Highway 8 Improvement Project

Purpose and Need Statement

Report Version 3.0

Chisago County
Minnesota Department of Transportation (MnDOT)
Washington County

Project Partners:

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Chapter 1 What Are Purpose and Need?

The Purpose and Need Statement explains why an agency or agencies are undertaking a project and the main objectives of the project. The "need" describes the transportation deficiencies or problems to be addressed by the project. The "purpose" is a broad statement of the primary intended transportation result and other related objectives to be achieved by the project. The purpose and need act as measuring sticks for the project alternatives, helping determine to what extent each alternative meets the project's needs. Alternatives that do not address the transportation needs of the project and do not meet the purpose of the project are not studied further. Assuming all other concerns are equal, if one alternative meets the project purpose and need better than another, then that alternative may be identified as the preferred alternative.

The purpose and need also help decide where a project will begin and end by defining the "who, what, where, when and why" of the transportation needs. This allows an agency or agencies to create alternatives that satisfy the project's needs.

The Purpose and Need Statement for the Highway 8 Improvement Project is divided into the following three chapters to help the reader better understand existing conditions, transportation needs, and the project purpose.

- Background Information. The Background Information chapter describes the existing characteristics of the Highway 8 corridor and findings from previous transportation studies.
- Project Needs. The Project Need chapter discusses transportation needs (problems) under existing conditions and the future year 2040 No Build Alternative. Primary transportation needs include pavement conditions, vehicle safety, and vehicle mobility. Secondary transportation needs include walkability/bikeability.
- Purpose Statement. The Purpose Statement chapter identifies the objectives for addressing the project needs.

Feasible alternatives are identified in the next step of the project development process. Alternatives are evaluated against project-specific evaluation criteria, including the need for the project; additional considerations; and social, economic, and environmental criteria. Alternatives that do not meet the transportation need for the project are not considered viable, and therefore, dismissed from further consideration. Detailed information regarding feasible project alternatives will be described in the "Alternatives Considered" section of the Environmental Assessment (EA).

Chapter 2 Background Information

2.1 Highway 8 Project Corridor

2.1.1 Project Location

The Highway 8 Improvement Project is in Washington and Chisago counties in the cities of Forest Lake, Wyoming, and Chisago City.[1] The western project terminus is the Interstate 35 (I-35)/Highway 8 interchange in Forest Lake. The eastern project terminus is the Highway 8/Karmel Avenue intersection in Chisago City. The total length of the Project is approximately 8.1 miles. Figure 2.1 and Figure 2.2 illustrate the project location.

2.1.2 Existing Characteristics

Highway 8 is an east-west, principal arterial highway that connects the Twin Cities Metropolitan Area, through Chisago County, to northwest Wisconsin and beyond. Highway 8 is a National Highway System (NHS) route, and serves as a major east-west transportation corridor for local, regional, and interregional traffic, including commercial and recreational traffic. Highway 8 provides one of the few St. Croix River crossings with a bridge in Taylor Falls.

As a NHS, principal arterial route, one of the primary functions of Highway 8 is to serve through traffic along the corridor. However, Highway 8 also serves an important local function as well. Highway 8 serves the cities of Forest Lake, Wyoming, and Chisago City, and provides local mobility and access for residents, businesses, and farms.

Existing Physical Characteristics

The project corridor from I-35 to east of Highway 61 (approximately 1.1 miles) is a four-lane roadway. The east and west travel lanes are separated by a raised center median. Ditches are along the outside shoulders. The speed limit for this section of Highway 8 is 60 miles per hour (MPH). Grade-separated interchanges are at I-35 and Highway 61. The existing average daily traffic volume on this segment of Highway 8 varies from approximately 21,900 vehicles per day to 22,700 vehicles per day. Figure 2.3 illustrates the four-lane Highway 8 typical section west of Highway 61.

[1] Highway 8 is also referred to as U.S. Highway 8 or Trunk Highway (TH) 8. In Minnesota, all U.S. Highways are also state trunk highways.

Figure 2.1 State Location Map

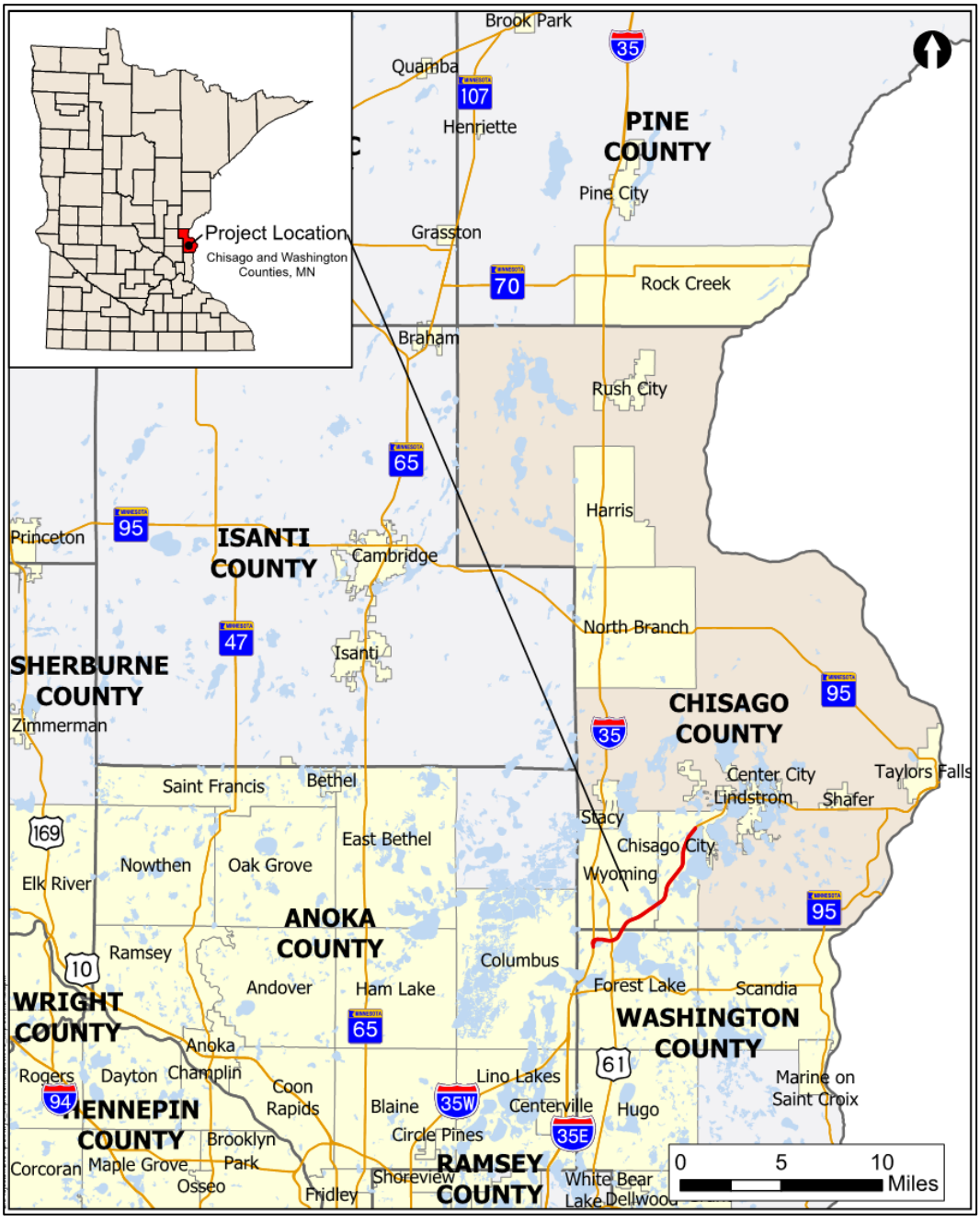


Figure 2.2 Project Location Map

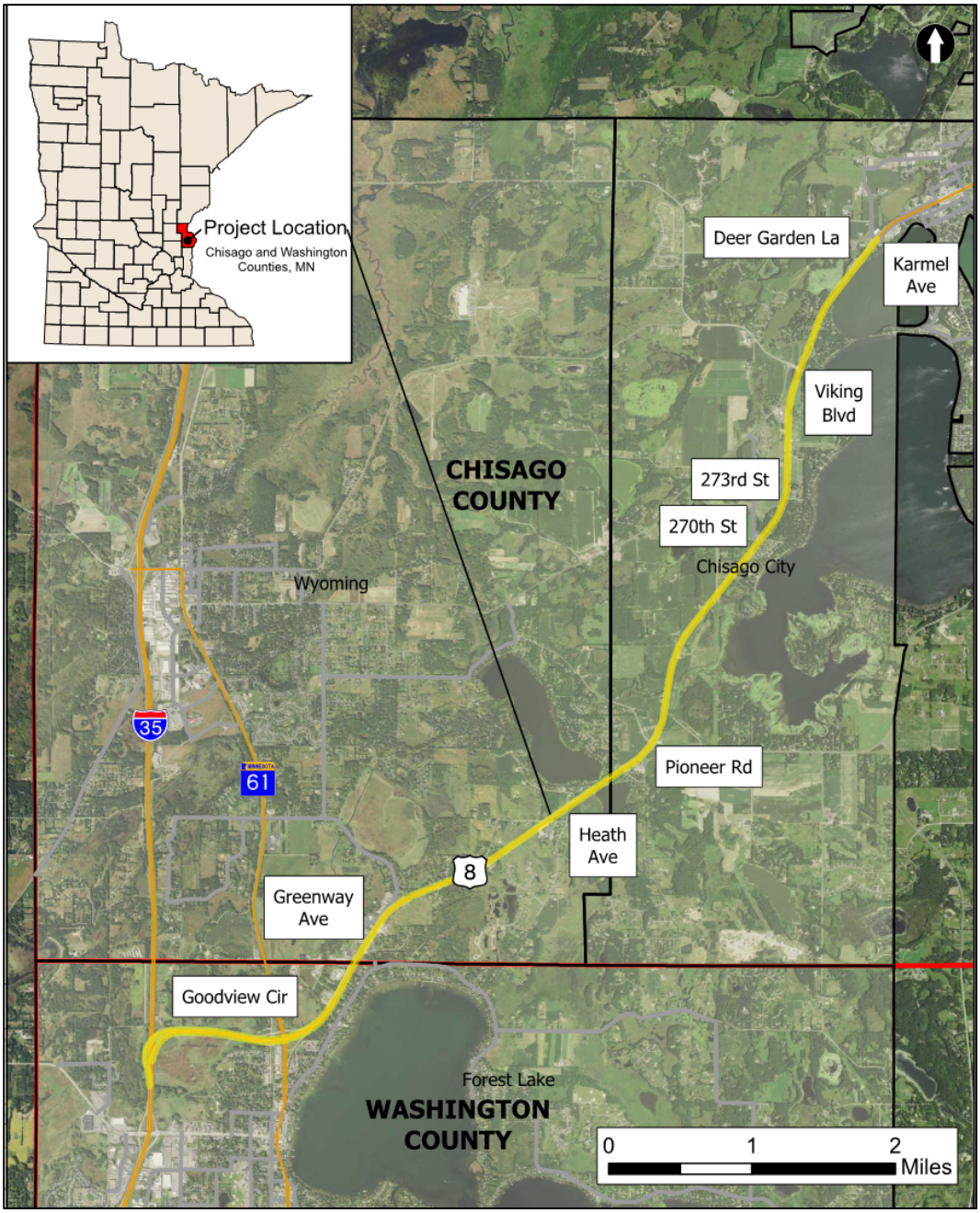
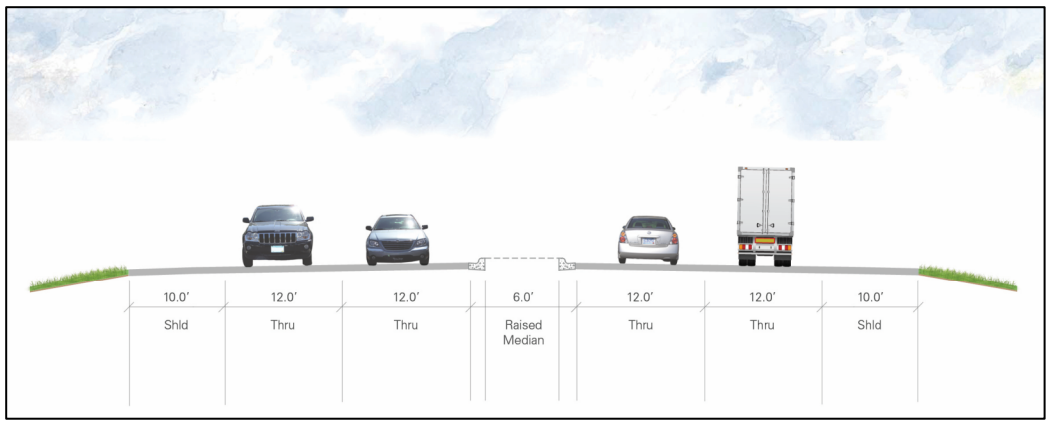
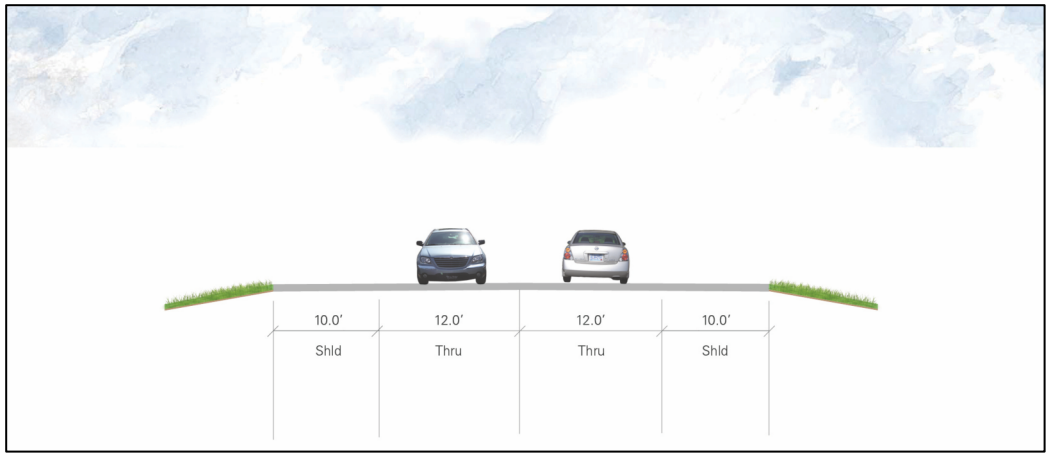


Figure 2.3 Highway 8 Existing Typical Section (Four-Lane Rural Section Roadway)



The remainder of the project corridor from east of Highway 61 to Karmel Avenue (approximately 7 miles) is a two-lane, rural section roadway. There are three signalized intersections along the project corridor (Greenway Avenue, Pioneer Road, and East Viking Boulevard), whereas the remaining public street intersections are side-street stop control. Turn lanes and painted medians are at select local street intersection locations. The speed limit for Highway 8 east of Highway 61 is 55 MPH. Existing traffic volumes vary from approximately 14,500 vehicles per day at County State Aid Highway (CSAH) 36 (East Viking Boulevard) to approximately 19,700 vehicles per day west of Pioneer Drive. Figure 2.4 illustrates the two-lane Highway 8 typical section from east of Highway 61 to Karmel Avenue.

Figure 2.4 Highway 8 Existing Typical Section (Two-Lane Rural Section Roadway)



Origin-Destination Analysis

An origin-destination analysis using StreetLight data was prepared for the Highway 8 corridor.[2] The origin-destination data included average weekday data for all of 2018 and included personal and commercial vehicles. The purpose of the origin-destination analysis is to identify the proportion of local and regional trips on Highway 8. A local trip is defined as a trip that originates or is destined for a location in the project area, whereas a regional trip is defined as a trip that passes through the project area.

Table 2.1 summarizes the results of the Highway 8 origin-destination analysis by direction. Most of the commercial vehicle trips on Highway 8 were regional trips (59 percent originating from the west and 81 percent originating from the east). Conversely, most of the personal vehicle trips on Highway 8 were local trips (64 percent originating from the west and 63 percent originating from the east).

Table 2.1 Highway 8 Origin-Destination Analysis Results

Direction on Highway 8	Personal Vehicle Regional Trips	Personal Vehicle Local Trips	Commercial Vehicle Regional Trips	Commercial Vehicle Local Trips
Eastbound Highway 8	36 percent	64 percent	59 percent	41 percent
Westbound Highway 8	63 percent	37 percent	81 percent	19 percent

Access Inventory

An access inventory was completed for the Project corridor. Access points were identified and cataloged based on access type and adjacent land uses (e.g., merge/diverge, agricultural full access, commercial full access, residential full access). Results of the access inventory were mapped using ArcGIS. Table 2.2 summarizes the results of the access inventory by type of access and number of access points. Figure 2.5 illustrates an example of the access inventory for the middle portion of the project corridor from Pioneer Road to East Viking Boulevard. Access inventory figures for the entire Highway 8 corridor are included in the *Highway 8 Improvement Project Existing and 2040 No Build Conditions Technical Memorandum* (October 25, 2019).

[2] StreetLight data uses anonymized location records from smart phones and navigation devices (GPS) to identify travel patterns and trip origins and destinations.

Figure 2.5 Highway 8 Access Inventory (Pioneer Road to East Viking Boulevard)

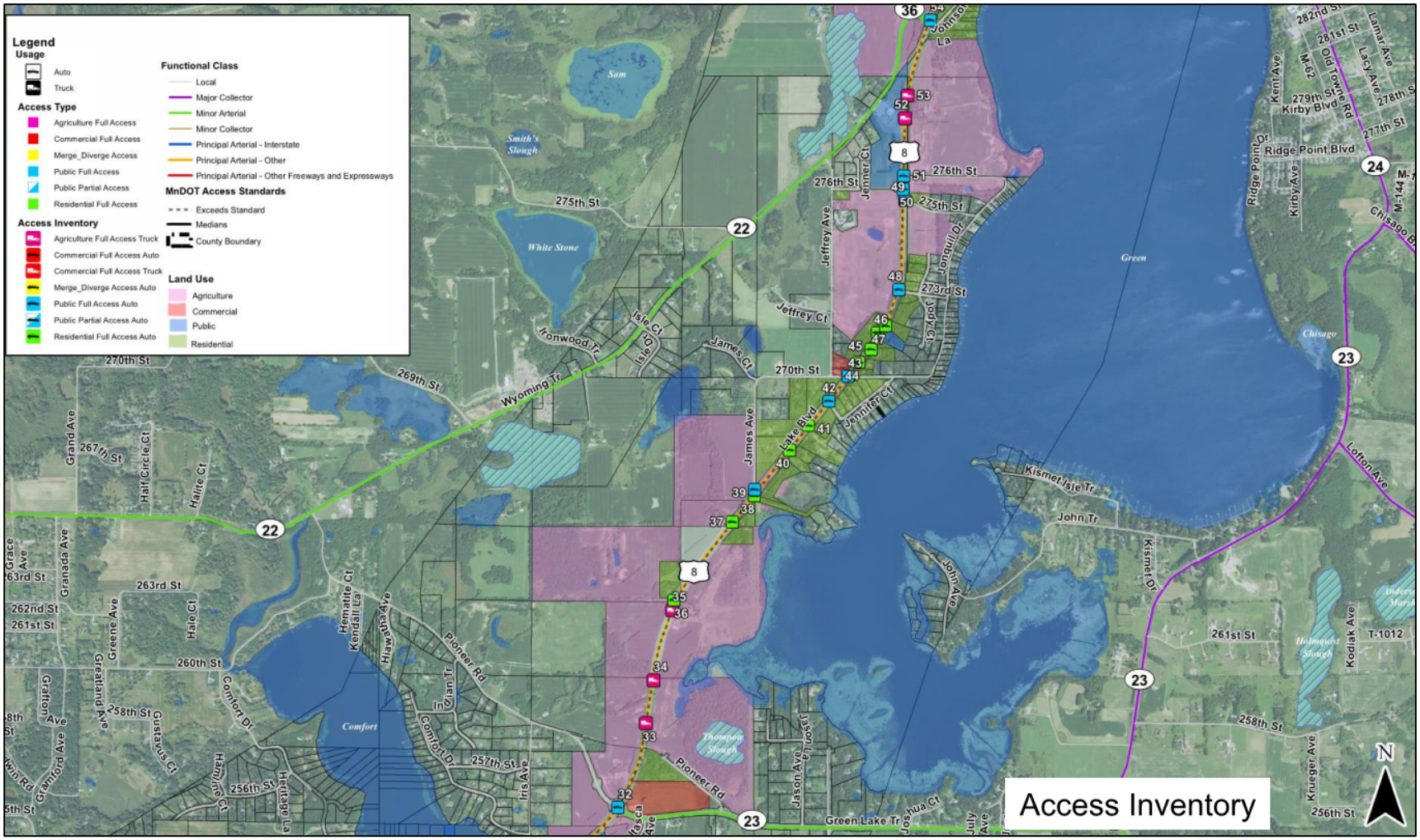


Table 2.2 Highway 8 Access Inventory Results

Type of Access	Number of Access Points on Highway 8
Agricultural Full Access	8 (14 percent)
Commercial Full Access	9 (16 percent)
Merge/Diverge Access	3 (5 percent)
Public Full Access	17 (30 percent)
Public Partial Access	1 (2 percent)
Residential Full Access	19 (33 percent)
Total Number of Access	57 (100 percent)

There are 57 access points along Highway 8 from I-35 to Karmel Avenue. Although access is not evenly distributed across the corridor, on average, this equates to approximately seven access points per mile. Residential full access driveways comprise 33 percent of the access points to Highway 8 between I-35 and Karmel Avenue. Full access public streets comprise 30 percent of the access points to Highway 8 between I-35 and Karmel Avenue.

The Minnesota Department of Transportation (MnDOT) has developed access spacing recommendations for the state trunk highway system.[3] The purpose of the access spacing recommendations is to promote better traffic flow and vehicle safety (i.e., lower potential for vehicle collisions). In general, increases in the amount of access decreases travel speeds and increases the potential for crashes. Highway 8 classified as a principal arterial roadway. Table 2.3 lists MnDOT recommendations for rural, principal arterial roadways and urban/urbanizing principal arterial roadways.

Table 2.3 MnDOT Access Spacing Recommendations for Principal Arterial Roadways

Type of Roadway	Spacing Between Primary, Full Movement Intersections	Spacing Between Traffic Signals	Spacing Between Secondary Intersections	Private Driveways
Rural Principal Arterial	1 mile	N/A	½-mile	Allowed if no other reasonable access exists. For 55 MPH roads, driveway spacing should be 100 feet.

[3] MnDOT Access Management Manual. January 2, 2008. Chapter 3: Guidelines for Public Street and Driveway Connections. Accessed November 1, 2019 and available at https://www.dot.state.mn.us/accessmanagement/docs/pdf/manualchapters/chapter3.pdf

Type of Roadway	Spacing Between Primary, Full Movement Intersections	Spacing Between Traffic Signals	Spacing Between Secondary Intersections	Private Driveways
Urban/Urbanizing Principal Arterial	½-mile	½-mile	¼-mile	Allowed if no other reasonable access exists. (1)

(1) MnDOT preference is for a supporting roadway network that is more conducive to private driveway access.

Source: MnDOT Access Management Manual. January 2, 2008. Chapter 3: Guidelines for Public Street and Driveway Connections.

Table 2.4 summarizes the results of the Highway 8 access inventory and MnDOT access spacing guidelines. Highway 8 from I-35 to Greenway Avenue is consistent with MnDOT access spacing guidelines (total of three accesses per mile). Highway 8 from Greenway Avenue to Karmel Avenue is not consistent with MnDOT access spacing guidelines. The total number of accesses currently exceeds MnDOT's preferred number of accesses for principal arterial roadways.

Table 2.4 Highway 8 Access Summary, I-35 to Karmel Avenue

Highway 8 Segment	MnDOT Access Category	MnDOT Preferred Number of Accesses	Length (Miles)	Total Number of Accesses	Total Number of Accesses Per Mile
I-35 to Greenway Avenue	Principal Arterial, Urban/ Urbanizing	5 per mile	2.0 miles	6	3 per mile
Greenway Avenue to Pioneer Road	Principal Arterial, Rural	3 per mile	2.4 miles	27	11 per mile
Pioneer Road to Deer Garden Lane	Principal Arterial, Rural	3 per mile	4.0 miles	25	6 per mile
Deer Garden Lane to Karmel Avenue	Principal Arterial, Urban/ Urbanizing	5 per mile	0.2 miles	2	10 per mile

2.2 Previous Studies

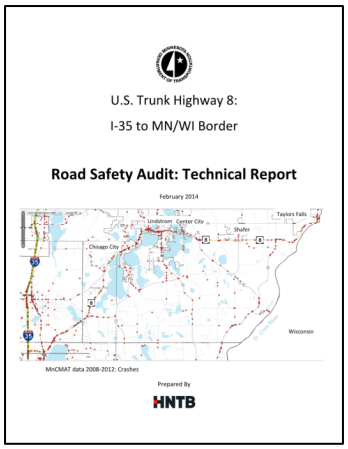
Several previous transportation studies have been recently completed for the Highway 8 corridor. These studies highlight existing and projected transportation problems on Highway 8 between Forest Lake and Chisago City.

2.2.1 Trunk Highway 8 Environmental Assessment Worksheet

The Trunk Highway 8 Environmental Assessment Worksheet (EAW) was completed by MnDOT in 2013. The purpose of the EAW study was to identify a footprint for future Highway 8 improvements between Greenway Avenue in Forest Lake and Karmel Avenue in Chisago City and to provide information to support a future National Environmental Policy Act (NEPA) review process. The EAW documented growing travel demand on Highway 8, capacity deficiencies, and vehicle safety needs along the corridor. MnDOT completed a Findings of Fact and Conclusion and issued a negative declaration, concluding that a State environmental impact statement was not required for the project.

2.2.2 US Trunk Highway 8 Road Safety Audit

MnDOT completed a road safety audit for the 22-mile segment of Highway 8 from I-35 to the Minnesota/Wisconsin border in 2014. The road safety audit included the project segment of Highway 8 from I-35 to Karmel Avenue. The findings were documented in a technical report titled U.S. Trunk Highway 8: I-35 to MN/WI Border Road Audit: Technical Report. (February 2014). The road safety audit documented the crash history along Highway 8 from Forest Lake to Chisago City. The crash analysis for the five-year period from 2008 to 2012 showed that crash rates and severity rates on the Highway 8 segment between Highway 61 and Karmel Avenue were below the critical rate; however, the Highway 8/Pioneer Road intersection had a severity and fatal crash rate that exceeded the calculated critical rate.[4] The Highway 8/East Viking Boulevard intersection had a fatal rate that exceeded the calculated critical rate. The Pioneer Road and East Viking Boulevard intersections each had one fatality during the five-year period from 2008 to 2012.



[4] MnDOT uses crash rates, severity rates, critical crash rates, and critical indices to evaluate vehicle safety at intersections and along roadway segments. Refer to the Section 3.1.2 Vehicle Safety of this report.

Chapter 3 Project Needs

This chapter discusses the transportation needs for the proposed action. The project need describes the transportation problems that currently exist or are reasonably expected to occur in the project area. Primary transportation needs for the proposed action include pavement conditions, vehicle safety, and vehicle mobility. Secondary transportation needs for the proposed action include walkability/bikeability.

3.1 Primary Needs

Primary needs are the transportation problems to be addressed by the proposed action and are the main needs that led to the initiation of the project. The primary needs for the Project include pavement conditions, vehicle safety, and vehicle mobility.

3.1.1 Pavement Conditions

Construction and Pavement Maintenance History

The Highway 8 roadway between Highway 61 and Karmel Avenue was originally constructed a gravel roadway, constructed as a concrete roadway in the 1950's, with bituminous resurfacing projects completed in the 1970's. The four-lane segment between I-35 and Highway 61 was constructed in 1969 as a concrete roadway and later resurfaced with a bituminous overlay. Since that time, there have been numerous pavement rehabilitation projects (e.g., milling, bituminous overlay, crack repair) and other improvements, such as turn lane construction and bypass lane construction. Most recently, bituminous overlay and crack repair projects were completed in 1988, the early and mid-2000's, and 2011. A crack fill project was completed on the two-lane section of Highway 8 east of Greenway Avenue in 2017.

Pavement Condition Indices

MnDOT uses several indices for reporting pavement performance: Ride Quality Index (RQI), Surface Rating (SR), and Pavement Quality Index (PQI). Each index captures a different aspect of pavement health and can be used to predict future pavement condition needs. MnDOT's pavement condition indices are summarized in the following sections.

Ride Quality Index (RQI)

The RQI is MnDOT's ride, or smoothness, index. The RQI is intended to represent the rating that a typical road user would give to the pavement's smoothness as felt

while driving his/her vehicle. RQI ranges from 0.0 to 5.0, with a higher RQI indicating a smoother road surface. Most new construction projects have an initial RQI above 4.0. Pavements are normally designed for a terminal RQI value of 2.5. When a road has reached its terminal RQI value it does not mean the road cannot be driven on, but rather that it has deteriorated to the point where most people feel it is uncomfortable. Table 3.1 shows the RQI categories and ranges.[5]

Table 3.1 Ride Quality Index (RQI) Categories and Ranges

Numerical Rating	Verbal Rating
4.1 – 5.0	Very Good
3.1 – 4.0	Good
2.1 – 3.0	Fair
1.1 – 2.0	Poor
0.0 – 1.0	Very Poor

Source: Minnesota Department of Transportation. *An Overview of MnDOT's Pavement Condition Rating Procedures and Indices*. September 2015. Accessed 11 October 2019 and available at https://www.dot.state.mn.us/materials/pvmtmgmtdocs/Rating_Overview_State_2015V.pdf.

Surface Rating (SR)

MnDOT uses SR to quantify pavement distress, or visible defects on the pavement surface. Pavement distresses are symptoms, indicating some problem or phenomenon of pavement deterioration such as cracks, patches and ruts. SR ranges from 0.0 to 4.0, with a higher SR indicating a better condition. A brand-new road with no defects is rated at 4.0. As the type, amount, and severity of defects increases, then SR will decrease. A road in need of major rehabilitation or reconstruction will generally have an SR near or below 2.5. Table 3.2 shows the SR categories and ranges.[6]

Table 3.2 Surface Roughness (SR) Categories and Ranges

Numerical Rating	Verbal Rating
3.3 – 4.0	Very Good
2.5 – 3.2	Good
1.7 – 2.4	Fair

[5] Minnesota Department of Transportation. *2018 Pavement Condition Annual Report*. March 2019. Accessed 11 October 2019 and available at https://www.dot.state.mn.us/materials/pvmtmgmtdocs/AnnualReport_2018.pdf.

[6] Minnesota Department of Transportation. Office of Materials and Road Research. Pavement Management Unit. *MnDOT Pavement Distress Identification Manual*. July 2011. Accessed 11 October 2019 and available at https://www.dot.state.mn.us/materials/manuals/pvmtmgmt/Distress_Manual.pdf.

Numerical Rating	Verbal Rating
0.9 – 1.6	Poor
0.0 – 0.8	Very Poor

Source: Minnesota Department of Transportation. *An Overview of MnDOT's Pavement Condition Rating Procedures and Indices*. September 2015. Accessed 11 October 2019 and available at http://www.dot.state.mn.us/materials/pvmtmgmtdocs/Rating_Overview_State_2015V.pdf.

Pavement Quality Index (PQI)

The PQI is MnDOT's measurement of overall pavement conditions. PQI combines RQI and SR values and ranges from 0.0 to 4.5, with a higher PQI indicating better overall pavement conditions. As overall pavement conditions deteriorate, then PQI will decrease. Table 3.3 shows the PQI categories and ranges.[7]

Table 3.3 Pavement Quality Index (PQI) Categories and Ranges

Numerical Rating	Verbal Rating
3.7 – 4.5	Very Good
2.8 – 3.6	Good
1.9 – 2.7	Fair
1.0 – 1.8	Poor
0.0 – 0.9	Very Poor

Source: Minnesota Department of Transportation. *An Overview of MnDOT's Pavement Condition Rating Procedures and Indices*. September 2015. Accessed 11 October 2019 and available at http://www.dot.state.mn.us/materials/pvmtmgmtdocs/Rating_Overview_State_2015V.pdf.

Highway 8 Pavement Conditions

Figure 3.1 through Figure 3.3 show the MnDOT Highway Pavement Management Application (HPMA) plots for existing and future conditions on Highway 8. Figure 3-1 shows the HPMA plot from I-35 to west of Highway 61. Figure 3-2 shows the HPMA plot from west of Highway 61 to east of Greenway Avenue. Figure 3-3 shows the HPMA plot from east of Greenway Avenue to Karmel Avenue. The blue triangles show RQI, the black triangles show SR, and the red squares show PQI. The RQI, SR, and PQI ratings represent 2018 pavement data collected by the MnDOT Pavement Management Unit, and include past pavement performance history as well as projected future pavement performance.

[7] Minnesota Department of Transportation. Office of Materials and Road Research. Pavement Management Unit. *MnDOT Pavement Distress Identification Manual*. July 2011. Accessed 11 October 2019 and available at https://www.dot.state.mn.us/materials/manuals/pvmtmgmt/Distress_Manual.pdf.

Figure 3.1 HPMA Pavement Performance Plot for Highway 8, I-35 to West of Highway 61

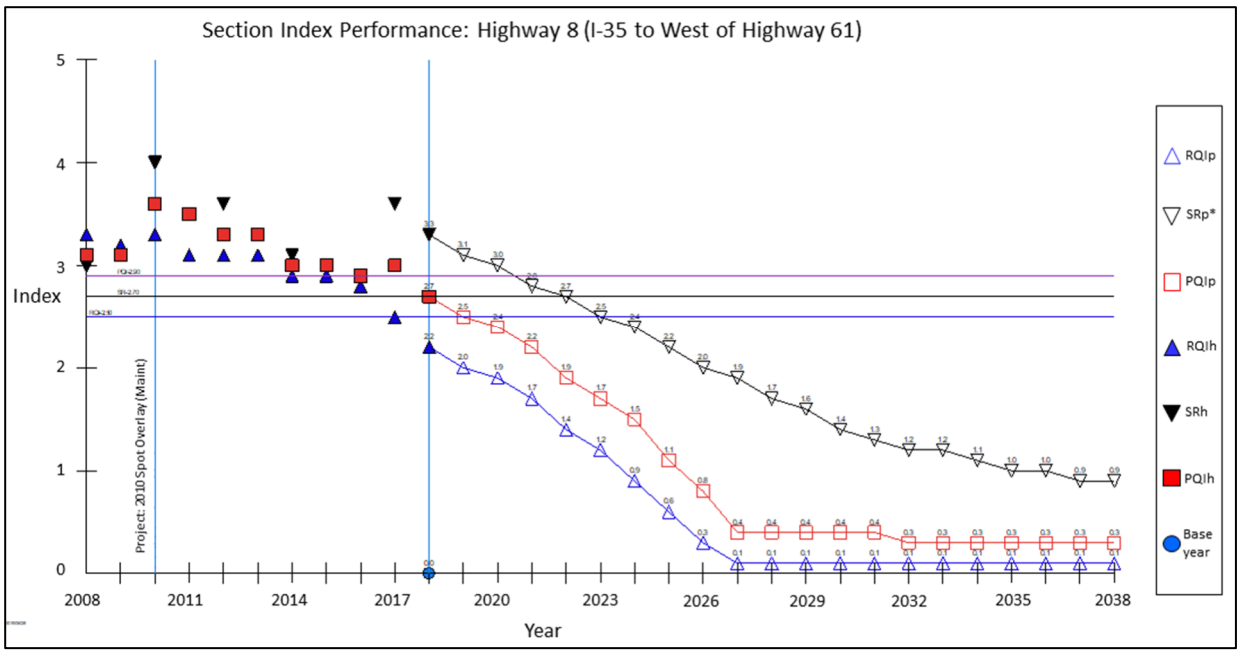


Figure 3.2 HPMA Pavement Performance Plot for Highway 8, West of Highway 61 to East of Greenway Avenue

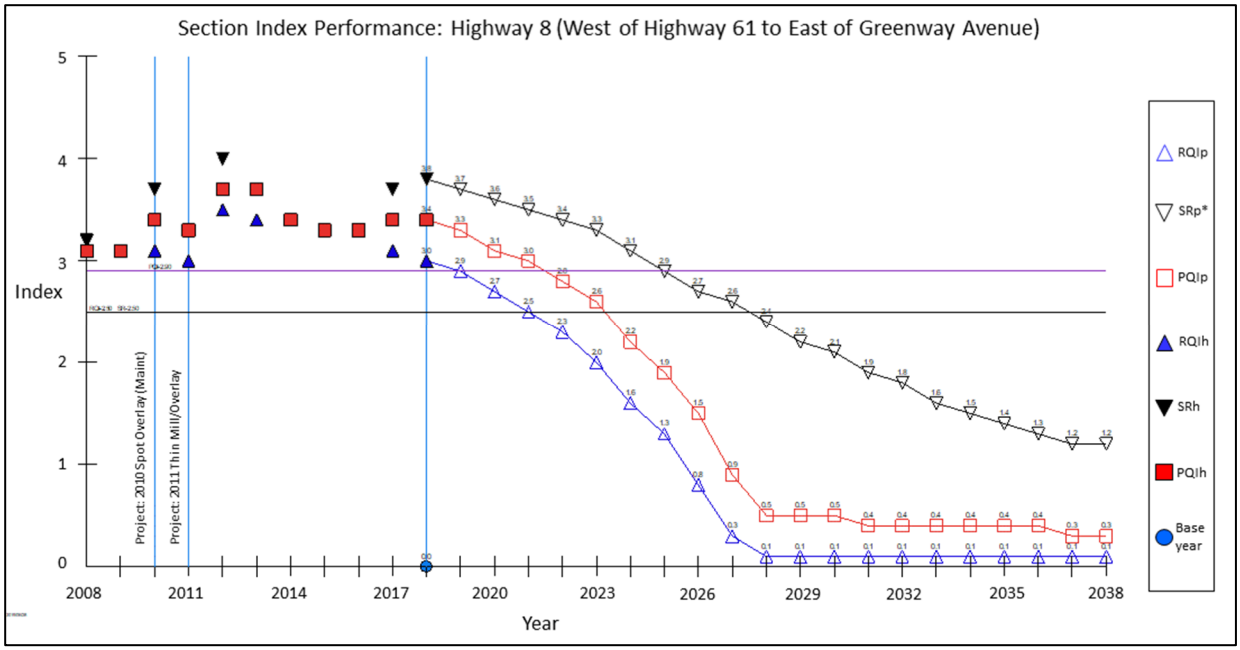
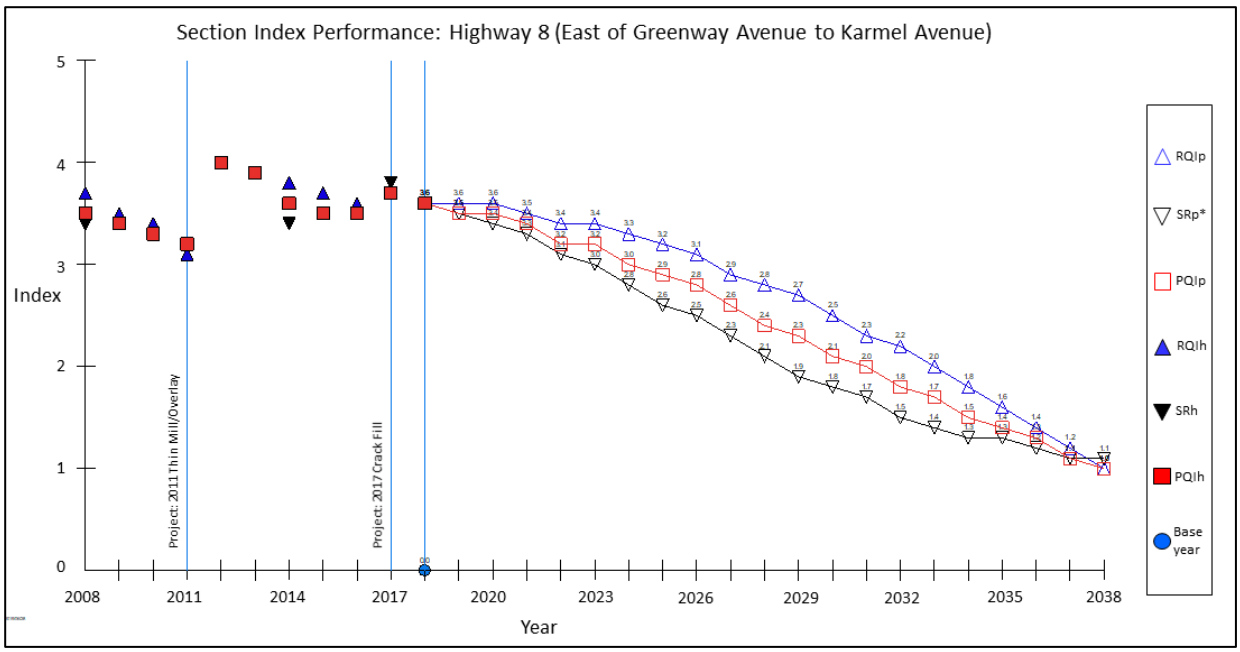


Figure 3.3 HPMA Pavement Performance Plot for Highway 8, East of Greenway Avenue to Karmel Avenue



The existing RQI for Highway 8 varies from 2.2 to 3.3 (fair to good condition), the existing SR varies from 3.3 to 3.8 (very good condition), resulting in a PQI that varies from 2.7 to 3.6 (fair to good condition). Pavement conditions on Highway 8 are projected to steadily decline over the coming years. The RQI rating is projected to fall below 2.5 (fair condition) by year 2022 for the Highway 8 segment west of Highway 61 to east of Greenway Avenue, and is projected to fall below 2.5 by year 2031 for the segment east of Greenway Avenue to Karmel Avenue. The SR rating is projected to fall into the poor category (SR < 1.6) between 2030 and 2034. Overall pavement quality is projected to fall into the poor category (PQI < 1.8) between 2023 and 2032.

3.1.2 Vehicle Safety

MnDOT's *Traffic Engineering Manual* describes the various measures used in a crash analysis.[8] A comparison of the crash rate and the critical crash rate is used to determine if there is a potential safety issue along a roadway segment or at an intersection. The segment crash rate is the number of crashes per million vehicle miles traveled (VMT). The intersection crash rate is the number of crashes per million entering vehicles (MEV). The critical crash rate is a statistical comparison based on similar segments or intersections statewide. An observed crash rate greater

[8] Minnesota Department of Transportation. September 2015. *Traffic Engineering Manual*. Chapter 11: Traffic Safety available at http://www.dot.state.mn.us/trafficeng/publ/tem/2015/chapter11.pdf.

than the critical crash rate indicates that the intersection operates outside of the expected, normal range. The critical index reports the magnitude of the difference between observed crash rates and critical rates. A critical index of less than one indicates that a segment or intersection is operating within expectations. A critical index greater than one indicates there may be a vehicle safety concerns along a segment or at an intersection.

High traffic volumes, high speeds, and access have caused a vehicle safety concern on the two-lane section of Highway 8 east of Highway 61 to Karmel Avenue. A crash analysis was prepared for Highway 8 for the five-year period from 2014 to 2018. There was a total of 236 reported crashes on Highway 8 during this period. Nearly half (119 crashes) of the reported crashes were segment crashes (non-intersection crashes). The remaining reported crashes (117 crashes) were intersection crashes. Segment crash history is presented first, followed by crash history for the nine intersections from Goodview Circle to Karmel Avenue.

Segment Crash History

Segment crash data (non-intersection) were reviewed for the five-year period from 2014 to 2018 for the two-lane segment of Highway 8 from east of Highway 61 to Karmel Avenue. There were 119 reported crashes on Highway 8 between 2014 and 2018, including 36 personal injury crashes. Most of the crashes (70 percent) were property damage only crashes. Table 3.4 summarizes the segment crash history on Highway 8 from 2014 to 2018.

Table 3.4 Highway 8 Segment Crashes, 2014 to 2018

Location	Fatal Crashes	Personal Injury Crashes	Property Damage Only Crashes	Total Crashes
East of Highway 61 to Pioneer Road	0	22	54	76
Pioneer Road to East Viking Boulevard	0	10	15	25
East Viking Boulevard to Karmel Avenue	0	4	14	18

A fatal crash occurred on Highway 8 near 276th Street in Chisago City in January 2019. The crash occurred when a vehicle crossed the center line and struck on-coming traffic. This fatal crash is not included in the five-year crash data for Highway 8 from 2014 to 2018.

Table 3.5 summarizes the Highway 8 segment crashes by crash type. Rear-end crashes accounted for 53 percent of the segment crashes on Highway 8 during the five-year period from 2014 to 2018. The second most frequent type of crash on Highway 8 during this period was run off road crashes (18 percent). Approximately 75 percent of the segment crashes on Highway 8 occurred during the day under dry road conditions.

Table 3.5 Highway 8 Segment Crash Types, 2014 to 2018

Crash Types	East of Highway 61 to Pioneer Road	Pioneer Road to East Viking Boulevard	East Viking Boulevard to Karmel Avenue
Rear End	37 (49%)	12 (48%)	14 (78%)
Sideswipe Passing	8 (11%)	0	0
Run Off Road	14 (18%)	7 (28%)	0
Angle	4 (5%)	1 (4%)	1 (6%)
Head On	3 (4%)	1 (4%)	1 (6%)
Sideswipe Opposing	1 (1%)	0	0
Other	9 (12%)	4 (16%)	2 (11%)
Total	76 (100%)	25 (100%)	18 (100%)

Table 3.6 tabulates the Highway 8 segment crash rates for the five-year period from 2014 to 2018. Segment crash rates for Highway 8 varies from 0.33 crashes per one million vehicle miles traveled to 0.64 crashes per one million vehicle miles traveled. Segment crash rates for the five-year period from 2014 to 2018 are below critical crash rates and critical indices are less than one, indicating that Highway 8 does not deviate from statewide trends for similar facilities and is performing within expectations.

Table 3.6 Highway 8 Segment Crash Rates, 2014 to 2018

Location	Highway 8 Observed Crash Rates	Statewide Average Crash Rate	Critical Crash Rate	Critical Index
East of Highway 61 to Pioneer Road	0.64	0.35	0.69	0.94
Pioneer Road to East Viking Boulevard	0.33	0.35	0.78	0.42
East Viking Boulevard to Karmel Avenue	0.37	0.35	0.89	0.42

Segment crash rates are in crashes per one million vehicle miles traveled (VMT).

Statewide average crash rates for rural, two-lane highways, five years of crash data, from 2015 MnDOT Green Sheets.

Intersection Crash History

Intersection crash data were reviewed for the five-year period from 2014 to 2018 for nine public street intersections with Highway 8 from east of Highway 61 to Karmel Avenue. There were 117 reported intersection crashes on Highway 8 between 2014 and 2018, including 36 personal injury crashes. Most of the crashes (70 percent) were property damage only crashes. One fatal crash occurred at the Highway 8 and Deer Garden Lane intersection in 2014. Three intersections, Greenway Avenue, Pioneer Road, and East Viking Boulevard, accounted for 76 percent of the intersection crashes. Table 3.7 summarizes the five-year crash history for Highway 8 intersections from 2014 to 2018.

Table 3.7 Highway 8 Intersection Crashes, 2014 to 2018

Highway 8 Intersection	Fatal Crashes	Personal Injury Crashes	Property Damage Only Crashes	Total Crashes
Goodview Circle	0	0	4	4
Greenway Avenue	0	10	22	32
Heath Avenue	0	2	2	4
Pioneer Road	0	12	21	33
270th Street	0	1	1	2
273rd Street	0	0	0	0
East Viking Boulevard	0	7	17	24
Deer Garden Lane	1	3	8	11
Karmel Avenue	0	1	5	6

Table 3.8 tabulates the Highway 8 intersection crash types from Goodview Circle to Karmel Avenue for the five-year period from 2014 to 2018. Rear-end crashes accounted for 67 percent of the intersection crashes. A rear-end crash is the most common type of crash across Minnesota, and is the most common type of intersection-related crash. Angle crashes accounted for 17 percent of the intersection crashes. In general, angle crashes have higher severity rates compared to other types of crashes.[9]

[9] Minnesota Department of Transportation. Office of Traffic, Safety and Technology. Revised June 2015. Traffic Safety Fundamentals Handbook. Accessed 12 November 2019 and available at https://www.dot.state.mn.us/trafficeng/publ/fundamentals/2015-mndot-safety-handbook-reduced.pdf.

Table 3.8 Highway 8 Intersection Crash Types, 2014 to 2018, Goodview Circle to Karmel Avenue

Crash Types	Goodview Circle	Greenway Avenue	Heath Avenue	Pioneer Road	270th Street	East Viking Boulevard	Deer Garden Lane	Karmel Avenue
Rear End	1 (25%)	21 (66%)	2 (50%)	18 (55%)	2 (100%)	21 (88%)	9 (75%)	4 (67%)
Sideswipe Passing	1 (25)	3 (9%)	0	0	0	0	0	0
Run Off Road	0	2 (6%)	1 (25%)	3 (9%)	0	0	0	1 (17%)
Angle	0	5 (16%)	1 (25%)	10 (30%)	0	2 (8%)	1 (8%)	1 (17%)
Head On	0	0	0	1 (3%)	0	1 (4%)	0	0
Sideswipe Opposing	0	0	0	1 (3%)	0	0	0	0
Other	2 (50%)	1 (3%)	0	0	0	0	2 (17%)	0
Total	4 (100%)	32 (100%)	4 (100%)	33 (100%)	2 (100%)	24 (100%)	12 (100%)	6 (100%)

Does not include the Highway 8 and 273rd Street intersection. Zero crashes were recorded at the Highway 8 and 273rd Street intersection over the five-year period from 2014 to 2018.

Almost 80 percent of the intersection crashes occurred during the day under dry road conditions.

Table 3.9 tabulates the Highway 8 intersection crash rates for the five-year period from 2014 to 2018. Highway 8 intersection crash rates vary from 0.00 crashes per one million entering vehicles (273rd Street) to 0.77 crashes per one million entering vehicles (East Viking Boulevard). The critical index is approaching one at the East Viking Boulevard intersection, is at one at the Greenway Avenue intersection, and exceeds one at the Pioneer Road intersection. Critical indices for the other six project area intersections are below one. Critical indices exceeding one indicate that there is safety concern at this location. Other intersections where critical indices are below one indicate that the intersection does not deviate from statewide trends (i.e., is performing within expectations).

Table 3.9 Highway 8 Intersection Crash Rates, 2014 to 2018

Highway 8 Intersection	Observed Crash Rate	Statewide Average Crash Rate	Critical Crash Rate	Critical Indices
Goodview Circle	0.10	0.25	0.46	0.21
Greenway Avenue	0.72	0.45	0.72	1.00
Heath Avenue	0.10	0.25	0.47	0.22
Pioneer Road	0.76	0.45	0.73	1.05
270th Street	0.08	0.25	0.52	0.14
273rd Street	0.00	0.25	0.52	0.00
East Viking Boulevard	0.77	0.45	0.78	0.99
Deer Garden Lane	0.37	0.25	0.49	0.75
Karmel Avenue	0.18	0.18	0.39	0.46

Intersection crash rates are in crashes per one million entering vehicles.

Statewide average crash rates for rural thru/stop, high volume/high speed traffic signal, and urban thru/stop intersections, five years of crash data, from 2015 MnDOT Green Sheets.

Traffic volumes are projected to increase on Highway 8 under the 2040 No Build Alternative, and side street delays at intersections are expected to increase (see Section 3.1.3, Vehicle Mobility). As traffic volumes increase, there will be fewer gaps for vehicles to turn on to Highway 8. Drivers are anticipated to take greater risks and un-safe gaps to enter onto Highway 8. It is expected that the increased traffic volumes and delays would also increase the number of crashes at Highway 8 intersections.

3.1.3 Vehicle Mobility

This section summarizes the traffic analysis completed for the Highway 8 corridor for existing and future No Build Alternative conditions. This analysis indicates that there are vehicle mobility deficiencies based on daily traffic volumes and at intersections during the morning and afternoon peak periods. Volume-to-capacity

ratio and intersection level of service analyses were used to evaluate Highway 8 corridor mobility performance.

Existing and Forecast Volumes

Traffic forecasts for the 2040 No Build Alternative were prepared by considering historical traffic volume growth rates in the project area, travel demand trends observed in the Metropolitan Council regional activity-based travel demand model (ABM) and Chisago County's traffic projection factor (annual growth rate of 1.3 percent). The Metropolitan Council's ABM is a computer model that uses travel behavior information and socio-economic forecasts to develop traffic volume forecasts. Background highway assumptions were included in the travel demand forecasts consistent with state, regional, and local improvement programs and plans.

Table 3.10 tabulates year 2017 existing conditions and year 2040 No Build Alternative forecast volumes for Highway 8. Existing volumes on Highway 8 range from 22,700 vehicles per day east of Highway 61 to 14,500 west of East Viking Boulevard. Highway 8 traffic volumes are projected to increase by approximately 3,600 vehicles per day to approximately 5,800 vehicles per day by year 2040, or approximately 25 percent compared to existing conditions.

Table 3.10 Highway 8 2017 Existing and 2040 No Build Alternative Forecast Traffic Volumes

Highway 8 Segment	2017 Existing Volumes (Vehicles Per Day)	Forecast Volumes 2040 No Build Alternative (Vehicles Per Day)	Change in Daily Traffic Volumes 2040 No Build – 2017 Existing (Vehicles Per Day)
I-35 to Highway 61	21,900	27,500	5,600
Highway 61 to Goodview Circle	22,700	28,500	5,800
Goodview Circle to Greenway Avenue	20,600	26,000	5,400
Greenway Avenue to East Viking Boulevard	14,500	18,100	3,600
East Viking Boulevard to Karmel Avenue	17,700	22,300	4,600

Volume to Capacity Ratios

Volume to capacity ratios were calculated for Highway 8 for 2017 existing conditions and the 2040 No Build Alternative. A roadway with a volume to capacity ratio of less than 0.85 is considered under capacity, a volume to capacity ratio between 0.85 and

1.00 is generally considered approaching capacity, and a volume to capacity ratio greater than 1.00 is considered over capacity.

Table 3.11 lists volume to capacity ratios for Highway 8 between I-35 and Karmel Avenue for 2017 existing conditions and the 2040 No Build Alternative. Existing volumes on the two-lane segment of Highway 8 from east of Highway 61 to Karmel Avenue are approaching or exceeding capacity. The two-lane segment of Highway 8 from is projected to be over capacity (i.e., volume to capacity ratios greater than 1.00) under the 2040 No Build Alternative.

Table 3.11 Highway 8 2017 Existing and 2040 No Build Alternative Volume to Capacity Ratios

Highway 8 Location	Facility Type	Capacity	2017 Existing ADT	2040 No Build Alternative ADT	2017 Existing Volume to Capacity Ratio	2040 No Build Volume to Capacity Ratio
West of Highway 61	4-lane divided	32,000	21,900	27,500	0.38	0.49
East of Highway 61	2-lane undivided rural	15,000	20,600	26,000	1.37	1.73
West of East Viking Boulevard	2-lane undivided rural	15,000	14,500	18,100	0.97	1.21
East of East Viking Boulevard	2-lane undivided rural	15,000	17,700	22,300	1.18	1.49

ADT = average daily traffic (vehicles per day).

Intersection Operations Analysis

An intersection operations analysis was prepared for Highway 8 for the weekday morning and afternoon peak hours under 2019 existing conditions and the 2040 No Build Alternative. The morning peak hour is from 7:00 a.m. to 8:00 a.m. The afternoon peak period is from 4:30 p.m. to 5:30 p.m. The intersections were analyzed using Synchro/SimTraffic (Version 9.2) software. Analysis results identify a Level of Service (LOS), which indicates the quality of traffic flow through an intersection. Intersections are given a ranking from LOS A through LOS F. The LOS results are based on average delay per vehicle. LOS A indicates the best traffic operation, with vehicles experiencing minimal delays. LOS F indicates an intersection where demand exceeds capacity, or a breakdown of traffic flow.

For side-street stop and yield controlled intersections, special emphasis is given to providing an estimate for the LOS of the side-street approach. Because the mainline does not have to stop, most of the intersection delay is attributed to the side-street

approaches. It is typical of intersections with higher mainline traffic volumes to experience high levels of delay (i.e., poor LOS) on the side-street approaches, but an acceptable overall intersection LOS during peak period conditions.

Table 3.12 tabulates intersection LOS results for the morning and afternoon peak periods under 2019 existing conditions. All Highway 8 intersections operate at an overall LOS C or better during the morning and afternoon peak periods. Side-street approaches at unsignalized intersections operate at LOS D or better. Although Highway 8 intersections operate at an acceptable LOS, traffic queues will exceed turn lane lengths during the morning and afternoon peak periods at Greenway Avenue and Pioneer Road and spill back into the through lanes.

Table 3.12 Highway 8 2019 Existing Conditions Intersection Level of Service (LOS) Results

Highway 8 Intersection	Morning Peak Hour LOS	Morning Peak Hour Delay (Seconds)	Afternoon Peak Hour LOS	Afternoon Peak Hour Delay (Seconds)
Goodview Circle (1)	A/A	9 sec.	A/A	5 sec.
Greenway Avenue	C	30 sec.	B	20 sec.
Heath Avenue (1)	A/C	16 sec.	A/C	17 sec.
Pioneer Road	C	31 sec.	C	26 sec.
270th Street (1)	A/B	13 sec.	A/D	29 sec.
273rd Street (1)	A/A	5 sec.	A/B	11 sec.
East Viking Boulevard	B	12 sec.	C	22 sec.
Deer Garden Lane (1)	A/A	1 sec.	A/B	11 sec.
Karmel Avenue (1)	A/C	18 sec.	A/C	22 sec.

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

The morning peak period is from 7:00 a.m. to 8:00 a.m. The afternoon peak period is from 4:30 p.m. to 5:30 p.m.

Table 3.13 tabulates the intersection operations analysis results for the morning and afternoon peak periods under the 2040 No Build Alternative. Most Highway 8 intersections are projected to operate at an overall LOS D or better during the morning and afternoon peak periods under the 2040 Build Alternative. However, the Highway 8/Greenway Avenue and Highway 8/Pioneer Road intersections are projected to operate at LOS E during the afternoon peak hour.

Table 3.13 Highway 8 2040 No Build Alternative Intersection Level of Service (LOS) Results

Highway 8 Intersection	Morning Peak Hour LOS	Morning Peak Hour Delay (Seconds)	Afternoon Peak Hour LOS	Afternoon Peak Hour Delay (Seconds)
Goodview Circle (1)	A/A	10 sec.	A/A	6 sec.

Highway 8 Intersection	Morning Peak Hour LOS	Morning Peak Hour Delay (Seconds)	Afternoon Peak Hour LOS	Afternoon Peak Hour Delay (Seconds)
Greenway Avenue	D	46 sec.	E	56 sec.
Heath Avenue (1)	A/D	33 sec.	A/E	37 sec.
Pioneer Road	D	39 sec.	E	62 sec.
270th Street (1)	A/C	20 sec.	A/E	47 sec.
273rd Street (1)	A/A	7 sec.	A/D	33 sec.
East Viking Boulevard	C	21 sec.	C	32 sec.
Deer Garden Lane (1)	A/A	4 sec.	A/F	62 sec.
Karmel Avenue (1)	A/F	61 sec.	A/F	127 sec.

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

The morning peak period is from 7:00 a.m. to 8:00 a.m. The afternoon peak period is from 4:30 p.m. to 5:30 p.m.

Traffic queues are projected to exceed turn lane lengths at several intersections during the morning and afternoon peak periods under the 2040 No Build Alternative. The left-turn queue on eastbound Highway 8 at Greenway Avenue is projected to be approximately 2,000 feet during the p.m. peak period. The left-turn queue on eastbound Highway 8 at Pioneer Road is projected to be approximately 1,350 feet during the p.m. peak period.

3.2 Secondary Transportation Needs

Secondary needs are other transportation problems or opportunities for improvements within the project area that may be able to be addressed, if feasible, with the project. The walkability/bikeability needs along the Highway 8 corridor are independent of the pavement conditions, vehicle safety, and vehicle mobility needs described in Section 3.1. The project provides the opportunity to address pedestrian and bicycle needs along Highway 8; therefore, walkability/bikeability was determined to be a secondary need.

3.2.1 Walkability/Bikeability

Background Information

There are no existing separate pedestrian and bicycle facilities along the Highway 8 corridor. Pedestrians and bicyclists must use the highway shoulders. Shoulder widths on the two-lane rural section roadway from east of Highway 61 to Karmel Avenue are 10 feet. Right-turn lanes are at many of the intersections along the Highway 8 corridor. There are no paved shoulders adjacent to the right-turn lanes, and pedestrians and bicyclists share the right-turn lanes with vehicular traffic.

One pedestrian/bicycle crash occurred along Highway 8 during the five-year period from 2014 to 2018. A crash involving a pedestrian occurred along Highway 8 southwest of 270th Street in August 2017. This crash was a property damage only crash in an active work zone with lane closures.

Table 3.14 lists key intersections along Highway 8 between I-35 and Karmel Avenue, existing traffic control, and pedestrian accommodations. Three of the nine key intersections are signalized intersections with pedestrian accommodations (Greenway Avenue, Pioneer Road, and East Viking Boulevard). These three intersections are approximately 2.5 miles apart from one another.

Table 3.14 Highway 8 Key Intersections, Traffic Control, and Pedestrian Accommodations

Highway 8 Intersection	Existing Traffic Control	Pedestrian Accommodations
Goodview Circle	Side-Street Stop Control	None
Greenway Avenue	Traffic Signal	Crosswalks, curb ramps, signal push buttons
Heath Avenue	Side-Street Stop Control	None
Pioneer Road	Traffic Signal	Crosswalks, curb ramps, signal push buttons
270th Street	Side-Street Stop Control	None
273rd Street	Side-Street Stop Control	None
East Viking Boulevard	Traffic Signal	Crosswalks, curb ramps, signal push buttons
Deer Garden Lane	Side-Street Stop Control	None
Karmel Avenue	Side-Street Stop Control	None

Qualitative Multimodal Assessment

A qualitative multimodal assessment was prepared for the Highway 8 corridor following a method developed by the Oregon Department of Transportation (DOT). This methodology considers the roadway characteristics and uses one of four subjective ratings to assess the multimodal aspects of the facility. The four context-based, subjective ratings include "excellent/good/fair/poor". The qualitative multimodal assessment methodology is appropriate for roadways with rural/suburban characteristics, with infrequent or no signal control.[10]

Table 3.15 presents the qualitative multimodal assessment for the two-lane rural section of Highway 8 from east of Highway 61 to Karmel Avenue. Because there are

[10] Oregon Department of Transportation. November 2018. Analysis Procedure Manual Version 2. Chapter 14: Multimodal Analysis. Section 14.3 Qualitative Multimodal Assessment. Accessed 18 November 2019 and available at https://www.oregon.gov/ODOT/Planning/Documents/APMv2_Ch14.pdf.

no separate pedestrian and bicycle facilities are in this segment of the Highway 8 corridor, non-motorized users must use the roadway shoulders. Although the shoulders are wide, providing a buffer for bicyclists, Highway 8 has relatively higher traffic volumes and higher vehicle speeds (see existing typical sections in Section 2.1.2 and existing ADT volumes in Table 3.10).

Table 3.15 Highway 8 Qualitative Multimodal Assessment

Mode	Qualitative Assessment Rating (1)	Rationale for Assessment Rating
Pedestrian	Poor	Lack of separate facility for pedestrians
Bicycle	Fair	Wider shoulders and travel lanes Higher traffic volumes and speeds

(1) Qualitative assessment ratings include excellent, good, fair, and poor.

Highway segment multimodal assessment only; does not include Highway 8 intersections.

Bicycle Level of Traffic Stress

The Highway 8 corridor was assessed for bicycle mobility and safety using a bicycle level of traffic stress method also developed by the Oregon DOT. This bicycle level of traffic stress (LTS) method provides a qualitative evaluation of the perceived safety issues of being near vehicles (i.e., proximity of passing traffic), traffic volumes, and traffic speeds. For example, a bicyclist will experience higher stress with high-speed traffic passing nearby compared to one riding in a buffered bicycle lane or separated trail facility. There are four bicycle LTS classifications, ranging from LTS1 to LTS4. Table 3.16 summarizes the bicycle LTS classifications.[11] [12]

[11] Oregon Department of Transportation. November 2018. Analysis Procedure Manual Version 2. Chapter 14: Multimodal Analysis. Section 14.4 Bicycle Level of Traffic Stress. Accessed 18 November 2019 and available at https://www.oregon.gov/ODOT/Planning/Documents/APMv2_Ch14.pdf.

[12] The pedestrian level of traffic stress (PTLS) methodology describes the level of pressure or strain experienced by sidewalk users. The Oregon DOT Analysis Procedure Manual notes that the PLTS methodology is intended for use primarily in urban areas; however, it can be applied in rural areas where pedestrian facilities exist. There are no sidewalks or trails along the project segment of Highway 8; therefore, a PTLS analysis was not prepared.

Table 3.16 Bicycle Level of Traffic Stress Classifications

Bicycle Level of Traffic Stress (LTS)	Definition	Examples
LTS1	Represents little traffic stress and requires less attention. Is suitable for all cyclists, including children.	Residential streets Separated bicycle paths/trails
LTS2	Represents little traffic stress but requires more attention. Is not suitable for young children. Suitable for teen and adult bicyclists with adequate bicycle handling skills.	Collector streets with bicycle lanes
LTS3	Represents moderate traffic stress. Suitable for observant adult bicyclists.	Low-speed arterials with bicycle lanes Moderate speed non-multilane roadways
LTS4	Represents high traffic stress and is suitable for only the most experienced cyclists.	High-speed/multi-lane roadways with narrow or no bicycle lanes

Source: Oregon Department of Transportation. November 2018. Analysis Procedure Manual Version 2. Chapter 14: Multimodal Analysis. Section 14.4 Bicycle Level of Traffic Stress. Accessed 18 November 2019 and available at https://www.oregon.gov/ODOT/Planning/Documents/APMv2_Ch14.pdf.

Application of bicycle LTS to high-speed (45 mph or greater) rural settings such as the Highway 8 corridor requires consideration of shoulder width and traffic volumes. The Highway 8 corridor received a bicycle LTS rating of LTS3 (i.e., moderate stress, suitable for most adult cyclists) for traffic volumes greater than 7,000 vehicles per day and shoulder widths equal to or greater than six feet. Many of the intersections along the Highway 8 corridor include right turn lanes. The presence of right turn lanes also will increase the bicycle LTS as this increases the likelihood that vehicles will cut across the bicyclist's path or that bicyclists will need to utilize these.

Chapter 4 Project Purpose

The purpose of the project is to improve pavement conditions, vehicle safety, and vehicle mobility on Highway 8 between I-35 in the City of Forest Lake and Karmel Avenue in Chisago City. In addition, the purpose of the project is to improve walkability/bikeability along the Highway 8 corridor in the project area.