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MINNESOTA

TH 15 CORRIDOR STUDY

FINAL REPORT

December 2020

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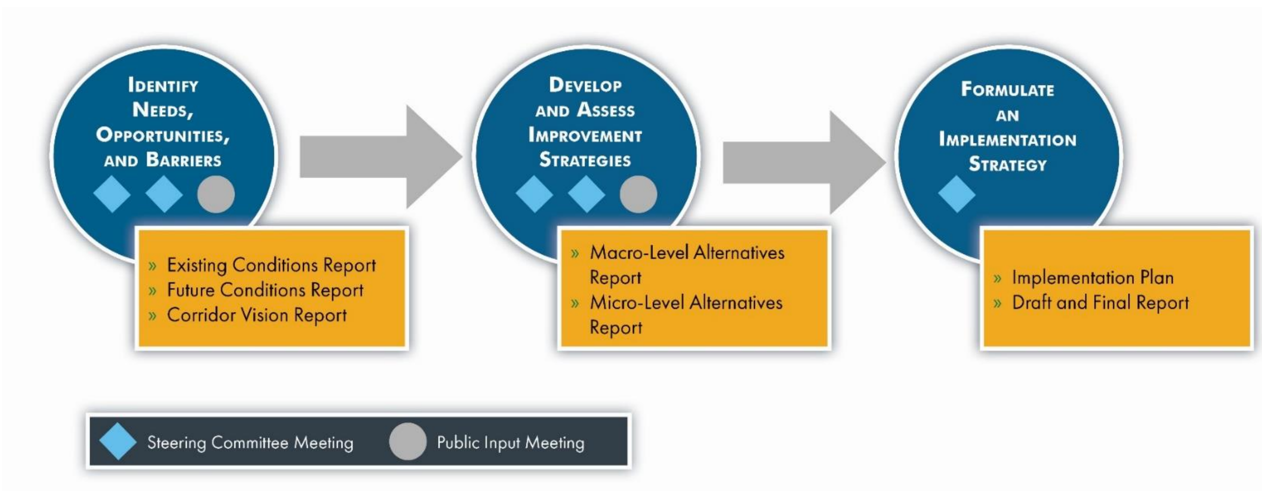
INTRODUCTION

Minnesota Trunk Highway (TH) 15 is a high-speed, high-volume, four-lane highway that serves as both a local and regional connection. Locally, it serves as one of the most intense commercial corridors in the St. Cloud and Waite Park communities making it an important corridor for the region's economic vitality. As a regional roadway, it distributes traffic to and from St. Cloud's commercial and retail districts, serving as a connection between TH 10 and I-94. TH 15 is bisected by TH 23 and Stearns County State-Aid Highway (CSAH) 75, sharing a one-quarter mile section of all three roadways, making it an important corridor for maintaining regional mobility. With these connections, it is one of the most critical corridors in the area to all user types.

The TH 15 Corridor Study is intended to understand the existing and future operations and safety, develop and analyze improvement alternatives, and build consensus around a preferred implementation strategy. Alternatives will be prepared to address actions in the near-, mid-, and long-term under both affordable and ultimate funding scenarios. The affordable scenario assumes funding that is achievable under the current revenue level, and the ultimate scenario assumes that cost is not the controlling factor. The study process for this corridor study is shown in Figure 1.

Figure 1 - Study Process for the TH 15 Corridor Study



STUDY AREA AND BACKGROUND

TH 15 is classified by the Minnesota Department of Transportation (MnDOT) as a High-Priority Regional Corridor with average daily traffic (ADT) volumes up to 38,000. The posted speed limit is 45 miles per hour through most of the study limits and 60 miles per hour at the northern end. The high speeds and traffic volumes result in TH 15 acting as a barrier to both vehicles and pedestrians. Currently, TH 15 experiences both a large number of crashes and significant intersection delays.

The TH 15 Corridor Study includes a primary and secondary study area. The primary study area includes TH 15 from 2nd Street South (TH 23) to 12th Street North. The secondary study area includes the corridors of Waite Avenue to the west and 33rd Avenue to the east, along with the east-west arterials in between (see Figure 3). The focus of this study will be to address operational and safety deficiencies in the primary study area. However, it is anticipated improvements will be necessary in the secondary study area to achieve this.

Primary and secondary intersections considered in the study area are all signalized and are shown below:

Primary Intersections

- TH 15 and 2nd Street South/TH 23
- TH 15 and Division Street/CSAH 75/TH 23
- TH 15 and 3rd Street North
- TH 15 and 8th Street North
- TH 15 and 12th Street North

Secondary Intersections

- Waite Avenue and 2nd Street South/TH 23
- Waite Avenue and Division Street/CSAH 75
- 33rd Avenue and 2nd Street South/CSAH 75
- 33rd Avenue and Division Street/TH 23

EXISTING CONDITIONS

The purpose of the existing conditions analysis is to provide a current in-depth analysis of the multimodal traffic operations and safety performance of the TH 15 corridor and surrounding study area. This section provides a baseline for future conditions analysis, alternative development, and alternative analysis.

CONSTRUCTION HISTORY

The TH 15 corridor has been the fastest growing roadway in St. Cloud over the last 30 years. In 1995, the Bridge of Hope was constructed which completed the TH 15 connection between I-94 and US Highway 10. As development continued to grow between 12th Street and the Mississippi River, at-grade intersections along this corridor reached capacity and needed grade separation. In 2013, a diverging diamond interchange was constructed at CSAH 120, which provided a grade-separated connection between the Sauk River and Mississippi River. This project also recommended that the at-grade intersection at CSAH 1/Riverside Avenue be converted to an overpass when TH 15 volumes cause the intersection to operate deficiently. South of the study area, the 33rd Street interchange was completed in 2015 that created the first access on the four-mile stretch of TH 15 between I-94 and 2nd Street. This project, in combination with overpasses at CSAH 6 and 7th Street, have created a fully access restricted corridor on TH 15 south of the study area.

PREVIOUS STUDIES

TH 15 Corridor Study (2007)

TH 15 was previously studied in 2007 from CSAH 47 (south of I-94) to US 10 to aid in the regional planning of the corridor and its interaction with other regional corridors. This study identified that by 2030, TH 15 speeds would degrade to around 10 miles per hour on average, and operations between 2nd Street S and 12th Street N would be deficient in both the AM and PM peak hours. Population forecasts used to estimate future traffic demand were 170,000 by 2030, compared to the current population forecasts of 130,000 by 2030. The proposed alternative for this study's study area included an elevated freeway with frontage roads providing slip ramps south of 2nd Street, north of Division Street, south of 8th Street, and north of 12th Street. This recommendation had a proposed 263 feet to 322 feet of needed right-of-way with a very substantial cost estimate of $75 to $100 million for corridor implementation.

Figure 2 - 2007 Study Long-Term Recommendation

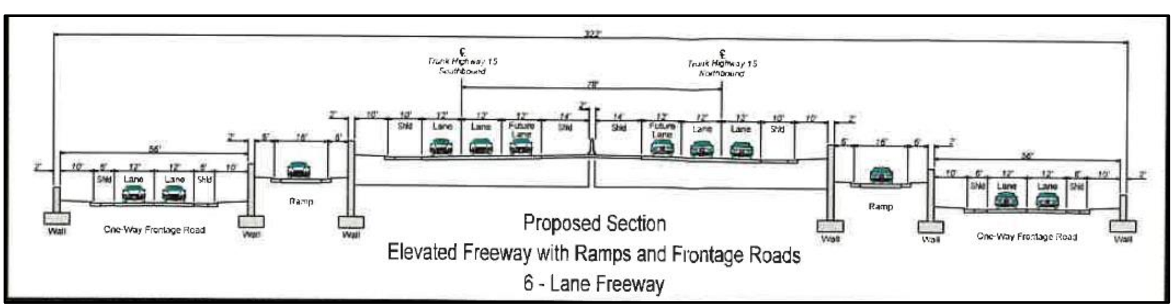
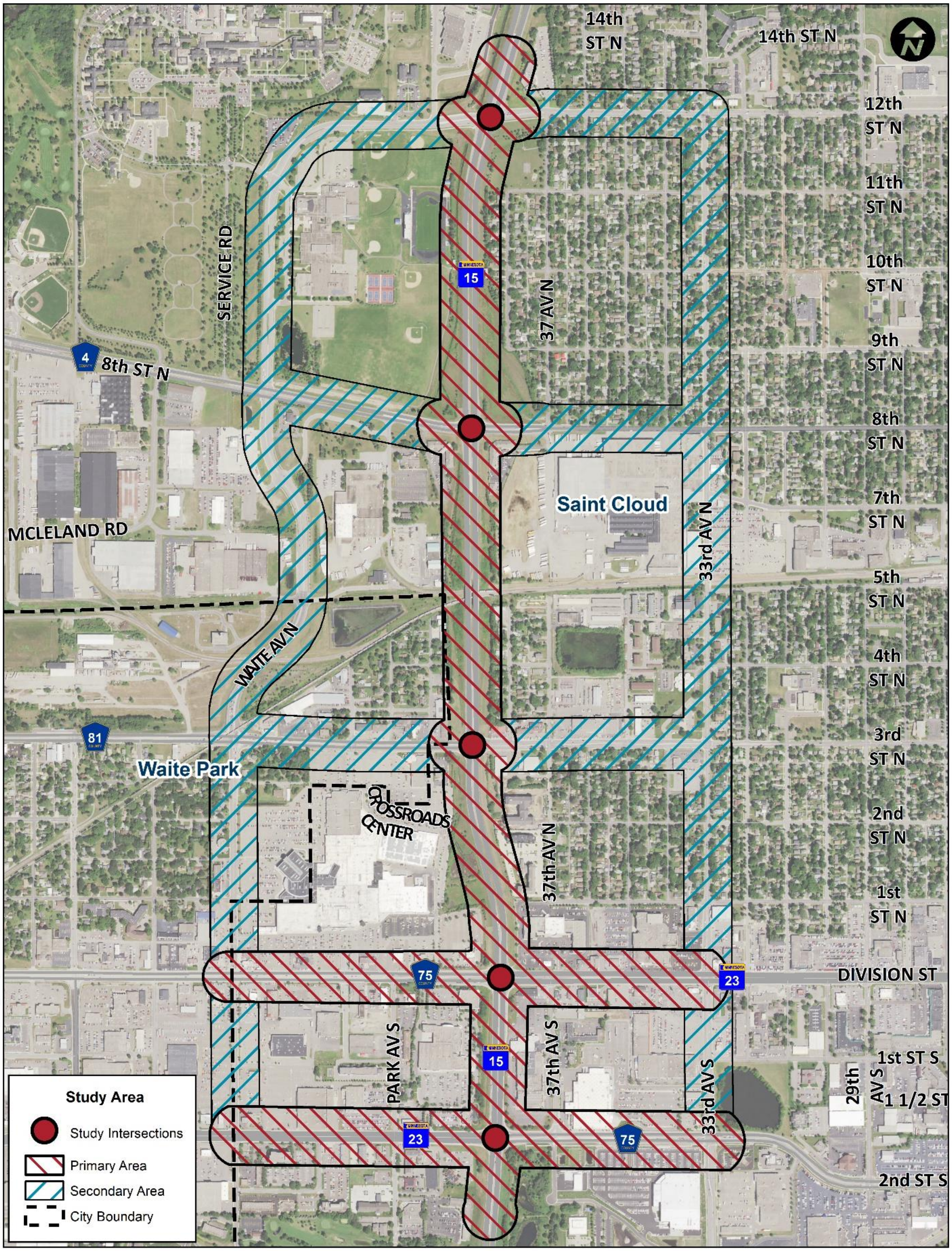


Figure 3 - Study Area



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Source: Saint Cloud APO, MnDOT, ESRI

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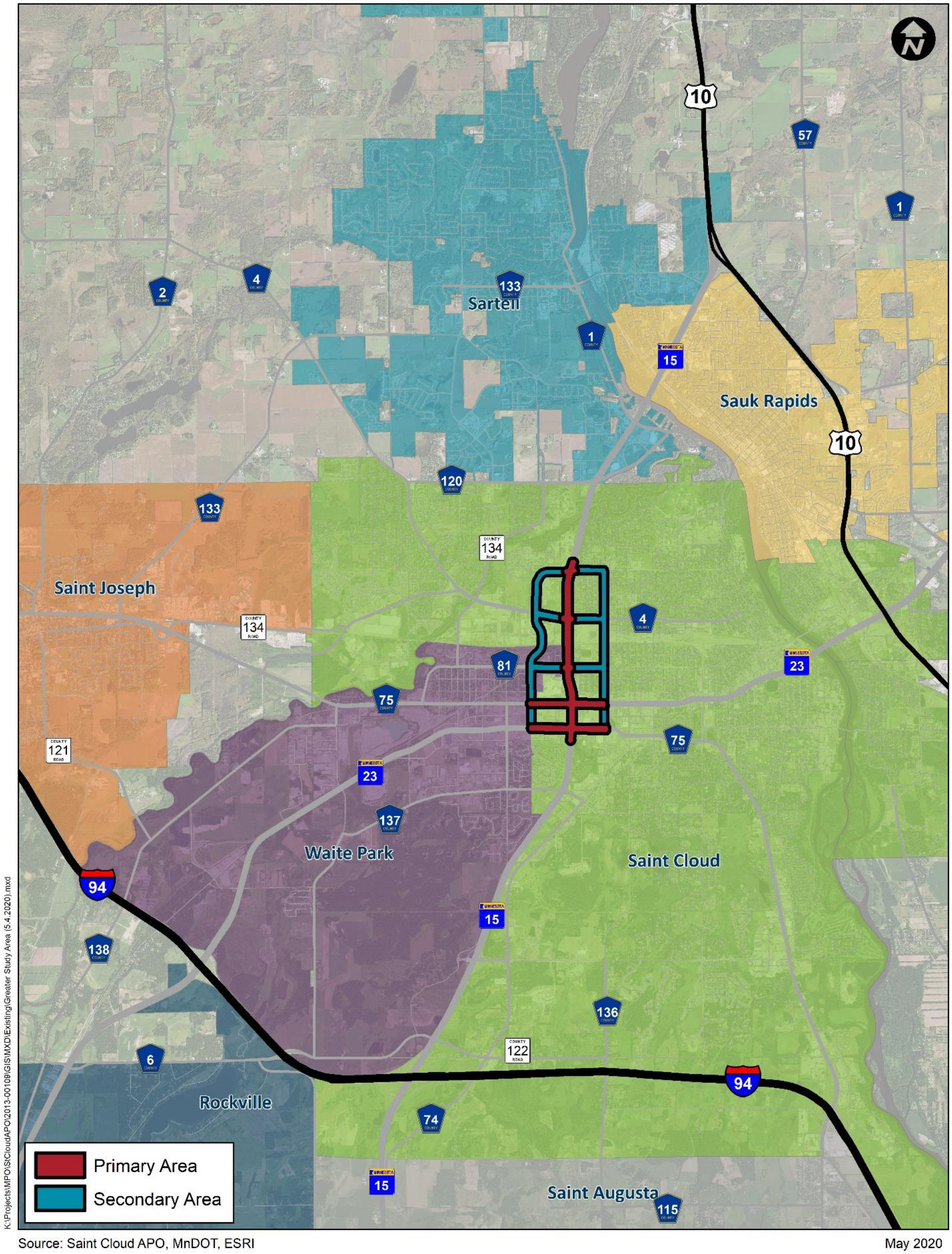
Figure 4 - Regional Context



Mapping 2045 (2019)

The St. Cloud APO Mapping 2045 metropolitan transportation plan (MTP) identified both existing and future failing conditions along the TH 15 corridor with LOS F by 2030. Public comment received during the Mapping 2045 process identified heavy support for reducing access in the current TH 15 study area and creating a grade-separated freeway. Although TH 15 was identified as having existing operational and safety issues, a new TH 15 interchange was not programmed in the fiscally constrained plan. Mapping 2045 did identify future improvements that would impact TH 15, including converting CSAH 75, east of TH 15, and CSAH 4 (8^{th} Street), west of TH 15, to six-lane divided arterials between 2030 and 2045.

MnDOT Statewide and District Plans

MnDOT and District 3 have completed a variety of planning documents over the last decade including Minnesota Go, the state's multimodal long range transportation planning document, which includes a Bicycle and Pedestrian Element, Freight Plan, Greater Minnesota Transit Plan, and Highway Investment Plan and the 10-year Capital Highway Improvements Plan. None of these plans include projects on TH 15. However, they did identify projects on TH 23 to resurface the roadway west of TH 15 in 2026 and east of TH 15 in 2028.

In addition to these long-range planning documents, MnDOT completed the Greater Minnesota Mobility Report which evaluated mobility on the state-owned highway system. This report found the TH 15 corridor to have the highest crash costs in the entire state and severe travel time reliability issues. Recommendations from this report include a traffic operations study, signal timing improvements, acceleration lanes, and continuous right-turn lanes.

INFRASTRUCTURE

Form and Function

Roadways must balance access and mobility. The function of the roadway is dependent on its classification; an interstate or freeway prioritizes mobility and has very strict access controls allowing for high speed, while a local road prioritizes access over mobility. Additionally, roadways that have a functional classification are tied to the Federal Aid and State Aid highway system, making them eligible for funding from federal and state governments.

TH 15, TH 23, and CSAH 75 are all identified as Principal Arterials and intersect in a one-quarter mile common section of roadway. As a principal arterial, TH 15's function is to provide a higher speed facility for longer, regional trips. 33^{rd} Avenue and Waite Avenue are both identified as Minor Arterial roadways. Figure 8 shows the functional classification of roadways in the study area.

TH 15 is a four-lane divided roadway, with all intersections having dedicated single or dual left-turn lanes and single right-turn lanes, shown in Figure 6. The speed limit ranges from 45 miles per hour between 12^{th} Street South and 12^{th} Street North, 55 miles per hour south of 12^{th} Street S, and 60 miles per hour north of 12^{th} Street N. TH 15 also serves as a limited pedestrian corridor with a sidewalk along northbound TH 15 between 2^{nd} Street South and Division Street.

Figure 5 - Functional Classification Tradeoffs Graphic

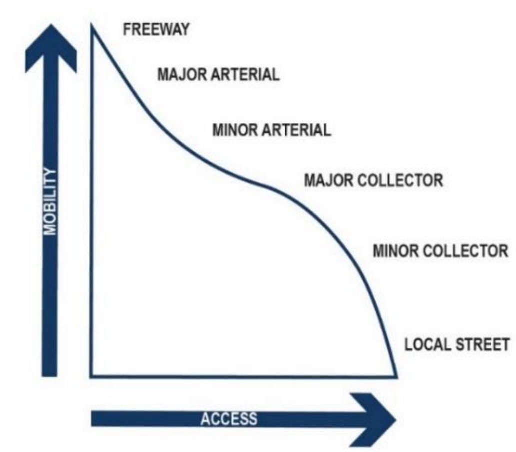


Figure 6 - TH 15 Typical Section

Both TH 23 and CSAH 75 are both important major arterial roadways that run east-west across the study area and provide access to the core business district, downtown St. Cloud, and other parts of the St. Cloud metro area. Both roadways are four-lane divided segments with turn lanes at intersecting roadways. Local north-south connections in the study area are also served by the parallel secondary study segments of Waite Avenue/44th Avenue and 33rd Avenue. Waite Avenue is a 30 miles per hour four-lane undivided section south of 3rd Street and a four-lane divided section north of 3rd Street. 33rd Avenue is a 30 miles per hour four-lane divided section south of 1st Street N and a four-lane undivided north of 1st Street N.

Pavement Conditions

Pavement condition data is currently collected for the National Highway System (NHS) by MnDOT and provided to the APO. Counties collect pavement condition for CSAHs and County Roads. The APO contracted in 2015 and 2019 for pavement condition data for other Federal-aid system roadways not already collected. The pavement conditions in the study area are based on the percent of total lane miles that are rated in good, fair, and poor condition calculated using the *International Roughness Index* (IRI) which includes cracking percent, rutting, and faulting as measurements. Figure 9 shows the pavement quality in the study area.

33rd Avenue and 12th Street N both exhibit failing pavement conditions and are identified in the St Cloud 2020 to 2025 Capital Improvements Plan for sealcoat pavement repair projects during the 2020 construction year. Waite Avenue is also scheduled for a mill and overlay during the 2023 construction year.

Bridge Conditions

MnDOT regularly inspects bridges to verify their condition. Bridge conditions are classified in good, fair, and poor condition using the *National Bridge Inventory* (NBI) ratings for deck, superstructure, substructure, and culverts. There are two bridges along the TH 15 corridor, including a railroad overpass south of 8th Street as well as a pedestrian overpass between 12th Street N and CSAH 4, as shown in Figure 7. Both the bridges were inspected between 2015 and 2017 and are in good condition. Bridge conditions are shown in Figure 9.

Figure 7 - Pedestrian Bridge connecting Apollo High School

Right-of-Way

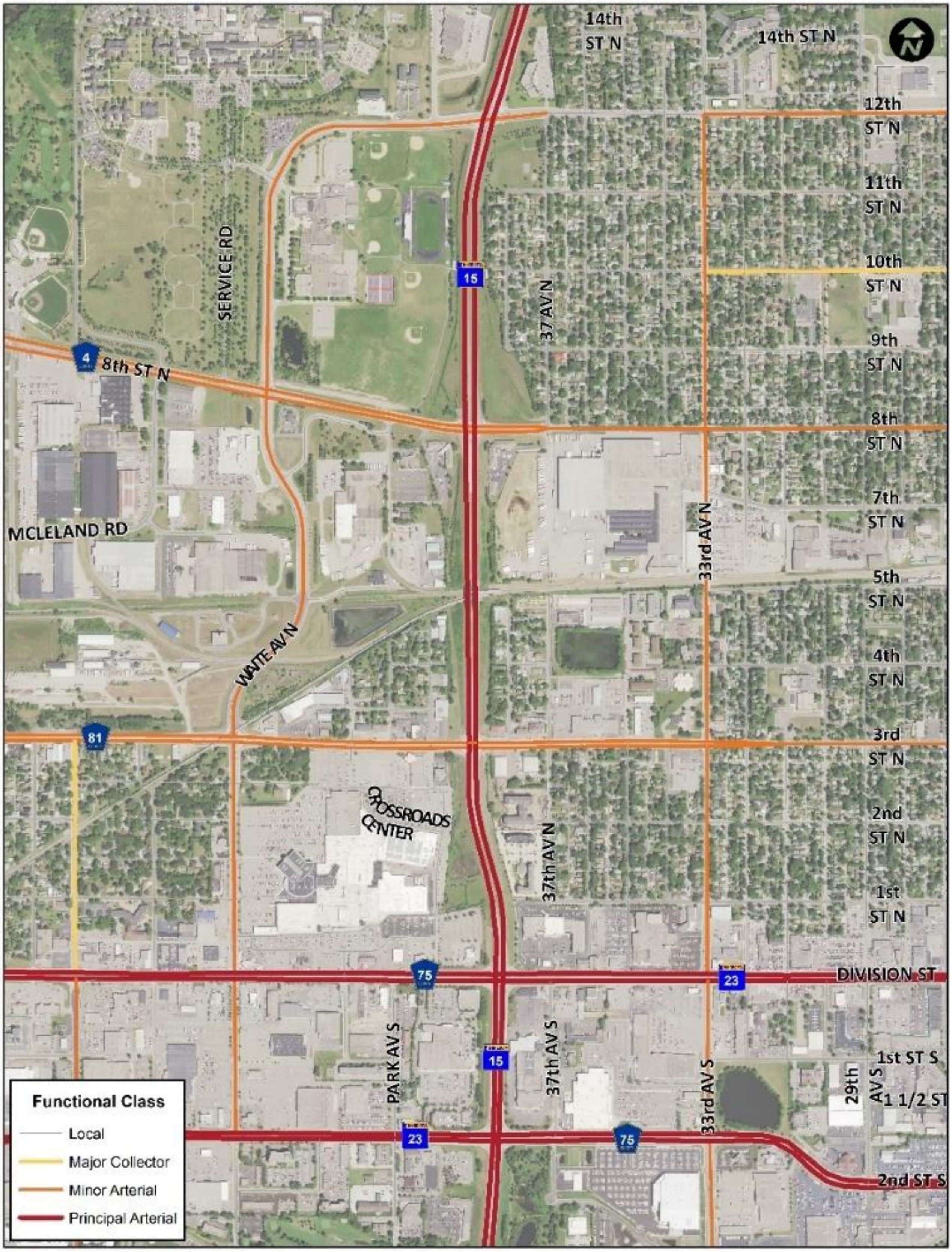
Right of way (ROW) is the available space owned by MnDOT on which the trunk highways reside. ROW is often a constraining factor in developing alternatives, because acquiring additional ROW can be costly, increase project delivery deadlines, or stop a project altogether.

ROW widths vary along the corridor, depending on the location, ranging from 390 feet at its widest, between 8th Street N and 3rd Street N, to 220 feet at its most constrained point, between Division Street and 2nd Street. The area between 2nd Street and Division Street is expected to be the most challenging area to resolve congestion and subsequent safety issues without widening, making the ROW width through this segment, a critical limitation.

Table 1 - Available Right-of-Way

Segment of TH 15 Between	Average ROW Width (ft)
12th St N and 8th St N	330
8th St N and 3rd St N	390
3rd St N and Division St	300
Division St and 2nd St S	220

Figure 8 - Functional Classification



Source: Saint Cloud APO, MnDOT, ESRI

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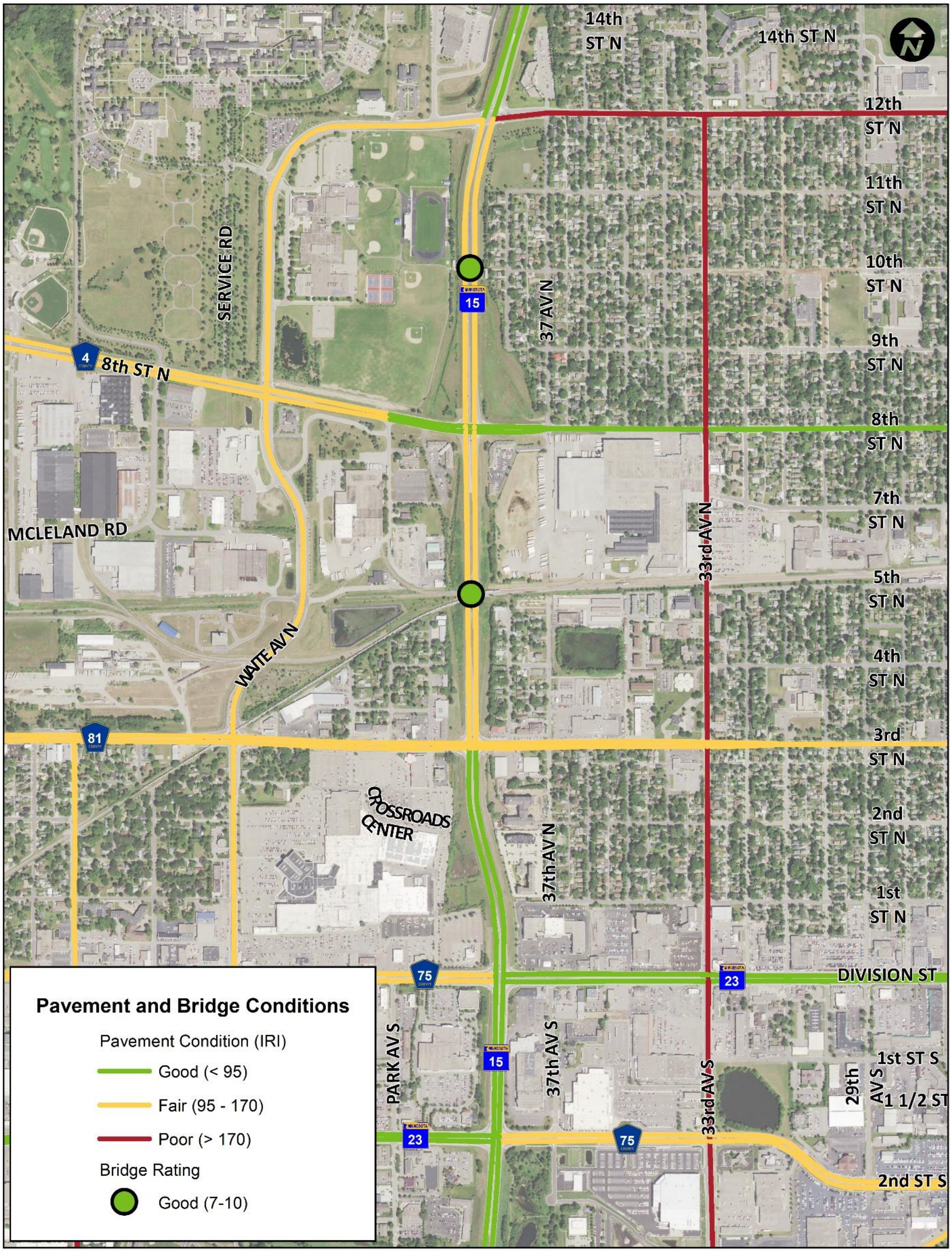
Figure 9 - Pavement and Bridge Conditions



Source: Saint Cloud APO, MnDOT, ESRI

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Traffic Control and Lighting

Traffic Control

Selecting the appropriate traffic control device requires consideration of traffic safety, patterns and volumes, roadway geometry, lane configurations, and multimodal aspects. The *Manual of Uniform Traffic Control Device* (MUTCD) provides guidance and standards on the installation of traffic control methods which considers vehicular volume, pedestrian volumes, and crash frequency thresholds for multiple roadway contexts. Warrant analysis does not require all-way stops or traffic signals to be installed and MnDOT policy typically requires multiple warrants being satisfied to consider alternative traffic control solutions.

Currently, all five intersections on TH 15 are traffic signal controlled. For northbound traffic entering the study area, the TH 15 and 2nd Street intersection is the first signal-controlled intersection in St. Cloud. The nearest signal-controlled intersection for northbound traffic is six miles south at CSAH 47/136 in St. Augusta. For southbound traffic entering the study area, the TH 15 and 12th Street intersection is 1.65 miles south of the nearest signal-controlled intersection. The changing land use context, high speeds, and spacing between traffic signal can create challenges and lead to crash issues, as discussed later in this report. The existing traffic control around the study area is shown in Figure 10.

Traffic Control Technology

All primary and secondary intersection signal controllers in the study area are Econolite ASC/2 or ASC/3 signal controllers (see Table 2). The consistent traffic signal controllers allows for seamless coordination, in both the north-south direction on TH 15 as well as east-west across the corridor on TH 23 and CSAH 75. Coordination does not guarantee improved operations. For example, the cycle lengths along TH 15 can be as high as 200 seconds to provide effective mainline throughput while also minimizing cycle failures at each high-volume intersection. Few corridors in Minnesota have cycle lengths of this duration because they create additional challenges, especially for bicycle and pedestrian movements. The corridor runs several time-of-day timing plans, most with two-minute cycle lengths or longer, except for the off-peak timing plan.

Table 2 - Existing Signal Controller Type

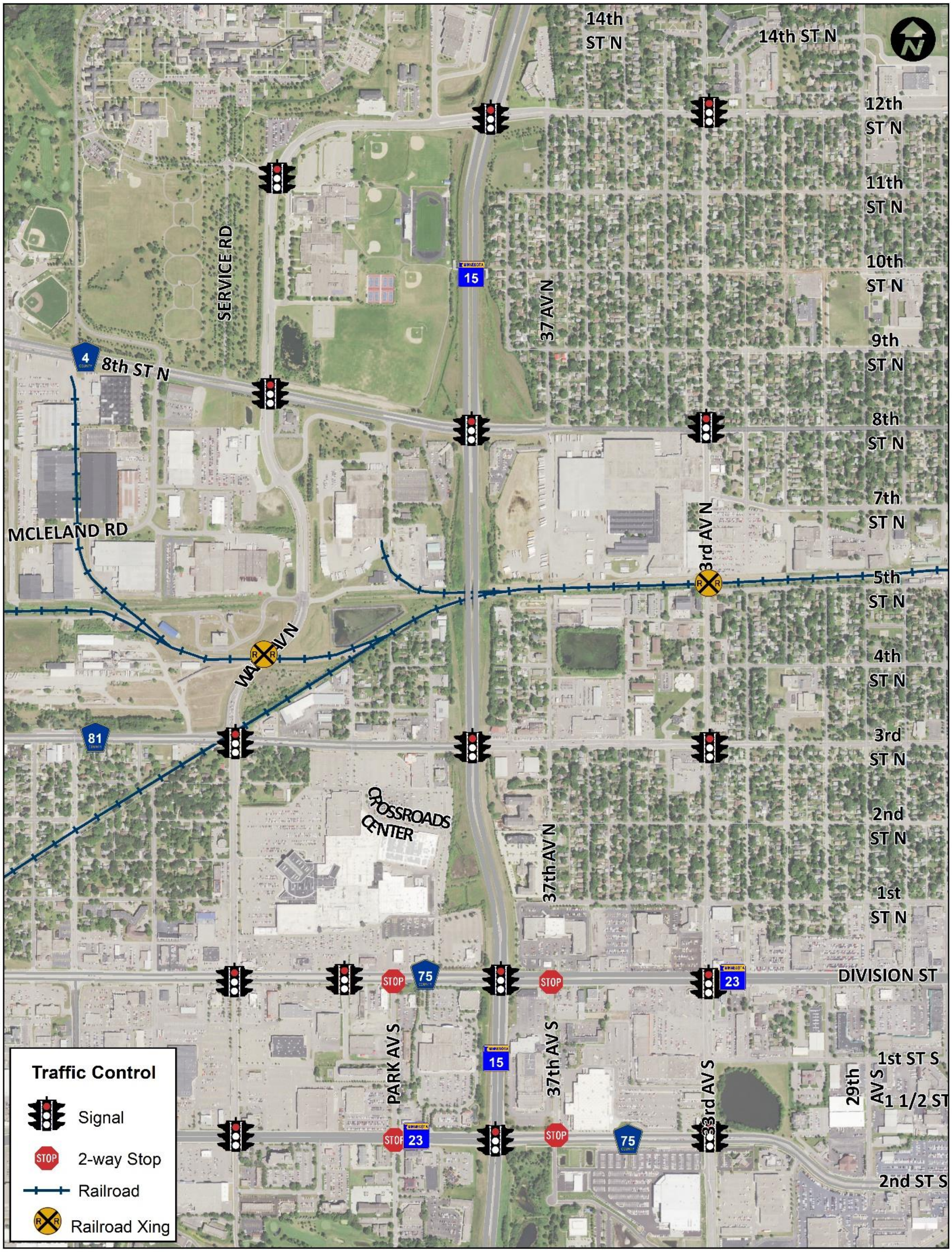
Econolite ASC/2 Controller	Econolite ASC/3 Controller
TH 15 and Division Street/CSAH 75/TH 23	TH 15 and 2nd Street South/TH 23
TH 15 and 8th Street North	TH 15 and 3rd Street North
TH 23 / Division Street and 33rd Avenue	TH 15 and 12th Street North
CSAH 75 / Division Street and Waite Avenue	TH 23 / 2nd Street and Waite Avenue
	CSAH 75 / 2nd Street and 33rd Avenue
	CSAH 75 / Division Street and Crossroads Ent (41st Ave)

Lighting

MnDOT provides lighting warrants to provide conditions that should be satisfied to justify the installation of lighting. However, local conditions like sight distance, crash rates, etc. may require roadway lighting even if warrants are not met. Additionally, meeting these warrants does not require MnDOT or any other jurisdiction to provide lighting or participate in its costs. Generally, the warrants are provided for roadway types, land use, crashes, traffic volumes, and other conditions.

Currently, along the TH 15 corridor there is no continuous lighting on the roadway. The five signalized intersections along TH 15 corridor have intersection lighting. Waite Avenue between 12th Street N and CSAH 75, and 33rd Avenue south of CSAH 4 have continuous lighting. The five study intersections currently meet multiple warrant criteria for intersections.

Figure 10 - Existing Traffic Control



Source: Saint Cloud APO, MnDOT, ESRI

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Environmental Conditions

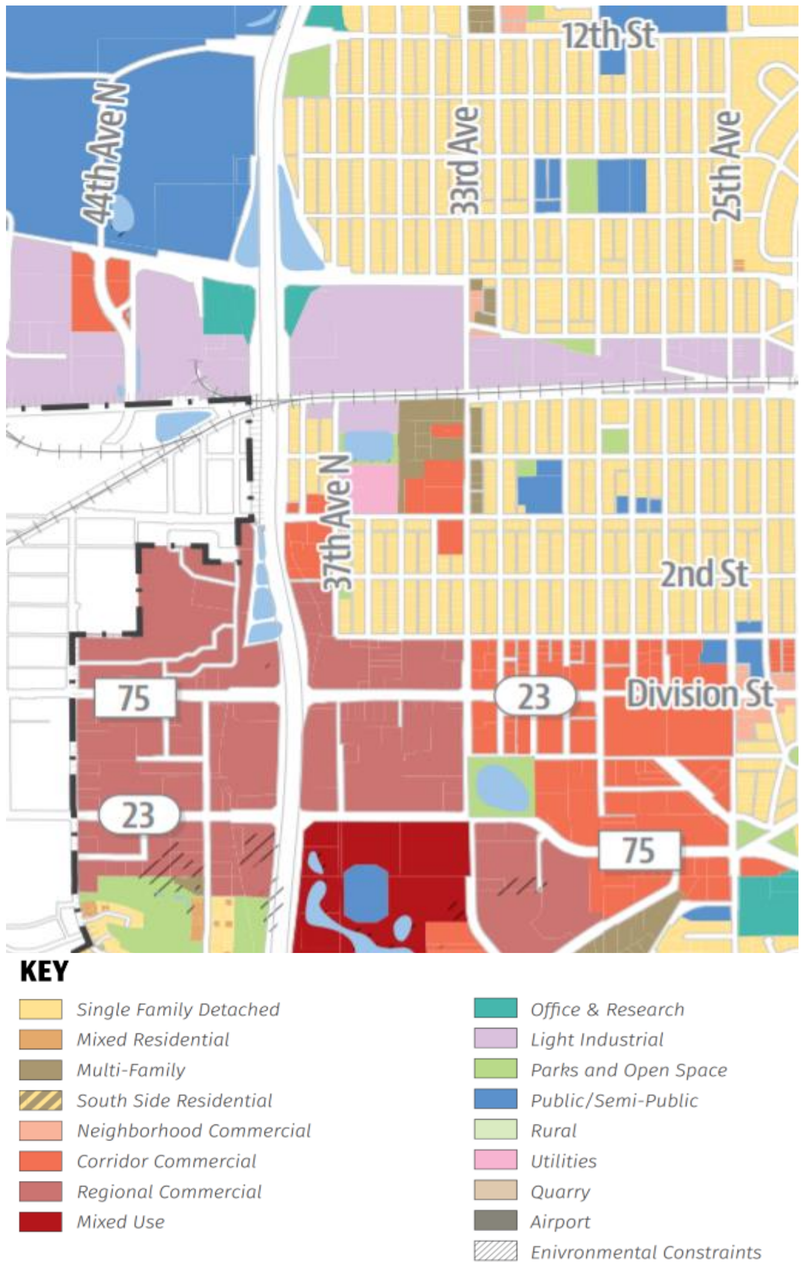
Land Use

Land use can have many implications on the efficiency of the transportation network. For example, a primarily industrial corridor will have peak traffic flows often associated with shift work and must accommodate heavy truck movements while a primarily residential corridor will have strong peaking and directional characteristics as people go to-and-from work and will also see higher bicycle and pedestrian activity throughout the day.

Existing land uses (shown in Figure 11) within the study corridor are mainly commercial, with several retail stores, restaurants and hotels located in the southern portion of the study area. These land uses transition to light industrial near the Burlington Northern-Santa Fe (BNSF) railroad crossing within the central portion of the study corridor both east and west of TH 15. The northern portion of the study corridor is residential to the east with Apollo High School and the St. Cloud VA Health Care facility to the west.

Heavy commercial and hotel developments lend themselves to high afternoon peak hour traffic that extends into the evening. These characteristics also contribute to high traffic volumes on the weekends and during the winter holiday season. The presence of the high school adds traffic during the AM peak hour and can create a new peak hour during school release times in the early afternoon. The school will also generate pedestrian and bicycle traffic adding to multimodal interactions. Finally, the industrial land uses bring into focus the need for truck accommodations.

Figure 11 - St Cloud Land Use Plan



Future Land Use, Growth Area, and Planned Developments

Understanding the goals of a City's growth plan is important in developing the appropriate roadway to accommodate that growth. According to the 2015 St. Cloud Comprehensive Plan, the City is expected to increase its population 26 percent. To address this growth rate and the needs of current and future residents, the City has identified goals and strategies to accommodate future growth in the Growth Areas Framework. The TH 15 study area is within the Core City component. Since this area has already seen extensive development, the goals for the City Core is to look for ways to improve quality of life through beautification projects, redevelopment/development of vacant buildings, and improve services and infrastructure. When planning for capacity enhancements, the Framework and its goals should be taken into consideration to make sure the proposed project matches the community's vision.

Environmental Justice Communities

Consistent with Executive Order (EO) 12898 - Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations, measures must be taken to avoid disproportionately high, adverse impacts on minority or low-income communities. According to the 2010-2018 US Census Bureau, a majority of St. Cloud's population identifies as White (78 percent), followed by Black or African American (13.5 percent), Asian (3.3 percent), two or more races (3.2 percent), Hispanic or Latino (2.7 percent), and American Indian and Alaska Native (0.7 percent). Within the residential area adjacent to the study area, approximately 52 percent of the residents identify as non-white. In addition to a high minority population located adjacent to the study area, approximately 59 percent of residents are considered low-income with public/subsidized housing to support these residents located throughout this residential area per the Minnesota Pollution Control Agency's (MPCA) EJ Screen tool.

Consideration of ways to avoid, minimize or mitigate impacts to the community that live near and rely on a roadways identified for upgrades or re-design as well as identifying the needs for pedestrian infrastructure is always an important factor for any project, especially as it relates to minority and/or low-income populations. Often, mobility focused improvements can positively impact those that utilize the roadway. On the other hand, concepts like a grade separated corridor can pose negative impacts to the adjacent residential communities including promoting social isolation of a particular population, reduction of neighborhood community access or mobility, or promotion the separation of residences or sections of a neighborhood from community facilities or services. It is important as this project progresses, that outreach be made to these communities to allow for residents to fully participate and understand how this project may affect their quality of life.

Parks and Sensitive Land Uses

Section 4F Properties

Although most of the study area adjacent to the roadway has been developed, there are still some areas of open space. Section 4(f) of the Department of Transportation Act (23 U.S.C. 138) prohibits federal transportation agencies from approving the use of significant public parks, recreational areas, wildlife and waterfowl refuges, or public and private historical sites unless no feasible and practicable avoidance alternative exists. If such an avoidance alternative is not available, only the alternative with the least harm, including all possible planning to minimize harm, can be approved.

Adjacent to the eastside of TH 15, just south of 12^{th} Street, is Jaycee Park which offers a playground, basketball court, and picnic areas. This park also offers one of the three off leash dog park areas in the City of St. Cloud. Across TH 15 is Apollo High School's recreation facilities including soccer fields, football stadium, and baseball diamonds. Potential impacts to Jaycee Park or Apollo High School's recreation facilities would require coordination with MnDOT and FHWA (if applicable) to determine which properties Section 4(f) applies to and can only approve the project alternative(s) that avoid Section 4(f) resources, if any such alternatives exist. If no feasible and prudent avoidance alternative exists, coordination with the official(s) with jurisdiction over the affected Section 4(f) resource(s) would be required to minimize and mitigate for impacts and identify the alternative(s) with least harm. Any Section 4(f) approval by the FHWA would require the appropriate coordination and documentation (e.g., Section 4(f) evaluation) efforts.

Hazardous Waste Sites

The Resource Conservation and Recovery Act and the Comprehensive Environmental Response, Compensation, and Liability Act regulate hazardous waste sites. In review of the EPA's Superfund National Priority List, Waite Park Wells, located at 253 N. Fifth Avenue in Waite Park, is located less than 0.5 miles from the study area. This site is being treated and remediated for contaminated groundwater plume (contaminates include trichloroethylene (TCE) and tetrachloroethylene (PCE), as well as free petroleum product) which impacted the City of Waite Park's municipal drinking water wells. Nearby properties including the State-listed Superfund sites identified as the Electric Machinery site (a 45-acre property located in St. Cloud) and the Burlington Northern Car Shop site (a 202-acre property located in Waite Park) are thought to be the source of the contamination. Both these sites also contain contaminated soils. Groundwater monitoring at the Electric Machinery site and on-site containment at the Burlington Northern Car Shop are being done to monitor the sites, with the MPCA providing oversight. In addition to the Federal and State Superfund sites, other hazardous materials/waste could be present along the study area (e.g., industrial areas, gas and service stations).

Improvements to the roadway would have the potential to encounter regulated materials/waste and/or contaminated properties. Surveys should be conducted to identify regulated materials/waste in structures that would be impacted so that any identified regulated materials/waste can be handled and disposed of according to state and federal law. Prior to right-of-way acquisition, large scale earthwork, groundwater dewatering, or work in commercial or industrial areas, surveys (e.g., Phase I and/or Phase II Environmental Site Assessment) should be conducted to identify contaminated properties so that liability and cost risk can be assessed.

Wetlands

Surface water resources generally include lakes, rivers, streams, floodplains, and wetlands. These resources have the potential to be protected by several decrees, including Executive Order 11990, Protection of Wetlands; Sections 401, 402, and 404 of the Clean Water Act (US Army Corps of Engineers [USACE]); Section 10 of the Rivers and Harbors Appropriation Act (USACE); Minnesota Wetland Conservation Act (local government unit); the Shoreland Development section under Minnesota Statute 103F; Minnesota Statute 103G - Waters of the State, pertaining to public waters and public waters wetlands (MnDNR); and local watershed district rules.

The study area is within the Sauk River Watershed District. Surface waters within the study area identified on the US Fish and Wildlife Service's (USFWS) National Wetlands Inventory including natural wetlands. Numerous artificial ditch wetlands were also noted during a review of the GoogleEarth imagery. Surface water within the study area generally flows toward the Sauk River and/or Mississippi River. A field aquatic resources delineation should be completed during the environmental review process for proposed improvements. Impacts to any of the identified surface water resources may require permits pursuant to the regulations above. In general, impacts to wetlands must be avoided, minimized, and mitigated in sequence. Increased impervious surface area may necessitate implementation of stormwater handling measures. Best management practices during construction activities to minimize erosion and sedimentation are typically required.

ACCESS

Access management is the process of balancing the competing needs of traffic movement and land access. Access points introduce conflict and friction into the traffic stream. Allowing dense, uncontrolled access spacing results in safety and operational deficiencies. According to NCHRP Report 420, Impact of Access Management Techniques, every unsignalized driveway increases the corridor crash rate by approximately two percent. Research included in the Highway Capacity Manual found that roadway speeds were reduced an average of 2.5 miles per hours for every ten access points per mile.

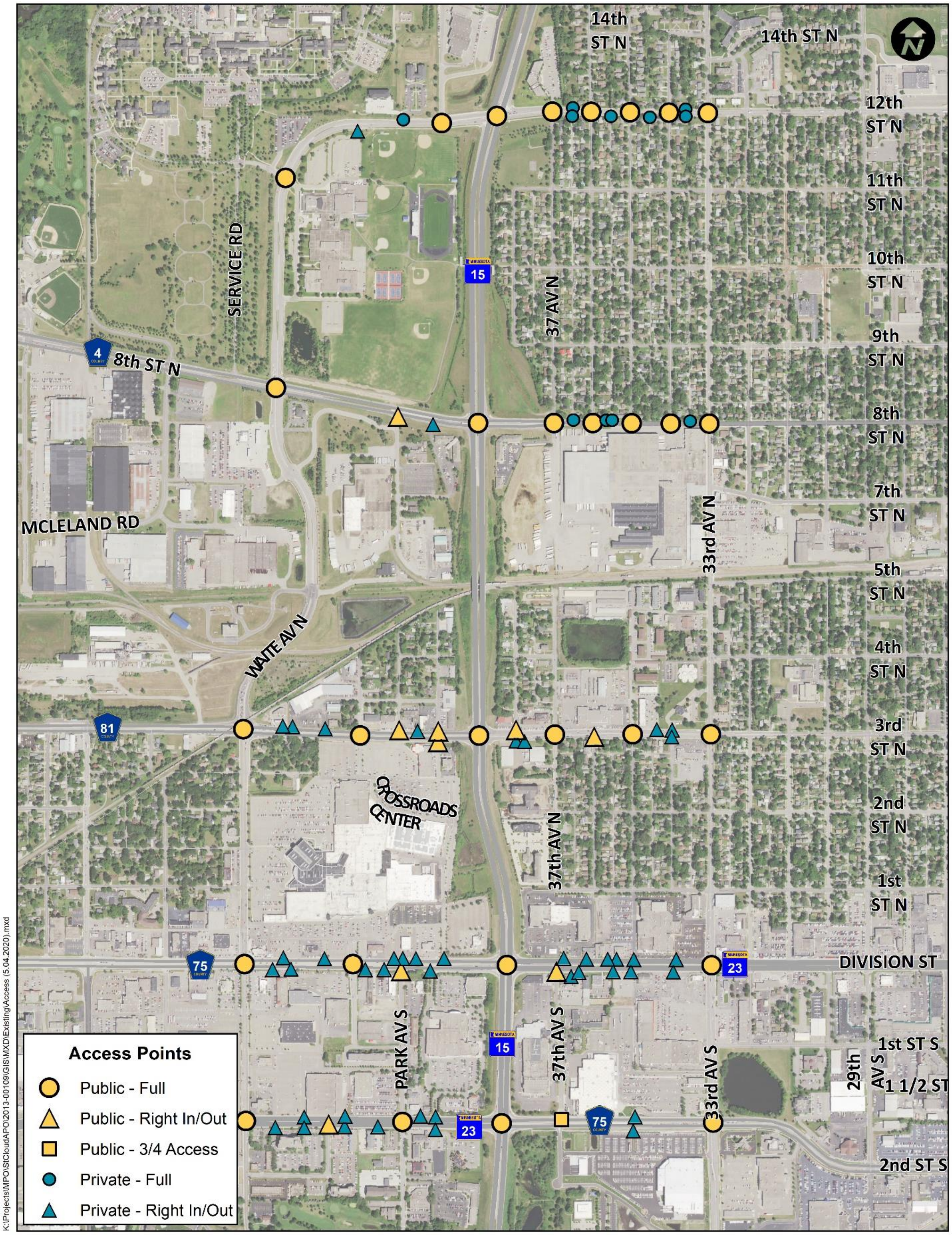
The existing access points along the corridor and side streets are shown in Figure 12. Table 3 shows the number of current access points and recommended access points based on the access spacing guidelines provided in the 2040 MTP for each segment.

Along the TH 15 corridor, there are five signalized intersections in the nearly 1.65-mile long corridor. This does not meet signal spacing criteria for Principal Arterials; however, under the existing intersection configuration, the removal of signals to meet recommended signal spacing guidelines would not provide adequate traffic operations. Alternatively, the side-streets have dense access spacing, particularly within the functional area of the intersections. Almost all side-street segments are above the recommended access density, with most segments having more than two times as many access points as recommended. For example, TH 23 has as many as 11 driveways within one-third mile. The high access point densities on the major side streets, like TH 23 and CSAH 75, can disproportionately increase crashes on these segments. Intersection delays on TH 23 and CSAH 75 approaches can generate long queues that block the upstream public intersections and driveways, which cause additional safety issues. Additional access management may be required within the functional area of the TH 15 intersections to fully address the operational needs of TH 15 and reduce crash rates.

Table 3 - Existing Access Points and Guidelines

Segment	Classification	Spacing Type	Access Points	Miles	Access Points per Mile		
					Actual	Recommended	% Over Recommended
TH 15 - 2nd St to 12th St	Principal Arterial	Intersection	5	1.65	3	2	+ 50 %
		Driveway	0	1.65	0	15	Acceptable
TH 23 - TH 15 to Waite Ave	Principal Arterial	Intersection	4	0.40	10	2	+ 400 %
		Driveway	9	0.40	23	18	+ 28 %
CSAH 75 - TH 15 to 33rd Ave	Principal Arterial	Intersection	3	0.34	9	2	+ 350 %
		Driveway	2	0.34	6	18	Acceptable
CSAH 75 - TH 15 to Waite Ave	Principal Arterial	Intersection	4	0.42	10	2	+ 400 %
		Driveway	11	0.42	26	21	+ 24 %
TH 23 - TH 15 to 33rd Ave	Principal Arterial	Intersection	3	0.33	9	2	+ 350 %
		Driveway	11	0.33	33	21	+ 58 %
CSAH 81 - TH 15 to Waite Ave	Minor Arterial	Intersection	6	0.38	16	4	+ 300 %
		Driveway	4	0.38	11	21	Acceptable
3rd St N - TH 15 to 33rd Ave N	Minor Arterial	Intersection	6	0.37	16	4	+ 300 %
		Driveway	5	0.37	14	27	Acceptable
CSAH 4 - TH 15 to Waite Ave	Minor Arterial	Intersection	3	0.33	9	4	+ 125 %
		Driveway	1	0.33	3	18	Acceptable
CSAH 4 - TH 15 to 33rd Ave N	Minor Arterial	Intersection	6	0.37	16	4	+ 300 %
		Driveway	4	0.37	11	27	Acceptable
Waite Ave - TH 15 to Service Rd	Minor Arterial	Intersection	3	0.37	8	4	+ 100 %
		Driveway	2	0.37	5	27	Acceptable
12th St N - TH 15 to 33rd Ave	Minor Arterial	Intersection	6	0.34	18	4	+ 350 %
		Driveway	6	0.34	18	27	Acceptable

Figure 12 - Existing Access Points



Source: Saint Cloud APO, MnDOT, ESRI

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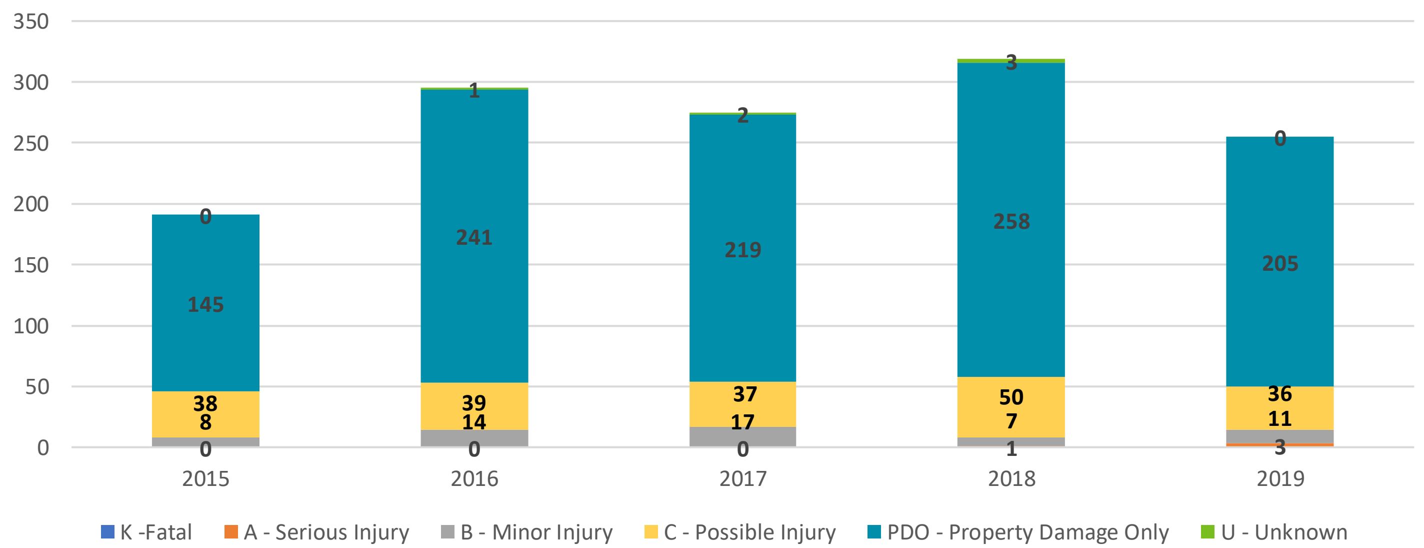
Safety Analysis

Crash History

Reviewing historic crash information can help identify existing deficiencies that can be addressed through this study. Five years of crash records between January 1, 2015 through December 31, 2019 were extracted from *Minnesota Crash Mapping Analysis Tool* (MnCMAT2). There were 1,335 crashes reported during this period in the 1.65-mile TH 15 corridor between 12th Street N and 2nd Street S and the TH 23 and CSAH 75 corridors between Waite Avenue and 33rd Avenue. This corresponds to an average of 267 crashes per year with 52.2 crashes per year resulting in an injury, including the possible injury classification. The number of crashes has fluctuated over the five-year period in a growing direction. Year 2018 saw the highest number of total crashes in the five-year analysis period.

There were no traffic fatalities reported during the analysis period on TH 15. There was one fatality on 33rd Avenue in 2018. Twenty percent of all crashes were injury (A type or B type) or possible injury (C type) related. Using the FY 2020 MnDOT estimated crash costs, the study area sees total crash costs of $7.6 million per year.

Figure 13 - Five-Year Crash Summary (2015-2019)

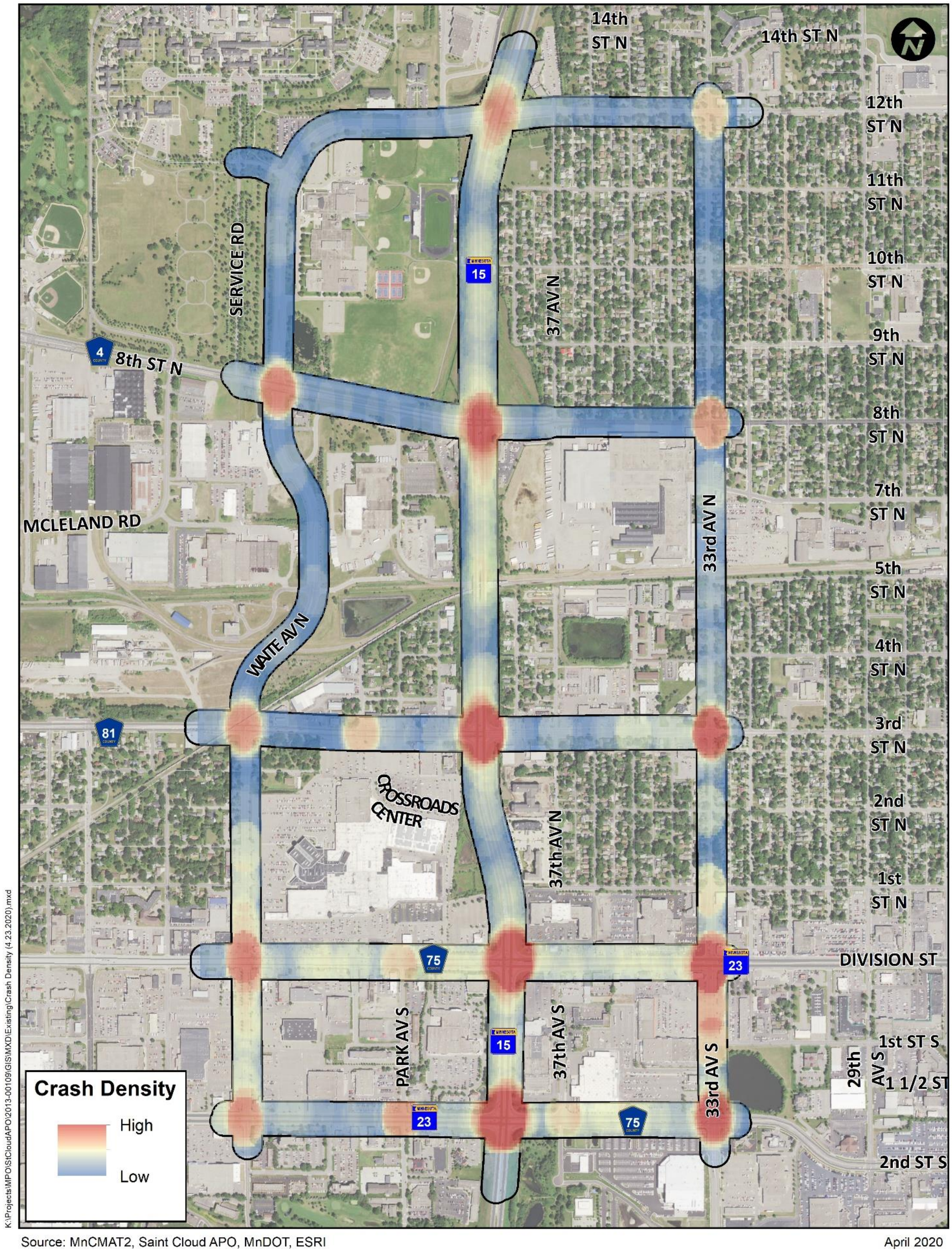


Crash density in the study area is shown in Figure 14. Most crashes occur at intersections. The segments of TH 23 and CSAH 75 between Waite Avenue and 33rd Avenue were identified earlier as having high access density, which is why these segments show the highest crash rates outside of the TH 15 corridor. Research has shown that high access density coupled with high traffic volumes increases crash frequencies.

Previous Crash Analysis

Recently, the City of St. Cloud completed a city-wide crash analysis report using crash data from 2010 to 2019. This analysis found that five of the highest crash rate intersections occurred within the primary study area. The findings of this study are included in the following sections. Additionally, three intersections were identified in Minnesota's Top 10 crash locations using data from 2015 to 2019. These intersections include TH 15 and 2nd Street (#4), TH 15 and Division Street (#7), and TH 15 and 3rd Street (#8).

Figure 14 - Crash Density (2015-2019)



Critical Crash Locations

To identify overrepresented crash locations within the study corridor, the critical crash rate analysis method was used. This method calculates location-specific crash rates and compares those rates against crash rates for similar facilities, based on methodologies developed by MnDOT. Using statistical analysis, the critical crash analysis method helps determine if differences between observed crash rates and typical crash rates are statistically significant and likely attributable to roadway design or traffic control. Intersections and segments with crash rates above the critical rate are considered overrepresented and in need of further review because there is a high probability that conditions at the site are contributing to the higher crash rate. Based on this analysis, shown in Table 4, the entire TH 15 study corridor experiences crash rates greater than the critical crash rates for similar facilities. TH 23, CSAH 75, Waite Avenue, 44th Avenue, and 33rd Avenue corridors also exhibit critical crash rates.

There are several locations that greatly exceed critical crash thresholds. For example, there are three intersections where the observed crash rate is three times higher than the critical crash rate. For links, the observed crash rate ranged from nearly twice to nearly five times the critical crash rate. There are few locations in the entire state that experience crash rates in this range.

Table 4 - Critical and FAR Crash Analysis

Intersection	Million Entering Vehicles	Total Crashes	Critical Crash Rate	Observed Crash Rate	Critical Index	FAR Index
TH 15 and 2nd Street S	95.1	250	0.66	**2.63**	**3.98**	0.93
TH 15 and Division Street	110.9	218	0.64	**1.96**	**3.07**	0.00
TH 15 and 3rd Street NE	87.5	178	0.66	**2.03**	**3.08**	0.95
TH 15 and 8th Street N	95.6	110	0.66	**1.15**	**1.74**	0.00
TH 15 and 12th Street N	85.5	65	0.67	**0.76**	**1.14**	0.00
Waite Avenue and 2nd Street S	55.0	35	1.02	0.64	0.62	0.00
Waite Avenue and Division Street	59.4	40	1.01	0.67	0.67	0.00
Waite Avenue and 3rd Street N	37.2	34	1.09	0.91	0.84	0.00
44th Avenue and 8th Street N	54.7	37	1.02	0.68	0.66	**1.09**
33rd Avenue and 2nd Street S	62.5	57	1.00	0.91	0.91	0.00
33rd Avenue and Division Street	75.5	84	0.98	**1.11**	**1.14**	0.00
33rd Avenue and 3rd Street N	38.7	52	1.08	**1.34**	**1.24**	0.00
33rd Avenue and 8th Street N	32.8	32	1.12	0.98	0.87	**1.24**
33rd Avenue and 12th Street N	29.1	23	1.14	0.79	0.69	0.00

Segment (non-intersection related)	Million Entering Vehicles	Total Crashes	Critical Crash Rate	Observed Crash Rate	Critical Index	FAR Index
TH 15 - 2nd Street S to 3rd Street N	58.4	153	0.75	**2.62**	**3.49**	0.00
TH 15 - 3rd Street N to 12th Street N	40.5	79	0.80	**1.95**	**2.44**	0.00
TH 23 (2nd St) - Waite Ave to TH 15	36.2	55	0.97	**1.57**	**2.47**	0.00
CSAH 75 (Division St) - Waite Ave to TH 15	34.4	60	0.98	**1.78**	**1.78**	0.00
CSAH 75 (2nd St) - TH 15 to 33rd Ave	15.9	87	1.16	**4.73**	**4.73**	0.00
TH 23 (Division St) - TH 15 to 33rd Ave	20.5	80	1.09	**3.59**	**2.28**	**2.50**
Waite Ave - 2nd St S to 3rd St N	9.1	67	1.71	**7.34**	**4.29**	**2.89**
44th Ave - 3rd St to 12th St	19.6	25	1.10	**1.28**	**1.16**	**1.26**
33rd Ave - 2nd St S to 12th St N	29.8	71	1.31	**2.39**	**1.82**	0.00

*Critical Index = Observed Crash Rate / Critical Crash Rate; FAR Index = Observed FAR Rate / Critical FAR Rate

Fatal and A-Injury Crash Rate (FAR) Analysis

FAR analysis is an analysis strategy designed to quantify crashes by severity. It is categorized based on the Fatal and A-injury (incapacitating) crashes. An incapacitating injury crash is defined as an injury, other than fatal which prevents the injured individual from walking, driving, or normally continuing the activities they could perform before the injury. This measure can be suited to quantify the safety of a stretch of road and for identifying candidate locations for investments from the Highway Safety Improvement Program (HSIP).

There were four incapacitating injury related crashes reported during the analysis period on TH 15.

- The first incident was reported in July 2019 at the intersection of TH 15 and 2nd Street S that involved a motor vehicle and bicyclist. The bicyclist was crossing westbound, failed to yield, and was hit by a southbound vehicle.
- The second incident was reported on November 2019 at the intersection of TH 15 and 3rd Street NE. The crash was a result of right-angle crash when the motorist travelling northbound ran the red light and collided with two motorists travelling eastbound.
- The last two incidents occurred on TH 23 (Division Street) west of 33rd Avenue in 2018 and 2019. Both crashes were rear end crashes with the front vehicle slowing due to congestion and the rear vehicle failing to stop in time.

The observed FARs were greater than the statewide average FARs but less than critical FARs at two intersections: TH 15 and 2nd Street and TH 15 and Division Street. The FAR was 2.5 times higher than the FAR critical rate for TH 23 from TH 15 to 33rd Avenue.

Crash Type

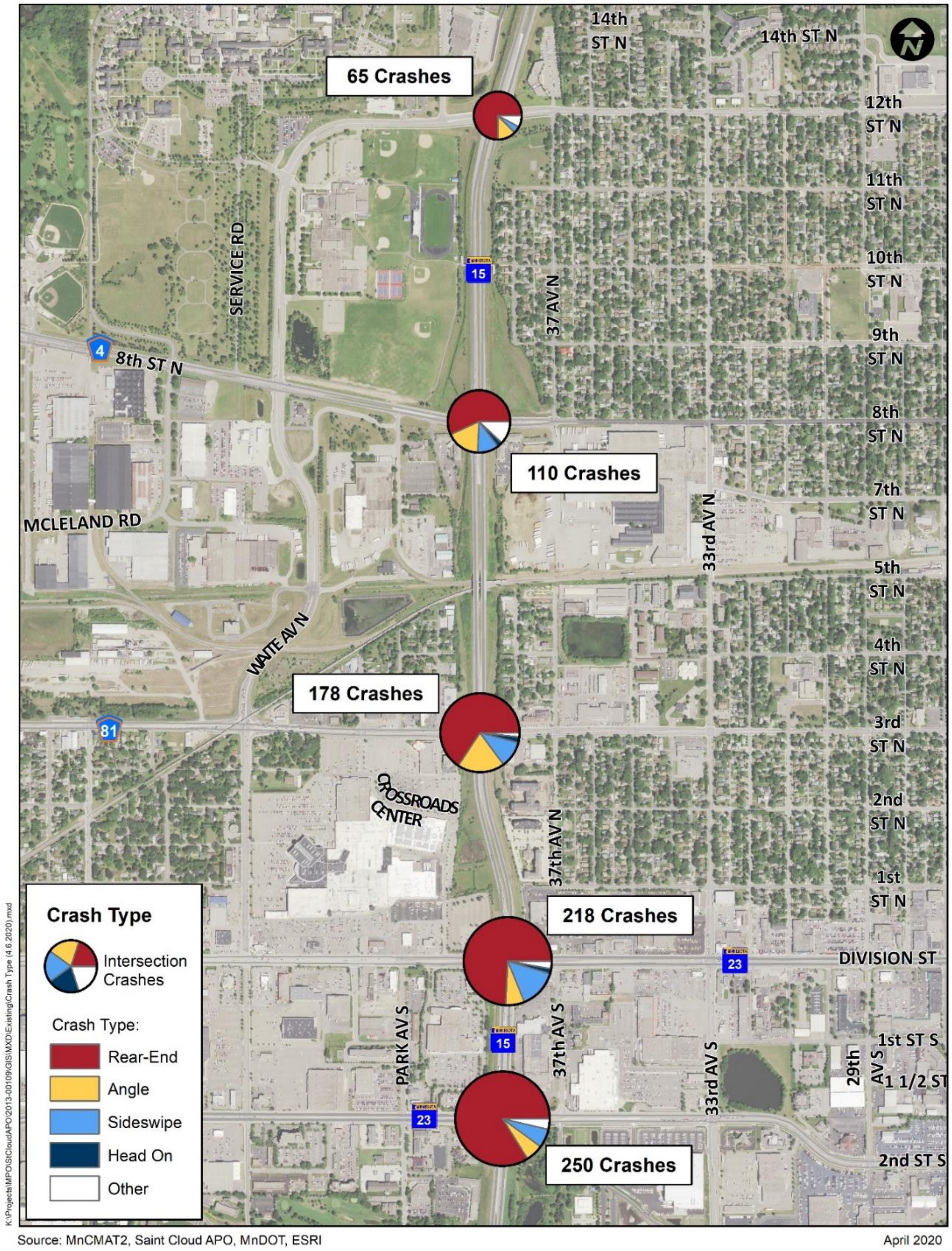
Identifying crash types assists in developing counter measures to mitigate or minimize the most prevalent crash types. The analysis revealed that rear end crashes (72 percent) are the most common crash type in the study corridor. Along the TH 15 roadway, including intersections, there were 960 rear end crashes with 385 crashes (40 percent) in the northbound direction and 244 crashes (25 percent) in the southbound direction. Rear end crashes are often the most common type of crashes in a signalized network corridor, especially when adjacent to access-controlled freeway segments, due to long queues and stop-and-go traffic flow. This is also common on corridors with high access density as slow-moving vehicles exiting driveways can disrupt natural traffic flow. Figure 15 presents the crashes by crash type at the study intersections during the analysis period. The larger the chart, the more crashes that occurred at that intersection.

The rear end crashes at the intersections were mostly attributed to following too close, distracted driving, and speeding. Many of the rear end crashes are due to the heavy congestion during the PM peak period from 4 PM to 6 PM. These crashes represent 19 percent of the total study area crashes. Other rear end crashes may be attributed to the right turn yield conditions on all approaches where drivers may be looking to their left for a gap in the traffic and the vehicle in front of them stops.

Sideswipe crashes represented 11 percent of study area crashes due to similar factors to rear end type crashes. Sideswipes occur as drivers attempt to switch lanes to find more favorable passing and routing conditions, usually during congested periods. This is common in four-lane undivided sections with dense driveway spacing as motorists route through congested corridors to find their destination.

While left turn and angle type crashes only represented nine percent of total crashes, these crash types are most associated with high severity results. There was a strong trend toward drivers failing to yield or obey the traffic signal, sometimes deliberately, including 45 crashes that included contributing factors of running red lights. Once again, this is potentially due to long cycle lengths and motorist frustration as drivers would prefer to take risks rather than wait another 200 second cycle for their green indication.

Figure 15 - Crash Type (2015-2019)



Crash Hotspots

Using the trends identified in the previous sections, additional analysis and evaluation was completed in the study area for the five TH 15 intersections. This crash hotspot analysis is used to identify specific combinations of crash type and direction to further identify the specific issues at each intersection.

TH 15 and 2nd Street Intersection

There were 250 crashes reported during the analysis period that corresponds to 50 crashes per year at the intersection. Rear end crashes (208 crashes or 83 percent) were the most prominent type of crashes at the intersection. Many of the rear end crashes involved collision between the interaction of vehicles travelling northbound (39 percent) where free-flow speeds are much higher. Westbound rear end crashes were the second highest direction even though this leg had the lowest traffic volumes. About 37 percent of crashes occurred between 3 PM and 7 PM. This can be attributed to high traffic volume at the intersection during the afternoon-evening congestion period.

Figure 16 - TH 15 and 2nd Street Intersection Is First Signalized Intersection

TH 15 and Division Street Intersection

There were 218 crashes reported during the analysis period that corresponds to 44 crashes per year at the intersection. Rear-end crashes (161 crashes or 74 percent) were the most prominent type of crashes at the intersection, skewed slightly to the northbound and westbound approaches. About 40 percent of crashes occurred between 3 PM and 7 PM and 10 percent of crashes occurred between 12 Noon and 1 PM. This can be attributed to high traffic volumes at the intersection during the lunch hour and evening peak hours. Angle crashes on the corridor identified six minor right turns failing to yield to TH 15 through volumes at the existing channelized right-turns.

Figure 17 - Minor Approach Channelized Right-Turn at TH 15 and Division Street

TH 15 AND 3RD STREET INTERSECTION

Figure 18 - Protected/Permitted Phasing at the TH 15 and 3rd Street Intersection

There were 178 crashes reported during the analysis period that corresponds to 36 crashes per year at the intersection. Rear end crashes (215 crashes or 65 percent) were the most prominent type of crashes at the intersection, followed by the right-angle crashes (31 crashes or 17 percent). Fifteen percent of all crashes occurred between 5 PM and 6 PM and 11 percent of crashes occurred between 1 PM and 2 PM. Forty-five percent of the right-angle crashes involved vehicles travelling eastbound. One right-angle crashes resulted in an incapacitating injury after an eastbound driver ran a red light. The high number of angled crashes at this intersection can likely be attributed to the protected/permitted left-turn phasing on the side street approaches. All other left-turns on TH 15 are protected only, reducing driver's judgement errors. Crashes were generally less frequent (seven crashes in five years) between 6 AM and 9 AM, the AM peak period.

TH 15 AND 8TH STREET INTERSECTION

There were 110 crashes reported during the analysis period that corresponds to 22 crashes per year at the intersection. Rear ends (62 crashes or 56 percent) were the most prominent type of crashes at the intersection followed by right-angle crashes (18 crashes or 16 percent). Many of the rear end crashes involved vehicles travelling northbound (38 percent). Northbound traffic is heading downhill toward the intersection from the railroad overpass, which may contribute to increased speeds and difficult stopping conditions during inclement weather conditions. Fifty percent of the right-angle crashes involved vehicles travelling southbound. Six of the right-angle crashes resulting in an injury were caused by vehicles running a red light. About 24 percent of crashes occurred between 2 PM and 4 PM, which corresponds to the school afternoon peak period, but only 17 crashes involved a high school aged driver.

TH 15 AND 12TH STREET INTERSECTION

There were 65 crashes reported during the analysis period that corresponds to 13 crashes per year at the intersection. Rear end crashes (48 crashes or 74 percent) were the most common crash type at the intersection followed by right-angle crashes (eight crashes or 12 percent). A majority of the rear end crashes were evenly split between northbound and southbound direction (42 percent each). Both injury related right-angle crashes were caused by failing to yield at a red light. About 45 percent of total crashes at this intersection occurred between 2 PM and 6 PM, which corresponds to the school afternoon and evening commute peaks.

Surrogate Safety Assessment Model (SSAM)

To establish a baseline for future safety comparisons between alternatives, simulated vehicle conflicts were collected from Vissim microsimulation results using the Surrogate Safety Assessment Model (SSAM). SSAM uses Vissim modeled vehicle trajectory information to analyze vehicle-to-vehicle interactions and identify conflict events and near-misses. This analysis is focused on intersections, and considers vehicle speeds, signal timing attributes, deceleration characteristics, typical gap acceptance behavior, traffic volumes, and site-specific vehicle paths to quantify predicted conflicts for rear end, crossing, and merging crash types.

Simulated conflicts do not directly correlate to crashes, rather the tool is intended to identify conditions with a high *potential* for crashes. Simulation results from an average of ten 24-hour Vissim model runs were used for this analysis and show the potential change of each crash type. Under the existing conditions, there were 5,138 total daily simulated conflicts (73 percent rear end, 19 percent merging, and eight percent crossing). After completing the SSAM conflict analysis, results were compared to reported crash data over the five-year study period. The SSAM results generally match study area trends. Table 5 shows where SSAM results may not always have a high correlation with existing crash history and can be used to identify where historic crash rate may be over- or under-represented.

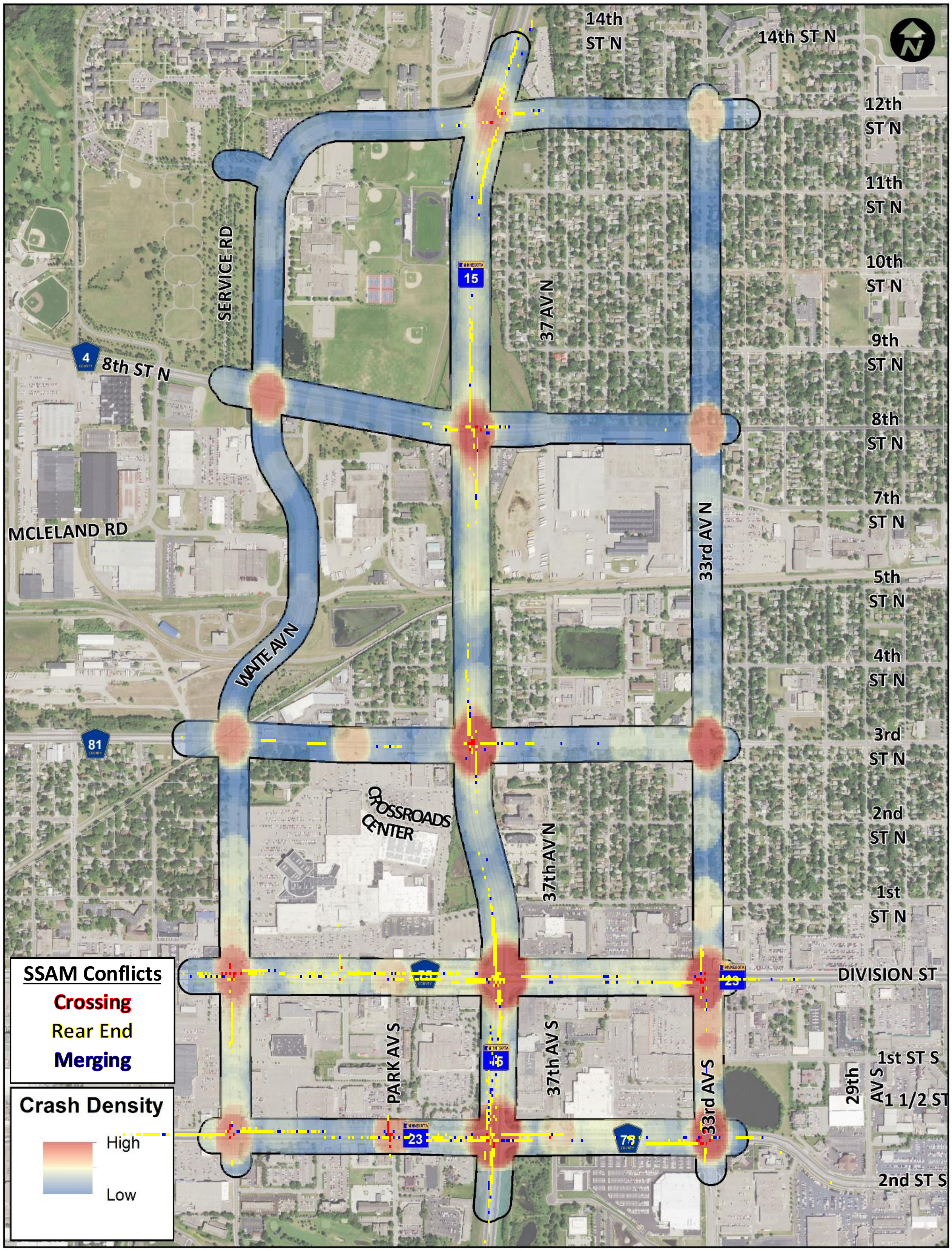
- Generally, the SSAM model matched existing crash trends. See Figure 19.
- The SSAM model projected much higher merging conflicts than historic crash records.

Reviewing the SSAM results found much of the merging conflict deviations occur due to the channelized right-turn lanes, which are yield controlled. In the field, these types of turns can be unpredictable, with some drivers coming to these turns more aggressively than others, generating a rear end crash instead of a merge crash. Also, the difference between a rear end and merge crash can often be the matter of a few degrees, making this a possible crash classification discrepancy. This data will be a critical tool in later phases of the project where traffic patterns change because of revised traffic projections and alternatives. SSAM will be used to estimate future crash trends to proactively address safety on the corridor.

Table 5 - Historic Intersection Crash Data and SSAM Conflicts

Intersection	Crash Type	Observed		SSAM	
		# Crashes	By Percent	Conflicts	By Percent
TH 15 & 2nd Street	Rear-End	208	87%	640	72%
	Crossing	15	6%	21	2%
	Merging	16	7%	233	26%
TH 15 & Division Street	Rear-End	161	77%	1009	79%
	Crossing	16	8%	21	2%
	Merging	31	15%	250	20%
TH 15 & 3rd Street (CSAH 81)	Rear-End	115	68%	295	43%
	Crossing	34	20%	287	42%
	Merging	19	11%	109	16%
TH 15 & 8th Street (CSAH 4)	Rear-End	62	67%	614	79%
	Crossing	19	20%	21	3%
	Merging	12	13%	146	19%
TH 15 & 12th Street	Rear-End	48	81%	605	80%
	Crossing	8	14%	15	2%
	Merging	3	5%	134	18%
TH 15 Segment	Rear-End	189	88%	607	86%
	Crossing	1	0%	5	1%
	Merging	24	11%	95	13%

Figure 19 - SSAM Conflicts and Existing Crash Density



Source: MnCMAT2, Saint Cloud APO, MnDOT, ESRI
April 2020

Traffic Conditions

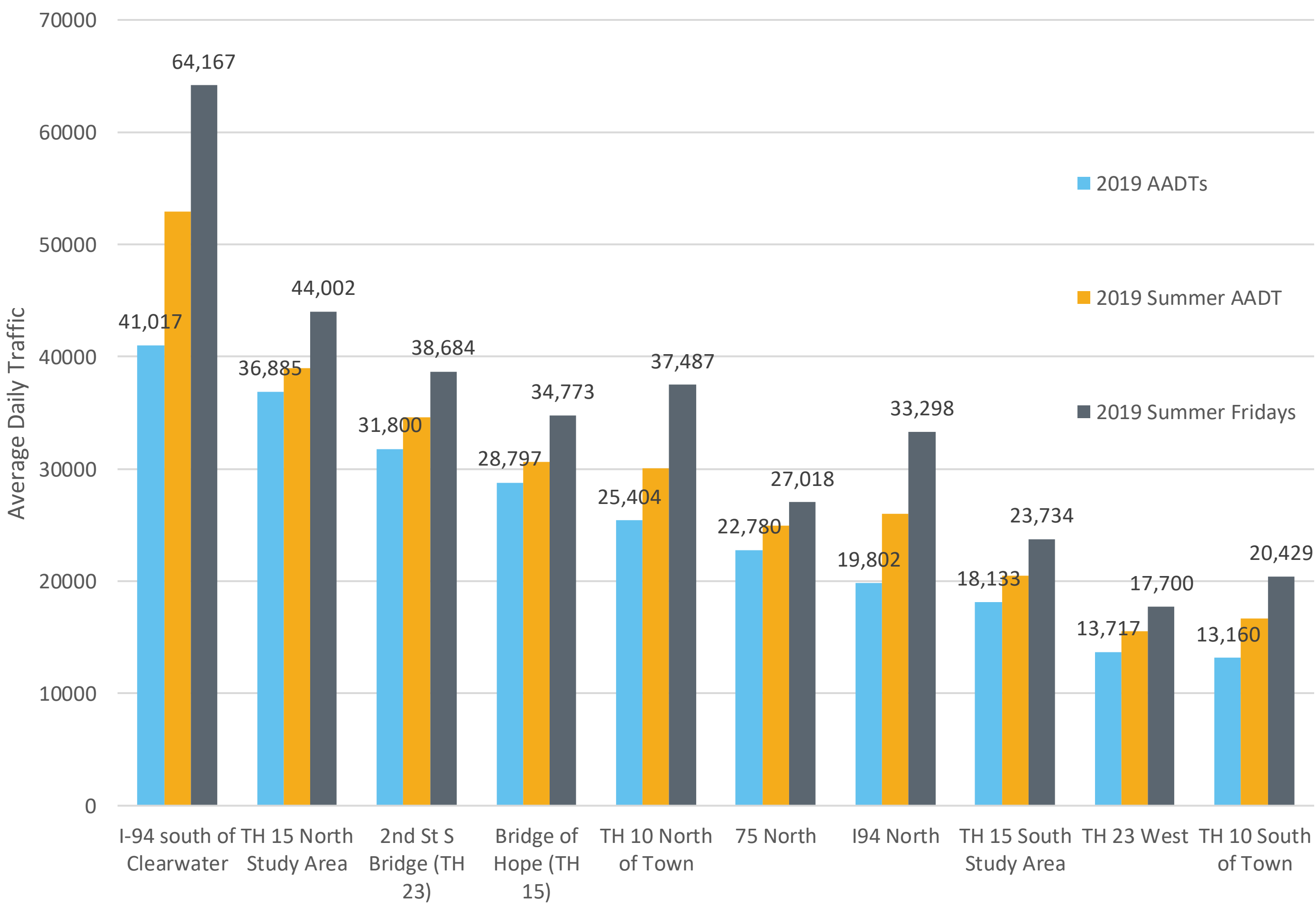
Regional Trends

Streetlight data was used to supplement existing traffic data to provide a better understanding of the existing regional trips, provide turning movement counts for adjacent intersections, and to better understand TH 15 system operations. Streetlight utilizes anonymized location records from smart phones and navigation devices in cars and trucks to analyze regional travel patterns while keeping the anonymity of individual trips.

Seasonal Changes

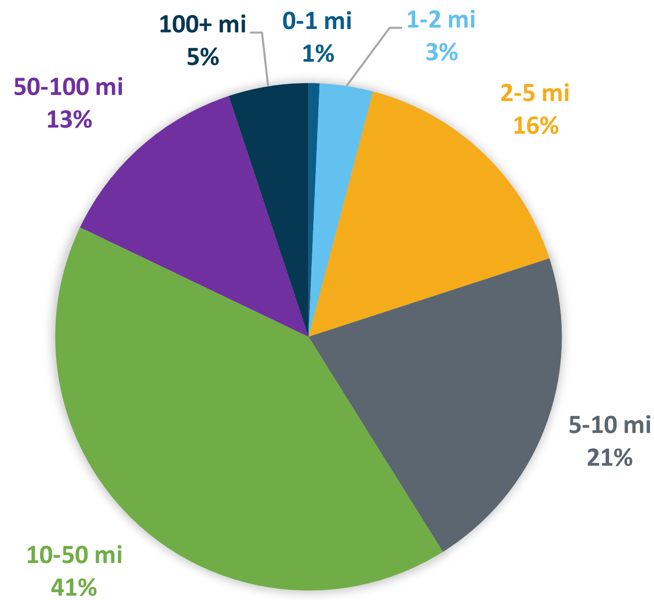
The St. Cloud region sees increased traffic during the summer months due to its connections to US 10 and I-94, providing access between Minnesota lakes country and the Minneapolis - St. Paul metro area. Traffic on US 10 and I-94 sees a 25 to 30 percent, or more than 15,000 trips, increase on all days between Memorial Day and Labor Day. Summer increases peak around 55 to 60 percent, around 30,000 trips, on Fridays during the summer months. These seasonal increases result in traffic increases on TH 15 around 2,000 to 2,500 vehicles, with a 5,600 to 7,200 vehicle increase on summer Fridays. Average Summer and Summer Friday daily traffic increases can be seen in Figure 20.

Figure 20 - Regional Seasonal Daily Traffic Trends



Trip Lengths

Figure 21 - Trip Length Percentages at TH 15 North of 2nd Street



Trip length percentages were also analyzed for the study area. Figure 21 shows the regional nature of the corridor. Fifty-four percent of trips are 10 miles in length or longer, meaning they are coming or going (or both) somewhere outside the metro area. Another 16 percent is five to 10 miles in length, meaning it is from the fringe of the metro area. This regional context is critical toward understanding how valuable parallel local collectors and arterials such as 33rd Avenue and Waite Avenue will be toward mitigating congestion. The regional zones with the longest trip length included connections to I-94, US 10, and the CSAH 24 Bridge. The local zones were TH 15 north of 12th Street, 1st Street N Bridge, Sauk Rapids Bridge, University Bridge, and Sartell Bridge.

Bridge Crossings

TH 15 supports a great deal of regional traffic, especially from I-94 and US 10. To move between I-94 and US 10, 73 percent of regional trips use the CSAH 24 bridge in Clearwater and 24 percent of regional trips use the TH 15 Bridge of Hope. These two connections account for 97 percent of the movements between I-94 and US 10. Even during peak recreational periods, only five percent of the total traffic crossing the TH 15 Bridge of Hope are regional trips between I-94 and US 10. Figure 22 highlights the regional use of the seven Mississippi River crossings in the St. Cloud area.

Work and Home Locations

A work and home locations analysis was completed to identify the important connections between home and work trips. Residential areas using the TH 15 corridor are mostly from Sartell and Sauk Rapids outnumbering neighborhoods directly along TH 15. Figure 23 identifies areas with the highest number of work and home locations using TH 15 in the study area.

Turning Movement Verifications

Turning movements for AM, midday, and PM peak hours on typical weekdays were provided by MnDOT at each of the study intersections from counts completed in Summer 2018. Accurate supplemental turning movement counts were unavailable for this study due to the COVID-19 outbreak in 2020. While volumes could be reduced throughout the study area due to this outbreak for months or even years, the traffic analysis in this section assumes that traffic will recover to pre-COVID-19 levels in the short-term once the pandemic subsides. Later chapters will assess the potential for scenarios with longer-lasting effects.

Intersection counts for this study were supplemented and verified with Streetlight data to estimate daily traffic patterns beyond peak hours and to analyze additional intersections and access locations along TH 23 and CSAH 75 that had not yet been collected. These turning movements were used to complete the 24-hour vehicular operational analysis. Existing daily traffic volumes are shown in Figure 24.

Figure 22 – Mississippi River Bridge Traffic Interactions with I-94 and US 10

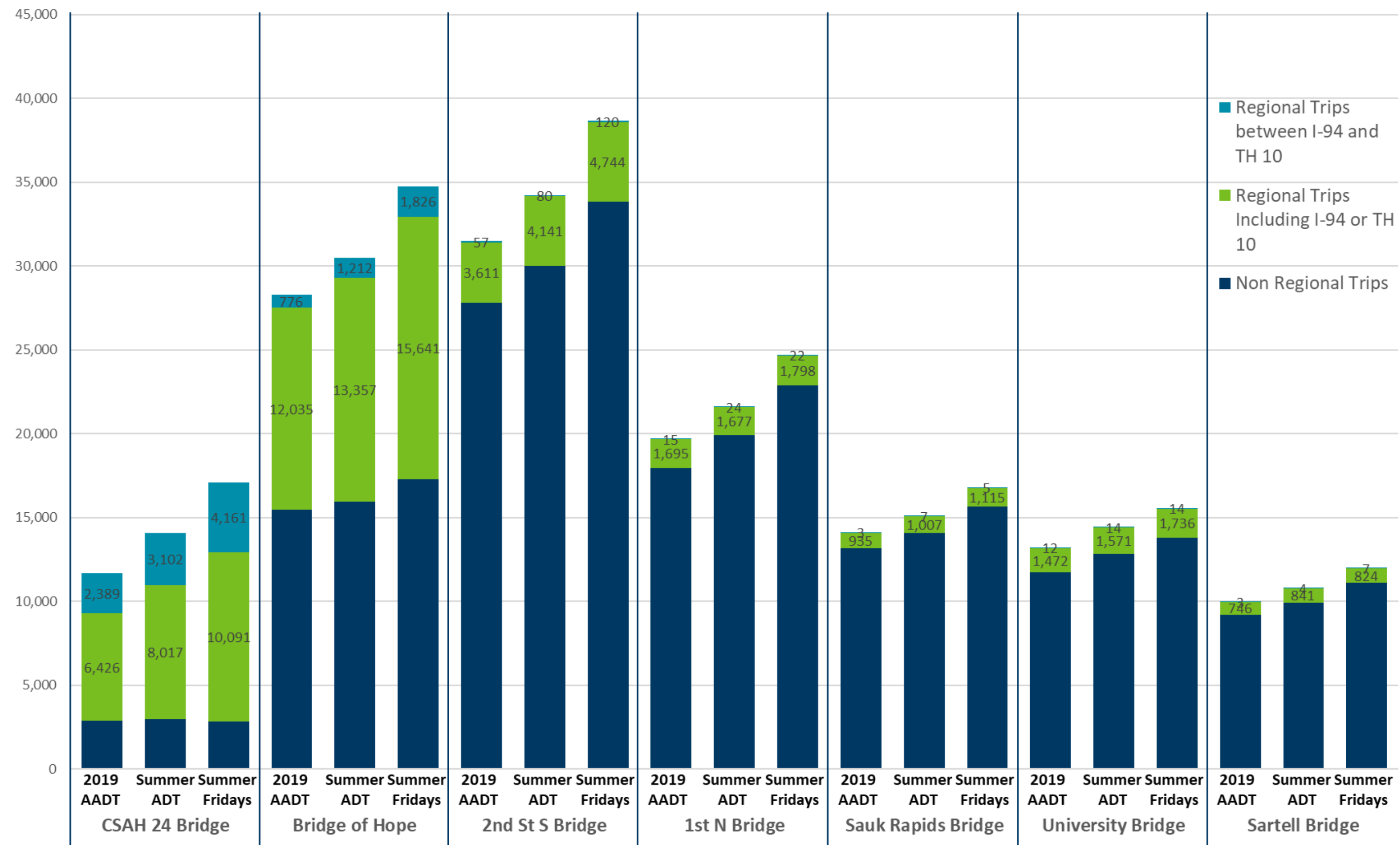


Figure 23 – TH 15 Study Area Work and Home Locations

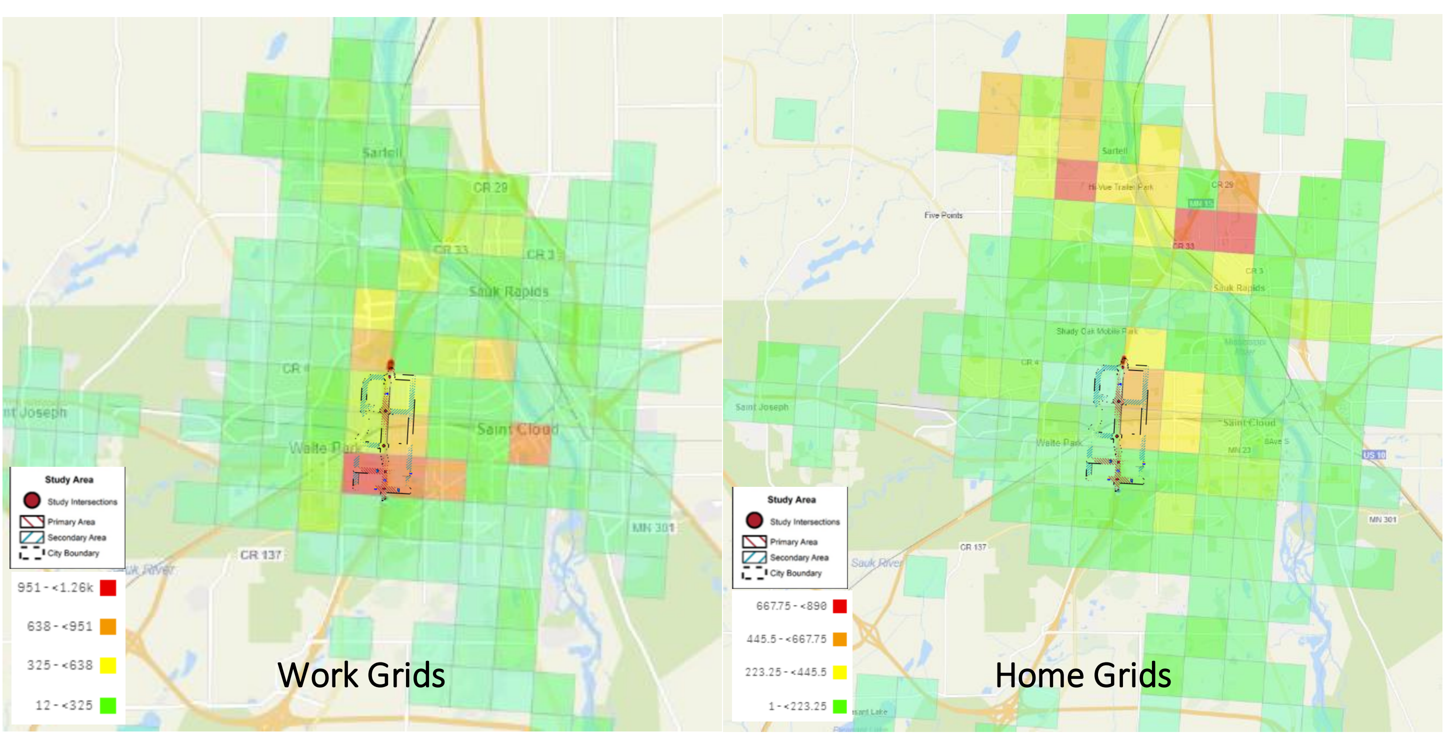
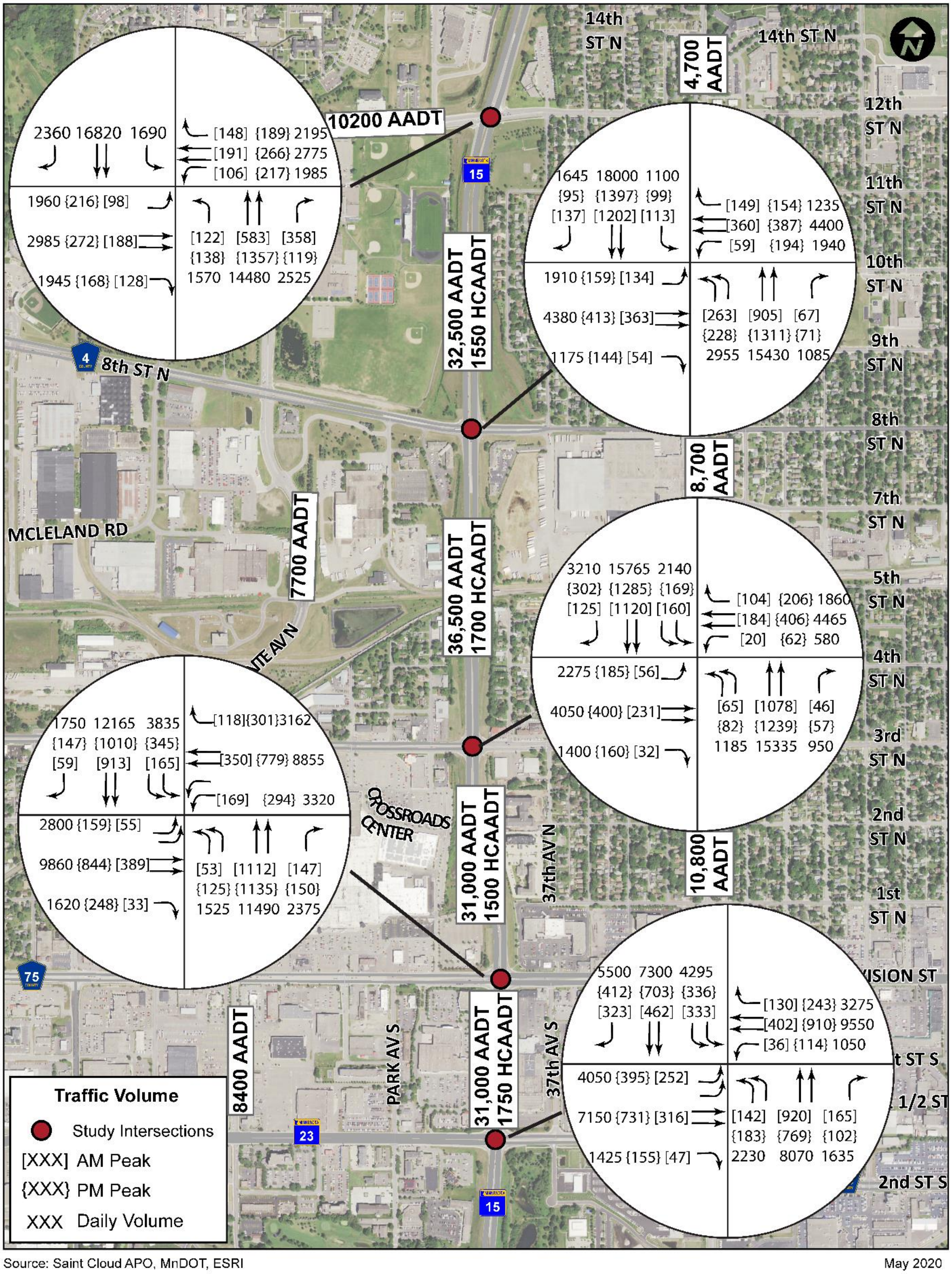


Figure 24 - Daily Traffic Volume



Daily Traffic Volumes

Streetlight data was also used as part of this study to fill in turning movement count volumes on Division Street and 2nd Street for the study analysis. Because the opening of Costco occurred after the previous data collection in summer 2018, additional data collection was scheduled for this study. However, COVID-19 impacts made it impossible to collect reliable traffic data in the field. Streetlight data was collected for September through October 2019 to account for traffic volume and turning movement trends surrounding the Costco location. Additional validation efforts compared Streetlight data to MnDOT AADT values and found the Streetlight traffic volumes to be reliable.

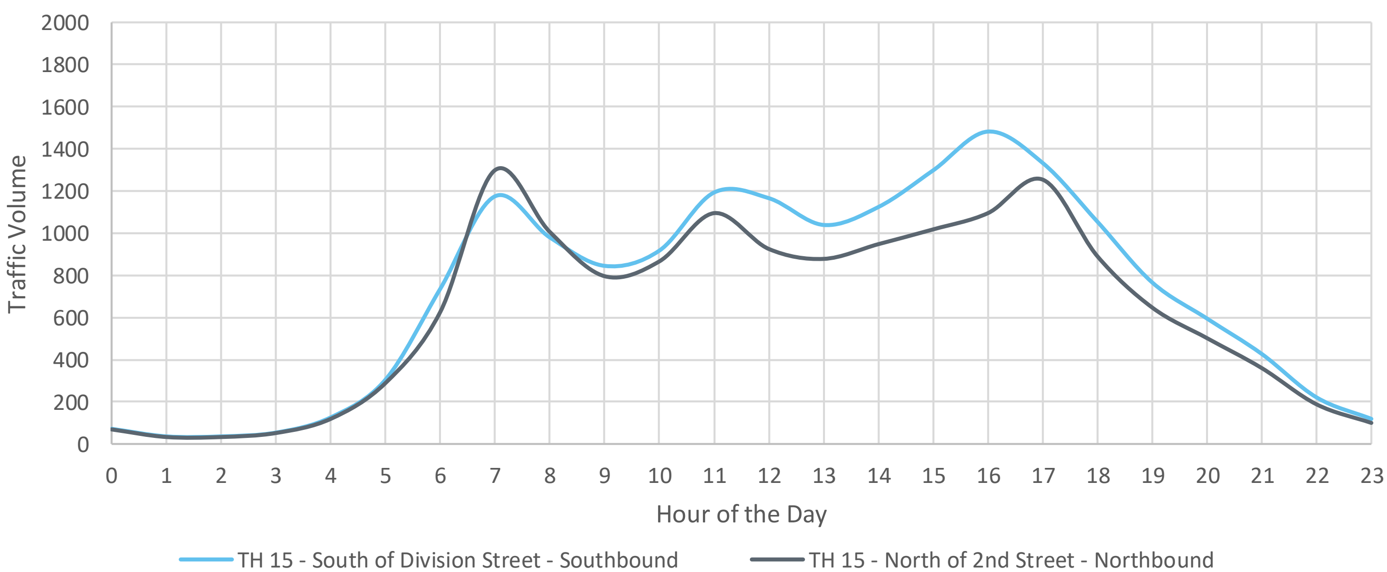
Traffic Trends

The daily northbound and southbound TH 15 directional traffic volumes range between 17,000 and 21,000 vehicles throughout the study area. The corridor is one of the highest trafficked corridors in all of MnDOT District 3. To assess traffic patterns further, the corridor was divided into two traffic volume analysis segments: south and north of Division Street.

South of Division Street

- Daily traffic is 18,500 northbound and 17,100 southbound, with heavy truck traffic between five and six percent.
- The intersections at TH 23 and CSAH 75 experience a high number of turning vehicles and through movements from east and west as traffic connects to major commercial centers and regional corridors. Specifically, 33 to 42 percent of the traffic at these intersections are turning movements and 47 percent of traffic is coming from the side streets (non TH-15 direction).
- The northbound volumes are higher in the AM peak (11 percent higher) but southbound volumes are higher on average for most of the day (9 AM to 6 PM), peaking during the PM peak hour (35 percent higher).
- The corridor experiences three distinct peak hours during the AM, mid-day, and PM peak hours. The greatest percentage of traffic occurs during PM peak hour with eight percent of total daily volumes. The commercial land uses prolong the PM peak hour for several hours.

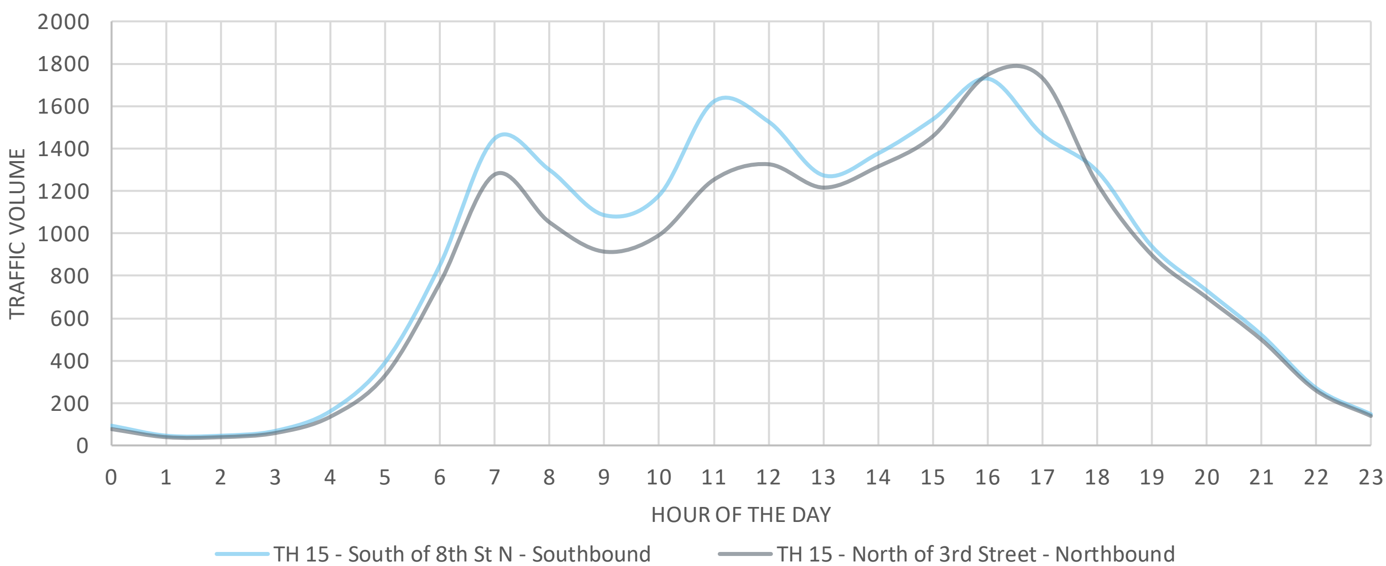
Figure 25 - TH 15 Volumes Between 2nd Street and Division Street



NORTH OF DIVISION STREET

- With fewer major regional connections and local destinations, this segment of TH 15 experiences higher through-movement percentages and lower turning movements. Specifically, 23 to 26 percent of the traffic are turning movements at the three north intersections, compared to the 33 to 42 percent at the TH 23 and CSAH 75 intersections.
- Similarly, far lower volumes come the side streets (non-TH 15 directions) than the south section. Specifically, the north segment has only 23 to 27 percent of the traffic coming from the side streets, compared to nearly double this figure to the south.
- Daily traffic is 19,500 northbound and 21,100 southbound, with heavy truck traffic between four and five percent.
- The northbound volumes are higher in the PM peak (4 PM to 6 PM) but southbound vehicles are higher on average for most of the day (6 AM to 4 PM).
- The north portion of the corridor similarly has three distinct peak hours, the key difference being that the influence of the Apollo High School introduces higher traffic volumes between the mid-day and PM peak hours.

Figure 26 - TH 15 Volumes Between 3rd Street and 12th Street



PARALLEL CORRIDORS

- Current traffic volumes on Waite Avenue from 2nd Street S to 3rd Street N are 7,700 to 8,400 vehicles each day. This represents a volume to capacity of 0.28 for a four-lane undivided segment, showing ample capacity.
- Current traffic volumes on Waite Avenue from 3rd Street N to 8th Street N are 7,000 vehicles each day. This represents a volume to capacity of 0.19 for a four-lane divided segment, showing ample capacity.
- Current traffic volumes on 33rd Avenue from 2nd Street S to 12th Street N are 4,700 to 12,400 vehicles each day. This represents a volume to capacity of 0.41 for a four-lane undivided segment, showing ample capacity.

Figure 27 - Truck Traffic is Between Four and Six Percent at the TH 15 and TH 23 Intersections

Traffic Operations Analysis

Vehicular traffic operations were analyzed at the key intersections along TH 15 but were modeled with an extended study area from I-94 to the Mississippi River to capture impacts outside of the study area. Extended corridors on TH 23 and CSAH 75 were also modeled between Waite Avenue and 33rd Street with all public intersections included.

Vehicular Level of Service Methodology

Intersection capacity analysis was evaluated in terms of delay and level of service (LOS). LOS is a term used to describe the operational performance of transportation infrastructure elements; it assigns a grade value that corresponds to specific traffic characteristics within a given system, as shown in Table 6.

At intersections, LOS is a function of average vehicle delay, whereas LOS for a roadway section is defined by the average travel speed. LOS A represents free flow traffic with little delay whereas LOS F represents gridlock. LOS E or worse is considered deficient while LOS D is approaching capacity, in accordance with MnDOT standards. Capacity analysis was conducted using Vissim microsimulation software, which simulates the movement of every vehicle through an intersection and then collects information for associated performance measures including delay, queue lengths, travel times, and network statistics.

Table 6 - Level of Service Thresholds

Level of Service	Average Delay (Seconds/Vehicle)	
	Unsignalized Intersection	Signalized Intersection
A	≤10	≤10
B	> 10 and ≤ 15	> 10 and ≤ 20
C	> 15 and ≤ 25	> 20 and ≤ 35
D	> 25 and ≤ 35	> 35 and ≤ 55
E	> 35 and ≤ 50	> 55 and ≤ 80
F	> 50	> 80

Queuing Analysis Methodology

Queuing of vehicles at intersections can have serious traffic safety implications if expected queues exceed available storage. For example, if projected queuing for a left turning movement exceeds available storage in the turn lane, the queue can extend into the through lane and cause safety concerns with potential rear end crashes. Excessive queuing can also impede business, other private, or public access to and from the roadway. Queuing analyses can determine whether queues are expected to clear during a signal cycle or on stop condition approaches, which can inform on the potential need for additional through lanes or other improvements. The following criteria was used to identify queuing issues for movements. A queueing deficiency was identified if any of the following conditions were met:

- 95th percentile queue length blocks upstream full access intersection.
- 95th percentile queue length exceeds turn-lane storage length and the movements operate worse than LOS "D".
- 95th percentile through lane queue blocks access to the turn lane bay.

Traffic Analysis Results

24 Hour Results

The existing 24-hour weekday intersection level of service for the study corridor is shown in Table 7. The intersection of TH 15 at Division Street experiences near-deficient operations, at LOS D from 10 AM to 7 PM daily but never quite crossing into a deficient LOS. This is partly due to the bottlenecks occurring throughout the corridor creating LOS C/D at all intersections from 7 AM to 7 PM daily, metering traffic between intersections. 3rd Street is the only location to operate deficiently during the PM peak hour at LOS E. The corridor generally experiences heavy traffic and congestion during the afternoon peak period from 3 PM to 6 PM in the core commercial area.

AM Peak

The intersection of TH 15 at 2nd St experiences increasing delays in the AM peak period, with the overall intersection operating at LOS D, as shown in Figure 28. All other intersections on TH 15 operate at LOS C or better during the AM peak hour. However, deficient operations are experienced on the side street approaches, with approaches operating deficiently.

Queuing deficiencies (Figure 29) were identified at the following intersections:

- The southbound through queues block the access to the turn lane at Division Street, 3rd Street, and 8th Street.
- The northbound through queue blocks the access to the turn lane at 8th Street and 12th Street.
- The southbound left queue exceeds the turn lane storage capacity and blocks southbound through traffic at Division Street.
- The northbound right queue exceeds the turn lane storage capacity and blocks northbound through traffic at 12th Street.
- The eastbound through queues block the access to the turn lane at 12th Street.
- The westbound through queues block the access to the turn lane bay area at 8th Street.

Table 7 - 24-Hour Intersection LOS for the TH 15 Corridor

Time	Level of Service				
	2nd St	Division St	3rd St	8th St	12th St
12:00 AM	C	C	B	B	B
1:00 AM	C	C	B	B	B
2:00 AM	C	C	B	B	B
3:00 AM	C	C	B	B	B
4:00 AM	C	C	B	B	B
5:00 AM	C	C	B	B	B
6:00 AM	C	C	B	C	B
7:00 AM	D	C	C	C	C
8:00 AM	C	C	C	C	C
9:00 AM	C	C	C	C	C
10:00 AM	C	D	C	C	C
11:00 AM	C	D	C	C	C
12:00 PM	D	D	C	C	C
1:00 PM	D	D	C	C	C
2:00 PM	D	D	C	C	C
3:00 PM	D	D	C	C	C
4:00 PM	D	D	D	D	D
5:00 PM	D	D	E	C	C
6:00 PM	C	D	D	C	C
7:00 PM	C	C	B	C	B
8:00 PM	C	C	B	B	B
9:00 PM	C	C	B	B	B
10:00 PM	C	C	B	B	B
11:00 PM	C	C	B	B	B

Figure 28 - Vehicular Level of Service for 2020 AM Peak Hour

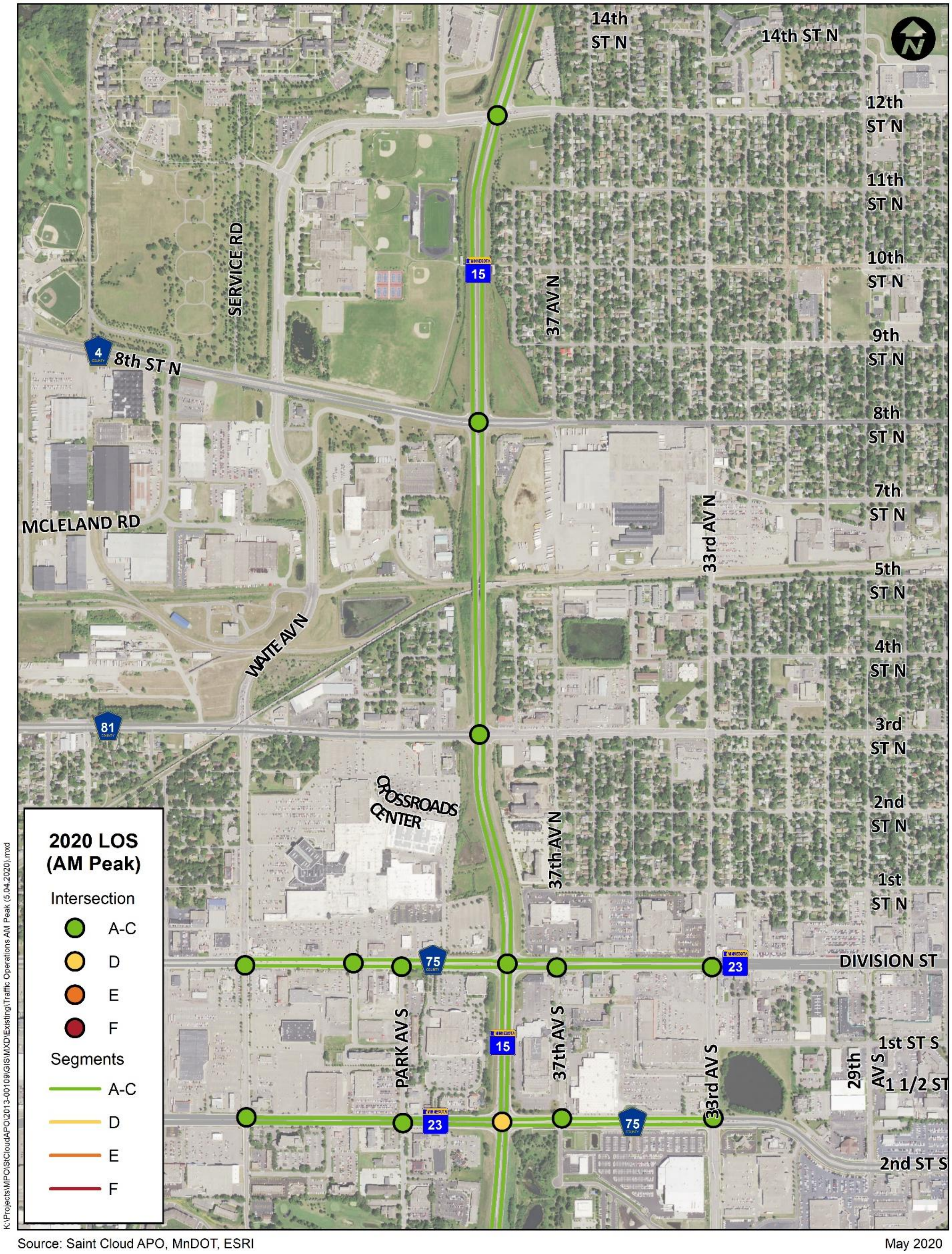
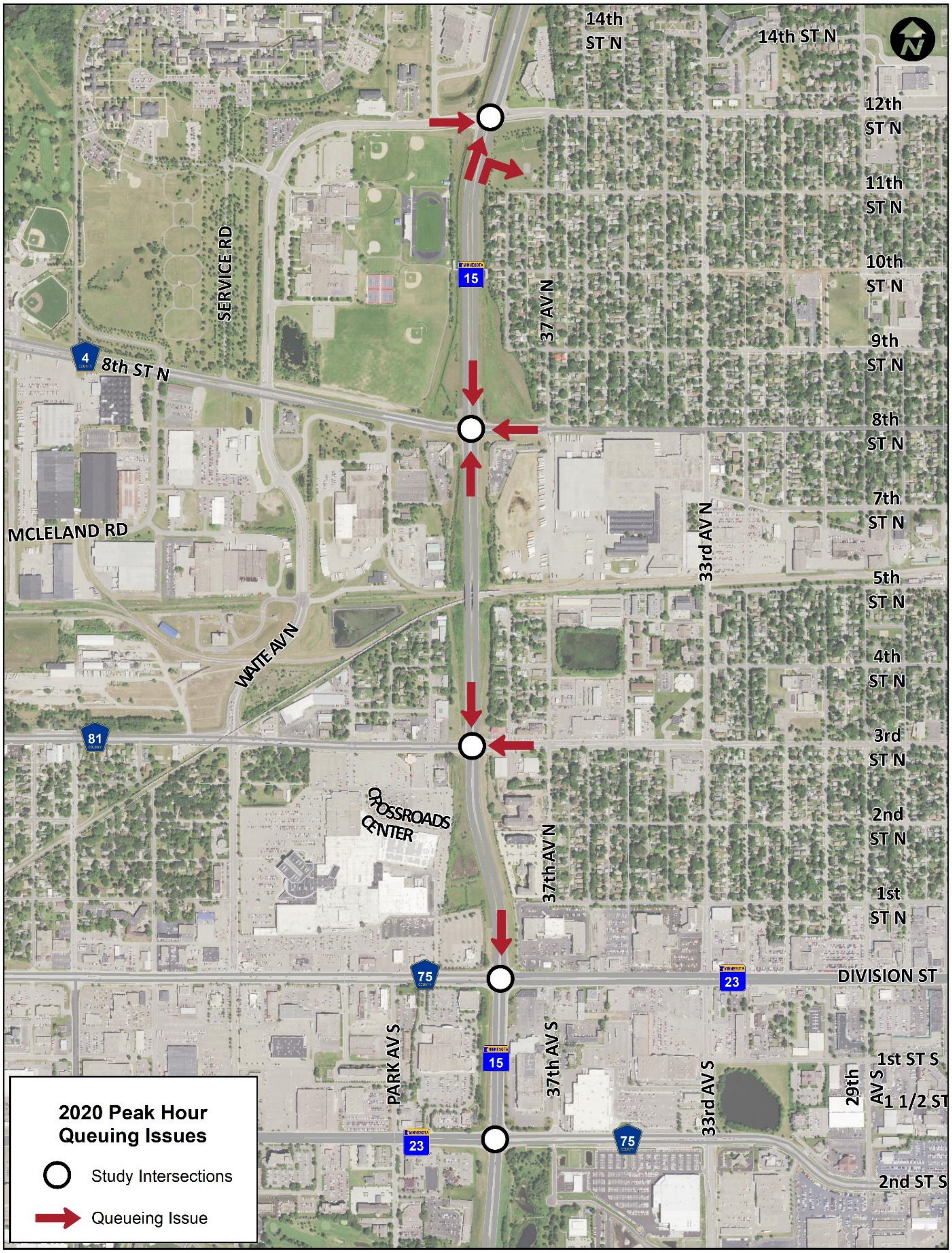


Figure 29 - Vehicular Queueing Issues for 2020 AM Peak Hour



K:\Projects\MPO\StCloudAPO\2013-00109\GIS\MXD\Existing\Traffic Operations Queuing Issues (5.05.2020) - AM Peak.mxd

Source: Saint Cloud APO, MnDOT, ESRI

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PM PEAK

With the higher volumes during the PM peak hour, the traffic operations tend to deteriorate with several intersections and their approaches operating at unacceptable delay and LOS as shown in Figure 30.

Queuing deficiencies (Figure 31) were identified on every intersection of TH 15 corridor during the PM peak hour.

- The northbound through queues block the access to the turn lane at Division Street, 8th Street, and 12th Street.
- The southbound through queues block the access to the turn lane at Division Street, 3rd Street, and 12th Street.
- The southbound left queue on Division Street exceeds storage capacity and blocks the southbound through traffic.
- The eastbound through queues block the access to the turn lane at 2nd Street, Division Street, 8th Street, and 12th Street. The eastbound through queues on 2nd Street, Division Street and 12th Street exceeds capacity and block the upstream intersection.
- The eastbound left queues exceed storage capacity and block the eastbound through traffic on 2nd Street, 3rd Street, 8th Street, and 12th Street.
- The eastbound right queues exceed storage capacity and block the eastbound through traffic on 12th Street.
- The westbound through queues block access to the turn lane at 2nd Street, Division Street, 3rd Street, 8th Street, and 12th Street. The westbound through queue on 2nd Street, 3rd Street, and 12th Street exceeds capacity and blocks the adjacent intersection.
- The westbound left queues at 2nd Street, 8th Street, and 12th Street exceed the storage capacity and block westbound through traffic.
- The westbound right queues exceed the storage capacity at all the intersections and block the westbound through traffic.

TRAVEL TIME RELIABILITY

Travel time reliability measures the extent of unexpected delay, as measured from day-to-day and across different times of the day. Most travelers are less tolerant of unexpected delays because they cannot be incorporated into planned travel time, resulting in late arrivals. Alternatively, budgeting twice as much time for a trip can result in wasted time. Typically, drivers are often far more sensitive to major deviations in travel time than consistent delays. The level of travel time reliability (LOTTR) is defined as the ratio of the 85th percentile travel time to an average travel time for all vehicles. A LOTTR of 1.50 and greater indicates severe unreliability. For example, a LOTTR of 2.00 means that motorists should plan for twice the amount of average travel time to arrive at their destinations on time.

Travel times and reliability were calculated for four locations on TH 15 and TH 23 in the study area.

- Northbound TH 15 from south of 2nd Street to north of 12th Street
- Southbound TH 15 from north of 12th Street to south of 2nd Street
- Eastbound TH 23 from west of 2nd Street/Waite Avenue to east of Division Street/33rd Avenue
- Westbound TH 23 from east of Division Street/33rd Avenue to west of 2nd Street/Waite Avenue

Figure 30 - Vehicular Level of Service for 2020 PM Peak Hour

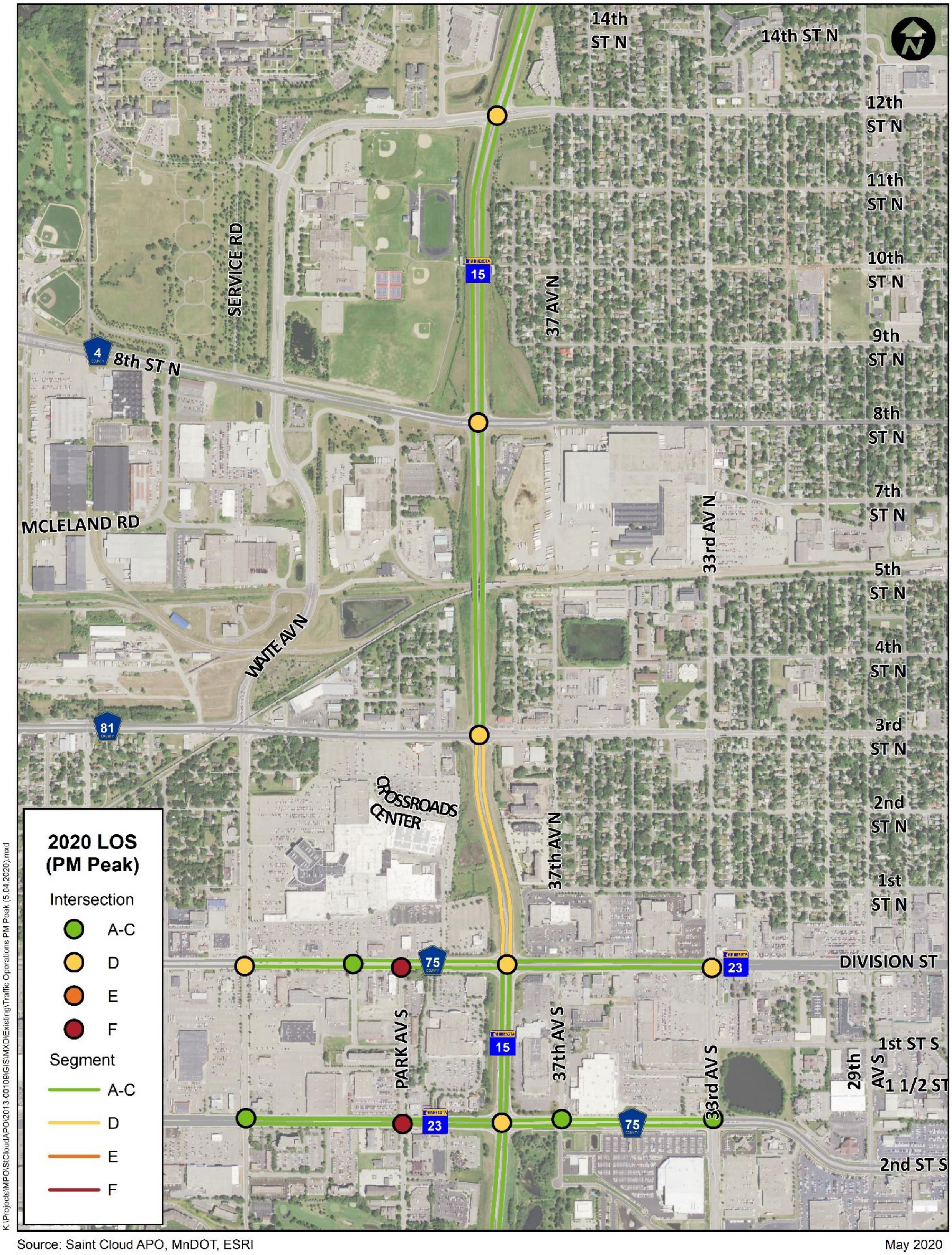


Figure 31- Vehicular Queueing Issues for 2020 PM Peak Hour

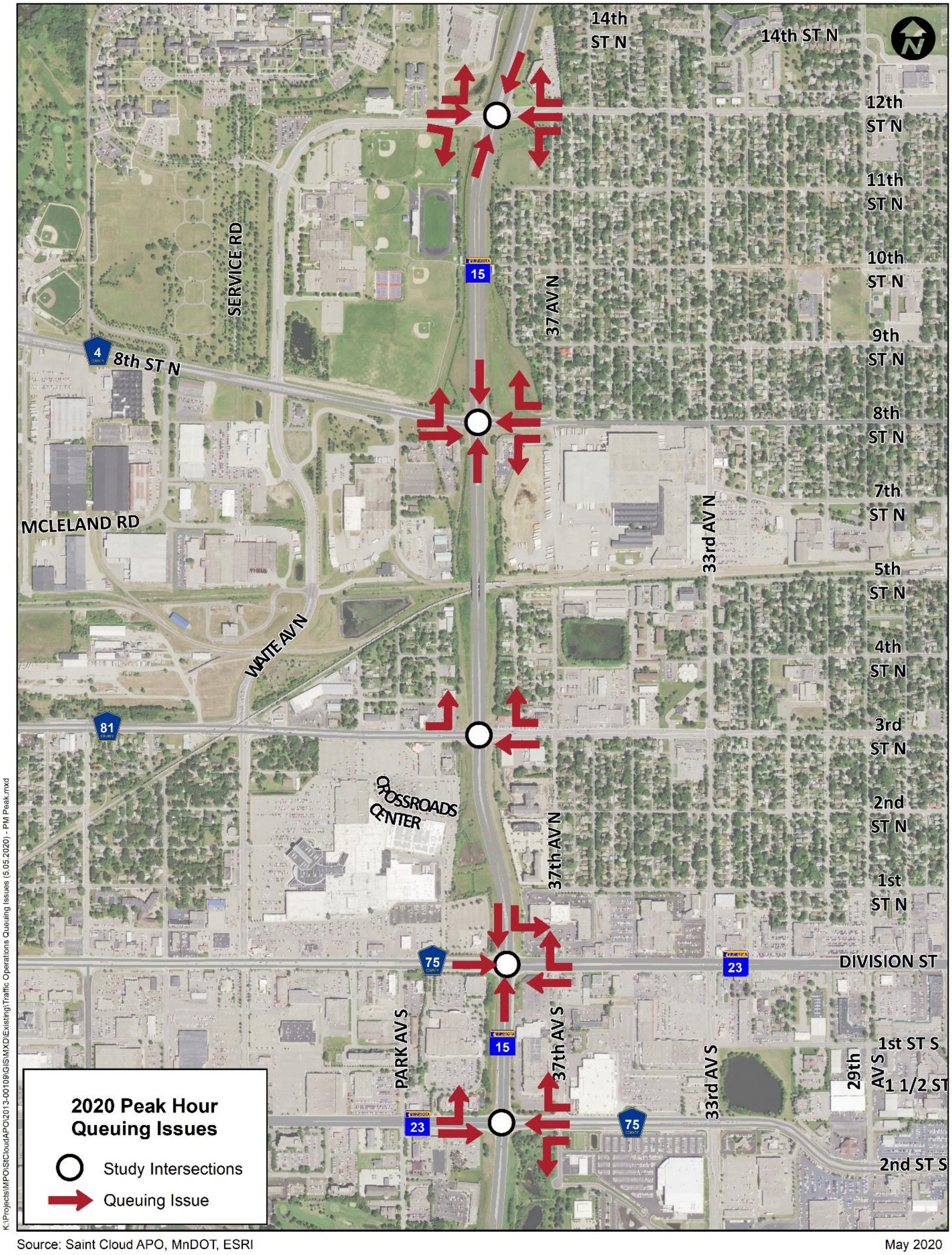
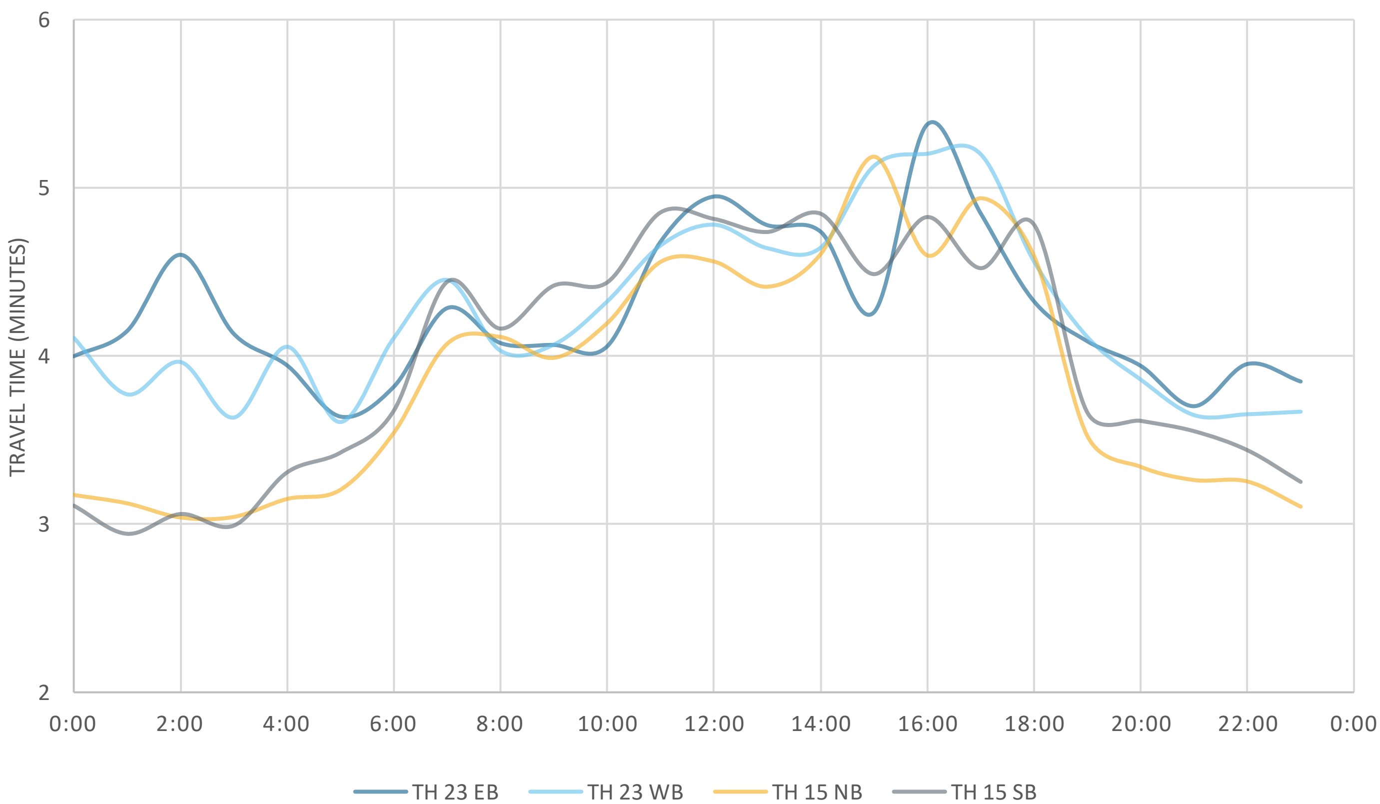


Figure 32 - 85th Percentile Daily Travel Times on TH 15 Corridor



Over the course of a regular day, VISSIM 85th percentile travel times vary throughout the day. Along TH 15, the longest travel times averaged 5.5 minutes and the shortest travel times during off-peak times were just 3.0 minutes. However, LOTTR is based on the 85th percentile and 50th percentile data so even though travel times increase by 60 to 90 percent over free-flow travel times, the corridor is reliably congested.

Heavy vehicle travel times were generally between two to 12 percent greater than normal traffic throughout the day. The five over-capacity traffic signals along the corridor create stop-and-go traffic, which is more impactful to heavy vehicles with long acceleration and deceleration times. With a higher percentage of truck traffic being regional, trucks navigating against the signal coordination patterns impact not only their own travel times but also any following traffic.

STREETLIGHT COMPARISON

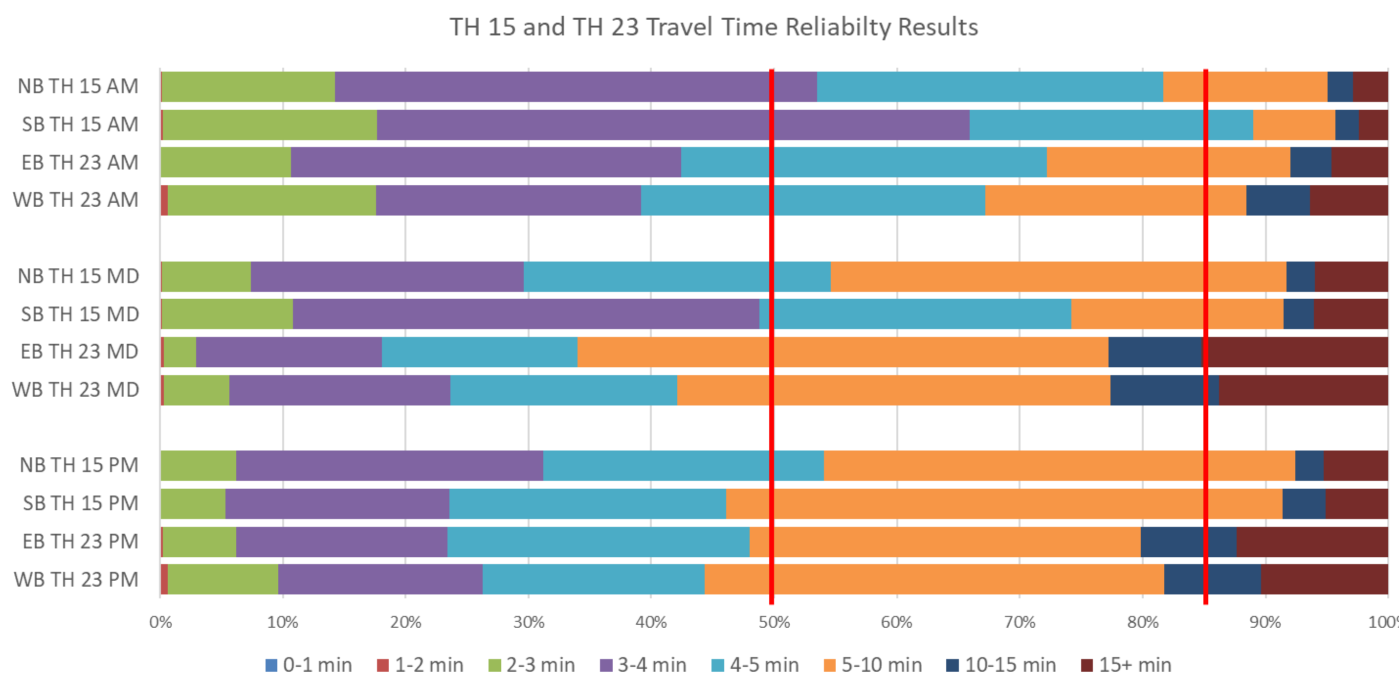
Streetlight data was pulled for the TH 15 and TH 23 study area corridors to assess the same travel time segments in the AM and PM peak periods based on 2019 annual data. This would identify any travel time reliability issues that occur due to seasonal changes in traffic volumes. Results in Figure 33 show that TH 15 travel time reliabilities are generally in acceptable ranges (less than 1.5) during peak periods while TH 23 shows a big drop in average travel times between the 70th percentile and higher during mid-day and PM peak periods leading to unreliable conditions. Table 8 shows that TH 15 is unreliable for southbound PM conditions of 1.5, TH 23 mid-day and PM peak periods have LOTTR between 2.2 and 2.6, and TH 23 westbound is 1.8 during the AM peak.

Table 8 - Level of Travel Time Reliability Results

Travel Time Segment	VISSIM Hourly LOTTR	Peak	Streetlight Yearly LOTTR
TH 15 Northbound (2nd Street to 12th Street)	1.20	AM	1.37
		MD	1.42
		PM	1.44
Th 15 Southbound (12th Street to 2nd Street)	1.21	AM	1.31
		MD	1.47
		PM	**1.50**
TH 23 Eastbound (Waite Avenue to 33rd Avenue)	1.15	AM	1.46
		MD	**2.58**
		PM	**2.55**
TH 23 Westbound (33rd Avenue to Waite Avenue)	1.15	**AM**	**1.88**
		MD	**2.56**
		PM	**2.21**

The results of the travel time reliability analysis for both VISSIM hourly LOTTR and Streetlight annual LOTTR give a clear picture of what can be expected along the TH 15 and TH 23 corridors. TH 15 is approaching unreliable conditions on an annual basis but shows more variation between travel times throughout the day (free flow versus congested). Alternatively, TH 23 is unreliable throughout the day and does not see a large improvement during AM or off-peak hours (always some congestion). This is due to northbound and southbound TH 15 traffic signal priority throughout the corridor while TH 23 traffic almost always experiences red lights as it combines with TH 15.

Figure 33 - TH 15 Annual Travel Time Results



NETWORK OPERATIONS

Each day, over 200,000 vehicle trips are made using the TH 15 corridor between I-94 and CSAH 1 and its intersecting streets; TH 23 between Waite Avenue and 33rd Avenue; and CSAH 75 between Waite Avenue and 33rd Avenue. Based on the trip making characteristics, the network details can be calculated for the study corridors and intersections. These details are summarized in Table 9 and will be used to compare the daily impacts of future No Build conditions as well as the benefits of alternatives developed later in this study.

As illustrated in the table below, the primary and secondary study corridors induce a disproportionate amount of delay to the transportation network, totaling nearly 400,000 hours of delay every day. The consecutive intersections experiencing high traffic volumes can often mask the overall problem a corridor faces by unintentionally metering traffic volumes between intersections but delay per vehicle can often uncover these issues. Between 6 AM to 6 PM, any driver trying to travel along TH 15 or through the study area can expect more than a full minute of traffic control delay. During the PM peak, driver delay is two to three times more than off-peak conditions for every vehicle interacting with the corridor.

Finally, the most important metric this table uncovers is latent demand. Latent demand occurs when traffic cannot enter the system from business access or minor roadways. This occurs when volume exceeds capacity or when driveways are blocked. This type of delay indicates a major deficiency. Between 4 PM and 7 PM, 238 hours of latent demand delay is experienced along the corridor that is not factored into the average delay per vehicle.

Table 9 - 2019 Daily Network Operations

Existing Hourly Results	Total Vehicles	Avg Delay (s/veh)	Latent Delay (hr)	VHT* (hrs)
12:00 AM	823	37	0	1,563
1:00 AM	463	34	0	819
2:00 AM	398	36	0	789
3:00 AM	588	36	0	1,174
4:00 AM	1,311	40	0	2,719
5:00 AM	3,053	43	0	6,698
6:00 AM	6,239	50	0	14,372
7:00 AM	11,820	65	0	24,916
8:00 AM	10,500	63	0	21,648
9:00 AM	9,790	61	0	18,929
10:00 AM	10,782	63	0	20,102
11:00 AM	13,996	75	0	26,621
12:00 PM	15,809	79	0	26,952
1:00 PM	14,300	75	1	24,329
2:00 PM	14,652	75	2	25,936
3:00 PM	16,188	79	0	28,335
4:00 PM	18,701	104	18	33,126
5:00 PM	18,098	114	137	32,413
6:00 PM	14,086	83	76	24,982
7:00 PM	10,410	56	6	18,064
8:00 PM	7,743	48	0	13,884
9:00 PM	5,316	47	0	9,924
10:00 PM	2,831	43	0	5,146
11:00 PM	1,529	40	0	2,804
Daily Total	**209,427**	**74**	**241**	**386,247**

**VMT - Vehicle miles traveled, VHT - Vehicle hours traveled*

Multimodal Environment

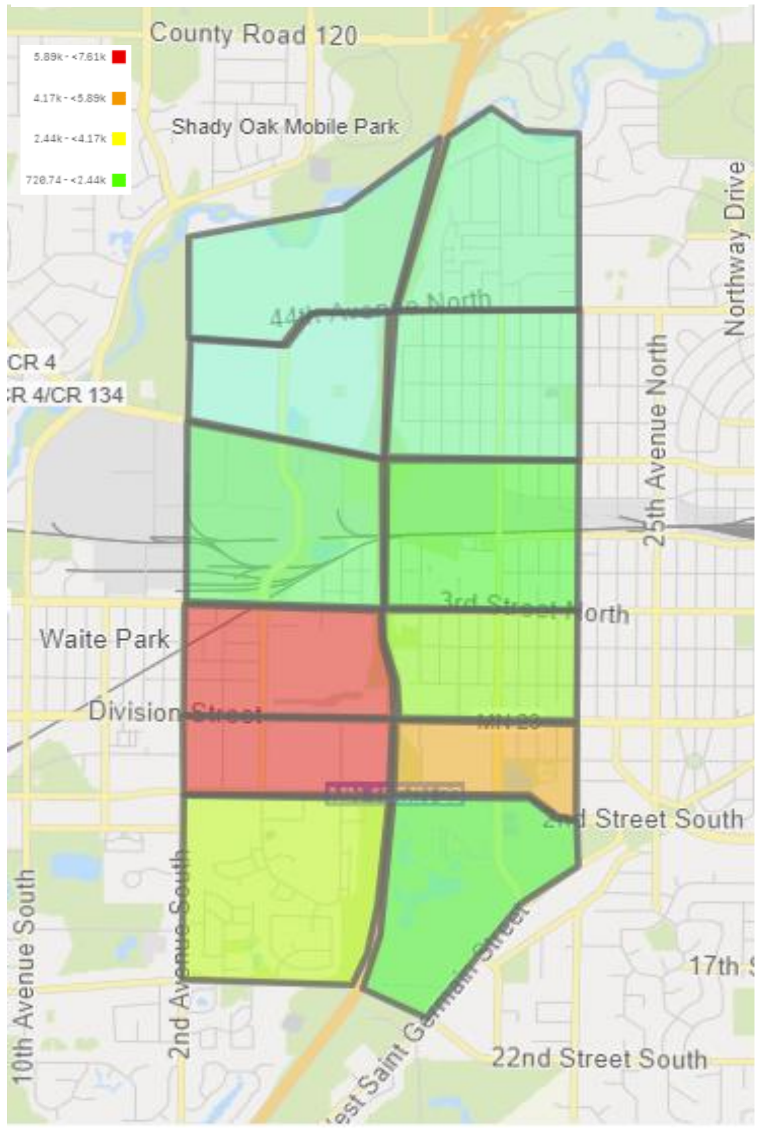
An online public survey was conducted to the residents of Saint Cloud Metropolitan Area in 2013 and approximately 80 participants submitted responses. Participants indicated the need for bicycle, pedestrian, and transit facilities as one of the most important improvements for a "livable" region. TH 15 remains one of the biggest bicycle and pedestrian barriers in the St. Cloud metro.

Active and Latent Demand

TH 15 is an urban corridor that passes through a core commercial area used throughout the region. The corridor provides visibility and indirect access to the Crossroads Shopping Mall and many commercial properties along 2nd Street, Division Street, 3rd Street, and 8th Street. There are no direct accesses to these generators on TH 15 but they demand high traffic volumes to-and-from these major intersections. Apollo High School is located west and adjacent to TH 15 north of 8th Street with the school's athletic fields bordering TH 15. The high speeds and volumes on TH 15 create a barrier for pedestrians and bicyclists crossing between the eastern and western sides of the corridor.

While over 200,000 daily vehicles were identified between I-94 and the Mississippi River, only 100 pedestrians were counted on an August 2018 day in the study area, with over 50 percent of these occurring at the 3rd Street intersection. It is important to note that the existing TH 15 corridor is not conducive to existing pedestrian or bicycle use, and to properly assess usage multimodal opportunities must be studied in addition to existing usage.

Figure 34 – Trips Less than 2 Miles in Length



Streetlight data analysis identified locations where existing trips being made were conducive to walking or biking. These areas were identified where trip lengths were less than one mile for walking and less than two miles for biking. Figure 34 shows zones with a high number of total multimodal trip opportunities (red and orange areas) but also identifying zones that showed a high percentage of trips that could be multimodal. The entire study area excluding the St. Cloud VA Hospital zone showed between 20 to 30 percent of trips could be made by walking or biking. The area including the VA hospital had less than 10 percent of trips of two miles or less. It should be noted that a trip segment is any movement that occurred between stops lasting more than five minutes so activity between so activity between multiuse locations in a block count as a trip.

Existing Amenities and Facilities

Pedestrian Amenities and Facilities

Enhancing the ability of people to walk and bike involves providing adequate infrastructure and linking urban design, streetscapes, and land use to encourage walking and biking.

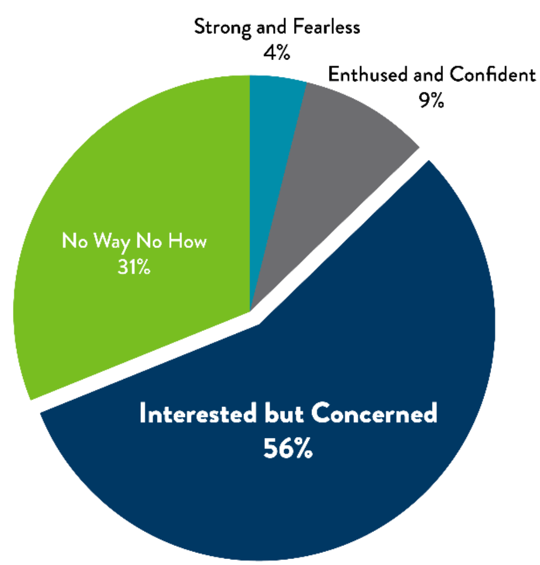
- » Streets designed with sidewalks, raised medians, traffic-calming measures and treatments for travelers with disabilities improves pedestrian safety. Research has shown that sidewalks alone reduce vehicle-pedestrian crashes by 88 percent.
- » Multiple studies have found a direct correlation between the availability of walking and biking options and obesity rates. The Centers for Disease Control and Prevention named adoption of complete streets policies as a recommended strategy to prevent obesity.

Figure 36 shows the existing pedestrian and bicycle facilities on TH 15 corridor, Waite Avenue, and 33rd Street. Throughout the TH 15 study corridor, sidewalks are only present on the east side of TH 15 between 2nd Street and Division Street providing only two feet of curb buffer between pedestrians and 30,000 vehicles traveling 45 miles per hour. Because of these conditions, existing pedestrian volumes along this segment of corridor are minimal.

Bicycle Amenities and Facilities

National research has found that there are generally four levels of interests/abilities when it comes to cycling.

Figure 35 - Cyclist Types and Their Behavior



- » Strong and Fearless riders are those that are very comfortable without bike lanes. They will ride under most roadway and traffic conditions.
- » Enthused and Confident riders will ride their bikes with appropriate infrastructure.
- » Interested but Concerned riders are interested in biking more but are not comfortable with the infrastructure or have other barriers to biking.
- » No Way No How are unable or uninterested in bicycling and no change to the environment or infrastructure is likely to encourage them to cycle more.

Nearly three-quarters of Strong and Fearless, Enthused and Confident, and Interested but Concerned cyclists had ridden at least once in the last 30 days for transportation or recreation. Improving infrastructure and the transportation environment can help encourage these three types of cyclists to choose bicycling more.

There are no dedicated bicycle facilities throughout the study area. There are areas with paved shoulders on the edge of the roadways that may serve as a functional space for bicyclists to travel in the absence of other facilities with more separation. Bicycle travel on paved shoulders may function on multilane roads with moderate to high volumes, speeds and heavy traffic, but fails to provide a low-stress experience for less confident riders. Throughout the corridor, there are paved shoulders ranging between six and ten feet on both sides. At the intersection approaches, the right-turn lane takes the place of the hard shoulders throughout the corridor. While the purpose of TH 15 based on its functional classification is to move vehicles, it is not uncommon for similar roadways across Minnesota to have accompanying separated shared-use paths to provide a safe and comfortable bicycle facility. Major arterials like TH 15 have excellent connectivity, access to destinations, and separation from major conflict points (i.e. rivers, railroad crossings). These factors make them similarly useful routes for bicycles.

Crossing Locations

Providing safe and efficient crossings are required for a successful pedestrian and bicycle network. There are five signalized intersections along the corridor, each including pedestrian phases and crossing heads. While a pedestrian can cross the roadway at any intersection, marked and traffic-controlled intersections are more desirable and increase safety (especially along a high-speed, high-volume corridor like TH 15). On TH 15, these crossings include cycle times that range from 90 to 200 seconds, meaning a diagonal crossing could take five minutes from initial crossing button activation during peak hours.

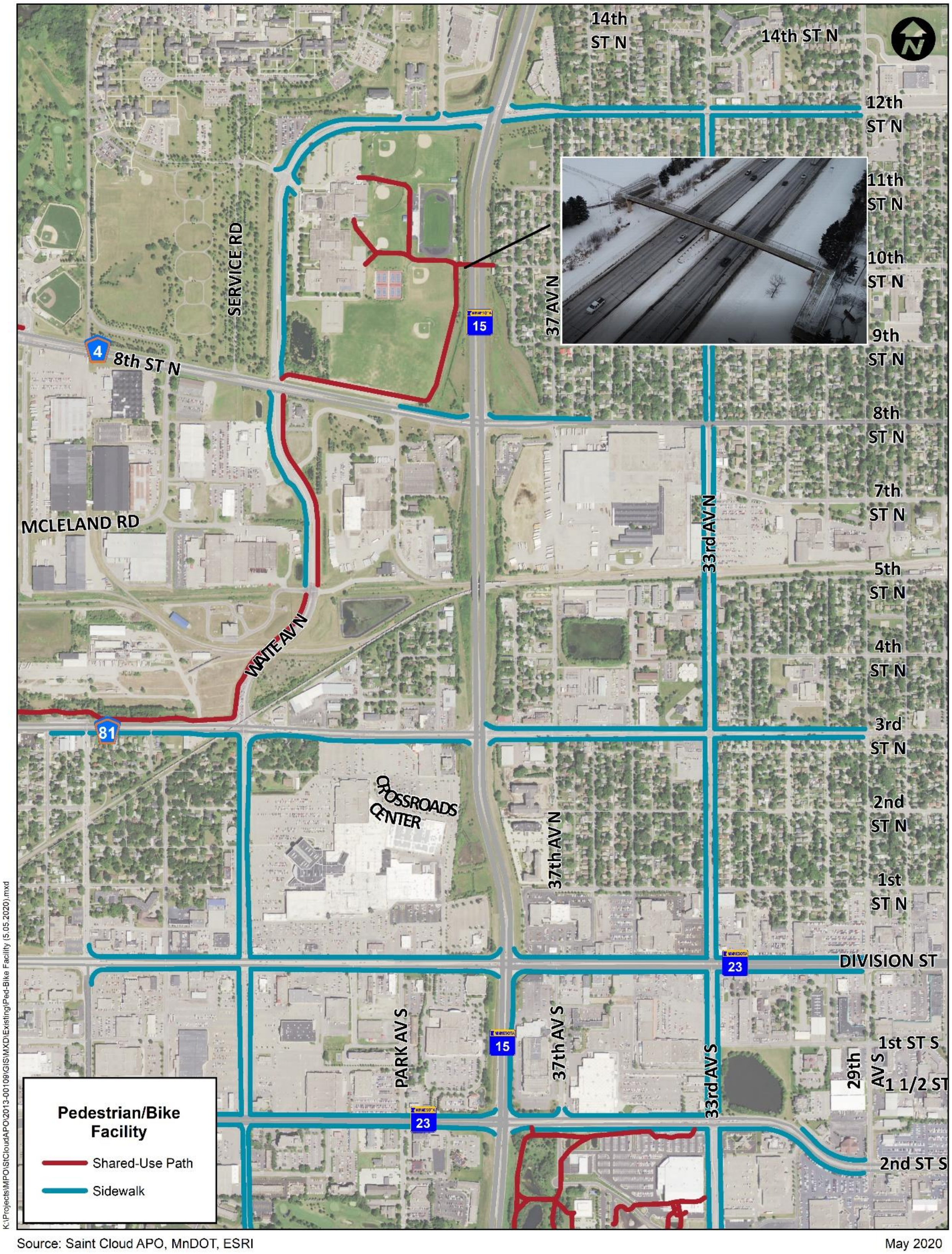
Marked crosswalks alone do not improve pedestrian safety and should be used with other safety strategies, like refuge islands, curb extensions, appropriate signage, and even grade separated crossings. The MTP calls for local jurisdictions to include pedestrian facilities on both sides of all the urban roadways as infrastructure projects occur in existing developing areas and where there are missing linkages to the sidewalk system. Therefore, any improvements to cross streets should include sidewalks. Table 10 shows the crossing amenities at the study intersections.

Table 10 - Crossing Amenities

TH 15 Intersection with	2nd Street	Division Street	3rd Street	8th Street	12th Street
Crossing Configuration					
Curb Ramps	✓	✓	✓	NW and NE Quadrant only	✓
Truncated Domes	✓	✓	✓	✓	✓
Sidewalk Connectivity	✓	✓	Except NW Quadrant	✓	✓
Pavement Markings					
Marked Crosswalks	✓	✓	✓	✓	✓
Stop Bar for Traffic	×	×	×	Present on non-crossing approaches	×
Signal Treatment					
Pedestrian Signal Head	✓	✓	✓	✓	✓
Push-Button Activators	✓	✓	✓	✓	✓
Push-Button Activators on Signal Pole	N/A	N/A	N/A	N/A	N/A
Push-Button Activators on Other Pole	✓	✓	✓	✓	✓
Pedestrian Countdown Timers	×	×	×	×	×
APS	✓	✓	✓	✓	✓

One of the most challenging aspects of crossing the street at any of the TH 15 intersections are the yield controlled right-turn lanes. Pedestrian comfort level is affected by drivers using these movements at higher speeds with drivers that are more worried about merging onto TH 15 than checking for pedestrians. Alternatively, the channelized right-turn lanes give drivers a clear view of pedestrians while approaching, where a standard right-turn lane views can be blocked by through traffic. While the crash data does not indicate any safety issues with these crossings, it is important to recognize that a low volume of pedestrians and high-volume and speed of vehicles can turn into a serious conflict. Attributes at each crossing location should be considered for improvements to balance safety related to crossing distances, crossing conflicts, sight lines, and crossing infrastructure.

Figure 36 - Pedestrian and Bicycle Facilities



Transit Conditions

Metro Bus is the area's transit provider responsible for the daily management, operation, and maintenance for both Fixed Route and Dial-a-Ride systems. Metro Bus provides stable, consistent, and comprehensive transit services for the cities of St. Cloud, Sartell, Sauk Rapids, and Waite Park. Metro Bus provides service coverage throughout the four-city transit service area making connections between and among neighborhoods, businesses, and retail centers. Dial-a-Ride is a shared ride service for individuals with disabilities who are unable to ride fixed route buses and require door to door service. Metro Bus has fixed routes (Route Number 1, and Route Number 2) that cross TH 15 at 2nd Street, Division Street, and 12th Street. There are no existing bus routes that run on the TH 15 corridor. Figure 37 shows the existing transit routes.

Non-Motorized Vehicular Related Crashes

Between 2015 and 2019, there were four non-motorized crashes (three bicycles and one wheelchair), with an additional 39 non-motorized crashes in the secondary study area, as shown in Figure 38. Of these crashes, 32 crashes resulted in injuries (74 percent), including three serious injuries. The pedestrian and bicycle crashes in the secondary study area highlight the impact that TH 15 has on east and west multimodal movements and the increased nature of multimodal crashes due to driveway access on TH 23 and CSAH 75.

Multimodal Level of Service

Pedestrian Level of Service

Pedestrian level of service (PLOS) incorporates a metric for segments (roadways between two intersections) and intersections. The *Highway Capacity Manual* provides a pedestrian level of service calculation for intersections that incorporates traffic volumes, speed, and the physical characteristics of the intersection. The PLOS represented in this study is based on the average time a pedestrian waits for a legal opportunity to cross an intersection leg. The LOS score is an indication of the typical pedestrian's perception of the overall crossing experience. For segments, PLOS incorporates the number of travel lanes, traffic volumes, traffic speeds, truck traffic, and buffer width.

Based on the methodologies discussed, the PLOS is shown in Figure 39. The segments have unacceptable level of service due to lack of sidewalks or pedestrian facilities along the corridor. All five signalized intersections of the corridor have pedestrian crossing facilities as discussed earlier. All the intersection of TH 15 corridor experiences PLOS C. Ultimately, it's difficult to have a PLOS less than C at a signalized intersection as long as pushbuttons, pedestrian heads, and crosswalks are provided. That doesn't mean that crossing TH 15 does not create discomfort and delays for pedestrians. For example, if a pedestrian is to travel diagonally across an intersection during the peak hour, they would wait through a 200 second cycle length twice and cross two yield controlled porkchop islands. This would likely take several minutes.

Bicycle Level of Service

Bicycle level of service (BLOS) incorporates a metric for segments (roadways between two intersections) and intersections. The *Highway Capacity Manual* provides a BLOS calculation for intersections that incorporate traffic volumes, speed, and the physical characteristics of the intersection. The intersection BLOS score is an indication of the typical bicyclist's perception of the overall crossing experience. For segments, BLOS incorporates traffic volumes, roadway width, speed, truck traffic, pavement condition, on-street parking, and shoulder width.

Based on the methodologies discussed, the BLOS at the study corridor is shown in Figure 40. All five intersections experience BLOS D due to lack of facilities. Throughout the corridor BLOS E is experienced due to the corridor lacking any continuous bicycle facilities. There are areas with shoulders that terminate at intersections, and thus the BLOS becomes unacceptable due to right-turn lanes eliminating the shoulder use for bikes and causing a high-volume shared lane condition.

Figure 37 - Existing Metro Bus Transit Routes

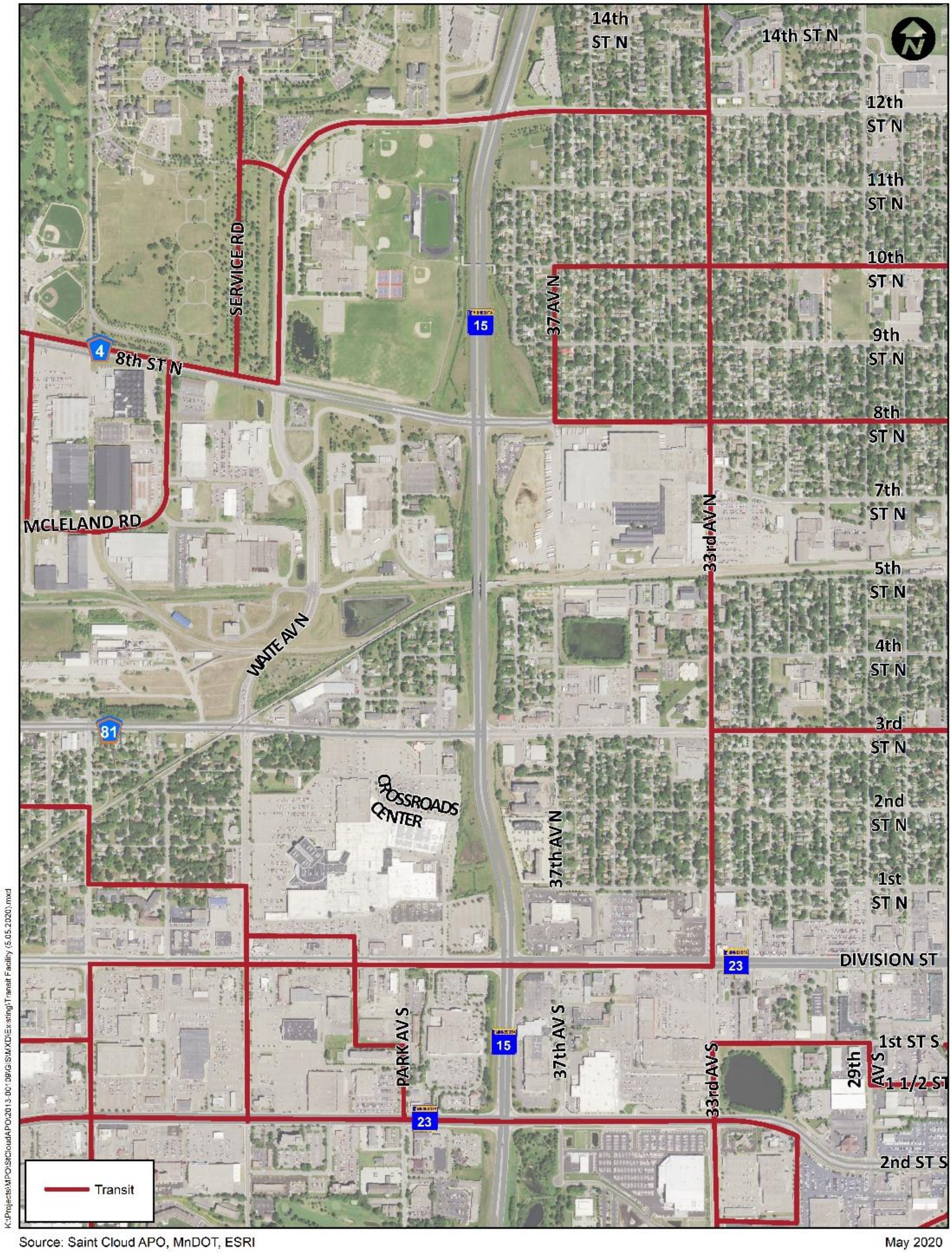
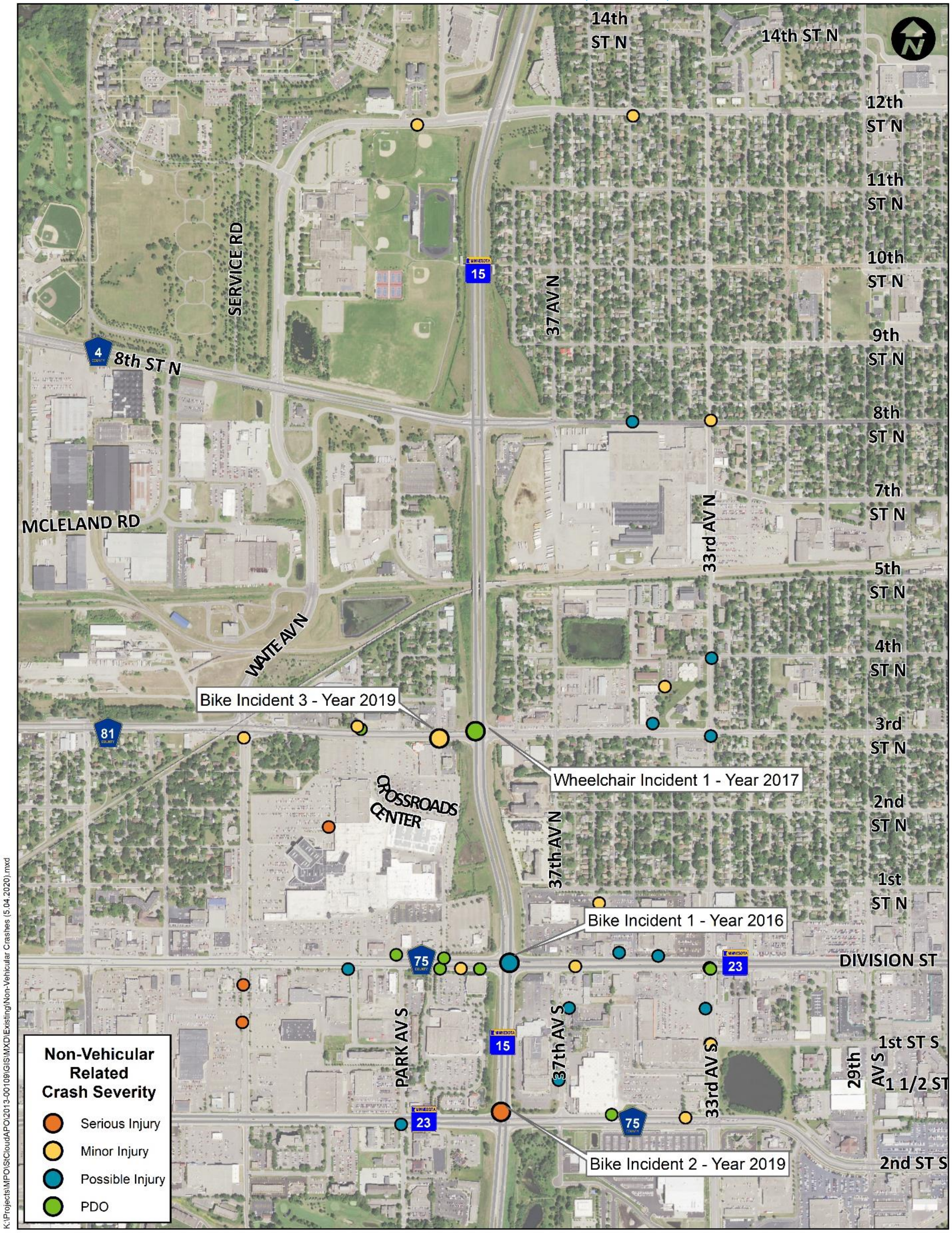


Figure 38 - Non-Vehicular Related Crashes (2015-2019)



Source: MnCMAT2, Saint Cloud APO, MnDOT, ESRI

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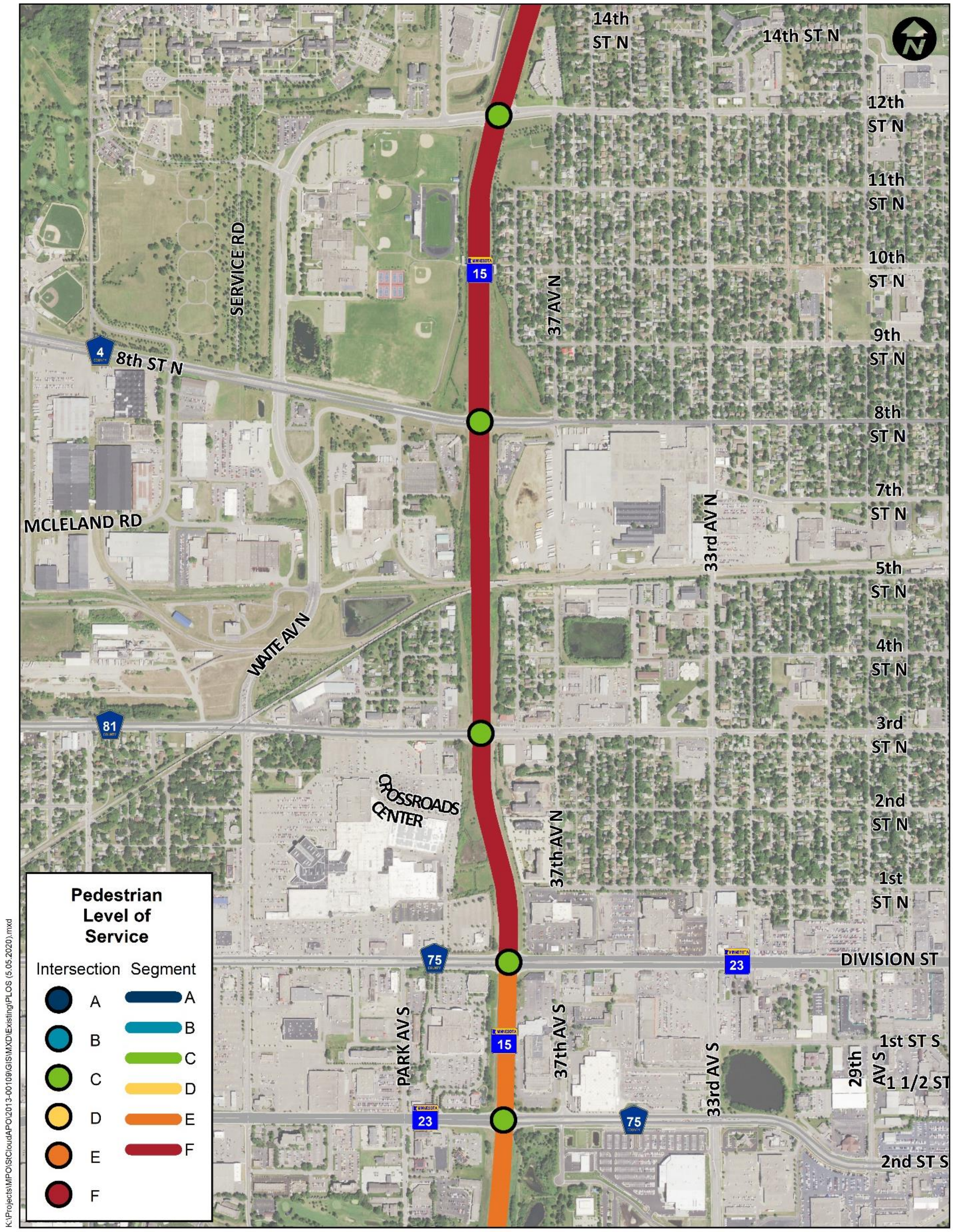
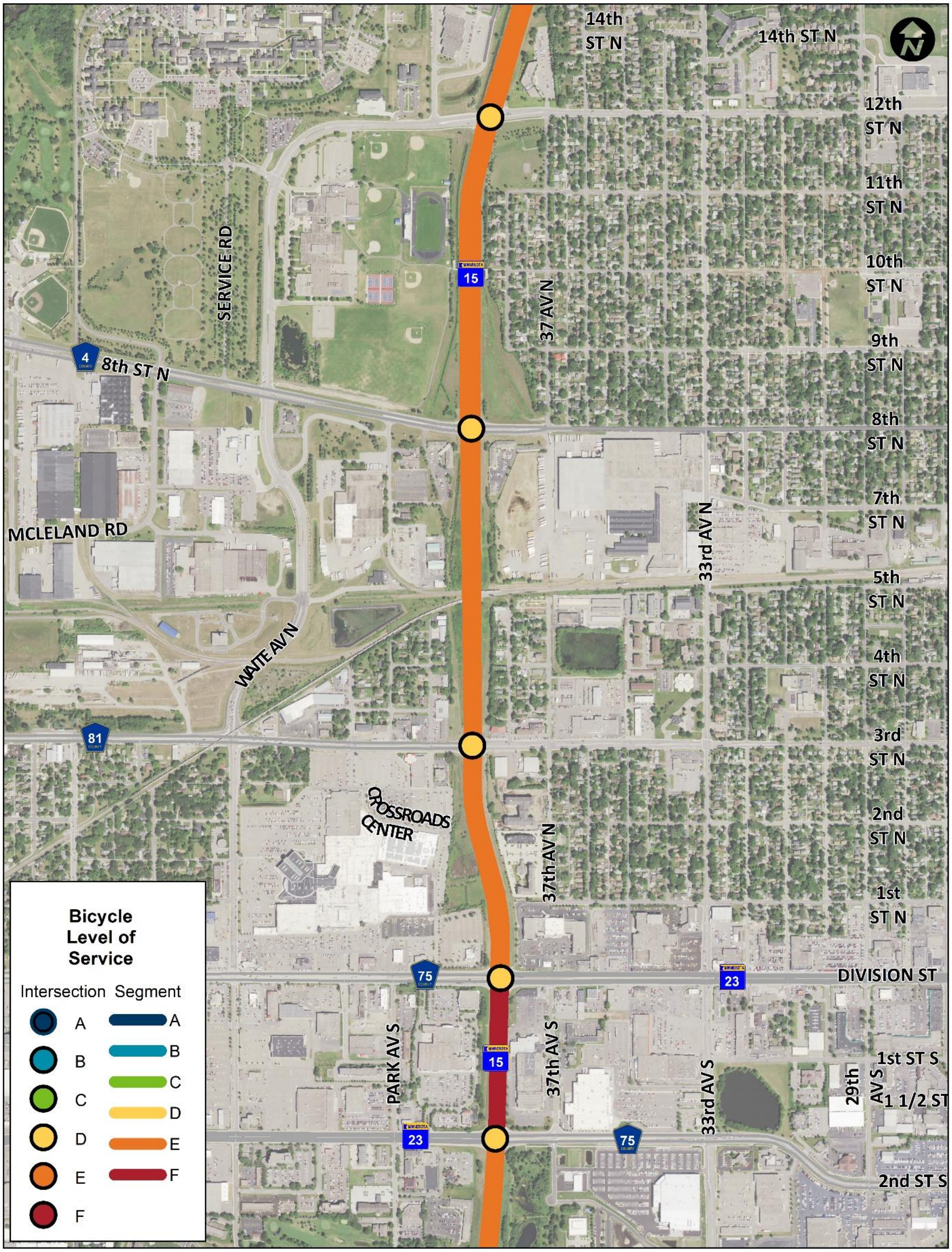
Figure 39 - Pedestrian Level of Service



Source: Saint Cloud APO, MnDOT, ESRI

May 2020

Figure 40 - Bicycle Level of Service



Source: Saint Cloud APO, MnDOT, ESRI

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Existing Conditions Summary

Trunk Highway (TH) 15 is one of the most challenging corridors in the entire state. It exhibits some of the lowest travel time characteristics and highest crash metrics of the entire statewide highway system. Its regional context and connectivity to I-94, US 10, TH 23, and CSAH 75 make it one of the most critical corridors in the St. Cloud area and surrounding region. The high-speed and high-capacity characteristics that make the TH 15 corridor such an asset for the motoring public, make this corridor equally as unappealing for alternative modes of travel such as pedestrians and bicycles. The existing conditions are summarized below.

Traffic Operations Summary

- Intersection operations are approaching deficient throughout the duration of the day with the capacity of minor approaches generating latent demand along closely spaced adjacent accesses. Most left-turning movements at major intersections experience up to two minutes of delay during the PM peak hour.
- TH 15 has several high-volume intersections, with heavy turning movements and through volumes from intersecting roadways. Despite the high volumes of mainline traffic, total side street volumes (non-TH 15 direction) range from 23 percent of the total intersection traffic on the north end of the corridor to as much as 47 percent on the south end of the corridor. These high-volume intersections impact TH 15 but also create long delays east-west across TH 15.
- Queueing is a major challenge, with eastbound and westbound queues generally reaching 400 to 800 feet with maximum queues extending over 1,600 feet (eastbound at 3rd Street).
- TH 15 exhibits consistent delays throughout the day at the five signalized intersections, which increases travel times by 60 to 90 percent above free flow travel times from 7 AM to 7 PM.
- The TH 15 corridor level of travel time reliability (LOTTR) is bordering unreliable conditions annually, with hourly analysis showing the corridor is reliably congested. TH 23 travel times were identified as being unreliable throughout the day.
- Average network delay in the study area is around 35 to 40 seconds during the off-peak times but is more than 100 seconds during the PM peak hours, causing additional latent delay at closely spaced business access and minor approaches on TH 23 and CSAH 75.
- Truck traffic was identified between four to six percent of total traffic averaging 1,500 to 1,750 daily truck trips and typically taking 10 percent longer than passenger vehicles to travel through the congested corridor.
- Streetlight analysis identified that seasonal traffic had a large impact on existing daily traffic, resulting in five percent higher average daily traffic during the summer months and up to 15 percent higher traffic volumes on summer Fridays.

Traffic Safety Summary

- Three intersections were identified as being in the Top 10 crash locations in the state with 2015 through 2019 crash data: TH 15 and 2^{nd} Street (#4), TH 15 and Division Street (#7), and TH 15 and 3^{rd} Street (#8).
- All study area intersections and roadway segments were identified as having critical crash rates, averaging 267 crashes per year between 2015 and 2019. Twenty percent of these crashes were injury or potential injury crashes.
- The primary crash type is rear ending crashes; particularly during peak hours. Nearly three-quarter (72 percent) of the corridor's crashes are rear ends and 12 percent occur during the PM peak hour alone. This is common on corridors with long queues and stop-and-go traffic, like TH 15.
- The secondary study area corridors exhibit similar crash tendencies with a crash rate one to five times the critical crash rates, primarily due to dense access spacing that exceeds standards.
- Existing SSAM conflict analysis trends used to identify future safety changes match the existing study area trends and will provide a crash type specific analysis for future conditions.

Multimodal Summary

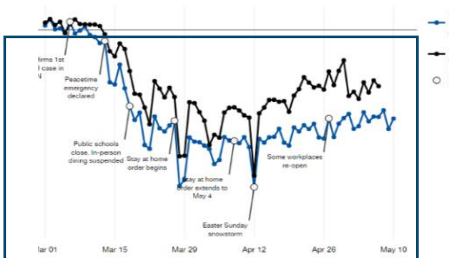
- There were 43 non-motorized crashes in the primary and secondary study area, including four on TH 15. These crash trends show that multimodal safety needs to be addressed with future alternatives.
- TH 15 serves a major barrier to pedestrian and bicycle travel. The high-speed, high-volume corridor has long crosswalks with high exposure rates. The yield controlled right-turn lanes add an extra layer of discomfort for those crossing the corridor.
- The lack of comfort limits pedestrian and bicycle activity across the corridor, showing a stark contrast between activity and latent demand in terms of trip that are two miles or less that could be completed by walking or biking.
- Other than one small stretch, there are no pedestrian and bicycle facilities along the corridor. While the regional context of the roadway does not generally lend itself to pedestrian and bicycle activity, it is not uncommon for major regional routes like TH 15 to support some type of bicycle activity given the high degree of connectivity.
- Signalized crossings include cycle times that range from 90 to 200 seconds which can cause a diagonal crossing to take up to five minutes long from initial crossing button activation during peak hours.

FUTURE CONDITIONS

Scenario Analysis

The first step of future conditions analysis was identifying a range of potential future traffic scenarios. Scenarios were developed using Steering Committee input on the range of topics described below. Steering Committee members included staff from MnDOT, St. Cloud APO, City of Saint Cloud, Stearns County, and St. Cloud Metro Bus.

Figure 41 - Future Scenarios

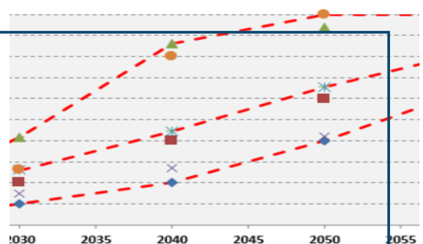


COVID-19 Impacts

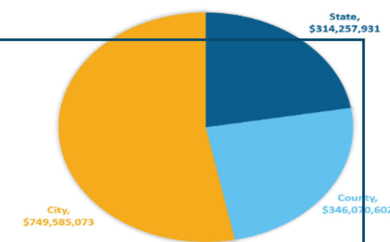
Modal Split

Land Use Changes

Regional Traffic Growth



Connected and Automated Vehicles



Financial Landscape

The scenarios are described below.

- **COVID-19 Impact.** COVID-19 has had widespread impacts to traffic patterns throughout Minnesota, reducing statewide traffic by as much as 70 percent compared to past years. This scenario assessed the long-term impacts to travel patterns related to COVID-19. The Committee primarily agreed that traffic patterns would return to typical conditions (pre COVID-19) in the long-term, with the potential for a slight downturn.
- **Modal Split.** Modal split is the percentage of traffic that is not in a single occupancy vehicle. Currently 19 percent of all commuting traffic in St. Cloud uses alternate modes of travel, however the regional future travel demand model does not include mode choice when forecasting traffic volumes. This is further exacerbated by the fact that COVID-19 has increased the demand for working from home as an alternative to driving to/from work each day. The Committee all agreed that mode choice should be factored into the analysis, mostly thinking that the current modal preferences would remain somewhat stable moving into the future.

» **Land Use Changes.** National development trends have indicated a shift away from big box retail toward multi-use developments, however study area trends have seen retail thriving and growing (i.e., recent Costco development). Various land use scenarios were discussed, with the Committee mostly agreeing that developing and redevelopment would occur along the corridor. The primary location for development was identified as the former Electrolux facility.

» **Regional Growth.** TH 15 is a major regional corridor, subject to major changes in regional traffic. The travel demand model assumes a 1.8 percent annual growth rate for regional traffic into the future, whereas the past 10 and 20 years of historical growth show 2.35 percent and 2.74 percent annual regional traffic growth rates, respectively. Other regional corridors in the metropolitan area on the other hand (TH 10 and TH 23) experienced very low regional growth rates over the past 20 years and even some areas of negative growth rates in the past ten years. The Committee agreed that a higher regional growth rate should be assumed.

» **Connected and Automated Vehicles.** Most national projection systems forecast notable percentages of connected and automated vehicles (CAV) by 2045. By most accounts, CAV is expected to increase vehicle-to-vehicle efficiency along an arterial but create such convenient commuting characteristics that vehicle miles travelled are expected to increase significantly. The Committee agreed that CAV was likely but expected relatively modest adoption rates.

» **Financial Landscape.** Minnesota GO forecasts a $6 billion dollar shortfall over the next 20 years in terms of transportation funding. COVID-19 is expected to further impact transportation funding. Transportation expansion has the potential to relieve pressure on TH 15, but without adequate funding it is likely that TH 15 will become even more heavily utilized. The Committee was mostly split on funding, with near equal parts agreeing that funding levels would stay the same, slightly decrease, or slightly increase.

Using the Steering Committee input, the following scenarios were evaluated using the St. Cloud APO's travel demand model (TDM). A travel demand model is a computer model that estimates traffic growth as a function of spatially allocated demographic data like households and employment. The St. Cloud TDM is used for long range transportation planning in the St. Cloud area, enabling planning staff to estimate future traffic conditions and how these conditions could change based on changes in assumed roadway infrastructure, demographic growth, or travel behavior.

The assumptions and revisions made to the TDM for each scenario are detailed below.

» **2045 Master Transportation Plan (MTP) Scenario.** This scenario used the TDM recently approved as part of the 2045 MTP. There were no edits made. Figure 42 shows estimated 2045 daily traffic volumes in this scenario.

» **2045 Multimodal Scenario.** This scenario assumed less dependency on automobile use by 2045, with more trips being completed by walking, biking, and transit. These changes were reflected in the trip-generation step of the travel demand model. The following mode choice assumptions were made:

  - Walking mode share increases from four percent to five percent.
  - Biking mode share increases from one percent to 1.25 percent.
  - The percentage of people working from home increases from five percent to 10 percent.
  - Transit use remains constant at two percent.
  - The current TDM already included activity at the Electrolux facility, so no changes were made to accommodate expected land use changes.
  - Given the increased interest in modal split, CAV was assumed to be primarily ridesharing, minimizing the overall impacts to traffic volumes.

  Since the MTP model does not have a mode choice step, overall trip generation within St. Cloud was reduced by 18.25 percent in the Multimodal Scenario (5 + 1.25 + 10 +2 = 18.25). This scenario did not include any changes to annual external traffic growth rates (i.e. trips with origins or destinations outside of Saint Cloud). Figure 43 shows estimated 2045 daily traffic volumes in this scenario.

» **2045 Auto Focused Scenario.** This scenario assumed that non-automobile use remains at current levels with some increase in auto traffic because of future adoption of connected and autonomous vehicles (CAV). The following modifications were made to the TDM to reflect CAV adoption.

- The annual growth rate of external traffic increases from 1.8 percent in the MTP scenario to 2.5 percent.
- Automobile trip generation within St. Cloud increases by 25 percent by 2045 due to more convenient travel associated with CAV adoption.
- The current travel demand model already included activity at the Electrolux facility, so no changes were made to accommodate expected land use changes.

Figure 44 shows estimated 2045 daily traffic volumes in this scenario.

» **2045 Balanced Scenario.** This scenario is a middle-ground between the Multimodal Scenario and the Auto Focused Scenario, assuming increased usage of other travel modes, but also a slight increase in automobile traffic associated with increased CAV adoption. The following modifications were made to the TDM for this scenario.

- The annual growth rate of external traffic increases from 1.8 percent in the MTP scenario to two percent. This accounted for more regional traffic related to natural regional growth and increased regional trips related to CAV.
- Automobile trip generation within St. Cloud decreases by 12 percent because of increasing trips by walking, biking, transit, working from home and CAV ridesharing.
- The current Travel Demand model already included activity at the Electrolux facility, so no changes were made to accommodate expected land use changes.

Figure 45 shows estimated 2045 daily traffic volumes in this scenario

In addition to the modifications noted above, there were some manual edits made to modeled volumes based on an evaluation of origin-destination data.

Figure 42 - 2045 MTP Scenario: Estimated Daily Volumes

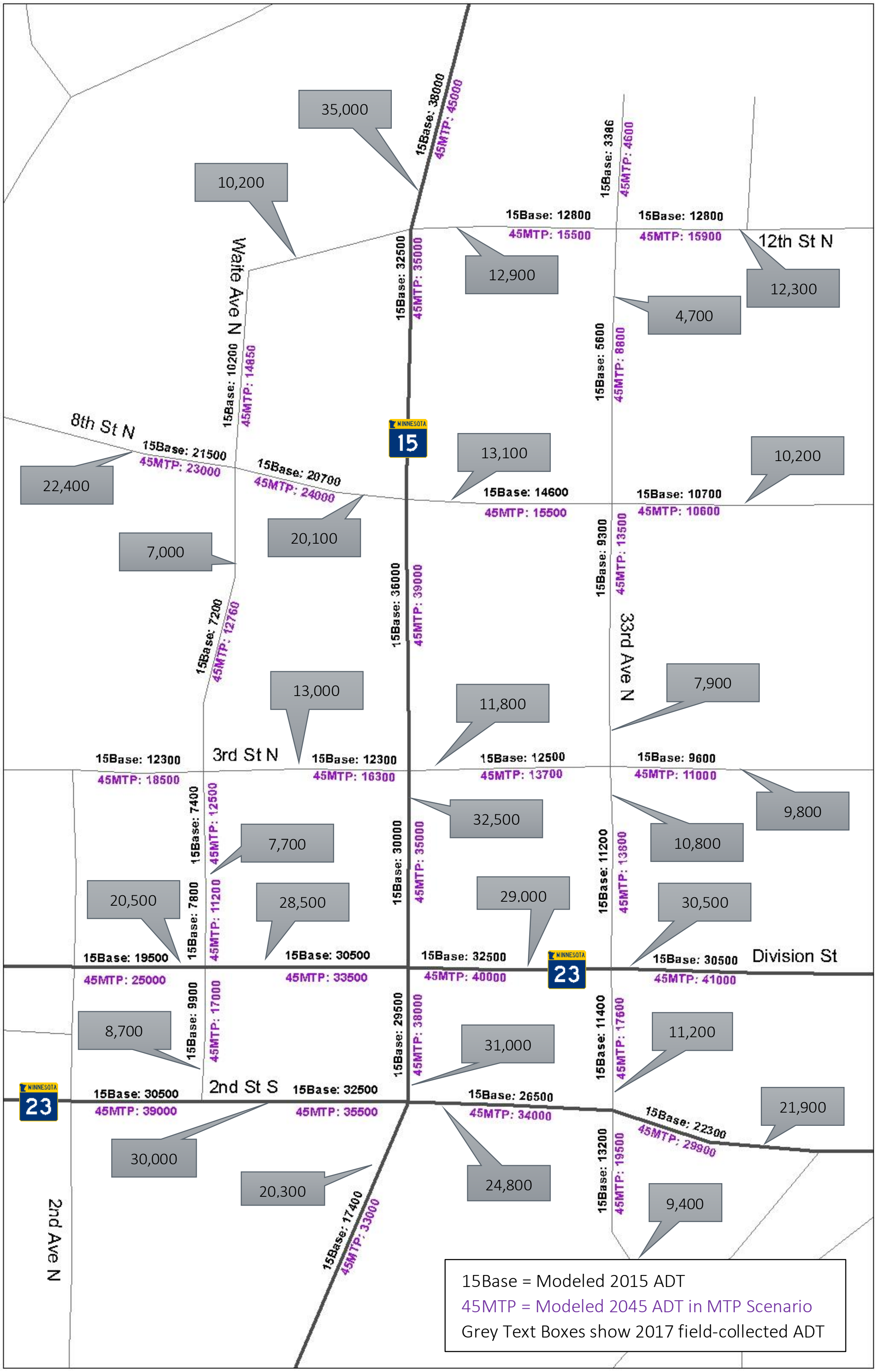


Figure 43 - 2045 Multimodal Scenario: Estimated Daily Volumes

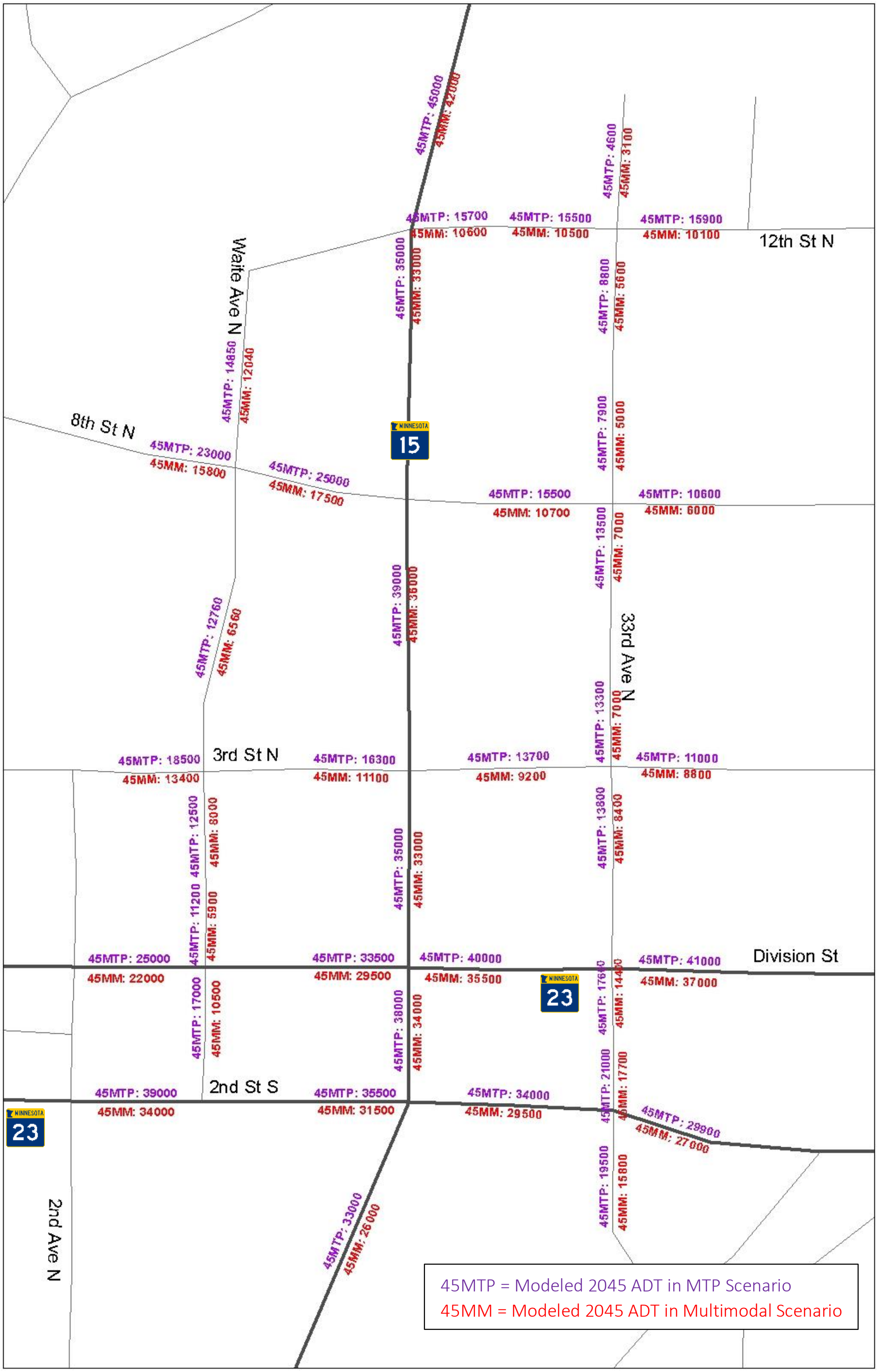


Figure 44 - 2045 Auto Focus Scenario: Estimated Daily Volumes

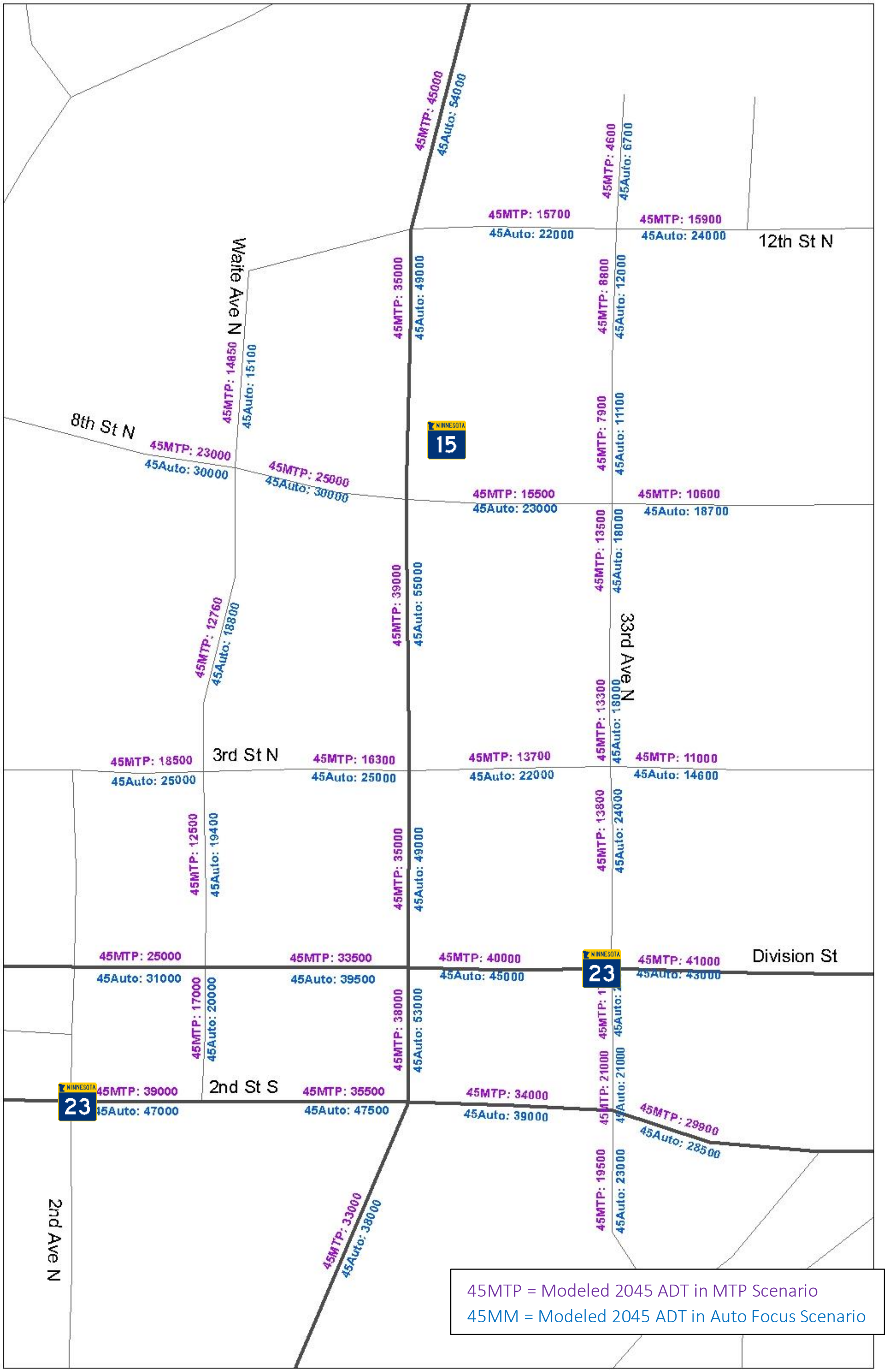
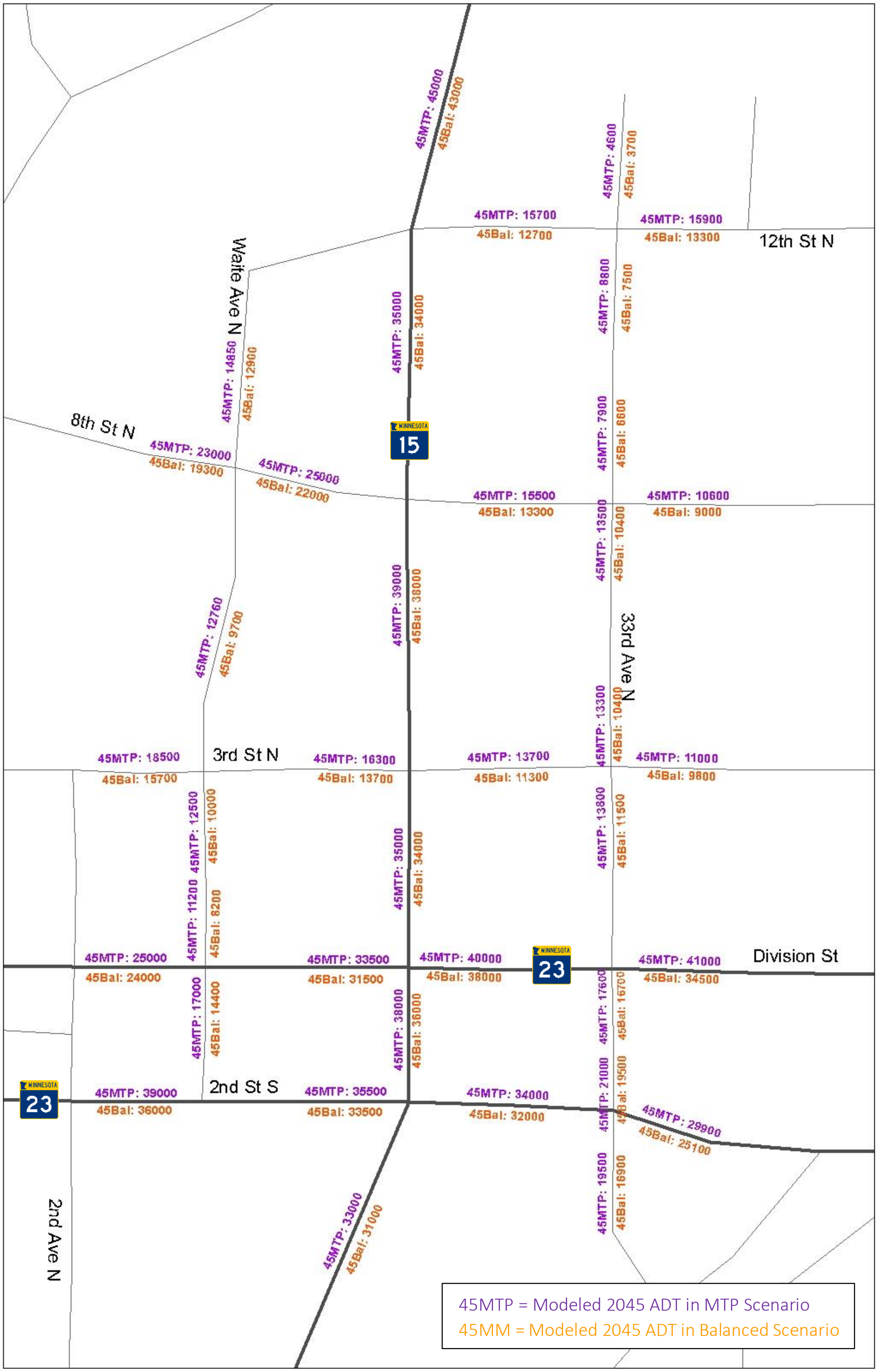


Figure 45 - 2045 Balanced Scenario: Estimated Daily Volumes



Scenario Analysis Summary

Below is a summary of the TDM scenario analysis results.

- The 2045 MTP scenario sees moderate to significant traffic growth on all the corridors in the study area. While the overall traffic demand increases, there are no major changes to how traffic moves through the transportation network when compared to existing conditions.
- The 2045 Multimodal scenario still sees some traffic growth, especially on the major corridors like TH 15, 2nd Street, and Division Street. On other corridors within the study area, particularly 3rd Street, 8th Street, 12th Street, Waite Avenue/44th Avenue, and 33rd Avenue, 2045 traffic demand declines from its current levels. This is likely because as fewer trips are demanded on high-speed corridors like TH 15, traffic using these minor corridors can reroute onto a more efficient route.
- The 2045 Auto Focused scenario sees major traffic growth on all corridors, even when compared to the 2045 MTP scenario. Traffic demand on major corridors like TH 15 and 2nd Street is expected to increase more than 50 percent over current conditions. Minor corridors like 12th Street and Waite Avenue are expected to see traffic demand increase more than 100 percent. As congestion builds in this model, traffic is rerouted to lower capacity corridors, resulting in the major increases in travel demand.
- The 2045 Balanced Scenario shows moderate growth over current traffic levels but estimates lower 2045 traffic volumes than all other scenarios except the Multimodal scenario.

The ADT ranges from the scenario analysis summary are shown in Table 11.

Table 11 - Scenario Analysis Summary

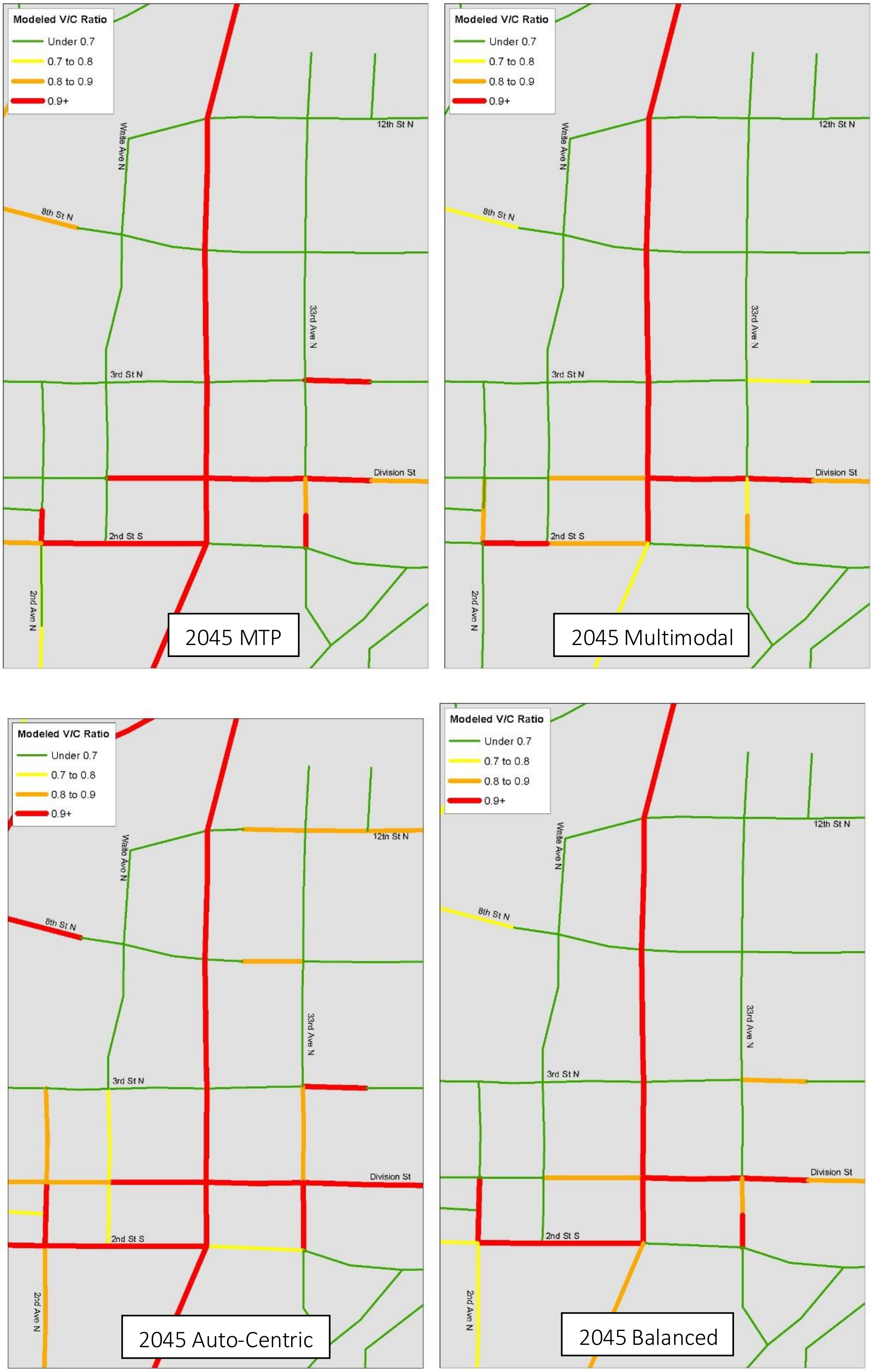
	Existing	2045 MTP	2045 Multimodal	2045 Auto Focused	2045 Balanced Scenario
TH 15	31,000 - 35,000	35,000 - 46,000	33,000 - 42,000	45,000 - 54,000	34,000 - 43,000
2nd Street	22,000 - 30,000	30,000 - 39,000	27,000 - 34,000	29,000 - 47,000	25,000 - 36,000
Division Street	20,000 - 30,000	25,000 - 41,000	22,000 - 37,000	31,000 - 45,000	24,000 - 38,000
3rd Street N	10,000 - 13,000	11,000 - 19,000	9,000 - 13,000	15,000 - 25,000	10,000 - 16,000
8th Street N	10,000 - 22,000	11,000 - 24,000	6,000 - 16,000	19,000 - 30,000	9,000 - 22,000
12th Street N	10,000 - 13,000	15,000	10,000	22,000 - 24,000	13,000
Waite Avenue	7,000 - 10,000	11,000 - 17,000	6,000 - 12,000	15,000 - 20,000	8,000 - 14,000
33rd Avenue N	5,000 - 11,000	9,000 - 20,000	6,000 - 17,000	11,000 - 24,000	8,000 - 20,000

Modeled Volume-To-Capacity Ratio

At a travel demand model level, volume-to-capacity (V/C) ratios compare the modeled volume on a roadway to the modeled roadway capacity. This analysis is not intended to identify every traffic operations issue, however it provides a high-level evaluation of corridors with potential capacity deficiencies. V/C ratios are important in travel demand modeling as it is a key criterion in determining which roadways modeled traffic use. As V/C ratios increase (i.e. more traffic and more congestion), the model will begin to assign traffic to other roadways with less congestion. An added benefit of V/C analysis in the travel demand model is that actual area-wide travel demand is all assigned to the roadway network, compared to more corridor specific analysis tools like traffic simulation that experience latent demand where network congestion results in a situation where modeled traffic cannot even enter the modeled network.

At the TDM level, the scenario that stands out with more congestion issues is the Auto-Centric scenario. All four scenarios see congestion issues on TH 15, and some congestion issues on 2nd and Division Streets, however additional congestion is seen on Waite Avenue and 33rd Avenue in the Auto-Centric scenario. TDM V/C ratios for each scenario are shown in Figure 46.

Figure 46 - 2045 Modeled Volume-to-Capacity Ratios by Scenario



Future No Build Traffic Operations

Future No Build traffic operations analysis was completed for the four 2045 scenarios to understand the intersection and network operations under the different traffic growth conditions. This analysis will identify which scenarios will create deficient traffic operations on TH 15 and identify when deficient level of service (LOS) occurs for each future scenario. Vehicular LOS was quantified using the same methodology as the existing conditions as summarized in Table 6.

Table 12 - Level of Service Thresholds

Level of Service	Average Delay (Seconds/Vehicle)	
	Unsignalized Intersection	Signalized Intersection
A	≤10	≤10
B	> 10 and ≤ 15	> 10 and ≤ 20
C	> 15 and ≤ 25	> 20 and ≤ 35
D	> 25 and ≤ 35	> 35 and ≤ 55
E	> 35 and ≤ 50	> 55 and ≤ 80
F	> 50	> 80

24 Hour Results

Using the TDM outputs from the four 2045 scenarios discussed above, 24-hour traffic operations were estimated for the study corridor. The results are shown in Table 13 and summarized below.

- Under existing conditions, only the TH 15 and 3rd Street intersection operates deficiently at LOS E during the PM peak hour.
- By 2045, most primary study intersections under the MTP scenario, operate deficiently for at least two hours of the day. TH 15 and 12th Street operates at LOS E between 4PM and 6 PM; TH 15 and 3rd Street operates deficiently between 5 PM and 7 PM; TH 15 and Division Street operates deficiently from 11 AM to 8 PM; TH 15 and 2nd Street operates deficiently between 1 PM and 9 PM.
- Under the 2045 multimodal scenario, there are fewer deficiencies than the other three 2045 scenarios. The TH 15 intersections with 12th Street and 8th Street experience no deficiencies throughout the day. TH 15 and 3rd Street operates deficiently between 4 PM and 7 PM; TH 15 and Division Street operates deficiently between 11 AM and 7 PM; and TH 15 and 2nd Street operates deficiently during the noon hour and between 2 PM and 7 PM.
- Under the 2045 auto focused scenario, every primary study intersection operates deficiently for most of the day. TH 15 and 12th Street experiences deficiencies from 8 AM to 10 PM, excluding the 10 AM hour. The TH 15 and 8th Street intersection operates deficiently from 7 AM to 9 AM and from 12 PM to 11 PM. The TH 15 and 3rd Street intersect operates deficiently from 12 PM to 11 PM; Division Street operates deficiently between 11 AM and 10 PM; and the 2nd Street intersection operates deficiently between 7 AM and 10 AM and 11 AM and 8 PM.
- Under the 2045 balanced scenario, there are fewer deficiencies throughout the day. The TH 15 and 12th Street and TH 15 and 8th Street intersections operate acceptably throughout the day. The TH 15 and 3rd Street intersection operates deficiently between 5 PM and 7 PM. The TH 15 and Division Street intersection operates deficiently from 11 AM to 7 PM and the TH 15 and 2nd Street intersection operates deficiently at 12 PM and from 2 PM to 8 PM.

It is important to note that if operations are improved at Division Street and 2nd Street with improvements, these bottlenecks will likely shift to any underimproved intersection along the corridor.

Table 13 - 24-Hour Intersection LOS Comparison

Scenario	Intersection	Level of Service (Hour of Day)																							
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
2020 Existing	TH 15 and 12th St	B	B	B	B	B	B	B	C	C	C	C	C	C	C	C	C	D	C	C	B	B	B	B	B
	TH 15 and 8th St	B	B	B	B	B	B	C	C	C	C	C	C	C	C	C	C	D	C	C	C	B	B	B	B
	TH 15 and 3rd St	B	B	B	B	B	B	B	C	C	C	C	C	C	C	C	C	D	E	D	B	B	B	B	B
	TH 15 and Division St	C	C	C	C	C	C	C	C	C	C	D	D	D	D	D	D	D	D	D	C	C	C	C	C
	TH 15 and 2nd St	C	C	C	C	C	C	C	D	C	C	C	C	D	D	D	D	D	D	C	C	C	C	C	C
2045 MTP	TH 15 and 12th St	A	A	A	A	B	B	C	D	D	D	C	D	D	D	D	D	E	E	D	C	C	B	B	B
	TH 15 and 8th St	B	B	B	B	B	B	C	C	C	C	C	C	D	C	C	C	D	D	C	C	C	C	B	B
	TH 15 and 3rd St	B	A	A	A	B	B	B	C	C	C	C	C	C	C	C	D	D	F	F	E	C	B	B	B
	TH 15 and Division St	B	B	B	B	B	C	C	C	C	D	D	E	E	E	E	E	E	F	E	E	D	C	C	B
	TH 15 and 2nd St	B	B	B	B	B	C	D	D	D	D	D	D	D	E	E	E	E	F	E	E	E	C	C	B
2045 Multimodal	TH 15 and 12th St	A	A	A	A	B	B	C	C	D	C	C	D	D	D	C	D	D	D	C	C	C	B	B	B
	TH 15 and 8th St	B	A	B	B	B	B	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	B	B	B
	TH 15 and 3rd St	A	A	A	A	B	B	B	B	C	C	C	C	C	C	C	C	D	E	E	C	C	B	B	B
	TH 15 and Division St	B	B	B	B	B	C	C	C	C	C	D	E	E	E	E	E	E	E	E	D	D	C	C	B
	TH 15 and 2nd St	B	B	B	B	B	B	D	D	D	D	D	D	E	D	E	E	E	E	E	D	D	C	C	B
2045 Auto Focused	TH 15 and 12th St	A	A	A	A	B	B	C	D	F	F	D	E	F	E	E	F	F	F	F	F	F	F	E	B
	TH 15 and 8th St	B	B	B	B	B	C	D	E	E	D	C	D	E	F	E	F	F	F	F	F	F	F	E	B
	TH 15 and 3rd St	B	A	A	B	B	B	C	C	C	C	C	D	F	F	F	F	F	F	F	F	F	E	E	E
	TH 15 and Division St	B	B	B	B	B	C	C	C	D	D	D	E	F	E	F	F	F	F	F	F	F	E	D	C
	TH 15 and 2nd St	B	B	B	B	B	C	D	E	E	D	D	E	E	E	F	E	F	F	F	E	D	D	E	E
2045 Balanced	TH 15 and 12th St	A	A	A	A	B	B	C	D	D	C	C	D	D	D	C	D	D	D	C	C	C	B	B	B
	TH 15 and 8th St	B	A	B	B	B	B	C	C	C	C	C	C	C	C	C	C	D	C	C	C	C	B	B	B
	TH 15 and 3rd St	B	A	A	A	B	B	B	C	C	C	C	C	C	C	C	D	D	E	E	D	C	B	B	B
	TH 15 and Division St	B	B	B	B	B	C	C	C	C	D	D	E	E	E	E	E	E	E	E	D	D	C	C	B
	TH 15 and 2nd St	B	B	B	B	B	C	D	D	D	D	D	D	E	D	E	E	E	E	E	E	D	C	C	B

Travel Time and Reliability

Travel time reliability measures the extent of unexpected delay, as measured from day-to-day and across different times of the day. Most travelers are less tolerant of unexpected delays because they cannot be incorporated into planned travel time, resulting in late arrivals. Alternatively, budgeting twice as much time for a trip can result in wasted time. Typically, drivers are often far more sensitive to major deviations in travel time than consistent delays. The level of travel time reliability (LOTTR) is defined as the ratio of the 85th percentile travel time to an average travel time for all vehicles. A LOTTR of 1.50 and greater indicates severe unreliability. For example, a LOTTR of 2.00 means that motorists should plan for twice the amount of average travel time to arrive at their destinations on time.

Travel times and reliability were calculated for both directions of TH 15 and TH 23 in the study area for the four 2045 scenarios. Free flow travel time for TH 15 is three minutes and for TH 23 is 2.2 minutes.

- Under existing conditions, travel time peaks at 5.1 minutes for northbound TH 15 and 4.8 minutes for southbound TH 15. For TH 23, travel time peaks at 5.1 minutes for eastbound and 5.1 for westbound traffic. All LOTTR measures are below 1.50.
- Under the 2045 MTP scenario, travel time peaks at 5.5 for northbound TH 15 and 5.2 for southbound TH 15. For TH 23 travel time peaks at 15.3 minutes for eastbound and 11.5 minutes for westbound. This scenario provides acceptable LOTTR for TH 15, but TH 23 eastbound and westbound have LOTTR greater than 1.50. For westbound TH 23, the LOTTR is 1.61 while for eastbound TH 23, the LOTTR is 2.78.
- Under the 2045 multimodal scenario, travel time peaks at 4.8 for northbound TH 15 and 5.0 for southbound TH 15. For TH 23, travel time peaks at 13.8 minutes for eastbound and 6.5 minutes for westbound traffic. Only the TH 23 eastbound route sees a LOTTR greater than 1.5.
- Under the 2045 auto focused scenario, travel times are the worst of all scenarios. TH 15 northbound traffic takes nearly 12 minutes and southbound takes more than nine minutes. This is four times and three times more, respectively, than free flow travel time of three minutes. TH 15 southbound, TH 23 eastbound, and TH 23 westbound have very poor travel time reliability, each more than 2.5, indicating travelers would need to plan for 2.5 times as much travel time to ensure they arrive on schedule.
- Under the 2045 balanced scenario, travel times peak at five minutes for both northbound and southbound TH 15. For TH 23, eastbound travel times peak at 14 minutes and westbound at just under nine minutes. Only the TH 23 eastbound LOTTR is unacceptable at 2.7.

By 2045, most hours of the day will see travel times well above the free flow travel time for TH 15 and TH 23. Travel time reliability begins to suffer as traffic volumes increase. Traffic modeling reflected current signal timing practices of prioritizing northbound and southbound movements along TH 15. This strategy helped maintain travel time reliability but did so at the expense of traffic trying to access TH 15. For example, routes on TH 23 begin to suffer because of the major left-turn movement onto TH 15 and additional delays at the Waite Avenue and 33rd Avenue signals on TH 23. Ultimately, it may be necessary that signal timing may be altered to better balance delays. Given the high future traffic volumes, it is expected that any strategy to balance delays will simply move deficiencies to the altered approach, in this case, TH 15.

Travel times for all four routes under all four scenarios can be seen in Figure 47 while travel time reliability can be seen in Table 14.

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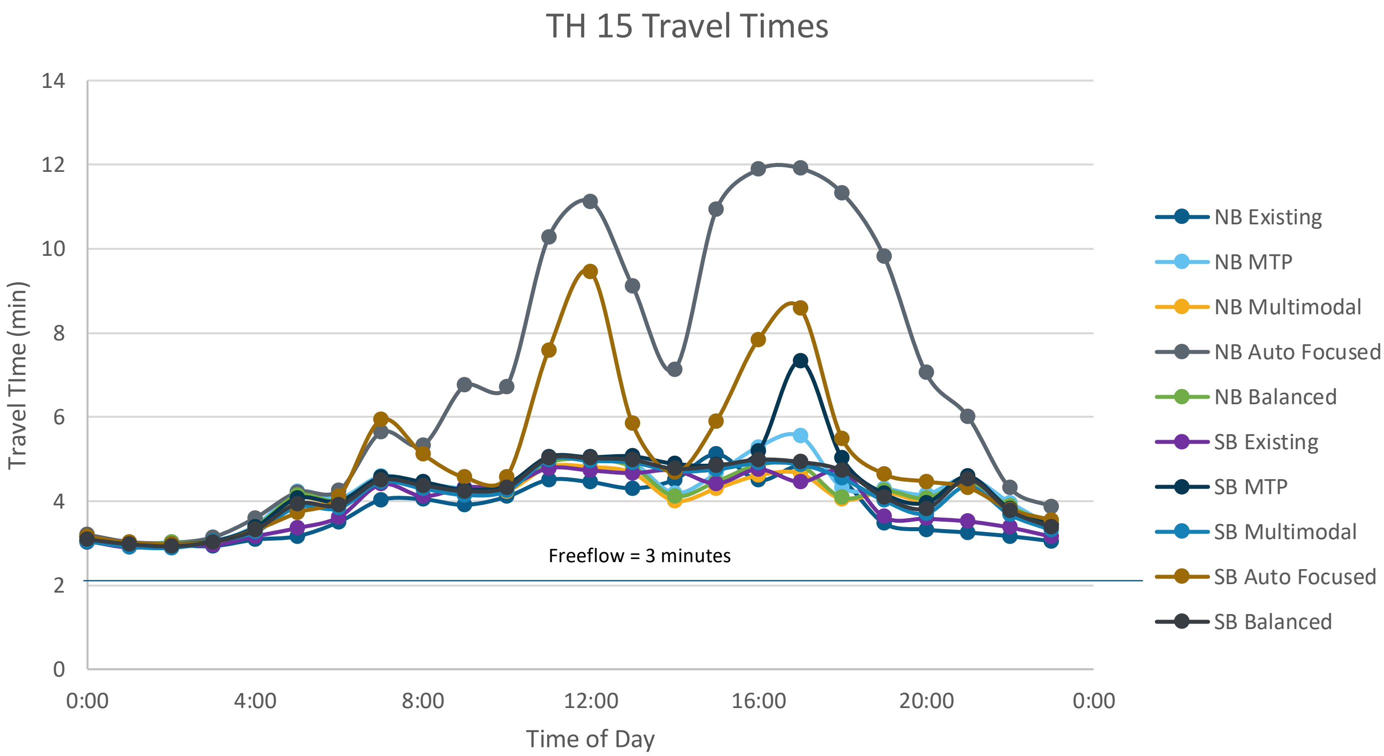
Figure 47 - 2045 Travel Times for TH 15 and TH 23



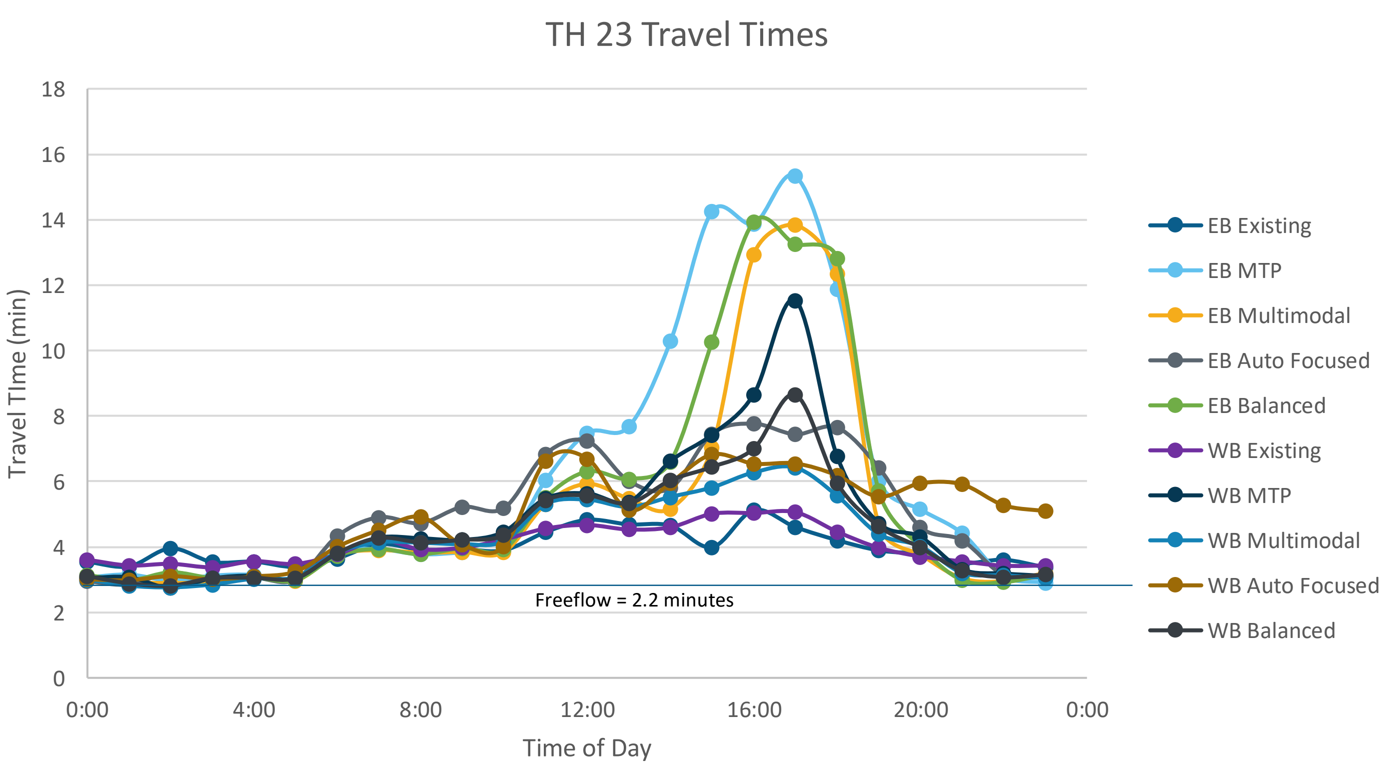


Table 14 - Level of Travel Time Reliability Results

Travel Time Segment	Reliability Metric	Daily LOTTR				
		Existing	MTP	Multimodal	Auto Focused	Balanced
TH 15 Northbound (2nd Street to 12th Street)	50th Percentile	3.53	4.26	4.10	4.58	4.15
	85th Percentile	4.56	4.91	4.62	5.90	4.79
	LOTTR	**1.29**	**1.15**	**1.13**	**1.29**	**1.15**
	85%/Free Flow Ratio	1.52	1.64	1.54	1.97	1.60
Th 15 Southbound (12th Street to 2nd Street)	50th Percentile	3.66	4.27	4.15	7.03	4.22
	85th Percentile	4.71	5.06	4.88	18.90	4.95
	LOTTR	**1.29**	**1.18**	**1.18**	**2.69**	**1.17**
	85%/Free Flow Ratio	1.57	1.69	1.63	6.3	1.65
TH 23 Eastbound (Waite Avenue to 33rd Avenue)	50th Percentile	3.97	4.14	3.87	5.82	3.86
	85th Percentile	4.68	11.51	7.15	14.93	10.46
	LOTTR	**1.18**	**2.78**	**1.85**	**2.57**	**2.71**
	85%/Free Flow Ratio	2.13	5.23	3.25	6.79	4.75
TH 23 Westbound (33rd Avenue to Waite Avenue)	50th Percentile	3.97	4.25	4.10	4.80	4.22
	85th Percentile	4.74	6.85	5.66	13.67	6.06
	LOTTR	**1.19**	**1.61**	**1.38**	**2.85**	**1.44**
	85%/Free Flow Ratio	2.15	3.11	2.57	6.21	2.75

Network Operations

Each day, over 200,000 existing vehicle trips are made using the TH 15 corridor between I-94 and CSAH 1 and its primary intersecting corridors: TH 23 between Waite Avenue and 33rd Avenue; and CSAH 75 between Waite Avenue and 33rd Avenue. These trips are expected to increase to between 24,000 (11 percent increase) and 125,000 (64 percent increase) additional vehicles traveling in the study area each day, depending on the scenario. The network modeling results for each scenario are summarized in Table 15.

Table 15 - Future Daily Network Operations

Network Operations Results	Daily Results				
	2020 Existing	2045 MTP	2045 Multimodal	2045 Auto Focused	2045 Balanced
Vehicles	209,424	272,280	233,352	343,248	253,872
Avg Daily Delay (s/veh)	60	97	66	209	79
Avg AM Peak Delay (s/veh)	34	23	22	23	22
Avg PM Peak Delay (s/veh)	63	61	58	113	60
Latent Demand (Veh)	150	4,201	675	28,772	1,769
Latent Delay (Hrs)	241	16,440	1,482	182,821	4,622
Daily VHT (Hrs)	12,856	21,665	15,538	43,339	18,418
Daily VMT (mi)	386,247	488,398	433,225	641,919	463,114

Even under existing conditions, the traffic operations model cannot process all traffic demand, resulting in latent demand and delay. By 2045, the amount of traffic unable to enter the network will increase dramatically, especially for the auto focused scenario. Under the auto focused scenario, nearly 29,000 vehicles are unable to enter the network, causing nearly 183,000 hours of additional delay. The other three scenarios see much smaller increases in latent demand and delay. The growing congestion under all four 2045 scenarios creates additional delay resulting in more hours and miles traveling.

Unlike many corridors in the region, TH 15 experiences delays beyond just the AM and PM peak hours. In fact, the AM peak hour is one of the lighter periods of the day, with traffic slowly building as the commercial land uses begin to generate traffic throughout the day. The multimodal scenario highlights the potential benefits that transportation demand management can have on mitigating congestion. This illustrates a best-case scenario for congestion on TH 15. The Auto-Focused scenario illustrates a worst-case scenario, where travel trends skew toward urban sprawl without concern for roadway capacity. The balanced scenario provides a middle ground between best and worst, while accounting for critical variables not considered in the last MTP.

Surrogate Safety Assessment Model (SSAM)

Simulated vehicle conflicts were collected from Vissim microsimulation results using the Surrogate Safety Assessment Model (SSAM) to understand how future traffic demand changes crash potential along the corridor. SSAM uses Vissim modeled vehicle trajectory information to analyze vehicle-to-vehicle interactions and identify conflict events and near-misses. This analysis is focused on intersections, and considers vehicle speeds, signal timing attributes, deceleration characteristics, typical gap acceptance behavior, traffic volumes, and site-specific vehicle paths to quantify predicted conflicts for rear end, crossing, and merging crash types.

It is important to note that simulated conflicts do not directly correlate to crashes, rather the tool is intended to identify conditions with a high *potential* for crashes. Simulation results from an average of ten 24-hour Vissim model runs were used for this analysis and show the potential change of total conflicts and each crash type.

- Under the existing conditions, there were more than 5,000 total daily simulated conflicts with 73 percent rear end, 19 percent merging, and eight percent crossing conflicts. This aligned very well with existing crash trends.
- Under the 2045 MTP scenario, daily conflicts increase 72 percent to more than 8,700. These conflicts were 76 percent rear end, 17 percent merging, and 6 percent crossing.
- Under the 2045 multimodal scenario, daily conflicts increase 25 percent to more than 6,300. These conflicts were 76 percent rear end, 18 percent merging, and six percent crossing. Rear end crash conflicts increased 29 percent over 2020 while crossing conflicts declined two percent.
- Under the 2045 auto focused scenario, daily conflicts increase 310 percent to more than 20,800. These conflicts were 77 percent rear end, 14 percent merging, and nine percent crossing. Crossing and rear end conflicts showed the most significant increase at 414 percent and 330 percent, respectively.
- Under the 2045 balanced scenario, daily conflicts increased 44 percent to more than 7,300. These conflicts were 76 percent rear end, eight percent merging, and six percent crossing.

This exercise clearly illustrates the connection between safety and operations. As delays increased, so too did conflict potential. This underscores the importance of managing congestion, either via infrastructure solutions or transportation demand management.

Ultimately, the future results showed that all scenarios are expected to increase conflicts in the study area, especially rear end conflicts, likely associated with more stop-and-go traffic and long queues associated with higher travel demand and poorer traffic operations. While existing crash history already showed a critical crash issue in the study area, future conditions will increase this crash rate even further with the increase in both traffic and conflicts.

It is also important to note that because of the latent demand (vehicles unable to enter the network), only vehicles within the model were captured and because of increased demand on other routes, conflicts are likely to rise outside of the study area too. Table 5 shows the SSAM comparison for future conditions for the TH 15 study area between 2nd Street and 12th Street.

Table 16 - Historic Intersection Crash Data and SSAM Conflicts

	Historical Crash Trend	2020 Existing	2045 MTP	2045 Multimodal	2045 Auto Focused	2045 Balanced
Total Multi Vehicle Conflicts	91%	5,079	8,732	6,327	20,823	7,304
Crossing	8%	370	572	361	1,899	448
Rear End	72%	3,747	6,650	4,832	16,109	5,566
Merging	11%	962	1,510	1,134	2,815	1,290

CORRIDOR VISION

The purpose of the corridor vision chapter is to summarize all the different ways that the existing and projected needs and opportunities of the corridor were identified. The results will help guide the alternatives development and analysis as well as the implementation. Ultimately, this report will summarize the key stakeholder engagement, the general public engagement, and the existing and future conditions in the Purpose and Need Statement.

KEY STAKEHOLDER ENGAGEMENT

The TH 15 Corridor Study is guided by a set of key stakeholders through the study's Steering Committee. Members of the committee represent the City of St. Cloud, City of Sartell, St. Cloud Metro Bus, Stearns County, and MnDOT. As part of the visioning process, the committee was asked to participate in a Goals, Objectives, and Vision Roundtable, to share their desired outcomes of this project.

As demonstrated in Figure 48, the key themes that emerged from this roundtable include:

- Public engagement is really important to understand what the ultimate vision for the corridor should be.
- Finding practical solutions that can be implemented in the short term and still support the ultimate vision in the long-term.
- Addressing the major safety, congestion, and reliability issues that persist along the corridor.

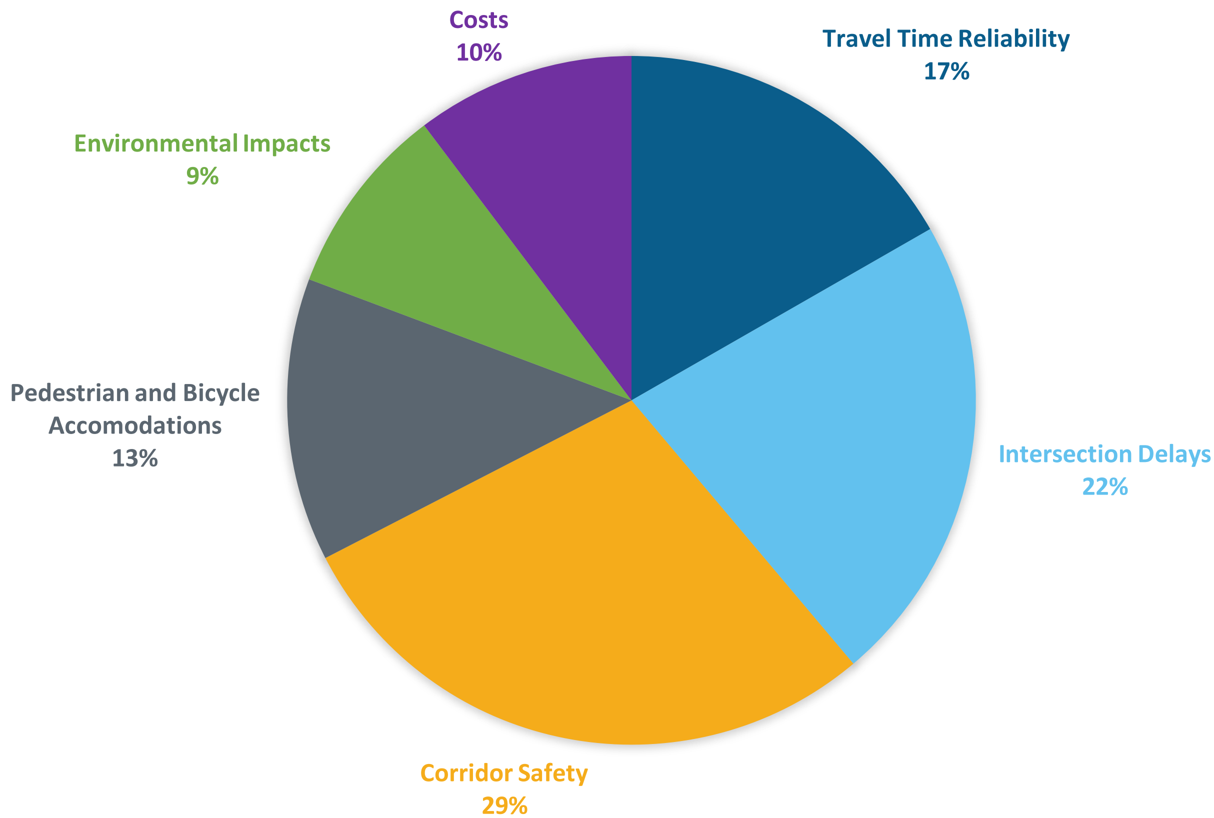
Figure 48 - Goals, Objectives, and Vision Roundtable Visual Results

In addition to the roundtable, the Steering Committee was also asked to complete a value profile. The value profile helps understand the community's priorities when developing and evaluating the alternatives. The committee was asked to assign a value between 1 and 100 to each of the following categories:

- » Travel time reliability: the ability to travel the corridor without turning, efficiently and reliably.
- » Intersection delays: the ability to cross and access the corridor without significant delays.
- » Corridor safety: the ability to reduce crash potential by reducing vehicle queue lengths and turning conflicts.
- » Pedestrian and bicycle accommodations: the ability to cross the corridor safely and efficiently by walking or biking.
- » Environment impacts: the desire to minimize impacts to adjacent properties and other environmental factors.
- » Costs: the desire to keep project costs low.

Figure 49 shows the Steering Committee's aggregated value profile. Generally, corridor safety was the highest priority for the committee, followed closely by intersection delays. The lowest values were applied to pedestrian and bicycle accommodations, environmental impacts, and costs.

Figure 49 - Steering Committee's Aggregated Value Profile



PUBLIC ENGAGEMENT

In addition to the Steering Committee, the first round of public engagement focused on identifying and understanding the communities' primary issues, needs, and opportunities as it relates to TH 15. This was done in two ways: listening sessions with stakeholders and a virtual open house.

Listening Sessions

As part of the initial round of public engagement listening sessions were held with some of the key stakeholders identified by the Steering Committee for this project. Four listening sessions were held with representatives from emergency services, elected officials, business community, and residents.

Figure 50 - Listening Session Participants

Emergency Services

- Chief Dean Wrobbel (St. Cloud Fire Battalion)
- Lt. Adam Meierding (St. Cloud Police Dept.)
- SO Lt. Kellan Hemmesch (Stearns County)
- Shawn Pierce (Metro Bus)

Elected Officials*

- Mayor Rick Miller (Waite Park)
- Commissioner Tarryl Clark (Stearns County)
- Commissioner Joe Perske (Stearns County)
- Mayor Ryan Fitzhum (Sartell)
- City Administrator Anna Gruber (Sartell)

Business Community

- Cory Schueler (Lamont Companies)
- Kurt Franke (Bike Advocate)
- Sam Wilson (Wal-Mart)
- Darcy Eigen (Crossroads Mall)

*At the request of City Staff, Elected Officials from the City of St. Cloud will be engaged using other processes set form in the public engagement plan (i.e., public input meetings) and through regular City update opportunities.

The purpose of the listening sessions was to provide an opportunity for the project team to listen and learn from those most directly impacted by the project regarding their concerns, issues, and visions of the corridor. The following is a summary based on questions asked of the participants. Four general questions were prepared for the listening sessions. The summary of the sessions is discussed below.

Listening Session Discussion Summary

WHAT DO YOU LOVE ABOUT YOUR COMMUNITY?

The participants were in sync with what they loved about their community.

- The location of St. Cloud as a regional hub offering major retail chains, great schools, and community activities while still allowing for a small-town value.
- The increased growth in St. Cloud and surrounding communities are providing new opportunities.
- The communities have been growing more diverse and now include at least 30 different countries represented and multiple languages. This has come with some challenges, but participants generally agreed it has been a welcome addition to their community.
- Finally, there was consensus regarding successful joint planning efforts across jurisdictions.

WHAT'S NEEDED NOW – AND IN THE FUTURE – IN YOUR COMMUNITY?

Four main themes emerged around the issues within the corridor study including safety, congestion, access, and non-motorized options.

- The topic most frequently discussed was the many safety issues within the corridor. Safety issues were often related to merge/yield lanes being too short and the inconsistency of these along the corridor. Additionally, many participants either experienced first-hand or witnesses rear end crashes and near misses. Speeding was also discussed as a safety challenge.
- Congestion is also a challenge within the corridor. Participants expressed concerns with the traffic signal timing as it results in long queues and travel time reliability. Overall, this then leads to drivers speeding and increase in other unsafe behaviors.
- The need to manage access was a topic of conversation. Access seemed to touch on each mode in different ways. For the freight industry and emergency response, access and movements are difficult within the corridor. Maintaining access to businesses is a priority for all the retailers within the area as it contributes to their vitality with both local and regional travelers. Some participants expressed strong support for a grade separated corridor, others noted it would create difficulties in their business.
- The need for increased bike and pedestrian facilities was mentioned several times. Currently, it is not safe to walk or bike due to the high speeds, ability to cross multiple lanes of traffic, and the lack of connections to stores. The need for increase additional transit options (i.e. later bus service, availability on Sunday) for those without automobiles.

WHAT WOULD ADD TO THE QUALITY OF LIFE IN YOUR COMMUNITY?

There was consensus among the groups that people want to come to their community and maintaining safe access was a priority. As the population increases and the demographics change, having the ability to walk, bike, take transit, or drive is desirable regardless of your age or income ability and to do it safely is what the community wants (and deserves).

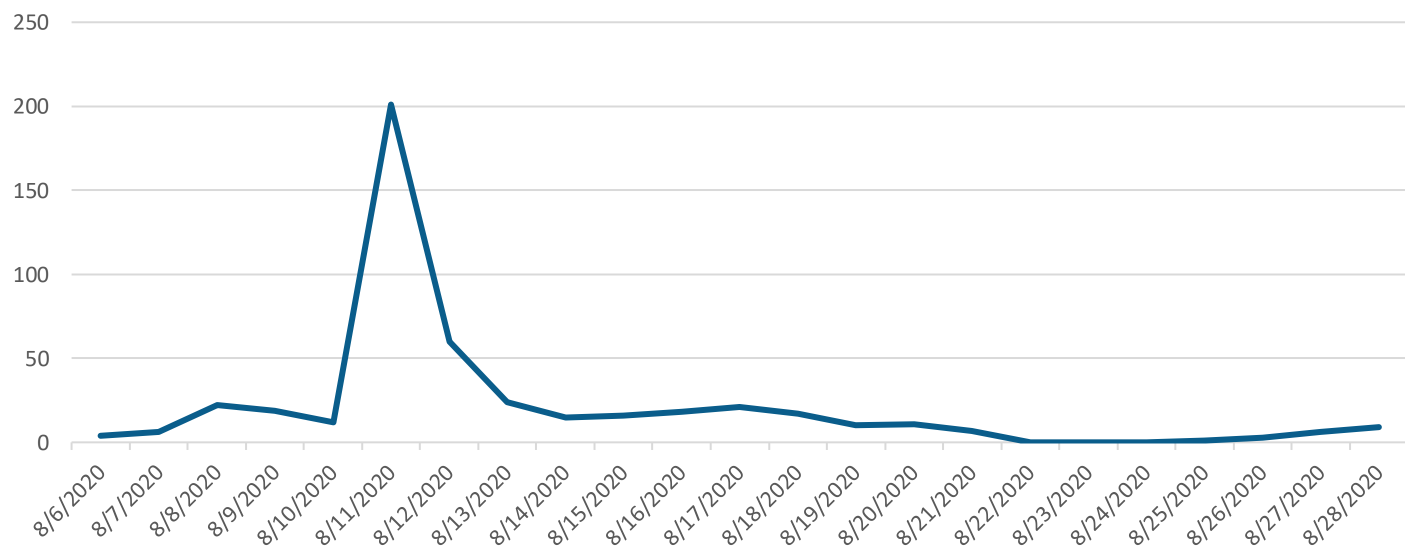
Virtual Open House

Virtual Open House

Due to the COVID-19 pandemic, the first public input opportunity was held entirely online on a dedicated open house webpage, www.mobilize15.com. At the virtual open house, visitors could review project documents, watch short topic videos, complete a survey, and leave comments on an interactive map.

The open house ran from August 6th through August 31st. Throughout this open house, there were 980 unique visitors. Of these visitors, there were 340 views of the videos, 43 comments left on the interactive map, 19 survey responses, and 14 written comments.

Figure 51 - Unique Visitors to the Interactive Map



MARKETING

A variety of different marketing tools were used to bring awareness to this public input opportunity and encourage the community to participate:

- A newsletter sent out through the APO's interested parties list.
- A press release to local news media.
- Social media campaign on the APO's Facebook page.
- Postcards sent to more than 3,100 parcels within one-half mile of the corridor.

The newsletter was translated into Spanish and Somali. Working with Wal-Mart, efforts were made to reach out to these cultural groups. However, they reported they were not aware of any issues.

SURVEY

The TH 15 survey contained three parts: a value profile, a series of questions regarding how they use the corridor, and their demographics.

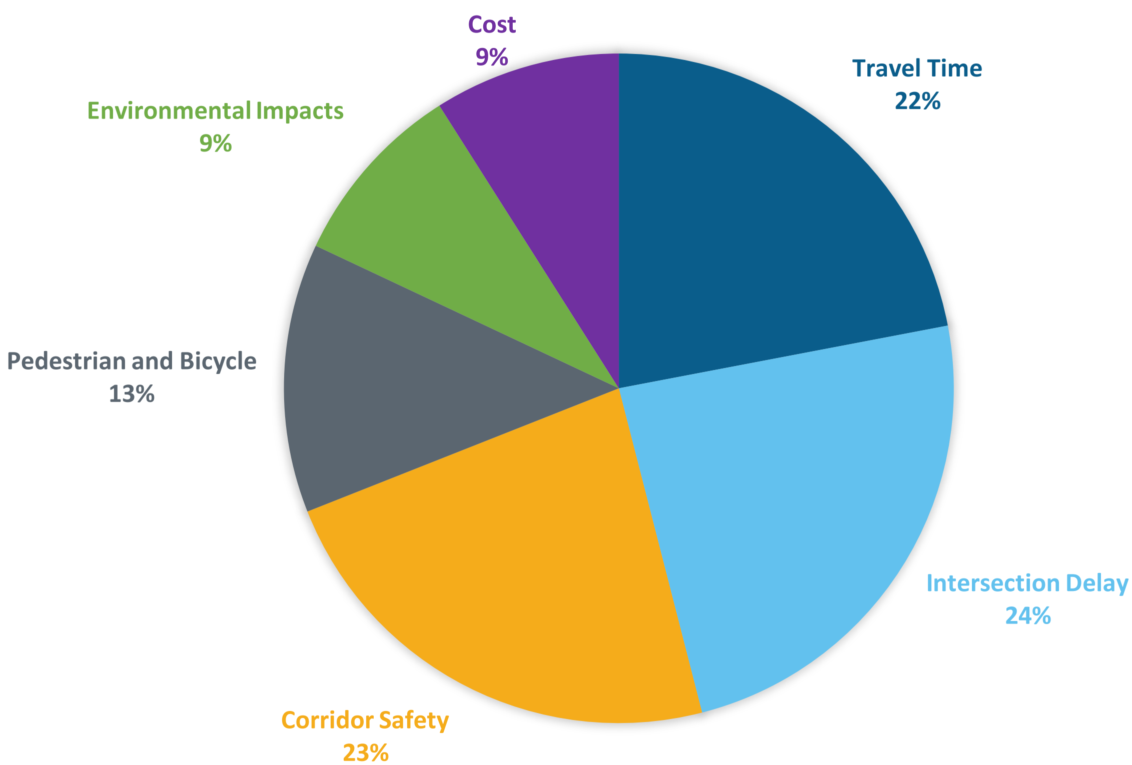
VALUE PROFILE

Similar to the Steering Committee, the value profile helps understand the community's priorities when developing and evaluating the alternatives. The public was asked to assign a value between 1 and 100 to each of the following categories:

- Travel time reliability: the ability to travel the corridor without turning, efficiently and reliably.
- Intersection delays: the ability to cross and access the corridor without significant delays.
- Corridor safety: the ability to reduce crash potential by reducing vehicle queue lengths and turning conflicts.
- Pedestrian and bicycle accommodations: the ability to cross the corridor safely and efficiently by walking or biking.
- Environment impacts: the desire to minimize impacts to adjacent properties and other environmental factors.
- Costs: the desire to keep project costs low.

Generally, the public chose safety, delay, and reliability nearly equally. These results matched well with the Steering Committee.

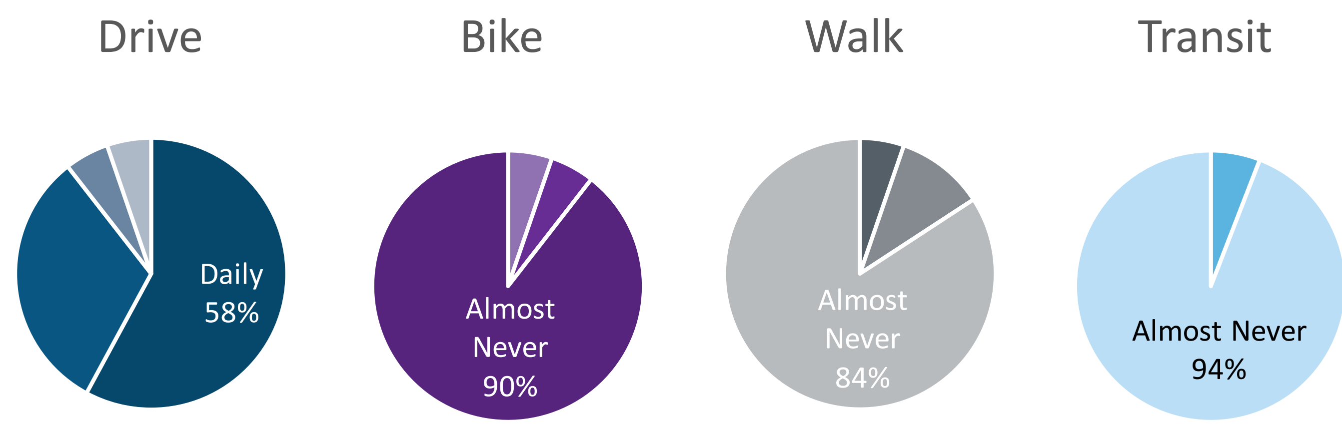
Figure 52 - General Public's Value Profile



HOW THE CORRIDOR IS USED

In this section of the survey, the public was asked how often they drive, walk, bike, and take transit on the corridor. Generally, most of the survey respondents drove alone or across TH 15 daily, but almost never bike, walk or take transit. These survey results are shown in Figure 53.

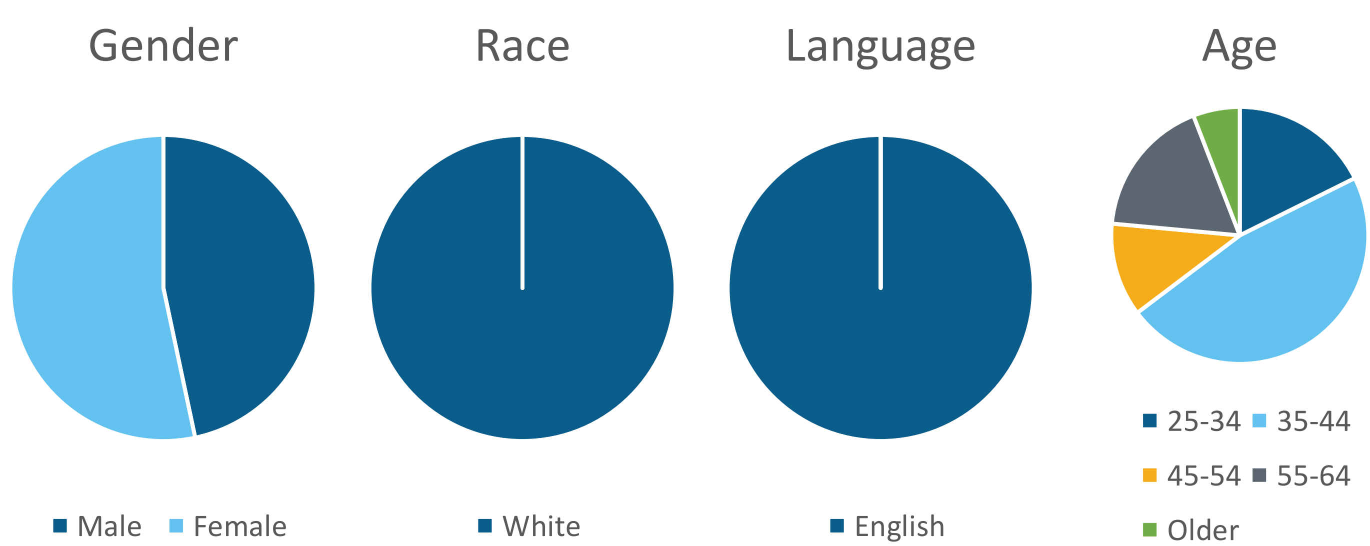
Figure 53 - Summary of Mode and Frequency



DEMOGRAPHICS

To better understand the participants and how they are (or are not) reflective of the demographics of the overall community, a set of demographic questions were included in the survey. Generally, survey respondents were split equally between male and female, were all white, and all spoke English. There was some age diversity, however most respondents were between 35 and 44. The demographic summary is shown in Figure 54.

Figure 54 - Demographic Summary



Interactive Issues Map

The interactive issues map allowed participants to drop comments at specific locations around four topic areas: congestion, safety, bicycle and pedestrian facilities, and other. There were 66 comments received on the map.

- At 12th Street N, 19 comments were received, with the primary concerns being safety and operations. Most commonly, comments focused on improved signal timing and working to address red light running; concerns of speeding; confusion surrounding the yielding and merging lanes; and improving turn lanes.
- At TH 23, 15 comments were received, with the primary concern being operations. The comments at this location suggested grade separation, improving right-turn lanes, and improving bicycle and pedestrian safety and crossing ability.
- At 8th Street, 12 comments were received. The primary comments at this location were signal timing, especially when emergency vehicles disrupt the signal timing, merge lanes, and the speed limit change.
- At 3rd Street, 11 comments were received. The most common comments at this location was queueing and sight lines creating unsafe conditions and the merge lanes.
- The remaining comment locations (Division Street and Waite Avenue, Division Street and TH 15, Division Street and 33rd Avenue, and 2nd Street and 33rd Avenue received three comments or less.

The summary of the comments received for all locations is shown in Figure 55 and by location in Figure 56. The comment types and density are displayed in Figure 57 and Figure 58, respectively.

Figure 55 - Most Common Comment Topics

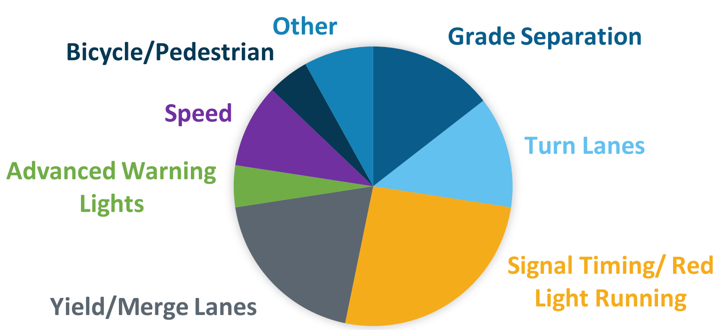


Figure 56 - Most Common Comment Topics by Location

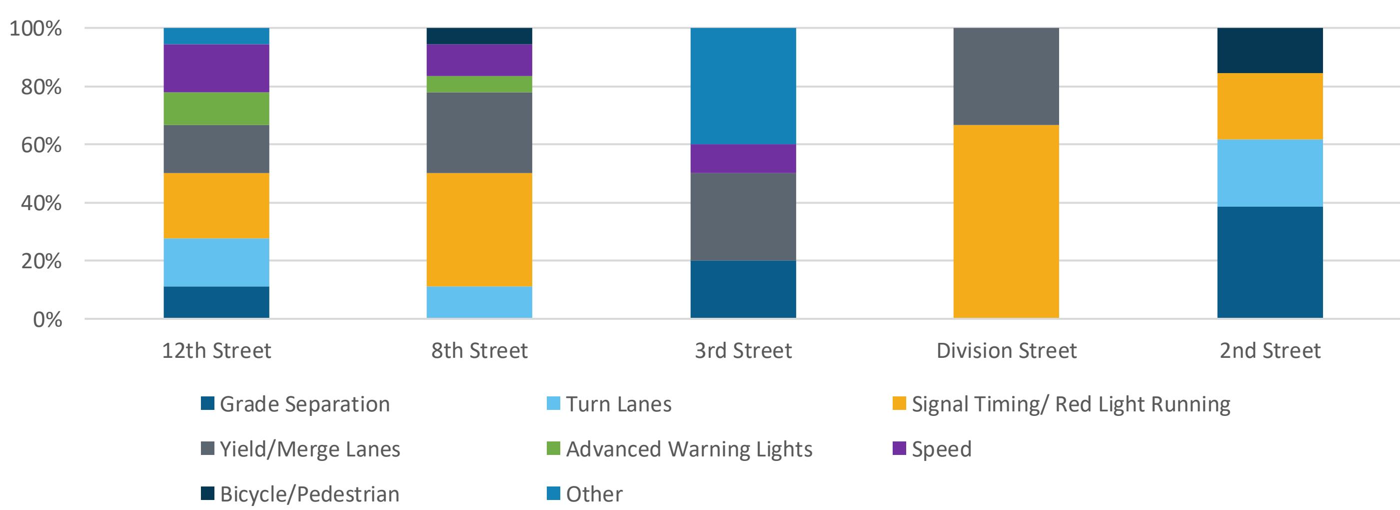


Figure 57 - Comments by Comment Location

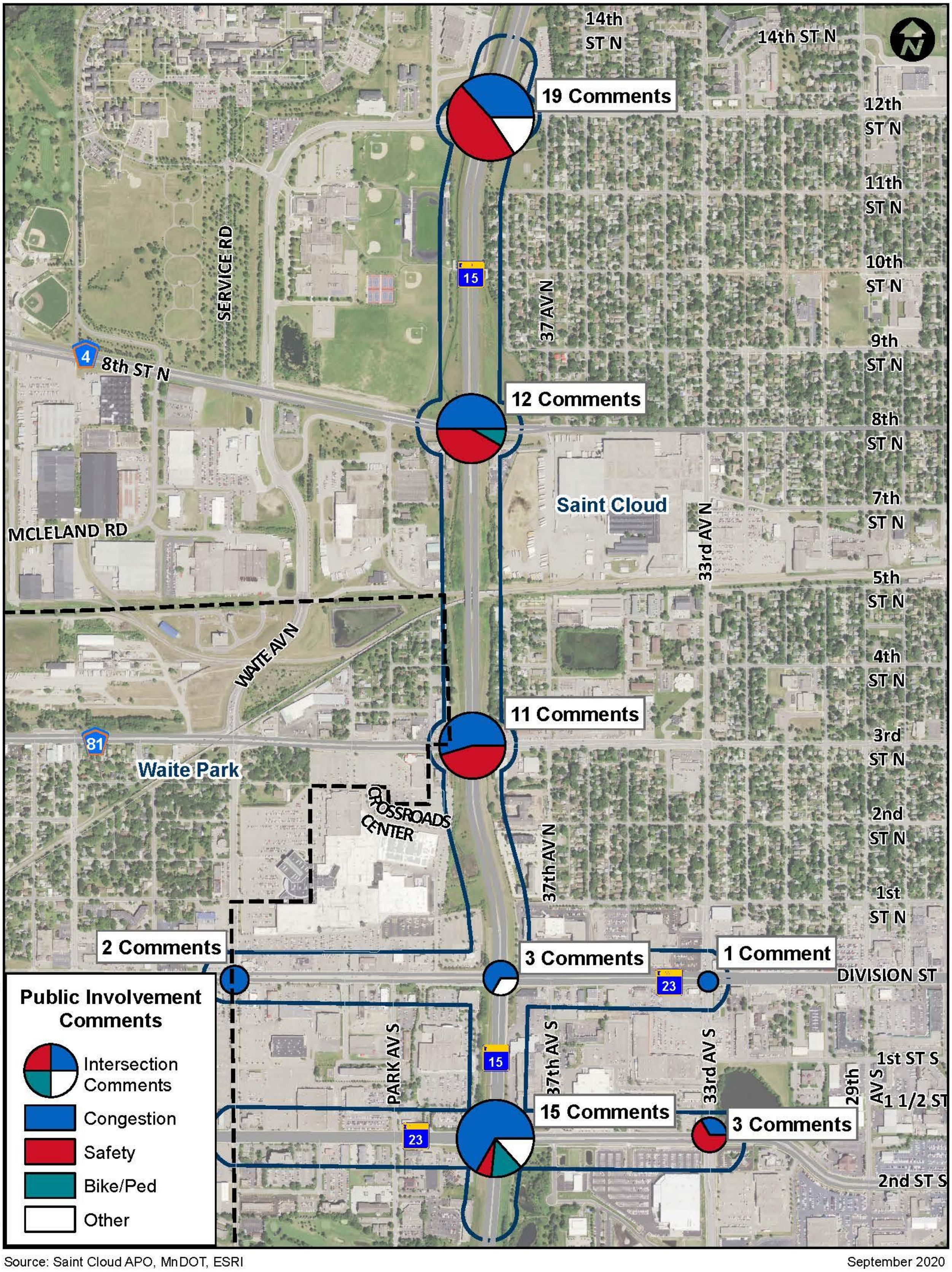
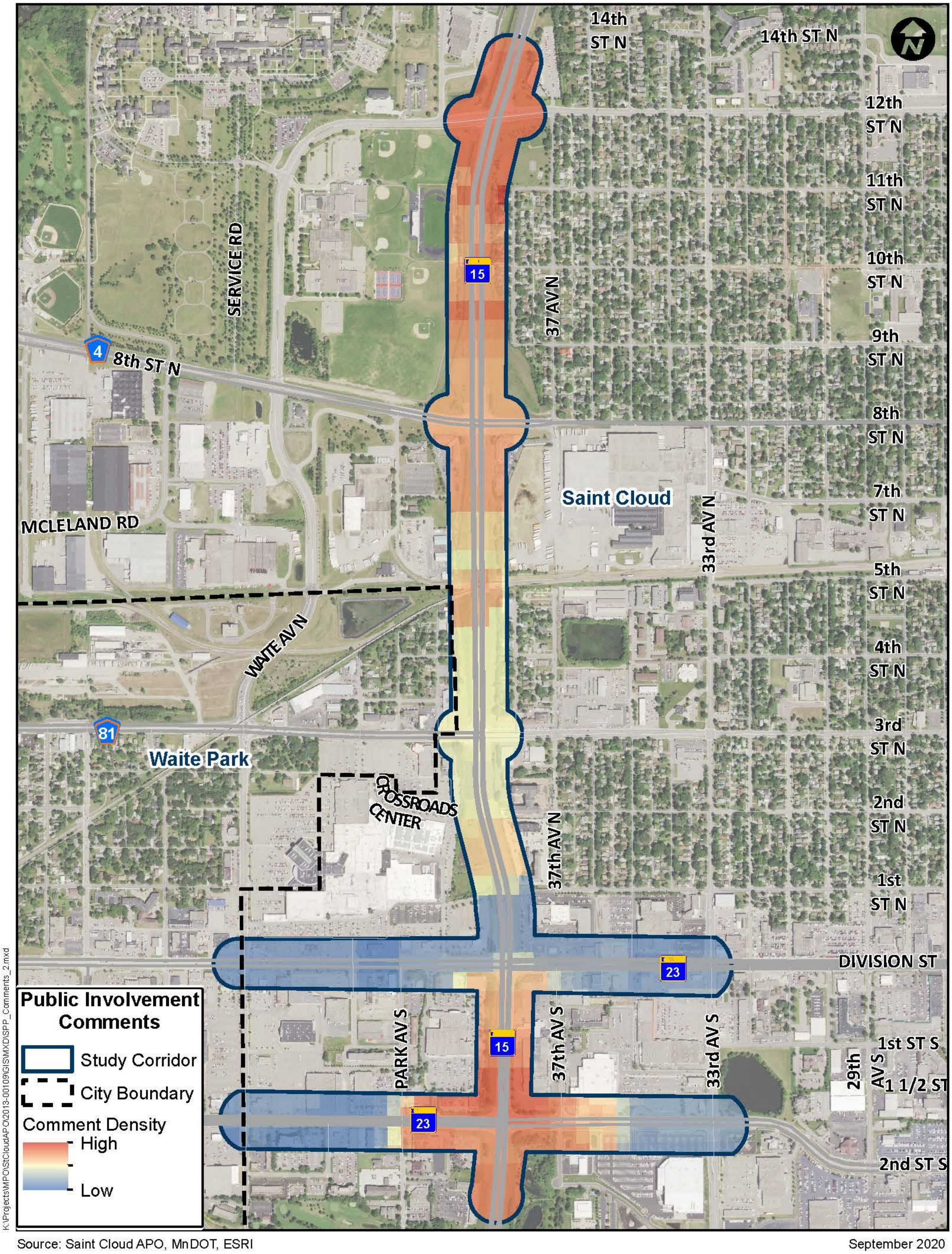


Figure 58 - Comment Density



Purpose and Need Statement

Introduction

The TH 15 corridor, running through City of St. Cloud and Waite Park, has many challenging issues that affect safety, mobility, and walkability/bikeability. There are several factors that impact traffic operations and safety on this corridor, from high-volume intersections to lack of multimodal facilities, indicating that modifications to this corridor are required. To begin this process, an in-depth review of the multimodal operations and safety performance of the TH 15 corridor was completed and documented in the existing conditions section. To understand future operations of the corridor, the future projected conditions were documented in the future conditions section. Based on the information gathered and documented, the purpose for the future alternatives to this corridor can be developed. In addition to the information compiled in this document, feedback from the City of St. Cloud, MnDOT District 3, and other stakeholders was taken into consideration when preparing this purpose and need document.

Background

Corridor Information

As described in the Existing Conditions, Minnesota Trunk Highway (TH) 15 is a high-speed (45 up to 60 mile per hour), high-volume (up to 38,000 Average Daily Traffic-ADT), four-lane roadway that serves as both a local and regional connection. Locally, it serves as one of the most intense commercial corridors in the St. Cloud and Waite Park communities making it an important corridor for the region's economic vitality. For this study, the TH 15 corridor includes a primary and secondary study area. The primary study area includes TH 15 from 2nd Street South (TH 23) to 12th Street North. The secondary study area includes the corridors of Waite Avenue to the west and 33rd Avenue to the east, along with the east-west arterials in between (see Figure 3). There are five signalized intersections along TH 15. As a regional roadway, TH 15 distributes traffic to-and-from St. Cloud's commercial and retail districts serving as a connection between TH 10 and I-94. TH 15 is bisected by TH 23 and Stearns County CSAH 75, sharing a one-quarter mile section of all three roadways, making it an important corridor for maintaining regional mobility. With these connections, it is one of the most critical corridors in the area to all user types.

The surrounding environment can be described as urban with development transitioning between residential, commercial, publicly owned, and light industrial. Apollo High School is located in the northwest portion of the corridor.

Need for Project

The need identified for this project was evaluated through the review of existing and future conditions on TH 15 and coordination with MnDOT District 3, the City of St. Cloud, the City of Waite Park, the St. Cloud APO, and other local stakeholders. A summary of the information compiled to develop the primary need statements and additional considerations are provided below. No secondary needs have been identified to date.

Primary Need

SAFETY

Number and Location of Crashes

Determining crash rates using the critical crash analysis method helps to determine conditions at the site that may be contributing to the higher crash rate. When rates are determined to be statistically significant, crashes are likely attributable to roadway design or traffic control. TH 15 has demonstrated deficient vehicular safety performance based on the location and frequency of crashes between 12th Street N and 2nd Street S and on the TH 23 and CSAH 75 corridors between Waite Avenue S and 33rd Avenue. A total of 1,335 crashes were reported from January 1, 2015 to December 31, 2019 on the TH 15, TH 23, and CSAH 75 primary and secondary corridors. Twenty percent of these crashes were injury or potential injury crashes. There were no traffic fatalities reported on TH 15 during this period. There was, however, one fatality on 33rd Avenue in 2018. (For further crash analysis, see the 'Crash History' section in the existing conditions chapter).

To identify overrepresented crash locations within the study corridor, the critical crash rate analysis method was used. This method calculates location-specific crash rates (observed crash rate) and compares those rates against crash rates for similar facilities (critical crash rate), based on methodologies developed by MnDOT. The three intersections listed above greatly exceed critical crash thresholds, as shown in Table 17.

Table 17 - Critical and Observed Crash Analysis for Intersections

Intersection	Million Entering Vehicles	Total Crashes	Critical Crash Rate	Observed Crash Rate
TH 15 and 2nd Street S	95.1	250	0.66	**2.63**
TH 15 and Division Street	110.9	218	0.64	**1.96**
TH 15 and 3rd Street NE	87.5	178	0.66	**2.03**
TH 15 and 8th Street N	95.6	110	0.66	**1.15**
TH 15 and 12th Street N	85.5	65	0.67	**0.76**
Waite Avenue and 2nd Street S	55.0	35	1.02	0.64
Waite Avenue and Division Street	59.4	40	1.01	0.67
Waite Avenue and 3rd Street N	37.2	34	1.09	0.91
44th Avenue and 8th Street N	54.7	37	1.02	0.68
33rd Avenue and 2nd Street S	62.5	57	1.00	0.91
33rd Avenue and Division Street	75.5	84	0.98	**1.11**
33rd Avenue and 3rd Street N	38.7	52	1.08	**1.34**
33rd Avenue and 8th Street N	32.8	32	1.12	0.98
33rd Avenue and 12th Street N	29.1	23	1.14	0.79

Further analysis of the roadway segments revealed that the entire TH 15 study corridor experiences crash rates greater than the critical crash rates for similar facilities, as shown in Table 18. For the segments in Table 18 the observed crash rate ranged from nearly twice to nearly five times the critical crash rate. There are few locations in the entire state that experience crash rates in this range.

Table 18 - Critical and Observed Crash Analysis for Road Segments

Segment (non-intersection related)	Million Entering Vehicles	Total Crashes	Critical Crash Rate	Observed Crash Rate
TH 15 - 2nd Street S to 3rd Street N	58.4	153	0.75	**2.62**
TH 15 - 3rd Street N to 12th Street N	40.5	79	0.80	**1.95**
TH 23 (2nd St) - Waite Ave to TH 15	36.2	55	0.97	**1.57**
CSAH 75 (Division St) - Waite Ave to TH 15	34.4	60	0.98	**1.78**
CSAH 75 (2nd St) - TH 15 to 33rd Ave	15.9	87	1.16	**4.73**
TH 23 (Division St) TH 15 to 33rd Ave	20.5	80	1.09	**3.59**
Waite Avenue - 2nd St S to 3rd St N	9.1	67	1.71	**7.34**
44th Ave 3rd St to 12th St	19.6	25	1.10	**1.28**
33rd Avenue from 2nd St S to 12 St N	29.8	71	1.31	**2.39**

Using the FY 2020 MnDOT estimated crash costs, this study area sees total crash costs of $7.6 million per year. MnDOT's *Greater Minnesota Mobility Report*, which evaluated mobility on the state-owned highway system, found the TH 15 Corridor to have the highest crash costs in the entire state as well as severe travel time reliability issues.

In addition to the MnDOT data used for this corridor study, the City of St. Cloud completed a City-wide crash analysis report using crash data from 2010 to 2019 which found that five of the highest crash rate intersections in the City occurred within the primary study area. Finally, three intersections were identified in Minnesota's Top 10 crash locations:

- TH 15 and 2nd Street (#4),
- TH 15 and Division Street (#7), and
- TH 15 and 3rd Street (#8).

Types and Severity of Crashes

Identifying crash types assists in developing counter measures to mitigate or minimize the most prevalent crash types. The analysis (St. Cloud crash analysis report, 2010 - 2019 data) revealed that rear end crashes (72 percent) are the most common crash type in the study corridor. Along the TH 15 roadway, including intersections, there were 960 rear end crashes with 385 crashes (40 percent) in the northbound direction and 244 crashes (25 percent) in the southbound direction. Rear end crashes are often the most common type of crashes in a congested signalized network corridor, especially when a corridor transitions to/from an access-controlled freeway, due to long queues and stop-and-go traffic flow.

The rear end crashes at the intersections were mostly attributed to following too close, distracted driving, and speeding. Many of the rear end crashes are due to the heavy congestion during the PM peak period from 4 PM to 6 PM. These crashes represent 19 percent of the total study area crashes. Other rear end crashes may be attributed to the right turn yield conditions on all approaches where drivers may be looking to their left for a gap in the traffic and the vehicle in front of them stops.

MOBILITY

Travel Time and Delay

TH 15 experiences operational delay during normal daily peak hours and extended periods during summer recreational traffic spikes. TH 15 corridor is one the highest trafficked corridors in all MnDOT District 3, which includes St. Cloud, Brainerd, Baxter, Elk River, and Monticello. These types of delays result in increased costs and travel times for users.

Traffic volumes in terms of Average Daily Traffic (ADT) for existing conditions and future conditions are provided in Figure 24An in-depth analysis of existing conditions and future conditions can be found in earlier chapters of this report.

Traffic volumes were calculated for a series of scenarios and evaluated using the St. Cloud APO's TDM. The results are used to estimate future traffic conditions and how they might change based on variables of roadway infrastructure, demographic growth, or travel behavior. A summary of the results shows that except for the Multimodal scenario there will be moderate to significant growth in traffic volumes for all scenarios. For additional details see the future conditions chapter.

Traffic Operations

Intersection capacity analysis was evaluated in terms of delay and level of service (LOS). LOS is a term used to describe the operational performance of transportation infrastructure elements. It assigns a grade value (A through F) that corresponds to specific traffic characteristics within a given system, on a scale of LOS A (no delay) to LOS E or F (a deficient ability to handle traffic movement resulting in delay. In the case of intersections, the delay can result in vehicles lined up (queued) delayed from continuing through the intersection. Delays can also result in blocked access to turn lanes, and block through-lanes in the intersection. For further detail, see the ECR.

Under existing conditions, only the TH 15 and 3rd Street intersection operates deficiently at LOS E during the PM peak hour. By 2045, most primary intersections will operate at a substantially reduced and deficient level of service.

Access management also impacts the traffic operations in this corridor. Access management is the process of balancing the competing needs of traffic movement and property access. Access points introduce conflict and friction into the traffic stream. Allowing dense, uncontrolled access spacing results in safety and operational deficiencies. Within this study area, the high access point densities on the major side streets, like TH 23 and CSAH 75, can disproportionately increase crashes on these segments (Figure 12).

Latent demand occurs when traffic cannot enter the system from business access or minor roadways, e.g. when volume exceeds capacity or when driveways are blocked. Intersection operations are approaching deficient throughout the duration of the day with the capacity of minor approaches generating latent demand[1] along closely spaced adjacent accesses. Most left-turning movements at major intersections experience up to two minutes of delay during the PM peak hour. Between 4 PM and 7 PM, 238 hours of latent demand delay is experienced along the corridor that is not factored into the average delay per vehicle. The presence of heavy commercial and hotel developments, as well as Apollo High School's release times are contributors to high afternoon peak hour traffic accessing TH 15 from minor roadways: TH 23, CSAH 75, 8th Street N, and 12th Street N.

Reliability

Travel time reliability measures the extent of unexpected delay, as measured from day-to-day and across different times of the day. The level of travel time reliability (LOTTR) is defined as the ratio of the 85th percentile travel time to an average travel time for all vehicles. A LOTTR of 1.50 and greater indicates severe unreliability. For example, a LOTTR of 2.00 means that motorists should plan for twice the amount of average travel time to arrive at their destinations on time.

TH 15 travel time reliabilities are generally in acceptable ranges (less than 1.5 LOTTR) during peak periods while TH 23 shows a big drop in average travel times between the 70th percentile and higher during mid-day and PM peak periods leading to unreliable conditions. TH 23 (eastbound or westbound) mid-day (MD) and PM peak periods have LOTTR between 2.21 and 2.58, and TH 23 westbound is 1.88 during the AM peak. TH 15 is approaching unreliable conditions on an annual basis but shows more variation between travel times throughout the day (free flow versus congested). Alternatively, TH 23 is unreliable throughout the day and does not experience a large improvement during AM or off-peak hours (always some congestion). This is due to northbound and southbound TH 15 traffic signal priority throughout the corridor while TH 23

[1] Latent (underlying) demand is a type of delay that indicates a major deficiency.

traffic almost always experiences red lights as it joins with TH 15. In other words, TH 15 is a major reliability barrier for priority intersecting corridors.

Unlike many other corridors in the region, TH 15 experiences delays beyond just the AM and PM peak hours. In fact, the AM peak hour is one of the lighter periods of the day, with traffic slowly building as the commercial land uses begin to generate traffic throughout the day. The 'Multimodal' scenario highlights the potential benefits that transportation demand management can have on mitigating congestion. This illustrates a best-case scenario for congestion on TH 15. The 'Auto-Focused' scenario illustrates a worst-case scenario, where travel trends skew toward urban sprawl without concern for roadway capacity. The 'Balanced' scenario provides a middle ground between best and worst, while accounting for critical variables not considered in the last MTP.

Seasonal Variation in Traffic

The St. Cloud region sees increased traffic during the summer months due to its connections to US 10 and I-94. US 10 and I-94 provide access between Minnesota lakes country and the Minneapolis - St. Paul metro area. Traffic on US 10 and I-94 experiences a 25 to 30 percent increase, or more than 15,000 trips, on all days between Memorial Day and Labor Day. On Fridays during the summer months, increases peak around 55 to 60 percent, or 30,000 trips. These seasonal increases result in additional traffic on TH 15 at around 2,000 to 2,500 vehicles, with a 5,600 to 7,200 vehicle increase on summer Fridays. *StreetLight* analysis identified that seasonal traffic had a large impact on existing daily traffic, resulting in five percent higher average daily traffic during the summer months and up to 15 percent higher traffic volumes on summer Fridays.

PEDESTRIANS AND BICYCLISTS

TH 15 is an urban corridor that passes through a core commercial area used by consumers, residents, students, and workers throughout the St. Cloud metropolitan region. The corridor provides visibility and indirect access to the Crossroads Shopping Mall and many commercial properties along 2nd Street, Division Street, 3rd Street, and 8th Street N. There are no direct accesses (driveways) to these commercial sites from TH 15, but they generate high traffic volumes to-and-from these major intersections. Apollo High School is located west and adjacent to TH 15 north of 8th Street N with the school's athletic fields bordering TH 15. There is a pedestrian overpass located between 12th Street N and CSAH 4 at Apollo High School. The high speeds and volumes on TH 15 create a barrier for pedestrians and bicyclists crossing between the eastern and western sides of the corridor, and it remains one of the greatest bicycle and pedestrian barriers in the St. Cloud metropolitan area.

Throughout the TH 15 study corridor, sidewalks are only present on the east side of TH 15 between 2nd Street and Division Street with barely two feet of curb buffer between people walking on the sidewalk and 30,000 vehicles traveling 45 miles per hour. Because of these dangerous conditions, existing pedestrian volumes along this segment of corridor are minimal. The 2040 MTP calls for local jurisdictions to include pedestrian facilities on both sides of all the urban roadways as infrastructure projects occur in existing developing areas and where there are missing linkages to the sidewalk system.

There are no dedicated bicycle facilities throughout the study area. There are areas with paved shoulders on the edge of the roadways that may serve as a functional space for bicyclists to travel in the absence of other facilities with more separation. Throughout the corridor, there are paved shoulders ranging between six and ten feet on both sides. At the intersection approaches, the right-turn lane replaces the hard shoulders throughout the corridor. While the purpose of TH 15 based on its functional classification is to move vehicles, it is not uncommon for similar roadways across Minnesota to have accompanying separated shared-use paths to provide a safe and comfortable bicycle facility.

For the five signalized intersections along the TH 15 corridor, each include pedestrian phases and crossing heads. While a pedestrian can legally cross TH 15 at any intersection, marked and traffic-controlled intersections are more desirable and increase safety (especially along a high-speed, high-volume corridor like TH 15). On TH 15, these crossing signals include cycle times that range from 90 to 200 seconds, meaning a diagonal crossing could take five minutes from initial crossing button activation during peak hours. Although there are marked crosswalks, this does not alone improve pedestrian safety and should be used with other safety strategies, like refuge islands, appropriate signage, and even grade separated crossings.

Pedestrian and bicycle access along the corridor will need to be considered to ensure reasonable accommodations are maintained to encourage walking and biking. Participants in a 2013 online survey indicated the need for bicycle, pedestrian, and transit facilities as one of the important improvements for a 'livable' region.

Additional Considerations

Pavement Conditions

Although the corridor pavement is dated, the majority of pavement conditions in the study corridor are considered good to fair based on the *International Roughness Index* (IRI).

Portions of the corridor that require pavement updates include 33rd Avenue and 12th Street N, with both exhibiting failing pavement conditions and are identified in the St Cloud 2020 to 2025 Capital Improvements Plan for sealcoat pavement repair projects during the 2020 construction year. Waite Avenue is also scheduled for a mill and overlay during the 2023 construction year.

Trip Length

In analyzing the length of trips for those within the study area, fifty-four percent of trips were ten miles or more in length, with 16 percent being five to 10 miles in length. Factors for the length of these trips are likely due to residences from Sartell and Sauk Rapids utilizing the corridor, outnumbering trips from neighborhoods directly adjacent to TH 15. This regional context is critical toward understanding how valuable parallel local collectors and arterials such as 33rd Avenue and Waite Avenue will be toward mitigating congestion.

With a projected population increase of 26 percent in the City as well as accommodating those who are traveling to the City's core, and those who are traveling through the region on TH 15, length of trips will likely continue to increase, further impacting the safety and mobility of the corridor.

Environmental Conditions

Potential Social, Economic and Environmental (SEE) constraints within the Project Area that were identified in the Environmental Conditions of the ECR include:

- Land use: residential, commercial, light industrial, Burlington Northern Santa Fe (BNSF) railroad underpass crossing TH15, Apollo High School, and the St. Cloud Veterans Administration Health Care facility.
- Environmental justice communities.
- Section 4(f) properties: Jaycee Park, Apollo High School's recreation facilities.
- Hazardous waste sites: Waite Park Wells, Electric Machinery site, and Burlington Northern Car Shop site.
- Wetlands.

Purpose of Project

Based on the data collected and initial analysis, the primary purpose of the Project is to improve vehicular safety on the TH 15 corridor between intersections 12th Street N and 2nd Street S; and on CSAH 75 and TH 23 between Waite Avenue and 33rd Avenue. These corridors have a crash rate above the critical crash rate, based on MnDOT evaluation methodology, for similar facilities and the corridors have an ongoing history of multiple crashes. The purpose is also to reduce delay and travel times on TH 15, which currently experiences peak period delay and high user costs; and to improve multimodal facilities within the corridor to allow for safe pedestrian/ bicycle use.

Corridor Vision

After a thorough review of technical traffic safety and environmental data that was corroborated by agency, stakeholder and public comments, the following key themes came together to shape the vision of the corridor:

- The issues are clear, experienced daily, and almost entirely agreed upon.
    - ***Safety:*** the corridor is one of the highest crash corridors in the state. Conditions along the corridor make walking and biking particularly uncomfortable and even drivers mentioned they had seen enough crashes to be wary. The safety of the corridor is directly tied to traffic operations and dense access spacing.
    - ***Traffic Efficiency:*** the corridor is reliability frustrating, underscored with long delays and frequent queueing. Seasonal variation can be particularly challenging as the corridor carries more traffic than its available capacity during the summer months. The corridor is also a major barrier for crossing traffic, which is heavy and includes multiple intersecting principal arterials.
    - ***Multimodal:*** the high vehicular and truck volumes, high speeds and challenging design, most notably the porkchop islands and wide intersections, make this corridor a major barrier for pedestrians and bicycles to cross. The delays and safety issues make the corridor challenging for transit to cross.
- The vision for the corridor is a bit less clear, with several nuances requiring further investigation.
    - ***Full-Build:*** most constituents agree that the full-build vision should be a grade separated freeway to alleviate congestion, mitigate crashes related to congestion, and provide a grade separated opportunity for pedestrians and bicycles.
    - ***Timing:*** a grade separated freeway has been identified for several decades with funding being unobtainable. Most, if not all, constituents agreed that improvements are needed in the near term, requiring both a short-term and long-term vision.
    - ***Access:*** property owners along the corridor want a safe and efficient TH 15 to support their businesses, however there is some concern that the access control required to achieve this vision will negatively affect business accessibility.

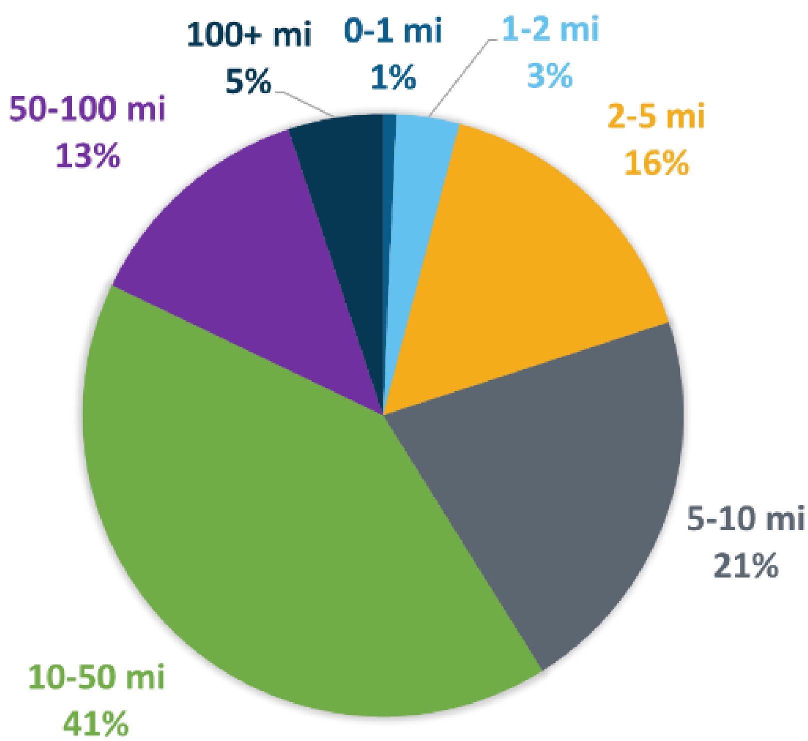
MACRO-LEVEL ANALYSIS

The purpose of this macro-level analysis is to begin evaluating potential roadway improvements to alleviate forecasted operations issues on TH 15 if no changes are made. In this report, analysis is kept at a high level, generally using 2045 daily modeled volumes from the St. Cloud TDM to evaluate impacts from various improvements. The primary goal of this analysis is to identify improvements that look promising at a high-level, and to discard improvements that are expected to provide minimal positive benefits to TH 15 and the greater transportation system.

Regional Traffic Using TH 15

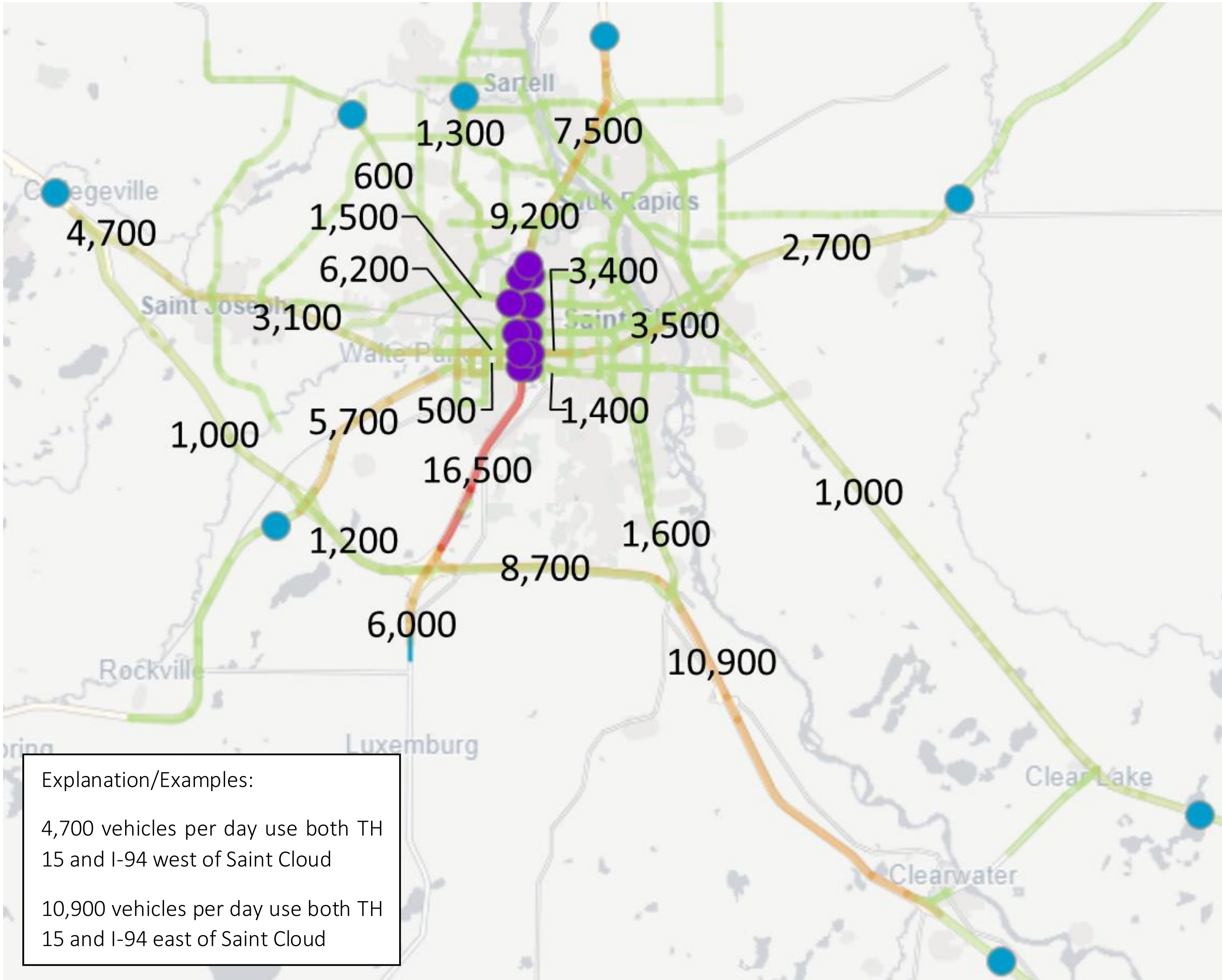
Regional traffic and other longer distance trips make up a large percentage of traffic on TH 15 in the study area. Origin-destination data from StreetLight Data. Streetlight utilizes anonymized location records from smart phones and navigation devices in cars and trucks to analyze regional travel patterns while keeping the anonymity of individual trips. This data shows 41 percent of trips have trip lengths between 10 and 50 miles in length, meaning these trips are originating or destined for locations outside of the Saint Cloud urban area. Another 21 percent of trips have trip lengths between five and ten miles, meaning the corridor is being used for a significant amount of cross-city travel as well.

Figure 59 - Trip Length Distribution on TH 15



StreetLight Data origin-destination data was also evaluated to estimate which corridors are being used before or after using TH 15 within the study area. This data is shown in Figure 60. Based on this analysis, the major regional connections that utilize TH 15 within the study area in descending order include I-94 east of the metro, TH 10 north of the metro, TH 15 south of the metro, TH 23 west of the metro, I-94 west of the metro and TH 23 east of the metro. As these high volumes converge upon TH 15 within the study area, a disproportionate percentage of this traffic ultimately ends up on Division Street compared to 2nd Street, despite both having significant regional connections.

Figure 60 - Origin-Destination Data for TH 15 Study Area Traffic



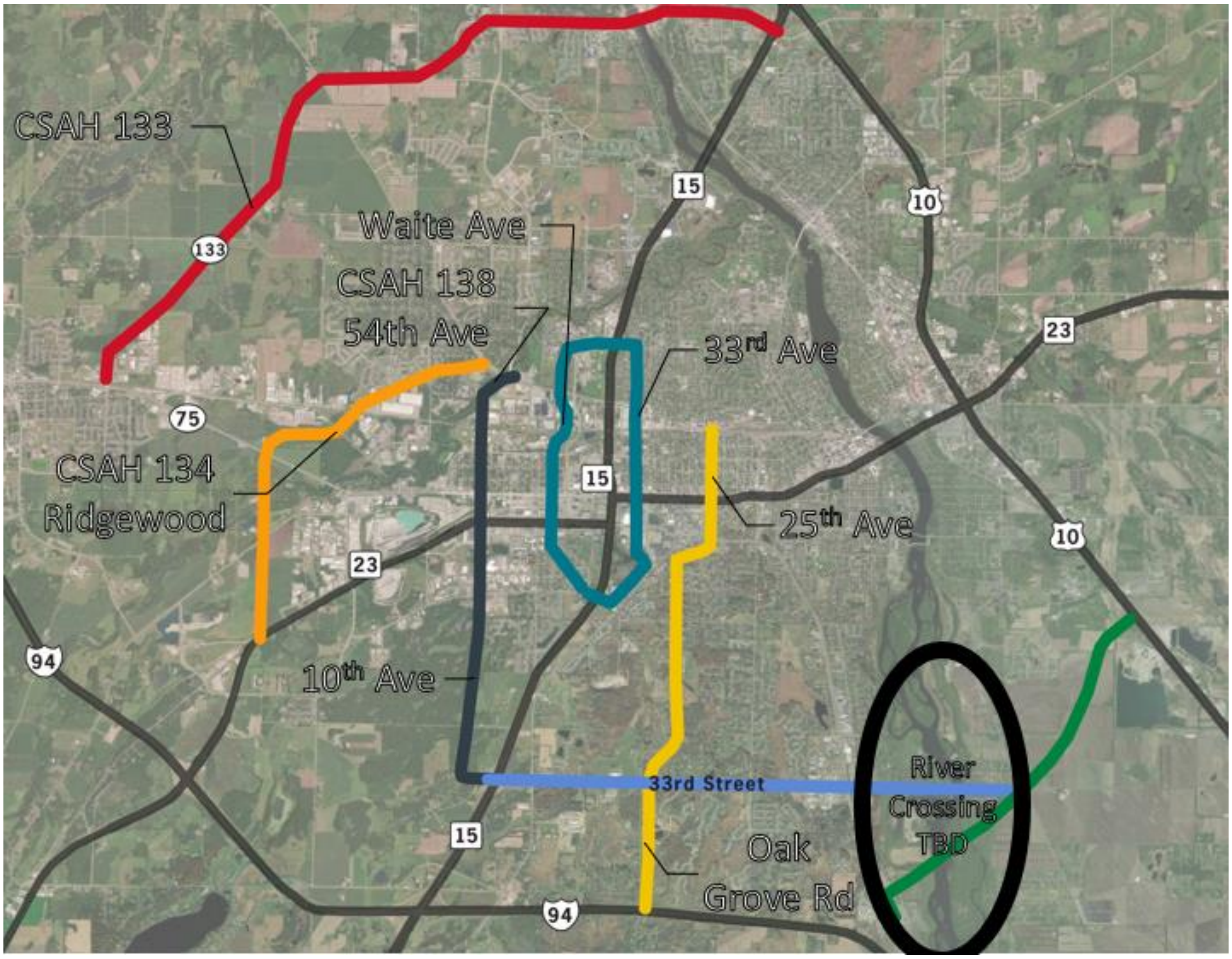
Provisions for Regional Traffic

Potential solutions for alleviating congestion on TH 15 via capacity expansion would be costly and have major impacts. Improvements on routes other than TH 15 can potentially alleviate congestion on TH 15, while accomplishing other regional mobility objections. These types of regional improvements have the potential to reduce overall regional investments by combining multiple needs into one singular project.

After reviewing the future conditions analysis, the project Steering Committee was asked to consider corridors that could be candidates for future projects and select the corridors they believed could provide the most benefit if feasible transportation improvements were made.

The corridors that were shown to the Steering Committee are shown in Figure 61.

Figure 61 - Potential Regional Transportation Improvement Corridors



POTENTIAL IMPROVEMENTS

Based on Steering Committee recommendations, the following improvements were advanced and studied for 2045 conditions using the regional travel demand model.

» 2045 traffic projections assume the following demographic changes in the St. Cloud metropolitan area:

Table 19 - 2015 and 2045 Demographic Assumptions for Travel Demand Modeling

Year	Households	Office Employment	Industrial Employment	Retail Employment
2015	55,464	6,418	16,932	11,338
2045	67,386	9,758	24,784	23,741
% Change	+21%	+52%	+46%	+109%

- Construct 33rd Street River Crossing.
  - Assumes that a four-lane bridge is constructed, connecting to County Road 8 on the east side of the river.
  - A fiscally unconstrained river crossing project is listed in the current MTP. This project is from the Mississippi River to CSAH 7 and has an estimated project cost of $91 million (2017 dollars).
  - See the blue alignment in Figure 61.
- Create a new arterial with access to I-94 along the alignment of the existing Oak Grove Road and 25th Avenue.
  - Assumes a new interchange at Oak Grove Road and I-94.
  - Assumes the Oak Grove Road segment is converted to a three-lane section with a two-way left-turn lane. This assumes existing speed limits on Oak Grove Road are maintained. The existing speed limit on Oak Grove Road is 45 to 50 miles per hour south of Oak Hill Elementary School and 30 miles per hour north of the elementary school.
  - Also assumes that the 25th Avenue segment is increased to 35 miles per hour. This would likely require access management improvements and consideration of enhanced multimodal crossing provisions.
  - No similar projects are listed in the current MTP.
  - See the yellow alignment in Figure 61.

Figure 62 - Potential Access Challenges on 25th Street

- Create a new arterial along the alignment of 10th Avenue in Waite Park.
  - Assumes 10th Avenue is extended to connect to the 33rd Street interchange with TH 15.
  - Assumes a four-lane section between TH 15/33rd Street interchange and 8th Street North.
  - Assumes a 40 miles per hour speed limit between the TH 15/33rd Street interchange and 7th Street South, and a 35 miles per hour speed limit between 7th Street South and 8th Street North. Some access management and multimodal improvements would likely be required to accommodate the 35 miles per hour speed limit (30 miles per hour today) between 7th Street South and 8th Street North.
  - A portion of this concept is in the MTP:
    - Four-lane arterial expansion on 10th Avenue between 3rd Street and Division Street.
      - Long range project (2030-2045) with estimated cost of $7.5 million (2017 dollars).
    - Four-lane arterial reconstruction on 10th Avenue between Division Street and 10th Street.
      - Long range project (2030-2045) with estimated cost of $10.6 million (2017 dollars).
    - See the navy blue alignment in Figure 61.

Figure 63 - Potential Access Challenges on 10th Avenue

» Connect the south end of Waite Avenue to TH 15.

- Assumes a three-lane section with a two-way left-turn lane between TH 15 and 2nd Street/TH 23, and the existing section north of 2nd Street.
  - Four-lane arterial reconstruction on Waite Avenue between 2nd Street and 3rd Street is listed in the MTP as a short term project (2020-2023) with an estimated cost of $3 million.
  - No current plans for extending the south end of Waite Avenue to TH 15.
  - Assumes a 35 miles per hour speed limit throughout the entire corridor, which will likely require access management improvements, especially in the residential area on the south end of the corridor.
  - See the teal alignment west of TH 15 in Figure 61.

Figure 64 - Access Challenges on Waite Avenue

» Ring Road.

- Assumes ring road concept that has long been under consideration in the St. Cloud Area.
- Many pieces of the Ring Road concept were included in the MTP, however over $250 million of projects were not included in the fiscally constrained plan.

» 7th Street Overpass.

- Assumes existing overpass at 7th Street South over TH 15 is converted to an interchange.
- Potential building impacts on the east side of TH 15 to accommodate ramps.

Figure 65 - Buildings Near TH 15 and 7th Street South

In addition to the five options discussed above, two TH 15 improvements were evaluated for 2045 conditions using the travel demand model to compare improvements directly onto TH 15 versus regional mobility strategies. These concepts will be studied in greater detail in the next chapter of the report.

» Expand TH 15 to six lanes.

- Two concepts were evaluated - one that widens TH 15 between I-94 and TH 10, and another that only widens in the study area (just south of 2nd Street to just north of 12th Street).
- Assumes existing speed limits and at-grade intersections remain as they are today
- A TH 15 pavement project is listed in the current MnDOT Capital Highway Improvement Plan between Stearns CSAH 47 and Benton CSAH 33 to be constructed between 2025 and 2030, with an estimated cost between $10.6 and $14.4 million.

» Convert TH 15 to an access-controlled freeway in the study area.

- Two concepts were evaluated - one that maintains four lanes, and another that widens to six lanes in the study area (just south of 2nd Street to just north of 12th Street).
- Assumes a 55 miles per hour speed limit for the entire segment.
- Assumes all at-grade intersections are removed, with interchanges at 2nd Street, 3rd Street, and 12th Street. All other existing intersections would be converted to overpasses without access to TH 15.

Figure 66 - 2045 Travel Demand Model Results: 33rd Street River Crossing

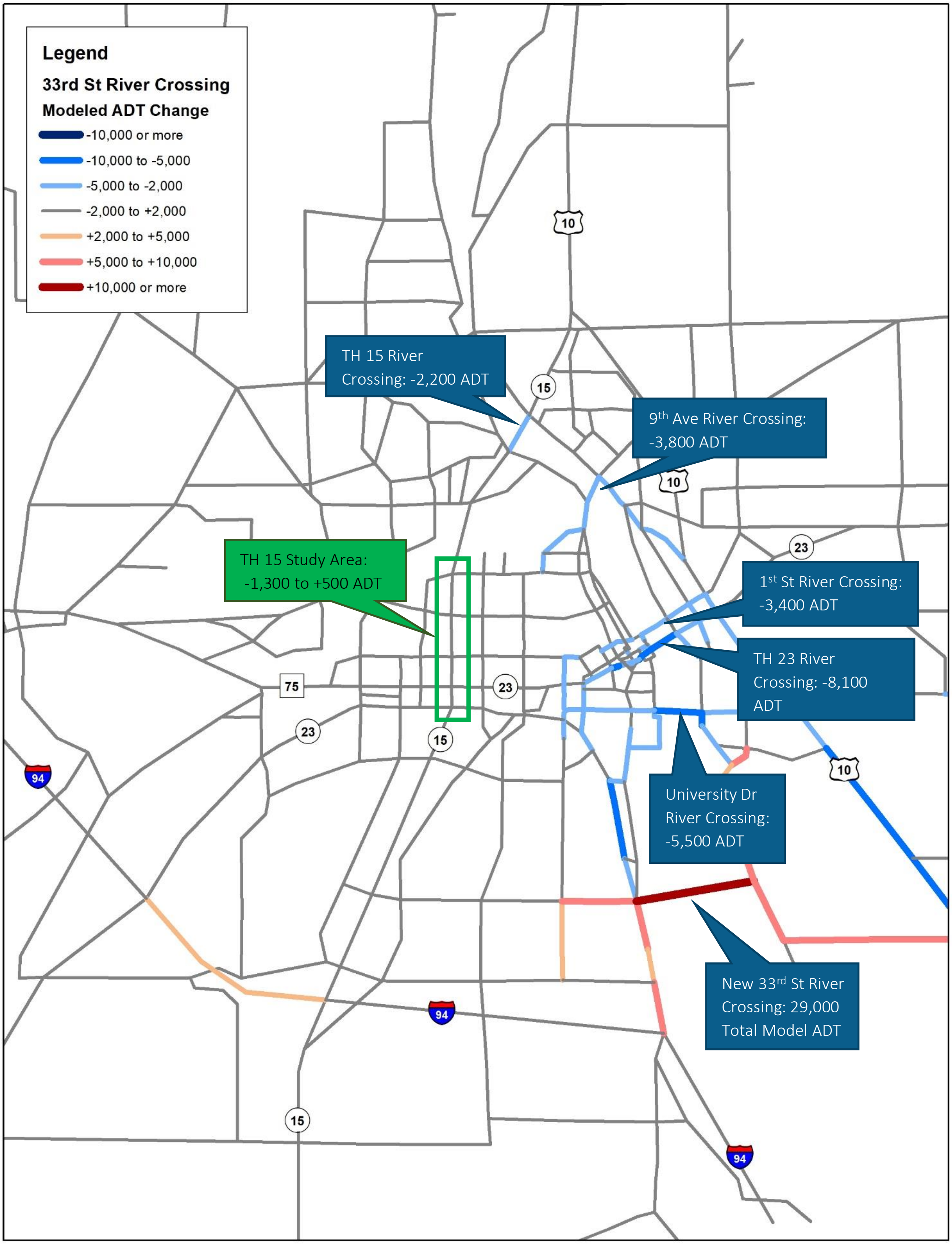


Figure 67 - 2045 Travel Demand Model Results: 25th Avenue/Oak Grove Road Corridor Improvements

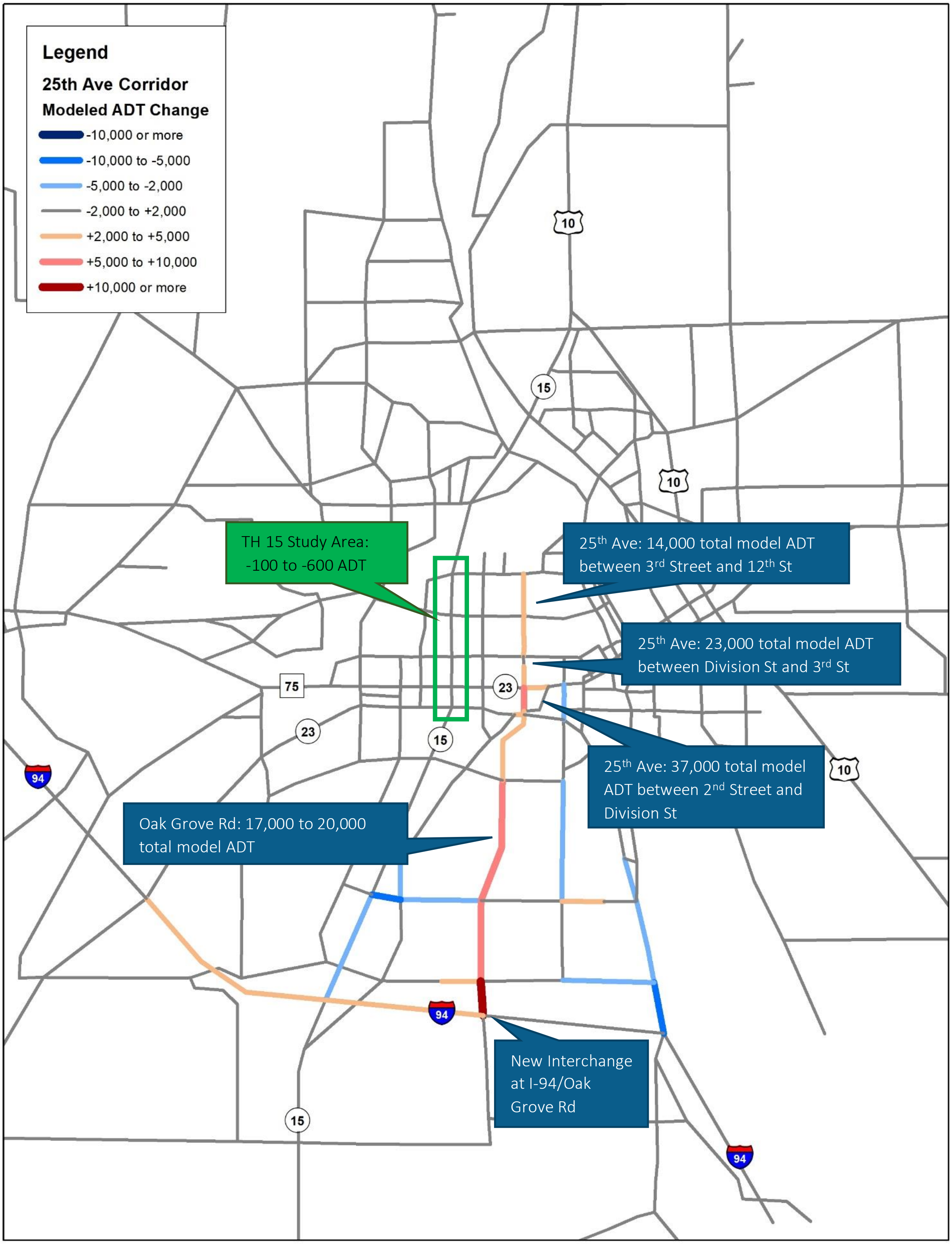


Figure 68 - 2045 Travel Demand Model Results: 10th Avenue Corridor Extension

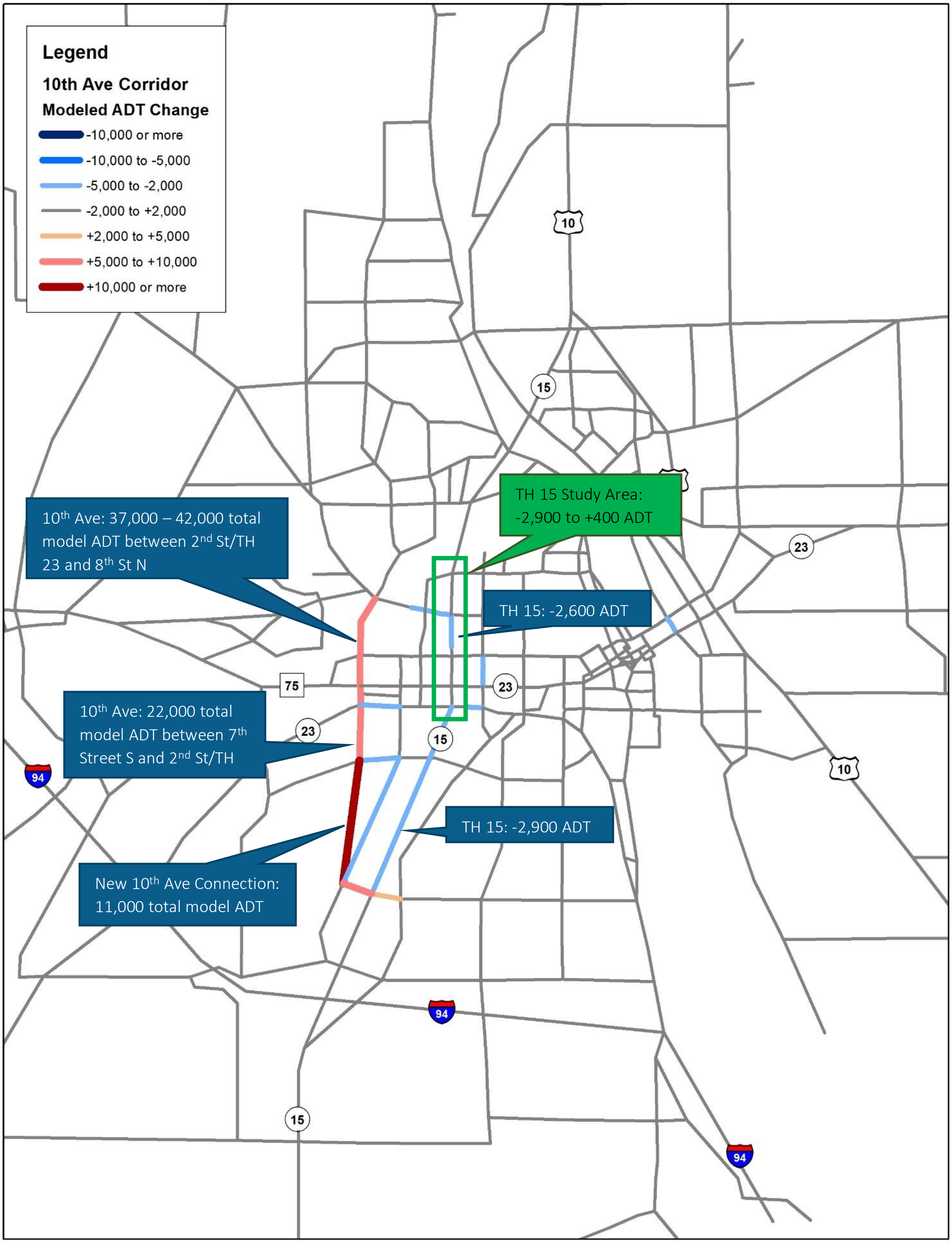


Figure 69 - 2045 Travel Demand Model Results: Waite Avenue Extension

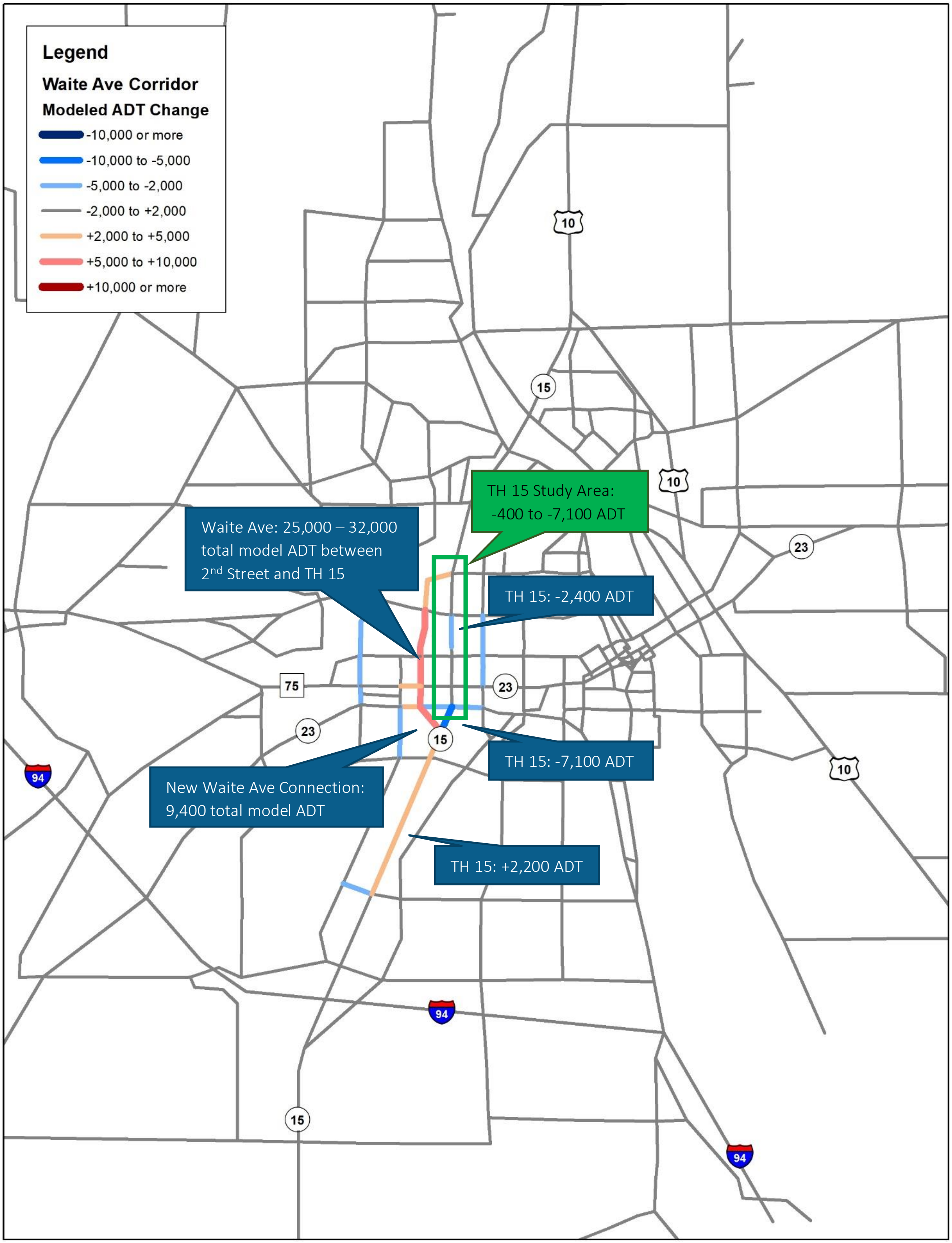


Figure 70 - 2045 Travel Demand Model Results: Ring Road

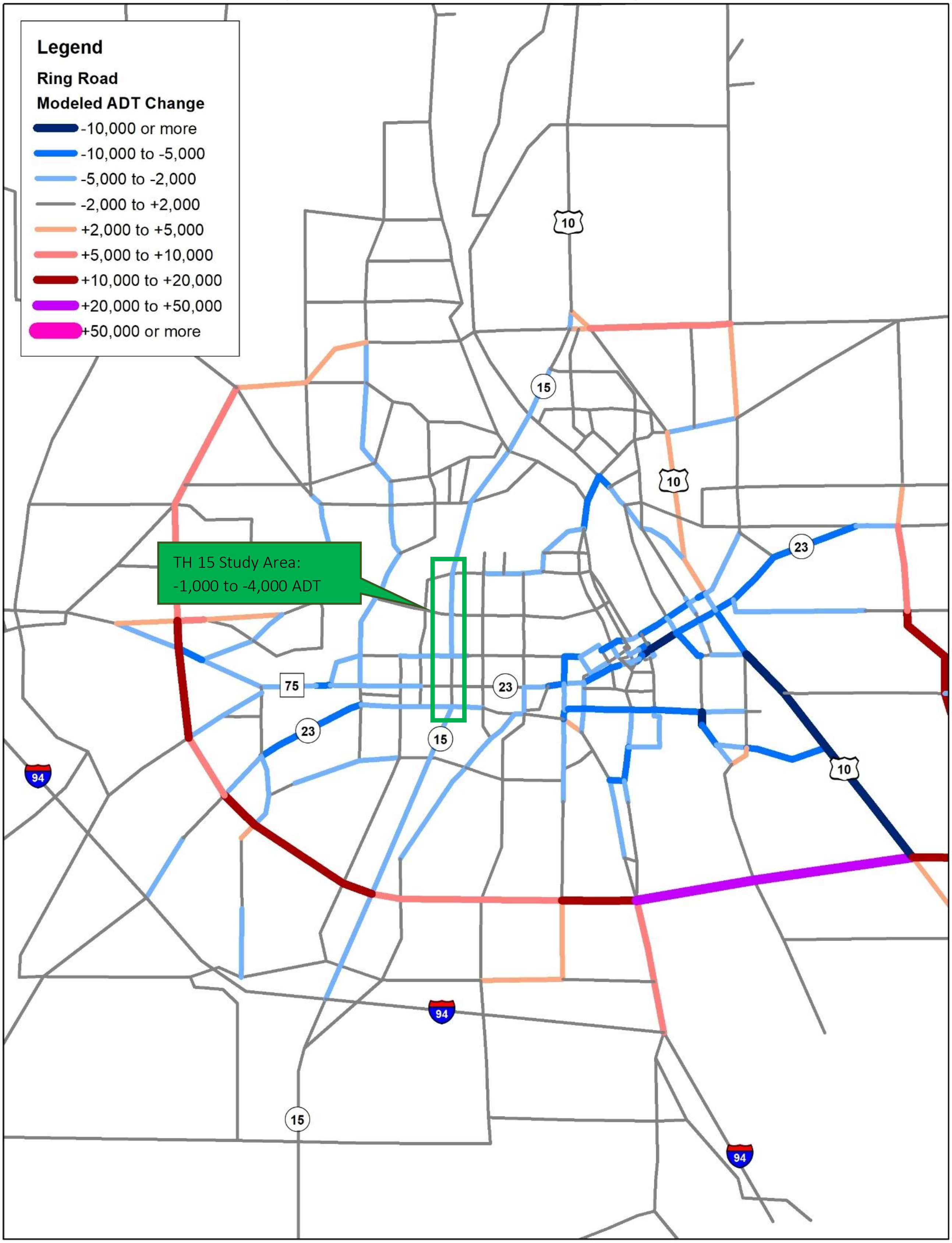


Figure 71 - 2045 Travel Demand Model Results: 7th Street Interchange

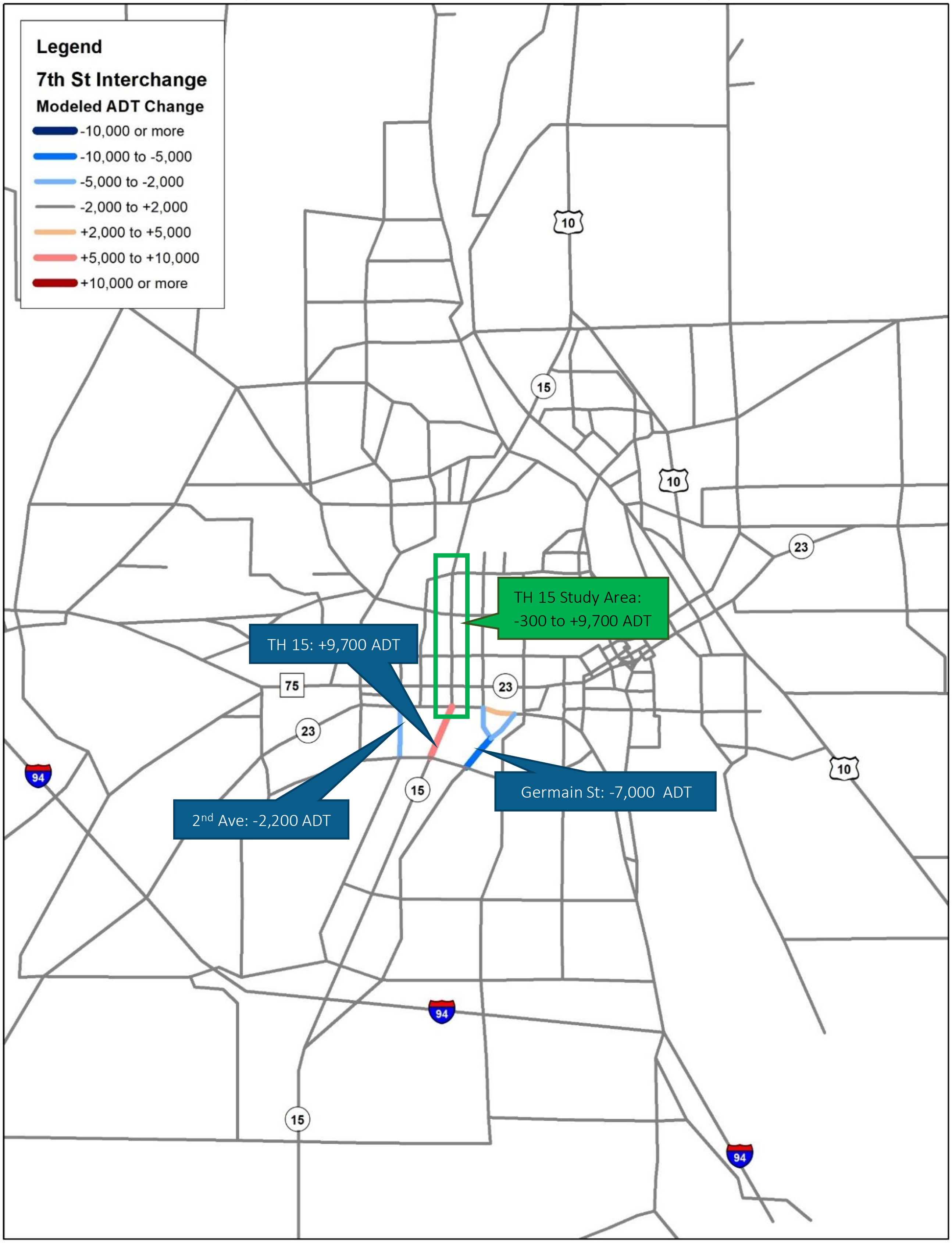


Figure 72 - 2045 Travel Demand Model Results: 6-Lane Expansion on TH 15 from I-94 to TH 10 (At-Grade Intersections)

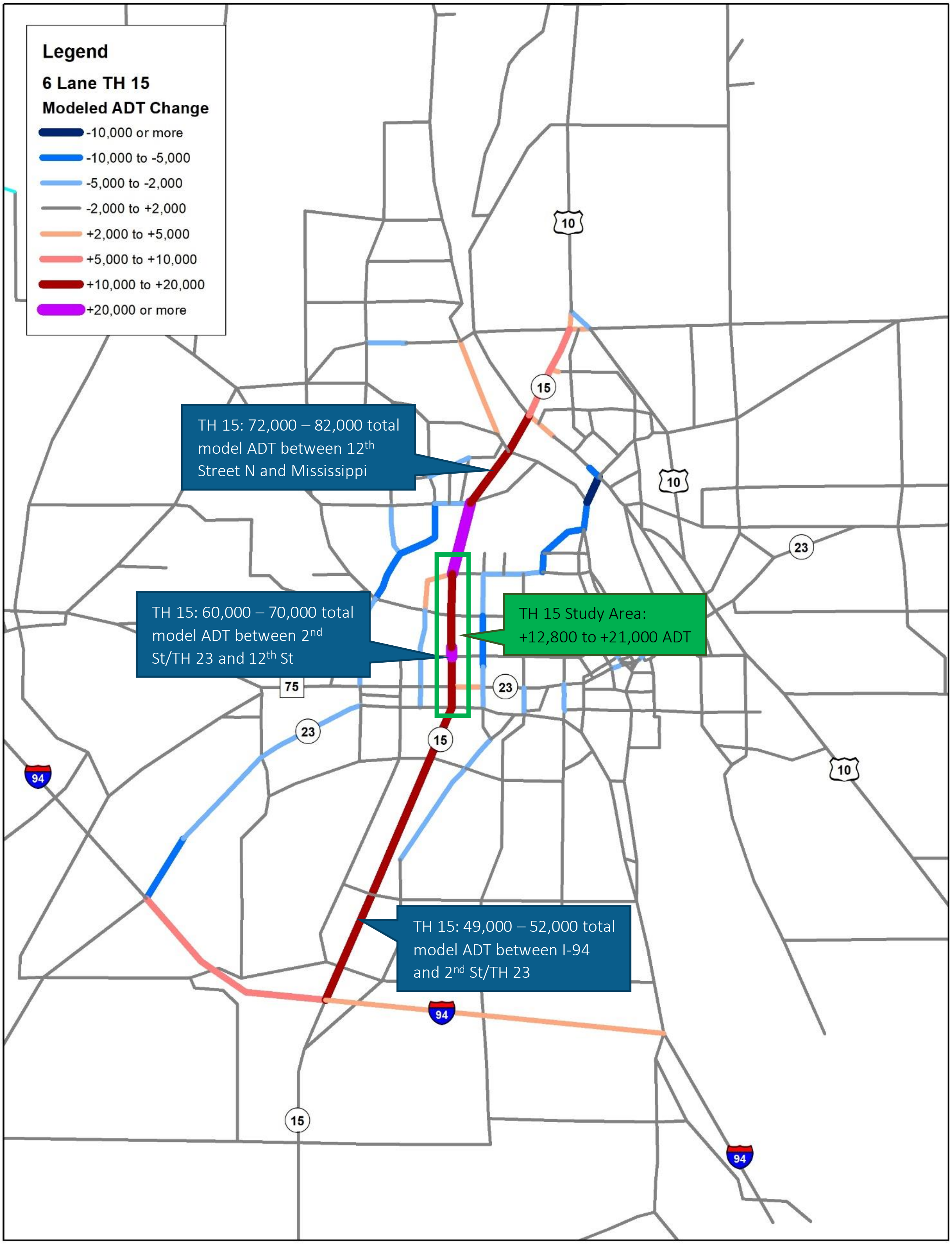


Figure 73 - 2045 Travel Demand Model Results: 6-Lane Expansion on TH 15 in Study Area (At-Grade Intersections)

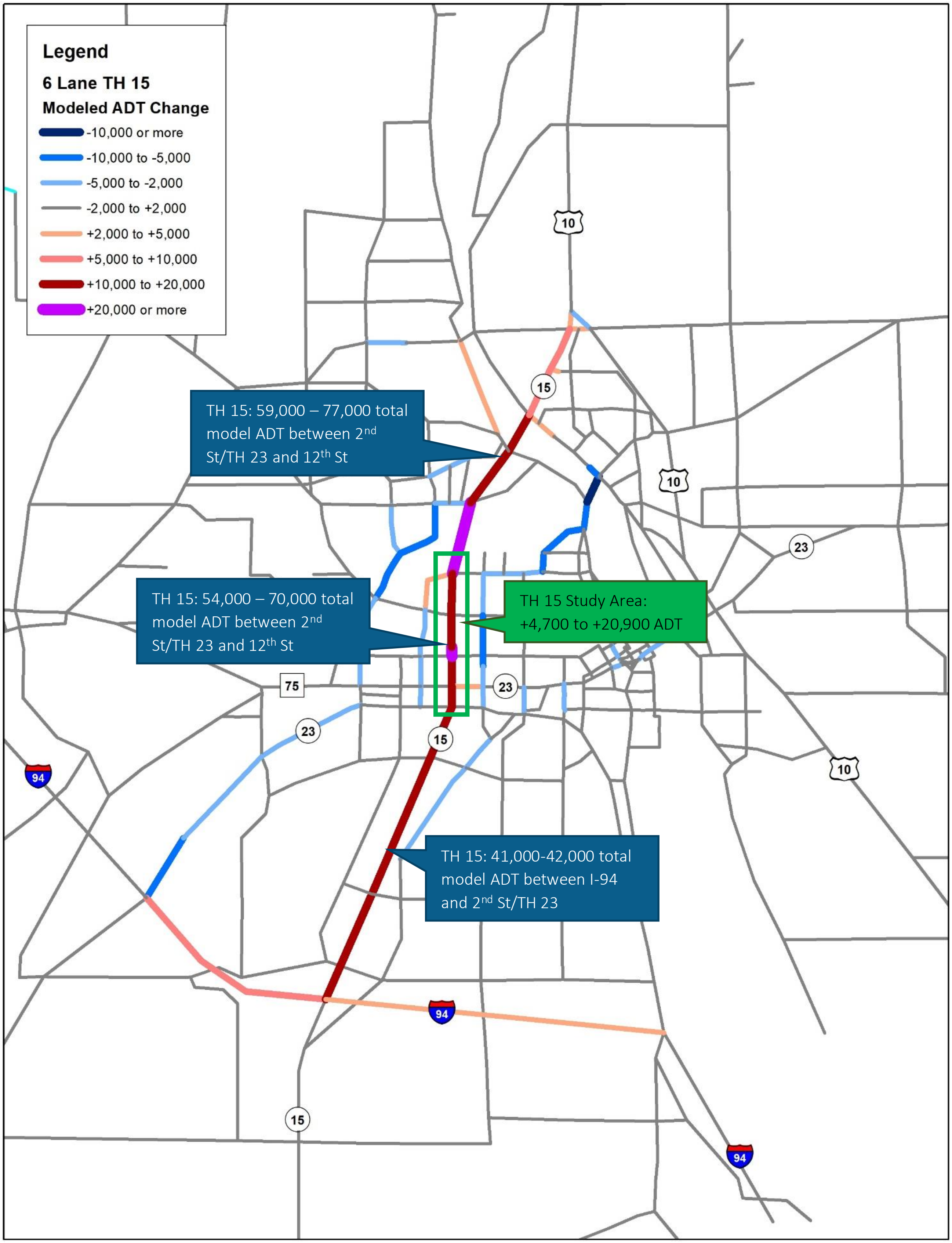


Figure 74 - 2045 Travel Demand Model Results: 4-Lane Freeway on TH 15 from 2nd Street to 12th Street (Grade Separated I-94 to River)

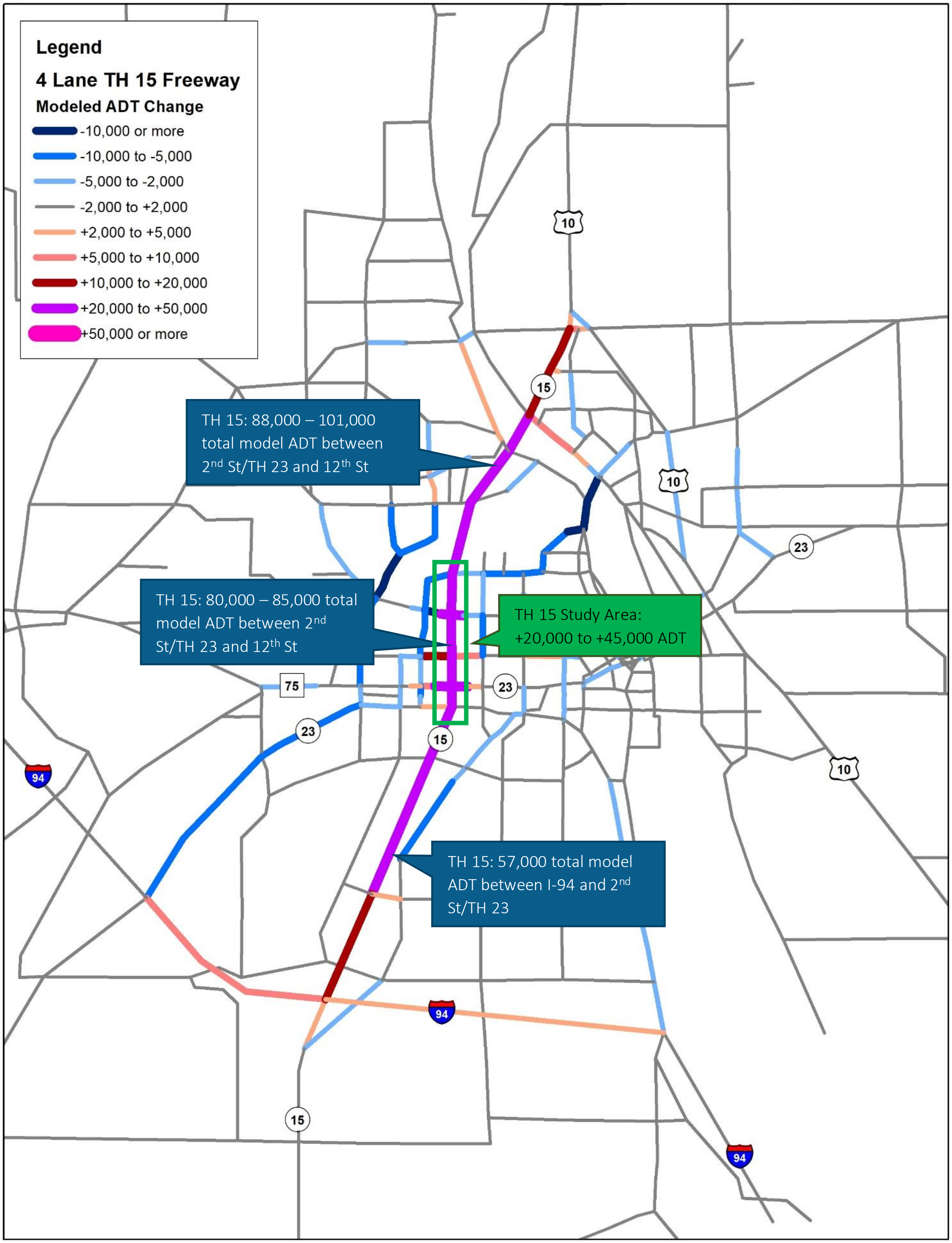
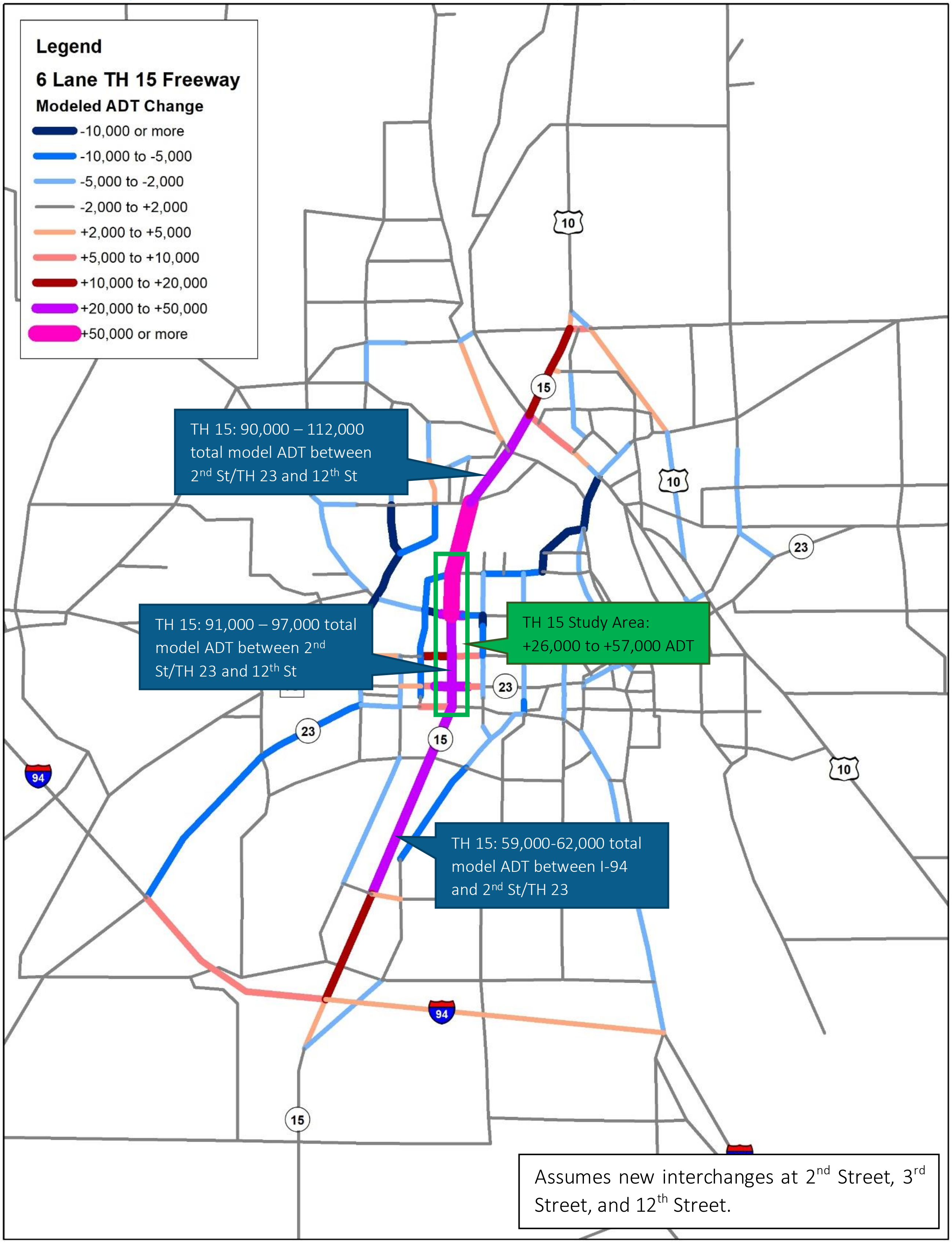


Figure 75 - 2045 Travel Demand Model Results: 6-Lane Freeway on TH 15 from 2nd Street to 12th Street



Travel Demand Modeling Notes

The travel demand model results presented in this macro-level analysis are not adjusted based on discrepancies between base-year modeled volumes and field-collected traffic counts as they were in the future conditions section. This decision was made since new roadway connections can have major impacts on regional traffic routing, therefore discrepancies between modeled volumes and field-collected volumes are expected.

This analysis is intended to identify options to be studied in greater detail, therefore results presented here should be interpreted as order-of-magnitude changes associated with various transportation system improvements results rather than volume inputs into detailed operations analysis for design decisions.

Travel demand model results for the seven transportation system improvement options are shown in Figure 66 through Figure 75.

MACRO LEVEL ALTERNATIVES ANALYSIS SUMMARY

The only alternatives that have significant impacts to TH 15 are the concepts with improvements to TH 15 itself.

- Six-lane expansion with at-grade intersections.
  - If expanded between I-94 and TH 10, this improvement is expected to add 13,000 to 21,000 vehicles per day to TH 15 compared to the 2045 baseline conditions, with the highest traffic increases being between Division Street and 8th Street. If only widened in the study area, traffic volumes are expected to increase by 5,000 to 21,000 vehicles per day.
  - This concept illustrates the latent potential of traffic demand on TH 15 in the future. Currently, the no-build travel demand model is diverting traffic to less congested corridors. By adding capacity, there are major regional benefits, however, the corridor will ultimately operate in a similar fashion as current conditions given the increased traffic volumes.
- Freeway concepts with grade separated intersections and interchanges at 2nd Street, 3rd Street, and 12th Street.
  - A freeway design would add between 26,000 and 57,000 ADT to TH 15 by 2045 if the study area is expanded to six lanes. If kept at four lanes, major changes are still expected, adding 20,000 to 45,000 ADT. Both a four-lane and a six-lane freeway concept have total modeled volumes over 100,000 ADT.
  - Like the widening concept, the grade separated concept induced a significant amount of latent demand, more than doubling traffic volumes when compared to existing ADTs in some areas. The travel demand model is not designed to create new trips so these trips are choosing TH 15 because it is a benefit to them, meaning despite the major increase in volumes, the overall regional benefit is substantial but will likely result in TH 15 still operating poorly in the future.

There are three alternatives with noteworthy impacts to TH 15, albeit much less significant than the two TH 15 corridor expansion options.

- Create a new arterial along the alignment of 10th Avenue in Waite Park.
  - This is expected to remove around 3,000 ADT from TH 15 by 2045, while also adding a new connection to the northwest part of the urban area. This improvement alone would not mitigate expected congestion on TH 15 but could potentially mitigate the scale of impacts associated with TH 15 improvements.
  - StreetLight Data origin-destination analysis suggests less impact to TH 15, with origin-destination patterns indicating fewer than 1,000 vehicles per day would be removed from TH 15 under existing traffic conditions.

- Connect the south end of Waite Avenue to TH 15.
  - This is expected to remove between 2,500 and 7,000 ADT from some of the more congested segments of the corridor by 2045, offering some traffic relief, especially just south of 2nd Street where the largest traffic reduction is expected. Around 2,000 ADT is expected to be added to TH 15 south of the new Waite Avenue connection.
  - StreetLight Data suggests less impact to TH 15, with origin-destination patterns indicating fewer than 1,000 vehicles per day would be removed from TH 15 under existing traffic conditions.
- Ring Road.
  - The ring road is expected to introduce major regional traffic pattern changes, most notably the river crossing becoming a major regional connection. Modeling shows the full ring road removing up to 4,000 ADT from TH 15 by 2045, however the added travel distance on the ring road compared to TH 15 limits additional benefits to TH 15 traffic.

While having some impact to areawide traffic patterns, the remaining two alternatives with improvements away from TH 15 offer little traffic relief to TH 15 itself.

- Construct 33rd Street River Crossing.
  - This alternative does draw considerable traffic to the river crossing, especially traffic currently utilizing downtown river crossings, however the north-south connectivity that TH 15 provides results in little benefits from an east-west river crossing.
  - It is important to note that travel demand model analysis does not factor in summer recreational peak traffic. StreetLight data origin-destination analysis reveals that a new river crossing could have major impacts to summer recreation traffic, removing up to 20,000 vehicles per day from TH 15 during these elevated traffic times. Under typical traffic conditions, StreetLight data suggests similar results to the travel demand model, removing 1,000 to 2,000 vehicles per day from TH 15 under existing traffic volumes. The feasibility and impacts of a 33rd Street River crossing are to be evaluated as part of an upcoming study in 2020/2021.
- Create a new arterial with access to I-94 along the alignment of the existing Oak Grove Road and 25th Avenue.
  - This alternative would draw traffic from other parallel north-south roadways, but the lack of connectivity north of 12th Street minimizes the overall traffic reduction to TH 15 according to the travel demand model.
  - StreetLight Data suggests similar impacts, removing 500 to 1,000 vehicles per day from TH 15 under existing traffic volumes.
- 7th Street Interchange.
  - The 7th Street interchange concept is expected to add traffic to TH 15 between 7th Street and 2nd Street, with impacts being minimal elsewhere.
  - Travel demand modeling shows an **increase** in daily VMT and VHT.

Table 20 - Macro Level Alternatives Analysis Summary

Scenario	2020: Impact to TH 15 (ADT Difference)[1]	2045: Impact to TH 15 (ADT Difference)[2]	% VMT Change	% VHT Change	Change in Miles at Deficient LOS[3]	Annual VMT + VHT Cost Savings[4]	Planning Level Project Cost Estimates
Baseline	-	-	-	-	-	-	-
33rd St River Crossing	-2,000 to -1,000	-1,300 to +500	-0.2%	-3.1%	-3	$33.2 M	$91 M
25th Ave Corridor	-1,000 to -500	-600 to -100	0.0%	-0.5%	-2	$4.9 M	$18 – $22 M
10th Ave Corridor	-1,000 to -500	-2,900 to +400	-0.1%	-0.4%	0	$4.3 M	$8 - $10 M
Waite Ave Corridor	-1,000 to -500	-400 to -7,100	0.1%	-.01%	-2	$644 K	$2 - $4 M
Ring Road	N/A	-1,000 to -4,000	0.4%	-7.0%	1	$71.5 M	$250 - $500 M
7th St Interchange	N/A	-300 to +9,700	0.1%	0.3%	0	-$3.7 M	$10 - $20 M
TH 15 to 6 Lanes	N/A	+12,800 to +21,000	0.5%	-2.6%	-3	$25.4 M	$35 - $45 M*
4-Lane Freeway	N/A	+20,000 to +45,000	1.1%	-4.1%	-5	$37.6 M	$80 - $90 M
6-Lane Freeway	N/A	+26,000 to +57,000	1.5%	-4.9%	-8	$44.1 M	$130 - $170 M*

[1]Based on StreetLight origin-destination data during typical traffic days.
[2]Based on 2045 TDM results – assumes fiscally constrained MTP projects are completed.
[3]Centerline miles.
[4]Using MnDOT benefit-cost analysis assumptions with 2045 traffic conditions.
*Assumes existing bridges on TH 15 are maintained with 11' lanes.

Most, if not all the regional concepts provide significant regional benefits that would achieve long-term benefit-cost ratios to justify their construction. Excluding the Waite Avenue corridor and 7th Street interchange concepts, each concept provided an annual benefit of more than $4 million dollars to the region, with the River Crossing and Ring Road concepts providing $33 million and $71 million dollars' worth of annual 2045 benefits, respectively. However, the goal of this study is not to identify concepts with overall regional benefits. The goal is to identify regionally valuable concepts that also mitigate deficiencies on TH 15. From that lens, no concept relocated more than a few thousand vehicles from TH 15, providing minimal benefits to the corridor.

The contrast between traffic volume changes when improvements were off TH 15 when compared to improvements directly to TH 15 were dramatic. This indicates there is substantial latent travel demand for the corridor, that is traffic that would prefer to use TH 15 if operations were acceptable. Ultimately, it seems likely that localized improvements will be necessary to resolve deficiencies on TH 15 with regional improvements to minimize latent demand impacts.

ALTERNATIVES ANALYSIS

Throughout the technical analysis and the community engagement, the issues on TH 15 became clear: safety, traffic efficiency, and better multimodal facilities are necessary. How to address these issues, however, is less clear.

This alternatives analysis report considered improvements that will directly respond to the major issues on the corridor. This alternatives analysis will consider and evaluate three types of alternatives.

- Short-term improvements are those that can be implemented within the next five years and will likely fit in existing budgets but fail to resolve long-term capacity and vehicular safety issues. Three short-term improvements were considered.
- At-grade improvements are those that could be implemented within the next five to 15 years and will resolve most of the expected operational and vehicular safety issues along the corridor. These improvements will likely require funds to be programmed at the City, County, and State level. Three at-grade improvements were considered.
- Freeway improvements are those that will require considerable efforts for implementation that would resolve all, or nearly all, of the operational and vehicular safety issues. They likely would occur after 15 years or more and likely require grant funds to complete. Two freeway improvements were considered.

EVALUATION APPROACH

The evaluation approach combined the technical analysis with the community's priorities to ensure the alternatives that are prioritized for implementation best reflect the community the corridor is meant to serve.

Value Profiles

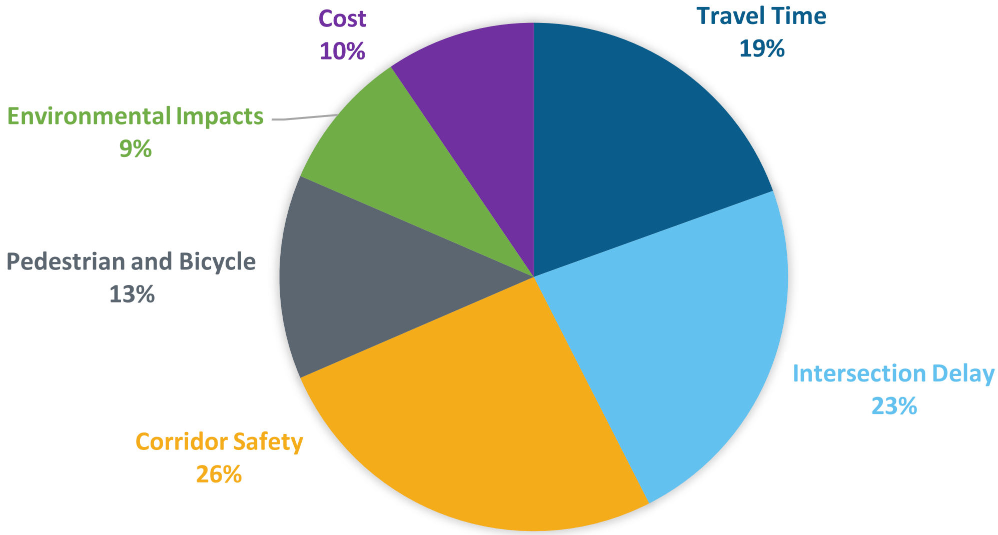
The value profile helps understand the community's priorities when developing and evaluating the alternatives. The study's Steering Committee and the public were asked to assign a value between 1 and 100 to each of the following categories:

- Travel time reliability: the ability to travel the corridor from 2nd Street S to 12th Street N, efficiently and reliably.
- Intersection delays: the ability to cross and access the corridor without significant delays.
- Corridor safety: the ability to reduce crash potential by reducing vehicle queue lengths and turning conflicts.
- Pedestrian and bicycle accommodations: the ability to cross the corridor safely and efficiently by walking or biking.
- Environment impacts: the desire to minimize impacts to adjacent properties and other environmental factors.
- Costs: the desire to keep project costs low.

A value profile was created for TH 15 by equally aggregating the Steering Committee and public feedback. The Steering Committee members represent St. Cloud, Stearns County, the St. Cloud Area Planning Organization, St. Cloud Metro Bus, and MnDOT.

Figure 49 shows the aggregated value profile for TH 15. Generally, corridor safety was the highest priority, followed closely by intersection delays. The lowest values were applied to pedestrian and bicycle accommodations, environmental impacts, and costs. These values were applied to the technical results as a weight to reflect the stated priorities.

Figure 76 - TH 15 Value Profile



Technical Criteria

Each alternative was evaluated on a set of technical criteria, which follows the value profile criteria. The focus of the technical evaluation was to compare the alternatives to one another, so the scoring criteria is relative, instead of absolute. The short-term alternatives were compared to the other short-term alternatives, while the at-grade and freeway concepts were compared to each other. Each criteria and their considerations are discussed below.

Traffic Flow

Traffic flow is the ability to travel along the corridor efficiently and reliably. This criterion includes both travel time and reliability. The longest travel time received a score of one and the quickest travel time received a score of 10. A penalty of one point was applied to any alternative with a level of travel time reliability (LOTTR) above 1.5.

This criterion is 19 percent of an alternative's total score based on the value profile established by the Steering Committee and public.

Intersection Delays

Intersection delays impact the ability to cross or access the corridor from the side streets without significant delay. This criterion considers network delay, which incorporates the level of service and delay at the study intersections.

The highest network delay per vehicle received a score of one and the lowest network delay per vehicle a score of 10. A penalty of one point was applied to any alternative with a latent demand (the amount of traffic unable to enter the traffic stream) greater than five percent. Additionally, alternatives that reduced access to TH 15 were penalized one point because they create new demand and delays at alternative intersections.

This criterion is 23 percent of an alternative's total score based on the value profile established by the Steering Committee and public.

Corridor Safety

Corridor safety is the ability to reduce crash potential by reducing vehicle queue lengths and conflict points. This criterion used the surrogate safety assessment model results to estimate the conflict potential of the alternative. Angle conflicts were assigned a weight of two, with rear end and sideswipe conflicts unweighted. This was done due to the higher severity rate of angle crashes compared to other crash types. The highest number of weighted conflict points received a score of one and the lowest a score of 10.

This criterion is 26 percent of an alternative's total score based on the value profile established by the Steering Committee and public.

Pedestrian and Bicycle Accommodations

Pedestrian and bicycle accommodations is the ability to cross the corridor safely and efficiently by walking or biking. This criterion considers a pedestrian and bicycle risk factor, which is the product of the number of uncontrolled crossings (channelized rights or permitted left-turns), the average daily speed on TH 15, and the length (in feet). This methodology incorporates the highest risk movements in high-speed uncontrolled movements, penalizing alternatives with the highest pedestrian exposure and crash severity rates. The existing conditions calculation is shown as an example below:

$$20\ uncontrolled\ crossings\ x\ 42.4\ mph\ x\ 120\ feet = 101{,}856$$

The highest risk factor received a score of one and the lowest a score of 10.

This criterion is 13 percent of an alternative's total score based on the value profile established by the Steering Committee and public.

Environmental Impacts

Environmental impacts is the desire to minimize impacts to adjacent properties and other environmental factors. Unlike the other criteria, the environmental impacts is highly qualitative, to consider direct and indirect impacts to the environment, socioeconomic impacts, business impacts, and impacts to cultural, recreational, and historical resources. Mitigation approaches were considered extensive if they were in excess of what would typically be required for projects of similar scope, which could include threatened and endangered species impacts or large impacts where mitigation would become cost prohibitive (extensive right-of-way acquisition). Also considered under this attribute are drainage and hydraulic issues. Environmental impact scores are shown in Table 21.

This criterion is nine percent of an alternative's total score based on the value profile established by the Steering Committee and public.

Table 21 - Environmental Impact Scoring

Rating	Label	Description
0	Unacceptable	Impacts are severe, and the project does not comply with state and/or federal environmental laws
2	Poor	Project introduces environmental impacts that are both significant in number and require extensive mitigation
4	Fair	Project introduces new environmental impacts that will require extensive mitigation
6	Good	Project introduces new environmental impacts that can be addressed through standard and accepted mitigation approaches
8	Very Good	Project introduces no new environmental impacts
10	Excellent	Project improves upon the existing environmental conditions while introducing no new environmental impacts

Costs

Given funding limitations, keeping project costs low is a consideration. This criterion considers planning level costs. The highest cost received a score of one and the lowest cost received a score of 10.

This criterion is 10 percent of an alternative's total score based on the value profile established by the Steering Committee and public.

Summary of Evaluation

Each alternative was compared on a set of weighted criteria, as discussed above, and summed to provide an alternative's weighted final score. The final score is rounded to the nearest whole number.

In this example, the alternative receives a final score of three, following the math shown in the equation below. An example scoring table is shown in Table 22.

$$\begin{aligned} &Weighted\ Final\ Score \\ &\quad = (Travel\ Time\ Score\ x\ 19\%) + (Intersection\ Delay\ Score\ x\ 23\%) + (Corridor\ Safety\ Score\ x\ 26\%) \\ &\quad + (Pedestrian\ and\ Bicycle\ Score\ x\ 13\%) + (Environmental\ Impacts\ Score\ x\ 9\%) + (Cost\ Score\ x\ 10\%) \end{aligned}$$

$$2.71 = (1\ x\ 19\%) + (1\ x\ 23\%) + (1\ x\ 26\%) + (1\ x\ 13\%) + (10\ x\ 9\%) + (10\ x\ 10\%)$$

Table 22 - Example Scoring Summary Table

Alternative	Criterion	Criterion Score	Criterion Weight	Weighted Final Score
Example	Travel Time	●○○○○○○○○○	19	●●●○○○○○○○
	Intersection Delays	●○○○○○○○○○	23	
	Corridor Safety	●○○○○○○○○○	26	
	Pedestrian and Bicycle Amenities	●○○○○○○○○○	13	
	Environmental Impacts	●●●●●●●●●●	9	
	Cost	●●●●●●●●●●	10	

Alternatives Development and Assessment

Short-Term Improvements

Short-term improvements are those that can be implemented within the next five years and will likely fit in existing budgets. Three alternatives were considered for the short-term: spot improvements, adaptive signal control, and noise walls. Unlike the at-grade and freeway improvement categories, these alternatives can build upon each other.

Each of the short-term improvement alternatives were evaluated using 2030 traffic volumes, unless otherwise noted. These alternatives were not compared to at-grade and freeway concepts discussed later in this report, so readers should not compare the scores between the two groups of concepts.

No Build

Description

Under the No Build, there would be no changes to the existing TH 15 corridor. The corridor would remain a four-lane arterial roadway with signals at the existing intersections.

Results

By 2030, under the No Build condition, the average daily travel time is 4.0 minutes with 1.1 minutes of network delay. The conflict potential will continue to increase as delays and congestion worsen. There would be no pedestrian and bicycle amenity improvements. There would also be no environmental impacts or costs associated with the existing conditions. Table 23 shows the scoring summary for the No Build alternative for 2030.

Table 23 - No Build Scoring Summary (2030)

Alternative	Criterion	Criterion Score	Criterion Weight	Notes	Weighted Final Score
2030 No Build	Travel Time	●○○○○○○○○○	19	4.0 minutes.	●●●○○○○○○○
	Intersection Delays	●○○○○○○○○○	23	1.1 minutes of delay.	
	Corridor Safety	●●●●○○○○○○	26	No changes to current conditions.	
	Pedestrian and Bicycle Amenities	●○○○○○○○○○	13	No changes to current conditions.	
	Environmental Impacts	●●●●●●●●○○	9	No changes to current conditions.	
	Cost	●●●●●●●●●●	10	No cost.	

Alternative (A) Spot Improvements

DESCRIPTION

Alternative (A) Spot Improvements would incorporate operational improvements and pedestrian crossing enhancements:

- Dual left-turn lanes would be added on the westbound approach at 2nd Street, eastbound and westbound approaches at 3rd Street, eastbound and westbound approaches at 8th Street, and eastbound and westbound approaches at 12th Street.
- Pedestrian crossing enhancements would be made at each study intersection.
    - Removing permitted left-turn phases, which has been shown to reduce vehicle-pedestrian crashes by 28 percent.
    - Adding push-button actuated no right-turn on red, which has been shown to reduce vehicle-pedestrian crashes by 60 percent.
    - Signalizing the channelized right-turn lanes.
    - Including a lead pedestrian interval, which has been shown to reduce vehicle-pedestrian crashes by 60 percent. Lead pedestrian interval gives pedestrians a three to seven second head start to enter the intersection while all vehicles have a red signal indication, as shown in Figure 77.

Figure 77 - Lead Pedestrian Interval Example

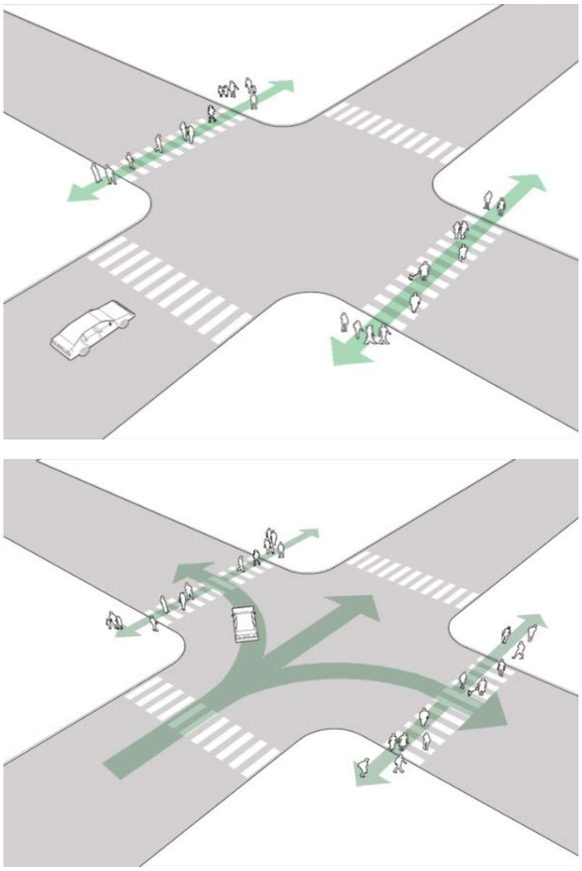


Figure 78 shows Alternative (A) Spot Improvements with the dual left-turn lane locations shown with blue arrows and the pedestrian improvement locations in the white circle.

Dual left-Turn Lane Intersection Priorities

Without any identified funding, the short-term improvements may need to be done piecemeal across multiple years. To identify which locations would most benefit from dual left-turn lanes being implemented, daily delay improvements were compared to prioritize locations with an immediate benefit along the corridor. Table 24 shows that implementing minor dual left-turn lanes provide the most benefit at 3rd Street and 12th Street by reducing total intersection delay by 117 hours and six hours respectively.

The secondary benefit of dual left-turn lanes is that they typically operate better with protected-only signal operations, which also supports bicycle and pedestrian crossing safety. The only intersection where permitted signal phasing occurs is at 3rd Street, where the dual left-turn lanes are most beneficial, making this an ideal opportunity for operations and safety. The other turn lane locations could be added or omitted, as necessary. This will be discussed further in the next chapter of this report.

Table 24 - Dual Left-Turn Lane Priority Locations

Intersection Daily Delay		No Builld	Dual Left-Turn Lanes
2nd Street (Dual WBL only)	Daily Delay	26	25
	Difference		-3%
3rd Street (Dual EBL / WBL)	Daily Delay	193	76
	Difference		-61%
8th Street (Dual EBL / WBL)	Daily Delay	92	91
	Difference		-1%
12th Street (Dual EBL / WBL)	Daily Delay	106	100
	Daily Delay		-6%

RESULTS

Alternative (A) Spot Improvements results in minimal changes to travel time and delays when compared to the No Build alternative. This alternative provides substantial improvements to the pedestrian and bicycle crossings by eliminating the highest risk crossing types (permitted lefts, channelized rights) and improving the signal timing. The pedestrian crossing enhancements and dual left-turn lanes also reduce vehicular conflict potential around two percent. There are minimal environmental impacts due to minor roadway widening to fit dual left-turn lanes. Alternative (A) Spot Improvements comes with an estimated $2.5 million in construction costs. Table 25 shows the scoring summary for Alternative (A).

Table 25 - Alternative (A) Spot Improvements Scoring Summary

Alternative	Criterion	Criterion Score	Criterion Weight	Notes	Weighted Final Score
(A) Spot Improvements	Travel Time	●●○○○○○○○○	19	Minimal changes to travel time.	●●●●●○○○○○
	Intersection Delays	●○○○○○○○○○	23	Minimal changes to daily delay.	
	Corridor Safety	●●●●●●●●●●	26	Minimal change in conflict potential (-2%).	
	Pedestrian and Bicycle Amenities	●●●●●●●●●●	13	Pedestrian/bicycle risks reduced by 95%.	
	Environmental Impacts	●●●●●●●○○○	9	Minimal environmental impacts.	
	Cost	●○○○○○○○○○	10	$2.5 M to construct.	

Figure 78 - Alternative (A) Spot Improvement Locations

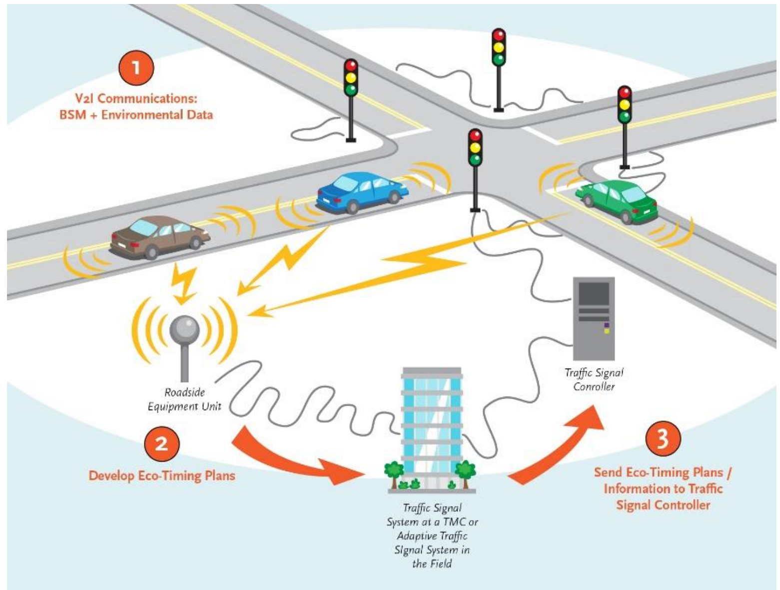
ALTERNATIVE (B) ADAPTIVE SIGNAL CONTROL

DESCRIPTION

Adaptive signal control (ASC) is a traffic management strategy in which traffic signal timing changes based on real-time traffic demand for both short-term special events (i.e. emergency vehicles, transit) and longer-term special events (i.e. recreational peaks). To model this, the adaptive signal controllers expanded the cycle lengths, removed maximum timing locks as part of the coordinated signal, and created a system that would end green signal indications if there was no traffic, while still striving to stay in coordination with mainline movements.

This alternative would require an Advanced Traffic Management System and improved detection at the signalized intersections. Figure 79 demonstrates how ASC works.

Figure 79 - Adaptive Signal Control Process



Sensitivity Testing

ASC is particularly advantageous along corridors that experience significant variability. Nationally, the Federal Highway Administration (FHWA) estimates that less than 50 percent of congestion is recurring, and the rest is non-recurring events like traffic crashes, weather incidents, work zones, and special events. In addition to the 2030 daily traffic analysis, two additional scenarios were developed and tested to understand the impact ASC would have on the most prevalent variability experienced on TH 15:

- Crash event where a crash was modeled as a lane blockage during the AM and PM peak hours.
- Recreational traffic scenario where traffic was increased 30 percent.

ASC did not provide benefits during these events because volumes exceeded capacity. ASC is not a substitute for capacity enhancements under such conditions.

RESULTS

Under 2030 conditions, Alternative (B) reduces travel time 3.4 percent and delay up to 10 percent. The reduced delay primarily comes from the side street approaches. This alternative does see a slight increase in conflict potential, likely due to increased stopping on TH 15. There is a moderate reduction to pedestrian and bicycle risk. This alternative does not see any notable environmental impacts. Alternative (B) Adaptive Signal Control comes with an estimated $400,000 in construction costs. Table 26 shows the scoring summary for this alternative.

Table 26 - Alternative (B) Adaptive Signal Control Scoring Summary

Alternative	Criterion	Criterion Score	Criterion Weight	Notes	Weighted Final Score
(B) Adaptive Signal Control	Travel Time	●●●●●●●●●●	19	Travel time reduced by 3.4%.	●●●●●●○○○○
	Intersection Delays	●●●●●●●●●●	23	Daily delays reduced by 9.9%.	
	Corridor Safety	●○○○○○○○○○	26	Minimal change in conflict potential (+1.6%)	
	Pedestrian and Bicycle Amenities	●●○○○○○○○○	13	Pedestrian/bicycle risks reduced by 16%.	
	Environmental Impacts	●●●●●●●●○○	9	Minimal environmental impacts.	
	Cost	●●●●●●●●○○	10	$400 K to construct.	

Alternative (C) Noise Wall

DESCRIPTION

The high speed and high traffic volumes on TH 15 can create a significant amount of noise that can reduce the quality of life for residents and businesses. MnDOT currently has a funding program called the Greater Minnesota Noise Barrier Program that allows jurisdictions to apply for funds to construct a noise wall along a state road. There are three qualifications a location must meet for a noise wall, as shown in Table 27.

Figure 80 shows the proposed noise wall locations and a summary of their likelihood to meet the required thresholds.

Table 27 - Greater Minnesota Noise Wall Criteria

Criteria	TH 15
No Type I project planned for 10 years. Generally, a Type I project is a major Federal or Federal-aid highway project in which an environmental document will be completed (bridge replacement, roadway expansion, new roadway, overpass, etc.).	There is no Type I project programmed for the TH 15 corridor. In later sections of this report, several Type I projects are proposed and each would require detailed noise analysis to determine whether noise walls were appropriate. Concepts like freeways that increase traffic speeds and volumes increase the need for noise walls.
Access controlled freeway/expressway. Roadways with multiple access points require gaps in a noise wall, reducing their effectiveness.	While TH 15 is not access controlled, it does have very limited access. The locations the noise wall would be constructed have no address points that would require gaps in a noise wall.
Noise and reduction thresholds versus cost effectiveness. The modeled traffic noise must be at least 66 decibels at the effected properties and a noise wall must reduce noise by least 5 decibels (one property must have a 7-decibel reduction) to be considered benefitted by the wall. The cost of the noise wall per benefitted house cannot exceed $78,500 (or current guidance).	Each of the three proposed noise wall locations have varying degrees of noise, reduction, and cost effectiveness as shown in Figure 80. However, MnDOT will need to conduct noise modeling to verify these parameters during the application process. Early analysis indicates at least two of the three proposed locations are worthy of application.

Figure 80 - Proposed Noise Walls

RESULTS

This alternative would have no impact on traffic operations or safety. Compared to the 2030 No Build scenario, constructing a noise wall is estimated to cost an additional $1,880,000, and have a positive environmental impact due to noise reduction on the study corridor. Table 28 shows the scoring summary for this alternative.

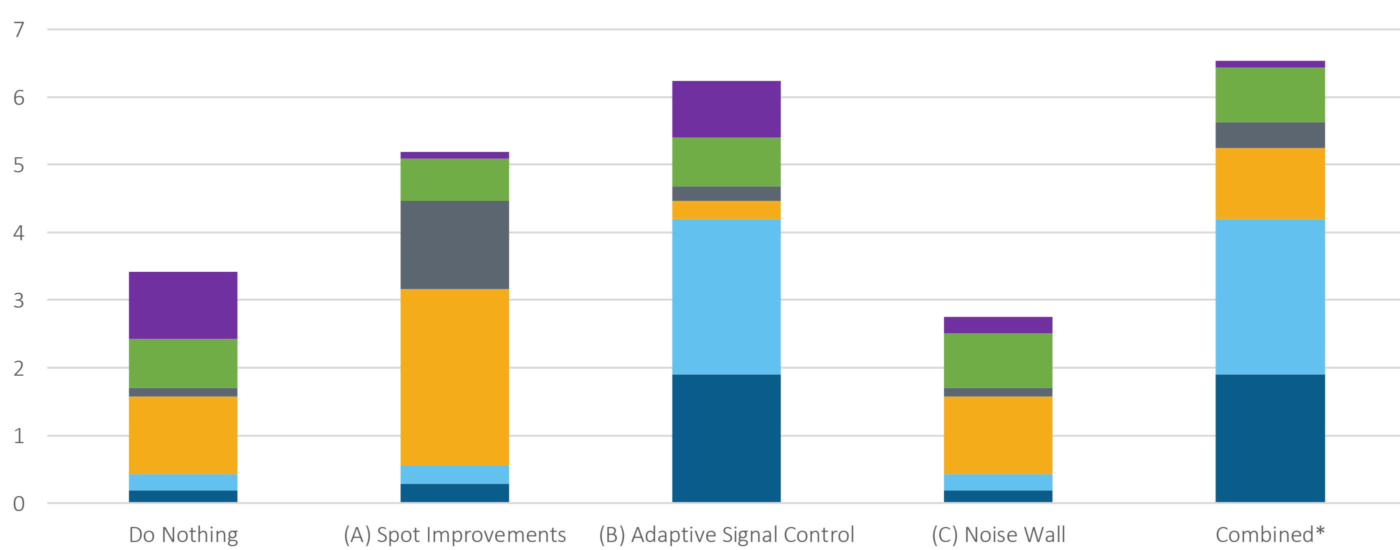
Table 28 - Alternative (C) Noise Wall Scoring Summary

Alternative	Criterion	Criterion Score	Criterion Weight	Notes	Weighted Final Score
(C) Noise Wall	Travel Time	●○○○○○○○○○	19	Minimal changes to travel time.	●●●○○○○○○○
	Intersection Delays	●○○○○○○○○○	23	Minimal changes to daily delay.	
	Corridor Safety	●●●●○○○○○○	26	Minimal changes to conflict potential.	
	Pedestrian and Bicycle Amenities	●○○○○○○○○○	13	Minimal changes to pedestrian/ bicycle risks.	
	Environmental Impacts	●●●●●●●●●○	9	Reduction in traffic noise.	
	Cost	●●○○○○○○○○	10	$1.88 M to construct.	

SUMMARY OF SHORT-TERM IMPROVEMENTS

Each of the short-term improvements can be combined into one improvement package to provide the best operational and safety results to improve the quality of life for people who use TH 15 and live nearby. Figure 81 shows how each of the alternatives scored, as well as the estimated benefits if all three short term improvements alternatives were implemented. Each alternative provides targeted benefits: Alternative (A) for pedestrians, Alternative (B) for traffic flow and safety, and Alternative (C) to minimize traffic noise.

Figure 81 - Summary of Short-Term Improvements Scoring



**No traffic operations model run.*

At-Grade Corridor Improvements

At-grade corridor improvements are those that could be implemented in the next five to 15 years and would resolve most, but not all, of the operational and vehicular safety issues. These improvements will likely require funds to be programmed at the City, County, and State level with possible safety or alternative intersection grant opportunities. Three at-grade alternatives were considered: corridor widening, median U-turn corridor, and displaced left-turn corridor.

Each of the at-grade improvement alternatives were evaluated using 2045 baseline traffic volumes, unless otherwise noted. These alternatives were compared against each other, as well as against the access-controlled freeway alternatives.

No Build

DESCRIPTION

Under the No Build, there would be no changes to the existing TH 15 corridor. The corridor would remain a four-lane divided arterial roadway with signals at the existing intersections.

RESULTS

By 2045, under the No Build condition, the average daily travel time is 4.33 minutes with 1.31 minutes of network delay. The conflict potential will continue to increase as delays and congestion worsen. There would be no pedestrian and bicycle amenity improvements. There would be no environmental impacts or costs associated with the existing conditions. Table 29 shows the no build scoring summary.

Table 29 - No Build Scoring Summary (2045)

Alternative	Criterion	Criterion Score	Criterion Weight	Notes	Weighted Final Score
2045 No Build	Travel Time	●○○○○○○○○○	19	4.3 minutes.	●●●●○○○○○○
	Intersection Delays	●○○○○○○○○○	23	3.2 minutes of delay.	
	Corridor Safety	●●●●●○○○○○	26	No changes to current conditions.	
	Pedestrian and Bicycle Amenities	●○○○○○○○○○	13	No changes to current conditions.	
	Environmental Impacts	●●●●●●●●○○	9	No changes to current conditions.	
	Cost	●●●●●●●●●●	10	No cost.	

Alternative (D) Corridor Widening

DESCRIPTION

Alternative (D) Corridor Widening would add a through lane in both directions from south of 2nd Street to north of 12th Street, as well as the pedestrian crossing enhancements and turn lanes, included in Alternative (A) Spot Improvements:

» Expansion from four-lanes to six-lanes along the TH 15 corridor.

» Dual left-turn lanes would be added on the westbound approach at 2nd Street, eastbound approach at 3rd Street, eastbound and westbound approaches at 8th Street, and eastbound and westbound approaches at 12th Street.

» Pedestrian crossing enhancements would be added at each study intersection, including removing permitted left-turn phases, adding push-button actuated no right-turn on red, signalizing the channelized right-turn lanes, and including lead pedestrian interval. Lead pedestrian interval gives pedestrians a three to seven second head start to enter the intersection while all vehicles have a red signal indication.

Figure 82 shows the corridor widening concept.

RESULTS

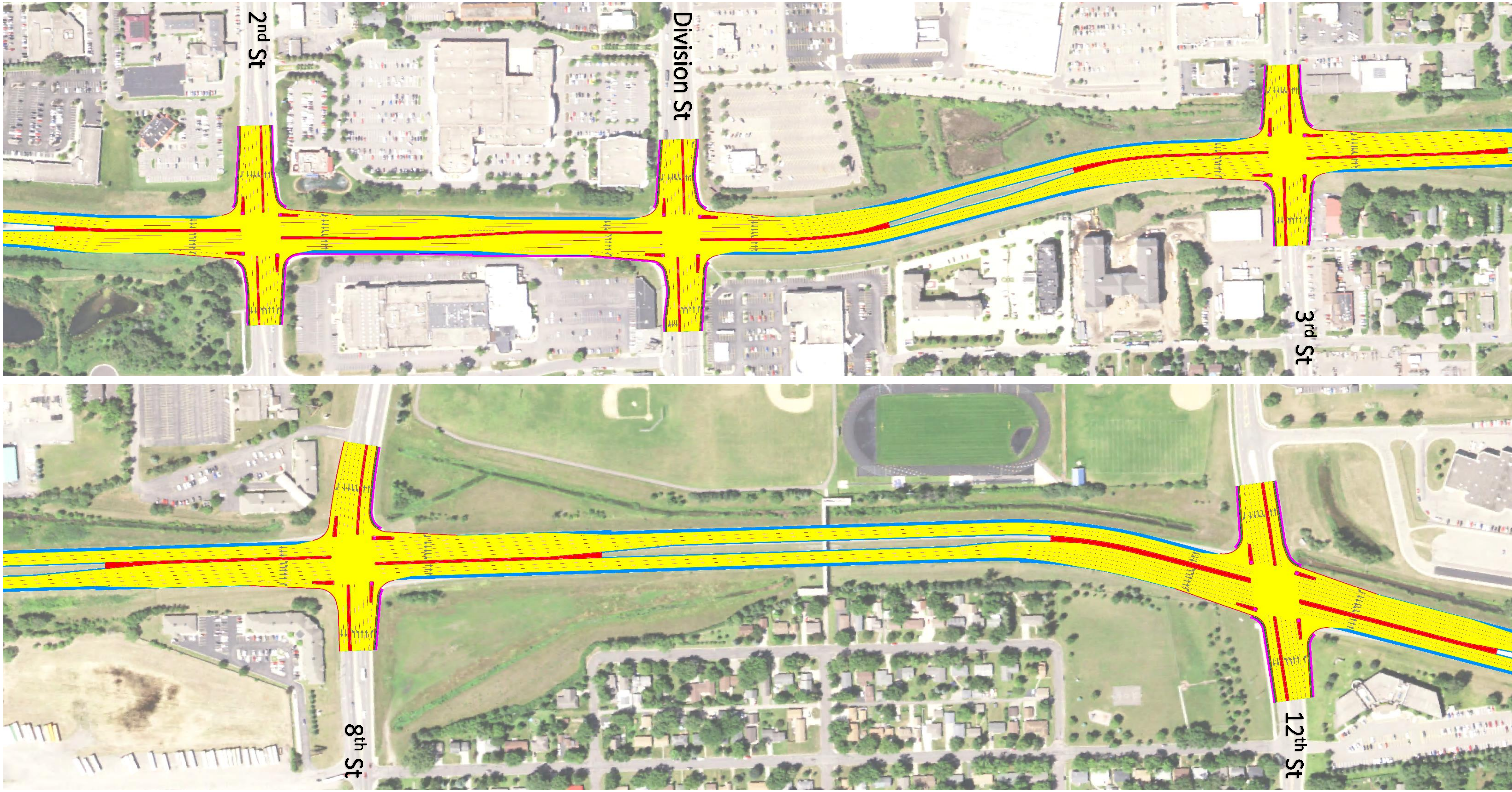
Compared to the 2045 No Build scenario, Alternative (D) reduces travel time by less than one percent and delay by two percent. The limited operational benefits are due to limited reductions in cycle length, similar minor approach delays compared to No Build, and less than 30 percent of traffic being through traffic along the TH 15 corridor. Furthermore, the short duration of the extra lane results in low lane utilization compared to the existing lanes. This alternative is expected to increase conflict potential, likely due to increased merging behavior with the added center lane on TH 15. Widening the corridor will lengthen the crossing distance between curbs, increasing exposure and risk for bicyclists and pedestrians. The environmental impacts of this alternative are primarily related to the need for more land; it is estimated this alternative would impact eight properties. Alternative (D) Corridor Widening comes with an estimated $17.4 M in construction costs. Table 30 shows the scoring summary for this alternative.

This alternative is not recommended to be carried forward for additional analysis and consideration.

Table 30 - Alternative (D) Corridor Widening Scoring Summary

Alternative	Criterion	Criterion Score	Criterion Weight	Notes	Weighted Final Score
(D) Widening	Travel Time	●○○○○○○○○○	19	Minimal changes to travel time (+2.5%).	●●●○○○○○○○
	Intersection Delays	●○○○○○○○○○	23	Daily delay increases by 7.6%.	
	Corridor Safety	●●●●●○○○○○	26	Minimal change in conflict potential (-0.9%).	
	Pedestrian and Bicycle Amenities	●○○○○○○○○○	13	Pedestrian/ bicycle risks increased by 14%.	
	Environmental Impacts	●●●●●●○○○○	9	Approx. 8 impacted properties and temporary environmental impacts.	
	Cost	●●●●●●●●●○	10	$17.4M to construct.	

Figure 82 - Alternative (D) Widening Concept Drawing



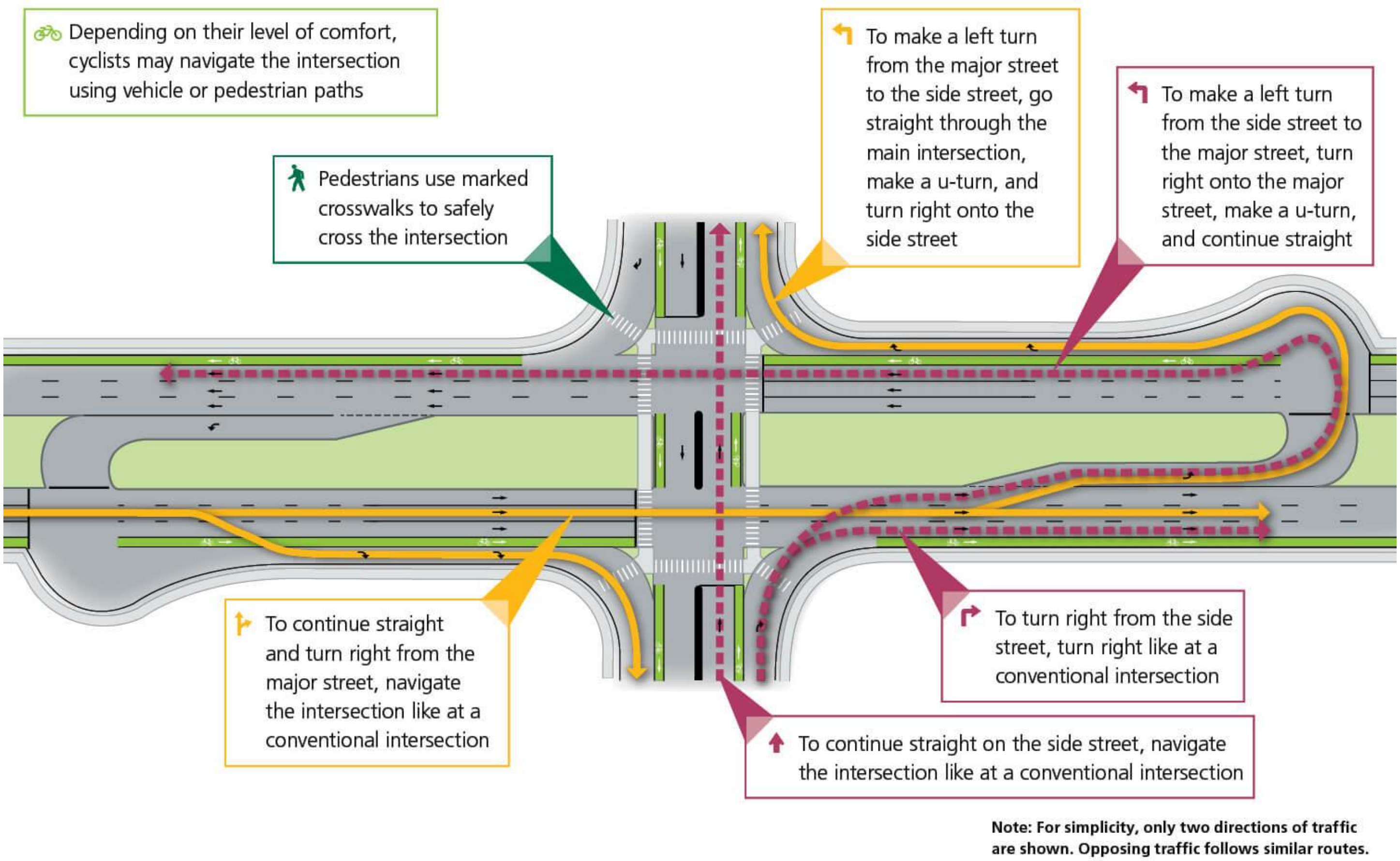
Alternative (E) Median U-Turn Corridor

DESCRIPTION

Alternative (E) Median U-Turn (MUT) Corridor alternative would remove left turns at the study intersections. MUTs first debuted in the early 1960s on highways with significant capacity issues. Since then they have been installed in over a dozen different states at more than 30 locations. FHWA research has found that MUTs increase a corridor's traffic throughput up to 50 percent and reduce all crash types up to 50 percent.

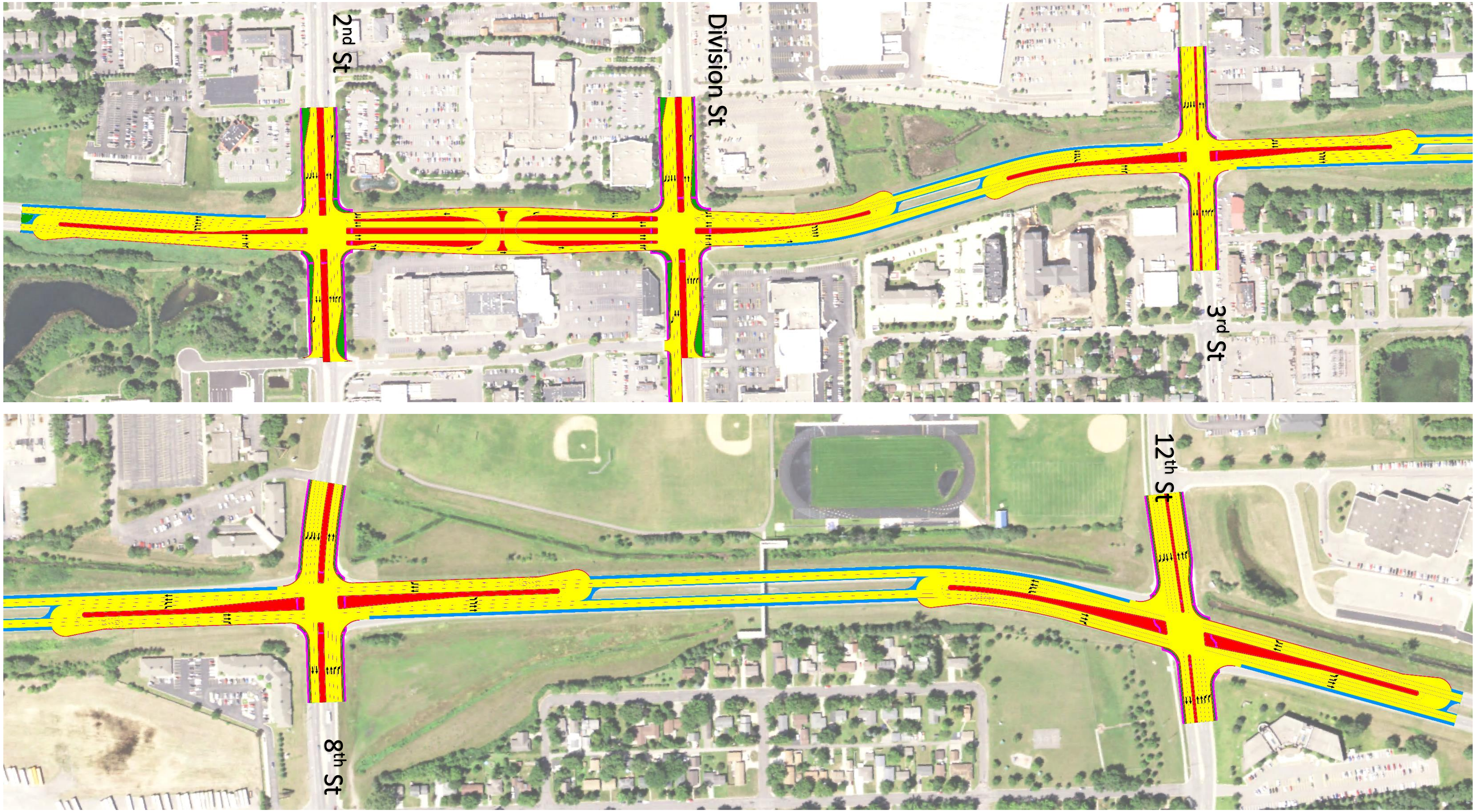
For drivers on TH 15 that need to make a left-turn, they would proceed through the intersection and make a U-turn. For drivers on the side streets, they would make a right-turn, then make a U-turn, and then complete their movement with another right turn or a through movement. An example MUT intersection is shown in Figure 83. This alternative also grade separates the U-turn locations between 2nd Street and Division Street to minimize queueing and crossing conflicts between the closely spaced intersections. Figure 84 shows the concept drawing.

Figure 83 - Example MUT Intersection Movements



Source: VA DOT

Figure 84 - Alternative (E) Grade Separated MUT Corridor Concept Drawing



RESULTS

Compared to the 2045 No Build scenario, Alternative (E) reduces travel time by 10 percent and delay by 24 percent. This alternative is expected to decrease conflict potential by 21 percent due to the substantial reduction in crossing conflicts. This alternative will reduce the number of uncontrolled crossings and reduce the road width compared to the 2045 No Build scenario, providing safety benefits to bicyclists and pedestrians. The environmental impacts of this alternative are primarily related to the need for more land especially at U-turn locations; this alternative is estimated to impact nine properties. Alternative (E) Corridor Widening comes with an estimated $45.1 M in construction costs. Table 31 shows scoring summary for this alternative.

Table 31 - Alternative (E) Grade Separated Median U-Turn Corridor Scoring Summary

Alternative	Criterion	Criterion Score	Criterion Weight	Notes	Weighted Final Score
(E) Grade Separated Median U-Turn (MUT) Corridor	Travel Time	●●●●○○○○○○	19	Travel time reduced by 9.5%.	●●●●●●○○○○
	Intersection Delays	●●●●●●●○○○	23	Daily delay reduced by 24.4%.	
	Corridor Safety	●●●●●●○○○○	26	Conflict potential reduced by 21.2%.	
	Pedestrian and Bicycle Amenities	●●●●●●●●○○	13	Pedestrian/ bicycle risks reduced by 50%.	
	Environmental Impacts	●●●●○○○○○○	9	Approx. 9 impacted properties and temporary environmental impacts likely.	
	Cost	●●●●●●●○○○	10	$45.1M to construct.	

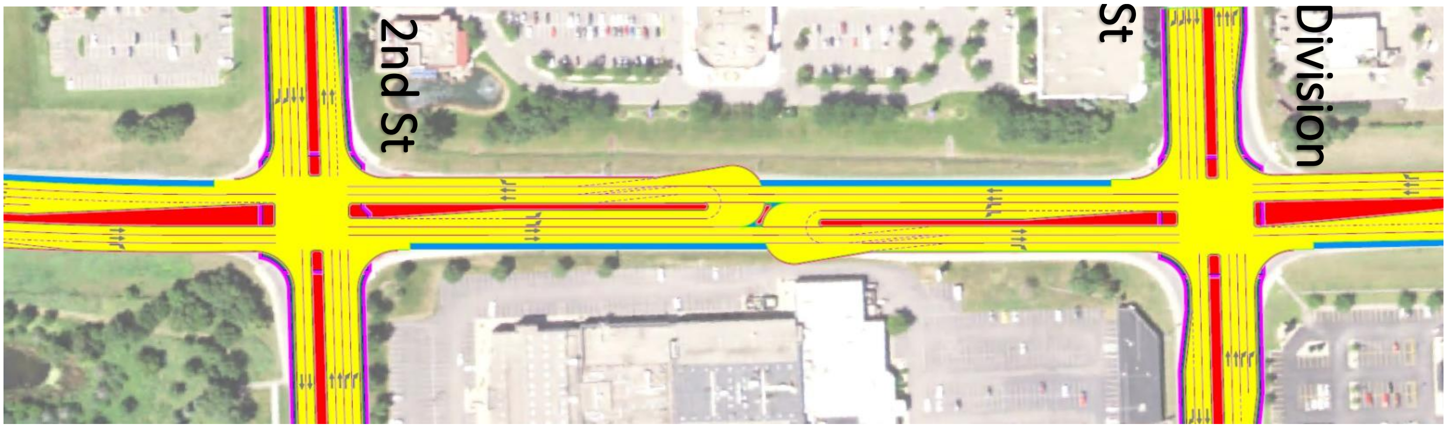
ALTERNATIVE (E) MUT CORRIDOR MODIFICATIONS

An at-grade MUT corridor was also considered due to the high cost of the grade-separated MUT corridor alternative. It does provide a similar level of benefits, however, would not be able to respond as well to spikes in traffic, like during the recreational peaks. The cost would be reduced by over 40 percent to $25.2 M with all intersections operating with acceptable levels of service.

Table 32 - Scoring Summary for MUT Corridor Alternatives

	2045 No Build	At-Grade MUT	Grade Separated MUT
Daily Travel Time	4.33 Minutes	4.01 Minutes	3.92 Minutes
Network Delay	1.31 Minutes	1.10 Minutes	0.99 Minutes
Conflict Potential	8,913	7,035	7,023
Pedestrian and Bicycle Risk	67,636	30,112	33,714
Environmental Impacts	8	6	4
Costs	$0	$25.2 M	$45.1 M

Figure 85 - At Grade MUT Corridor



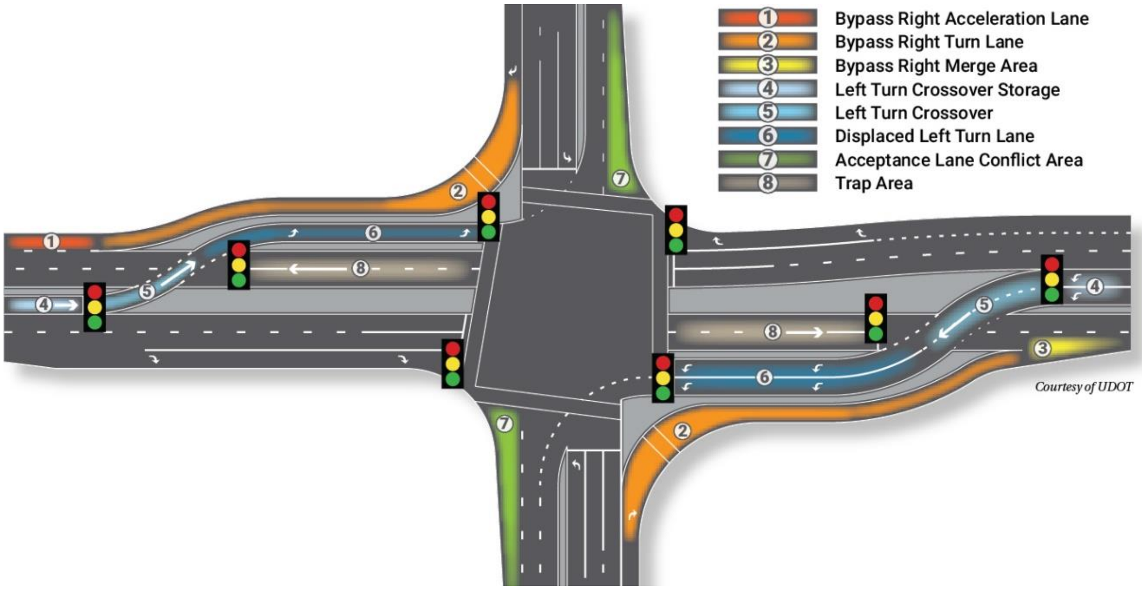
ALTERNATIVE (F) DISPLACED LEFT TURN CORRIDOR

DESCRIPTION

Alternative (F) Displaced Left Turn (DLT) Corridor alternative relocates left-turn movements on an approach to the other side of the opposing traffic flow at an upstream location. This allows left-turn movements to proceed simultaneously with the through movements at the main intersection, eliminating the left-turn phase at the signalized intersection and increasing the capacity at the main intersection. The DLT design was first constructed in the United States in 1995. There are now more than 30 locations. FHWA research has found that DLTs reduce all crash types up to 12 percent and increase traffic throughput up to 60 percent.

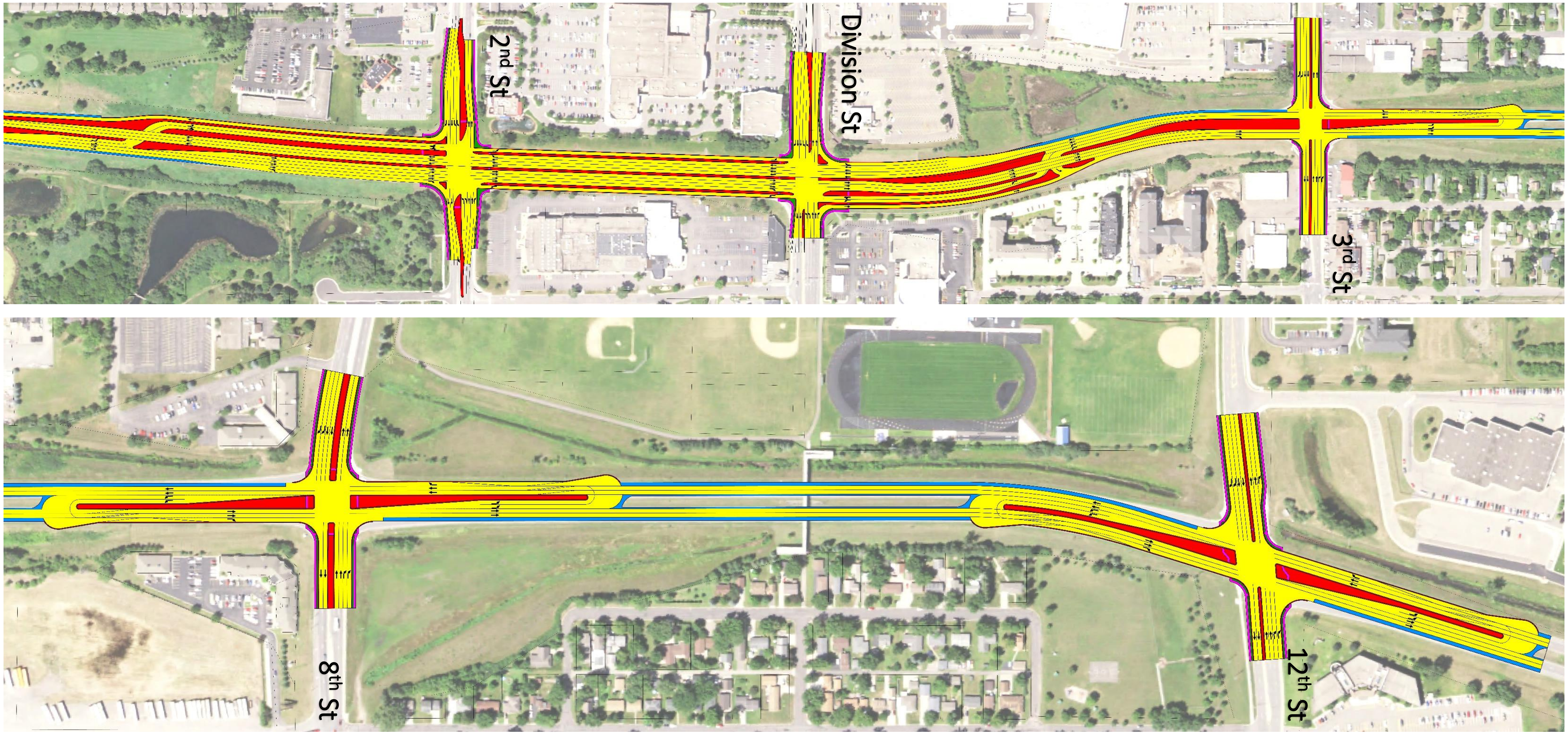
On this corridor, the affected left-turning movements would only be on TH 15. This alternative would also add a third through lane in both directions on TH 15 to increase capacity between 2nd Street and 3rd Street. Due to the proximity and high traffic volumes between 2nd Street and Division Street, crossover intersections were not included. Instead, a U-turn location was included between Division Street and 3rd Street. Figure 86 shows an example DLT intersection with Figure 87 showing the concept drawing.

Figure 86 - Example DLT Intersection Movements



Source: UDOT

Figure 87 - Alternative (F) Displaced Left Turn Corridor Concept Drawing



RESULTS

Compared to the 2045 No Build scenario, Alternative (F) reduces travel time by seven percent and delay by 12 percent. This alternative is expected to greatly decrease the frequency of rear end crashes, resulting in an overall reduction in conflict potential of 14 percent. This alternative will reduce the number of uncontrolled crossings and reduce the road width compared to the 2045 No Build scenario, providing safety benefits to bicyclists and pedestrians. The environmental impacts of this alternative are primarily related to the need for more land. Alternative (F) Corridor Widening comes with an estimated $32.6 M in construction costs. Table 33 shows the scoring summary for this alternative.

Table 33 - Alternative (F) Displaced Left Turn Corridor Scoring Summary

Alternative	Criterion	Criterion Score	Criterion Weight	Notes	Weighted Final Score
(F) Displaced Left Turns (DLT)	Travel Time	●●●○○○○○○○	19	Travel time reduced by 6.5%.	●●●●●○○○○○
	Intersection Delays	●●●●○○○○○○	23	Daily delay reduced by 12.2%.	
	Corridor Safety	●●●●●●○○○○	26	Conflict potential reduced by 14.2%.	
	Pedestrian and Bicycle Amenities	●●●○○○○○○○	13	Pedestrian/ bicycle risks reduced by 6.8%.	
	Environmental Impacts	●●●●●●○○○○	9	Approx. 7 impacted properties with temporary environmental impacts likely.	
	Cost	●●●●●●○○○○	10	$32.6M to construct.	

Freeway Corridor Improvements

Freeway corridor improvements are those that would convert the corridor from an at-grade signalized corridor to an access controlled, grade-separated freeway. These concepts are likely to improve efficiencies and mitigate most, or all, of the existing and forecasted operational and vehicular deficiencies. Two alternatives were considered: Volume Focused Freeway and Spacing Focused Freeway. Each of the freeway improvement alternatives were evaluated using 2045 base traffic volumes to be consistent with at-grade alternatives, with sensitivity results considering the induced demand expected by 2045 with a grade separated concept.

Alternative (G) Volume Focused Freeway

DESCRIPTION

Alternative (G) Volume Focused Freeway would convert TH 15 to an access-controlled freeway segment. As part of the freeway:

- 2nd Street and Division Street intersections would become a split diamond interchange, with connection roadways in between.
- A folded diamond interchange would be constructed at 8th Street.
- 3rd Street and 12th Street would be constructed as grade separated overpasses, with no access to TH 15.
- Increases corridor speeds to 55 miles per hour.

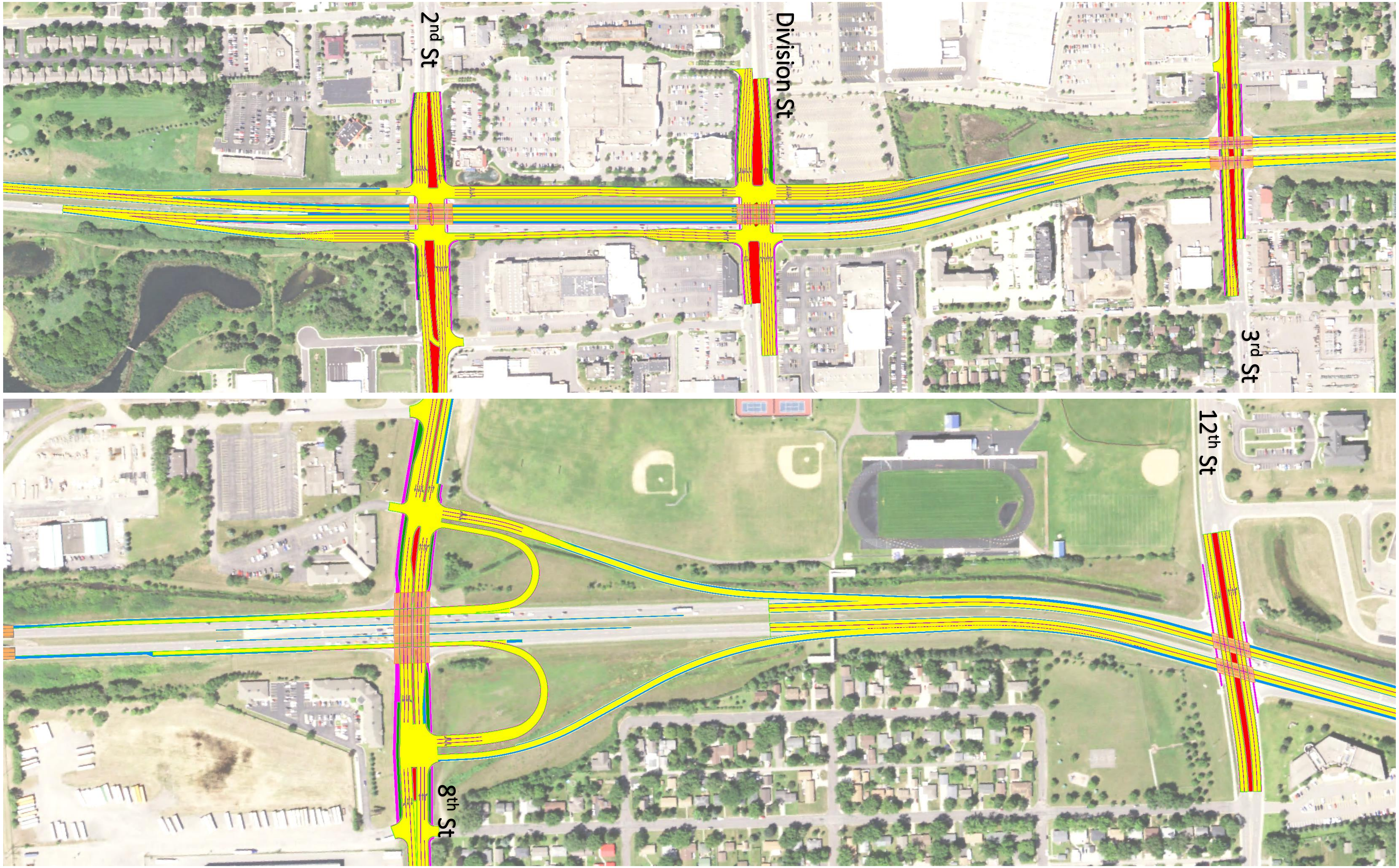
RESULTS

Compared to the 2045 No Build scenario, Alternative (G) reduces travel time by 18 percent and delay by 47 percent. While this alternative is expected to decrease rear end crashes compared to the no build scenario, crossing and merging conflicts are expected to increase. Overall, conflicts are expected to be 56 percent higher than the 2045 No Build scenario. This is due to the addition of three new intersections at the interchange locations. This alternative will provide two grade separated uncontrolled crossings at the overpass locations, providing safety benefits to bicyclists and pedestrians compared to the 2045 No Build scenario. The environmental impacts of this alternative are primarily related to the need for more land and potential for additional traffic noise (with the interchanges); it is estimated this alternative will impact 13 properties. Alternative (G) Volume Focused Freeway comes with an estimated $93.3 M in construction costs. Table 34 shows the scoring summary for this alternative.

Table 34 - Alternative (G) Volume Focused Freeway Scoring Summary

Alternative	Criterion	Criterion Score	Criterion Weight	Notes	Weighted Final Score
(G) Volume Focused Freeway	Travel Time	●●●●●●●○○○	19	Travel time reduced by 17.6%.	●●●●●○○○○○
	Intersection Delays	●●●●●●●●○○	23	Daily delays reduced by 47.4%.	
	Corridor Safety	●○○○○○○○○○	26	Conflict potential increased by 56.4%.	
	Pedestrian and Bicycle Amenities	●●●●●●●●●●	13	Pedestrian/bicycle risks reduced by 62.2%.	
	Environmental Impacts	●●●●○○○○○○	9	More traffic noise is likely, approx. 13 impacted properties.	
	Cost	●○○○○○○○○○	10	$93.3M to construct.	

Figure 88 - Alternative (G) Volume Focused Concept Drawing



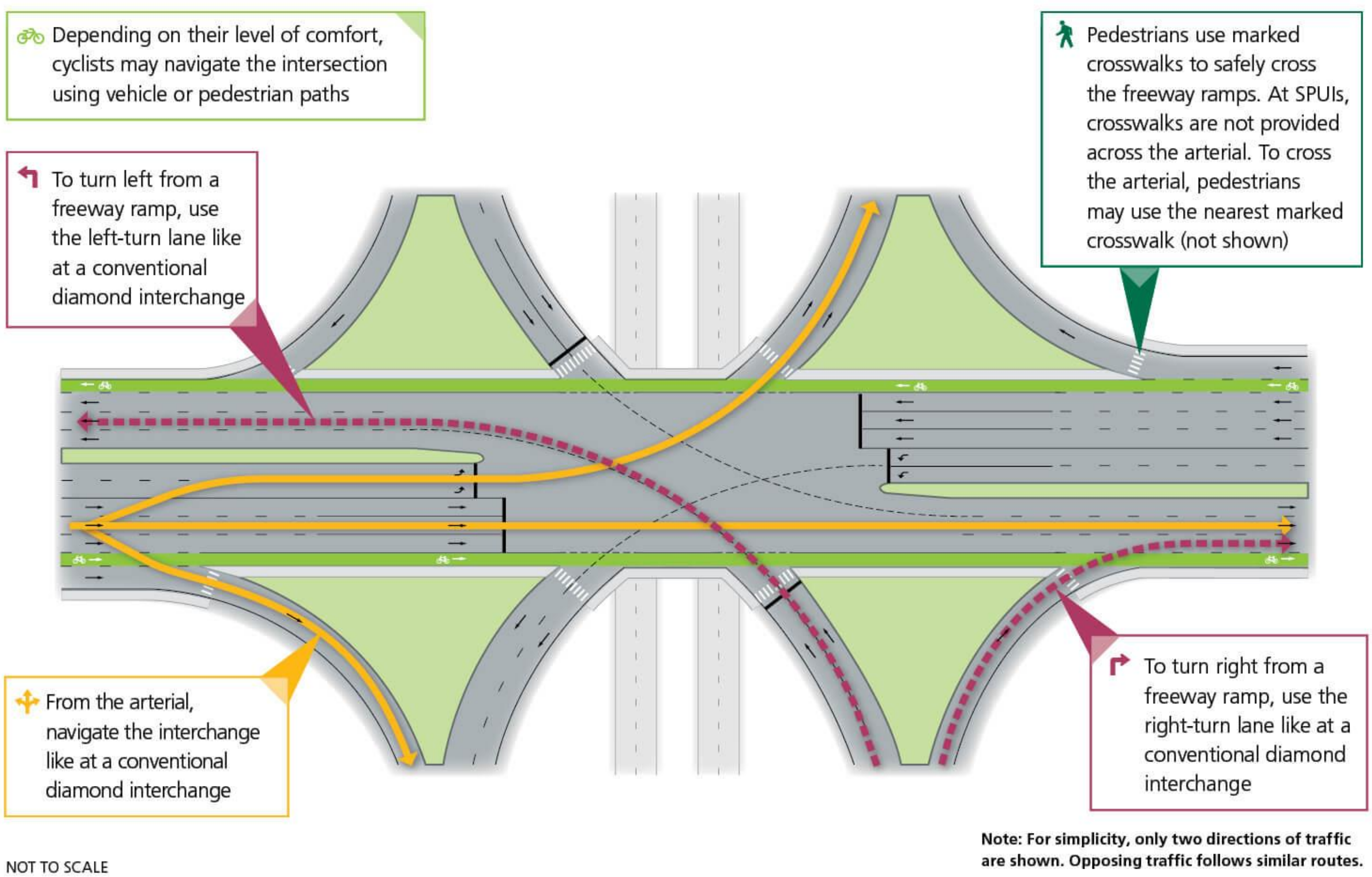
ALTERNATIVE (H) SPACING FOCUSED FREEWAY

DESCRIPTION

Alternative (H) Spacing Focused Freeway would convert TH 15 to an access-controlled freeway segment. As part of the freeway:

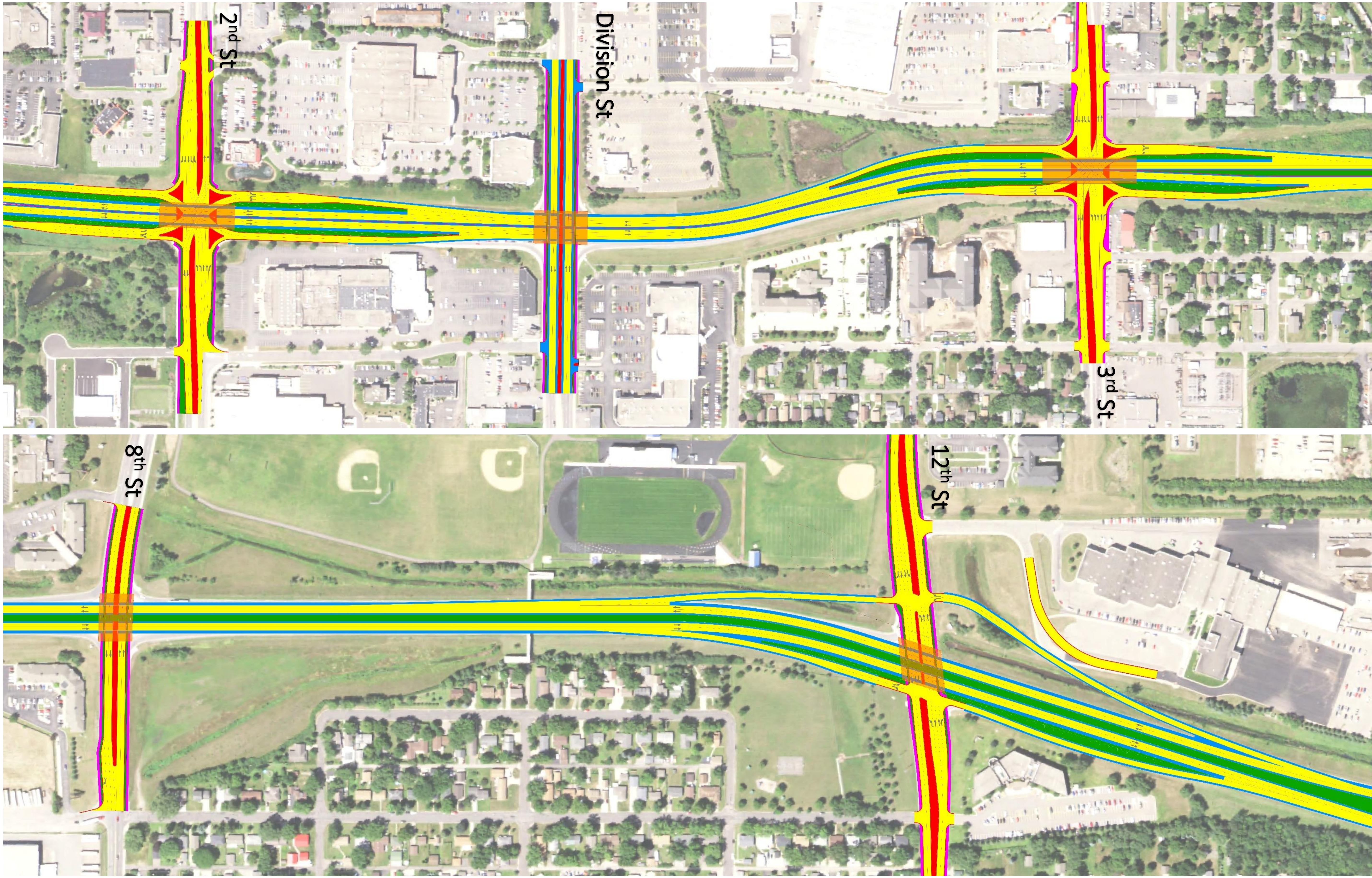
- Single Point Urban Interchanges (SPUI) would be constructed at 2nd Street and 3rd Street, with a tight diamond interchange at 12th Street. SPUIs combine both ramp intersections into one intersection, as shown in Figure 89.
- Division Street and 8th Street would be converted to grade separated intersections with no access to TH 15.
- Increases corridor speeds to 55 miles per hour.

Figure 89 - Example Single Point Urban Interchange Movements



Source: VDOT

Figure 90 - Alternative (H) Spacing Focused Freeway Concept Drawing



RESULTS

Compared to the 2045 No Build scenario, Alternative (H) reduces travel time by 26 percent and delay by 51 percent. This alternative is expected to have 58 percent fewer traffic conflicts compared to the 2045 No Build scenario. This is a result of reducing five at-grade signalized intersections into four grade-separated signalized intersections. This alternative will have fewer uncontrolled crossings and a narrower roadway than the 2045 No Build scenario, providing safety benefits to bicyclists and pedestrians. The environmental impacts of this alternative are primarily related to the need for more land as well as traffic noise from the interchanges; it is estimated this alternative will impact 13 properties. Alternative (H) Spacing Focused Freeway comes with an estimated $105.8 M in construction costs. Table 35 shows the scoring summary for this alternative.

Table 35 - Alternative (H) Spacing Focused Freeway Scoring Summary

Alternative	Criterion	Criterion Score	Criterion Weight	Notes	Weighted Final Score
(H) Access Spacing Focused Freeway	Travel Time	●●●●●●●●●●	19	Travel time reduced by 26.4%.	●●●●●●●●○○
	Intersection Delays	●●●●●●●●●○	23	Daily delays reduced by 51.9%.	
	Corridor Safety	●●●●●●●●●●	26	Conflict potential decreased by 58.8%.	
	Pedestrian and Bicycle Amenities	●●●●●●●○○○	13	Bike/ped risks reduced by 39.1%.	
	Environmental Impacts	●●●●○○○○○○	9	More traffic noise is likely, approx. 10 impacted properties.	
	Cost	●○○○○○○○○○	10	$105.8M to construct.	

Discarded Concepts

In addition to the at-grade and freeway alternatives discussed above, three other concepts were discarded from further consideration due to poor operations and high costs:

» DLT and MUT Combination. This concept would utilize DLTs on mainline TH 15 and MUTs on the minor streets. This combination failed between the intersections of Division Street and 3rd Street given the high turning demand.

» Echelon. An echelon is a grade separated intersection where one approach on both roadways is elevated to create a pair of one-way intersections. This alternative was discarded because it provided comparable benefits to the at-grade alternatives (specifically the MUT) with the costs of the grade separated concepts.

» Collector-Distributor Concept. The collector-distributor concept would create a series of frontage roads and overpasses to maintain a similar grid network but allowing TH 15 to be an access controlled freeway. An example from St. Paul Minnesota is shown in Figure 91. Because less than 25 percent of traffic on TH 15 uses it the entire length of the study area, this alternative results in more indirect routing, increasing travel time, latent demand, and network delay compared to the 2045 no build conditions.

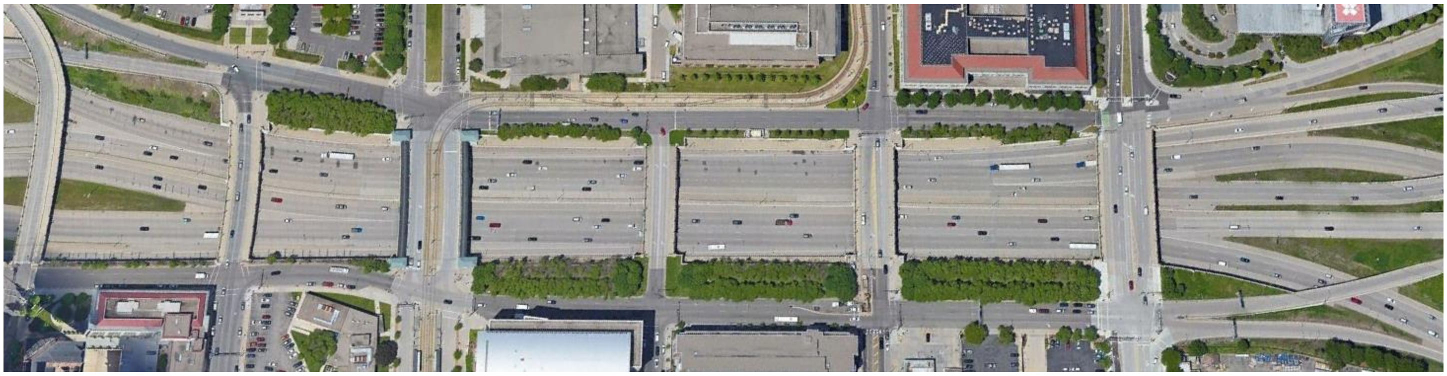
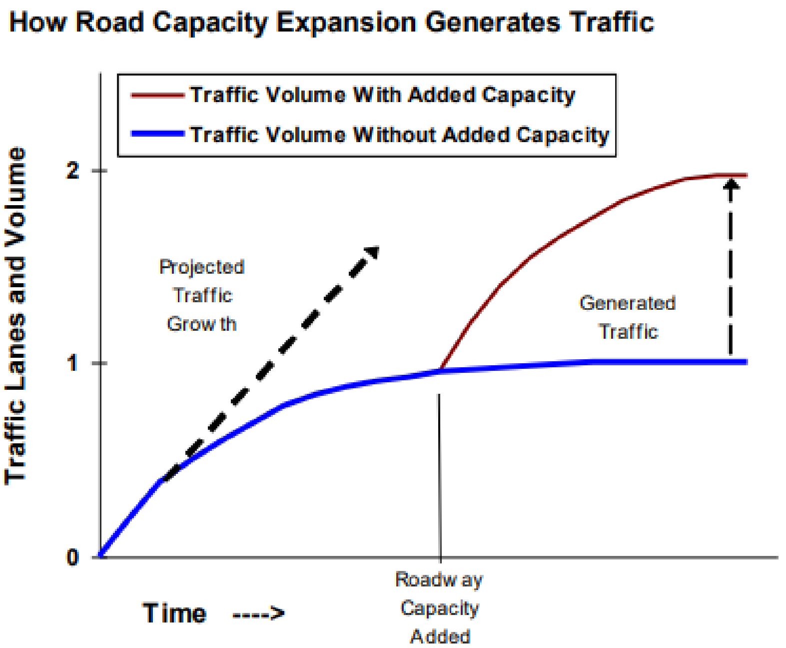


Figure 91 - Collector-Distributor Freeway in St. Paul, MN

Sensitivity Testing

Induced demand occurs when operational improvements, like added capacity, induce drivers to select the new, and improved routes, until equilibrium is reached, and operations are reduced to the point they were before the improvements were made. The regional travel demand model estimates that improvements on TH 15 will induce significant new traffic demand on the corridor.

Figure 92 - Principles of Induced Demand



- Improving the corridor to a six-lane at-grade highway would likely add 15,000 new vehicles to the corridor by 2045, in addition to the growth already expected. The more direct routing and improved operations would save more than $25 M each year from regional reductions in vehicle miles traveled and vehicle hours traveled.
- Improving the corridor to a four-lane access controlled freeway would likely add 25,000 new vehicles to the corridor by 2045, in addition to the growth already expected. The more direct routing and improved operations would save more than $44.1 M each year from regional reductions in vehicle miles traveled and vehicle hours traveled.

A sensitivity analysis was completed to ensure each of the concepts are flexible enough to respond to the induced demand the regional travel demand model estimated.

At-Grade Alternatives Sensitivity Analysis

The at-grade sensitivity analysis increased traffic volumes nearly 40 percent to reflect the potential induced demand. Table 36 compares the 2045 base and sensitivity volumes for Alternative (E) and Alternative (F). With the significant traffic volumes, both alternatives see a significant increase in daily delay and latent demand. Both alternatives provide a similar level of travel time on TH 15 when comparing the sensitivity volumes to the base volumes and both see the southbound direction become extremely unreliable.

Table 36 - Sensitivity Testing for Long-Term Improvements Alternatives

	Alternative (E) Grade Separated MUT		Alternative (H) DLT Corridor	
	2045 Base	Sensitivity	2045 Base	Sensitivity
Daily Delay	60	157	69	143
Latent Demand	0.37%	6.21%	0.56%	6.52%
Travel Time	NB 3.51 | SB 3.61	NB 4.21 | SB 4.61	NB 3.35 | SB 3.34	NB 4.05 | SB 3.92
LOTTR	NB 1.16 | SB 1.10	NB 1.11 | SB 3.57	NB 1.16 | SB 1.12	NB 1.18 | SB 1.95
Conflicts	7,430	38,261	6,625	31,360

Level of service (LOS) assigns a letter grade to intersections based on their level of delay. LOS A indicates there is very minimal delay at the intersection, while LOS F indicates severe congestion and delays. Generally, LOS A through D is considered acceptable, with LOS E and F are considered deficient. Both the grade separated MUT (E) and the DLT alternatives operate acceptably, even under the higher volumes. The at-grade MUT alternative does see one hour of deficiencies at the noon hour.

Table 37 - At-Grade Concepts Sensitivity LOS

	Alt.	Level of Service (Hour of Day)																							
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Division Street	(E) GS MUT - Base	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	C	C	C	B	B	B	B	A	A
	(E2) AG MUT - Base	B	B	B	B	B	B	B	B	B	B	B	C	C	C	C	C	C	C	C	B	B	B	B	B
	(F) DLT - Base	B	B	B	A	B	A	B	B	B	B	B	B	C	B	C	C	C	C	C	B	B	B	B	B
	(E) GS MUT - Sensitivity	A	A	A	A	A	A	B	B	B	B	B	C	D	D	D	D	C	D	D	C	C	B	B	A
	(E2) AG MUT - Sensitivity	B	B	B	B	B	B	B	B	B	B	B	C	E	D	D	D	D	D	D	D	D	B	B	A
	(F) DLT - Sensitivity	B	A	A	A	A	A	B	B	B	B	B	C	D	C	C	C	C	C	C	C	C	B	B	A
2nd Street	(E) GS MUT - Base	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B	C	B	B	B	B	A	A
	(E2) AG MUT - Base	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	C	C	C	B	B	B	B	B
	(F) DLT - Base	B	A	A	A	B	B	B	B	B	B	B	B	B	B	B	C	C	C	C	B	B	B	B	B
	(E) GS MUT - Sensitivity	A	A	A	A	A	A	B	B	B	B	B	C	C	B	C	C	C	D	C	C	C	C	C	C
	(E2) AG MUT - Sensitivity	B	B	B	B	B	B	B	C	C	B	B	C	C	C	D	C	D	D	D	C	C	B	B	C
	(F) DLT - Sensitivity	A	A	A	B	B	B	B	B	B	B	B	C	D	C	D	C	C	D	D	C	C	B	B	C

FREEWAY ALTERNATIVES SENSITIVITY TESTING

The macro-level analysis pointed to induced demand for TH 15, that is vehicles that would prefer to use TH 15 if there was available capacity. Based on this analysis, it is expected that converting TH 15 to a freeway could attract up to 82,000 vehicles a day, compared to the 43,000 estimated if TH 15 remains as it is (four-lane at-grade highway). To ensure the long-term improvement alternatives can handle the extreme traffic volumes expected for a freeway, an additional sensitivity analysis was completed. This sensitivity analysis increased traffic volumes over 90 percent.

Table 38 compares the 2045 No Build, with the 2045 base and sensitivity volumes for Alternative (G) and Alternative (H). With the increased traffic volumes, both alternatives begin to break down. Alternative (G) sees more than double the daily delay and triple the conflict potential. Alternative (H) also sees the increase in delay and conflicts, but additionally becomes unreliable in the southbound direction due to queuing back into the freeway at 3rd Street.

Table 38 - Sensitivity Testing for Long-Term Improvements Alternatives

	Alternative (G) Volume Focused Freeway		Alternative (H) Spacing Focused Freeway	
	2045 Base	Sensitivity	2045 Base	Sensitivity
Daily Delay	41	88	38	94
Latent Demand	0.15%	5.0%	0.19%	4.6%
Travel Time	NB 2.75 | SB 2.22	NB 2.77 | SB 2.26	NB 2.22 | SB 2.22	NB 2.24 | SB 2.25
LOTTR	NB 1.01 | SB 1.01	NB 1.02 | SB 1.04	NB 1.01 | SB 1.01	NB 1.22 | SB 2.18
Conflicts	10,575	34,218	3,311	34,807

Level of service (LOS) assigns a letter grade to intersections based on their level of delay. LOS A indicates there is very minimal delay at the intersection, while LOS F indicates severe congestion and delays. Generally, LOS A through D is considered acceptable, with LOS E and F are considered deficient. Table 39 shows the expected LOS at the two most congested intersections on the corridor under the base volumes and the sensitivity volumes. Ultimately, both alternatives begin to experience deficiencies under the higher volumes. Alternative (G) Volume Freeway is only deficient at Division Street around the noon hour, while Alternative (H) Spacing Freeway experiences deficiencies during the PM peak hour at Division Street and multiple hours between 12 Noon and 6 PM at 2nd Street.

Table 39 - Freeway Concepts Sensitivity LOS

	Alt.	Level of Service (Hour of Day)																							
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
Division Street	(G) Volume - Base	B	B	B	B	B	B	C	C	C	C	C	D	D	D	D	D	D	D	D	C	C	B	B	B
	(H) Spacing - Base	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	(G) Volume - Sensitivity	B	B	B	B	B	B	C	C	C	C	C	D	E	D	D	D	D	D	D	D	D	C	C	C
	(H) Spacing - Sensitivity	A	A	A	A	A	A	A	A	B	A	A	A	D	D	B	D	D	E	E	C	A	A	A	A
2nd Street	(G) Volume - Base	B	A	A	A	B	B	B	C	C	C	C	C	C	C	C	C	C	C	C	C	C	B	B	B
	(H) Spacing - Base	A	A	A	A	A	B	B	B	B	B	B	C	C	C	C	C	C	C	C	B	B	B	B	A
	(G) Volume - Sensitivity	A	A	A	A	A	B	B	C	C	C	C	C	D	C	C	C	C	D	C	C	C	C	C	C
	(H) Spacing - Sensitivity	A	A	A	A	A	A	B	B	B	B	B	D	E	D	D	E	E	F	F	D	C	B	B	B

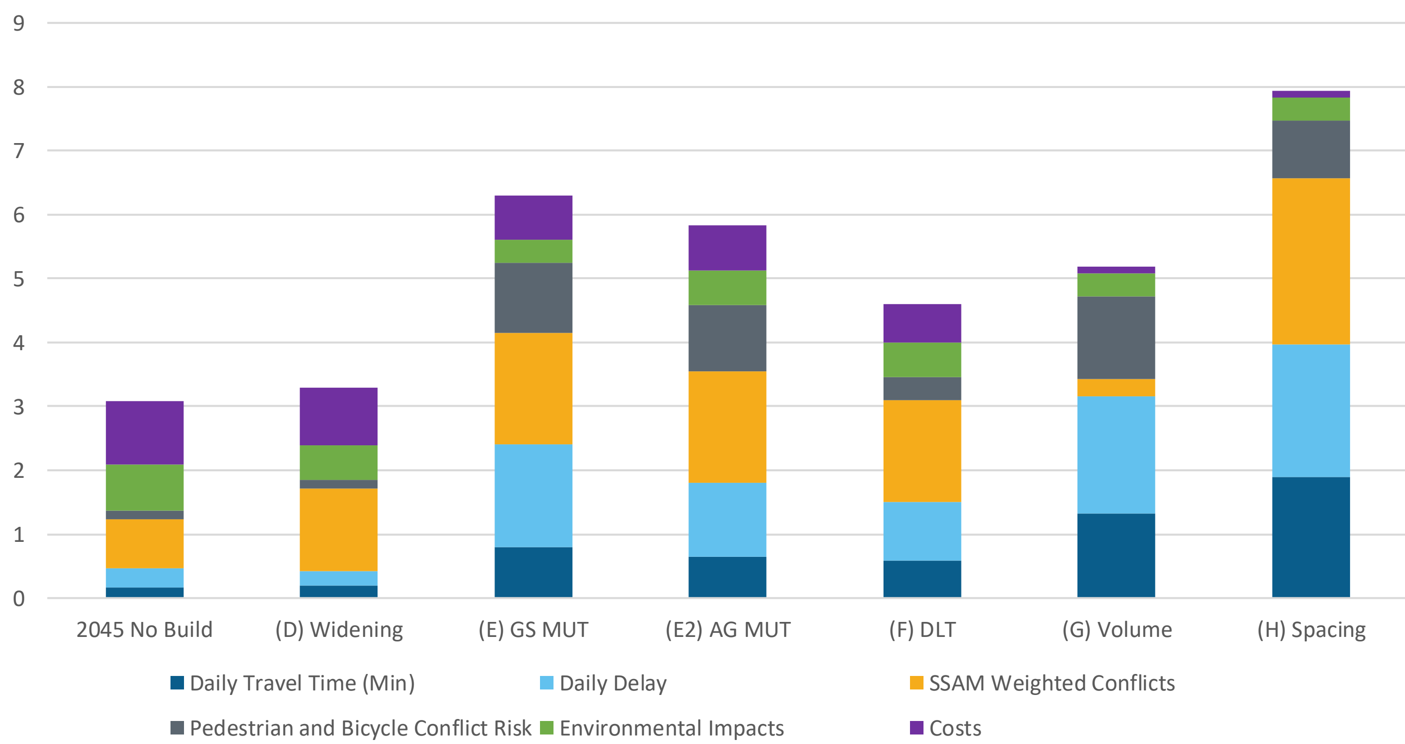
Sensitivity Summary

The freeway concepts do not reach their equilibrium the way the at-grade concepts do. The freeway concepts provide such significant priority and travel time advantages to mainline TH 15, that they continue to attract new traffic. The major limitation to the freeway concepts is the capacity at the intersections that provide access to TH 15. When operations at these intersections begin to fail, queues will extend to the freeway and begin to impact the mainline operations. Said differently, a freeway in its most congested conditions reduce speeds to the best conditions for the at-grade concepts.

At-Grade and Freeway Concepts Analysis Summary

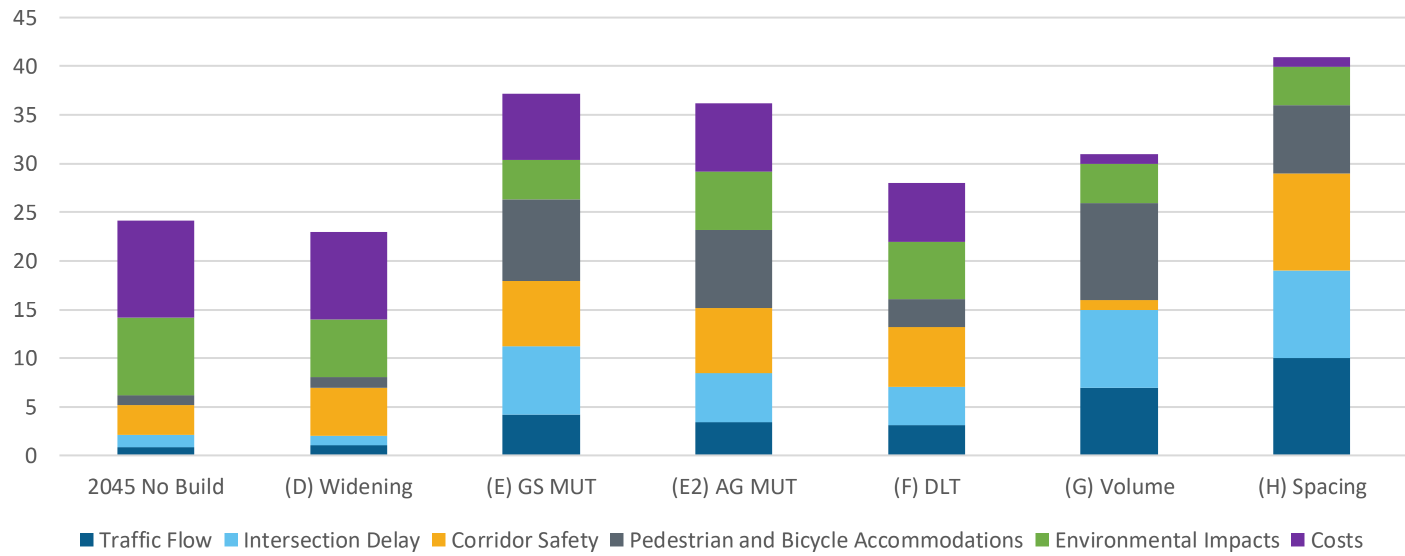
Alternative (E) Median U-Turn corridor, with and without a grade separation, and Alternative (I) Spacing Focused Freeway were the highest performing alternatives based on the value profile weighted scoring. The way each alternative achieved their score was different, however. Alternative (I) achieved major benefits from travel time improvements by increasing speeds to 55 miles per hour, whereas the MUT concepts struck a finer balance between all the scoring criteria with major benefits to travel time, daily delay, conflict potential, and pedestrian and bicycle conflict risk while minimizing the impact and cost categories. Figure 93 shows the weighted scores of the at-grade and freeway concepts.

Figure 93 - Comparison of At-Grade and Freeway Corridor Improvement Alternatives with Weighted Scores



An assessment of unweighted results was also completed, understanding that preferred values are not often what gets a project built. Often times, costs are more than 10 percent of the deciding factor when projects get into the hundreds of millions of dollars. The MUT alternatives, continue to perform strongly, even more closely scored to Alternative (H) Spacing Focused Freeway. This is primarily due to the freeways impacts to properties and costs and indirectly to lowered access to TH 15. Figure 94 shows the unweighted scores of the at-grade and freeway concepts.

Figure 94 - Comparison of At-Grade and Freeway Corridor Improvement Alternatives with Unweighted Scores



The study team also assess level of service metrics as a basis for understanding the concepts. Primarily, to resolve congestion, we do not need to build infrastructure to the highest level of service. In fact, doing so often results in overinvestment, induced demand, and corridors that are not friendly to pedestrians and cyclists. Table 40 illustrates the LOS results for each of the alternatives. Both the best at-grade and grade separated concepts achieve acceptable LOS. The freeway generally has better LOS, but the results are mostly similar. This is the due to the number of access points being reduced from five to three in the freeway concepts. The freeway scenarios force drivers to reroute through Waite Avenue or 33rd Avenue, increasing their travel times and length.

One aspect that cannot be quantified is the ease in which the MUT and DLT concepts can be understood by the general commuting public. Most national experience points to these concepts being quickly understood and endorsed, but there are still often polarizing concepts. Out of town drivers generally benefit from the use of navigational technology to guide them through these concepts effortlessly, but without such technology more local drivers may be even more intimidating.

Finally, the topic of induced demand is a hot button issue at a national level. The idea that widening corridors or converting them to freeways merely induces more traffic makes for solving such congestion related problems challenging. What is unclear is where this is seen as a positive or negative. Is it positive to move regional traffic off the local system to a corridor designed to move regional traffic, providing overall network benefits? Alternatively, is it negative to take traffic from under capacity corridors with lower posted speeds and move them back to TH 15, reintroducing the very issue we these alternatives are trying to resolve.

In summary, there are multiple alternatives capable of resolving the issues on TH 15, each with clear implementation challenges. The at-grade solutions need to address the topics of public buy-in and reduced mainline and regional benefits, while the freeway concepts will have to more closely consider the impacts, costs, and induced demand.

Table 40 - 2045 Level of Service

	Hourly Time Period	Level of Service (Hour of Day)																							
		0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23
TH 15 and 12th St	No Build	B	A	A	A	B	B	C	D	D	C	C	D	D	D	C	D	D	D	C	C	C	B	B	B
	(D) Widen	A	A	A	A	B	B	C	C	C	C	C	C	C	C	C	D	D	D	C	C	C	B	B	B
	(E) MUT - AG	A	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A
	(E) MUT - GS	A	A	A	A	A	A	A	B	B	A	A	B	B	B	B	B	B	B	B	A	A	A	A	A
	(F) DLT Corridor	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	C	B	B	B	B	A	A	A
	(G) Volume Freeway	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	(H) Spacing Freeway	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A	A	B	A	A	A	A	A	A	A
TH 15 and 8th St	No Build	B	A	B	B	B	B	C	C	C	C	C	C	C	C	C	C	C	C	C	C	C	B	B	B
	(D) Widen	B	A	B	B	B	B	C	D	C	C	C	C	C	C	C	C	D	D	C	C	C	B	B	B
	(E) MUT - AG	A	A	A	A	A	A	A	B	A	A	A	B	B	B	B	B	B	B	B	A	A	A	A	A
	(E) MUT - GS	A	A	A	A	A	A	B	B	B	A	A	B	B	B	B	B	B	B	B	A	A	A	A	A
	(F) DLT Corridor	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A
	(G) Volume Freeway	B	A	A	A	B	B	C	C	B	B	B	B	B	B	C	C	C	C	C	B	B	B	A	A
	(H) Spacing Freeway	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
TH 15 and 3rd St	No Build	A	A	A	A	B	B	B	C	C	C	C	C	C	C	C	D	D	E	E	D	C	B	B	B
	(D) Widen	A	A	A	A	B	B	B	C	C	C	C	C	C	C	C	D	D	D	C	C	C	B	B	B
	(E) MUT - AG	A	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A	A
	(E) MUT - GS	A	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A
	(F) DLT Corridor	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A
	(G) Volume Freeway	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
	(H) Spacing Freeway	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	A	A	A
TH 15 and Division Street	No Build	B	B	B	B	B	C	C	C	C	D	D	E	E	E	E	E	E	E	E	D	D	C	C	B
	(D) Widen	B	B	B	B	B	C	C	C	D	D	D	E	E	E	D	E	E	E	E	D	D	C	C	B
	(E) MUT - AG	B	B	B	B	B	B	B	B	B	B	B	C	C	C	C	C	C	C	C	B	B	B	B	B
	(E) MUT - GS	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	C	C	C	B	B	B	B	A	A
	(F) DLT Corridor	B	B	B	A	B	A	B	B	B	B	B	B	C	B	C	C	C	C	C	B	B	B	B	B
	(G) Volume Freeway	B	B	B	B	B	B	C	C	C	C	C	D	D	D	D	D	D	D	D	C	C	B	B	B
	(H) Spacing Freeway	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
TH 15 and 2nd Street	No Build	B	B	B	B	B	C	D	D	D	D	D	D	E	E	E	E	E	E	E	E	D	C	C	B
	(D) Widen	B	B	B	B	B	C	D	D	D	D	D	D	E	E	E	E	E	E	E	D	D	C	C	B
	(E) MUT - AG	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	B	C	C	C	B	B	B	B	B
	(E) MUT - GS	A	A	A	A	A	A	B	B	B	B	B	B	B	B	B	B	B	C	B	B	B	B	A	A
	(F) DLT Corridor	B	A	A	A	B	B	B	B	B	B	B	B	B	B	B	C	C	C	C	B	B	B	B	B
	(G) Volume Freeway	B	A	A	A	B	B	B	C	C	C	C	C	C	C	C	C	C	C	C	C	C	B	B	B
	(H) Spacing Freeway	A	A	A	A	A	B	B	B	B	B	B	C	C	C	C	C	C	C	C	B	B	B	B	A

IMPLEMENTATION PLAN

This Implementation Plan is intended to synthesize analyses from all the previous phases of the TH 15 Corridor Study to provide a path to eventual project implementation for roadway improvements in the study area.

Summary of Studied Roadway Improvement Alternatives

Detailed technical analysis was completed for the following roadway improvement alternatives in the TH 15 study area. More details related to this analysis can be found in the alternatives analysis section of this report.

- Short-term improvement alternatives (2020-2025)
  - Alternative (A) Spot Improvements. Generally small-scale intersection geometry improvements like turn lanes, additional pedestrian accommodations, and improvements to signal operations.
  - Alternative (B) Adaptive Signal Control.
  - Alternative (C) Noise Walls.
- At-grade corridor improvements.
  - Alternative (D) Widen. This would widen the corridor to six lanes.
  - Alternative (E) Median U-turn Corridor (grade separated and at-grade options). This would expand the corridor to six lanes and restrict turning movements at study intersections, to be completed at U-turn locations north and south of study intersections.
  - Alternative (F) Displaced Left Turn Corridor. This would expand the corridor to six lanes and install continuous flow or DLT intersections at the study intersections.
- Freeway corridor improvements.
  - Alternative (G) Volume Focused Freeway. This alternative would create an access-controlled freeway with interchanges at 2nd Street, Division Street, and 8th Street.
  - Alternative (H) Spacing Focused Freeway. This alternative would create an access-controlled freeway with interchanges at 2nd Street, 3rd Street, and 12th Street.

Steering Committee Review of Alternatives

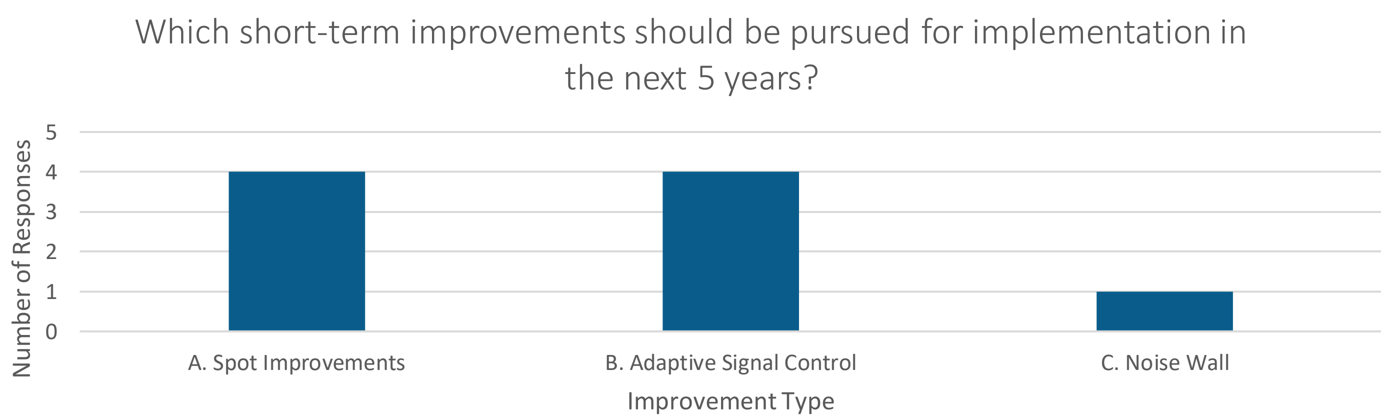
The project's Steering Committee members were asked to provide feedback related to improvement alternatives that were presented in the alternatives analysis. Feedback was provided by eight committee members, including staff from MnDOT, St. Cloud APO, Stearns County, and the City of Saint Cloud. A summary of feedback that was received is provided below.

Short-Term Improvements

Short-term improvements were classified as low-cost improvements with specific benefits. Most strategies had limited impacts beyond five to 10 years and are unable to address the most significant issues expected through 2045. Based on Steering Committee feedback, several short-term, low-cost, improvements were identified as favorable. Specifically, Alternative (A) Spot Improvements and Alternative (B) Adaptive Signal Control both received support from half of committee members.

Alternative (C) Noise Wall was not directly opposed by most but was generally not identified as resolving the core issues along the corridor. Additionally, many felt that noise walls could be considered with any alternative. This concept was not discarded from further analysis, but rather it was determined that the type of project that was to be pursued (at-grade or freeway) would determine the type of noise wall project that would be pursued. If a Type I project is pursued (any of the at-grade or freeway alternatives), then further noise analysis will be required as part of the environmental process. If Do Nothing is pursued, or a slow-moving implementation strategy, the Greater Minnesota Noise Barrier Program can be pursued for funding.

Figure 95 - Steering Committee Feedback: Short-Term Improvements



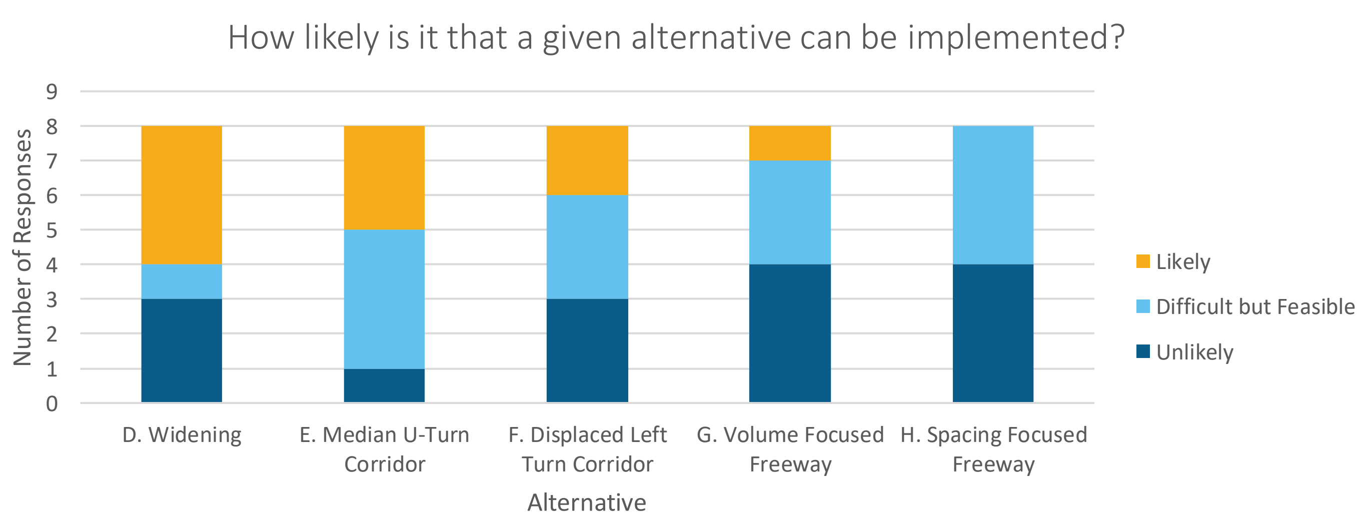
Note: Respondents could select multiple options.

At-Grade and Freeway Improvements

Feasibility Assessment and Implementation Challenges

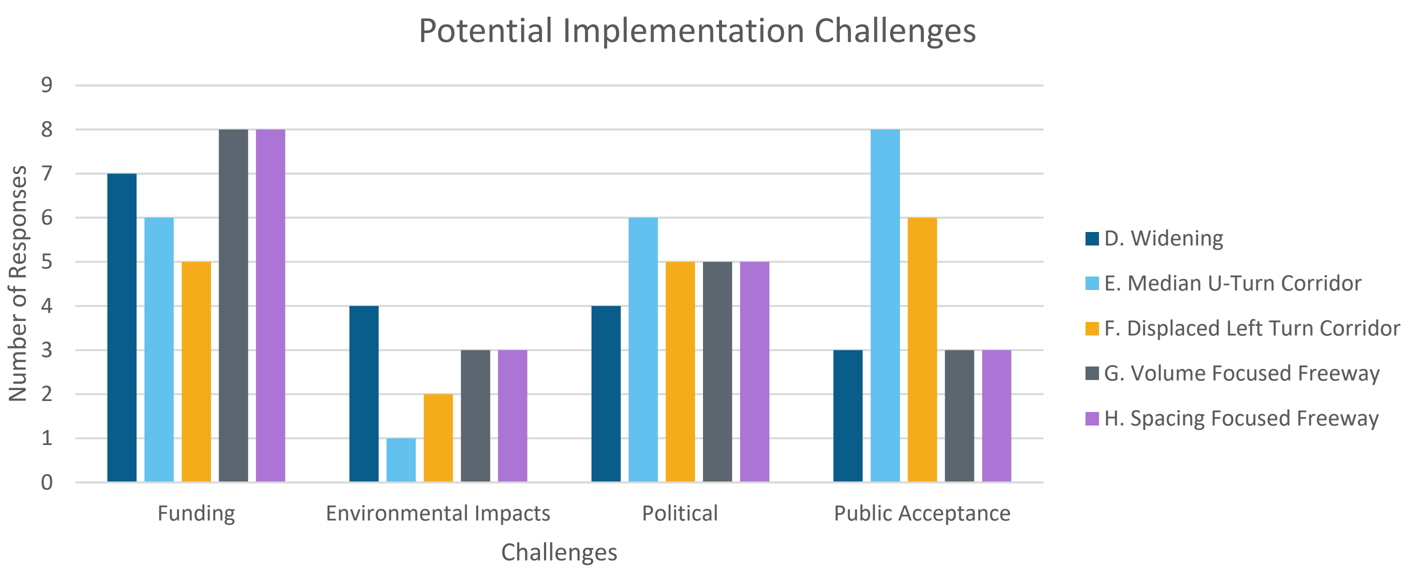
The committee was asked about the feasibility of implementing more transformative projects with long range benefits. Committee feedback shows that corridor widening or conversion to a median U-turn corridor are expected to be the most feasible improvement types, with freeway concepts being deemed the most infeasible. Many committee members believe that freeway concepts are not completely infeasible but would face significant implementation challenges.

Figure 96 – At-Grade and Freeway Improvements: Feasibility Assessment



The committee was then asked to provide details related to potential implementation challenges for each alternative that is being considered. Funding constraints and political challenges are expected with all alternatives, with non-traditional improvements like median U-turns or displaced left turns likely facing some opposition from the general public.

Figure 97 - Mid and Long-Term Improvements: Implementation Challenges



Note: Respondents could identify multiple challenges associated with an alternative.

Ranking of Alternatives

The Steering Committee also provided feedback on which alternatives had potential to advance through project development and which were likely infeasible. This feedback was designed to understand whether qualitative instincts matched quantitative technical analysis. Generally, they did, but the Committee also made it clear that more public and political involvement was necessary before opinions could be formalized.

Public Feedback Related to Improvement Alternatives

The public was invited to provide feedback related to roadway alternatives that are being considered in a virtual open house format hosted on the project website, www.mobilize15.com, that ran from December 2nd to December 15th. Three opportunities for feedback were provided:

- Submitting written comments.
- Participating in the alternatives survey. A total of 36 people responded to the alternatives survey.
- A live Q&A on December 10th. Three people participated in the live Q&A. A representative from Crossroads Mall was one of the participants and represented multiple tenants within the mall.

Detailed information related to public engagement is provided in the appendix, with key details summarized below. Further engagement will be necessary as the project advances.

Alternatives Presented to the Public

Short-Term Improvements

For short-term improvements, it was determined that noise walls should be considered for all alternatives, including those being considered for longer-term implementation. As such, noise walls were not presented as an alternative, but rather an element that can be included in any alternative.

For spot improvements, the most beneficial improvements (like small-scale intersection geometry improvements, signal revisions, and multimodal enhancements) were presented a single set of improvements.

Long-Term Improvements

To best obtain meaningful feedback, only two long-term improvement alternatives were presented to the public. This decision was made to avoid confusion related to highly technical design concepts that could be difficult for the general public to differentiate during a short public engagement event. Furthermore, the technical analysis results clearly found two alternatives as being the most beneficial and implementable solutions. The two long-term concepts that were presented to the public were:

» One at-grade concept: Alternative (E) Median U-turn Corridor.

» One freeway concept: Alternative (H) Spacing Focused Freeway.

Public Feedback

Through the survey, the public was asked to provide feedback on the proposed alternatives and implementation.

How Well Do the Alternatives Address the Issues?

The first set of questions was aimed at understanding whether the public views the alternatives as effective.

» For the spot improvements, nearly 60 percent of the public did not believe these improvements would address the issues at all (score of one) over the next five to 10 years. See Figure 98 for more details.

» For the at-grade improvements, nearly 50 percent of the public believed these improvements would address the issues somewhat (score of three) over the next 10 to 30 years. See Figure 99 for more details.

» For the freeway improvements, more than 60 percent of the public believed these improvements would address the issues extremely well (score of five) over the next 10 to 30 years. Another 30 percent believed the freeway improvements would address the issues very well (score of four). See Figure 100 for more details.

Figure 98 - Spot Improvements: How Well Does it Address the Issues?

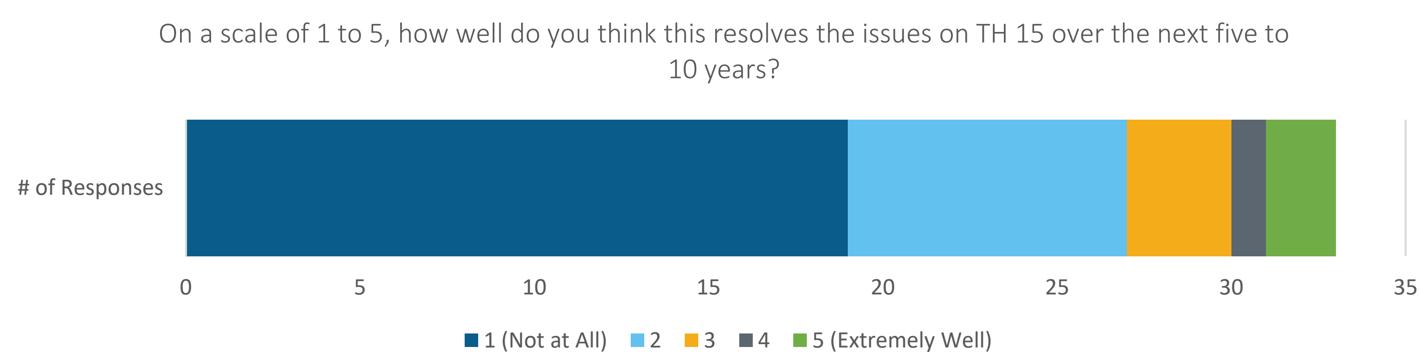


Figure 99 - At-Grade Improvements - How Well Does it Address the Issues?

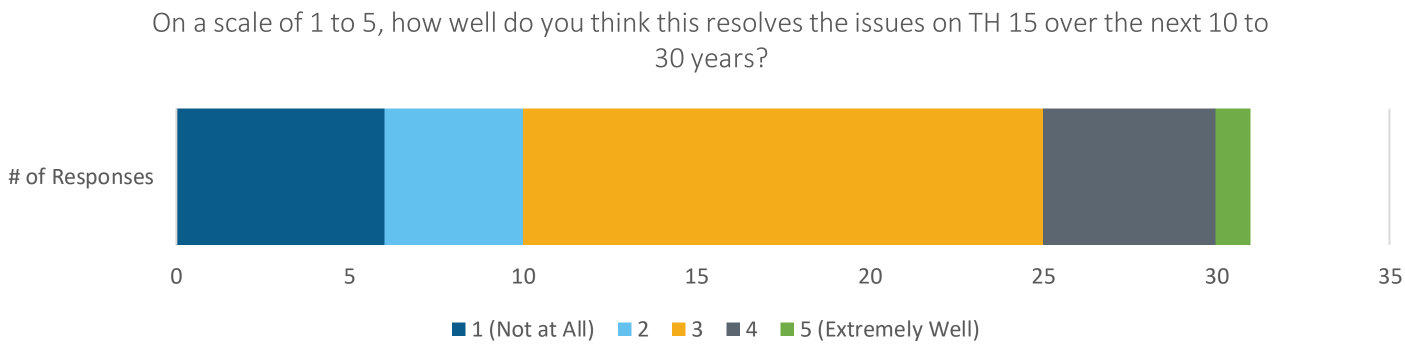
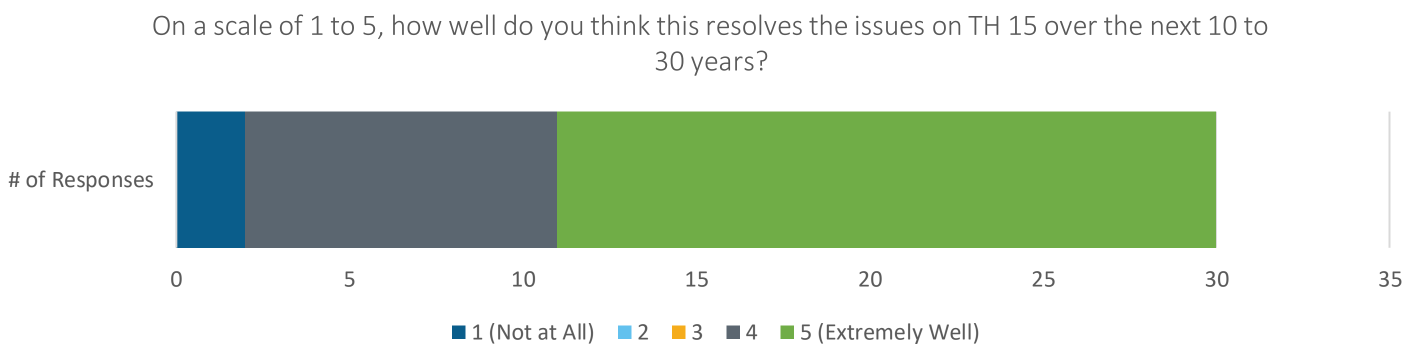


Figure 100 - Freeway Improvements - How Well Does it Address the Issues?

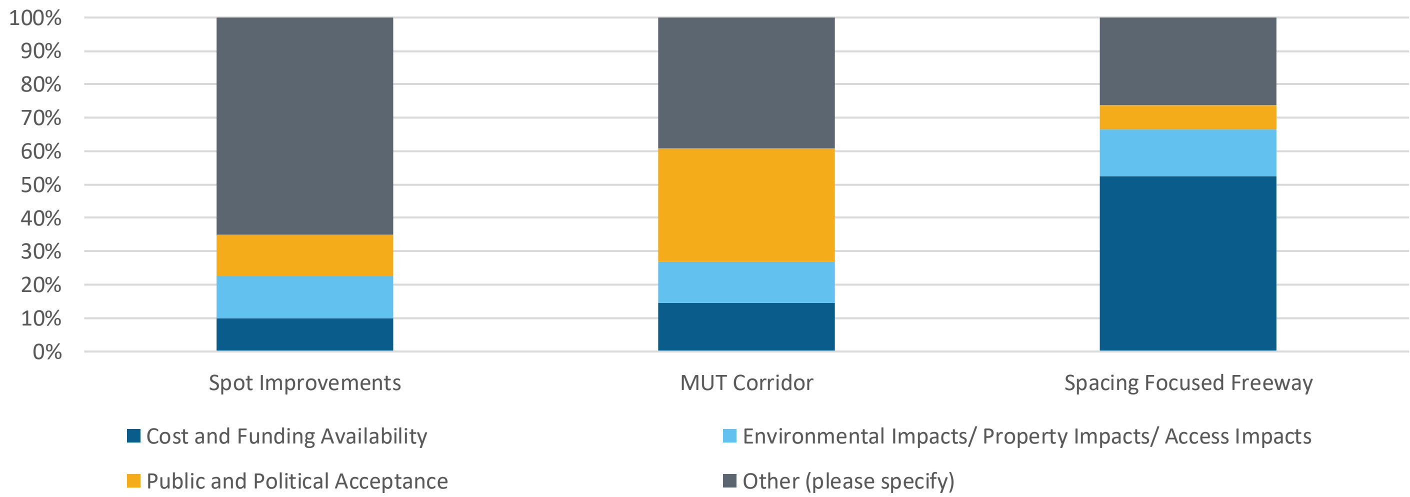


Barriers to Implementation

The public was asked what the primary barriers to implementation are for each of the three presented alternatives. Figure 101 shows the primary barriers to implementation for each of the alternatives.

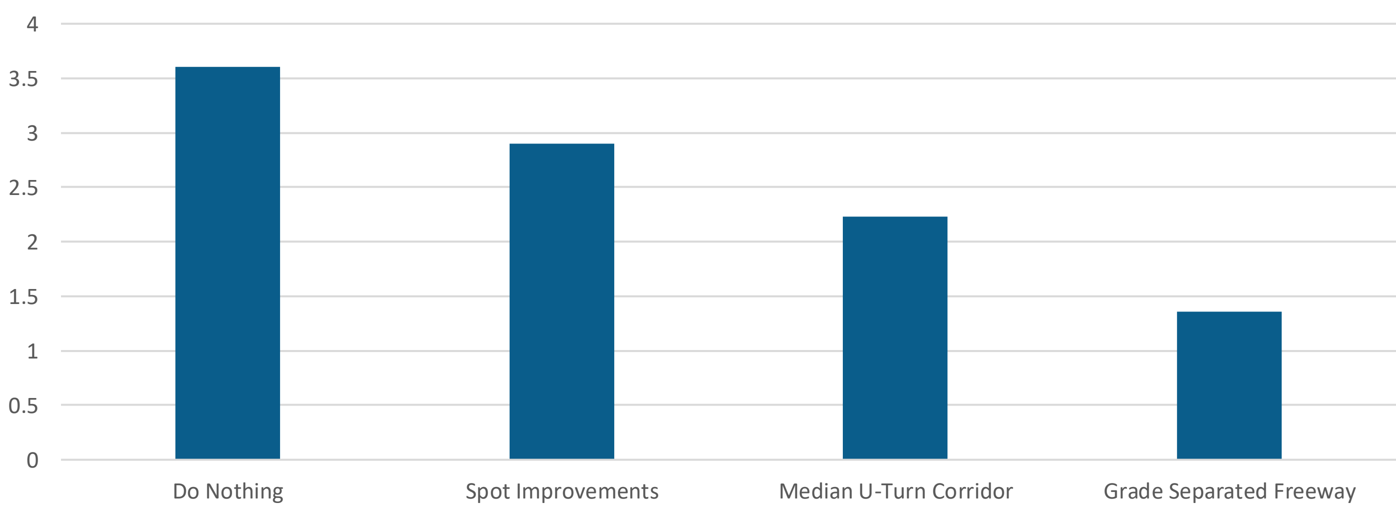
- For the spot improvements, there were few concerns about cost, public and political acceptance, and impacts. There were 26 “Other” issues, that primarily focused on no long-term benefit and the alternative does not do enough to address safety and congestion.
- For the at-grade improvements (MUT corridor), public and political acceptance was the primary barrier to implementation, as well as “Other” issues. The public was concerned about drivers understanding the MUT, congestion at the U-turn locations creating other safety issues, and that it still is a temporary fix. Based on some of the comments, it was not clear to respondents that the U-Turn locations would be signalized, like the Reduced Conflict Intersection designs that many drivers have encountered in greater Minnesota.
- For the freeway improvements, cost and funding was the primary concern. There were a significant number of “Other” issues identified, but they generally focused on the length of time to implementation.

Figure 101 - Primary Barriers to Implementation



The public was also asked to prioritize the improvements, with one being the most preferred alternative and four being the least preferred alternative. Figure 102 shows the freeway concept is the most preferred concept. Only 16 percent of respondents did not identify the freeway as their most preferred concept.

Figure 102 - Public Ranking of the Alternatives



The final set of questions asked for the public's preference on four different implementation concerns:

» Would you rather see some issues resolved in the next 10 years or wait until all issues can be resolved, but it may take 30 years or longer for funding? More than 60 percent of respondents said they would prefer to resolve some issues sooner. See Figure 105 for more details.

» Would you rather have efficient and safe travel conditions if it meant you needed to backtrack to reach a destination? Nearly 80 percent of respondents said they would prefer direct access. See Figure 106 for more details.

- Would you rather see the biggest problem area resolved in the next 10 years and wait for the rest of the corridor or resolve everything at once? More than 63 percent of respondents said they would prefer to wait to resolve everything at once. See Figure 104 for more details.
- Are property and environmental impacts acceptable if it means the safety, operations, and pedestrian and bicycle issues can be resolved? More than 90 percent of respondents said impacts are acceptable. See Figure 103 for more details.

Figure 105 - Resolve Some Issues or Wait for Everything?

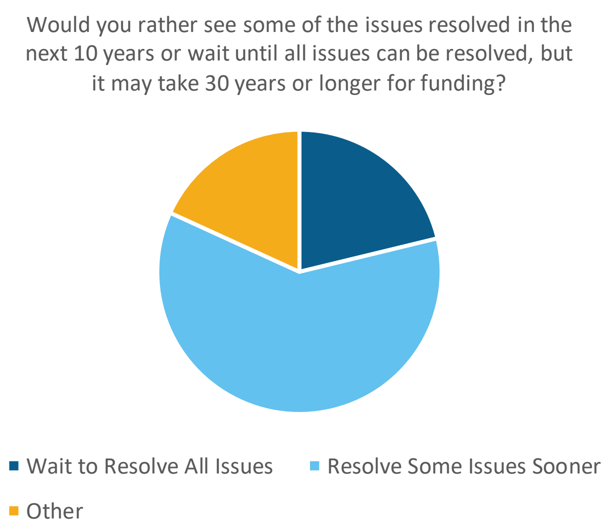


Figure 106 - Direct Access or Backtrack?

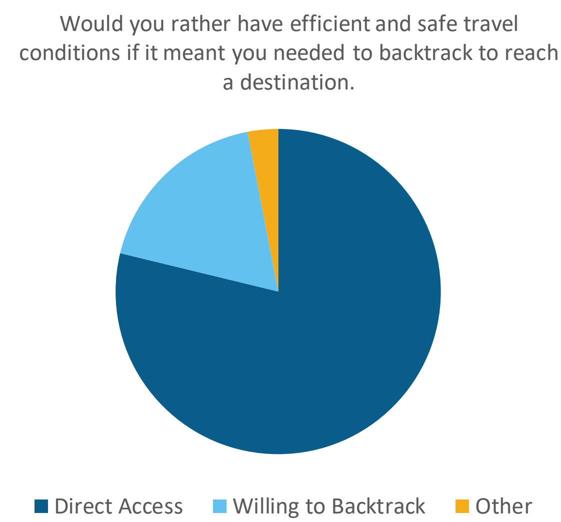


Figure 104 - Biggest Issues First or Wait for Everything?

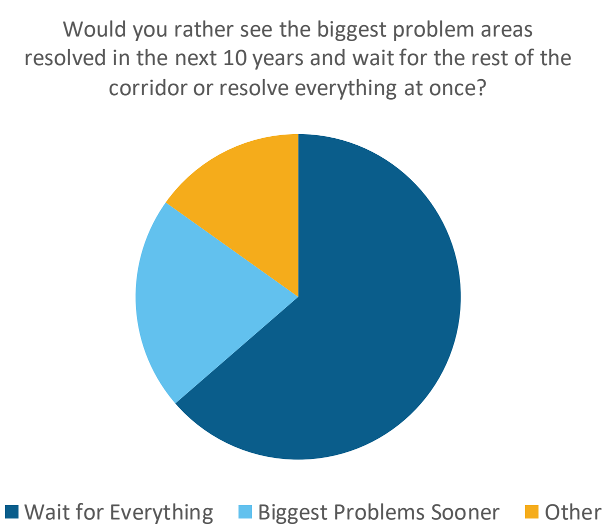
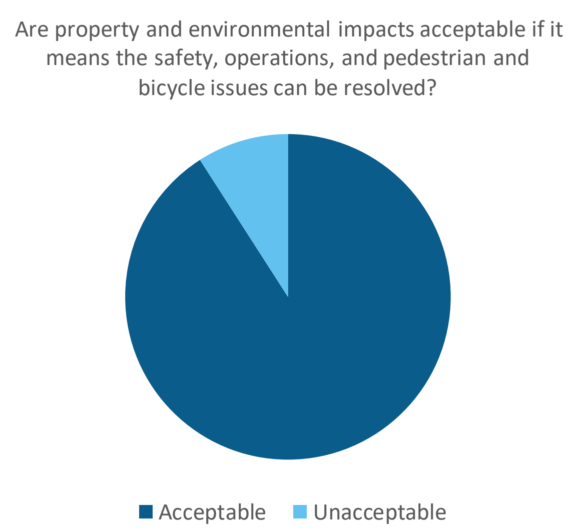


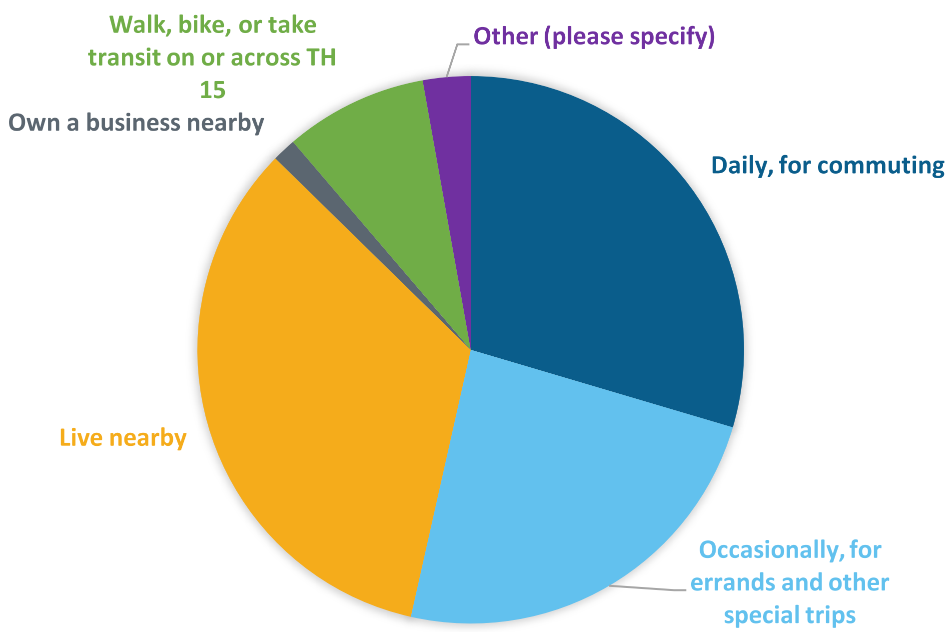
Figure 103 - Are Property Impacts Acceptable?



Non-Survey Comments

At the virtual Public Input Meeting, the St. Cloud Area Chamber of Commerce and representatives from the Crossroads Center Shopping Mall made it clear that closing Division Street would be a major barrier for businesses along that corridor. While the mall has access from 3rd Street as well, the primary access, along with several driveways, is from Division Street. The Chamber echoed the concerns as it related to several other businesses along the corridor. Both entities had less concern with the Median U-Turn Corridor given it maintained access at Division Street. Based on this feedback, and the results of the proximity to TH 15 question in the survey, a potentially underrepresented voice in the public survey is the business community. Figure 107 shows how survey respondents use the corridor.

Figure 107 - How Do You Use the Corridor?



Summary

The following key takeaways were drawn from the public input process:

- The general commuting public far prefers the freeway concept but acknowledges concerns related funding and timing.
- The Median U-Turn Concept was less desired, but the primary concern was related to educational topics: understanding the concept and misunderstanding of the U-turn traffic control devices.
- The public was clear that they wanted the issues resolved, noting that short-term improvements would not resolve the problem and noting that impacts would be acceptable to resolve the issue.
- There was some misunderstanding in the relationship between costs and impacts to implementation timeline. Most said they would rather have some issues resolved than wait 30 years, but most still preferred the Grade Separated Freeway Concept and did not support phased implementation.
- There are some business concerns that may be underrepresented in the survey with the interchange concept limiting access to Division Street.

Concept Refinement

The following improvement alternatives have been advanced to implementation planning. Each alternative advanced to this phase of the process was studied in greater detail to better estimate costs and impacts. The primary change from the previous cost estimates was factoring in high-level property impact and noise wall costs. The refinements made to each alternative and the impacts is discussed below.

Spot Improvements

The Spot Improvements alternative would include the following:

- Add dual left-turn lanes on the minor streets (where they did not exist already) to reduce queueing and improve throughput.
- Incorporate multiple pedestrian crossing safety enhancements such as signalized crossings at porkchop islands with no right-turn on red when pedestrians are crossing and lead pedestrian interval. Lead pedestrian interval allows pedestrian specific timing to improve visibility.
- Adaptive Signal Control (ASC). ASC uses real-time traffic information to dynamically change signal timing. These improvements have been found to reduce vehicle-pedestrian crash by more than 60 percent. ASC along this corridor can reduce daily delays by up to 10 percent in the short-term by being more responsive to off-peak traffic fluctuations.

After five to 10 years, the operational benefits are mitigated by the increase in traffic volumes and the only remaining benefits are pedestrian and bicycle crossing benefits. A summary of the spot improvements alternative is shown in Figure 108.

Refinements

The refinements made to the spot improvement alternative included reducing the number of double left-turn lanes from six to two based on a more refined analysis of the concept. This reduced the overall cost by $300,000. Detailed cost estimates are included in the appendix.

Median U-Turn Corridor

The Median U-Turn (MUT) corridor removes left-turns at intersections. To complete a left-turning movement.

- Drivers on TH 15 would continue straight through the intersection and make a U-turn and then a right-turn.
- Drivers on the intersecting roads would make a right-turn and then a U-turn.

By removing left-turn phasing from the intersection, the extra green time can be spent on the higher volume through movements, effectively reducing delays and long queues that frequently result in rear-end crashes. Nationally, this type of concept has been constructed in nearly a dozen states since the 1960s. Studies have found this concept can reduce delays and crash potential by 20 to 50 percent. Corridor specific modeling found the following:

- Reduce bicycle/pedestrian crossing risk up to 50 percent.
- Reduce delays up to 24 percent.
- Reduce conflict potential up to 21 percent.

Removing the grade separated U-turn between 2nd Street and Division Street would reduce costs significantly, but also see around 10 percent fewer benefits. A summary of the MUT corridor alternative is shown in Figure 109.

Refinements
There were minor refinements made to the MUT corridor, including more detailed costs for property impacts and noise walls. This increased the overall cost by approximately $6 million. Further refinement can occur at each intersection if it is determined that a third through lane is desired that feeds directly into the U-turn lane. This improvement can be accomplished without widening given the existing cross-section and is expected to have notable operational benefits. The potential downside is lane assignments from the side streets and longer pedestrian crossings. Detailed cost estimates are available in the appendix.

Spacing Focused Freeway
The Spacing Focused Freeway concept would create a grade separated freeway for the entire length of the corridor. Grade separated interchanges would be constructed at 2nd Street, 3rd Street, and 12th Street, with underpasses constructed at Division Street and 8th Street. This alternative comes with notable benefits but also major costs, that may preclude the concept from being built in the short- or mid-term.

- Reduce bicycle/pedestrian crossing risk up to 39 percent.
- Reduce delays up to 52 percent.
- Reduce conflict potential up to 59 percent.

The major efficiencies may also draw upwards of 15,000 new vehicles to the area, providing regional benefits but potentially minimizing overall corridor benefits.

Refinements
There were refinements made to the freeway concept, including more detailed costs for property impacts and noise walls, which increased the overall cost by approximately $11.5 million. Further refinements can occur if it is determined that the interchange location should be located at 8th Street instead of 12th Street. This variation provides worsened operations, due to the lack of right-of-way for a full diamond concept on the south side of 8th Street. The benefits 8th Street provides is more regional connectivity, higher traffic volumes, and reduced traffic impacts to Apollo High School, as well as a lowered cost, around $8 million. Detailed cost estimates are available in the appendix.

Figure 108 - Spot Improvements

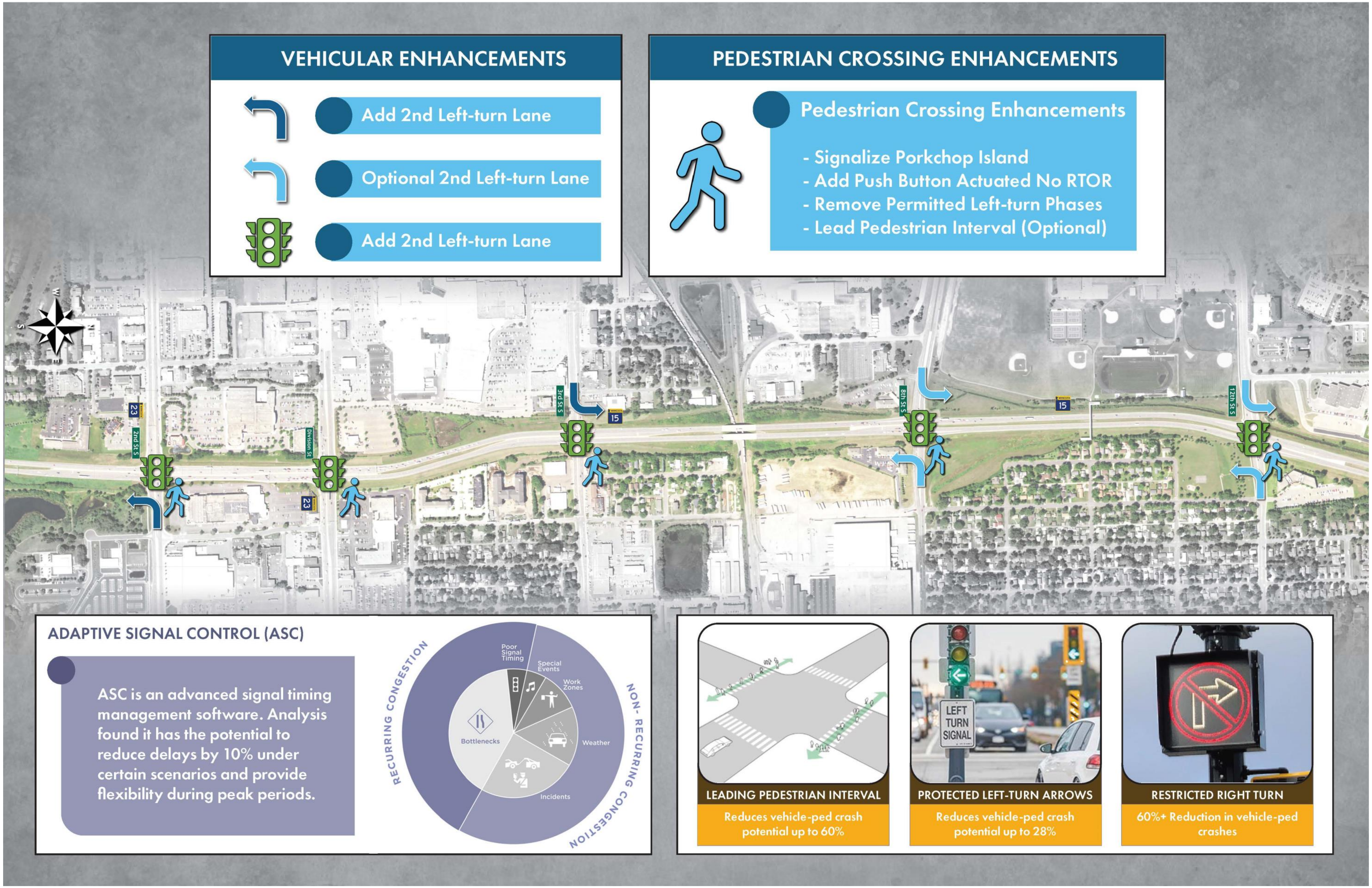


Figure 109 – Median U-Turn (MUT) Corridor

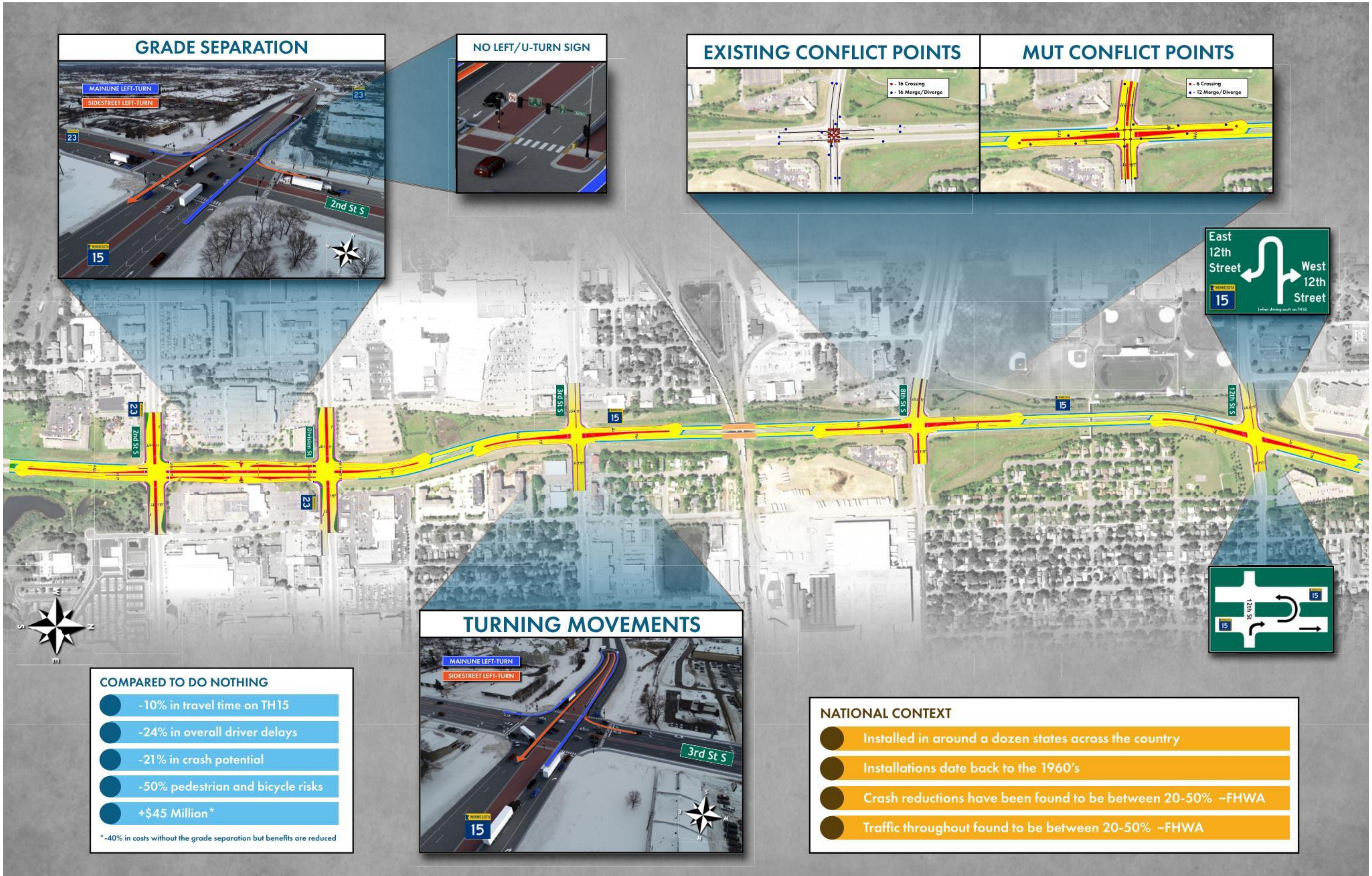
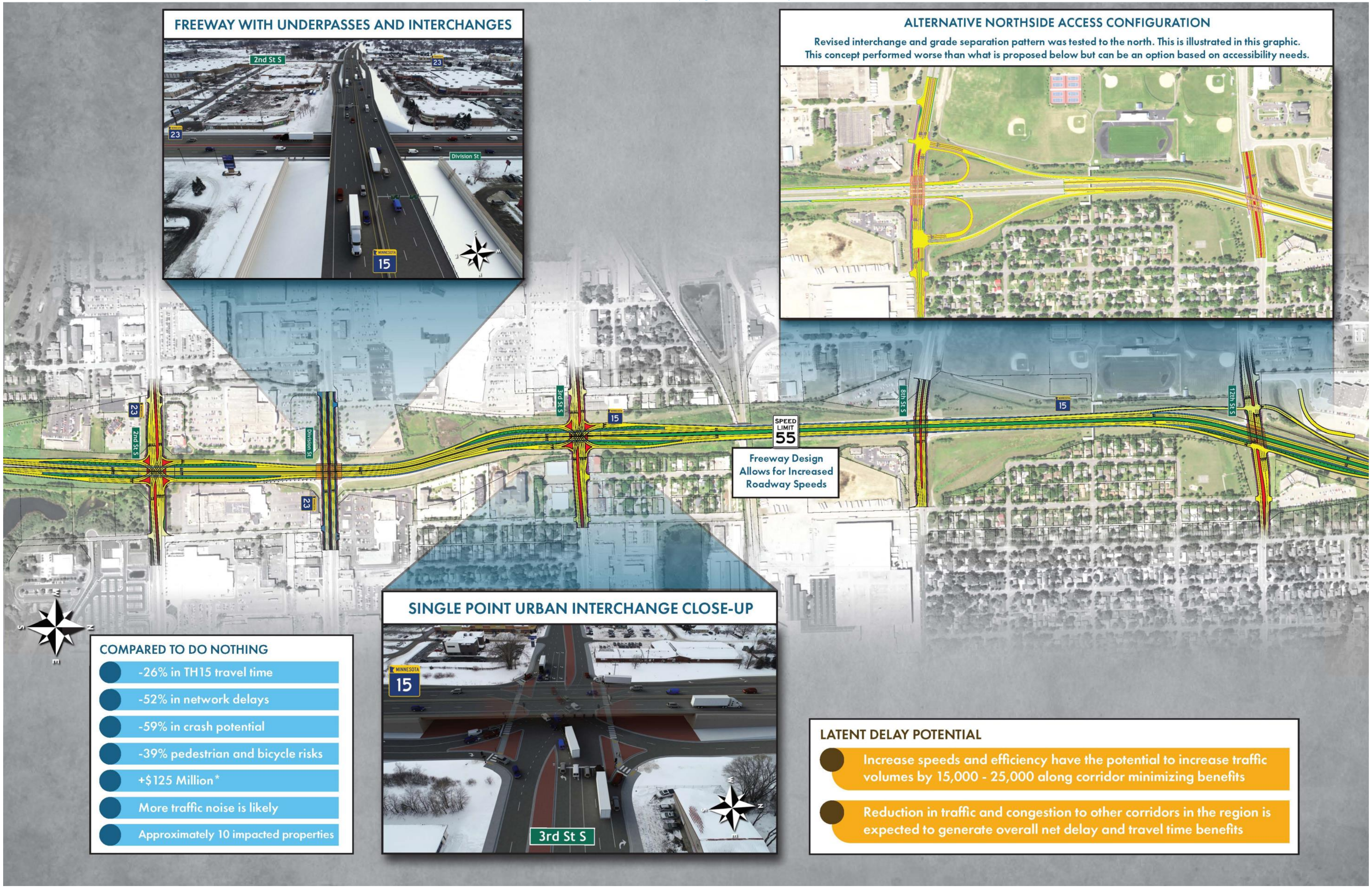


Figure 110 – Access Spacing-Focused Freeway



Funding Availability Assessment

To establish reasonable funding availability assumptions, various planning documents and potential funding sources were evaluated to see how they fit into the goals of this corridor study. There are multiple funding opportunities that can be pursued to support the implementation of improvements on TH 15. Due to the magnitude of the improvements, multiple funding opportunities are likely required for full implementation.

MnDOT District 3 Capital Highway Improvement Plan (CHIP)

MnDOT's Capital Highway Improvement Plan (CHIP) establishes the next ten years of planned projects within each district. The TH 15 corridor is located in District 3, which operates nearly 4,000 lane miles. District 3 is projected to invest $1.3 billion in state highway projects between 2021 and 2030, with annual investments ranging between $75 million and $200 million in this timeframe, with an average around $80 million. Maintenance activities are typically around 75 percent of their annual budget.

- System stewardship - $954.7 million
- Transportation safety - $58 million
- Making critical transportation connections - $37 million
- Supporting healthy communities – $70 million
- Delivering transportation projects – $190 million

Generally, District 3 has around $25 million each year to dedicate to safety and capacity deficiencies, like those found on TH 15. Potential mid-term to long-term improvements identified in this corridor study are estimated to cost between $31.77 million (at-grade MUT corridor) to $117.18 million (freeway conversion). Given the current CHIP funding forecast, other funding sources may need to be considered if improvements are desired in the short to mid-term.

Short-Term Funding Programs

The following funding sources would not provide sufficient funding for major projects that are proposed in the mid- or long-term but could be used for short-term spot improvements that are being proposed.

MnDOT Local Partnership Program (LPP)

This is a state-funded program intended to pay for a portion of the Trunk Highway eligible construction costs of the project and up to eight percent of the construction engineering costs. Desired projects are locally led projects that are not large-scale enough to be led by MnDOT. Funds can also be used for trail projects that increase pedestrian safety along or crossing Trunk Highways.

Solicitation timing for this program is determined by MnDOT District 3 state aid and has recently typically been released in November and due late January.

- Historic max award: $710,000
- Historic amount available per fiscal year: $1.2 million

Highway Safety Improvement Program (HSIP)

This funding is awarded to projects that have great potential in achieving a significant reduction in traffic fatalities and serious injuries on all public roads. Projects must aim to identify, implement, and evaluate cost effective safety projects focused on reducing fatal and serious injury crashes. The program is also focused on reduced pedestrian and bicycle related crashes. Solicitation is available every two years typically in late summer and applications are typically due in late November.

- Historic max award: $2 million
- 2020 amount available to District 3: $2.8 million (FY's 2023-24)

Transportation Alternatives (TA)

This is a federally funded program intended to pay for pedestrian and bicycle facilities, historic preservation, Safe Routes to School, and more. The primary purpose must be transportation (not recreational). Awards for this program require a 20 percent local match. Letters of intent are typically due at the end of October, with full applications due in early January. Grant awards are typically announced by early spring.

- Historic max award: $1M
- Historic amount available for ATP 3: $1.6 million

Greater Minnesota Standalone Noise Barrier Program

This is a state funded program intended to pay for noise barrier projects outside of the Twin Cities metro area. Locations eligible for the noise barrier program must be adjacent to a limited access roadway, approach or exceed the noise abatement criteria, and cannot require a right-of-way purchase. Applications are typically accepted between October 1 and December 31. Awards are typically announced before June of the following calendar year.

Grant Opportunities for Transportation Funding

MnDOT Transportation Economic Development (TED) Program

This program provides competitive grants to construction projects on state highways that provide measurable economic benefits. The TED program specifically targets transportation improvements that will lead to measurable economic benefits. For a project to be eligible, it must contribute to job creation, retention, or another measurable economic benefit. Expressions of interest for this program are typically due in late summer and applications are due in the fall.

- Historic max award: $10 million
- Historic amount available each year: $20 million

Minnesota Highway Freight Program (MNHFP)

The Minnesota Highway Freight Program is a grant program designed to improve safety, mobility, and meet the needs of the state's freight transportation system at a local level. Minnesota cities, counties, ports, waterways, railroads, and airports can apply for funding for highway transportation and intermodal projects that benefit freight movement throughout the state. Freight improvements that are funded will also help to meet the investment goals identified in the State Freight Plan. Applications for this program are typically due in the fall.

- Historic max award: $10 - $20 million (depending upon annual allocation)
- Historic amount available per fiscal year: $20 - 22 million

MnDOT Local Roads Improvement Program Bond Request

This is a formal application request to have a project included in a state bonding bill and is intended to pay for public facility construction or reconstruction projects with local, regional, or statewide significance. Funds can be requested for roadway and/or standalone non-motorized transportation projects in addition to community development projects.

Applications for this request are typically due in June, prior to a bonding year, and inclusion in the proposed bonding bill is announced between later summer through the following early spring. Bonding was passed in October 2020, so applications for the 2022 bonding year will be due in June 2021.

» Historic max award: Varies
» Historic amount available per bonding cycle: Varies

Corridors of Commerce

The Corridors of Commerce program is a state funded program that recognizes that transportation investments directly and indirectly foster economic growth. There are a series of key criteria projects must meet to be eligible for this program, including consistency with the statewide transportation plan, on a state highway, reduce freight bottlenecks, cannot be listed in a transportation improvement program, and must be able to begin construction within four years of award. This program relies on legislative authorizations and grant awards are roughly split 50-50 between the MnDOT Metro district and Greater Minnesota. No funding has been provided to this program since 2017.

Better Utilizing Investments to Leverage Development (BUILD) Transportation Discretionary Grant Program

BUILD grants are awarded on a competitive basis for surface transportation capital infrastructure projects that will have a significant local or regional impact. Grant awards in rural areas (which includes St. Cloud) are between $1 million and $25 million. No more than $100 million can be awarded to a single State. Not more than 50 percent of funding is awarded to projects located in urban and rural areas, respectively. Money is also made available for eligible planning and preconstruction activities that do not result in construction of a capital project. Applications for this program are typically due in late spring.

» Historic max award: $25 million
» Historic amount available each year nationwide: $1 billion

In 2020, there were 656 applications submitted for BUILD funding, collectively requesting $9.2 billion worth of projects. Seventy projects in 44 states were awarded funding totaling $1 billion. In all, just 10 percent of funding applications received an award. However, award success varies by year.

Infrastructure for Rebuilding America (INFRA)

This program advances a grant program established in the FAST Act of 2015 to help rebuild America's aging infrastructure. INFRA utilizes selection criteria that promote projects with national and regional economic vitality goals while leveraging non-federal funding to increase the total investment by state, local, and private partners. The program also incentivizes project sponsors to pursue innovative strategies, including public-private partnerships.

The US Department of Transportation will make awards under the INFRA program to large and small projects. For a large project, the INFRA grant must be at least $25 million. For a small project, the grant must be at least $5 million. For each fiscal year of INFRA funds, 10 percent of available funds are reserved for small projects with at least 25 percent of INFRA grant funding to rural projects. Applications for this program are typically due in winter or early spring.

» Historic max award: no max set, average award size $40 million
» Historic amount available each year nationwide: $906 million

In 2020, there were 173 applications submitted for INFRA funding, collectively requesting $7.4 billion worth of projects. Twenty projects in 20 states were awarded funding totaling $293 million. In all, just 11 percent of funding applications received an award. However, award success varies by year.

IMPLEMENTATION SCENARIOS

Based on a range of potential funding sources and timelines, four separate implementation strategies were developed. The primary goal of developing these strategies is to provide a guide to project implementation with and without the receipt of grant funds. The first two scenarios are incremental solutions informed by historic funding and develop "best guess" timelines on when funding could be available for each scenario. The last two scenarios we completed to show a comparison of both full-build concepts if funding could be secured to build in the short-term.

Scenario 1: Phased Improvement Strategy – At-Grade Emphasis

This concept assumes signal improvements can be implemented without major construction impacts in the short-term, with more significant improvements planned in the mid- and long-term. The mid-term vision is implementing an at-grade median U-Turn (MUT) corridor, with a future conversion to a grade-separated MUT corridor in the long-term. Table 41 shows the phased improvement strategy for scenario one.

Table 41 - Scenario 1: Phased Improvement Strategy

	Short-Term	Mid-Term	Long-Term
Improvement	Adaptive Signal Control	At-grade MUT configurations for minor approach left turns at 2nd Street, Division Street, 3rd Street, 8th Street, and 12th Street	Modifies MUT configuration to grade separated U-turns between 2nd Street and Division Street
Cost	$400,000	$31.77 M	$20.98 M
Anticipated Implementation	2022	2030	2040 or beyond
Potential Funding Sources	CHIP	CHIP, HSIP, TED, MNHFP, LRIP, BUILD, INFRA	CHIP, HSIP, TED, MNHFP, LRIP, BUILD, INFRA

Scenario 2: Phased Improvement Strategy – Freeway Emphasis

Like Scenario 1, this scenario assumes an incremental improvement strategy that can be implemented as funding becomes available. Scenario 2 starts with intersection-level spot improvements in the short-term, with a phased conversion to a grade-separated freeway within the study area over time. Table 42 shows the phased improvement strategy for scenario two.

Table 42 - Scenario 2: Phased Improvement Strategy

	Short-Term	Mid-Term	Long-Term
Improvement	Implement Alternative (A) Spot Improvements: » Dual left-turn lanes on the westbound approach at 2nd Street and the eastbound and westbound approaches at 3rd Street » Pedestrian safety improvements at all study intersections » Adaptive signal control	Convert to access-controlled freeway between 2nd Street and 3rd Street including SPUIs at 2nd Street and 3rd Street and a grade separation without access to TH 15 at Division Street	Complete the freeway conversion between 3rd Street and 12th Street including a diamond interchange at 12th Street and a grade separation without access to TH 15 at 8th Street
Cost	$2.4 M	$75.78 M	$40.36 M
Anticipated Implementation	2025	2040	Beyond 2050
Potential Funding Sources	CHIP, HSIP, TA, LPP	CHIP, HSIP, TED, MNHFP, LRIP, BUILD, INFRA	CHIP, HSIP, TED, MNHFP, LRIP, BUILD, INFRA

Scenario 3: Grant Funding Strategy - At-Grade Emphasis

This scenario assumes grant funds are available to expedite implementation timelines compared to scenarios one and two, placing emphasis on at-grade improvements in the short and mid-term. This would implement the short-term spot improvements from scenario two and the long-term grade separated MUT concept from scenario one. Table 43 shows the phased improvement strategy for scenario three.

Table 43 - Scenario 3: Phased Improvement Strategy

	Short-Term	Mid-Term	Long-Term
Improvement	Adaptive Signal Control	MUT configurations for minor approach left turns. U-turns would be grade separated between 2nd Street and Division Street, with all other U-turns at grade	None
Cost	$400,000	$36.45 M	-
Anticipated Implementation	2022	2030	-
Potential Funding Sources	CHIP	BUILD, INFRA, LRIP	-

Scenario 4: Grant Funding Strategy – Freeway Emphasis

This scenario assumes grant funds are available to expedite conversion to a grade-separated freeway in the study area. This would implement the short-term spot improvements from Scenario 2 and the long-term freeway concept from Scenario 2. Table 44 shows the phased improvement strategy for scenario four.

Table 44 - Scenario 4: Phased Improvement Strategy

	Short-Term	Mid-Term	Long-Term
Improvement	Adaptive Signal Control	Convert to access-controlled freeway between 2nd Street and 12th Street including SPUIs at 2nd Street and 3rd Street, diamond interchange at 12th Street, and grade separations without access to TH 15 at Division Street and 8th Street.	None
Cost	$400,000	$117.18 M	-
Anticipated Implementation	2022	2030	-
Potential Funding Sources	CHIP	BUILD, INFRA, LRIP	-

BENEFIT/COST ANALYSIS

Benefit/cost analysis (BCA) was performed for each implementation scenario discussed above, as well as a scenario that only assumes short-term improvements. BCA provides an indication of the economic desirability of an alternative by comparing the calculated monetary value of benefits to the estimated project cost. Projects are considered cost-effective if the benefit cost ratio is greater than 1.0. The larger the ratio, the greater the benefits per unit cost.

Methodology

The BCA is based on MnDOT Benefit-Cost Analysis Guidelines (SFY2021). To establish a monetary value of project benefits, vehicle miles traveled (VMT), vehicle hours traveled (VHT), and simulated crash potential were quantified for each implementation scenario and compared to the No Build condition. Construction costs (including right-of way estimates), maintenance costs, and remaining capital value of infrastructure were quantified to represent the total user costs expected for the project.

Some key assumptions made by the project team for BCA analysis include:

- BCA performed for the time period between 2025 and 2044 (start of 2045).
  - Assumes the project benefits or costs are not factored in until the stated implementation year.
    - For example, in Scenario 2 it is assumed the 12th Street interchange will not be implemented until 2050. As such, benefits associated with this improvement are not factored into the BCA, but neither are the costs.
- Number of Days Analyzed – 365 days. This assumes uniform traffic between weekdays and weekends on TH 15 which is expected due to recreational and commercial use on the corridor.
- Safety-related benefits for each scenario were based on simulated conflicts rather than traditional crash modification factor methods.

Table 45 shows a summary of the BCA results for each implementation scenario.

BCA Summary for Implementation Scenarios

- All scenarios that were evaluated have a positive benefit/cost ratio.
- Short-term improvements provide some value over the next five to 10 years, however benefits begin to diminish over-time as traffic growth starts to require more comprehensive solutions.
- Each of the four scenarios provided a similar BCA (3.1 to 4.7), indicating that each project was a worthy investment. It is important to note that if the grade separated U-turn is not deemed necessary in the future, the BCA increases to 6.6.
- When comparing the two phased implementation strategies where the relationship between cost and time to implement is factored, it is important to understand that 57 percent of the overall value from the freeway concept is related to remaining service life. In terms of benefits felt by the driving public, the phased MUT concept (scenario one) provides $81 M worth of operational and safety benefits to drivers, before the freeway concept even begins to accumulate benefits, providing a clear study horizon advantage.
- When both projects are capable of being built at the same time (2030), the freeway concept provides a slightly better BCA with substantially more total benefits. Most of these benefits are felt on mainline TH 15, where the safety and operational benefits are concentrated.

» Note that this analysis only covers the time period up to 2045, meaning the full-build freeway condition is not factored into BCA calculations for scenario two (phased freeway) since it is expected the full configuration would not be completed until 2050 or later. Using a modest inflation rate of one percent, the overall costs projected to the year of construction year for the phased freeway concept increase to $148 M or around $88 M more than the phased MUT concept.

Consideration of Induced/Latent Traffic Demand Scenarios

» The study team evaluated induced demand scenarios due to improved TH 15 mobility with improvements. Travel demand modeling indicates a 40 to 90 percent increase in projected 2045 traffic volumes if widening or freeway concepts were implemented.

» BCA for induced demand scenarios were inconclusive since No Build simulation models cannot accommodate the assumed traffic volume increases, making comparisons to improvement scenarios difficult. A proper evaluation of these induced demand scenarios would need to expand the analysis area to understand operations impacts on corridors that have been impacted by major changes on TH 15. A high-level review of the latent demand scenarios reveals the following:

- The at-grade MUT configuration experiences notable congestion when major traffic growth is assumed, meaning significant induced demand is unlikely without conversion to a freeway. Even with the expected congestion when induced demand is assumed, this is still an improvement over a Do Nothing condition, with a benefit/cost ratio above 1.0 expected.
- An improved benefit/cost ratio is expected with the freeway configuration under induced demand compared to the at-grade MUT configuration. Under increased traffic volumes, the comparison is essentially between total gridlock with an at-grade configuration and a slow-moving freeway. Key flaws begin to arise as volumes increase on the freeway, namely congestion on surface streets with proposed freeway access.

Table 45 - BCA Results for Implementation Scenarios

Implementation Scenario	Assumed Improvements	Present Value of User Benefits (Millions of Dollars)				Present Value of User Costs (Millions of Dollars)				Benefit / Cost Ratio
		VHT Benefits	VMT Benefits	Crash Reduction Savings	Total Benefits	Construction Costs	Roadway Maintenance Costs	Remaining Capital Value of Infrastructure	Total Costs	
Only Short-Term Improvements	2022 - Spot Improvements + Adaptive Signal Control	10.1	0.0	5.6	**15.7**	2.6	0.1	0.0	**2.8**	**5.6**
Scenario 1 - Phased Improvements: At-Grade Emphasis	2030 - At-Grade MUT Corridor 2045 - Grade Separated MUT between 2nd St And Division St	154.2	-32.5	13.5	**135.1**	45.2	0.2	-13.2	**32.1**	**4.2**
Scenario 2 - Phased Improvements: Freeway Emphasis	2040 - Interchanges at 2nd St and 3rd St 2050 - Interchange at 12th St	108.4	1.2	31.4	**141.0**	64.7	0.0	-36.8	**27.9**	**5.1**
Scenario 3 - Grant Funding: At-Grade Emphasis	2030 - MUT Corridor with Grade Separation between 2nd St and Division St	180.3	-30.5	-0.3	**149.5**	48.2	0.3	13.9	**48.5**	**3.1**
Scenario 4 - Grant Funding: Freeway Emphasis	2030 - Interchanges at 2nd St, 3rd St, and 12th St	461.7	-33.8	79.2	**507.1**	107.1	0.3	-36.8	**107.4**	**4.7**

Alternative Comparison

Throughout this study, there has been a myriad of evaluation criteria uncovered, which encapsulate the difficult decisions key leadership are forced to weigh and evaluate when deciding a major project like those proposed in this study. Below is a summary of the key findings as they relate to the remaining alternatives two long-term alternatives: the MUT Corridor and the Grade Separated Freeway. Table 46 shows the summary of the considerations.

Table 46 - Alternatives Comparison Summary

	Pros	Cons	Advantage
Value Scoring Assessment	Factors qualitative and quantitative data using the value profiles established by the public and Steering Committee.	Value profiles exhibit desires as opposed to their assessment of the actual real-world constraints, which often leads to barriers like costs and property impacts having less weight than benefits.	**Freeway.** The grade separated freeway provides disproportionate value in terms of travel time and safety. Given the public priority on safety and improved operations, this alternative scored the highest because it provided the greatest benefits. When values are unweighted the two concepts are essentially equal.
Benefit/Cost Ratio	Provides insight into whether a project is worthy of investment over the study horizon and through the life cycle of the project.	Is not designed to be used as a ranking criterion and can often struggle to accurately factor environmental impacts and pedestrian/bicycle benefits.	**Cost Unconstrained: Freeway.** Both concepts provide worthy investments. If funding can be secured in the short-term for either concept, the Freeway provides substantially greater benefits. **Phased Implementation: MUT Corridor.** If time to secure funding is factored (most likely scenario), then the MUT Corridor provides clear advantages during the study horizon.
Induced Demand Impacts	Improvements to TH 15 may induce more traffic on the corridor, removing it from other congested or unsafe corridors.	May minimize overall benefits and may draw traffic from corridors that have ample capacity and are designed to support TH 15.	**MUT Corridor.** The analysis found the freeway concept would attract significantly more traffic to TH 15 than the MUT corridor. This may over burden the interchange intersections, creating new challenges.
Public Survey Responses	The survey provided the largest sample of public commentary.	The majority of respondents did not attend the live Q&A and comments left in the survey indicated there was some confusion with one of the alternatives.	**Freeway.** Despite concerns regarding costs and timeline, the public believed the freeway would address the most issues.
Public Non-Survey Responses	Special meetings and the live Q&A provided respondents with a good understanding of the tradeoffs between alternatives.	Only a few key stakeholders participated in the non-survey options.	**MUT Corridor.** The adjacent business community is concerned about lack of access at Division Street and how it will impact business.

Ultimately, through all the analysis, no one alternative rose to the top. Both alternatives outperformed in four categories. Decision makers will need to weigh all options before committing to an implementation plan. The final decision lies in the committee's feelings on the following topics:

» Timeline for funding: which would sway the benefit/cost ratio category. If a freeway cannot be built in the mid-term, a MUT corridor provides the clear advantage within the study horizon.

» Perception of Induced Demand: whether moving traffic off the local roadway system onto TH 15 is perceived as positive or negative would sway the scoring.

» Ease of Education: may have the potential to quell the primary concern related to the MUT Corridor which is concern over how to use it and how it would function.

Table 47 - Summary of Analysis

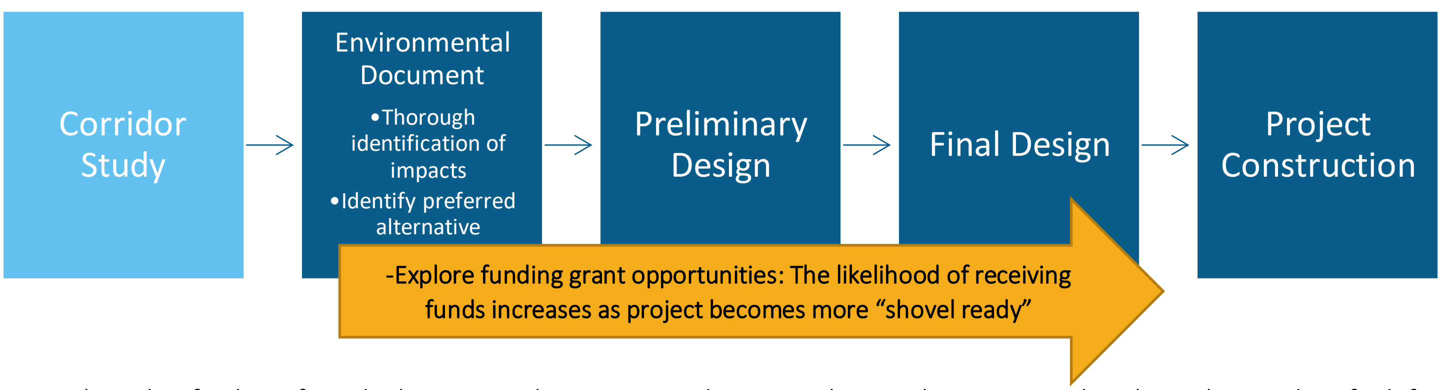
Alternative	Weighted Value	Unconstrained Benefit/Cost Ratio	Phased Implement. Benefit/Cost Ratio	Induced Demand	Public Survey Responses	Public Non-Survey Responses
Median U-Turn Corridor			✓	✓		✓
Grade Separated Freeway	✓	✓			✓	

Next Steps

Project Development

The primary goal of this Corridor Study was to identify potential solutions to mitigate known transportation-related deficiencies in the project area. This study is not intended to provide final recommendations for the corridor, rather it is intended to serve as a guide for future project development phases like environmental documentation, preliminary design, and final design. As such, concepts discussed throughout this study can be modified in future stages of project development to better meet area transportation needs or improve the feasibility/likelihood of project implementation. Figure 111 shows the key milestones in project implementation.

Figure 111 - Project Development Milestones



Note that the final preferred alternative does not need to exactly match concepts that have been identified for implementation in this study. For example, while a MUT corridor or freeway configuration meet project goals, perform well on a technical basis, and have support from local technical staff and the community, concepts from other alternatives (displaced left turns, for example) could also be re-assessed.

As major project development milestones are met, solicitation for funding grants should be increased. Projects that are "shovel ready" tend to have much higher success rates when seeking grant dollars. This is because such projects have addressed environmental requirements, have much more detailed cost estimate information, and show local willingness for funding participation.

Three next step scenarios were assessed, depending upon the Steering Committee's preferences:

» Advance the MUT Concept
» Advance the Freeway Concept
» Hybrid Scenario

Key Considerations for MUT Concept

Keys for Success

With unconventional roadway designs, a common barrier to achieving project support is public understanding. It is recommended that education and outreach efforts related to MUT operations and benefits are made if this improvement type is desired. This can be achieved using demonstration videos and visualizations that clearly show how the MUT corridor would operate, showing how delays and crash potential are significantly improved by reconfiguring left-turning movements.

Project Champion

Programming for this concept can be led by MnDOT given it is more likely to fit within MnDOT programs. Local support is however important and can help meet the desired implementation timeline or aid in the potential receipt of funding via grants.

Moving Forward

A public outreach and education strategy should be developed to obtain public support for the project. If public engagement results in this being a viable alternative, the MUT concept can be advanced into project development.

Key Considerations for Freeway Concept

Keys for Success

This concept has two critical barriers that compete with one another. One major barrier is the magnitude of impacts from freeway construction, which cannot be fully understood until the completion of environmental documentation. The other major barrier is funding. Given the uncertainty related to project funding, there may be reservations related to committing more planning funds to key project development elements like environmental documentation if it is unknown if a project will eventually be implemented.

Project Champion

If project implementation is desired in the short to mid-term the most likely source of funding is from grants. Grants require local champions to emerge, therefore the Cities and/or County will need to lead this effort, possibly with the support of local political leadership.

Moving Forward

If the freeway configuration is desired, an application should be submitted for the next round of BUILD or INFRA grants to see if the project can be funded, given the clear needs. If the application is unsuccessful, feedback should be obtained to identify where the project is lacking and identify next steps. If possible, advancing to project development will likely increase the likelihood of submitting a successful grant application.

Hybrid Approach

A hybrid strategy is possible for this corridor that concurrently pursues a freeway as the desired improvement and the MUT as a backup strategy. This strategy could be pursued in the short-term in the following manner:

- Begin project development to facilitate public education efforts for the MUT alternative and assess environmental and funding needs for the freeway concept.
- Begin programming using traditional funds (CHIP) for the phased MUT implementation approach.
- Simultaneously apply for grant funding for the freeway concept.
- Construct whichever can be funded first as both provide clear benefits over a do-nothing condition.

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