road system to serve the property." In the urban core, driveways are permitted in areas where properties have access rights and no reasonable alternative is available for access to a public street.

8th Street (US 75) and Center Avenue (US 10/75) west of 14th Street are classified as urban core. Center Avenue (US 10/75) from 14th Street to 34th Street is classified as urban/urbanizing. Based on these assumptions, all segments except Center Avenue (US 10/75) from 14th Street to 21st Street/1st Avenue exceed the standard with respect to access density (i.e., number of access points per mile).

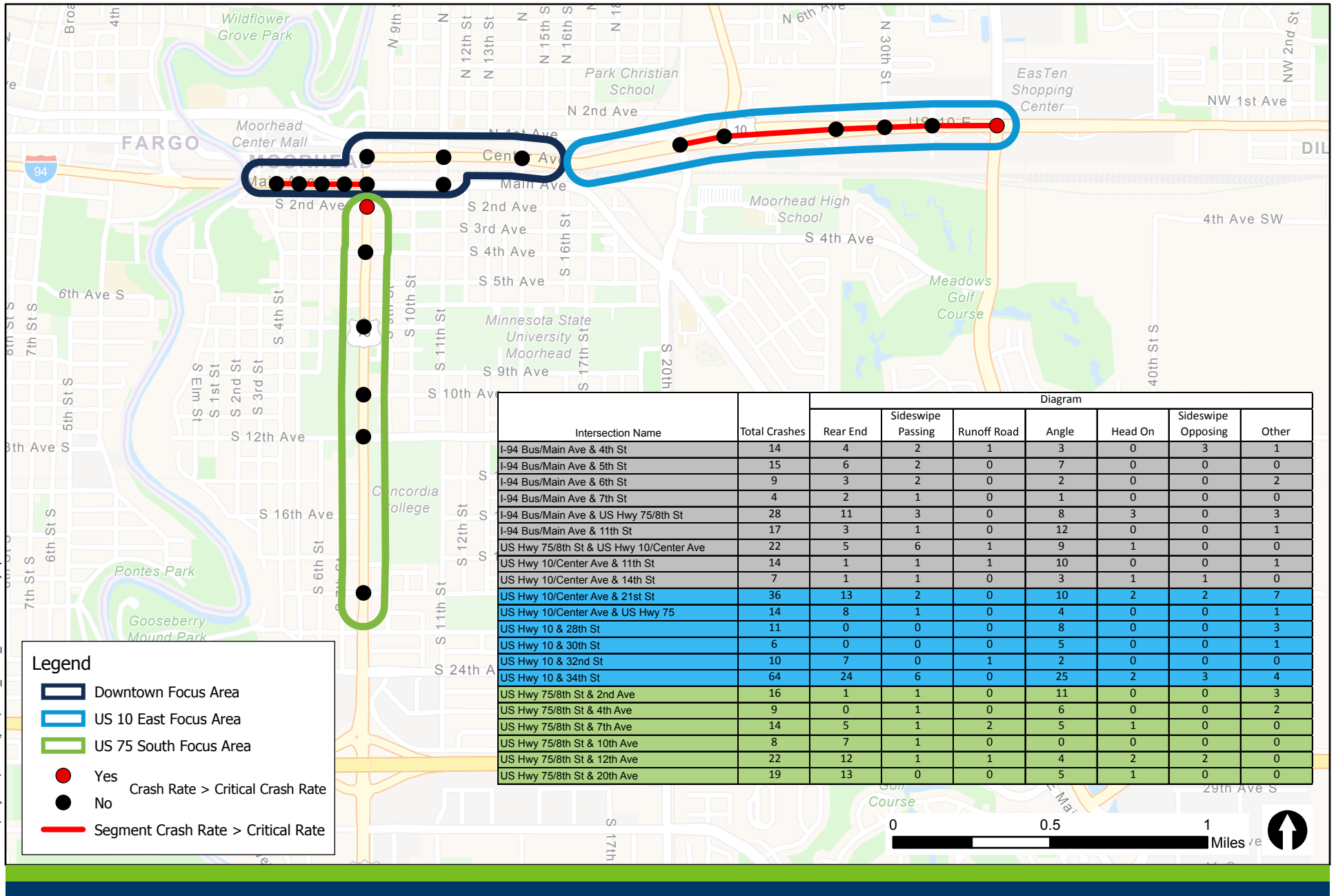
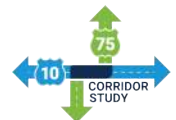


Figure 5: Crash History (2013-2017)



Pedestrian and Bicycle Facilities

Existing facilities for pedestrians and bicyclists were inventoried (see Figure 6). There is an existing gap in the network for both users along Center Avenue (US 10/75) between the 11th Street and 21st Street/1st Avenue intersections. Bicycle facilities (i.e., shared use trails) are provided along 8th Street (US 75) south of 12th Avenue on the east side of the road and along Center Avenue (US 10) east of 28th Street. No other existing or planned trails are included elsewhere along the US 10 and US 75 study corridors.

Transit Considerations

MATBUS operates routes in Moorhead that travel either along or across the US 10 or US 75 study corridors, as shown in Figure 6. Based on information provided by MATBUS, the average dwell time for a bus at a transit stop is 11 seconds. This, however, does increase when a bike or wheelchair loads or unloads.

Land Use

Understanding the existing land use informs the vision by balancing the needs to different and conflicting users. The following summarizes the existing land uses along the US 10 and US 75 corridors. The existing land use zoning map is summarized in Figure 6.

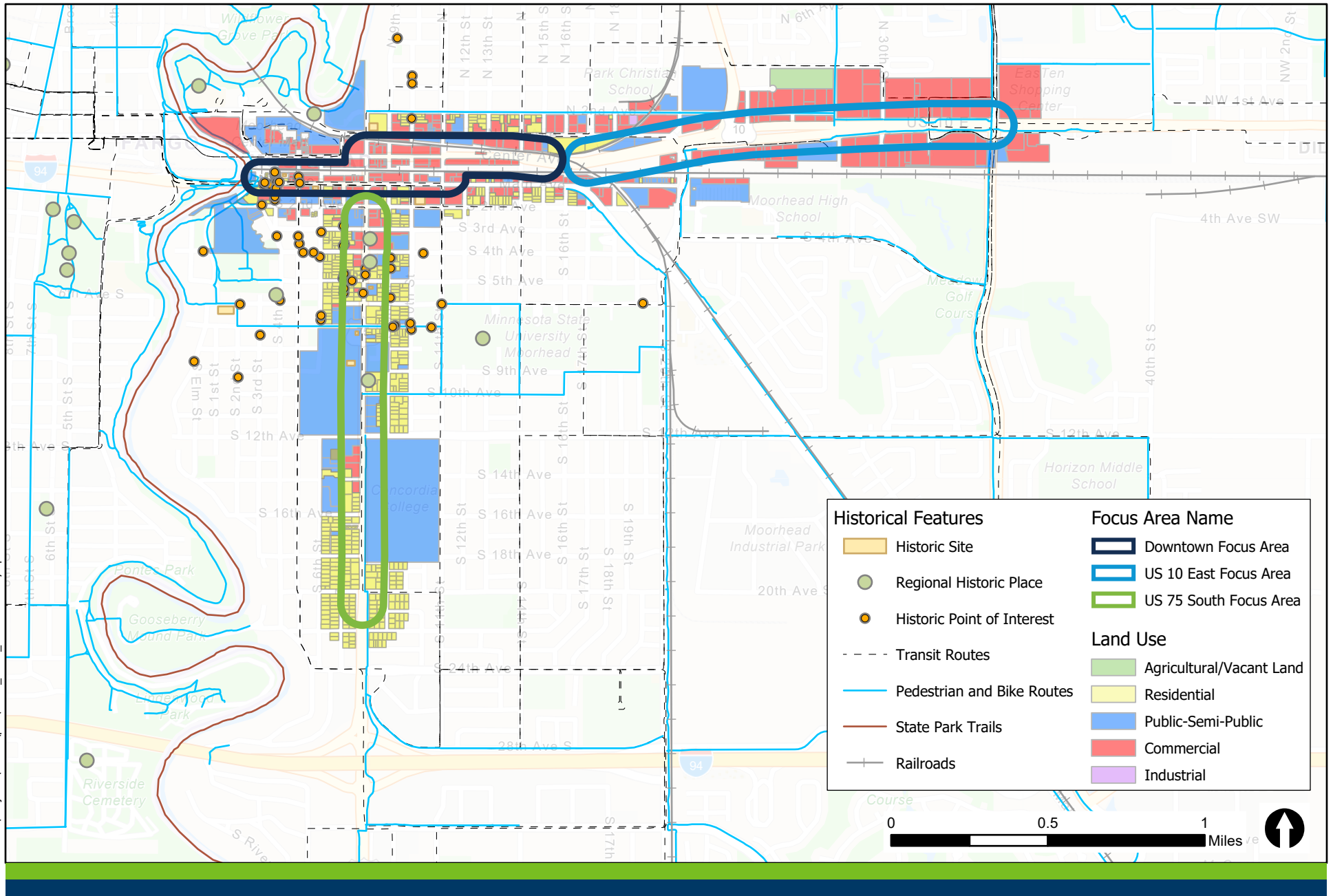
Main Avenue/Center Avenue (US 10/75)

Along Main Avenue (US 10/75) between 4th Street and 11th Street the corridor has a combination of low-density office, service, and commercial land uses. In addition, there are existing high-density residential developments located near 4th Street and additional residential developments currently under construction in the southeast quadrant of the Main Avenue (US 10/75)/8th Street (US 75) intersection, the southwest quadrant of the Main Avenue (US 10/75)/10th Street intersection, and the northwest quadrant of the Center Avenue (US 10)/10th Street intersection. Near 11th Street, it transitions to an assortment of light industrial and light commercial uses.

As previously noted, the BNSF's KO and Prosper Subdivisions also line the north and south sides of Main Avenue/Center Avenue (US 10/75) between 11th Street and 14th Street. The land use pattern, which also includes vacant parcels and a few residential uses, extends through 28th Street. East of 28th Street, there are commercial land uses, such as big box retailers and strip shopping centers.

8th Street (US 75)

Along 8th Street (US 75) between 4th Avenue and 20th Avenue, the corridor consists of low- to mid-density residential and institutional land uses (i.e., Concordia College, churches, and surface parking lots). The existing land uses along 8th Street (US 75) between Main Avenue (US 10/75) and 4th Avenue are largely a combination of downtown office, service and commercial uses. Nearly all parcels adjacent to the 8th Street (US 75) corridor are privately held, excluding the Comstock House site between 5th Avenue and 6th Avenue, which is owned by the Minnesota Historical Society.



Roadway Characteristics

The existing street and highway typical sections and right-of-way were documented. Also, MnDOT performed pavement condition ratings along the study corridor via a Digital Inspection Vehicle that used the severity of transverse and longitudinal cracking, the severity of longitudinal joint distress, and the severity of cracking, rutting, raveling, and patching to determine a surface rating. The scale ranges from 0.0 for very poor to 5.0 for very good. Based on the surface rating, MnDOT estimated an infrastructure improvement “need” year, which is detailed in later sections of this report.

Utilities

Existing utilities (i.e., lighting, drainage/storm sewer, sanitary sewer, watermain, and private utilities) were documented. The existing lighting levels should be investigated with the reconstruction project and compared to current standards. The Downtown and US 75 South focus areas have urban drainage systems and the US 10 East focus area is primarily rural drainage consisting of ditches and culverts. The sanitary sewer system consists of a mixture of large diameter vitrified clay, reinforced concrete, brick, and PVC pipe that drains via gravity to two different lift stations and then from the lift stations to the wastewater treatment facility via forcemain. The watermain for the Downtown and US 10 East focus areas consist of PVC pipe. The US 75 South focus area watermain consists of a mixture of cast iron and PVC pipe. Private utilities in all three focus areas consist of facilities owned by Century Link, Windstream, Sanford Hospital, MnDOT, Enventis, Concordia College, CableOne, 702 Communications, Dakota Carrier Network, Midco, Xcel Energy, Charter Communications, and Zayo bandwidth. These facilities are located within road right-of-way or within utility easements. Corridor improvements will likely impact private utilities and adjustment or relocation could be required.

Historic Resources

Preliminary archaeological, cultural, and historic resources near the US 10 and US 75 corridors were identified through data provided by Metro COG, the City of Moorhead, and National Register of Historic Places. Additional classification of historic districts and sites currently registered on the National Register of Historic Places was also completed. Additional analysis and identification of sites will be completed as part of the environmental documentation phase of the future reconstruction project. This may include discovery of new sites that were not previously identified in any of the above-mentioned resources. Six sites located along the study corridors are registered on the National Register of Historic Places. Three (3) sites of regional historic importance are located within 1/8 mile of the corridors. There are three Moorhead parks and recreation areas located within 1/8 mile of the corridors.

Additional points of interest were identified through data provided by the MN State Historic Preservation Office (SHPO) and the MnDOT Cultural Resources Unit (CRU) in the 2013 Corridor Study. Of the SHPO and CRU points of interest, 37 sites fall within 1/8 mile of the corridors, contained identifiable address data, and are not already registered on the National Register of Historic Places or recognized as a regional historic place. 21 of these places are private residences and 16 are commercial sites. The identification and proper consideration of these sites is necessary to ensure that impacts to known or previously identified archaeological, cultural, and historic resources are minimized as part of the evaluation of the corridor alternatives.

Defining the Purpose and Need

Highlights:

- The purpose and need explain why an agency or agencies are undertaking a project and the main objectives of the project.
- The jurisdictional transfer of US 10 and US 75 from 8th Street and along Center Avenue to along Main Avenue and 11th Street was assumed. This transfer is expected to occur regardless of if or when 11th Street has grade-separated railroad crossings between Main Avenue and 1st Avenue.
- Historical traffic volumes in Moorhead have remained relatively unchanged. Redevelopment growth in Downtown Fargo has significantly increased, but traffic volumes on major roadways have not increased, suggesting that a mode shift has occurred.
- An annual growth rate of one (1) percent is expected; however, based on the review of historical traffic volume trends, one-half (0.5) percent will be considered at intersections/segments with capacity issues.
- It is estimated that with the jurisdictional transfer, approximately 15 percent of motorists will change their route.
- If/when 11th Street is grade-separated, approximately 75 percent of motorists will change their route from the current jurisdiction to the future jurisdiction; however, only 50 percent are expected to change their route during the peak hours due to operational and queuing issues along Main Avenue at the 8th Street and 11th Street intersections.
- All study segments were identified to need pavement quality improvements within 10 years.
- Based on crash history, two study intersections and two segments were identified to have a crash rate above the critical rate; however, all study segments and 18 intersections were identified as being “at risk” locations for safety issues.
- All study intersections currently operate acceptably during the a.m. and p.m. peak hours with two locations identified as having operational issues (i.e., Center Avenue (US 10)/30th Street and 8th Street (US 75)/2nd Avenue).
- Train events impact traffic resulting in poor travel time reliability in the downtown area causing drivers to re-route.
- With future year 2045 traffic volumes and no changes being made other than adjustments to signal timing and the jurisdictional transfer, all study intersections are expected to continue to operate acceptably during the a.m. and p.m. peak hours, but eight intersections are expected to have movements that experience long delays and queuing.
- There is an existing gap in the sidewalk network along Center Avenue (US 10/75) between 11th Street and 28th Street with no connections planned for this gap.

Defining the purpose and need explains why an agency or agencies are undertaking a project and the main objectives of the project. The “need” describes the transportation deficiencies or problems to be addressed by the project. The “purpose” is a broad statement of the primary intended transportation result and other related objectives to be achieved by the project. The purpose and need act as measuring sticks for the project alternatives, helping determine to what extent each alternative meets the project’s needs. Alternatives that do not address the transportation needs of the project and do not meet the purpose of the project are not studied further. Details for the purpose and need are included in Appendices A-D and summarized in this section of the report.

Coordination with Other Studies

There are three other ongoing studies that overlap with the study area of the US 10 / US 75 Corridor Study. The study partners have been coordinating with the project teams of those studies to ensure a cohesive vision and plan for the corridors. Those studies include:

- Downtown Grade Separation Study and Environmental Documentation
- 12th Avenue Corridor Study
- Downtown Moorhead Master Planning

The 12th Avenue Corridor Study has been completed and those recommendations are included in the future corridor vision for the US 75 South focus area.

Traffic Projections

To evaluate how the existing roadway network and alternatives will operate in the long-term, year 2045 traffic forecasts were developed using the Fargo-Moorhead Regional Travel Demand Model, which accounts for planned roadway and land use within the area, as well as engineering judgment.

Recent and historical annualized average daily traffic (AADT) volumes provided by MnDOT were reviewed to identify traffic volume growth trends. A review of data between year 2009 and 2017 indicates that traffic volumes have remained relatively consistent, but there are some locations where traffic volumes have increased an average of three (3) percent per year (i.e., along 8th Street (US 75) between 5th Avenue and 6th Avenue) and where traffic volumes have decreased an average of five (5) percent per year (i.e., along Center Avenue (US 10/75) between 11th Street and 21st Street/1st Avenue).

Additional traffic volume data in Downtown Fargo were also reviewed. In the last 10 to 15 years, redevelopment growth in Fargo has significantly increased with the addition of apartment complexes along with office and retail development. However, traffic volumes along the major roadways in Downtown Fargo, such as Main Avenue, 10th Street, and University Drive, have not increased. This could suggest that a mode shift has occurred that is associated with the development growth in Downtown Fargo where there is a greater number of people walking/biking/taking transit and/or residents/employees are making more multi-use type trips.

As part of this study, the year 2045 socio-economic (SE) data in the traffic analysis zones (TAZs) near Downtown Moorhead were reviewed and updated based on input provided by Metro COG and the City of Moorhead to be consistent with current development expectations in the downtown area. Additionally, the external growth rate was modified in the Travel Demand Model from 2.5 percent to 0.25 percent. A growth rate of 0.25 percent is more consistent with the historical traffic volume growth along roadways external to the Fargo-Moorhead area.

Results of this analysis indicate that an annual growth rate of approximately one (1) percent is expected, which was assumed in this study for evaluation of year 2045 conditions. However, for intersections/segments that are identified to have capacity issues, an annual growth rate of one-half (0.5) percent was considered to better understand the likelihood of an improvement being needed.

Jurisdictional Transfer of US 10

The 2013 Corridor Study and subsequent Moorhead Downtown Grade Separation Study recommended a jurisdictional transfer of US 10 and US 75 from the existing jurisdiction along 8th Street (between Main Avenue and Center Avenue) and along Center Avenue (between 8th Street and 11th Street) to a future jurisdiction along Main Avenue (between 8th Street and 11th Street) and along 11th Street (between Main Avenue and Center Avenue). This transfer is expected to occur regardless of if or when 11th Street has grade-separated railroad crossings between Main Avenue and Center Avenue (BNSF KO Subdivision) and between Center Avenue and 1st Avenue (BNSF Prosper Subdivision). For this study, expected traffic shifts for the jurisdictional transfer were determined to inform decisions the roadways that will no longer be on the US Highway system.

With the jurisdictional transfer, it is expected approximately 15 percent of motorists will change their route from the current route to the future jurisdiction. This includes trucks, which make up approximately five (5) percent of vehicles, as well as motorists that are using GPS or are unfamiliar with the area, which are estimated to make up approximately 10 percent of vehicles.

Potential Grade-Separation at 11th Street

If/when 11th Street is grade-separated between Main Avenue and Center Avenue (BNSF KO Subdivision) and between Center Avenue and 1st Avenue (BNSF Prosper Subdivision), this provides a reliable routing option for motorists without risk of getting stopped by a train. Once this grade-separation occurs, it is anticipated that more motorists will change their route to 11th Street and a behavioral change will result in more motorists using 11th Street regardless if there is a train or not.

It is estimated that with the grade-separation, approximately 75 percent (60 percent shift plus 15 percent from jurisdictional transfer) of daily traffic volume trips will change their route to utilize the grade-separation along 11th Street. This is consistent with the assumptions used for the 2013 study. However, during peak periods, it is expected that less than 75 percent of trips will shift to 11th Street due to traffic operational and queueing issues along Main Avenue at the 8th Street and 11th Street intersections. Therefore, through an iterative process that balanced the expected demand of motorists that would want to use 11th Street with the expected traffic operations during the peak periods at the study intersections, it was determined that approximately 50 percent of peak hour trips would be expected to change their route from 8th Street to 11th Street.

Roadway Capacity Analysis

Congestion on the roadway system is judged to exist when the ratio of traffic volume to roadway capacity (i.e., v/c ratio) approaches or exceeds 1.0. The ratio of volume-to-capacity provides a measure of congestion along a stretch of roadway and can help determine where roadway improvements, access management, transit services, or demand management strategies need to be implemented. It does not, however, provide a basis for determining the need for specific intersection improvements. Table 1 provides a summary assuming no jurisdictional transfer or grade-separation at 11th Street. For each facility type, the typical planning-level AADT capacity ranges and 85th percentile AADT volume ranges are listed. These volume ranges are based upon guidance from the Highway Capacity Manual and professional engineering judgment. A range is used since the maximum capacity of any roadway design (i.e., v/c = 1.0) is a theoretical measure that can be affected by its functional classification, traffic peaking characteristics, access spacing, speed, and other roadway characteristics. This allows for capacity improvements that can be achieved by roadway performance enhancements.

Table 1: Roadway Capacity Analysis without Jurisdictional Transfer or Grade-Separation

Section	Existing Roadway Type	Near Capacity	Existing AADT (V/C)	Year 2045 AADT 0.5% (V/C)	Year 2045 AADT 1.0% (V/C)
Main Avenue (US 10) the River to 8th Street	Five-lane Urban	27,200	18,500 (0.68)	21,500 (0.79)	24,900 (0.92)
Main Avenue (US 10) 8th Street to 11th Street	Five-lane Urban	27,200	10,600 (0.39)	12,300 (0.45)	14,300 (0.53)
Center Avenue (US 10/US 75) 8th Street to 14th Street	Five-lane Urban	27,200	9,600 (0.35)	11,200 (0.41)	12,900 (0.47)
Center Avenue (US 10/US 75) 14th Street to 21st Street/1st Avenue	Four-lane Divided Rural	32,300	10,600 (0.33)	12,300 (0.38)	14,300 (0.44)
Center Avenue (US 10) 21st Street/1st Avenue to 34th Street	Four-lane Divided Rural	32,300	22,000 (0.68)	25,500 (0.79)	29,700 (0.92)
8th Street (US 75) 2nd Avenue to 10th Avenue	Five-lane Urban	27,200	17,500 (0.64)	20,300 (0.75)	23,600 (0.87)
8th Street (US 75) 10th Avenue to 22nd Avenue	Five-lane Urban	27,200	19,700 (0.72)	22,900 (0.84)	26,600 (0.98)

Table 2 provides a summary assuming the jurisdictional transfer and a grade-separation at 11th Street.

Table 2: Roadway Capacity Analysis with Jurisdictional Transfer or Grade-Separation

Section	Existing Roadway Type	Existing AADT (V/C)	Year 2045 AADT 1.0% (V/C)	Year 2045 Transfer (V/C)	Year 2045 Separation (V/C)
Main Avenue (US 10) 8th Street to 11th Street	Five-lane Urban	10,600 (0.39)	14,300 (0.53)	14,800 (0.54)	19,300 (0.71)
Center Avenue (US 10/US 75) 8th Street to 14th Street	Five-lane Urban	9,600 (0.35)	12,900 (0.47)	12,400 (0.46)	10,900 (0.40)

As shown in Tables 1 and 2, no study segments were identified to have existing capacity issues or are expected to in the current planning horizon.

Purpose of Project

The purpose of this study is to develop a vision to improve system deficiencies, multimodal traffic operations, and safety along the US 10 corridor between the Red River and 34th Street and along US 75 between Main Avenue (US 10) and 20th Avenue South. Recommendations are intended to serve as a planning tool to initiate the identification of suitable and feasible alternatives for the US 10 and US 75 corridors. The corridor study results serve to inform staff and elected officials so that sound land use, economic development, and transportation planning decisions made during the planning phase can be fully linked with, and integrated into, the later phases of project development for MnDOT’s 2025-2026 reconstruction project.

Identification of Needs

The need for the multimodal transportation improvements and the relationship to regional transportation need is based on the transportation analyses completed as part of this study. The study partners determined sufficient need was identified to inform the framework for MnDOT’s year 2025-2026 project and warranted the development of future corridor improvement concepts for both corridors. It was determined that future corridor planning and improvements should address the following for each respective corridor:

- Pavement Condition
- Vehicle Safety
- Vehicle Mobility
- Walkability/Bikeability
- Systemic Safety Risk Location

Pavement Condition

Due to the urban setting of the corridors with manhole castings and gate valve riser boxes that can impact ride quality, MnDOT’s Surface Rating (SR) evaluation was used to represent pavement conditions and distress. The SR is based on visible defects in the pavement surface, which indicate some problem or phenomenon of pavement deterioration such as cracks, patches, and/or ruts. From the data, MnDOT estimates an “Estimate Need Year” for when pavement is expected to reach “poor” conditions. The estimated timeframe for when the study corridors will require attention is illustrated in Figure 7. All study segments were identified to need pavement quality improvements within 10 years.

Vehicle Safety

A crash analysis was performed for key intersections and roadway segments along the US 10 and US 75 corridors based on data from the time period of January 1, 2013 to December 31, 2017. Two study intersections and two segments were identified to have a crash rate above the critical crash rate, as identified in Figure 7.

Vehicle Mobility

As previously noted, results of the existing capacity analysis indicate that all study intersections currently operate acceptably during the a.m. and p.m. peak hours with existing the traffic controls and geometric layout. While the intersections operate acceptably, two locations were identified as having operational issues (i.e., Center Avenue (US 10)/30th Street and 8th Street (US 75)/2nd Avenue). Train events impact intersection operations resulting in poor travel time reliability in the downtown area. During train events, queuing will extend into the adjacent intersections. After the train events (i.e. the gate arms raise), many vehicles can clear in one signal cycle, with a portion of vehicles taking two cycles to clear. During train events, vehicles were observed to reroute through the study area to avoid the train.

With future year 2045 traffic volumes and no changes being made other than adjustments to signal timing and the jurisdictional transfer, all study intersections are expected to continue to operate acceptably during the a.m. and p.m. peak hours. While the intersections will operate acceptably, eight intersections are expected to have movements that experience long delays and queuing, including:

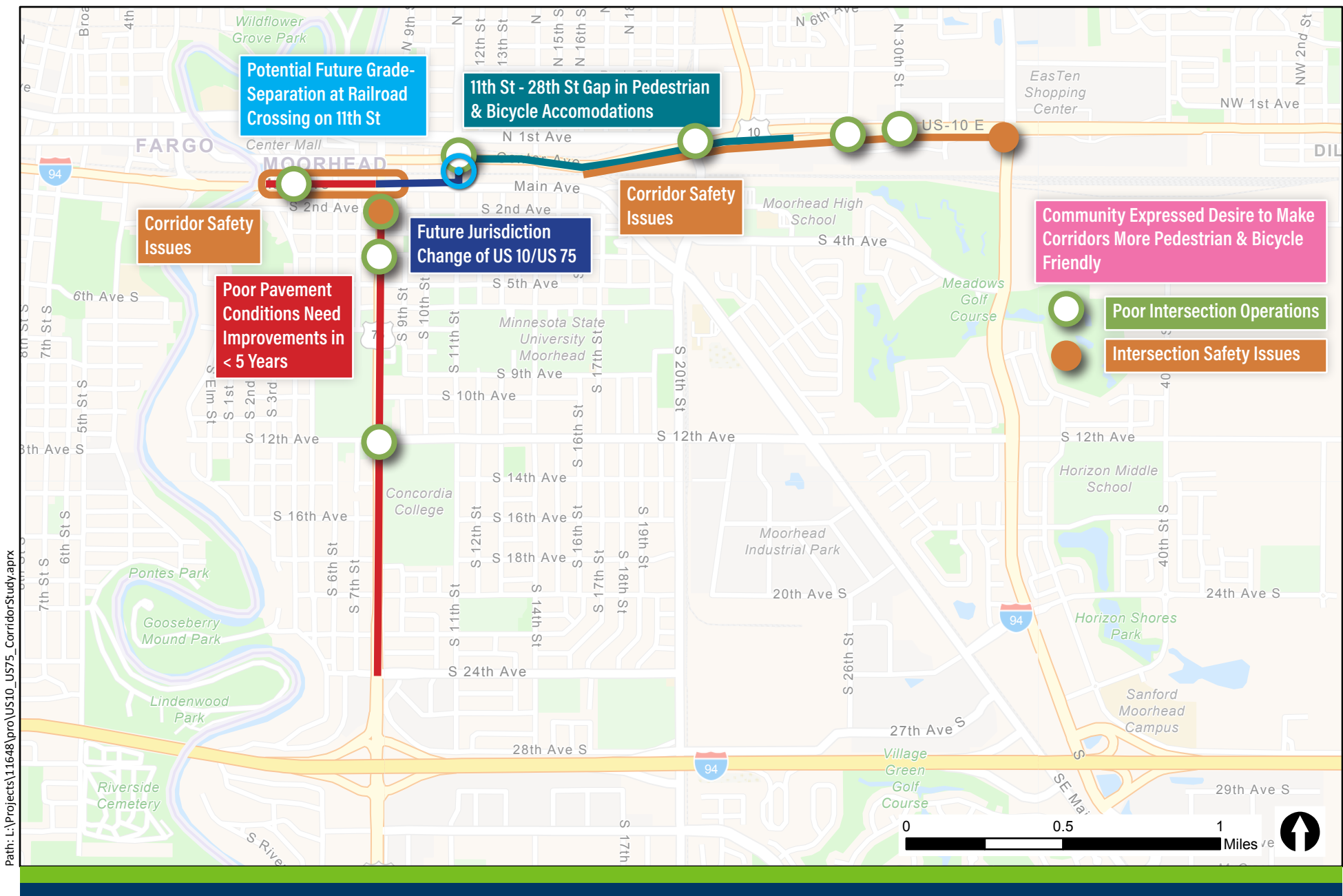
- Main Avenue (US 10)/4th Street
- Center Avenue (US 10/75)/11th Street
- Center Avenue (US 10/75)/21st Street/1st Avenue
- Center Avenue (US 10)/28th Street
- Center Avenue (US 10)/30th Street
- 8th Street (US 75)/2nd Avenue
- 8th Street (US 75)/4th Avenue
- 8th Street (US 75)/12th Avenue

Walkability/Bikeability

Pedestrian and bicycle data were collected during the weekday a.m. and p.m. peak hours. It should be noted that the crossing data was collected between year 2011 and year 2018 in warmer weather months while schools were in session. The 8th Street (US 75)/12th Avenue intersection had the highest observed pedestrian activity as this intersection bisects the Concordia College Campus – more than 300 pedestrians per hour have been observed to cross at this intersection. Additionally, redevelopment plans in Downtown Moorhead are expected to increase the pedestrian/bicycle activity in the overall study area. As illustrated in Figure 7, there is an existing gap in the sidewalk network along Center Avenue (US 10/75) between 11th Street and 28th Street. No connections are planned for this gap.

Systemic Safety Risk Location

Severe crashes may be widely (but not randomly) scattered around the highway system. Therefore, the basic premise behind the systemic risk assessment approach is to examine the system to prioritize candidates according to similar characteristics attributed to severe crashes. Locations with more characteristics associated with locations with severe crashes are more “at-risk” and, therefore, are a higher priority for safety investment. Therefore, a systemic risk location is an opportunity, not an existing transportation “issue”. Based on data provided in the May 2016 MnDOT District 4 Safety Plan Update, all study segments and 18 intersections along the US 10 and US 75 corridors were identified as being “at risk” locations. The plan stated that right-angle collisions and pedestrian involved crashes in urban areas were identified as priorities for safety investment and represent the greatest opportunity for reducing severe crashes in urban areas across the state system.

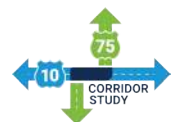


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Figure 7: Purpose and Need

US 10 / US 75 Corridor Study



Engaging the Community

Highlights:

- Community input was a major component of the study since there are varying land uses and many different types of users along the US 10 and US 75 corridors.
- In-person stakeholder meetings, public community events and pop-up meetings were used to obtain input from a wide cross-section of the community.
- On-line surveys were also used to capture even a broader cross-section of corridor users.
- Presentations were conducted to keep elected officials informed.
- Many communication channels were used to reach out the community, including hosting a study website.
- **Statistics summary will be added upon completion of the TBD events.**

The US 10 and US 75 corridors are unique and serve many land uses and corridor users. To ensure the proper balancing of needs between motorized and non-motorized users while considering the benefits and impacts to local businesses, community input was a major component of the study. The following summarizes the opportunities provided for public input along with what we heard throughout.

Opportunities for Community Input

Stakeholder Focus Group Meetings

Stakeholder focus group meetings were held in March, May and August of 2019 with five main stakeholder groups. The first round of meetings focused on business and property owners and neighborhood groups adjacent to the corridors in all three focus areas. Meetings included a presentation followed by a facilitated discussion regarding issues, concerns and priorities, and to brainstorm ideas for the corridors. The second meeting was a presentation to the Moorhead Business Association, which also included discussion and a question and answer session. The last meeting was with Fire, Emergency Services and Police to discuss options for maintaining the vehicle inspection site on US 10 just east of the US 10 and US 75 split. Feedback was important as it help shaped an overall understanding of key issues and priorities of those directly impacted by the corridors.

Community Events

Two community open houses were held throughout the study. The purpose was to share information about the study face-to-face with community members and ask for their experiences and feedback based on the information presented. All informational materials shared at the events were made available on the study website. Study partners were available to help answer questions, address concerns and collect input from the attendees.

The first public community event held in February 2019 occurred at the beginning of the study. The event served as an opportunity to introduce the study, the partners, and explain how the public would play a role in shaping the final recommendations. This was the first study partners met with the overall community in-person and allowed for two-way dialogue to occur. Verbal and written feedback were documented with the **first study survey** providing a foundation of information to guide the study forward. For community members unable to attend the community event, an online survey was made available which sought similar feedback as the community event, making it possible for community members to provide input in a variety of ways.

The second community event held in XXXX of 2020 was the culmination of data collection, analysis, and public engagement efforts. A formal presentation and boards highlighted the analysis of alternatives and recommended visions for the corridors. Additional information was provided on next steps regarding the implementation of the vision. Like the first community event, the information presented at this event was also available online for those who could not attend the event in person. THIS WILL BE UPDATED FOLLOWING EVENTS TBD.

Between the community events, **pop-up meetings** were held in June of 2019. The purpose of these meetings was to meet people where they are as opposed to asking people to come to us. These meetings were used to disseminate information to the community about the study, where they can find more information, how they can become involved, and to issue the **second study survey**.

Elected Officials

THIS WILL BE UPDATED FOLLOWING EVENTS TBD.

Communications

Metro COG hosted a **study website** (<http://www.fmmetrocog.org/projects-rfps/us-1075-corridor-study>) that contained background information, promotion of upcoming public engagement events, meeting materials, and contact information. Information on “what we heard” throughout the study was also included to report back to the public regarding their input and feedback. Additionally, multiple communication channels were used to notify area businesses and residents, community members, and regional users about the study’s engagement activities.

Email announcements were distributed prior to each focus group and community event. **Social media** was used via Metro COG and MnDOT social media channels. MnDOT ran Facebook ads in advance of both community events. **Press releases** were sent to local media outlets and posted on the Metro GOG website prior to the two community events.

What We Heard

Summaries of what we heard throughout our engagement efforts are included in Appendix E. Below are key statistics regarding who we reached for input. THIS WILL BE UPDATED FOLLOWING EVENTS TBD.

Brainstorming Ideas and Concepts

Highlights:

- A range of alternatives was developed for each of the three focus areas to address the purpose and need of the project.
- Current urban design standards along with Performance Based Practical Design (PBPD) practices were used to develop four street types ranging in the number of travel lanes and presence or absence of a raised median.
- Alternatives were developed for each study focus area, ranging from major infrastructure improvements to capacity and safety improvements to implementation of technology. Pedestrian and bicycle enhancements were also included.
- Once the alternatives were developed and shared with the public, study partners evaluated each alternative with respect to safety benefits, capacity and mobility benefits, social or economic goals, walkability and bikeability benefits and cost.
- MnDOT is committed to working with study partners as the 2025-2026 reconstruction project develops to ensure coordination on roadway aesthetics takes place.

To address the purpose and need for the project a range of alternatives was identified during discussions with study partners and public engagement efforts. Alternatives were separated based on the three focus areas and were reviewed based on a variety of objectives, including potential safety benefits, traffic operational benefits or impacts, social and economic goals, walkability and bikeability benefits and preliminary costs.

Design Standards and Street Types

Pertinent design standards were identified for this study to develop street types. Resources included:

- Minnesota State-Aid Standards
- MnDOT Design Guides
- NACTO Urban Roadway Design Guide
- AASHTO Guide for the Development of Bicycle Facilities
- FHWA Separated Bike Lane Planning and Design Guide

Based on a recent legislative request, the MnDOT State Aid Department updated the State Aid Design Standards to be more inclusive of multimodal systems. This review was to help merge the gap between the differences of the Minnesota (MN) Trunk Highway Standards and the Minnesota State Aid Standards. Ultimately, edits to the State Aid Design Standards created a level a flexibility like the MN Trunk Highway Standards. These edits have been adopted into Minnesota State Statute.

For this study, four street types were developed with the goal of taking advantage of the new urban design flexibility and guidance to improve the walkability and bikeability of the corridors by reducing lane widths and increasing sidewalk and trail widths. Typical street types considered are illustrated in Figures 8-11. These show a range of minimum right of way widths depending on if a trail and/or sidewalks are assumed on each side of the roadway. It's important to note that the corridors do vary in typical section today. While the goal is to provide a consistent typical section, some locations will continue to be varied to ensure existing street trees are not impacted with the reconstruction.

Figure 8: 3-Lane Undivided Roadway

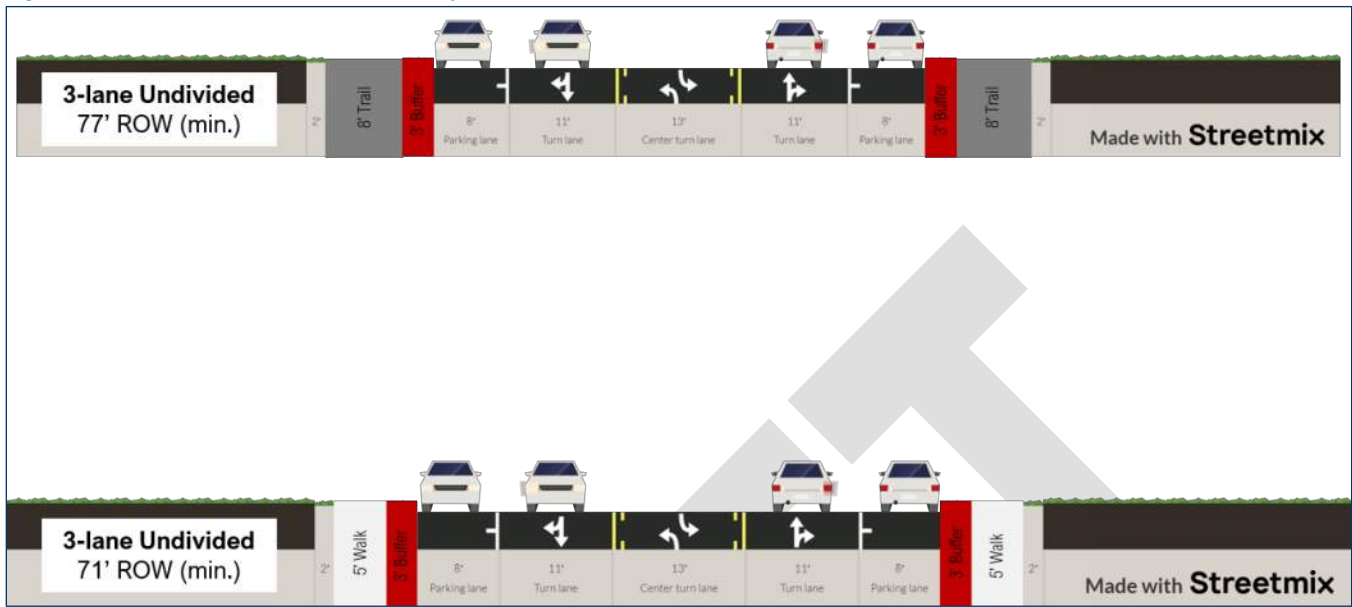


Figure 9: 4-Lane Undivided Roadway

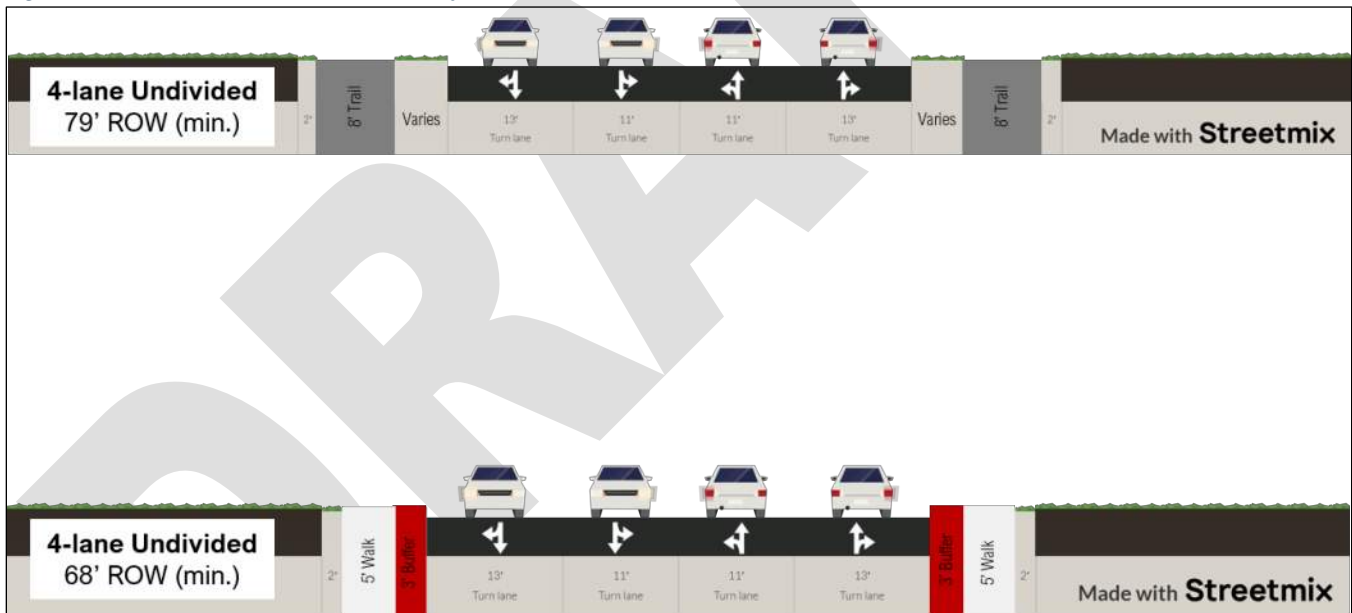


Figure 10: 5-Lane Undivided Roadway

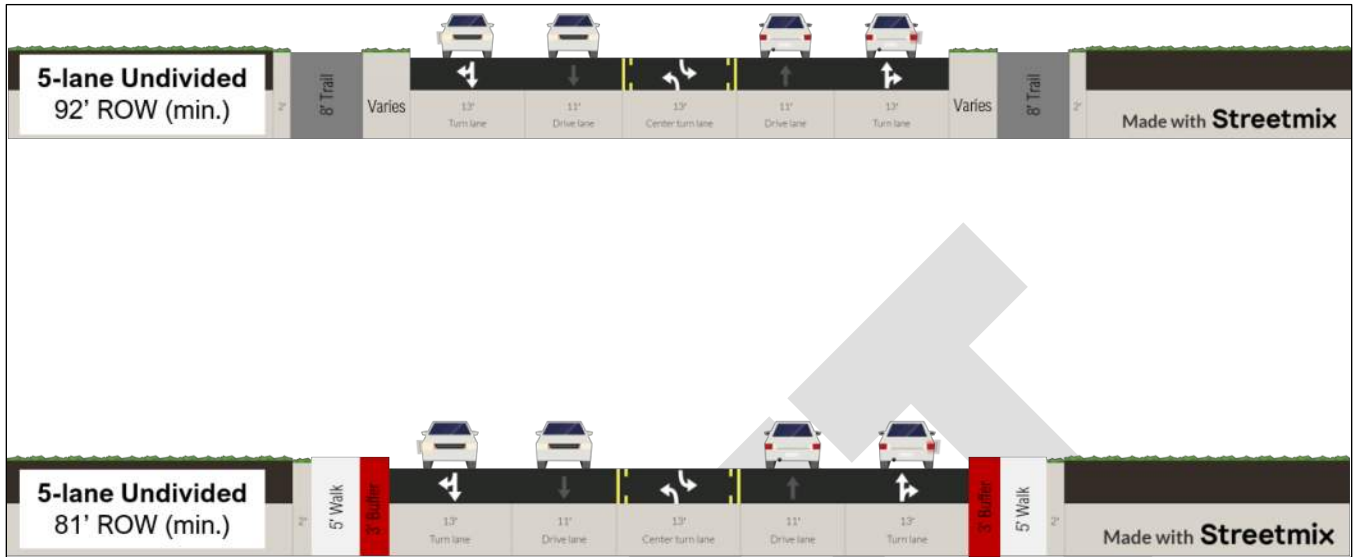


Figure 11: 4-Lane Divided Roadway



Roadway Alternatives, Feasibility and Risk Assessment

The alternatives developed for each focus area ranged from grade-separation of users (i.e., roadways, railroads, and pedestrian/bicycle accommodations) to adding and/or removing lanes of traffic to restricting access at low-volume intersections and mid-block driveways. Converting one-way streets to two-way traffic were considered along with changes to how intersections are controlled (i.e., roundabouts vs. traffic signals). Incorporating technology to reduce impacts caused by train activities was considered. Lastly, alternatives were developed to focus on improving the experience for pedestrians and bicyclists.

The alternatives were reviewed by the study partners and shared with the community to obtain feedback. Once the alternatives were shared with the public, each alternative was evaluated with respect to the following:

- **Safety**
 - Reduces crashes at critical crash and systemic crash risk locations.
 - Improves compliance with access spacing guidelines.
 - Improves roadway geometrics for safer pedestrian/bicycle facilities.
- **Capacity/Mobility**
 - Reduces intersection delay during peak hours (improves Level of Service).
 - Reduces intersection delay during non-peak hours.
 - Accommodates year 2045 traffic volumes (one percent growth rate).
- **Social or Economic Goals**
 - Opportunity to provide context sensitive design streetscape treatments.
 - Reduces average travel speed (mph).
- **Walkability/Bikeability**
 - Addresses a gap or enhances multi-modal trail/sidewalk linkage.
 - Improves pedestrian intersection crossing.
- **Preliminary Costs**
 - Minimizes right of way acquisition

For each criterion, alternatives were compared against the do-nothing alternative (i.e., no build) and given a score ranging from 1-5. A score of 5 meant the alternative meets the criteria well. A score of 1 meant the alternative failed to meet the criteria. Illustrations of the range of concept alternatives (where applicable) and evaluation results are provided with the technical memorandum in Appendix F. Further, Intersection Control Evaluation (ICE) reports (see Appendix G) were prepared for the US 10/US 75 and 8th Street (US 75)/20th Avenue intersections to identify the most appropriate form of intersection control. Results from this evaluation helped form the corridor visions presented in the next section of this report.

Roadway Aesthetics

MnDOT is undertaking an effort to work with community partners to enhance and maintain the highway right of way. Stakeholder discussions have gathered feedback on aesthetic elements such as maintenance quality, vegetation appearance, paint condition on noise walls, presence of litter in their right of way, artistic treatments, etc. MnDOT staff presented an overview of their work and its intent to the study partners. MnDOT is committed to working with study partners as the 2025-2026 reconstruction project develops to ensure coordination on roadway aesthetics takes place.

Vision for US 10 and US 75 Corridors

Highlights:

- Each focus area varies in land uses thus requiring priorities to be established for all users based on the issues and needs identified through the technical work and through input obtained from the community.
- Corridor visions were developed for each focus area.
- Downtown focus area prioritizes walkability and bikeability by “right sizing” the roadways.
- US 10 East focus area prioritizes providing a consistent typical section that is more of an urban feel.
- US 75 South focus area priorities addressing existing safety and operational deficiencies and improving accommodations for pedestrians and bicyclists while maintaining its historical feel.

As previously noted, each focus area for the US 10 / US 75 Corridor Study varies in land uses requiring priorities to be established for all users based on the issues and needs identified through the technical work and through input obtained from the community. From this, corridor visions were developed for each focus area. This section of the reports summarizes the issues and needs and community input for each focus area and identifies the recommended corridor visions developed by the study partners.

Downtown Moorhead

Issues & Needs

- Dense commercial area with many business accesses.
- Future redevelopment will increase residential living opportunities.
Existing high pedestrian activity with future redevelopment opportunities to further increase this activity.
- Red River crossing at Main Avenue is important as a mobility corridor but also needs to balance the needs of a downtown that desires to become a more pedestrian friendly environment.
- Needs for railroad, pedestrian/bicycle accommodations and vehicles are at odds with each other.
- Numerous transit routes serve the corridors.
- Future route jurisdiction change will alter traffic patterns providing opportunities.

Community Input

- Widen the sidewalk along 8th Street between 1st Avenue and Center Avenue.
- Utilize dead-end spaces for public uses like park space, benches, or parking.
- Add signage that notifies motorists to find an alternative route when trains are approaching downtown.
- Make street design improvements (i.e., streetscaping and reduced roadway width) to reduce traffic speeds along Center Avenue between 14th Street and 21st Street/1st Avenue.
- Improve the pedestrian crossing at the Main Avenue/7th Street intersection.
- Redesign Center Avenue to work for walkers, bikers and drivers.
- Potentially redesign Main Avenue following Main Avenue project in Fargo.

Recommended Vision

The recommended vision for the Downtown focus area is illustrated in Figure 12. The vision prioritizes walkability and bikeability by right sizing the roadways, while utilizing dynamic signing to help alert drivers of when trains are arriving. Figure 13 illustrates an alternate option where US 10 (Main Avenue) from the river to US 75 (8th Street) and 8th Street from Center Avenue to US 10 (Main Avenue) have a reduction in the numbers of lanes to take advantage of a potential reduction in traffic resulting from the Main Avenue work in Fargo. This is the preferred vision of the study partners that will need to be further vetted when additional traffic data is available following the construction project in Fargo.

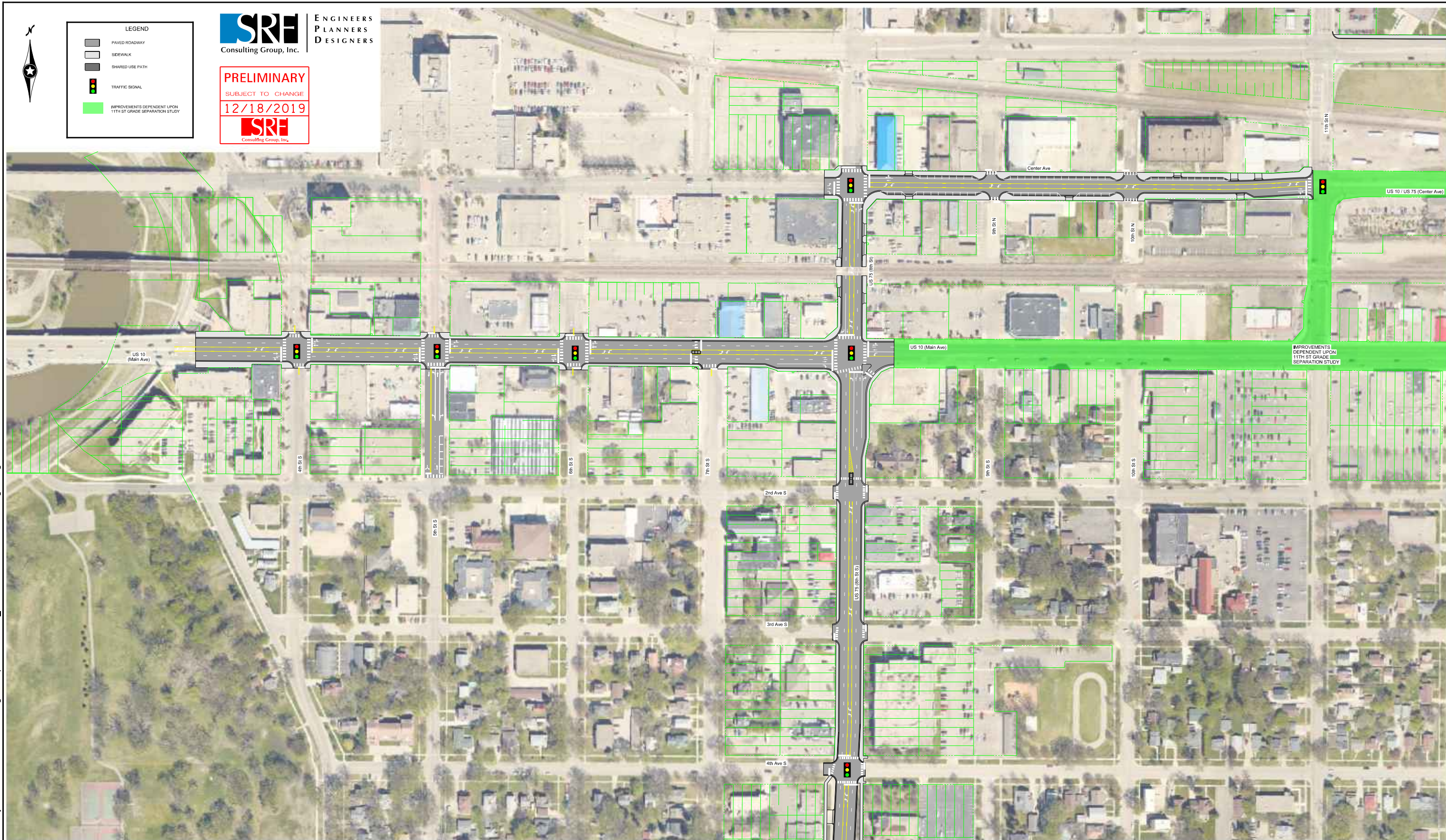


LEGEND	
	PAVED ROADWAY
	SIDEWALK
	SHARED USE PATH
	TRAFFIC SIGNAL
	IMPROVEMENTS DEPENDENT UPON 11TH ST GRADE SEPARATION STUDY

SRE ENGINEERS
Consulting Group, Inc. PLANNERS
DESIGNERS

PRELIMINARY
SUBJECT TO CHANGE
12/18/2019

SRE
Consulting Group, Inc.



H:\Projects\1000\11648\Design\Graphics\11648_Downtown Focus Area Fig. 9.dgn

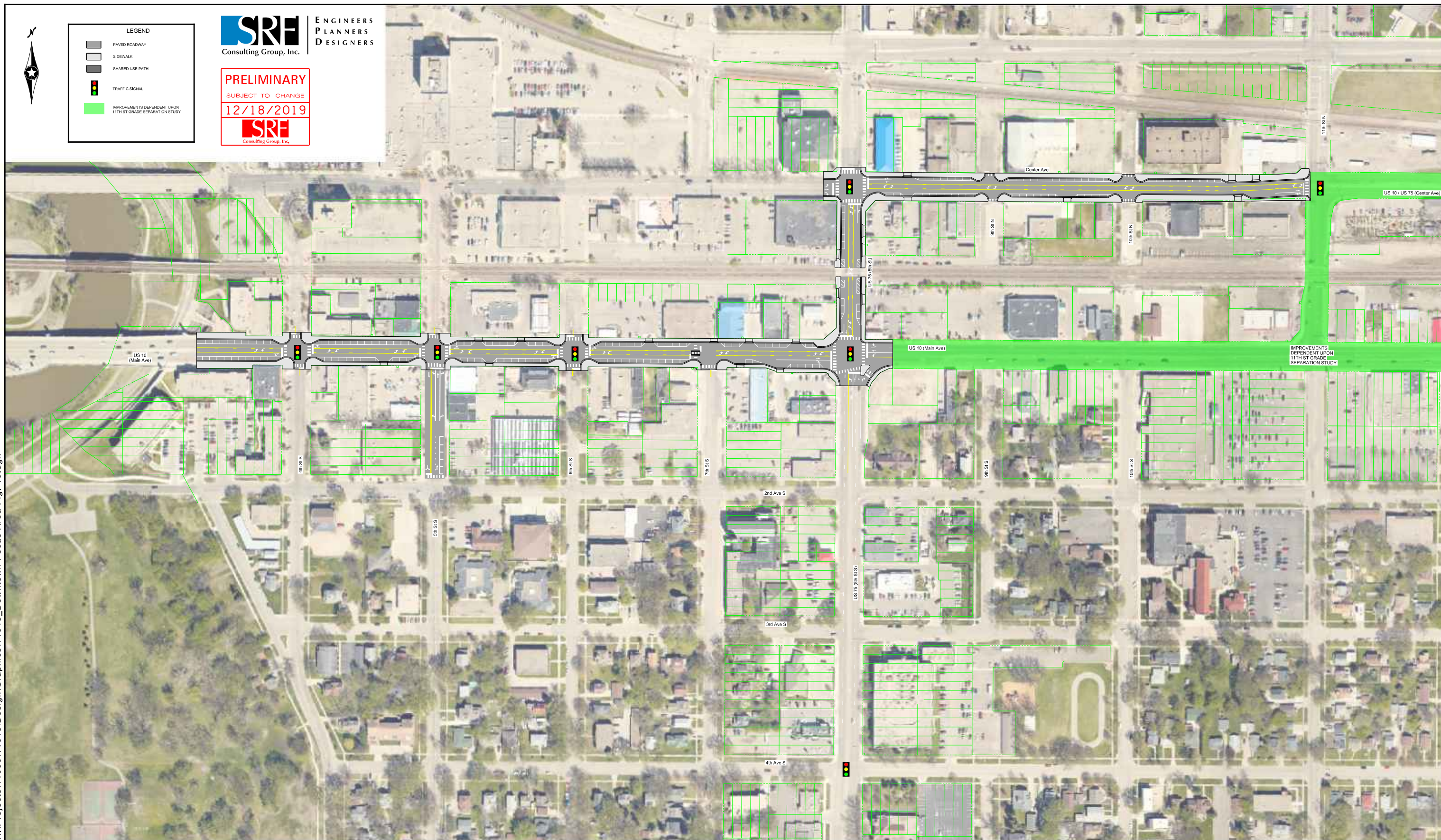


LEGEND	
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DESIGNERS

PRELIMINARY
SUBJECT TO CHANGE
12/18/2019

SRE
Consulting Group, Inc.



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SRE Downtown Focus Area Corridor Vision - Reduced Lanes

US 10 / US 75 Corridor Study
Moorhead, Minnesota

Job # 11648
12/18/2019

Figure 13

US 75 South of Downtown

Issues & Needs

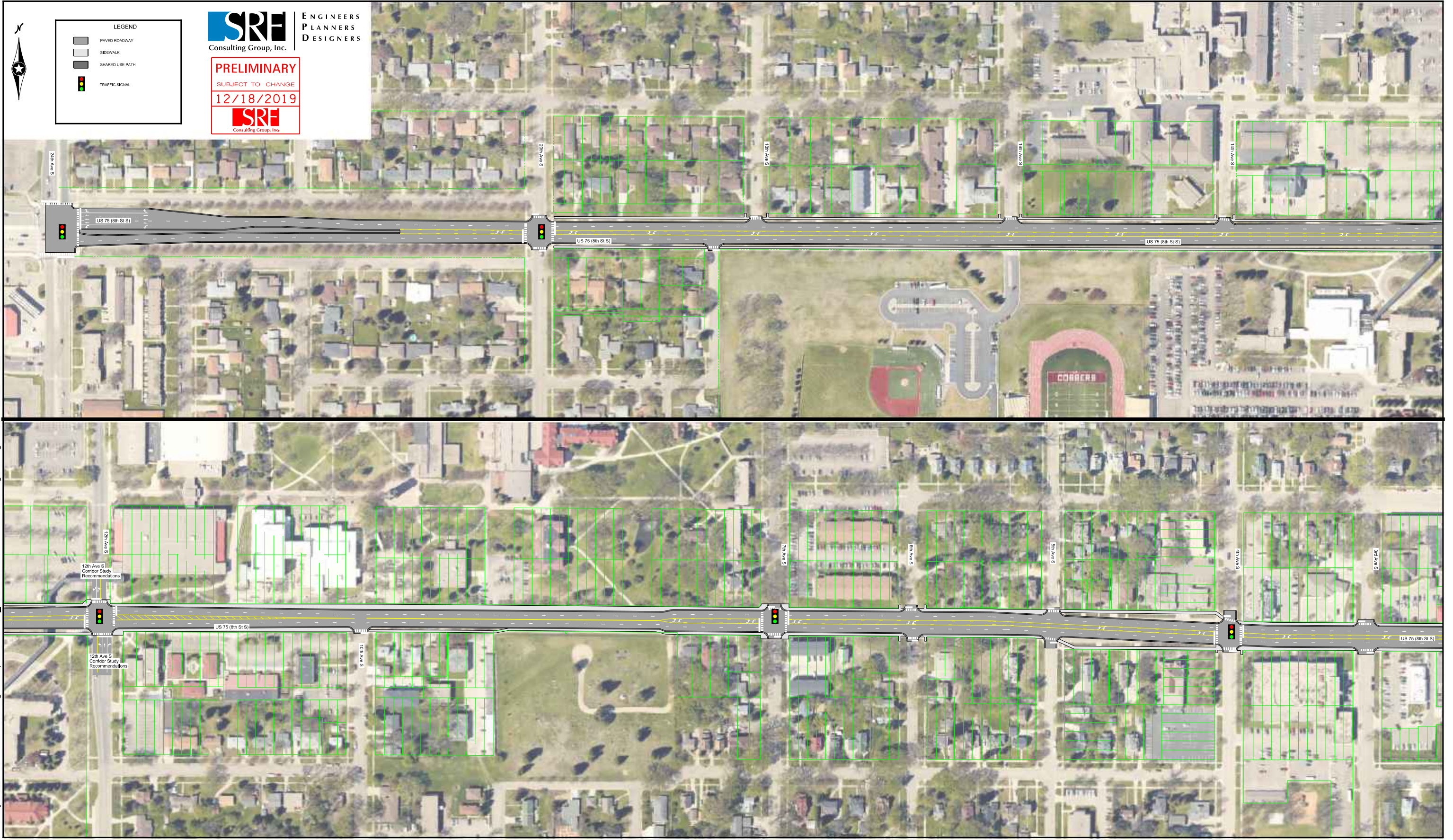
- Area roughly encompasses the neighborhoods surrounding the three main higher education institutions in the City (Concordia College, Minnesota State University Moorhead, and Minnesota State Community and Technical College).
- Commercial uses on the northern end transition to low/medium density housing to institutional use (Concordia College) as you head south.
- Pavement conditions are poor.
- Direct driveway access is provided throughout corridor to commercial and residential properties.
- Corridor bisects Concordia College Campus with high pedestrian activity.
- Event traffic at Concordia College needs to be considered.
- Traffic safety and operation issues were identified at some intersections.

Community Input

- Corridor “feels like a highway”.
- Need to consider multi-use path along US 75 (8th Street).
- Need to address safety concerns along US 75 (8th Street) between Main Avenue and 4th Avenue.
- Consider removing the existing “jog” in US 75 (8th Street).
- Heaving pedestrian activity crossing at 2nd Avenue.

Recommended Vision

The recommended vision for the US 75 South focus area is illustrated in Figure 14. The vision prioritizes reducing lane widths where possible to reduce “feels like a highway” atmosphere while removing the jog and addressing traffic safety and operation issues on the north end by restricting access at 2nd Avenue. The vision also improves pedestrian crossings on the north end by providing a marked crossing with raised median refuge at 2nd Avenue and a signalized crossing at 4th Avenue. A multi-use path along US 75 (8th Street) was considered but the impacts to existing street trees and utilities is an issue and was not supported by the public. Alternate routes will be considered as part of future pedestrian and bicycle connections. It should also be noted the recommendations from the recently completed 12th Avenue Corridor Study are adopted as part of this study to address traffic operation issues caused by heavy pedestrian activity.



H:\Projects\11000\11648\Design\Graphics\11648_US 75 South Focus Area Fig. 14.dgn

US 10 East of Downtown

Issues & Needs

- Land uses are primarily industrial and commercial type uses but focus area has been identified as an area with opportunities for redevelopment.
- US 10 transitions from urban to rural with limited access through this focus area.
- Trails are not provided on both sides of US 10 with no pedestrian and bicycle connections to downtown.
- Need to address intersection and corridor safety issues identified.
- Need to address traffic operation issues identified at several intersections.

Community Input

- Convert to “urban” corridor by removing the ditch median to be consistent with the roadway both east and west of the focus area.
- Limit movements that can be made at certain intersections to help improve safety.
- Construct trails along both the north and south sides of corridor.
- Consider pedestrian and bicycle underpasses at US 10/US 75 and 21st Street/1st Avenue intersection.
- Maintain opportunity for vehicle inspection site.

Recommended Vision

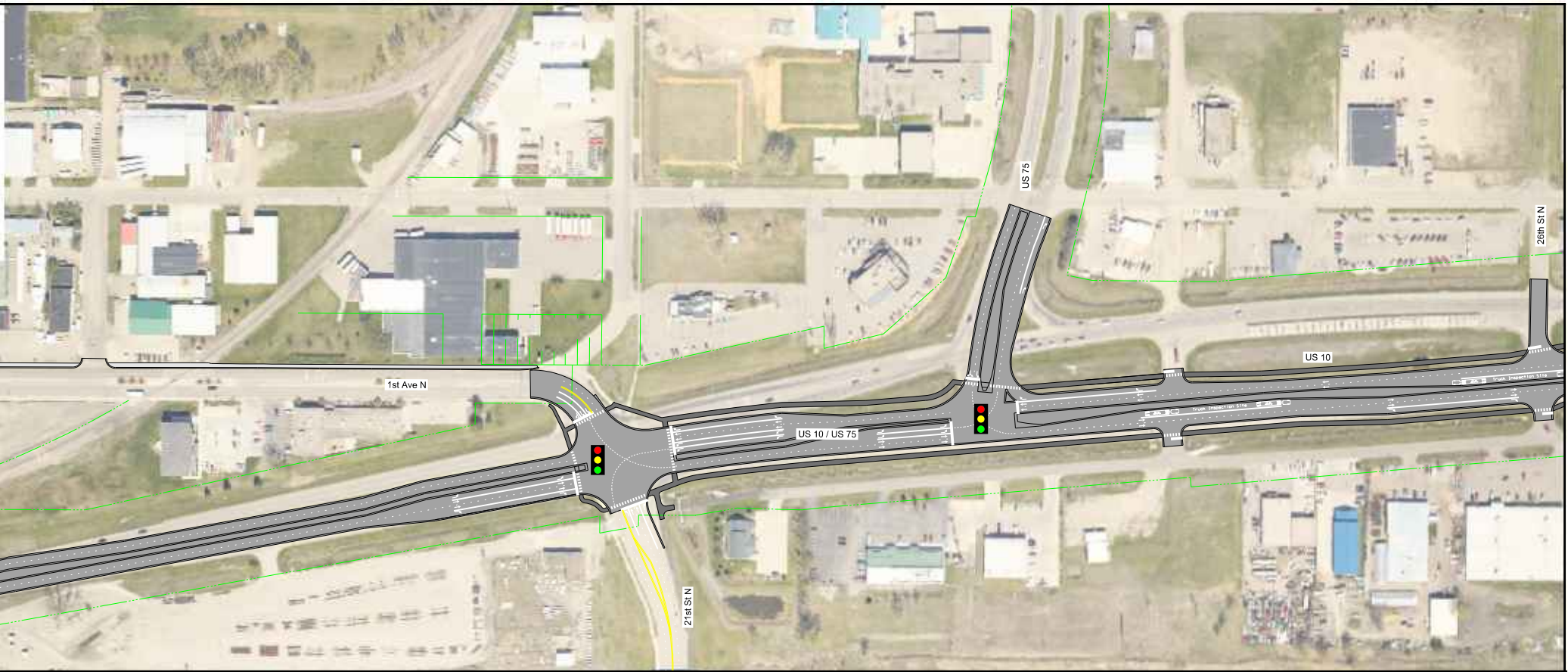
The recommended vision for the US 10 East focus area is illustrated in Figure 15. The vision prioritizes changing the character of this area to have a more “urban” feel to better connect this area with downtown and make it consistent with US 10 east of 34th Street. The vision includes removing the existing wide median and providing better pedestrian and bicycle connections while implementing appropriate access management techniques and intersection control treatments to address traffic safety and operation issues.



LEGEND	
	PAVED ROADWAY
	SIDEWALK
	SHARED USE PATH
	TRAFFIC SIGNAL

SRE ENGINEERS
 CONSULTING GROUP, INC. PLANNERS
 DESIGNERS

PRELIMINARY
 SUBJECT TO CHANGE
 12/18/2019
SRE
 CONSULTING GROUP, INC.



H:\Projects\11000\11648\Design\Graphics\11648_US 10 East Focus Area Fig. 12.dgn



Implementing the Visions

Highlights:

- MnDOT has a fiscally constrained 4-year program of projects and a 10-year plan of projects.
- Roadway capacity and safety needs, pavement condition, and construction staging were used to develop implementation plan.
- Phase 1 prioritizes the need to address deteriorating pavement conditions (year of need) along US 75 (8th Street) and along US 10 (Main Avenue) west of US 75 (8th Street) while minimizing potential construction staging and coordination issues associated with a future grade-separation project in downtown.
- Phase 2 reconstructs the US 10 East focus area reconstructing US 10 (Center Avenue) from 14th Street to 34th Street.
- Reconstruction of US 10/75 (Main Avenue) east of US 75 (8th Street) will be planned and coordinated with future grade-separation project at 11th Street (future US 10/75).
- US 10 east of 34th Street will be determined in an upcoming corridor study to be completed in 2020/2021.

MnDOT has a fiscally constrained 4-year program of projects and a 10-year plan of projects. These only include projects that MnDOT can reasonably be expected to construct in a given year based on the projected revenues it predicts to receive. Base on MnDOT's near- and long-term needs, the visions for US 10 and US 75 will need to be implemented in phases. One of the key aspects of implementation is to find discrete segments of the project that could move forward based on the available funding while identifying logical sequencing or staging of the project. To accomplish this, criteria were used to prioritize improvements along US 10 and US 75, focusing the immediacy of need (i.e., roadway capacity, safety, and/or condition of pavement) and construction staging (i.e., minimization of construction related impacts). Based the needs and construction coordination for US 10 and US 75, the following implementation plan was developed:

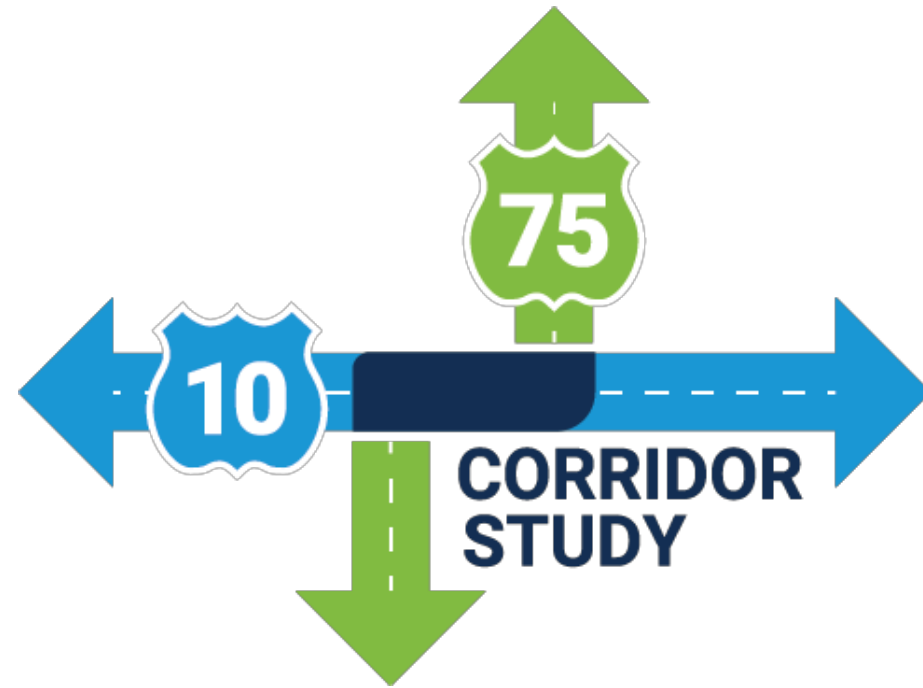
- **Phase 1 (Construction Year 2025)**
 - US 75 (8th Street): 24th Avenue to US 10 (Main Avenue)
 - US 10 (Main Avenue): River to US 75 (8th Street)
 - MnDOT Programmed Funds = \$14.6M
- **Phase 2 (Construction Year 2026)**
 - US 10 (Center Ave): 14th Street to 34th Street
 - MnDOT Programmed Funds = \$10.8M

Phase 1 of the implementation plan prioritizes the need to address deteriorating pavement conditions (year of need ranges from 2021-2024) along US 75 (8th Street) and along US 10 (Main Avenue) west of US 75 (8th Street) while minimizing potential construction staging and coordination issues associated with a future grade-separation project in downtown. This also addresses higher than expected crashes on US 10 (Main Avenue) from the river to US 75 (8th Street) and on US 75 (8th Street) at the 2nd Avenue intersection. The current location of the grade-separation project is unknown. MnDOT and the City of Moorhead are currently working through the environmental documentation process and developing preliminary design plans; however, funding is not currently identified for any changes.

Phase 2 of the implementation plan reconstructs the US 10 East focus area reconstructing US 10 (Center Avenue) from 14th Street to 34th Street, which addresses pavement needs (year of need is 2026) and higher than expected crashes along this segment. Construction staging and coordination is not expected to be an issue in the area because of the amount of existing right of way available for construction.

Reconstruction of US 10/75 (Main Avenue) east of US 75 (8th Street) will be planned and coordinated with any future grade-separation project, which is anticipated to be at 11th Street. The future vision for US 10 east of 34th Street will be determined in an upcoming corridor study to be completed in 2020/2021. Restriping of Center Avenue between US 75 (8th Street) and 11th Street will occur following the jurisdictional transfer of this segment to the City of Moorhead, which will provide a consistent roadway with Center Avenue just west of US 75 (8th Street). 8th between Center and Main? Trail along 1st Avenue? Need to discuss timing with SRC.

DRAFT



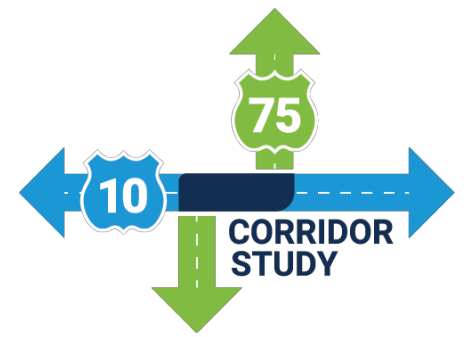
Study Review Committee (SRC) Meeting #6

January 9, 2020 | 11:00 AM-1:00 PM

SRF Consulting Group
1 North Second Street, Case Plaza Suite 226
Fargo, ND 58102

Agenda

- Introductions
- Schedule Update
- Draft Study Report
 - Updated Alternatives & Evaluation
 - City of Moorhead Field Observations along 8th Avenue (US 75)
 - US 10 East Inspection Site Options
 - Main Avenue 3-Lane vs. 5-Lane Considerations
 - Other Outstanding Issues?
- ~~Draft Intersection Control Evaluation (ICE) Reports~~
- Public & Stakeholder Engagement
 - Website Updates
 - Round 3 Outline/Schedule/Prep
- Next Steps



Schedule Update

Schedule Update

- SRC Meeting: **January 8, 2020**
- Draft Report
 - Overview of Draft Report and Discuss Outstanding Issues: **January 8, 2020**
 - Submit Revised Draft Report (including ICE Reports) to SRC: **January 13, 2020**
 - **SRC Review Time: January 13-31, 2020 (allows 3 weeks)**
 - Submit Updated Draft Report to SRC: **February 7, 2020**
- Engagement: **Week of February 10th or 17th, 2020**
- Present to Moorhead City Council: **February 24, 2020**
- Present to Metro COG TTC: **March 12, 2020**
- Present to Metro COG Policy Board: **March 19, 2020**
- Submit Final Study Report: **March 30, 2020***

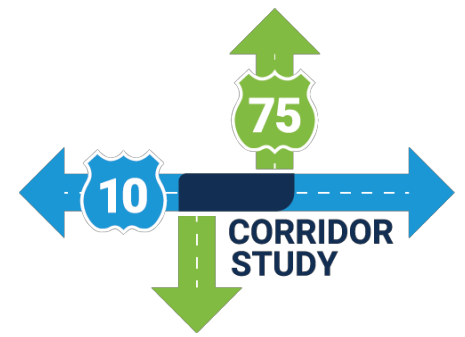
* Original Schedule: August 2019

Schedule Update

- Additional meetings to consider:
 - Meeting with MnDOT management?
 - Meeting with MnDOT Pedestrian and Bicycle Unit?
 - SRC meeting in February?
 - Others?

Staffing Update

- Project Manager: **Leif Garnass**
- Oversight: **Craig Vaughn**
- Traffic Engineers: **Phil Kulis, Brent Clark**
- Designers: **Chris Dahl, Stacy Johnson**
- Engagement: **Daniel McNiel**
- Document Preparation: **Molly Stewart**

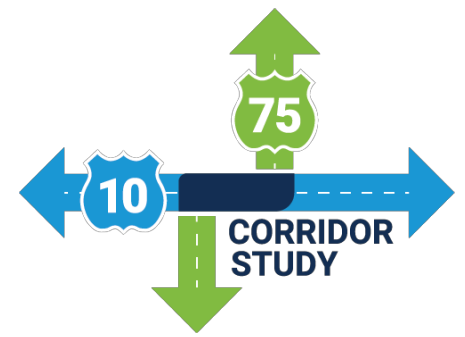


Draft Study Report

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Appendix A:	Data Collection Technical Memorandum
Appendix B:	Existing Conditions Technical Memorandum
Appendix C:	Traffic Forecasts Technical Memorandum
Appendix D:	Purpose and Need Technical Memorandum
Appendix E:	Public Engagement Plan and Summaries
Appendix F:	Alternatives Technical Memorandum
Appendix G:	Intersection Control Evaluation (ICE) Reports



Downtown Focus Area

Downtown Moorhead

Issues & Needs

- Dense commercial area with many business accesses.
- Future redevelopment will increase residential living opportunities.
Existing high pedestrian activity with future redevelopment opportunities to further increase this activity.
- Red River crossing at Main Avenue is important as a mobility corridor but also needs to balance the needs of a downtown that desires to become a more pedestrian friendly environment.
- Needs for railroad, pedestrian/bicycle accommodations and vehicles are at odds with each other.
- Numerous transit routes serve the corridors.
- Future route jurisdiction change will alter traffic patterns providing opportunities.

Community Input

- Widen the sidewalk along 8th Street between 1st Avenue and Center Avenue.
- Utilize dead-end spaces for public uses like park space, benches, or parking.
- Add signage that notifies motorists to find an alternative route when trains are approaching downtown.
- Make street design improvements (i.e., streetscaping and reduced roadway width) to reduce traffic speeds along Center Avenue between 14th Street and 21st Street/1st Avenue.
- Improve the pedestrian crossing at the Main Avenue/7th Street intersection.
- Redesign Center Avenue to work for walkers, bikers and drivers.
- Potentially redesign Main Avenue following Main Avenue project in Fargo.

Downtown Focus Area

- Consideration of 3-lane roadway on 8th between Center and Main:
 - A.M. Peak hour operations are anticipated to be acceptable
 - During the P.M. Peak hour, EB movements will break down at the Main Avenue/4th Avenue intersection, not allowing vehicles through the network which causes model failure
 - During the P.M. Peak Hour, the Southbound queue at the Main Avenue/8th Street intersection will queue into the Center Avenue/8th Street intersection, impacting operations

Table 1. 2045 – 3-Lane Alternative Operations

Intersection	A.M. Peak Hour		P.M. Peak Hour	
	LOS	Delay	LOS	Delay
Main Avenue (US 10)/4th Street	A	9 sec.	F	102 sec.
Main Avenue (US 10)/5th Street	C	23 sec.	E	69 sec.
Main Avenue (US 10)/6th Street	A	8 sec.	C	24 sec.
Main Avenue (US 10)/7th Street ⁽¹⁾	A/D	32 sec.	C/F	201 sec.
Main Avenue (US 10)/8th Street (US 75)	C	30 sec.	F	81 sec.
Center Avenue (US 10/US 75)/8th Street	B	19 sec.	F	165 sec.

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

Downtown Focus Area

- December 2019 Recommendations from MnDOT's Pedestrian and Bicycle Unit:
 - Provide a separated and protected bikeway facility along or adjacent to US 10
 - Consider pedestrian crossings across US 75 and US 10 at uncontrolled crossing locations
 - Provide pedestrian facilities and crossings at signalized intersections

Downtown Focus Area

- Consideration of 3-lane roadway on Main between River and 8th:
 - A.M. Peak hour operations are anticipated to be acceptable
 - Main Avenue/5th Street intersection will be the most challenging with NBL queues extending beyond 2nd Avenue
 - During the P.M. Peak hour, EB movements will break down at the Main Avenue/4th Avenue intersection, not allowing vehicles through the network which causes model failure

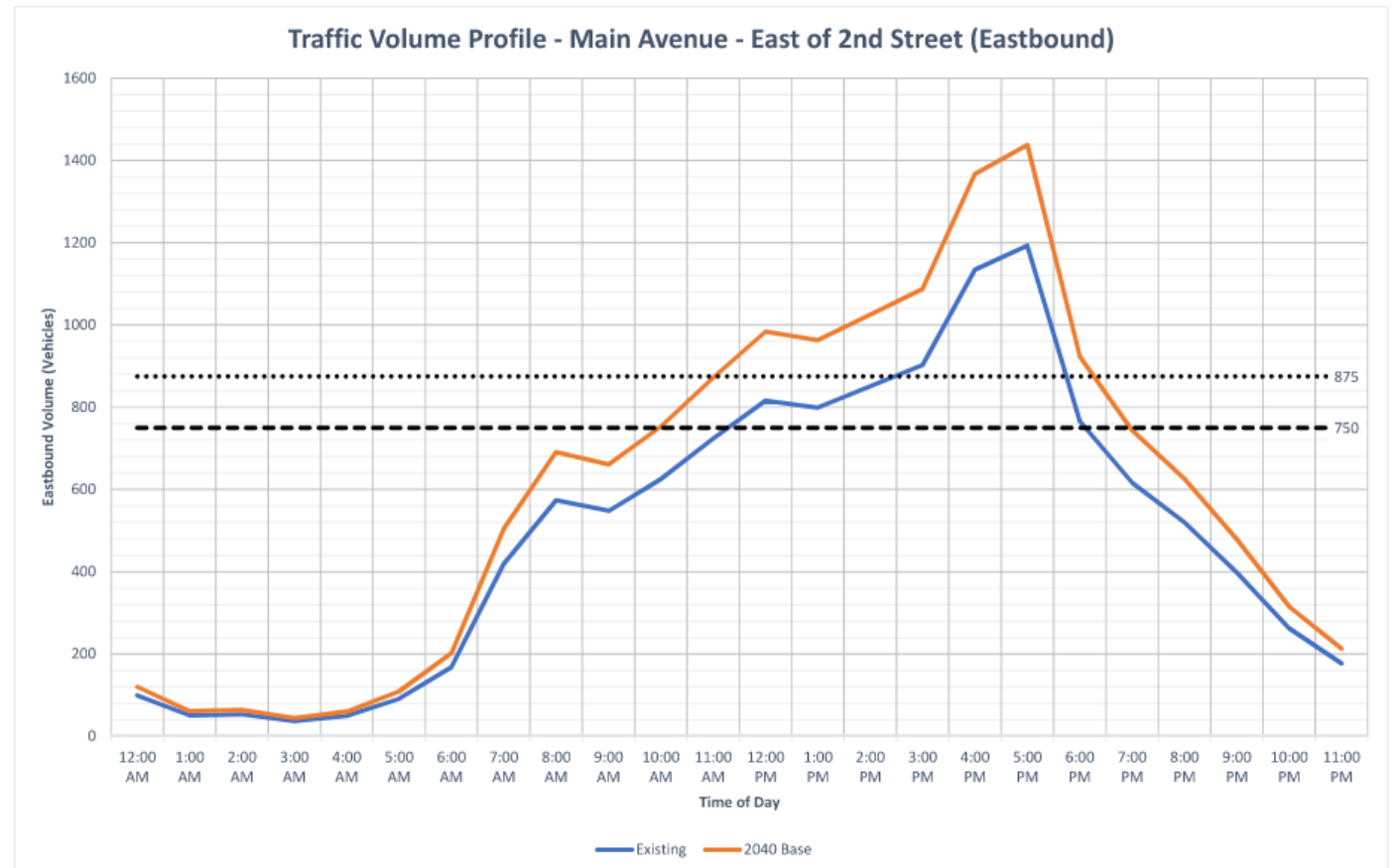
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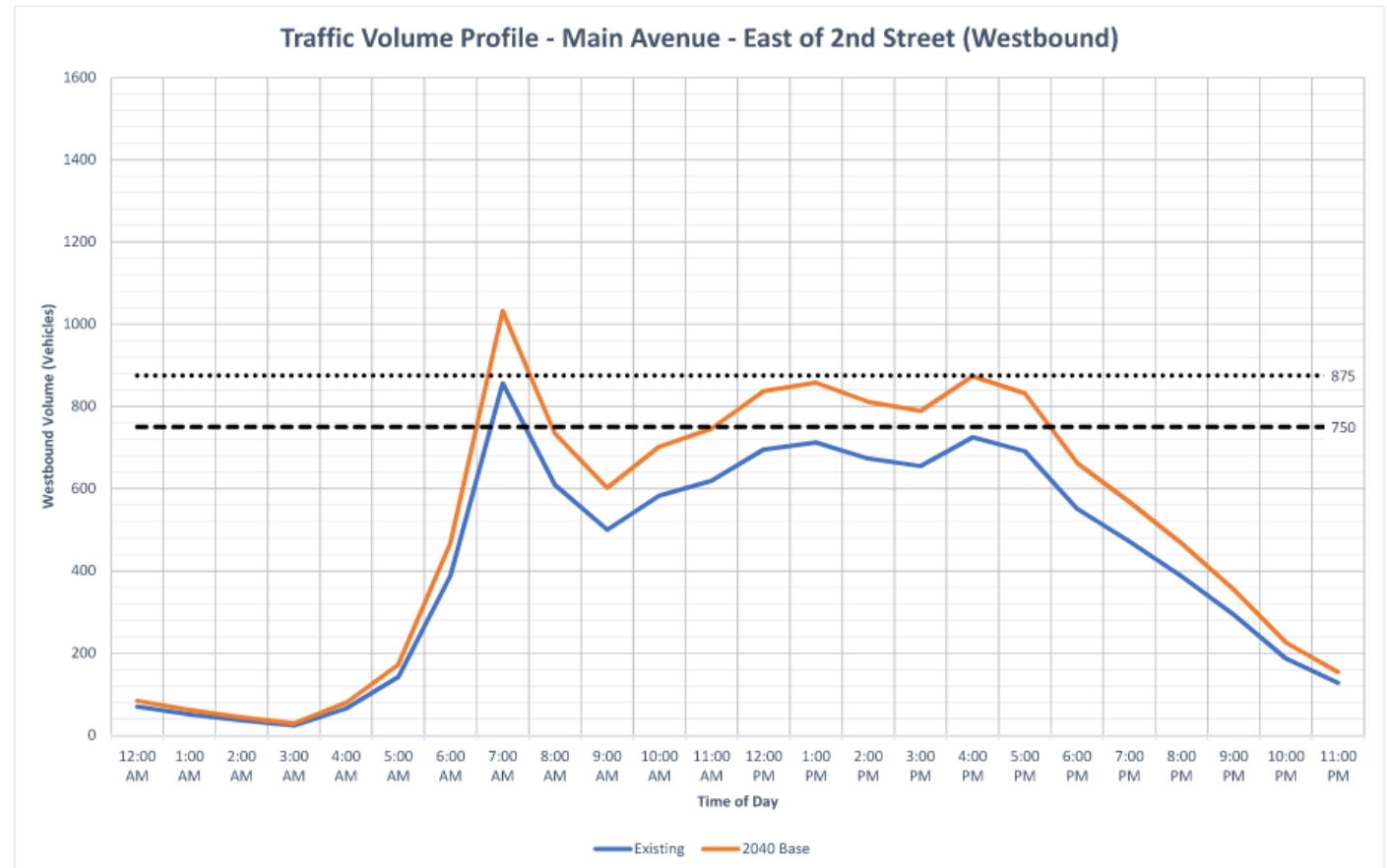
Downtown Focus Area

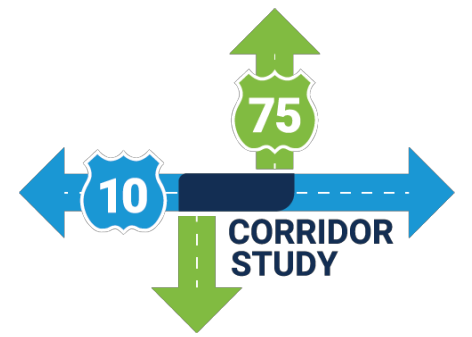
- Consideration of 3-lane roadway on Main between River and 8th:
 - Congestion expected eastbound for ~7 hours



Downtown Focus Area

- Consideration of 3-lane roadway on Main between River and 8th:
 - Congestion expected westbound for ~1 hour
 - Nearing capacity westbound for ~5 hours





US 10 East Focus Area

US 10 East Focus Area

US 10 East of Downtown

Issues & Needs

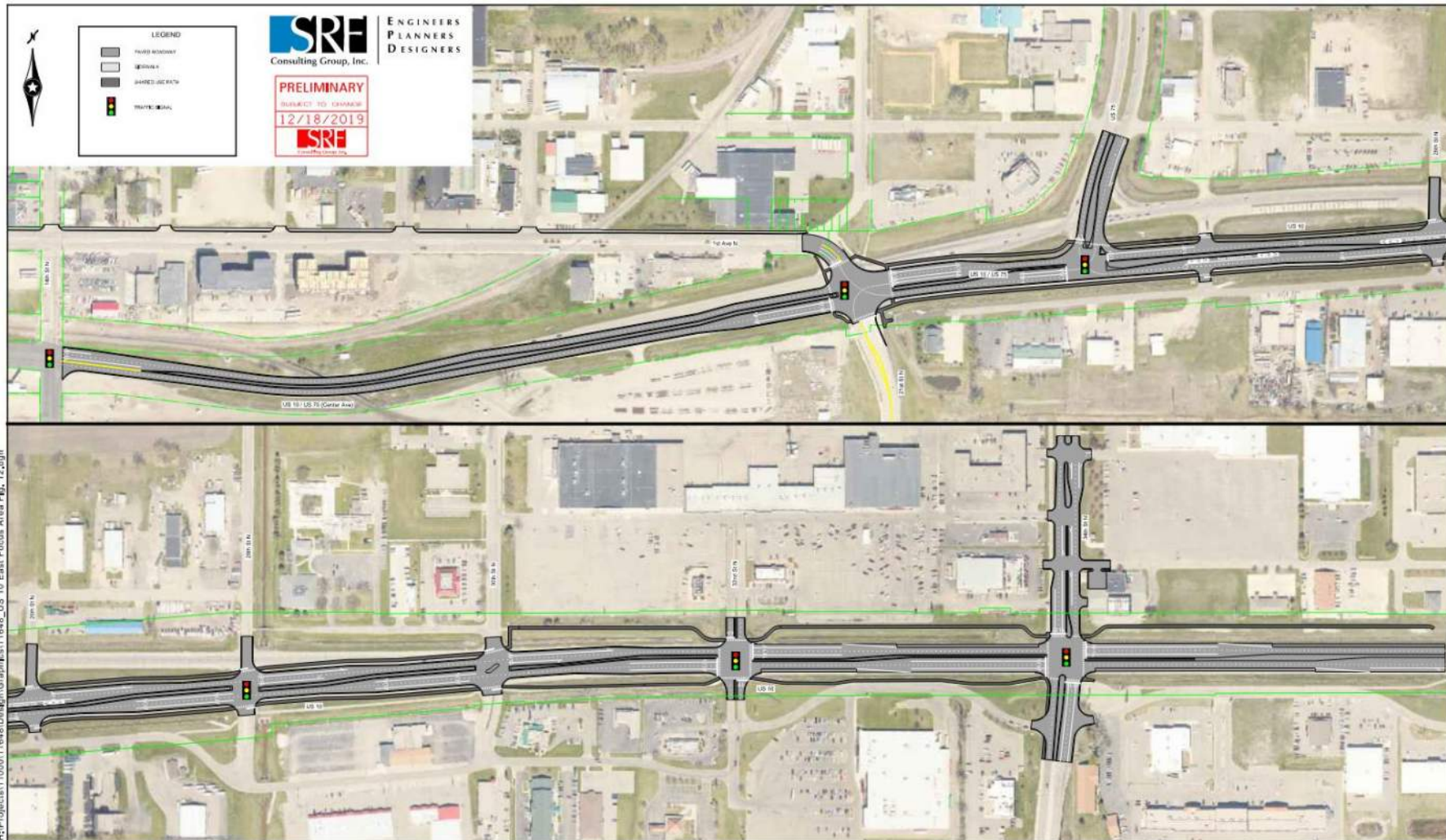
- Land uses are primarily industrial and commercial type uses but focus area has been identified as an area with opportunities for redevelopment.
- US 10 transitions from urban to rural with limited access through this focus area.
- Trails are not provided on both sides of US 10 with no pedestrian and bicycle connections to downtown.
- Need to address intersection and corridor safety issues identified.
- Need to address traffic operation issues identified at several intersections.

Community Input

- Convert to “urban” corridor by removing the ditch median to be consistent with the roadway both east and west of the focus area.
- Limit movements that can be made at certain intersections to help improve safety.
- Construct trails along both the north and south sides of corridor.
- Consider pedestrian and bicycle underpasses at US 10/US 75 and 21st Street/1st Avenue intersection.
- Maintain opportunity for vehicle inspection site.

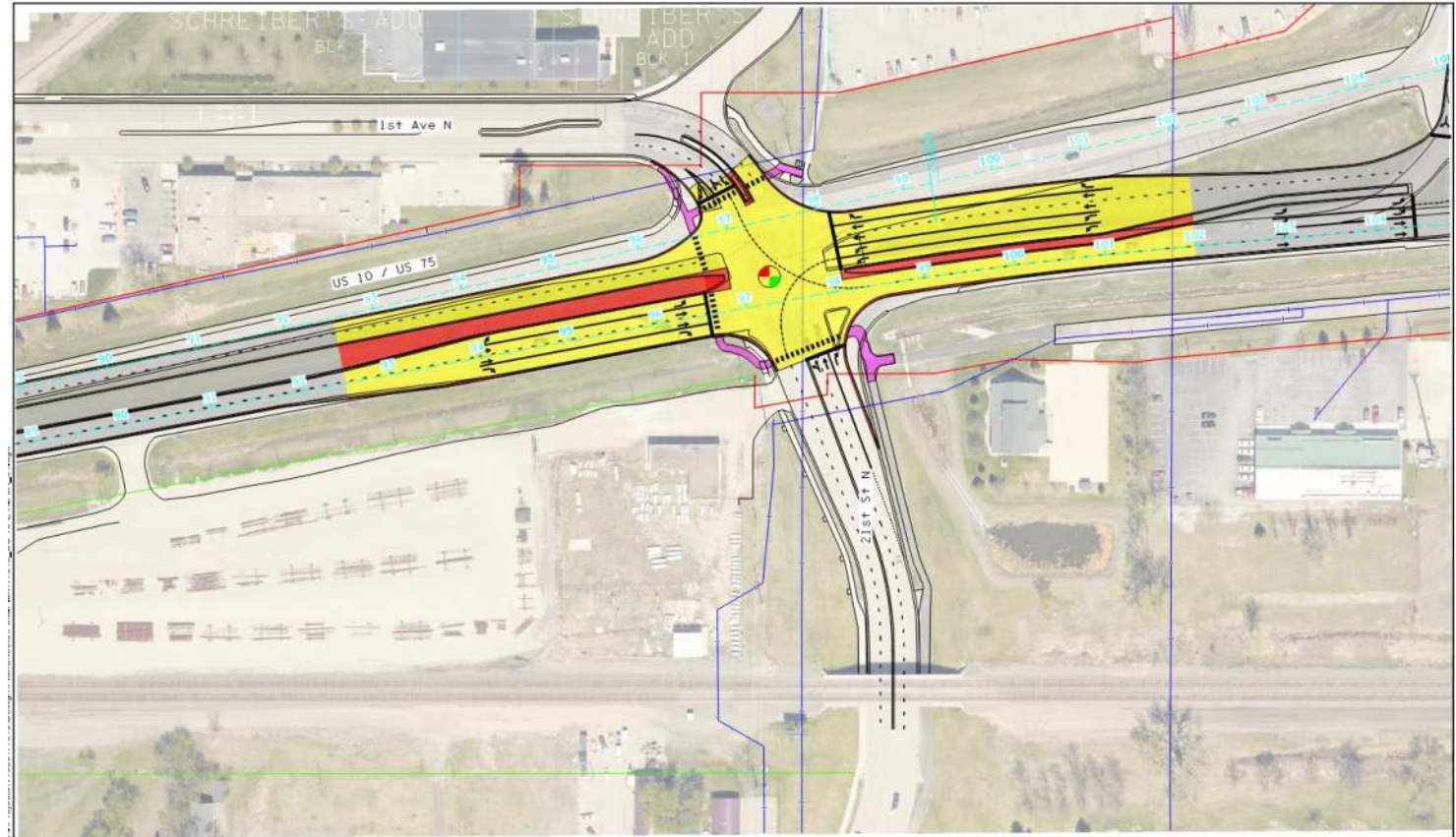
US 10 East Focus Area

- Access restrictions with full access at 28th Street:



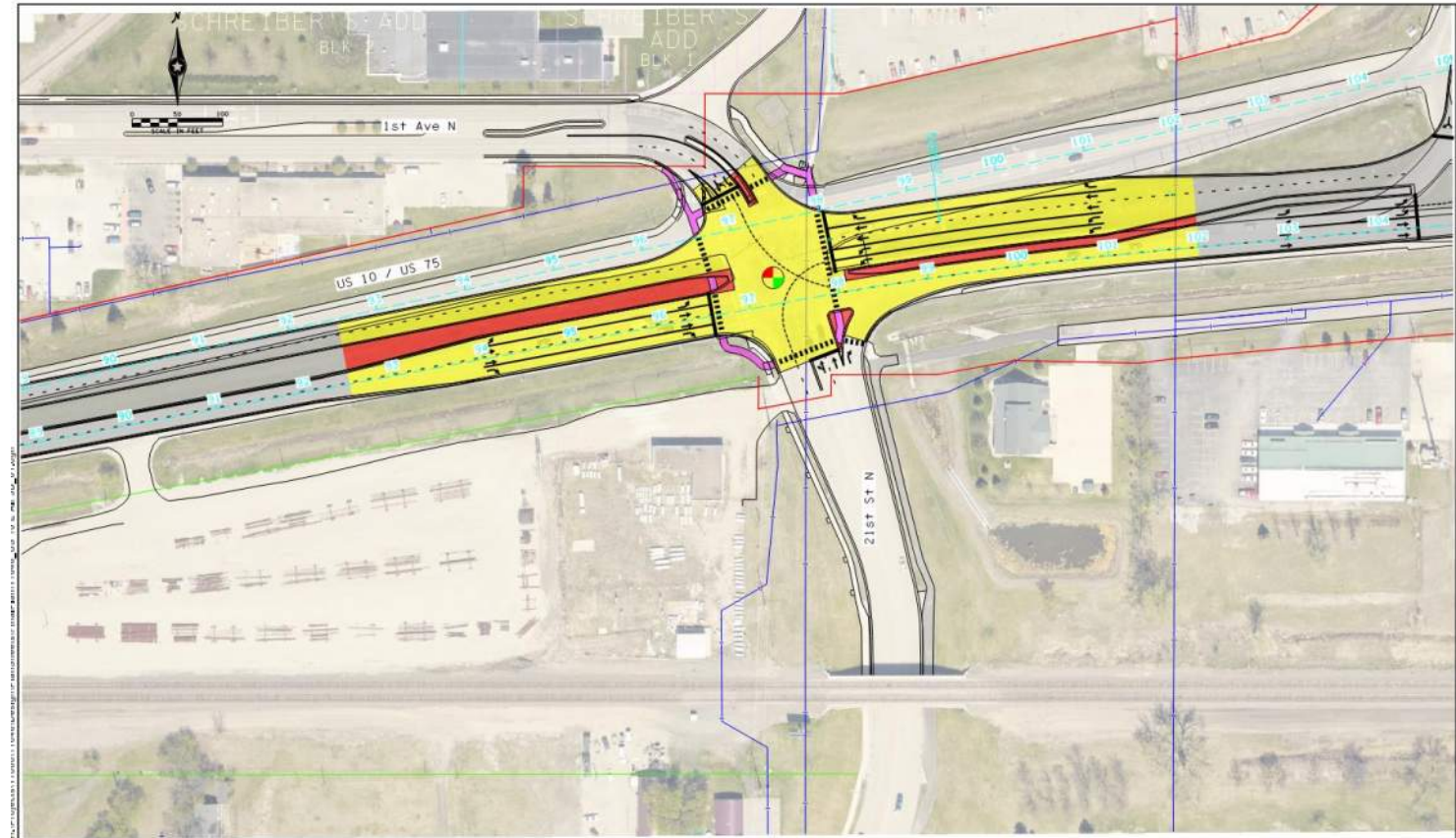
US 10 East Focus Area

- Split Phase Alternative (3A)
 - Eliminated NBR Channelized Right-Turn provides opportunity for NBR/WBL Overlap Phase – Improved Operations.
 - With narrowed median on the east side – the NB/SB Ped crossing is no longer two-stage. This will result in about 40 seconds of walk time with pedestrians crossing, which will impact operations for EB/SB movements. Therefore, this pedestrian crossing is eliminated.



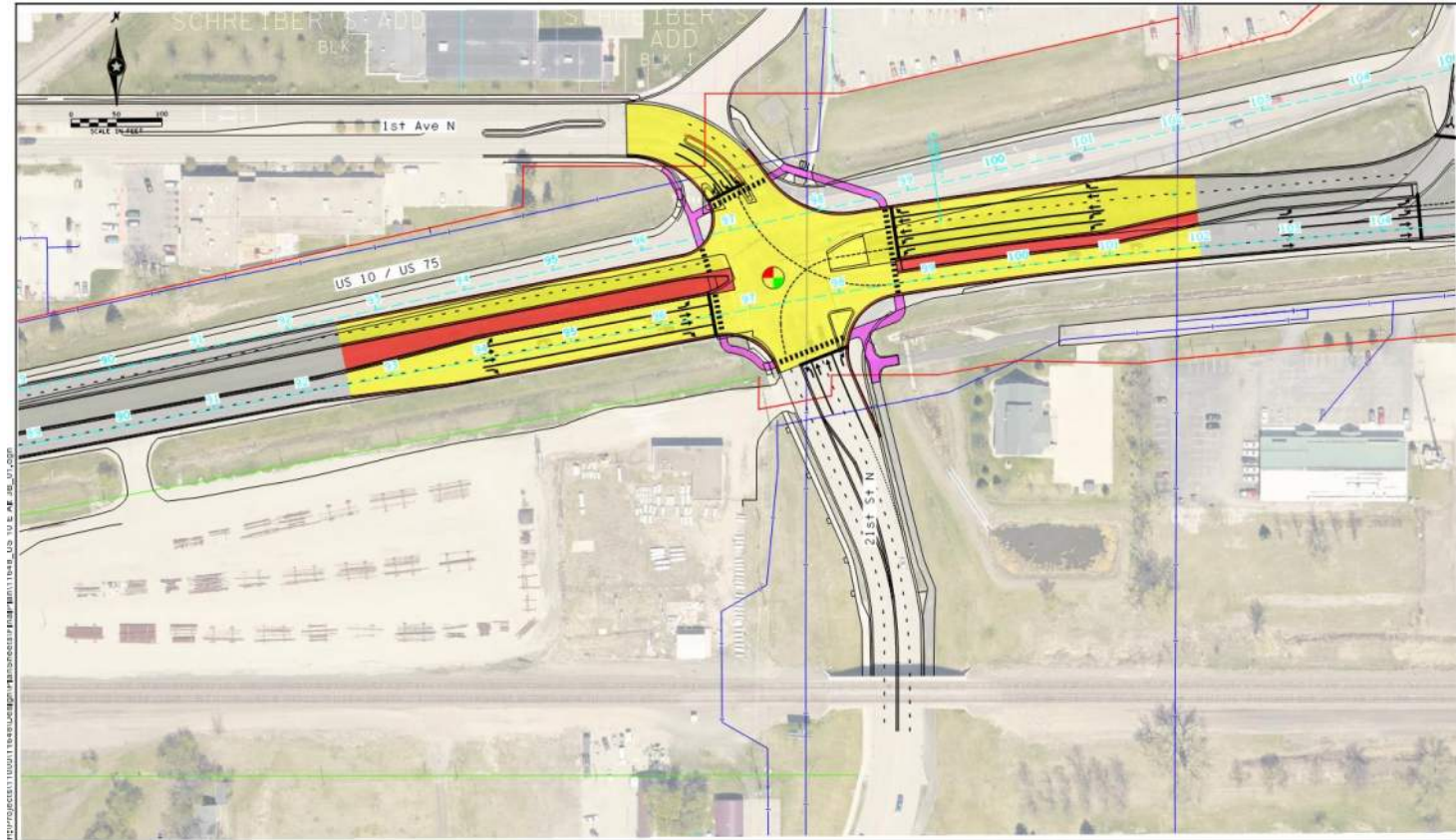
US 10 East Focus Area

- Split Phase Alternative (3A optional)
 - Channelized NBR turn reintroduced to provide pedestrian crossing.
 - The NB/SB Ped crossing is still anticipated to impact operations for EB/SB movements



US 10 East Focus Area

- Split Phase Removed (3B)
 - Improved operations.
 - Shifts the WB Approach back (needed for SBL turning movements). This creates an awkward intersection.
 - With the WB approach shifted back, the configuration results in a potentially unsafe crossing for the NBR to EB and WBR to NB, since the pedestrian crossing is essentially at the end of the turn. Would likely need to eliminate pedestrian crossing.



US 10 East Focus Area

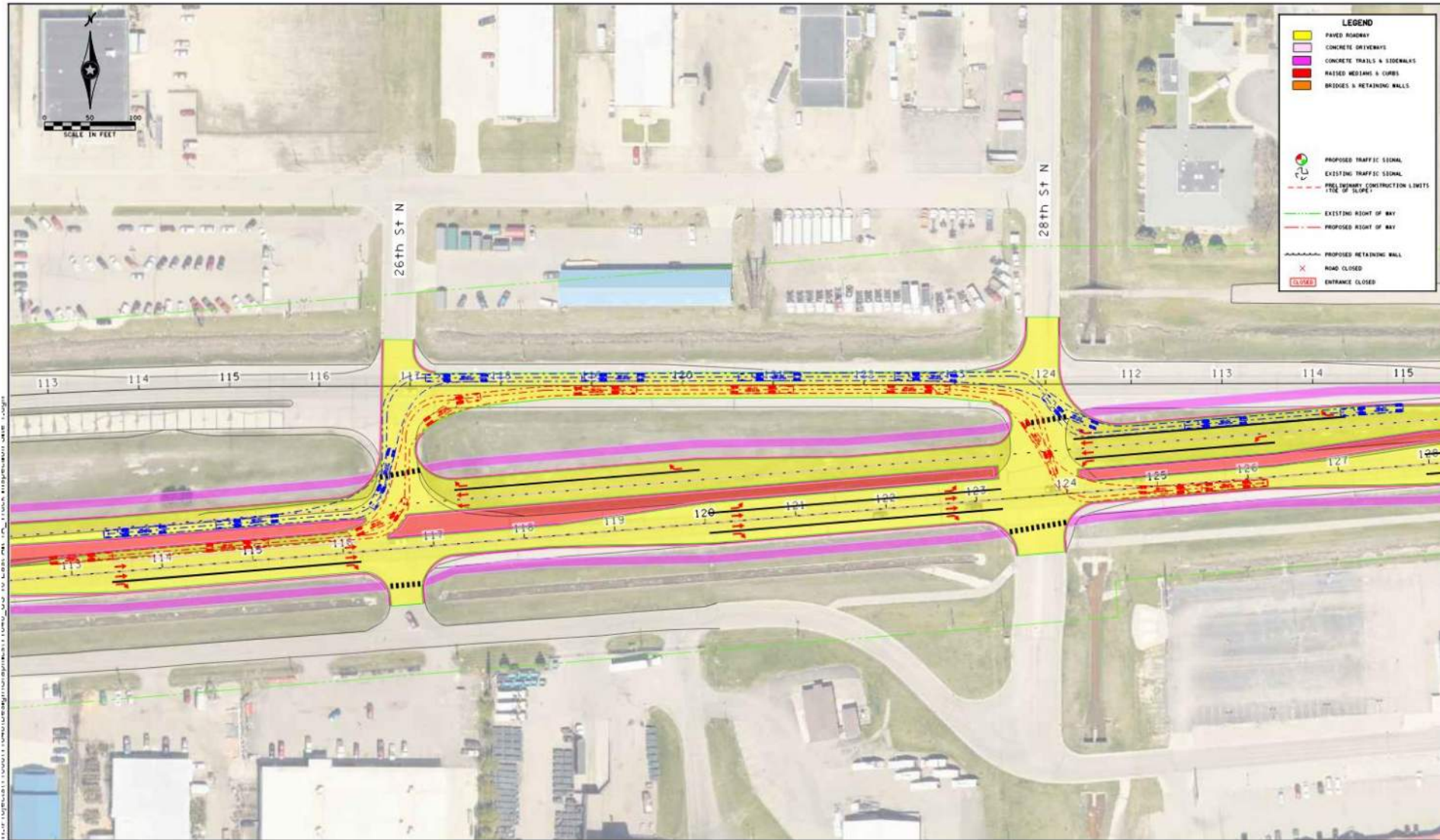
- Access restrictions to Frontage Road along 34th Street impacts transit route:



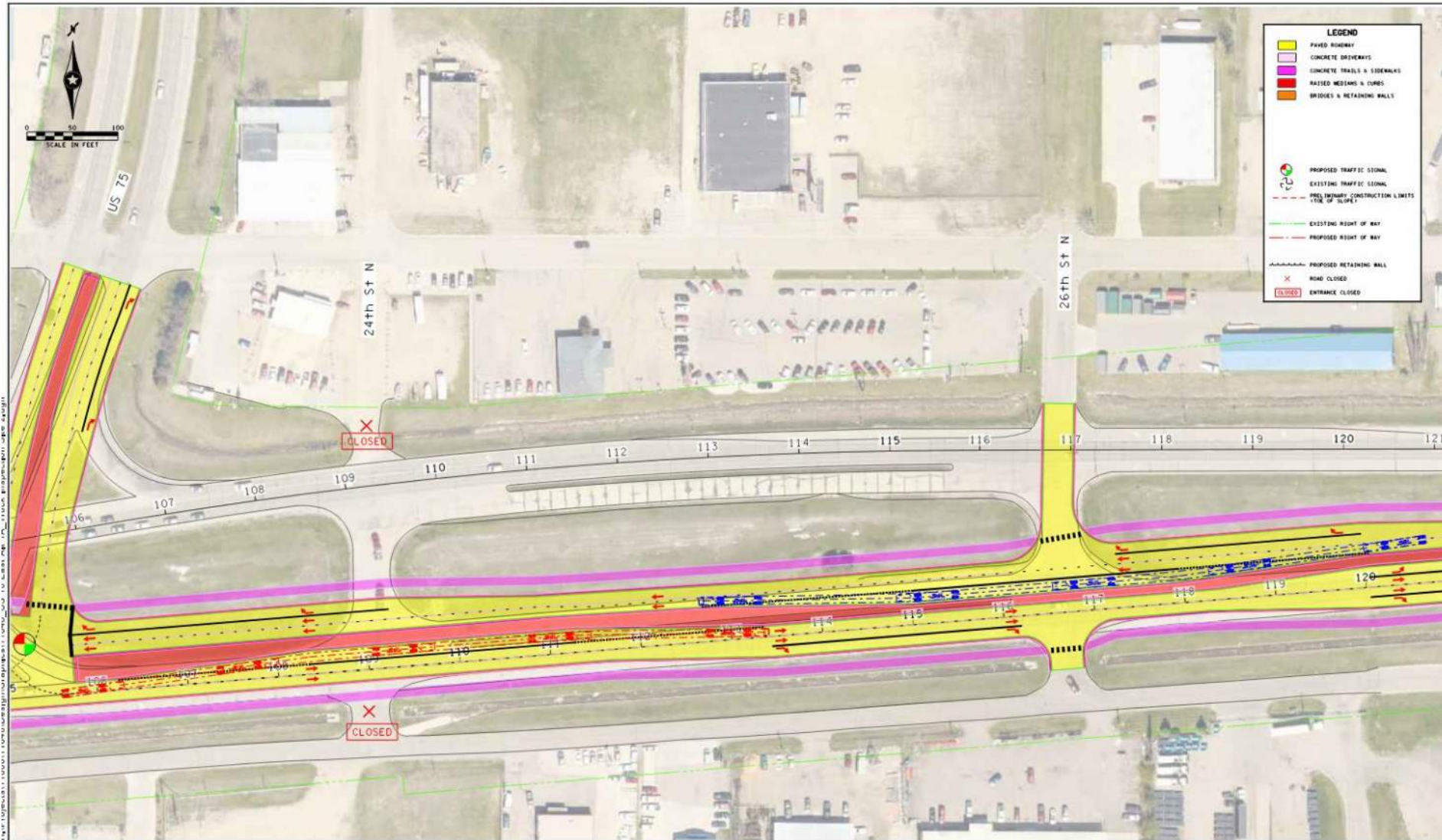
US 10 East Focus Area

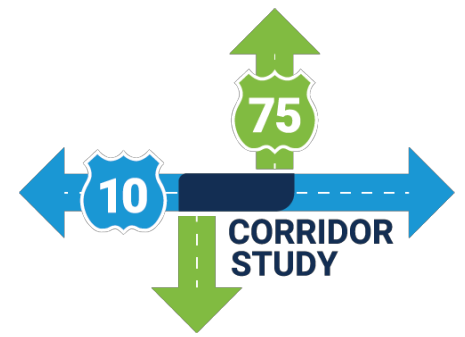
- Four options to maintain an inspection site along US 10 east of US 75, assuming 28th Street is the main access in the future:
 - Utilize existing WB US 10 on the north side of the new alignment. Truck turn moves were confirmed.
 - Provide pull-off in each direction (in median) for both EB and WB.
 - Provide pull-off in each direction (on shoulder) for both EB and WB (like what exists today).
 - Utilize the city-owned property (transfer station) in the SW corner of the US 10/28th Street.

US 10 East Focus Area



US 10 East Focus Area





US 75 South Focus Area

US 75 South Focus Area

US 75 South of Downtown

Issues & Needs

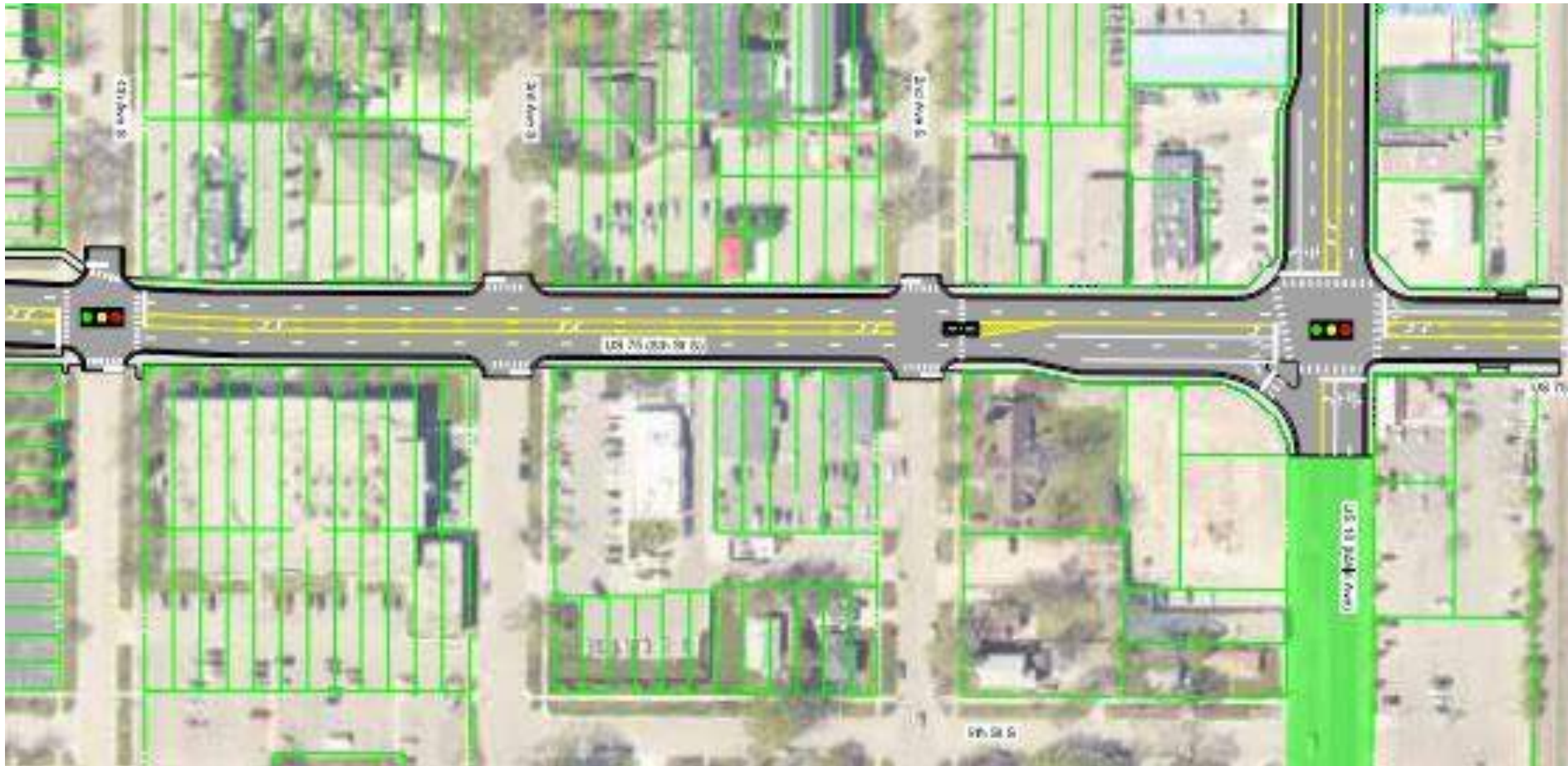
- Area roughly encompasses the neighborhoods surrounding the three main higher education institutions in the City (Concordia College, Minnesota State University Moorhead, and Minnesota State Community and Technical College).
- Commercial uses on the northern end transition to low/medium density housing to institutional use (Concordia College) as you head south.
- Pavement conditions are poor.
- Direct driveway access is provided throughout corridor to commercial and residential properties.
- Corridor bisects Concordia College Campus with high pedestrian activity.
- Event traffic at Concordia College needs to be considered.
- Traffic safety and operation issues were identified at some intersections.

Community Input

- Corridor “feels like a highway”.
- Need to consider multi-use path along US 75 (8th Street).
- Need to address safety concerns along US 75 (8th Street) between Main Avenue and 4th Avenue.
- Consider removing the existing “jog” in US 75 (8th Street).
- Heavy pedestrian activity crossing at 2nd Avenue.

US 75 South Focus Area

- Changes between Main Avenue and 4th Avenue:



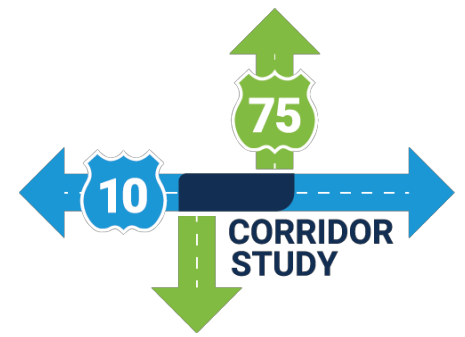
US 75 South Focus Area

- Eliminate lane shift between 4th Avenue and 6th Avenue:



US 75 South Focus Area

- December 2019 Recommendations from MnDOT's Pedestrian and Bicycle Unit:
 - [See document](#)



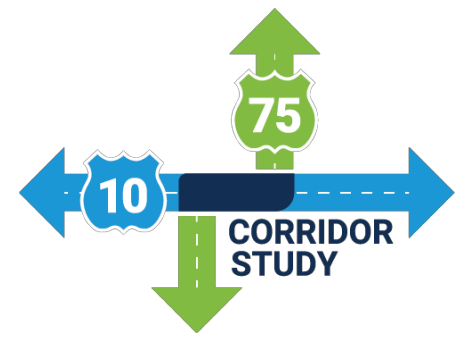
Public & Stakeholder Engagement

Public & Stakeholder Engagement

- Website Updates: **Ongoing**
- Engagement (Public Open House): **Week of February 10th or 17th, 2020**
- **Opportunity for Pop-Up Event (Frostival – Saturday, February 1st)?**
 - **Outdoor events at the Hjemkomst Center**

Public & Stakeholder Engagement

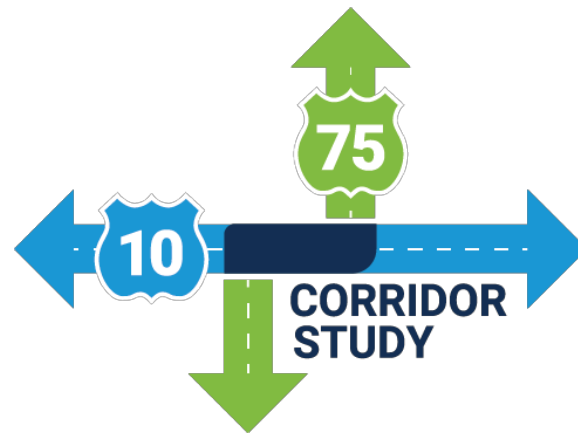
- Purpose: **Inform Public of “What we Heard” and Study Recommendations**
- Outline
 - About the Study – Goals, Process
 - Defining the Purpose and Need
 - Engaging the Community – Opportunities for Input, What we Heard
 - Vision for US 10 and US 75 Corridors
 - Implementing the Visions



Next Steps

- Draft Report
 - Submit Revised Draft Report to SRC: **January 13, 2020**
 - **SRC Review Time: January 13-31, 2020 (allows 3 weeks)**
 - Submit Updated Draft Report to SRC: **February 7, 2020**
- Confirm Engagement: **Week of February 10th or 17th, 2020**
- Draft Engagement Materials (during SRC review of Draft Report)

Thank you!



Downtown Focus Area – SRC #6 | 1/8/2020

Vision		Status	Resolution ⁽¹⁾
1	11th Street Grade-Separation	What is status of study? How should we “show” improvements on vision?	A / R / N
2A	3-Lane Cross-Section along Center Avenue between 8th Street and 11th Street	3-lane on Center Avenue provides acceptable traffic operations and is consistent with recent changes west of 8th Street MnDOT’s Ped/Bike Unit recommends separated and protected bikeway facility (not consistent with changes west of 8th) Queuing issues ⁽³⁾ with 3-lane between Center Avenue and Main Avenue due to close intersection spacing	A / R / N
2B	3-Lane Cross-Section along 8th Street between Center Avenue and Main Avenue		A / R / N
3A	Add Trail on the North Side of 1st Avenue between 11th Street and 21st Street/1st Avenue	Feasible to add trail connection	A / R / N
3B	Add Trail on the North or South Side of Center Avenue (US 10/75) between 11th Street and 21st Street/1st Avenue	Long-term recommendation for when railroad bridge is reconstructed Near-term recommendation is 3A	A / R / N
4	One-Way to Two-Way Conversion along 5th Street between Main Avenue (US 10) and 2nd Avenue	Recommendation from study – configuration coordinated with City of Moorhead staff	A / R / N
5A	Maintain 5-Lane Roadway on Main Avenue (US 10) between the River and 8th Street	Acceptable considering daily volumes ⁽²⁾ (Existing = 18,500, 2045 @ 0.5% = 21,500, 2045 @ 1.0% = 24,900) Peak hour modeling ⁽³⁾ has operational issues Consistent with MnDOT’s Ped/Bike Unit recommendations	A / R / N
5B	Modify the Main Avenue (US 10) Cross-Section to a 3-Lane Roadway		A / R / N
6A	Add Dynamic Signage to Notify Vehicles of Approaching Trains	Recommendation from study	A / R / N
6B	Add Pedestrian Crossing Enhancements at Main Avenue (US 10)/7th Street	Consistent with MnDOT’s Ped/Bike Unit recommendations	A / R / N
6C	Increase the Sidewalk Width along 8th Street between 1st Avenue and Center Avenue	Recommendation from study (future project since will be part of City roadway system)	A / R / N
6D	Utilize Dead-End Space for Parking, Streetscaping, Park Space, etc.	Recommendation from study – input from DMI study to lead this future effort	A / R / N
6E	Add Streetscaping Elements and Reduce Roadway Width along Center Avenue (US 10/75) between 14th Street and 21st Street/1st Avenue to Reduce Travel Speeds	Ongoing coordination needed in PE phase with MnDOT’s aesthetic initiative	A / R / N
7	Restrict or Close Driveway Accesses in Downtown	Need SRC input for inclusion in study	A / R / N

Note:

(1) “A” = Accept, “R” = Reject, “N” = Need more information

(2) FHWA suggests that roadways under 20,000 ADT can be good candidates, with a maximum threshold of 25,000 ADT (Source: FHWA Road Diets)

(3) Modeling assumes 1.0% growth rate and future jurisdictional transfer of US 75

US 10 East Focus Area – SRC #6 | 1/8/2020

Vision		Status	Resolution ⁽¹⁾
1A	Remove the Grass Ditch Median along Center Avenue between the 21st Street/1st Avenue and 32nd Street Intersections with Access Restrictions (28th Street is Full Access)	30th Street does not provide the same regional connectivity as 28th Street provides since 30th Street dead-ends approximately one-half mile to the north of Center Avenue; however, 1A: <ul style="list-style-type: none"> Removes an existing signal at 32nd Street – coordination with the Eastern Shopping Center would be needed and potential modifications to their parking lot to encourage vehicles to exit onto 30th Street or 34th where signals would be provided Removes pedestrian crossings on Center Avenue are removed at 32nd Street Impacts transit with closure of 24th Street – need to coordinate with MATBUS to determine how transit would be re-routed or if an eastbound right-in is needed 	A / R / N
1B	Remove the Grass Ditch Median Along Center Avenue between the 21st Street/1st Avenue and 32nd Street Intersections with Access Restrictions (30th Street is Full Access)		A / R / N
2	Add Trail on Center Avenue between 21st Street/1st Avenue and 28th Street	Recommendation from study	A / R / N
3A	Center Avenue (US 10/75)/21st Street/1st Avenue Intersection – Modify Intersection Configuration but keep Split Phasing	Split phasing operates acceptably but not as efficient as removing the existing split phasing Removing split phasing requires westbound stop bar to be pushed east, likely removing pedestrian crossing – would be more operationally efficient if pedestrian bridge overpass/underpass (Alt 6) were provided removing the crossings Narrowing median eliminates existing 2-stage pedestrian crossings Multi-lane roundabout is over capacity with during both peak hours	A / R / N
3B	Center Avenue (US 10/75)/21st Street/1st Avenue Intersection – Modify Intersection Configuration with Protected/Permitted Left-turn Phasing		A / R / N
3C	Center Avenue (US 10/75)/21st Street/1st Avenue Intersection – Construct a Multi-Lane Roundabout		A / R / N
4A	Center Avenue (US 10)/US 75 East Junction – Modify Intersection with Typical Signal Phasing	4A revises intersection now requiring eastbound traffic to “stop” Continuous Green-T intersection is not consistent with “urban” character Potential eastbound queuing concerns with roundabout during PM peak (queues are approximately 370 feet) – queues could back-up into 21st Street/1st Avenue intersection	A / R / N
4B	Center Avenue (US 10)/US 75 East Junction – Construct an Urban Continuous Green-T		A / R / N
4C	Center Avenue (US 10)/US 75 East Junction – Construct a Multi-Lane Roundabout		A / R / N
5A	Center Avenue (US 10)/34th Street Intersection – Relocate/Restrict Access to the North and Restrict South Frontage Road to Right-In/Right-Out	Three-quarter access has queuing issues/concerns with close spacing between frontage road and US 10 Right-in/Right-out impacts transit – need to determine alternate route	A / R / N
5B	Center Avenue (US 10)/34th Street Intersection – Relocate/Restrict Access to the North and Restrict South Frontage Road to Three-Quarter Access		A / R / N
6	Grade Separated Pedestrian/Bicyclist Crossing Between 21st St/1st Ave and US 75 East Junction	Influences recommendation for 4A vs. 4B vs. 4C Assume as recommendation? Location?	A / R / N
7A	Vehicle Inspection Site – use existing WB US 10	Need discussion with SRC City’s preference is to redevelop their property if other viable options exist	A / R / N
7B	Vehicle Inspection Site – pull-off in median		A / R / N
7C	Vehicle Inspection Site – pull-off on shoulder		A / R / N
7D	Vehicle Inspection Site – use City property		A / R / N

Note:

(1) “A” = Accept, “R” = Reject, “N” = Need more information

US 75 South Focus Area – SRC #6 | 1/8/2020

Vision		Status	Resolution ⁽¹⁾
1	Access Modifications between Main Avenue and 4th Avenue, with signalization at 4th Avenue and pedestrian crossing at 2nd Avenue	Coordinated alternative with City of Moorhead staff as 2nd Avenue intersection has crash issues – confirm with SRC?	A / R / N
2	8th Street (US 75) Lane Alignment Shifts at 4th Avenue and 5th Avenue	Significant community input asking to address shift – does impact on-street parking	A / R / N
3A	Construct Trail on the East Side of 8th Street (US 75) between Main Avenue (US 10) and 12th Avenue	Trail would impact existing trees and utilities, and impact private property Recommendations inconsistent with MnDOT's Pedestrian and Bicycle Unit – need review and discussion by SRC	A / R / N
3B	Identify an Alternative Corridor for a North/South Pedestrian/Bicycle Connection	4th Street/5th Street or 11th Street are alternative corridors for consideration Wayfinding signage would be provided along 12th Avenue to direct pedestrians/bicyclists to the alternative route	A / R / N
4	12th Avenue Intersection	Recommendation from study is to adopt 12th Avenue study recommendations	A / R / N
5A	20th Avenue Intersection – Signalize with Closing Both the East and West Frontage Roads at 20th Avenue	Close access to frontage roads does not address any safety issues Re-installation of signal provides comparable operations in 2045 to roundabout Roundabout would likely have Right of Way impacts	A / R / N
5B	20th Avenue Intersection – Signalize	Traffic signal is consistent with recommendations from MnDOT's Pedestrian and Bicycle Unit	A / R / N
5C	20th Avenue Intersection – Consider Multi-lane Roundabout	Traffic signal 2045 average delay per vehicle/level of service: AM = 8.1/A, PM = 12.7/B Roundabout (2x1) 2045 average delay per vehicle/level of service: AM = 11.5/B, PM = 11.5/B	A / R / N

Note:

(1) "A" = Accept, "R" = Reject, "N" = Need more information

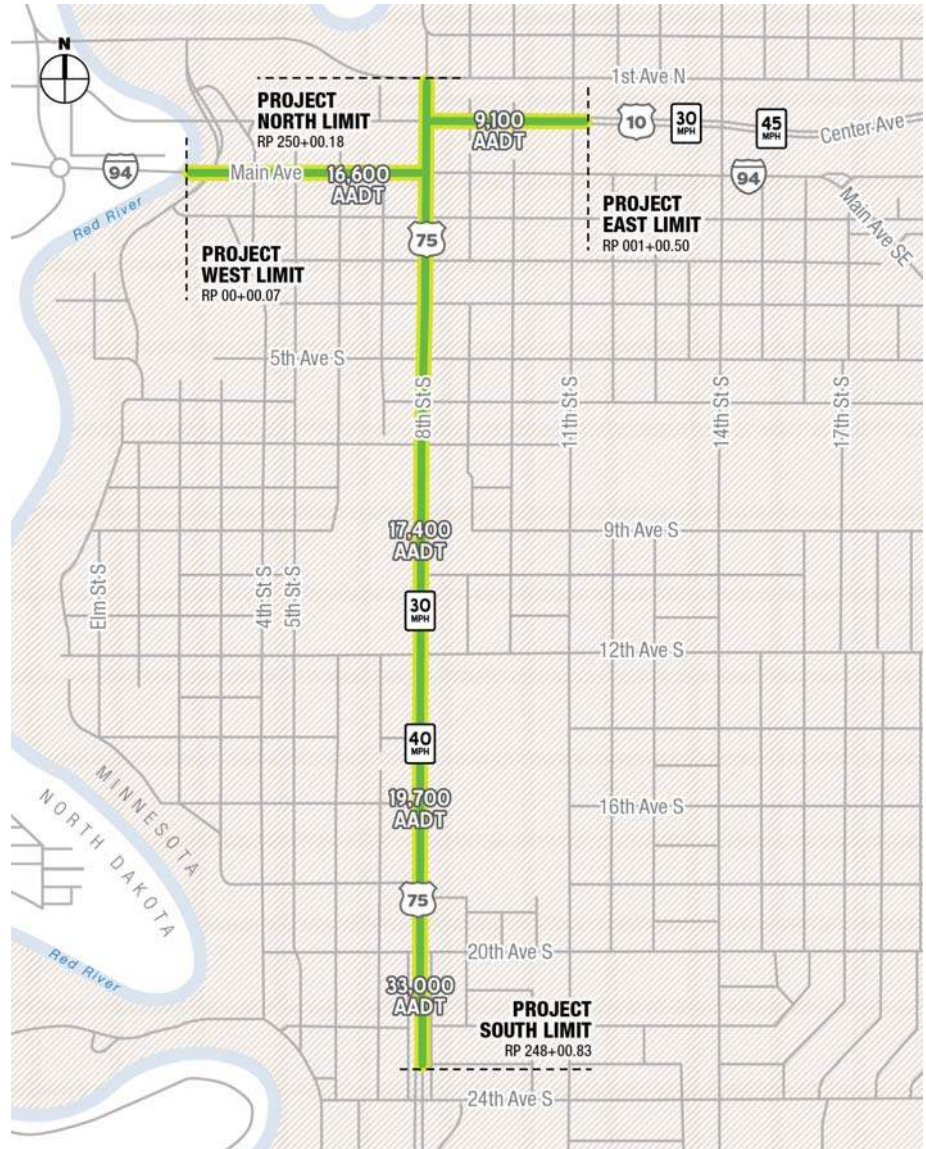
TH 75 and TH 10 ■ S.P. 1406-76 ■ MnDOT District 4

MOORHEAD

The purpose of this document is to provide non-motorized transportation improvement recommendations to be considered during scoping with the project based on the scoping decisions. These recommendations are based on observations made by MnDOT’s Bicycle & Pedestrian Safety Engineer and staff during a project field walk, along with project background and other information about the area that has been collected and reviewed. The recommendations are for scoping purposes and all concepts are intended to be discussed with the City and used to facilitate discussion with all stakeholders.

All recommendations listed are expected to comply with ADA and are in addition to ADA requirements.

This project is currently programmed as a concrete urban reconstruction.



Project scope

- The project is currently programmed as a FY 2025 urban reconstruction.
- Project limits are approximately:
 - On TH 75/8th Street S., from north of 24th Avenue S. to TH 10/Center Avenue.
 - On TH 10/Center Avenue, from the bridge joint over the Red River to 200 feet east of 10th Avenue S. or the grade separation limit.

Project background/context

- The grade separation project on TH 71 and TH 10 (SP 1401-177) is expected to occur prior to this project. The project limits of the grade separation project are assumed to be on TH 71 from 2nd Avenue S to 2nd Avenue N and on TH 10 from 8th Street S. to 11th Street S. The project includes a railroad bridge over 11th Street S. to provide separation for all modes, with a shared use path and roadway traveling under the railroad bridge. It is expected the SP 1406-76 project will coordinate with the future grade separation project.
- The SP 1406-76 project limits have been modified to align with adjacent projects. Adjacent project limits are approximately:
 - TH 75/Center Avenue from the end of the grade separation project limit on the west (approximately 14th Street), past the TH 75/US 10 intersection, east along US 10, end at 34th St; FY 2026 reconstruction with concrete pavement
- TH 75 is on the District 4 Bicycle Plan as a State Highway Bicycle Investment Route to 11th Street N., where it continues north.
- TH 75/8th Street S. is a transit line for bus route 1 for Fargo-Moorhead metro (MATBUS),

including a stop within the project limits at Concordia College.¹

Project needs

- Network connectivity: Sidewalk gaps exist within the project limits. Origins and destinations exist on the project such as Concordia College, hotels, convenience stores and historic places. Secondary schools and MN State University Moorhead, as well as parks, the Red River, and trail system are within a few blocks of the corridor on either side.
- Bicycle connections: No bicycle facilities exist along TH 75, a State Highway Bicycle Investment Route on the District 4 Bicycle Plan.
- Safer crossings: multiple intersections within the project are identified in the District Safety Plan with higher risk ratings, both for vehicles and for pedestrians and bicyclists. Two intersections have higher crash ratings (2014 to 2018) when compared with other statewide average (2011 to 2015) crash rates of similar intersections.

General recommendations

- Provide a roadway reconfiguration along TH 75 that allows for both a continuous bikeway facility and a separated pedestrian facility.
- Provide red-light running confirmation lights as recommended in the District Safety Plan at specific intersections within the project.

Specific recommendations

- Provide additional mid-block crossing locations across TH 75, particularly next to Concordia College.

Review signal timings at signalized intersections and provide crossings that can be made in one signal phase.

¹ Fargo-Moorhead Metro. <http://www.matbus.com/>

Recommendation: Consider Roadway Reconfiguration on TH 75

RECOMMENDED IMPROVEMENT

The following roadway reconfiguration options show possible alternatives to provide non-motorized facilities within the existing ROW. Coordinate with the City of Moorhead to determine their desired bikeway network and facility type.

Notes:

Within the urban reconstruction project, consider a 3-lane section through the City of Moorhead. FHWA suggests that roadways under 20,000 ADT can be good candidates, with a maximum threshold of 25,000 ADT.² Conduct a traffic study and traffic counts as needed in combination with the 11th Street grade separation traffic modeling. Consider starting the 3-lane section at 20th Avenue S where ADTs lower to 19,700 (2015), or at 12th Avenue S, where ADTs lower to 17,400 (2013).

Consider the roadway reconfiguration as a traffic calming measure for the desired speed of 30 mph, and as a way to add additional space for non-motorized facilities within existing ROW.

Section A – A: Option 1, 5-lane, Shared Use Paths

Provide shared use paths on both sides of TH 75 as bicycle facilities and continuous pedestrian facilities.



Narrow lanes to 11-ft. Minimize or remove shoulder width and use the 2-ft gutter pan as the curb reaction distance.

Provide minimum 6-ft boulevard space. Consider alternating street trees with pedestrian level street lighting.

Section A – A: Option 2, 3-lane, Shared Use Paths, Cycle-tracks

Provide a separated continuous bikeway facility along both sides of TH 75. Consider a cycle-track and shared use path.



Narrow lanes to 11-ft. Minimize or remove shoulder width and use the 2-ft gutter pan as the curb reaction distance.

Provide minimum 6-ft boulevard space. Consider alternating street trees with pedestrian level street lighting.

² FHWA. https://safety.fhwa.dot.gov/road_diets/

RECOMMENDED IMPROVEMENT

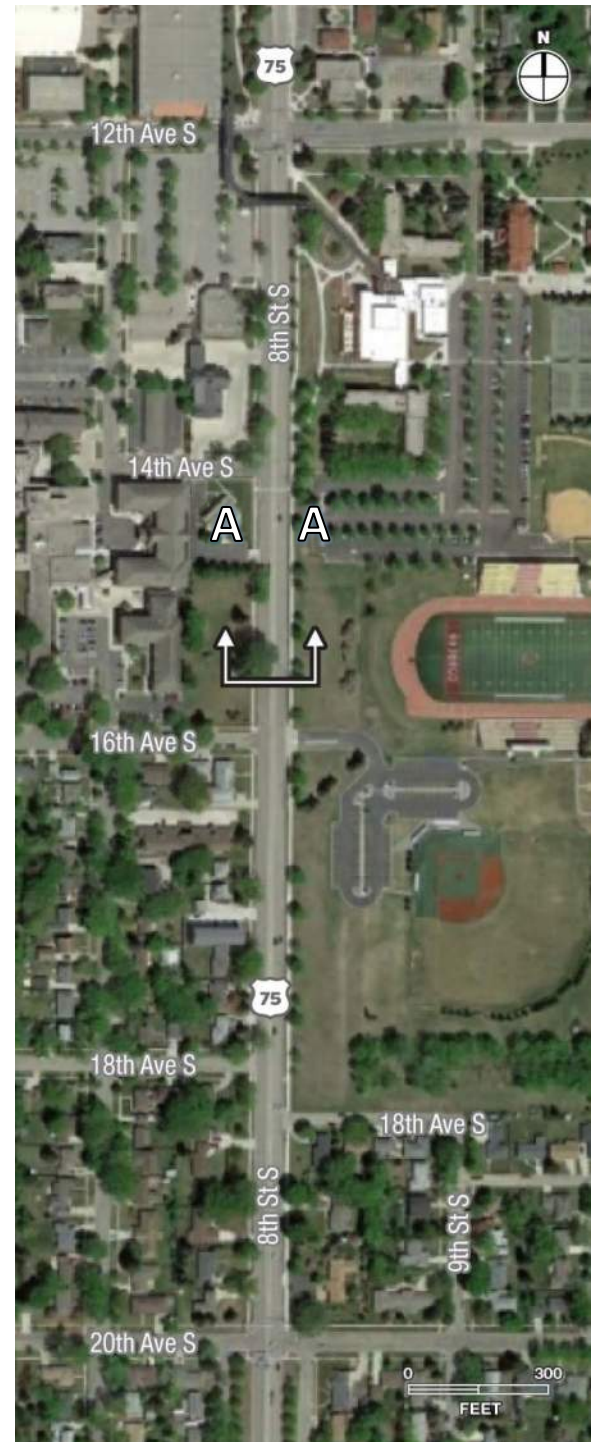
Section A – A: Option 3, 3-lane, Buffered Bicycle Lanes

Provide a continuous bikeway facility along both sides of TH 75. Consider buffered bicycle lanes.



Narrow lanes to 11-ft. Minimize or remove shoulder width and use the 2-ft gutter pan as the curb reaction distance.

Provide minimum 6-ft boulevard space. Consider alternating street trees with pedestrian level street lighting.



Existing Cross Section



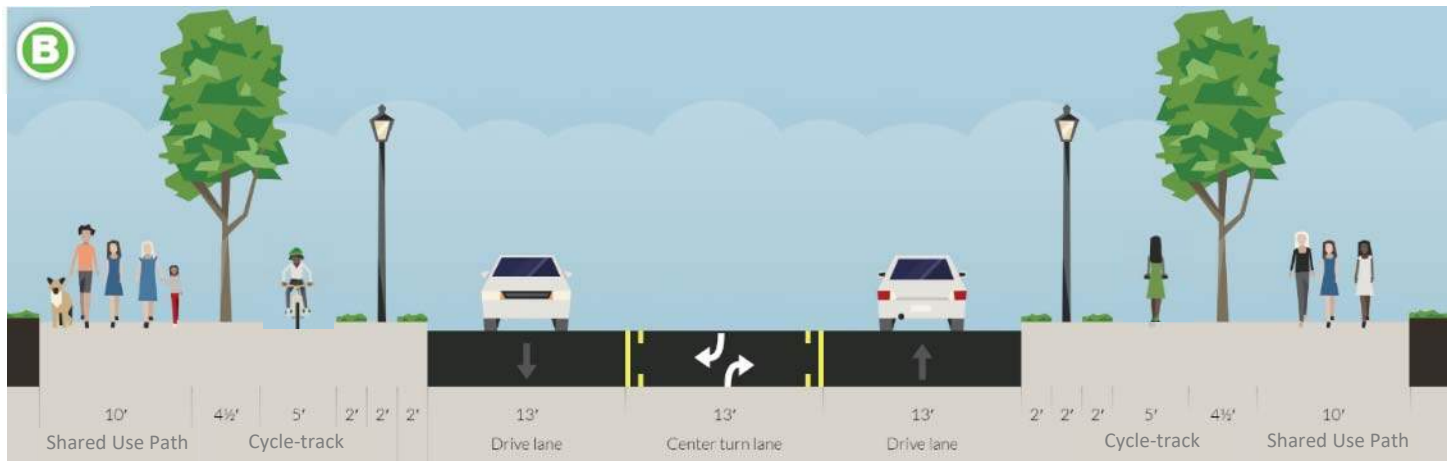
Section A – A: Option 1, 5-lane, Shared Use Paths



Project assumptions:

- Existing 90-ft ROW
- Full reconstruction
- 2-ft clear zone is included on outside of shared use paths via a limited use permit if additional ROW is not acquired
- 5-ft boulevard space is minimized in order to not acquire additional ROW; however, recommendation is to maximize separation between traffic
- Outside vehicle lane includes 2-ft curb and gutter width

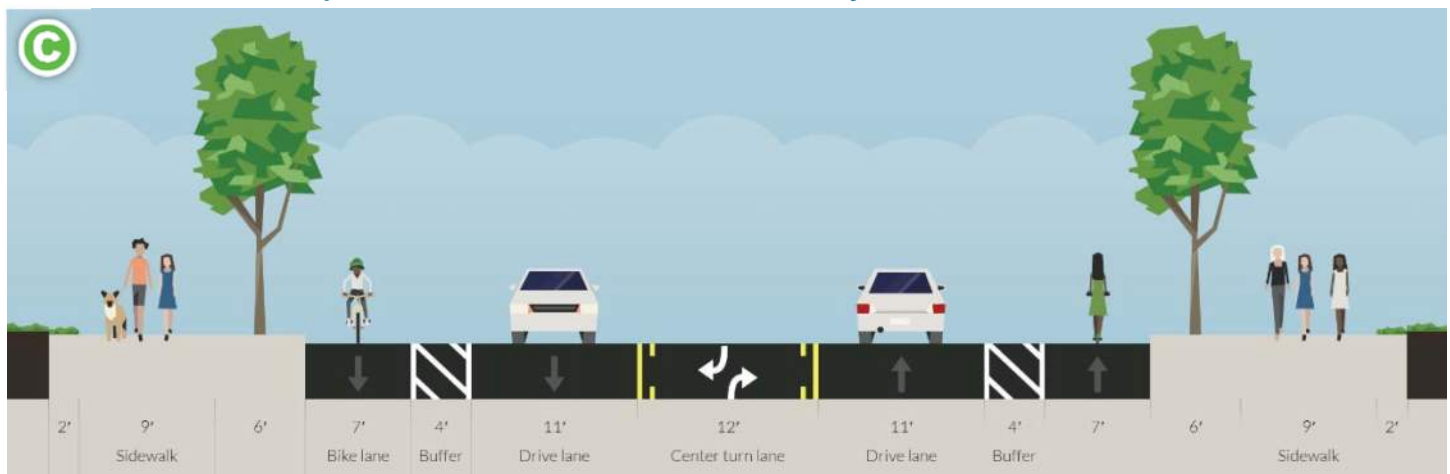
Section A – A: Option 2, 3-lane, Shared Use Paths, Cycle-tracks



Project assumptions:

- Existing 90-ft ROW
- Full reconstruction
- Trees and pedestrian level street lighting can alternate, either are acceptable treatments for vehicular/bicycle/pedestrian separation. Benches, bicycle parking, street furniture and public art in combination could also serve as acceptable separation.
- 2-ft clear zone is needed on outside of shared use path via a limited use permit if additional ROW is not acquired

Section A – A: Option 3, 3-lane, Buffered Bicycle Lanes



Project assumptions:

- Existing 90-ft ROW
- Full Reconstruction
- Bike lane width includes 2-ft gutter pan width
- Bike lane buffer width could be minimized to 2-ft and additional width provided for the sidewalk
- Vehicular lanes could be narrowed to 10-ft or 11-ft given the urban context and 30 mph speed limit

Recommendation: Consider Roadway Reconfiguration on TH 10, East of TH 75 and West of TH 75

RECOMMENDED IMPROVEMENT

Section B – B: Option 1, 3-lane, Reconstruction.

Within the urban reconstruction project, consider a 3-lane section thru the City of Moorhead. Consider FHWA and ADT threshold maximums of 25,000 ADT.³ Conduct a traffic study and traffic counts as needed. Consider starting the 3-lane section east of 4th Street S., where ADTs lower to 16,600 (2013), at 8th Street S., where ADTs lower to 10,000 (2013), or at TH 10/Center Avenue to 10th Street N and carrying the cross section through to the grade separation project.



Consider the roadway reconfiguration as a traffic calming measure to achieve the desired speed of 30 mph, and as a way to add additional space for non-motorized facilities within existing ROW.

Coordinate the roadway reconfiguration with the preferred cross section on TH 10/Main Street within the 11th Street grade separation project (SP. 1401-177). Consider ADTs on each side of TH 75 when determining the extents of the roadway reconfiguration or 3-lane section.

Narrow lanes to 11-ft.

Section B – B: Option 2, 3-lane, Reconstruction, Buffered bicycle lanes



Consider a continuous bikeway facility along TH 10 on both sides. Consider a cycle-track and shared use path or sidewalk. Confirm with the City of Moorhead, their desired bikeway facility and the existing bikeway network.

Consider same recommendations as Section B – B: Option 1.

³ FHWA. https://safety.fhwa.dot.gov/road_diets/

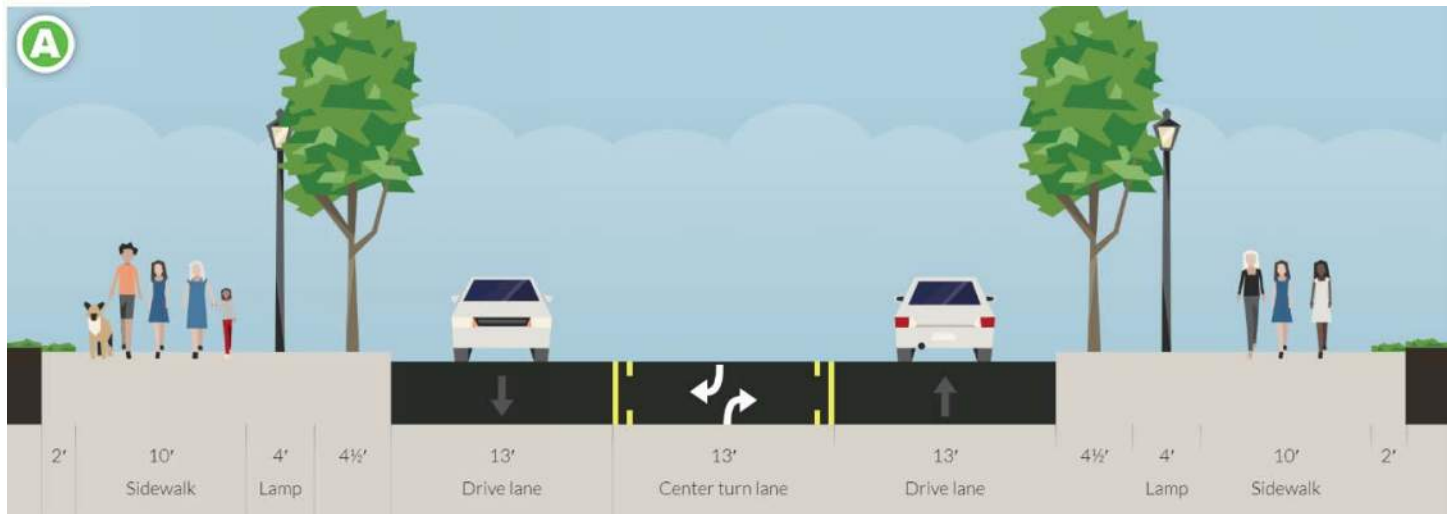
Concept B – B



Existing Cross Section west of TH 75



Concept B – B: Option 1, 3-lane, Reconstruction



Concept B – B: Option 2, 3-lane, Reconstruction, Buffered bicycle lanes



Project assumptions:

- Existing 80-ft ROW
- Full Reconstruction
- Bike lane width includes 2-ft gutter pan width
- Bike lane buffer width could be minimized to 2-ft and additional width included in the boulevard
- Vehicular lanes could be narrowed to 10-ft or 11-ft given the urban context and 30 mph speed limit

Recommendation: Provide a separated and protected bikeway facility along or adjacent to TH 75

RECOMMENDED IMPROVEMENT

Consider an advisory shoulder treatment on S. 8th Street, or on lower volume roadways adjacent and parallel to TH 75. Use signing in addition to pavement markings. The treatment is not recommended for the whole corridor, but utilizing a more preferred alternative route, while providing a continuous network for people bicycling.



Advisory shoulder markings are an innovative treatment that require an approved Request to Experiment as detailed in Section 1A.10 of the MUTCD. Discuss with the City. If provided, consider supporting the City with public education and engagement.

Consider a yield roadway or other treatments instead of an advisory shoulder on S. 8th Street.⁴ Consider a sidewalk or shared use path facility parallel to TH 75 instead of the advisory shoulder or yield roadway.



Provide a continuous shared use path along one side of TH 75, and consider both sides depending on the preferred roadway reconfiguration recommendation. Coordinate with the City of Moorhead to determine their desired bikeway network and facility type.



Depending on the roadway reconfiguration, and ownership of S. 8th Street and the frontage road, consider a sidewalk on the east side of S. 8th Street that connects to the 24th Avenue S. intersection and fills the sidewalk gap.

Note: Where bicycle facilities are implemented, also provide facilities at and through intersections. See NACTO's guide *Don't Give Up at the Intersection*.⁵

⁴ FHWA. December 2016. "Small Town and Rural Multimodal Networks."

https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/fhwahep17024_lg.pdf pg .2-3.

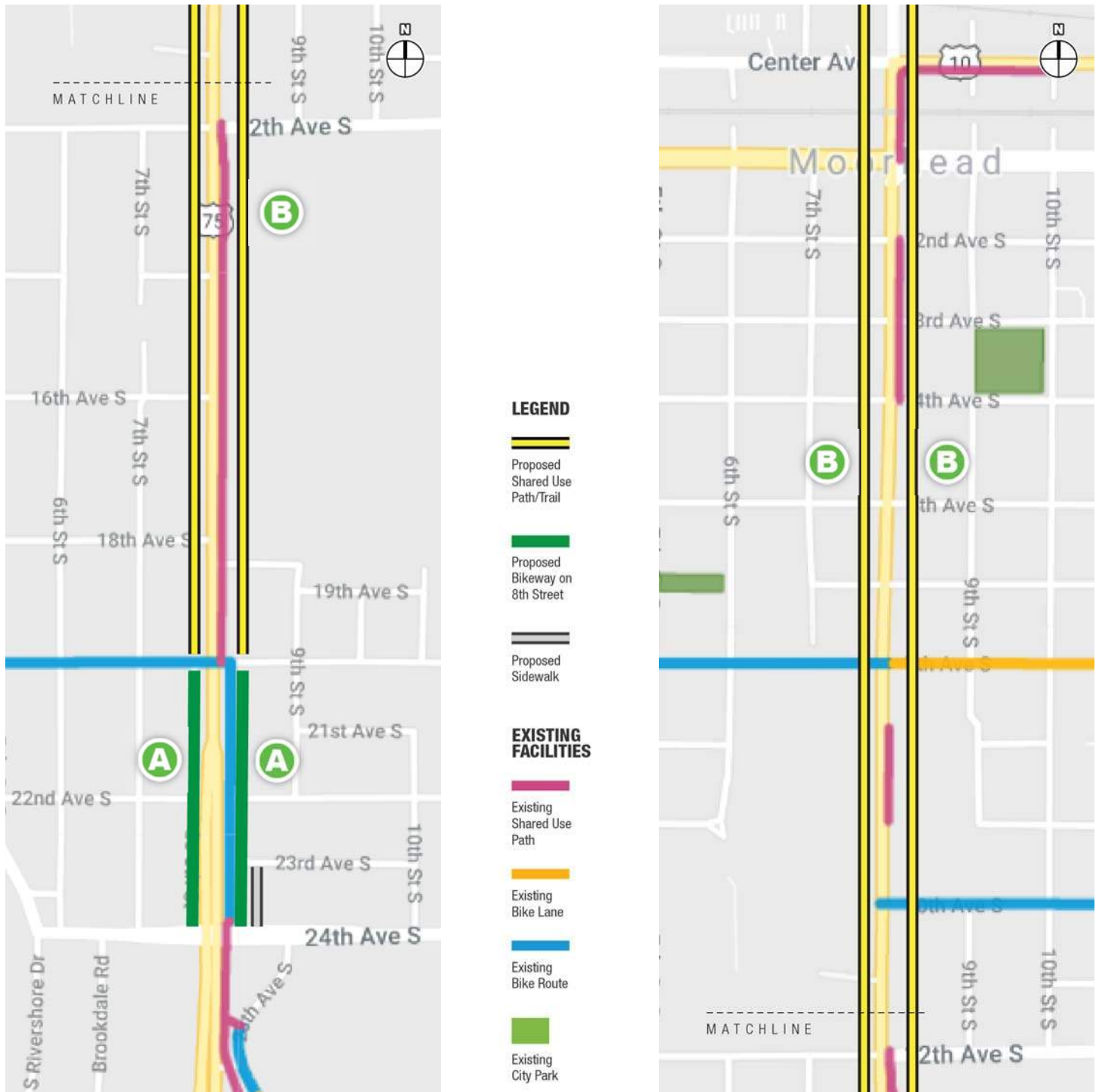
⁵ NACTO. Don't Give Up at the Intersection. May 2019. <https://nacto.org/publication/urban-bikeway-design-guide/dont-give-up-at-the-intersection/>



Example advisory shoulder markings on So. 8th St



City of Moorhead Existing Bikeway Facility Map



Source: Fargo-Moorhead Metropolitan Council of Governments. City of Moorhead existing bikeway facilities.
<http://www.fmmetrocog.org/fmbikemap>

Recommendation: Provide a separated and protected bikeway facility along or adjacent to TH 10

RECOMMENDED IMPROVEMENT

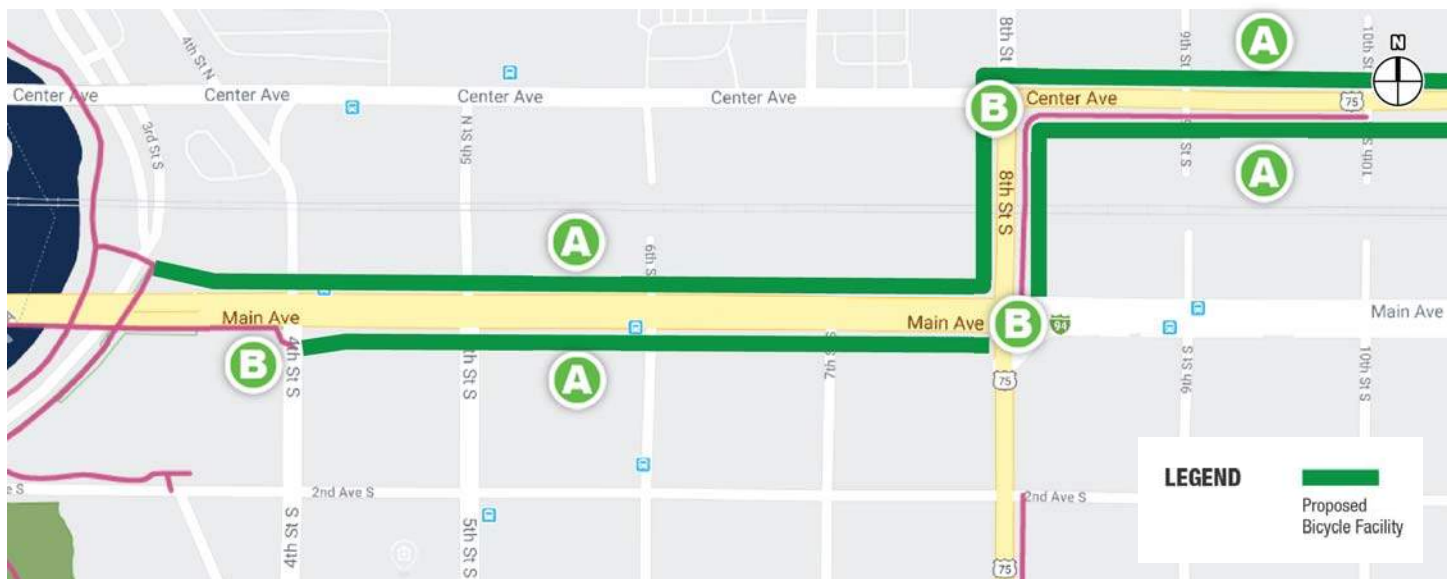


Provide a continuous bikeway facility along both sides of TH 10, depending on the preferred roadway reconfiguration. Confirm with the City of Moorhead their desired bikeway network and facility type.



If bikeway facilities are provided, mark the facilities at and through the intersections. See NACTO's guide *Don't Give Up at the Intersection*.⁶

City of Moorhead Existing Bikeway Facility Map



Source: Fargo-Moorhead Metropolitan Council of Governments. City of Moorhead existing bikeway facilities. <http://www.fmmetrocog.org/fmbikemap>

⁶ NACTO. Don't Give Up at the Intersection. May 2019. <https://nacto.org/publication/urban-bikeway-design-guide/dont-give-up-at-the-intersection/>

Recommendation: Improve connections adjacent to Concordia College

RECOMMENDED IMPROVEMENT

Conduct a survey of students, staff, and residents to determine their ideal crossing locations across TH 75 adjacent to the Concordia College campus. Phrase questions in a way that encourages people to think about how they would like the network to look rather than how it exists today. Consider doorways and destinations on the college campus and people's tendency to walk in the shortest path. Consider conducting video counts along the section; however, consider the effect of the existing fencing.

A

Consider a midblock pedestrian crossing at 11th Avenue S, between the signalized intersection and the existing pedestrian hybrid beacon (PHB) at 10th St, given the spacing is greater than 1/8 of a mile between controlled crossings.⁷ Provide a pedestrian refuge island. Consider removing the multiple threat for this crossing within the roadway reconfiguration.

Consider the loading docks or driveways on each side of TH 75 when considering placement of the crossing. Consider the transit station, and provide connecting sidewalk outside of the vehicular paths on either side of TH 75.

Consider treatments used at Macalester College in St. Paul, MN, shown below. Consider narrowing the roadway cross section specifically for segments where crossings are desired. Provide a median pedestrian refuge island with signs informing who has the ROW. Consider the treatment with caution, as crashes have still occurred despite treatments and education.

B

Consider removing the fence along the college to allow pedestrians or students to cross at their desired locations. Evaluate the pedestrian crossing needs that caused the placement of the fence. Enhance the crossing treatments at those locations. Consider the environment for people walking and bicycling in and around the Concordia college campus, a major origin and destination, on either side of TH 75.

Remove the temptation for pedestrians to use the non-compliant sidewalk space next to traffic and immediately adjacent to the curb. Add this space to the sidewalk.

Discuss with the City and Concordia College.

C

Maintain pedestrian crossing with the PHB at 10th Ave/ Concordia College. Consider providing additional warning devices prior to the crossing such as signing or lighting because of the sight distances and shade caused by the street trees.

⁷ MnDOT (2017). "Pedestrian Crossing Facilitation." MnDOT Tech Memo No. 15-01-T-01. <https://techmemos.dot.state.mn.us/>



Example at Macalester College in St. Paul, MN



Recommendation: Consider pedestrian crossings across TH 75 and TH 10 at uncontrolled crossing locations

RECOMMENDED IMPROVEMENT

A

Consider pedestrian crossings, including high visibility crosswalk markings, signs, and pedestrian ramps.⁸ Consider the appropriate crossing treatment from MnDOT's Pedestrian Crossing Facilitation technical memorandum, and the Traffic Engineering Manual.⁹

B

Consider the roadway reconfiguration recommendations and removing the multiple threat for pedestrian safety. Depending on the preferred roadway reconfiguration, consider median pedestrian refuge islands for reduced crossing distance and to allow people to cross one direction of traffic at a time.

C

Consider future development or the plans for Concordia College and needs for a midblock pedestrian crossing at the termini of sidewalk sections.

TH 75/ 8th Street S.



⁸ MnDOT (2017). "Pedestrian Crossing Facilitation." MnDOT Tech Memo No. 15-01-T-01. <https://techmemos.dot.state.mn.us/>

⁹ MnDOT Traffic Engineering Manual. Ch. 13: Non-Motorized Facilities. <http://www.dot.state.mn.us/trafficeng/publ/tem/index.html>

¹⁰ MnDOT (2018). "Performance-Based Practical Design Guidelines." MnDOT Tech Memo No. 18-09-TS-07. <https://techmemos.dot.state.mn.us/>



TH 75/ 8th Street S.



TH 10/ Main Ave



TH 10/ Center Ave



Recommendation: Provide pedestrian facilities and crossings at signalized intersections

RECOMMENDED IMPROVEMENT

A

Maintain pedestrian crossings, including high visibility crosswalk markings, signs, and pedestrian ramps on all four legs of the intersection.¹¹ Review pedestrian signal timing and provide pedestrian clearance times that allow people to cross in one signal phase.

B

Provide improvements at the 24th Avenue S. intersection, extending the project limits. Provide a leading pedestrian interval (LPI) with the pedestrian signal phase. Consider median pedestrian refuge islands. Consider narrowing radii with S. 8th Street.

The intersection has a vehicular risk rating of 5 (out of 6) and a bicycle and pedestrian risk rating of 5 (out of 6) in the District Safety Plan. Provide red-light running confirmation lights as listed in the District 4 Safety Plan for this intersection. Improvements listed in the District Safety Plan are potentially eligible for HSIP funding.



¹¹ MnDOT (2017). "Pedestrian Crossing Facilitation." MnDOT Tech Memo No. 15-01-T-01. <https://techmemos.dot.state.mn.us/>



General Strategy List

- ✓ **Bicycle Lanes**
- ✓ **Crosswalks**
- ✓ **Crosswalk Visibility Enhancements**
- ✓ **Curb Extensions**
- ✓ **Pedestrian Facilities at Signals**
- ✓ **Pedestrian Hybrid Beacon (PHB) / HAWK**
- ✓ **Pedestrian Rectangular Rapid Flashing Beacon (RRFB)**
- ✓ **Pedestrian Refuge and Crossing Islands**
- ✓ **Roadway Reconfiguration**
- ✓ **Sidewalks**
- ✓ **Speed Reduction Measures (Traffic Calming)**



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BICYCLE FRIENDLY EDGELINE RUMBLES

Longitudinal rumble strips and stripes are grooves cut into the paved shoulder that alert motorists if they have left their travel lane.

A rumble stripe is a rumble strip that contains a pavement marking stripe.

Rumble strips are outside the edge/fog line.



Source: www.adventurecycling.org/bicycle-tourism/national-advocacy-projects/rumble-strips/

NEED

Provide placement that does not interfere with non-motorized uses.

BENEFITS

The edgeline rumbles reduce the number of road departure crashes by alerting drivers to the road edge and keeping drivers on the road.

Installing the edgeline rumbles correctly ensures there is space for people bicycling to use the shoulder and do not jar the bicyclist forcing unsafe movements.

DESIRED (STANDARD)

Maximize the distance of the rumbles from the bicycle travel path.

MINIMUMS (CONSTRAINED)*

Install rumbles along the paint line, or within 2 feet of the outer edge of the paint line if the paved shoulder is 6 feet or wider.

Provide a minimum clear path of 4 feet from the rumbles to the outside edge of the paved shoulder.

Provide a minimum clear path of 5 feet from the rumbles to the adjacent curb, guardrail, or another obstacle.

* Review MnDOT Technical Memorandums 17-12-TS-05, 17-08-T-02, and 11-02-T-02.

BICYCLE LANES

A bicycle lane is “a portion of the roadway or shoulder designated for exclusive or preferential use by people using bicycles. Bicycle lanes are distinguished from the portion of the roadway or shoulder used for motor vehicle traffic by striping, marking, physical barrier or other similar technique.”¹

On-road bicycle lanes provide a designated space for the exclusive use of bicycles, creating a separation of vehicles by size, weight and speed. The safest applications are on roadways with moderate speeds, moderate volumes of traffic and fewer heavy commercial vehicles. As speeds, volumes, and trucks increase, providing a buffer becomes critical.^{2,3,4}

A buffered or separated bicycle lane provides either a painted or a physical buffer between the bicycle and vehicle traffic, and provides a greater shy distance between them. This encourages bicycling by contributing to either real and/or perceived safety among people using the bicycle facility.⁵

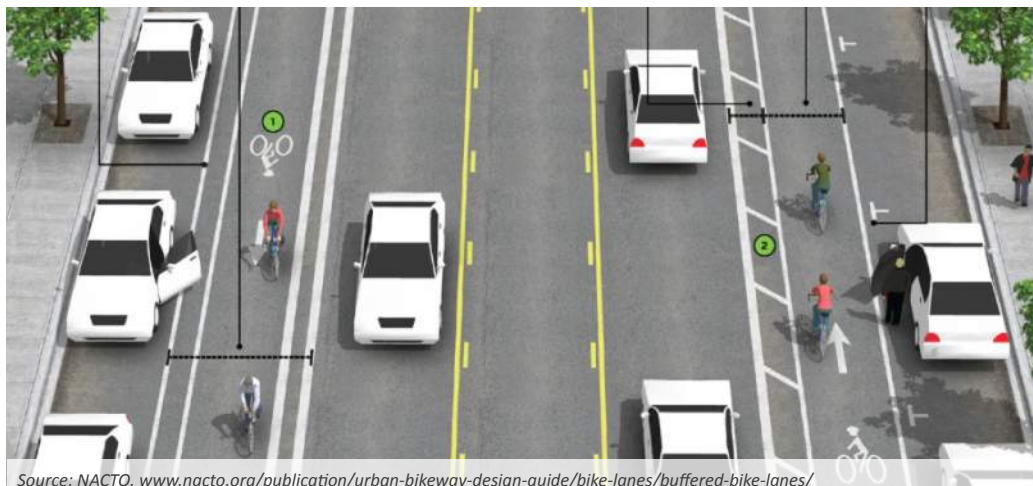
Shared paved shoulders can be designated as a bicycle lane. See Strategy Sheet on Shared Paved Shoulders.

1, 2 MnDOT Bikeway Facility Design Manual. March 2007. <http://www.dot.state.mn.us/bike/pdfs/manual/manual.pdf>

3 MnDOT. Minnesota's Best Practices for Pedestrian/Bicycle Safety. September 2013. pg. 32-37. <http://www.dot.state.mn.us/research/TS/2013/201322.pdf>

4 AASHTO Guide for the Development of Bicycle Facilities. 2012. (For purchase only).

5 FHWA. Separated Bike Lane Planning and Design Guide. May 2015. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/separated_bikelane_pdg/separatedbikelane_pdg.pdf



NEED

Provide bicycle facilities to:

- Balance the needs of all transportation users and achieve “complete streets.”
- Address the vulnerability of people using the roadway on a bicycle.
- Encourage safety by providing designated space for all modes of transportation.

BENEFITS

Bicycle lanes can:

- Improve conditions for bicyclists on roadways with higher speeds or traffic volumes. More width results in better conditions for the bicyclists.
- Increase motorist comfort by providing more consistent separation between bicyclists and passing vehicles.
- Organize modes of traffic by their speed, which eliminates the slowing of vehicle traffic because of a bicycle in the lane.
- Improve sight distance for motorists at driveways.
- Provide a buffer area between sidewalks and traffic lanes.

Space for bicycle facilities can be provided by narrowing vehicle travel lanes, which may reduce vehicle speeds and have a traffic calming effect.

6 MnDOT Bikeway Facility Design Manual. March 2007. pg. 81-94. <http://www.dot.state.mn.us/bike/pdfs/manual/manual.pdf>

7 MnDOT Bikeway Facility Design Manual. March 2007. pg. 83. <http://www.dot.state.mn.us/bike/pdfs/manual/manual.pdf>

8 MnDOT Bikeway Facility Design Manual. March 2007. pg. 81-94. <http://www.dot.state.mn.us/bike/pdfs/manual/manual.pdf>

9 NACTO. <https://nacto.org/publication/urban-bikeway-design-guide/bike-lanes/buffered-bike-lanes/>

DESIRED (STANDARD)

A buffered bicycle lane with 5-ft width (not including the gutter pan) with a buffer as described below.⁶

Provide a painted buffer with two solid striped lines. Paint a striped hatch if the buffer is 3-ft wide or wider. Bollards are also beneficial and can be removed in winter for snow removal. Physical protection such as a concrete barrier is ideal when high speed vehicular traffic is adjacent to the bicycle lane.

Parking lanes can also be used as a buffer space between traveling vehicles and the curb line. Bicycle lanes are recommended to be 6 feet next to parking lanes.⁷

Drainage grates and gutter seams should not be included in the usable width.

MINIMUMS (CONSTRAINED)

A bicycle lane with 4-ft width (not including the gutter pan). More width is preferred.⁸

If a buffer is provided the minimum width is 18 inches marked with two solid white lines.⁹

CROSSWALKS

A marked crosswalk is a type of pavement marking that shows people walking the recommended location to cross the roadway and alerts approaching motorists to where people may be crossing the street.¹

In MN, a legal crosswalk does not necessarily have to be marked at an intersection. State laws define a legal crosswalk as the extension of the sidewalks across a road, whether it has a marked crosswalk at the intersection or not.²

Marked crosswalks are often installed at signalized intersections, at a school zone crossing (whether signalized or not), and at unsignalized locations where engineers determine there are enough people crossing to justify a marked crossing. Mid-block crossings are sometimes necessary and must be marked according to the law.³ Marked crosswalks are accompanied with ADA compliant facilities as required, including ramps, landings, pedestrian signal heads, APS, and other facilities.⁴

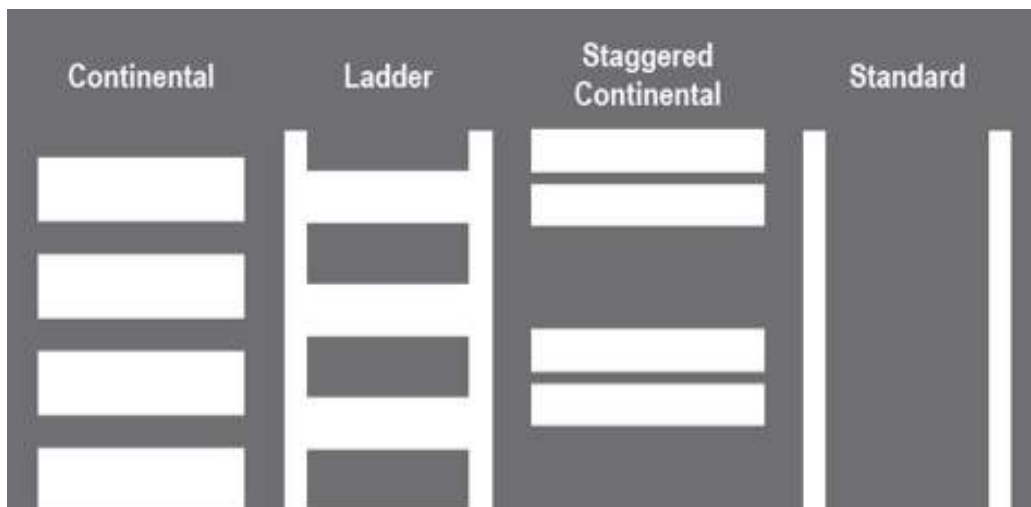
Crosswalks can be combined with additional crossing treatments including (but not limited to): overhead lighting, raised crosswalks or crosswalk visibility enhancements, median refuge islands, pedestrian hybrid beacons, curb extensions, or pedestrian rectangular rapid flashing beacons (RRFBs).⁵

^{1,2} Minnesota's Best Practices for Pedestrian/Bicycle Safety. September 2013. www.dot.state.mn.us/research/TS/2013/201322.pdf

³ <https://www.fhwa.dot.gov/publications/research/safety/04100/01.cfm>

⁴ MnDOT. Accessibility. www.dot.state.mn.us/ada/design.html

⁵ Minnesota's Best Practices for Pedestrian/Bicycle Safety. September 2013. www.dot.state.mn.us/research/TS/2013/201322.pdf



NEED

Examples of when crosswalk markings are needed include:⁶

- Intersections or connecting sidewalk, trail or shared use path.⁷
- Locations with high crash rates or high predicted crash rates.
- When there are destinations such as convenience stores, grocery stores, restaurants or anywhere people need to go and often walk.
- If sidewalks don't exist but there is evidence that people are walking in the area such as worn paths.
- Around schools, often shown in a Safe Routes to School Plan.

BENEFITS

Crosswalks help make pedestrians more visible. They can help people decide where to cross, reduce vehicle speeds and enhance the pedestrian crossing environment.

Crosswalks alert drivers to a potential location to expect a pedestrian.

⁶ MnMUTCD. www.dot.state.mn.us/trafficeng/publ/mutcd/mnmutcd2018/mnmutcd_entiredoc.pdf

⁷ Traffic Engineering Manual: Non-Motorized Facilities. June 2015. www.dot.state.mn.us/trafficeng/publ/tem/2015/chapter13.pdf

⁸ MnMUTCD. www.dot.state.mn.us/trafficeng/publ/mutcd/mnmutcd2018/mnmutcd_entiredoc.pdf

Sources:

Minnesota's Best Practices for Pedestrian/Bicycle Safety. September 2013. www.dot.state.mn.us/research/TS/2013/201322.pdf

Traffic Engineering Manual: Non-Motorized Facilities. June 2015. www.dot.state.mn.us/trafficeng/publ/tem/2015/chapter13.pdf

MnMUTCD. www.dot.state.mn.us/trafficeng/publ/mutcd/mnmutcd2018/mnmutcd_entiredoc.pdf

DESIRED (STANDARD)

10 ft or more in width.

High visibility striping pattern such as the continental or ladder.

Combine the crosswalk with other crossing enhancements and standard requirements.⁸ See Crosswalk Visibility Enhancements Strategy Sheet.

Place the striping outside of the vehicle path to avoid wearing.

MINIMUMS (CONSTRAINED)

The minimum requirements vary by municipality.

Match the width of connecting or adjacent sidewalks, shared use paths, or shoulder.

Align the crosswalk with ADA compliant ramps and avoid skew.

Provide with ADA compliant facilities.

CROSSWALK VISIBILITY ENHANCEMENTS

Crosswalk visibility enhancements, or pedestrian crash countermeasures, make crosswalks and pedestrians more visible to motorists, and encourage people to use crosswalks. Both FHWA¹ and MnDOT² provide resources to select appropriate countermeasures for a project.



Source: https://safety.fhwa.dot.gov/ped_bike/step/resources/

NEED

When vehicle speed is an issue; often improvements that lower speeds also provide visibility enhancements for non-motorized users, such as with curb extensions.

When physical conditions such as parked cars or horizontal and vertical roadway curvature reduce visibility at crosswalks and contribute to higher crash rates.

When there are poor lighting conditions.

BENEFITS

Crosswalk visibility enhancements can reduce crashes by 23-48 percent.³

Specific benefits of each type of countermeasure can be found in FHWA's Crash Modification Factor Clearinghouse.⁴

DESIRED (STANDARD)

Enhancements listed as appropriate for the type of project.

MINIMUMS (CONSTRAINED)

High visibility crosswalk markings and signing.

Sources:

Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations. FHWA. 2017. www.fhwa.dot.gov/innovation/everydaycounts/edc_4/guide_to_improve_uncontrolled_crossings.pdf

Minnesota's Best Practices for Pedestrian/Bicycle Safety. September 2013. www.dot.state.mn.us/research/TS/2013/201322.pdf

MnDOT Office of Traffic Engineering: Crosswalk Marking.

MnMUTCD. www.dot.state.mn.us/trafficeng/publ/mutcd/mnmutcd2018/mnmutcd_entiredoc.pdf

Safe Transportation for Every Pedestrian (STEP). June 2018. [www.safety.fhwa.dot.gov/ped_bike/step/resources/](https://safety.fhwa.dot.gov/ped_bike/step/resources/)

Traffic Engineering Manual: Non-Motorized Facilities. June 2015. www.dot.state.mn.us/trafficeng/publ/tem/2015/chapter13.pdf

TYPE OF ENHANCEMENTS

High-visibility marking such as a ladder design improves visibility of the crosswalk compared to standard parallel lines.

Parking restriction on the crosswalk approach improves the sightlines for motorists and people crossing.

STOP or YIELD markings and signs in advance of crosswalks further enhance crosswalk visibility. On multiple lane roadways they also help prevent multiple-threat crashes by requiring motorists to stop further from the crosswalk.

Curb extensions and refuge islands improve sight distance between drivers and pedestrians, as well as narrow the crossing distance for pedestrians.

In-street STOP or YIELD signs improve driver yielding rates. They can be used in the roadway or in conjunction with a refuge island.

Street lights or pedestrian level lights at intersections and crosswalks or continuous lighting along roadway corridors increases visibility of non-motorized and motorized traffic.

Raised crosswalks are an extension of the sidewalk height into the roadway, which requires vehicles to slow down. Raised crosswalks should be avoided on major truck routes, emergency routes and arterial streets, and should consider large vehicle noise, bus transit routes, snow clearing and drainage issues.⁵

1 Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations. https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/guide_to_improve_uncontrolled_crossings.pdf

2 MnDOT Pedestrian Crossing Facilitation Technical Memorandum No. 15-01-T-01. <https://techmemos.dot.state.mn.us/mn.us/research/TS/2013/201322.pdf>

3 Crosswalk Visibility Enhancements. https://safety.fhwa.dot.gov/ped_bike/step/docs/TechSheet_VizEnhancemnt_508compliant.pdf

4 CMF Clearinghouse. <http://www.cmfclearinghouse.org/index.cfm>

5 MnDOT Best Practices for Pedestrian and Bicycle Safety. September 2013. <http://www.dot.state.mn.us/stateaid/trafficsafety/reference/ped-bike-handbook-09.18.2013-v1.pdf>

CURB EXTENSIONS

A curb extension, or “bumpout,” is an extension of the sidewalk into the roadway, which reduces the effective roadway width and crossing distance for pedestrians, reduces their exposure to vehicle traffic, and improves the ability of pedestrians and motorists to see each other.

Typically, a curb extension is on a roadway with a parking lane, and parking setback restrictions are already in-place at the intersection. The curb extension typically extends to the edge of the parked vehicles.

Consider the amount of heavy truck or bus traffic when determining the curb radius or providing a curb extension.

Mountable curb extensions for large or heavy vehicles are optional; however, a mountable curb may encourage fast turning.

Larger vehicles are not always expected to turn from a right lane to another right lane – the vehicle can encroach into adjacent lanes safely where volumes are low and/or vehicle speeds are slow. Adjacent stop bars can also be adjusted to provide more space.

When designing, consider the design vehicle versus the control vehicle.¹

¹ Performance-Based Practical Design Guidelines. MnDOT Technical Memorandum No. 18-09-TS-07.

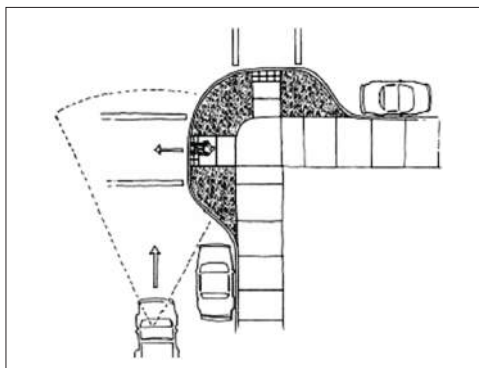


ABOVE Permanent bumpout: full reconstruction

NEED

Use curb extensions:

- To reduce the roadway crossing distance.
- To improve the safety and comfort for users of all ages and abilities to cross the roadway.
- When parking limits the sight distances for pedestrians and motorists.



Source: MnDOT Best Practices for Pedestrian and Bicycle Safety. pg. 12. September 2013. <http://www.dot.state.mn.us/stateaid/trafficsafety/reference/ped-bike-handbook-09.18.2013-v1.pdf>

DESIRED (STANDARD)

5-ft radius on both roadways.

1:5 taper to the established curb line.

ADA compliant pedestrian ramps.

Locate drainage structures outside of the curb extension.

Grass or low-level landscaping can be used to improve drainage conditions.

Colored concrete is optional.

Source: Minnesota’s Best Practices for Pedestrian/Bicycle Safety,



ABOVE Temporary bumpout: mill and overlay

BENEFITS²

Curb extensions:

- Improve the visibility of pedestrians by positioning them in front of parked cars, traffic, signs and streetlights.
- Reduce the time and distance pedestrians are in the street and exposed to traffic.
- Improve sight lines and visibility of pedestrians near parked vehicles by moving the vehicles back from an intersection.
- Calm traffic by restricting street widths, sending a visual cue to drivers to reduce speeds. A tight curb radii further calms traffic by requiring slower turning speeds.
- Often improve emergency access as intersections are kept clear of parked cars. Fire engine and other emergency vehicle drivers can climb a curb, but they would not be able to move around a parked car. At mid-block locations, curb extensions can keep fire hydrants clear of parked cars and make them more accessible.
- Can be used to place landscaping and street furniture where sidewalks are otherwise too narrow.

² Some cities have deployed curb extensions in a temporary condition to explore their effectiveness. Additional information for a pilot location on 7th Street S and Chicago Avenue in Minneapolis, including photos, can be found at <http://www.dot.state.mn.us/trafficeng/pub/tem/index.html>

MINIMUMS (CONSTRAINED)

1:2 taper to the established curb line.

ADA compliant pedestrian ramps.

Locate drainage structures outside of the ADA compliant pedestrian ramps and flares.

PEDESTRIAN FACILITIES at TRAFFIC SIGNALS



Traffic signals are used at locations where there are high traffic volumes intersecting so people walking or biking must be aware of traffic in multiple directions. Less conventional intersection designs can further increase the complexity for non-motorized users.

Traffic signals are effective at stopping traffic to allow people to cross; however, turning conflicts exist between motorists, people walking or biking and other users.

Traffic signals sometimes have long cycle lengths that make crossing inconvenient.

The approach used at each traffic signal should meet the needs of all the users.

Also consider that the number of people currently walking and biking may be limited by their comfort level on the roadways. Improving the conditions may increase those that choose a non-motorized option.

There are many ways that traffic signal timings can be changed to create a friendlier non-motorized user environment:

- Countdown timers are flashing timers installed with pedestrian indication lights that provide the number of seconds remaining during the pedestrian phase. Countdown timers have become common and are used at most traffic signals.
- A leading pedestrian interval provides people 3 to 5 seconds ahead of the vehicle's green light, allowing people a head start and the ability to enter the crosswalk before right-turning vehicles can turn into the crosswalk.
- Prohibiting right turns on red. Motorists trying to turn right on a red light sometimes look left to see vehicles but not right to see pedestrians. They also sometimes encroach on the crosswalk while waiting to make their turn.
- Using pedestrian phase recall at traffic signals allows people to walk with the traffic at any time, without relying on pushing the button.
- Provide enough crossing time for the types of people commonly using the crossing. As an example, increase the crossing time in areas with senior housing or at school crossings.
- Consider not using flashing yellow arrows when the pedestrian phase in conflict with it is activated. If there is a high number of people using the crossing it can be difficult for motorists turning left to find a gap in both traffic and pedestrians.

NEED

Adequate crossing time is needed for people of all ages and ability to cross the roadway. The minimum crossing time is 3.5 ft/sec from the pedestrian push button to the far side.

Enhanced pedestrian visibility is needed when there is a high number of turning vehicle conflicts.

BENEFITS

Improving traffic signal timings to be more pedestrian friendly may increase the number of people walking and biking.

Leading pedestrian intervals have been shown to reduce pedestrian-vehicle crashes as much as 60%.¹

Countdown timers have also been shown to reduce the number of crashes.²

DESIRED

Additional improvements described above that are appropriate for the intersection and improve the comfort and safety of non-motorized users.

MINIMUMS

Include pedestrian signal heads with countdown timers.

Provide pedestrian crossing times that allow people to cross the roadway in one phase.

Provide timings that accommodate the types of people using the crossings; sometimes the average walking speed is slower than the standard 3.5 feet per second.

1, 2 www.dot.state.mn.us/stateaid/trafficsafety/reference/ped-bike-handbook-09.18.2013-v1.pdf

PEDESTRIAN HYBRID BEACON (PHB/HAWK)

A pedestrian hybrid beacon system, also known as a high-intensity activated crosswalk, is a beacon installed at mid-block crosswalks that requires vehicles to stop for people crossing, similar to a traffic signal.

For motorists it consists of two side-by-side red lenses on top with a single yellow lens below. For non-motorized traffic it consists of typical pedestrian signal heads with a walk, don't walk and countdown timer displays.

The beacon remains dark until the pushbutton is activated by a person needing to cross the roadway. The beacon then flashes a sequence of amber warning beacons followed by a red stop beacon for vehicle traffic, which requires motorists to stop for pedestrians at the crosswalk.¹

Pedestrian hybrid beacons are used in conjunction with signs and pavement markings.



Source: FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations. 2017. https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/guide_to_improve_uncontrolled_crossings.pdf

NEED

PHBs are typically used on roadways with higher AADTs and speeds and multiple lanes of traffic.²

PHBs are intended for mid-block crossings, but can be installed at intersections using engineering judgment.

BENEFITS

A 2015 study showed:³

- Vehicle-pedestrian crashes were reduced by 69 percent.
- Total crashes were reduced by 29 percent.
- Serious injury and fatal crashes were reduced by 15 percent.

PHBs can reduce pedestrian crashes by 55 percent.⁴

PHBs control traffic in a similar way as traffic signals. They are considered an FHWA proven pedestrian crash countermeasure.⁵

Drivers		Pedestrians	
... will see this	... will do this	... will see this	... will do this
	Proceed with Caution		Push the Button to Cross
	Slow Down (Pedestrian has activated the push button)		Wait
	Prepare to Stop		Continue to Wait
	STOP! (Pedestrian in Crosswalk)		Start Crossing
	STOP! Proceed with Caution if Clear		Continue Crossing (Countdown Signal)
	Proceed if Clear		Push the Button to Cross

Source: MnDOT Best Practices for Pedestrian and Bicycle Safety. September 2013. <http://www.dot.state.mn.us/stateaid/trafficsafety/reference/ped-bike-handbook-09.18.2013-v1.pdf>

DESIRED (STANDARD)

MUTCD compliant design.

1 MnDOT Best Practices for Pedestrian and Bicycle Safety. September 2013, pg. 13-15. <http://www.dot.state.mn.us/stateaid/trafficsafety/reference/ped-bike-handbook-09.18.2013-v1.pdf>

2 FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations. 2017, pg. 16. https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/guide_to_improve_uncontrolled_crossings.pdf

3 FHWA Proven Safety Countermeasures. Pedestrian Hybrid Beacons. October 2017. https://safety.fhwa.dot.gov/provencountermeasures/ped_hybrid_beacon/

4 FHWA Safe Transportation for Every Pedestrian (STEP). June 2018. https://safety.fhwa.dot.gov/ped_bike/step/resources/

5 Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations. 2017, pg. 16. https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/guide_to_improve_uncontrolled_crossings.pdf

PEDESTRIAN RECTANGULAR RAPID FLASHING BEACON

RRFBs are a strategy to enhance safety by increasing driver awareness of pedestrians in crosswalks.

RRFBs consist of two rapidly and alternately flashing rectangular yellow indications that are attached to supplement the pedestrian warning sign (W11-2) or school crossing sign (S1-1) at a crosswalk.

The RRFB uses an irregular flash pattern similar to emergency flashers on police vehicles.

The RRFB is activated either manually when a pedestrian pushes a button or passively by an automatic pedestrian detection system. A speech push-button says, “Yellow lights are flashing” when the RRFB is activated.

RRFBs are installed with ADA compliant sidewalk and curb ramps connecting to a sidewalk or trail network.

The RRFB is often used with high visibility crosswalk marking, raised islands, advance STOP or YIELD signs, and other enhanced crosswalk treatments.



Source: MN Best Practices for Pedestrian/ Bicycle Safety September 2013

NEED

Consider an RRFB when:

- There are moderate traffic speeds, moderate traffic volumes and/or multiple lanes of traffic for pedestrians to cross.
- There is a high volume of non-motorized traffic, although consider that poor existing crossing conditions may discourage people from crossing.
- Motorist yielding compliance is low.

RRFBs can be used at any mid-block or uncontrolled intersection crossing. Mid-block crossings can be considered when a signalized crossing or uncontrolled intersection crossing is more than 1/8 of a mile walking distance from the potential mid-block crossing

Refer to the [Traffic Engineering Manual \(TEM\)](#)¹ and the Pedestrian Crossing Facilitation Technical Memorandum No. 15-01-T-01 (included in TEM)² for more information.

¹ <http://www.dot.state.mn.us/trafficeng/publ/tem/index.html>

² FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations. 2017. http://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/guide_to_improve_uncontrolled_crossings.pdf



Source: MN Best Practices for Pedestrian/ Bicycle Safety September 2013, NACTO

BENEFITS

Studies^{3,4} show that RRFBs increase yielding compliance dramatically, and yielding rates did not decline over time. Compliance rates are higher than any system other than those that include a red indication, such as a traffic signal.

The studies^{3,4} also show that drivers yield or slow down further in advance of the crosswalk with RRFBs than with standard round yellow flashing beacons. This is important on multilane roads for numerous reasons:

- To decrease the likelihood of multiple threat crashes⁵ by increasing the visibility of the pedestrian by motorists in the adjacent lane.
- To reduce the risk of a vehicle approaching a yielding vehicle and attempting to pass without seeing the crossing pedestrian.
- To decrease the chance that a yielding vehicle is struck from behind and propelled forward into the crossing pedestrian.

RRFBs increase driver awareness of the presence of pedestrians, and they allow for normal traffic flow when not actuated.

RRFBs can also include software to count the number of activations, providing helpful information about non-motorized users for engineers and planners.

Source: FHWA-SA-09-009

³ MnDOT Traffic Engineering Manual. Chapter 13. June 2015. <http://www.dot.state.mn.us/trafficeng/publ/tem/2015/chapter13.pdf>

⁴ Van Houten, R., R. Ellis, and E. Marmolejo. “The Use of Stutter Flash LED Beacons to Increase Yielding to Pedestrians at Crosswalks.” Presented at the Transportation Research Board Annual Meeting, Washington, DC, 2008.

⁵ http://www.pedbikeinfo.org/topics/crash_scenarios.cfm

PEDESTRIAN REFUGE and CROSSING ISLANDS

Raised areas that are constructed in the center portion of a roadway that can serve as a place of refuge or protection for pedestrians who cross the road mid-block or at an intersection. After crossing to the center island, pedestrians wait for motorists to stop or for an adequate gap in traffic before crossing the second half of the street.

They are referred to as medians, pedestrian refuge islands, refuge islands, crossing islands or pedestrian islands.

Pedestrian islands may be appropriate at both unsignalized and signalized crossing locations.



Source: NACTO



Source: www.pedbikeinfo.org/planning/facilities_crossings_sliplane.cfm

NEED

When signal timings, roadway width and/or number of lanes do not provide adequate crossing time for all ages and abilities.

Highly desirable for midblock pedestrian crossings on roads with four or more travel lanes, especially where speed limits are 35 mph or greater and/or where annual average daily traffic is 9,000 or higher.¹

¹ FHWA Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations. 2017. http://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/guide_to_improve_uncontrolled_crossings.pdf

BENEFITS

Pedestrian refuge islands can reduce pedestrian crashes by 32%.²

Medians provide a simplified crossing maneuver by allowing pedestrians to concentrate on only one direction of traffic at a time, creating the equivalent of two narrower one-way streets instead of one wide two-way street to cross.

Medians provide space for landscaping that can be used to change the visual cues of the roadway and reduce driver speeds.

A pedestrian refuge island can improve safety and comfort by providing pedestrians with the option of waiting in the median area before beginning the next stage of the crossing.

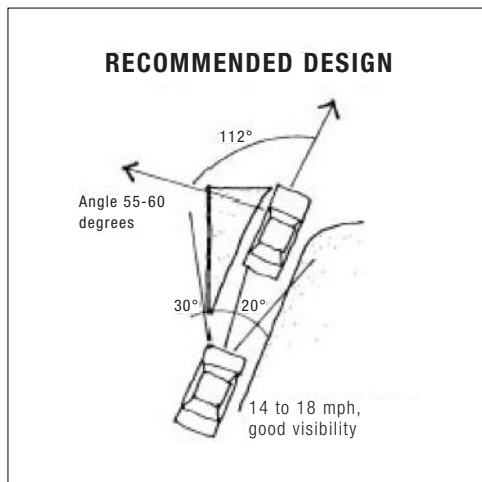
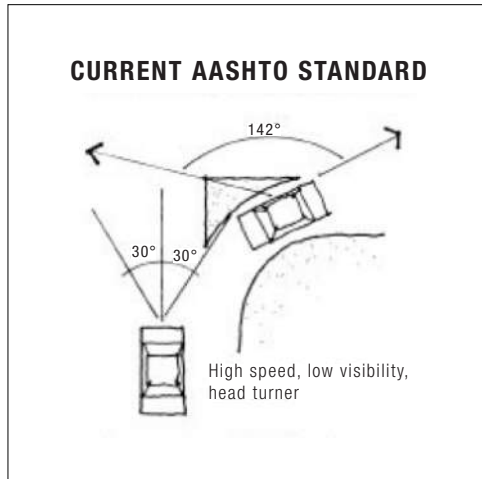
Improves pedestrian safety, especially on multi-lane arterials. One example found 39 to 46% reduction in pedestrian-vehicle crashes at unsignalized crosswalks on multi-lane roads.³

Having raised medians, or median islands, typically reduces motor-vehicle crash rates (such as head-on crashes) as well as pedestrian crash rates. Medians that are only painted do not provide the same safety benefits as raised ones.

² FHWA Safe Transportation for Every Pedestrian (STEP). June 2018. http://safety.fhwa.dot.gov/ped_bike/step/resources/

³ MnDOT Best Practices for Pedestrian and Bicycle Safety. September 2013. <http://www.dot.state.mn.us/stateaid/trafficsafety/reference/ped-bike-handbook-09.18.2013-v1.pdf>

PEDESTRIAN REFUGE and CROSSING ISLANDS
CONTINUED



Source: FHWA, Mark Brown @CompletedStreet

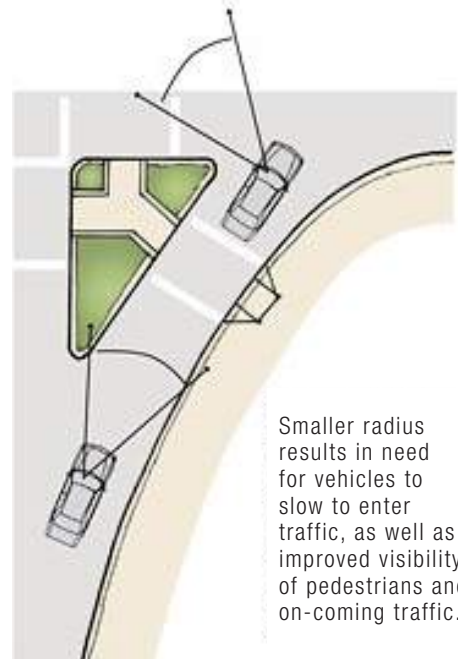
DESIRED (STANDARD)

Pedestrian refuge and crossing islands at crosswalks or RRFBs of multi-lane roadways.

Use with crosswalk visibility enhancements.

Provide curb extensions where road width/parking lane allows an 8-ft wide curb extension.⁴

⁴ MnDOT Bikeway Facility Design Manual, March 2007. <http://www.dot.state.mn.us/bike/pdfs/manual/manual.pdf>



Source: FHWA, Mark Brown @CompletedStreet

MINIMUMS (CONSTRAINED)

Raised medians must:

- Be fully accessible by curb ramps or cut through.
- Provide tactile cues for pedestrians with visual impairments to indicate the border between the pedestrian refuge area and the motorized vehicle roadway.
- Minimum of 6 feet wide.⁵

Landscaping in medians should not obstruct the visibility between pedestrians and approaching vehicles. Winter maintenance should be considered to keep the pedestrian route clear of snow.

⁵ MnDOT Roadway Design Manual. <http://roaddesign.dot.state.mn.us/roaddesign.aspx>

ROADWAY RECONFIGURATION

A common roadway reconfiguration converts an existing four-lane, undivided roadway to two through lanes and a center, two-way left turn lane. Roadway reconfigurations are also called road diets or road reallocations

There are numerous possible reconfigurations, including taking width from a three-lane roadway to add bicycle lanes, or converting a five-lane roadway to three driving lanes with diagonal parking and separated bicycle lanes. The intent is to accommodate all roadway users while increasing safety and improving quality of life.

Roadway reconfigurations can include pedestrian refuge islands¹, medians, crosswalk visibility enhancements², curb extensions³, on-street parking with restrictions at crosswalk approaches, widened sidewalks, landscaped buffers, bicycle lanes, and/or transit lanes.

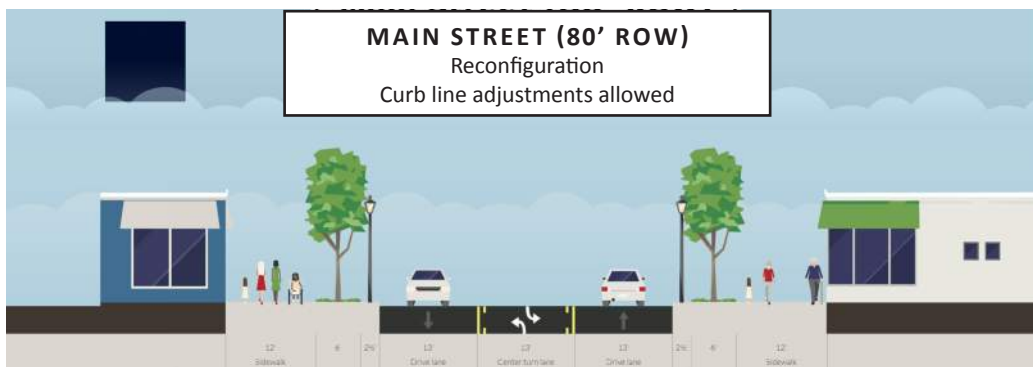
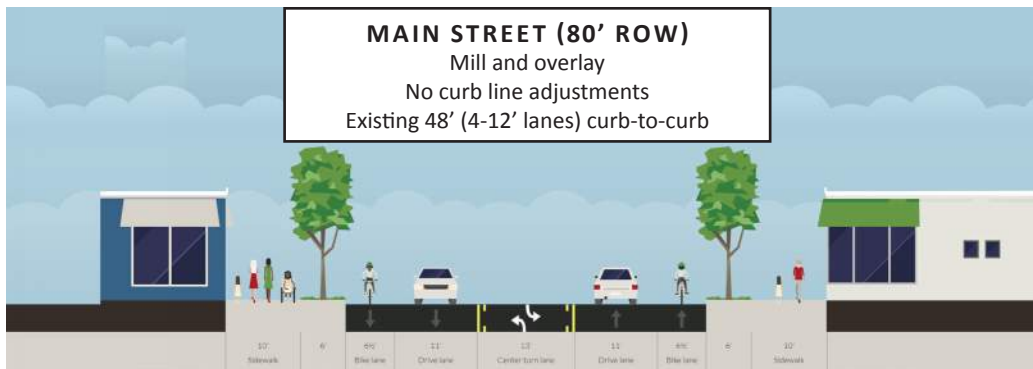
Suitable roadways have daily traffic volumes between 8,000 and 24,000 vehicles. In some instances, reconfigurations have been successful on roads as high as 25,000 vehicles. With higher traffic volumes, more traffic analysis should be done to validate operations.⁴

1 http://safety.fhwa.dot.gov/provencountermeasures/ped_medians/

2 http://safety.fhwa.dot.gov/ped_bike/step/docs/TechSheet_VizEnhancemnt_508compliant.pdf

3 <http://nacto.org/publication/urban-street-design-guide/street-design-elements/curb-extensions/>

4 https://safety.fhwa.dot.gov/road_diets/guidance/info_guide/ch3.cfm#s335



Source: Streetmix.net



Source: www.wherethesidewalkstarts.com/2012_11_01_archive.html

NEED

Consider a roadway reconfiguration when:⁴

- An existing four-lane roadway has a high crash frequency and moderate traffic volumes, including turning traffic.
- Seeking to integrate and serve multiple types of roadway users.

4 MnDOT Land Use Contexts: Types, Identification and Use. June 2018. MnDOT Technical Memorandum 18-07-TS-05. <http://techmemos.dot.state.mn.us/>

* Depends on engineering standards for roadway type and class, and vehicle types. Refer to the MnDOT Roadway Design Guide and the Performance-Based Practical Design Policy (www.dot.state.mn.us/policy/operations/op012.html).

DESIRE: BALANCED VEHICLE AND NON-MOTORIZED FACILITIES

10- to 11-ft travel lanes in urban areas or city limits. Begin cross section planning using 10-ft travel lanes, which encourages slower speeds yet does not negatively impact operations.

10- to 11-ft turn lanes in urban areas or city limits. Begin cross section planning using 10-ft travel lanes.

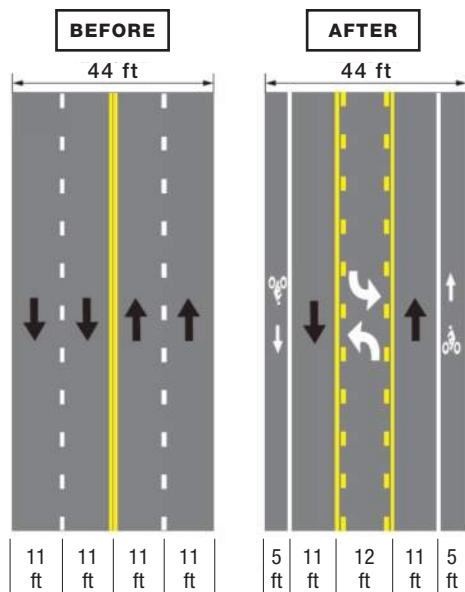
7- to 8-ft parking lanes in urban areas or city limits.

6-ft bicycle lane with buffer.

5- to 9-ft wide sidewalks; more width is preferred.

Up to a 14-ft shared use path, depending on use, with a buffer from vehicle lanes, as right of way allows.

ROADWAY RECONFIGURATION CONTINUED



Source: American Association of State Highway and Transportation Officials (AASHTO) *Guide for the Development of Bicycle Facilities*, Fourth Edition, 2012.

MINIMUM NON-MOTORIZED FACILITIES WITH MAXIMUM ROADWAY WIDTHS^{5, 6}

12-ft travel lanes in urban areas or city limits; less width is preferred to encourage slower speeds.

8- to 12-ft parking lanes in urban areas or city limits, less width is preferred.

5-ft bicycle lanes; more width is preferred.

5-ft sidewalks; more width is preferred.

1-ft buffer against building face for doors, more width is preferred.

8-ft shared use path, if used, for two-way traffic.

⁵ MnDOT Roadway Design Manual. <http://roaddesign.dot.state.mn.us/roaddesign.aspx>

⁶ Performance Based Practical Design. September 2018. MnDOT Technical Memorandum 18-09-TS-07. <http://techmemos.dot.state.mn.us/>

BENEFITS

Roadway reconfigurations can:

- Decrease the lane crossing distance and pedestrian exposure time.
- Reduce the speed differential and overall vehicle speeds. Lower travel speeds can reduce potential crash severities for all users.
- Reduce crashes. A road diet has shown a 29% reduction in all roadway crashes.⁷ Road reconfigurations can reduce total crashes by 19% to 47% depending on the area.⁸
- Reduce vehicle-pedestrian, vehicle-bicycle, and vehicle-vehicle conflicts. They also have been shown to reduce crashes involving drivers under 35 and over 65 years of age.⁹

Adding a two-way center left-turn lane can:

- Provide a place for both motorists and bicyclists to turn left, thus reducing the incidence of left-turn and rear-end crashes.
- Reduce the incidence of sideswipe crashes because motorists will no longer change lanes to pass a vehicle waiting to turn left from the left-most travel lane.
- Improve visibility for left-turning motorists, who only have to clear one travel lane to complete their turn.

Reducing the number of travel lanes to just one lane in each direction substantially reduces the likelihood of multiple-threat¹⁰ crashes. This safety benefit applies to pedestrians, left-turning motorists and bicyclists.

Roadway reconfigurations promote “complete streets” by better integrating space for all roadway users, allowing designers to “do more with less.” They provide potential space for installing curb extensions and widening sidewalks, and adding bicycle, transit and/or parking lanes.

⁷ MnDOT Best Practices for Pedestrian and Bicycle Safety. September 2013. pg. 30. <http://www.dot.state.mn.us/stateaid/trafficsafety/reference/ped-bike-handbook-09.18.2013-v1.pdf>

⁸ NCHRP 17-25, Safety Effects of Four-Lane to Three-Lane Conversions.

⁹ FHWA, “Evaluation of Lane Reduction ‘Road Diet’ Measures on Crashes.” FHWA Report No. FHWA-HRT-10-053. (Washington, D.C.: 2010).

¹⁰ http://www.pedbikeinfo.org/topics/crash_scenarios.cfm

Other resources:

FHWA: http://safety.fhwa.dot.gov/road_diets/

NACTO: <http://nacto.org/publication/urban-bikeway-design-guide/>

MnDOT Bikeway Facility Design Manual. <http://www.dot.state.mn.us/bike/pdfs/manual/manual.pdf>

MnDOT Roadway Design Manual. <http://roaddesign.dot.state.mn.us/roaddesign.aspx>

ROUNDAABOUT/ MINI- ROUNDAABOUT



Source: <https://roaddesign.dot.state.mn.us/>

Roundabouts and mini-roundabouts are intersection design techniques intended to control traffic, reduce conflicts between traffic movements and lower speeds. Because of the reduced conflict points and lower speeds, they are a safer type of intersection design.

Roundabouts are usually built with a circular raised island and splitter medians on all approaches to help slow vehicles and direct traffic into the counterclockwise flow around the center island.

Pedestrians are accommodated at pedestrian crosswalks around the perimeter of a roundabout.

Mini-roundabouts operate similar to roundabouts, but have a smaller footprint and typically fit within the existing right of way, or even the existing curb lines. Large trucks typically overrun the mountable center island.

The splitter medians at mini-roundabouts typically do not provide the same degree of refuge as those at roundabouts.

Bicyclists are generally as comfortable negotiating a roundabout as motorists but can also travel as a pedestrian.

General design characteristics for speed and traffic are:¹

	Mini-roundabout	Single-lane roundabout	Multi-lane roundabout
Entry speed	15 to 20 mph	20 to 25 mph	25 to 30 mph
Typical daily traffic	up to 15,000	up to 25,000	up to 45,000 (two-lane roundabout)



Mini-roundabout in Shakopee, MN. Source: <https://www.google.com/maps/@44.7834643,-93.5201076,115m/data=!3m1!1e3>

1, 2 NCHRP Report 672. Roundabouts: An Informational Guide 2nd Ed. 2010. <http://www.trb.org/Publications/Blurbs/164470.aspx>

3 <https://roaddesign.dot.state.mn.us/>

4 https://safety.fhwa.dot.gov/intersection/innovative/roundabouts/case_studies/rounds4ped.pdf

NEED

Consider a roundabout or mini roundabout as an intersection design to improve safety. Single lane roundabouts designed for low-speed operation are one of the safest treatments available for at-grade intersections.²

DESIRED (STANDARD)

Use the slowest design entry and exit speed possible.

Use the smallest design and control vehicle appropriate for the project.

Single lane roundabouts are preferred.

MINIMUMS (CONSTRAINED)

Use Chapter 12 of the MnDOT Road Design Manual 3 to properly design the roundabout for non-motorized users. Include facilities appropriate for the project.

Use lessons learned such as FHWA's Making Roundabouts Work for Pedestrians and Bicycles⁴

BENEFITS

In addition to the safety benefits to vehicles, roundabouts have additional benefits, described below.

A roundabout:

- Increases the likelihood of drivers yielding to pedestrians (compared to an uncontrolled crossing).
- Makes crashes with pedestrians and bicyclists less frequent and less severe.
- Simplifies pedestrian crossings; allows people walking to cross one direction of traffic at a time on each leg of the roundabout.
- Uses geometric design rather than traffic control to provide traffic calming.
- Provides the opportunity for a gateway treatment for a community, providing space for landscaping and other aesthetic treatments.
- Signifies a transition area by reinforcing a change in the driving environment.

SHARED PAVED SHOULDERS

A shared paved shoulder is a section of the roadway alongside the driving lane that is continuous and on the same level as the regular travel lanes. It is available for use by bicycles and pedestrians and directional on both sides of the highway.

A shared paved shoulder can range in width from 4 to 8 feet of smooth surface outside of the rumble strips.

Widths narrower than 4 feet are not navigable for people riding a bicycle. If less than 4 feet of width is provided expect people walking or bicycling to use the travel lane and weigh safety risks accordingly.

Rumble strips and rumble stripe placement is a critical component of the shared paved shoulder.¹ See the strategy sheet on Bicycle Friendly Edgeline Rumbles, as well as the MnDOT technical memorandum² for installation guidance.

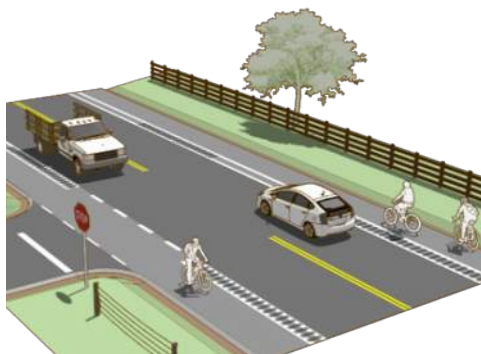
Shared paved shoulders can be marked as a bicycle lane only if it meets bicycle lane criteria. Bicycle lane markings are not required because use is encouraged by both people walking and bicycling when no other adjacent facilities are available.



Source: MnDOT. <http://www.dot.state.mn.us/trafficeng/safety/rumble/images/RumbleBars.jpg>



Source: FHWA. https://safety.fhwa.dot.gov/geometric/pubs/mitigationstrategies/chapter4/images/figure_32.jpg



Source: *Small Town and Rural Multimodal Networks*. December 2016. <http://ruralsdesignguide.com/visually-separated/paved-shoulder>

NEED

Provide shared paved shoulders to balance the needs of all transportation users and achieve “complete streets.”

Use the guidance on the following page to help include an appropriately sized shoulder for the project and users of the roadway.

BENEFITS

Paved shoulders improve conditions for people walking and biking on roadways with higher speeds or traffic volumes to varying degrees based on the width of the shoulder. Shared paved shoulders also increase motorist comfort by providing consistent separation between people and passing vehicles.

Because shared paved shoulders provide a separate space for people walking and biking, they reduce “walking along roadway” and “struck from behind” crashes.³

Shared paved shoulders provide a higher bicycle level of service as defined by AASHTO, Transportation Research Board Highway Capacity Manual and the updated MnDOT Bikeway Facility Design Manual.

The higher level of service provided with wider shoulders can equate to increased comfort, security, and higher quality of life for vulnerable users, and therefore more non-motorized use of the facility.

Other benefits of 8-ft shoulders can include:

- Longer pavement life
- Use by farm equipment
- Use by Amish populations including horse and buggies
- Use by Native American and Tribal communities with high non-motorized and ATV use

¹ FHWA. *Rumble Strips and Rumble Stripes*. https://safety.fhwa.dot.gov/roadway_dept/pavement/rumble_strips/accommodating-all-users.cfm

² *Rumble Strips and Stripes on Rural Trunk Highways*. MnDOT Technical Memorandum No. 17-08-T-02. August 2017. <https://techmemos.dot.state.mn.us/>

³ *Small Town and Rural Multimodal Networks*. December 2016. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/fhwahep17024_tg.pdf

SHARED PAVED SHOULDERS CONTINUED



SHOULDER WIDTH PLANNING AND OTHER CONSIDERATIONS

Sizing a shared paved shoulder appropriately involves a number of considerations. Right of way and costs are important considerations; however, the long-term plan for the roadway and community should be considered.

Shared paved shoulders with 8 feet of smooth usable surface are ideal. If 8-ft shoulders are considered necessary, also evaluate a separated shared use path due to costs.

Consider striping bicycle facilities through turn lanes if use is anticipated to be high for people bicycling. Refer to *Small Town and Rural Multimodal Networks*.⁴

Place drainage structures outside of the shared paved shoulder width.

The minimum shared paved shoulder width is 4 feet from the rumble strip to the outside edge of the paved shoulder.^{5,6}

The greatest benefit is provided by an 8-ft. wide shared paved shoulder; however, a 4 to 6-ft. shoulder can be considered if:

- The roadway average daily traffic is less than 2,000 vehicles. Use Table 4-2 in the Bikeway Facility Design Manual for guidance on traffic volumes and speeds.⁷
- The roadway is not included in a District Bicycle Plan route.
- The roadway is not being considered for other bicycle designations such as a future United States Bicycle Route.
- The project is not connected to a Bicycle Friendly Community or a Safe Route to School plan.
- The roadway is not connected to a state or regional trail.
- There is a nearby facility with more separation.⁸
- Motor vehicle speeds are less than 50 mph.
- There is lower than average heavy trucks, buses or recreational vehicles.
- The right side of the roadway is free from static obstructions.⁹
- The community is not actively seeking to increase the quantity and quality of their bicycle and pedestrian facilities through trail groups, active living planning, non-motorized committees or other organizations.
- The roadway is not adjacent to a high volume of origins and destinations for people walking and bicycling.

⁴ *Small Town and Rural Multimodal Networks*. December 2016. Shared Paved Shoulders: pg. 50-57. https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/small_towns/fhwahep17024_lg.pdf

⁵ *Minnesota's Best Practices for Pedestrian/Bicycle Safety*. September 2013. <http://www.dot.state.mn.us/research/TS/2013/201322.pdf>

⁶ *Shoulder Width Standards for State Highways*. MnDOT Technical Memorandum No. 17-12-TS-05. December 2017. <https://techmemos.dot.state.mn.us/>

⁷ <http://www.dot.state.mn.us/bike/pdfs/manual/Chapter4.pdf>

⁸ *Small Town and Rural Multimodal Networks*. December 2016. <http://ruraldesignguide.com/visually-separated/paved-shoulder>

⁹ *Minnesota's Best Practices for Pedestrian/Bicycle Safety*. September 2013. <http://www.dot.state.mn.us/research/TS/2013/201322.pdf> pg. 35

SIDEWALKS

Sidewalks are walkways that are separated from the travel lanes and bicycle facilities that improve the safety of people walking or wheeling.

A sidewalk that is at least 5 feet wide allows people to walk side by side. Wider sidewalks allow for passing and two-way traffic.

Separation between the sidewalk and higher speed traffic increases people's comfort and safety on the sidewalk.



WHY PROVIDE SIDEWALKS?

Walking is an essential part of our transportation system and an important contributor to the health of Minnesota residents.¹

Providing sidewalks makes walking more viable for people.

Research indicates that 40 percent of community health outcomes are related to features in the local environment.² Providing sidewalks improves the local environment.

“Design for all: Plan and design streets so that all people are able to safely and comfortably walk or roll to their desired destinations. If a sidewalk is not provided, people will walk in the street to get to their destination, putting them at risk of being hit.”

— *Minnesota Walks*³

Minnesota Walks⁴ is a useful resource to help create walkable communities that are safe, convenient and desirable for all.

NEED

Sidewalk should be added when:

- There are sidewalk network gaps with missing, non-ADA compliant or non-traversable walking space.
- There is evidence of people walking (desire lines) in areas without sidewalk, depicting the desired path where there is not existing sidewalk.
- There are destinations that people commonly walk to, like schools, convenience or grocery stores, parks or anywhere people want to go.

BENEFITS

The safety benefit of sidewalks comes from providing people walking or wheeling with their own travel space that is separated from the traffic on a roadway.

Sidewalks on both sides of a street reduce occurrences of “walking along the roadway” crashes by 88%, and therefore reduce all levels of crash risks.⁵

¹ Charles Zelle in *Minnesota Walks*. www.dot.state.mn.us/peds/plan/index.html

² Ross C.E., *Mirowsky, J.*, 2008

^{3, 4} *Minnesota Walks*. www.dot.state.mn.us/peds/plan/index.html

⁵ *Minnesota's Best Practices for Pedestrian/Bicycle Safety*. September 2013. www.dot.state.mn.us/research/TS/2013/201322.pdf

SIDEWALKS CONTINUED



A sidewalk in Barnesville, MN, with a colored concrete furniture zone providing separation.



A sidewalk in Lowry, MN, with a tree-lined boulevard providing separation.

DESIRED* (STANDARD)

A 5-foot wide, continuous ADA compliant sidewalk on both sides of the street.

If the sidewalk is adjacent to buildings an additional 1 to 3 feet is needed as a door zone.

Sidewalk should extend to the city limits, the edge of the residential area or higher density development or a logical destination.

Minimize driveway crossings or other points of conflict with vehicular traffic.

Refer to MnDOT's ADA standards⁶ for more detail.

MINIMUM (CONSTRAINED)

A 5-foot wide ADA-compliant sidewalk to origins and destinations in the area.

SEPARATION

A separated ADA compliant sidewalk facility on both sides of the street is ideal.

A curb and gutter is the minimum separation, and does not provide a comfortable distance from vehicle traffic, especially at higher speeds.

A boulevard or furniture zone provides additional separation width from the roadway to increase people's comfort.

- A minimum furniture zone is typically 3 feet wide to allow for a light pole base and the top of the curb and gutter.
- For healthy tree growth, a 6-foot wide furniture zone is recommended. Tree grates need to be located 1 foot from the face of curb.
- With a 6-foot boulevard, other amenities like benches can then be provided.

Separation can also be accomplished in other ways, like parking or bicycle lanes on the roadway.

⁶ www.dot.state.mn.us/ada/pdf/mndot-ada-standards.pdf

* Depends on engineering standards for roadway type and class

SPEED REDUCTION MEASURES (TRAFFIC CALMING)

Speed reduction measures, or traffic calming, is the combination of mainly physical measures that reduce the negative effects of motor vehicle use, alter driver behavior and improve conditions for non-motorized street users.¹ The information in this strategy sheet is mostly referenced from the Institute of Transportation Engineers website, ite.org.²

GOALS

Traffic calming goals include:

- Incorporating the preferences and requirements of the people using the area (e.g., working, playing, residing), along the street(s), or at intersection(s)
- Creating safe and attractive streets
- Promoting pedestrian, cycle and transit use
- Increasing the quality of life
- Helping to reduce the negative effects of motor vehicles on the environment (e.g., pollution, sprawl)

OBJECTIVES

Traffic calming objectives include:

- Achieving slow speeds for motor vehicles
- Reducing collision frequency and severity
- Increasing the safety and the perception of safety for non-motorized users of the street(s)
- Reducing the need for police enforcement
- Enhancing the street environment (e.g., street scaping)
- Encouraging water infiltration into the ground
- Increasing access for all modes of transportation
- Reducing cut-through motor vehicle traffic

TYPES

Physical traffic calming measures include:

- Street width reductions
- Horizontal deflections
- Vertical deflections
- Routing restrictions

Fact sheets for the different types of calming measures are available on the Institute of Transportation Engineers website.⁴

Other types of treatments or traffic control that have been used to reduce speeds include signing and marking, gateway treatments, streetscaping, landscaping, curb extensions, and radius reductions.

Education and enforcement are also components of a speed reduction plan.



Example of a city gateway treatment. Source: <https://jeanbourret.weebly.com/>



Traffic circle in Seattle, WA,³ an example of a horizontal deflection speed reduction measure.

BENEFITS

In addition to the goals listed, speed reduction measures encourage drivers to travel the speed limit. As speeds increase the risk of being injured in a crash increase. When non-motorized users are on the roadway their risk of being injured is much higher than people driving a car. Lowering the vehicle speeds creates a more forgiving roadway system.

NEED

Use speed reduction measures when:

- Vehicular travel speeds do not conform to posted speed limits.
- A roadway transitions from a rural roadway to an urban section with lower traffic speeds.

DESIRED (STANDARD)

The most effective way to lower vehicle speeds is to change driver's perception of the road environment through the application of speed reduction measures.

Apply the type of speed reduction measures for the roadway that meet the needs of the project and the community.

¹ Lockwood, Ian. *ITE Traffic Calming Definition*. ITE Journal. pg. 22. July 1997.

² <https://www.ite.org/technical-resources/traffic-calming/>

³ <http://www.seattle.gov/transportation/projects-and-programs/safety-first/traffic-operations/traffic-circles>

⁴ <https://www.ite.org/technical-resources/traffic-calming/traffic-calming-measures/>