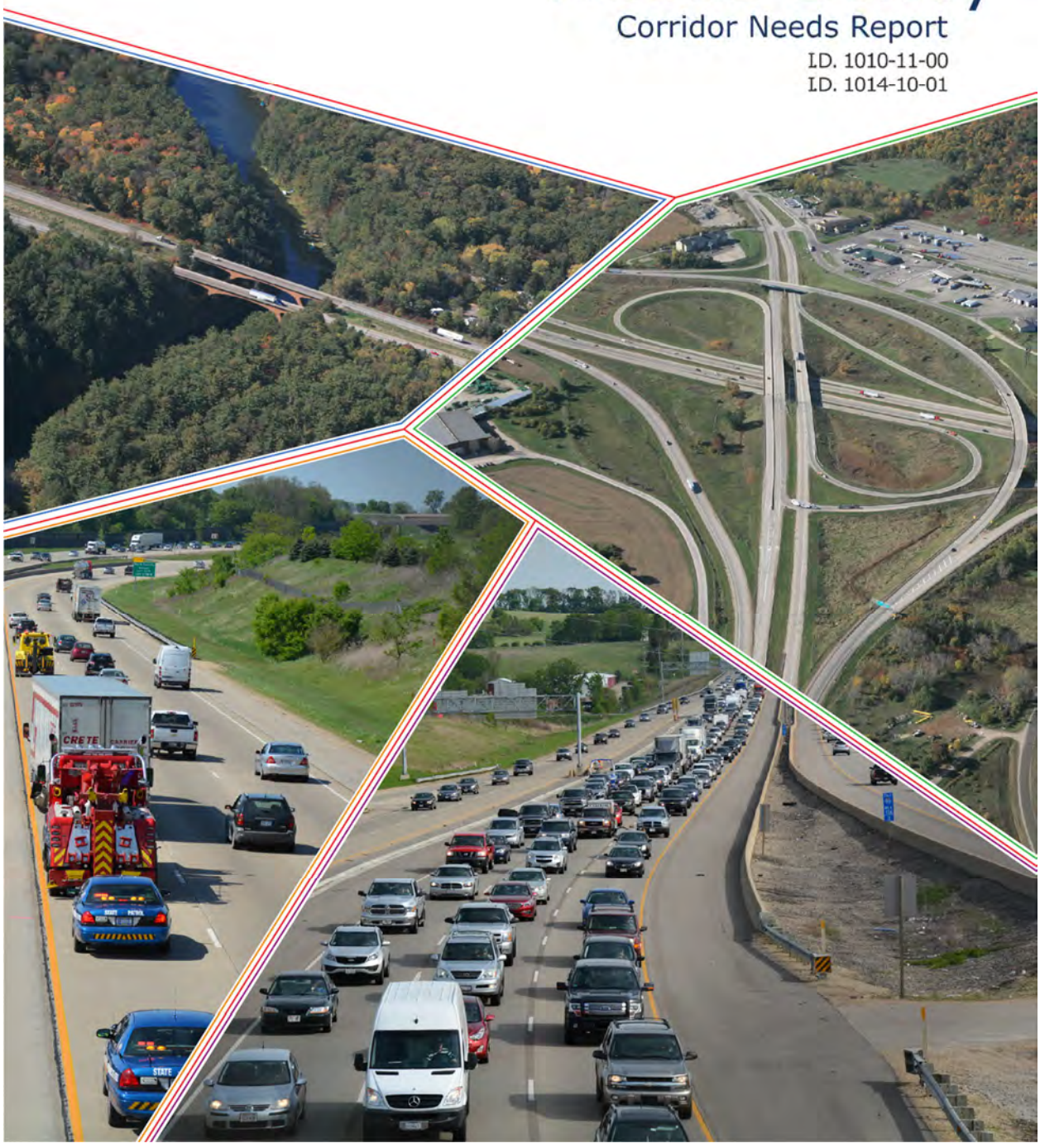
I-90 Madison to Tomah Needs Study

Corridor Needs Report

I.D. 1010-11-00
I.D. 1014-10-01



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I.D. 1010-11-00

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AECOM I.D. 60609449

I-39/90/94

Dane, Columbia, Sauk, Juneau, and Monroe Counties, Wisconsin

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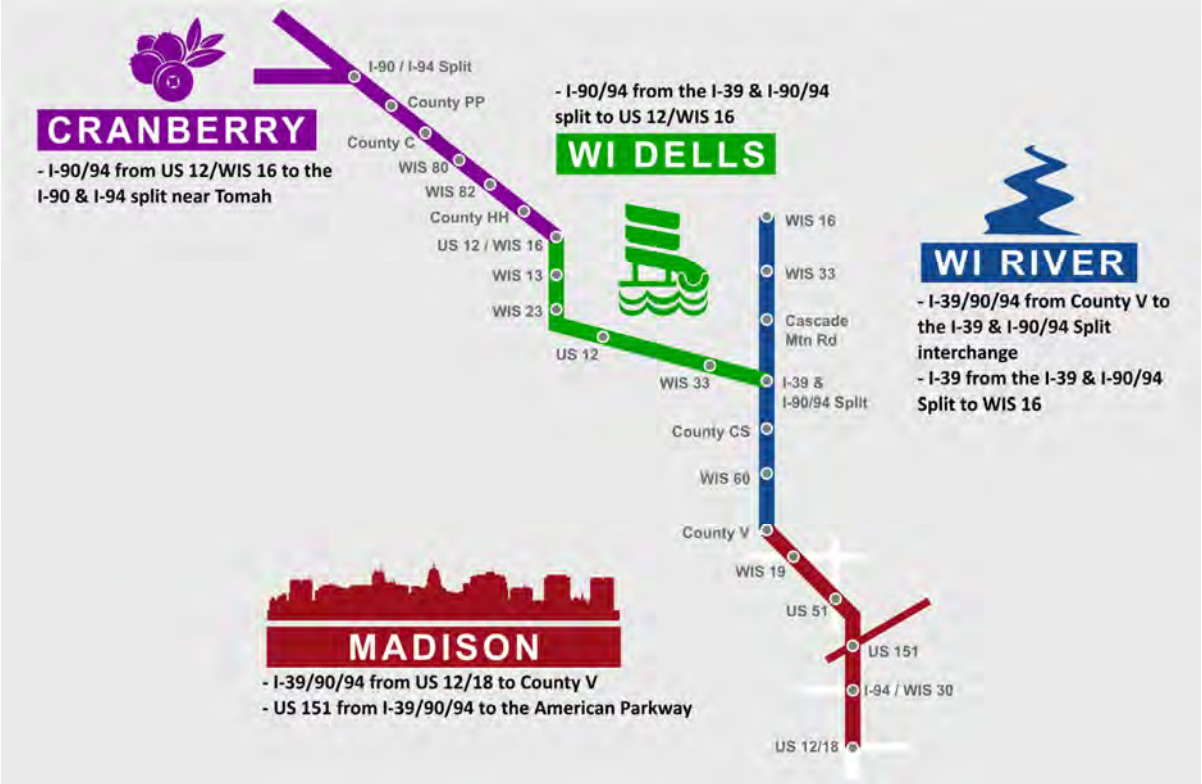
EXECUTIVE SUMMARY

The I-90 Madison to Tomah Needs Study evaluated the existing and future conditions along I-90 corridor from US 12/18 in Madison to the I-90/94 split in Tomah (approximately 100 miles). Evaluations included analysis of traffic, safety, pavement, and structures within the corridor. Existing year data was gathered in 2019. Future year analysis included forecasts for conditions through the year 2050. The purpose of this study was to provide information to inform decisions regarding potential future safety, pavement, bridge, or other improvement projects.

This *Corridor Needs Report* summarizes information from three reports generated during this study: *Existing Conditions Report*, *Future No Build Report*, and *Traffic Management Report*. Each of these reports can be found in the appendix for more detailed information about the analysis conducted during I-90 Madison to Tomah Needs Study.

- ***Existing Conditions Report*** details of the needs currently in the corridor for safety, pavement, bridge, and traffic operations.
- ***Future No Build Report*** analyzes the future traffic operational needs to the year 2050.
- ***Traffic Management*** Report focused in on traffic delay impacts of future pavement and bridge projects and includes information on travel patterns and travel time reliability analyses.

Figure 1. Section Boundaries



Needs by Category

The following summarizes the main findings of the I-90 Madison to Tomah Needs Study organized by category (traffic, safety, pavement, and structures).

Traffic

I-90 Will Have Undesirable Congestion From Madison to Tomah. The following table shows the expected congestion levels in 2020, 2030, 2040 and 2050

Section *See previous page for section limits*	Expected Congestion Level			
	2020	2030	2040	2050
Madison	D	E	E	**F**
Wisconsin River	C	D	D	**E**
Wisconsin Dells	D	D	D	**E**
Cranberry	C	C	D	D

Undesirable Congestion (1 level below desirable LOS)
Undesirable Congestion (2 or more levels below desirable LOS)
Desirable Congestion is LOS D in urban areas (Madison) and LOS C in rural areas (rest of the corridor) based on FDM 11.5-3.2.1

In the Madison Section, undesirable congestion will occur in the recreational summer Friday and Sunday peak hours by 2030 and commuting AM and PM peak hours by 2040. The Wisconsin Dells section has undesirable congestion on summer Friday and Sunday peak hours in the base 2020 year. The remainder of the corridor will experience undesirable congestion in the recreational summer Friday and Sunday peak hours by 2040.

Travel times on summer Friday and Sunday peaks are unreliable. Drivers value consistent trips without unexpected delays. However, I-90 travel times tend to vary day-to-day due to crashes, lane closures, high volume recreational peak periods, and weather. The least reliable travel times tend to occur on EB I-90 summer Sundays in the Wisconsin Dells section between US 12/WIS 16 and the I-39 & I-90/94 split. Travel times in this section that normally take about 20 minutes at the 70 mph posted speed limit can double on summer Sundays due to congestion, or even quadruple during the most severe crash events. Unreliable travel makes trip planning difficult and leads to driver frustration.

Safety

Safety concerns are found in high crash rate areas. The Madison and Wisconsin Dells areas have the greatest number of high crash locations. These high crash areas are caused primarily by congestion and/or road geometry. Overall, about 11% of the corridor has safety issues, defined by a crash rate above the upper control limit for similar facilities around the state. From 2014 through 2018, the crash frequency in the study area was about 2 crashes per day (3,533 total), 5 injuries per week (1,337 total), and 1 fatality every 2 months (33 total).

As traffic volumes continue to increase, the number of congestion related crashes is also expected to increase. Congestion related crashes typically involve more than one vehicle and are typically rear end crashes or sideswipe same direction crashes. Congestion related crashes account for almost half of the total crashes in the corridor (1,664 of 3,533). Congestion related crashes are more likely to lead to secondary crashes. Secondary crashes occur after a traffic backup is caused by an initial crash. Drivers are 70% more likely to be injured in a secondary crash as measured in this corridor because of the speed differential of high speed traffic mixing with stopped or slow traffic.

Pavement

Pavement repair projects along the corridor are anticipated in 24 of the next 30 years. Many areas of pavement are reaching the end of their expected life cycle and will require more maintenance in the form of significant pavement repair and overlay projects. The entire 101 mile corridor needs some form of pavement maintenance before 2035.

Work Zone traffic staging for pavement replacement and repair projects will become more difficult as traffic volumes grow. Work zone traffic control restrictions such as reduced construction windows, time of day work restrictions, and inability to close travel lanes to prevent large delays and long queues will continue to become stricter as traffic volumes grow in the future. For normal pavement maintenance lane closures, many segments may require night work only to avoid large delays. Some projects may require constructing temporary pavement and bridges to maintain traffic, increasing the cost of pavement and bridge repair projects.

Structures

As structures continue to age across the corridor, more maintenance will be required over time. Three structures along the corridor have been identified as structurally deficient. In the next thirty years, 104 of the 192 structures in the study area are anticipated to require rehabilitation and 66 bridges are anticipated to be replaced within the corridor.

The I-90/94 bridges over Mirror Lake are unique structures that are reaching the end of their useful life. The existing 320 foot long K-frame structures were constructed in 1961 and are fracture critical. The bridges are narrow (32 feet) and experience high summer traffic making traffic control challenging for maintenance activities. In addition, the over 100 foot drop from the bridge to the water has been a crash severity issue. In the past 10 years, three vehicles have dropped into the lake below resulting in three fatalities in two fatal crashes.

Other Considerations

Economics and resiliency were two other areas evaluated in the I-90 Madison to Tomah Needs Study.

I-90 provides mobility for the freight and tourism industries. Freight traffic carries over $116 billion[1] of goods through I-90. Freight traffic volume has grown by about 1000 trucks per day (5-11%) from 2015 to 2019. Regarding tourism, the five counties in the I-90 study area accounted for over $4 billion in tourism business sales in 2018[2], about 20% of the state's total tourism. These dollar values demonstrate that I-90 has regional importance. Maintaining mobility for freight and tourism on this interstate route will help support both local and regional economies

[1] 2017 Freight Value and Tonnage data from TranSearch through WisDOT BPED
[2] Wisconsin Department of Tourism http://industry.travelwisconsin.com/research/economic-impact

Photo Source: Portage Daily Register, June 14, 2018

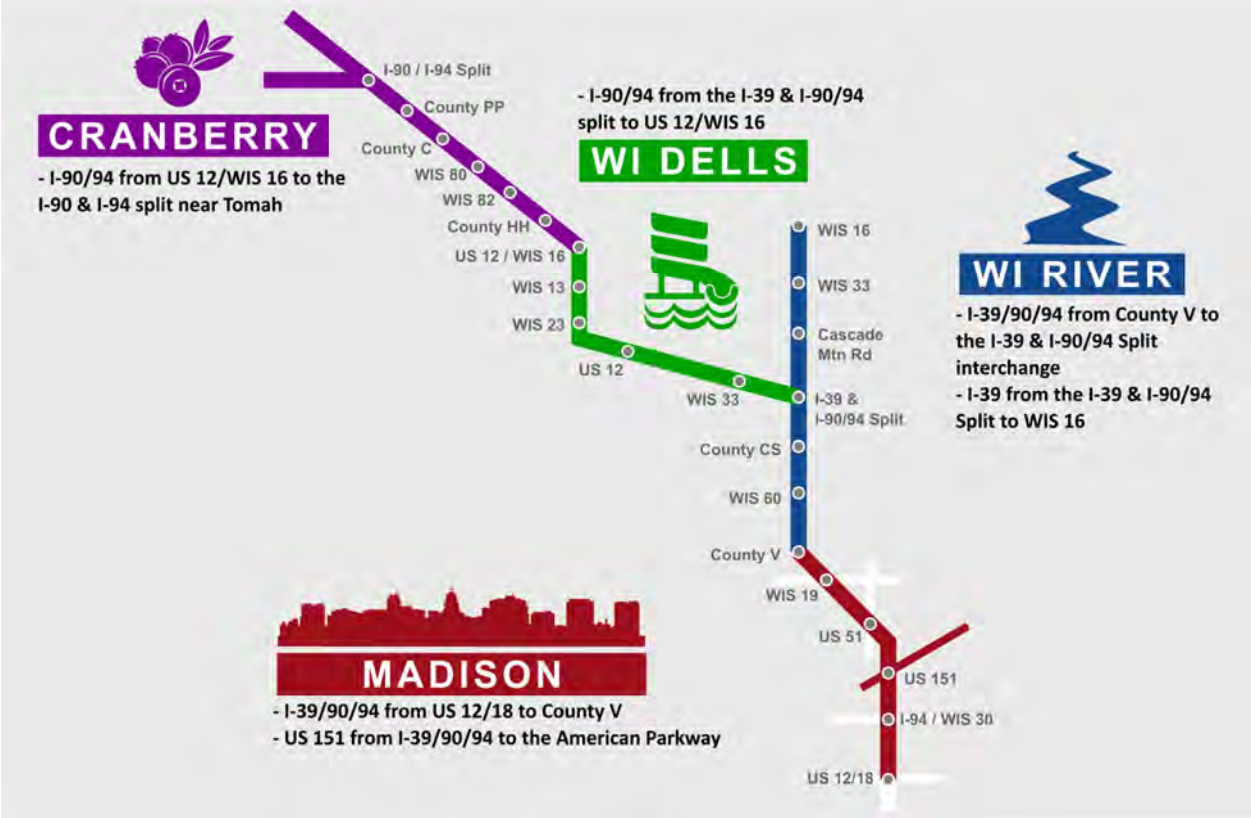
Major flooding events have demonstrated that I-90 faces resiliency challenges. There have been 4 major flooding events on the Baraboo and Lemonweir Rivers that resulted in partial or full closure of the interstate in this corridor since 2008. Local alternate routes to I-90 have limited and low-capacity river crossings, intersection delays, and bottlenecks. High-capacity alternate routes to the interstate involve long-distance detours that impact commerce by delaying freight.

Needs by Geographic Location

I-90 was divided into four sections to simplify communicating results. Section limits are shown in Figure 2. The sections are:

- **Madison** – Includes the only urban section in the study area and experiences the highest traffic volumes.
- **Wisconsin River** – This section crosses the Wisconsin River twice. Traffic patterns change, and this section is controlled primarily by recreational trends.
- **Wisconsin Dells** – Is defined by the recreational destination of the Wisconsin Dells and the many attractions found there.
- **Cranberry** – This section is characterized by high truck percentages and is named for the large cranberry bogs found on either side of I-90/94.

Figure 2. Section Boundaries

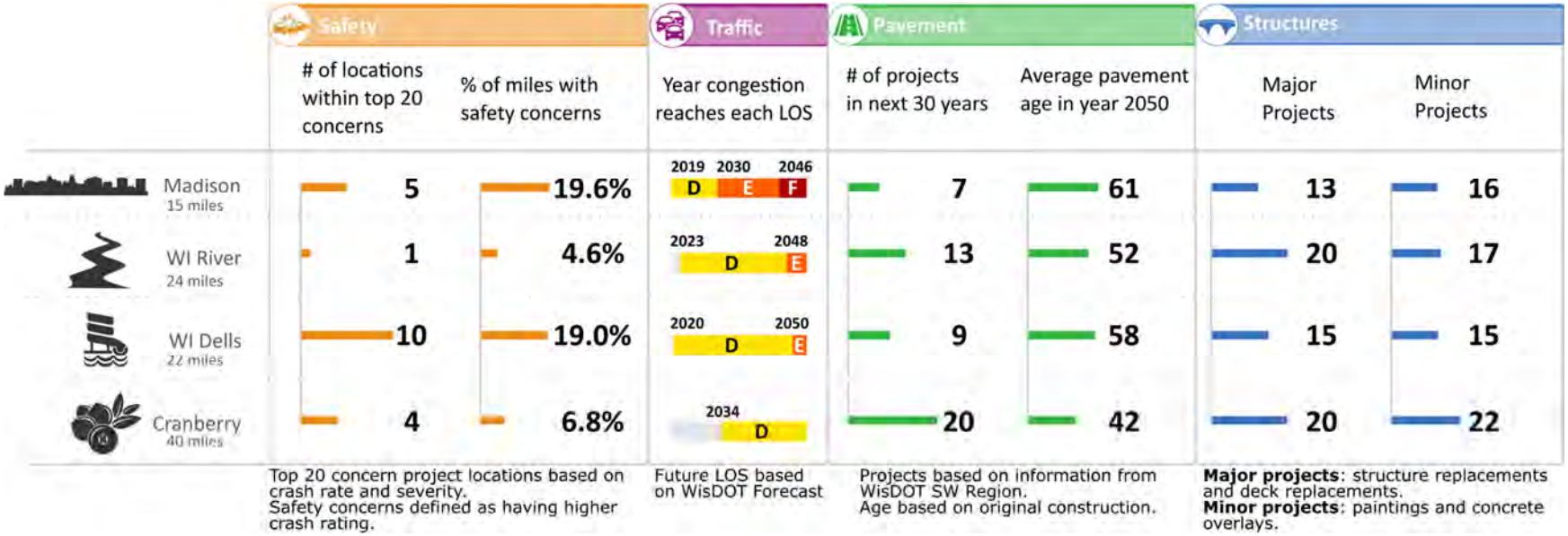


For each of the four sections, the main safety, traffic, pavement, and structures findings are summarized into the matrix shown in Figure 3 on page ix. These findings were derived from detailed "summary of needs" maps shown in Exhibits 1-5. The summary of needs exhibits show the year and location of potential future pavement and structures projects that would be needed

to maintain the current infrastructure. The exhibits also highlight current safety issues and how traffic congestion increases over time. While all sections of the corridor have traffic, safety, pavement, and structures needs, the main needs in each section include the following:

- **Madison – Traffic and safety** are pronounced needs in the Madison section. This section already experiences traffic congestion issues, especially with overcapacity interchange ramps at the US 151 interchange and is the first section anticipated to reach LOS E by year 2030. Safety is also a primary concern as increased congestion increases the risk for crashes.
- **Wisconsin River – Pavement and structures** are prominent needs in this section. 13 potential pavement projects and 36 major or minor structures projects are anticipated to be needed before the year 2050 in order to maintain the existing infrastructure.
- **Wisconsin Dells – Traffic, safety, pavement, and structures** are needs in the Wisconsin Dells section. This section contains half of the top 20 safety locations of concern. Pavement and structures projects may face significant traffic control restrictions in order to minimize impact to traffic. This section also contains major bridges over Mirror Lake that will likely need to be replaced by the mid 2030's.
- **Cranberry – Pavement and structures** projects are the main needs in this section, with 14 pavement projects and 42 major or minor structures projects anticipated to be needed before the year 2050.

Figure 3. Safety, Infrastructure, and Congestion Summary by Location.



Next Steps

The purpose of I-90 Madison to Tomah Needs Study was to provide information to inform decisions regarding potential future safety, pavement, bridge, or other improvement studies and projects. Next steps beyond this study may include prioritizing, scoping, and detailed study of future projects. The “summary of needs” maps in Exhibits 1-5 can serve as a tool for identifying and packaging potential future projects to gain cost and time efficiencies. I-90 was divided into four sections to communicate information for this study; however, actual project boundaries may vary as improvement alternatives are developed.

End of Executive Summary

INTRODUCTION

The purpose of the I-90 Madison to Tomah Needs Study was to provide information to inform decisions regarding potential future safety, pavement, structures, or other improvement projects. This report summarizes existing and future needs throughout the I-90 corridor in the following categories:

The **traffic** analysis evaluated traffic operations and Level of Service (LOS) for both the existing year 2019 and forecasted year 2050 traffic.

The **safety** evaluation screened total and KAB (fatal, A, and B severity) crash rates to compile a list of the top twenty greatest safety concern locations throughout the corridor. Future predictive safety analysis was not part of the I-90 Madison to Tomah Needs Study scope.

The **pavement** analysis documented the amount of previous and future maintenance expected for each section.

The **structures** analysis evaluated the current condition of bridges and forecasted future bridge needs.

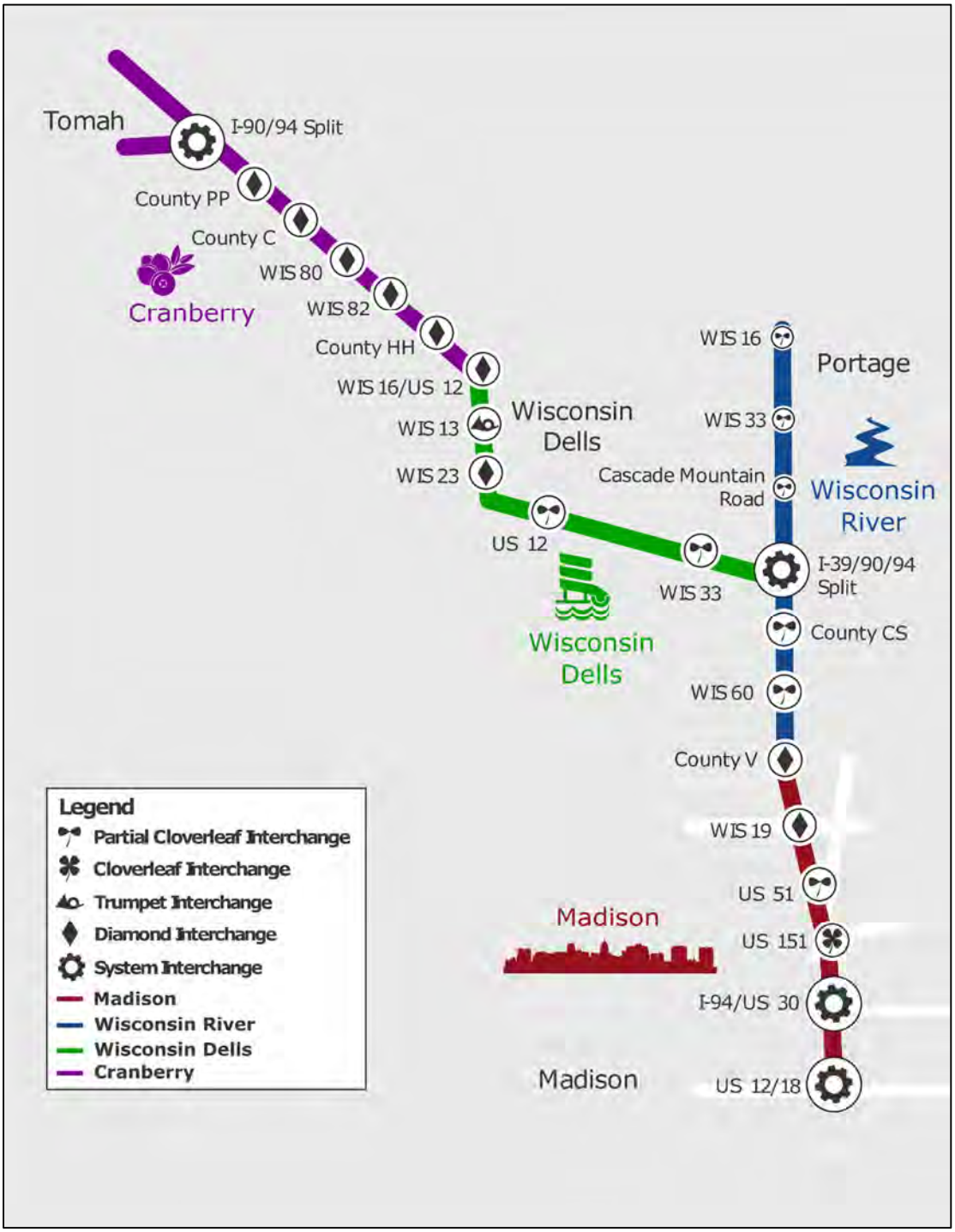
The appendices of this report include the three supporting reports generated during the I-90 Madison to Tomah Needs Study. These reports contain more detailed information on each of the needs:

- **Existing Conditions Report** (Appendix I & II) – contains details regarding traffic, safety, pavement, bridge and geometric conditions in the corridor as of 2019.
- **2050 Future No Build Report** (Appendix III & IV) – contains analysis of future year 2050 traffic congestion in the corridor.
- **Traffic Management Report** (Appendix V & VI) – documents the pavement and bridge maintenance traffic staging limitations in the corridor. This report also provides additional information on travel time reliability and origin-destination travel patterns on I-90.

Corridor Section Definitions

For evaluation and reporting purposes, the corridor was separated into four sections: Madison, Wisconsin River, Wisconsin Dells, and Cranberry. These sections are shown in Figure 4.

Figure 4. Section Boundaries



Madison

This section stretches along I-39/90/94 from US 12/18 to County Rd. V. US 151 from the I-39/90/94 interchange to the American Parkway interchange was also included. It is the only urban section in the project study area and experiences the highest traffic volume.

Wisconsin River

This section extends along I-39/90/94 from County Rd. V to the I-39 & I-90/94 split interchange. The section also includes I-39 from the I-39 & I-90/94 split north to WIS 16. This section crosses the Wisconsin River twice and is the transition in the corridor from urban commuter traffic to recreational rural traffic.

Wisconsin Dells

This section goes along I-90/94 from the I-39 & I-90/94 split to US 12/WIS 16. This is a unique section defined by the recreational destination of the Wisconsin Dells, and the many attractions found there.

Cranberry

This section stretches along I-90/94 from US 12/WIS 16 up to the I-90 & I-94 split near Tomah. It is characterized by large truck percentage and is named for the large cranberry bogs found on either side of the freeway.

TRAFFIC

Existing year 2019 and forecasted year 2050 no build traffic congestion was evaluated on I-90 to identify areas potentially needing traffic improvements. A variety of data sources and tools were used in the analysis, including: existing traffic counts, traffic speeds, highway capacity software (HCS), and third-party data sources such as the National Performance Management Research Data Set (NPMRDS) and StreetLight origin-destination data. All of the analysis produced detailed information regarding the following:

- Traffic level of service (LOS)
- Traffic speeds
- Travel times and travel time reliability
- Origin-destination travel patterns
- Ramp terminal intersection LOS
- Estimated hours of congestion
- Estimated work zone delays

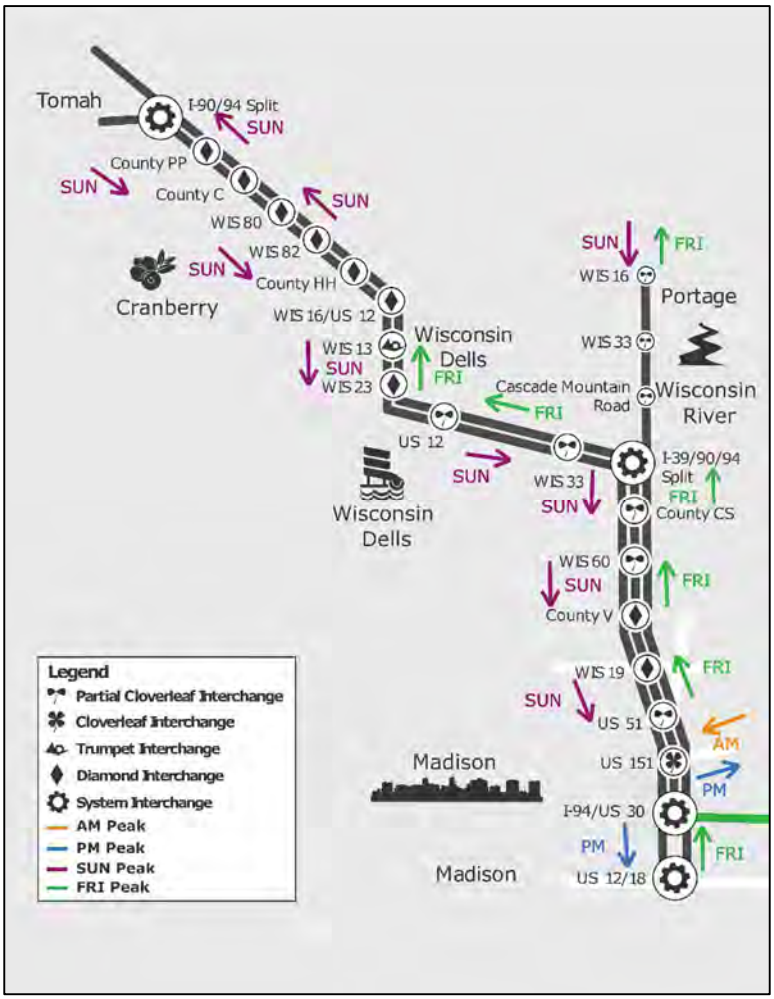
Given the large amount of traffic analysis, and that the various results generally point to the same conclusions, this report focuses on summarizing general traffic trends and the freeway LOS analysis that can be compared to the Wisconsin Department of Transportation Facilities Development Manual (FDM) standards. More information regarding other traffic analyses listed above can be found in the appendices.

Traffic Volumes and Patterns

There are three main types of travel patterns in the corridor that control traffic operations: recreational, commuting and freight traffic. Recreational traffic typically occurs on summer weekends, especially Fridays and Sundays, and reflects that tourism is an important part of Wisconsin's economy. Commuting traffic typically occurs during the weekday AM and PM peak hours throughout the year. Freight traffic occurs throughout the week and demonstrates the importance of this corridor for moving goods. Freight traffic is further discussed in the Freight section of this report.

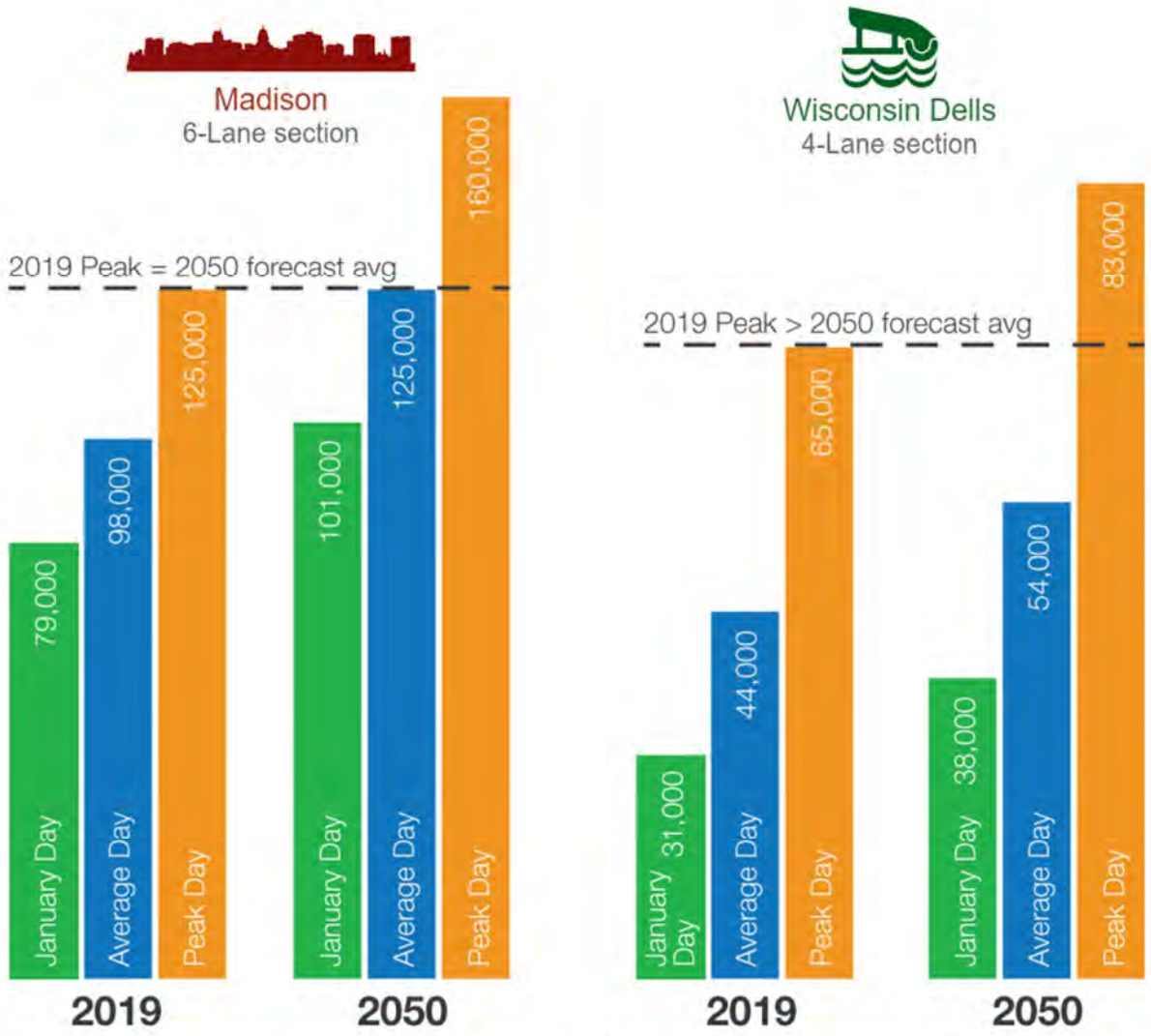
Traffic volume data from each of the Automatic Traffic Recorder (ATR) locations within the corridor was collected to evaluate volume trends. The controlling peak period for each ATR is shown in Figure 5. These are typically the highest-volume time periods that occur at the ATR locations. The Madison area has the highest commuting traffic volumes and reflects the strong base of employment in the Madison area. In the northern parts of the study area, the recreational traffic represents the highest traffic volumes. Each of the four peak time periods: AM, PM, Friday, and Sunday were analyzed for existing and future freeway level of service as discussed in the Traffic Level of Service section of this report.

Figure 5. Controlling Peak Periods throughout Corridor



The typical high existing summer seasonal traffic volumes make it possible to anticipate what future 2050 average daily traffic could look like. Traffic on an average day in 2050 may resemble existing peak summer volumes as shown in Figure 6. For instance, in the Madison area the 4th of July, 2019 weekend daily volume (125,000 vehicles) is about the same as the 2050 average day forecast. Near Wisconsin Dells, the 2019 4th of July weekend daily volume (~68,000 vehicles) exceeds the projected 2050 average day forecast (~54,000 vehicles). This means that the traffic congestion on holiday weekends in 2019 will become more and more common as traffic volumes grow to 2050.

Figure 6. Average and Peak Future and Existing Day Comparisons

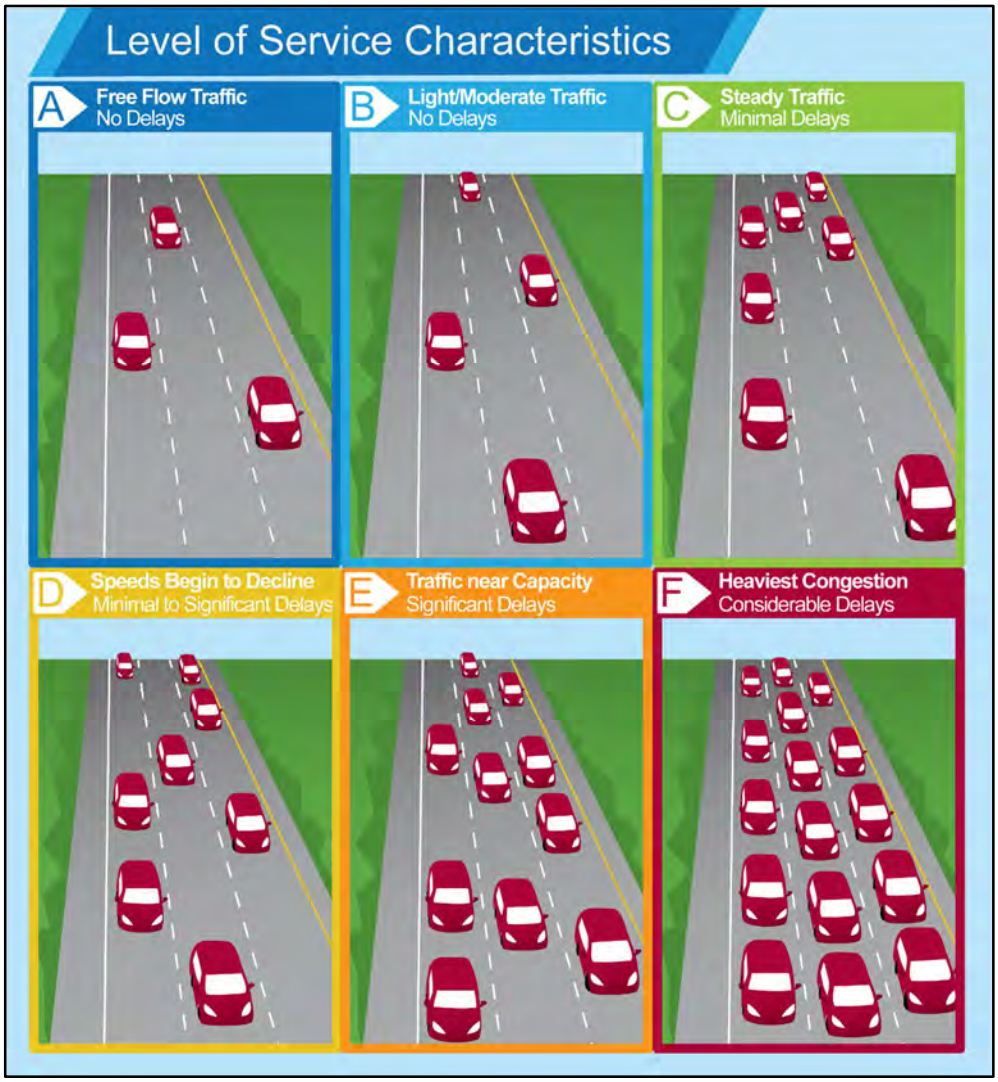


January Day is average of all days in January 2019; Average Day is average volume of all days within the given year; Peak Day is from July 4th weekend, 2019

Traffic Level of Service

Traffic operational analysis primarily focused on level of service (LOS) as a planning-level indicator of congestion, driver discomfort, frustration, and increased travel time. Figure 7 shows the differences between levels of service.

Figure 7. Level of Service



FDM section 11.5-3.2.1 sets LOS D as acceptable in urban areas and LOS C as acceptable in rural areas. LOS on the I-90 freeway was estimated using the Highway Capacity Software (HCS) and compared against the FDM criteria. Data inputs for the LOS analysis were obtained from existing year 2019 traffic counts and WisDOT year 2050 traffic forecasts. The following report sections discuss freeway LOS and traffic congestion on I-90.

Madison Section Traffic

The Madison section in the existing year experiences congestion at the lowest allowable level of service for an urban area, LOS D, based on FDM 11.5-3.2.1. Table 1 shows the estimated I-39/90/94 freeway LOS based on HCS analysis. The existing traffic congestion occurs mainly in the Madison urban area on I-39/90/94 between US 12/18 and US 151. This area carries the highest traffic volumes in the study area, with a mix of both commuting and recreational traffic. Each of the locations with existing LOS D reflect bottleneck locations due to weaving or merging traffic. The US 151 interchange in particular has multiple ramps that are overcapacity in the existing year and have been observed to cause queueing along the mainline of both I-39/90/94 and US 151 (further discussed below).

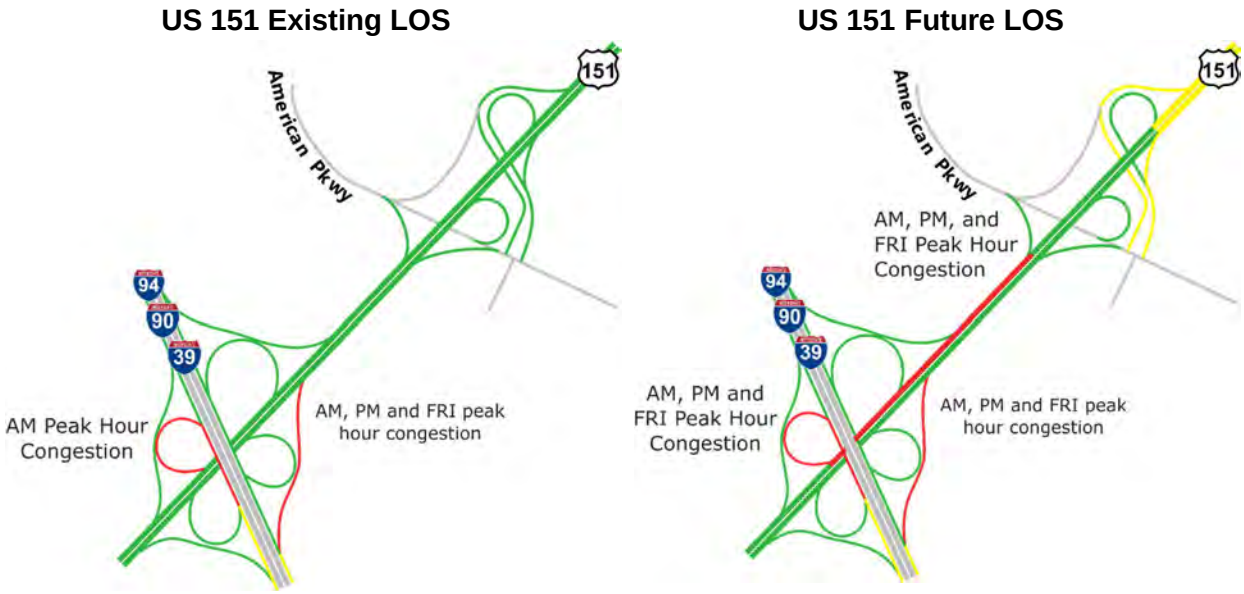
Table 1 also shows that congestion is anticipated to reach undesirable LOS E and LOS F conditions in the future. Worsening congestion is due to forecasted increases in traffic demand and limited spare capacity of existing bottleneck locations. The Madison area is forecasted to reach LOS E in at least one peak by 2030 and may reach LOS F by year 2046. For more details about the interim LOS analysis see Appendix III.

Table 1. Freeway Level of Service – Madison Section

	Existing Year 2019								Future Year 2050							
	AM		PM		SUN		FRI		AM		PM		SUN		FRI	
I-39/90/94 Segment	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB
County V - WIS 19	B	B	B	C	D	C	B	C	B	B	B	C	E	C	C	E
WIS 19 - US 51	B	B	B	C	D	C	C	D	C	B	C	D	E	C	D	E
US 51 - US 151	B	B	B	C	D	C	C	D	B	B	C	D	E	D	D	E
US 151 - I-94	B	C	C	D	D	C	D	D	C	C	D	D	E	C	F	E
I-94 - US 12/18	C	D	D	D	D	C	D	D	D	E	D	E	E	D	F	F
FDM 11.5-3.2.1 Urban Area Desirable LOS D or better																

The Madison section also included an analysis of US 151. US 151 is the main commuter route from the Sun Prairie area, and two of the ramps operate at LOS F in the existing condition. These two ramps represent the worst congestion in the existing conditions. Existing queuing stretches back onto US 151 towards American Parkway. These conditions will only worsen in the future. These LOS results can be seen graphically in Figure 8.

Figure 8. US 151 LOS Results



Congestion at the I-39/90/94 & US 151 interchange occurs due to the following:

- **Over-capacity ramps** – both the NB I-39/90/94 to NB US 151 ramp and the SB US 151 to SB I-39/90/94 ramps have existing traffic demands at-or-above capacity. Future demands are projected to exceed capacity. These ramps are slow-speed, single-lane connections that have limited ability to safely and efficiently accommodate high traffic volumes. Both ramps are within the top 20 areas of safety concerns in the study area (discussed in the Safety section).

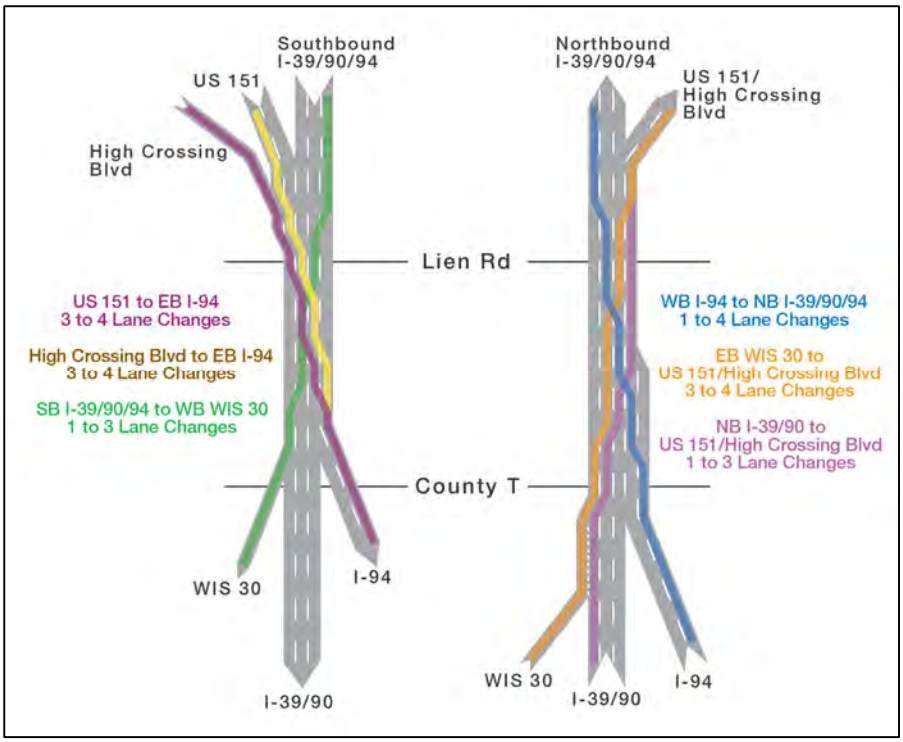
  Queues from the single-lane ramps can form along the freeway mainline, creating unsafe speed differential between ramp traffic and mainline traffic. Congestion is further exacerbated by poor lane utilization at the NB I-39/90/94 exit to the US 151 / High Crossing Boulevard collector-distributor (CD) road. The CD road exit is two lanes, but only the outside lane is predominantly used because of the large volume of traffic headed to take the single lane ramp to NB US 151. NB I-39/90/94 congestion at the CD road exit is shown in Figure 9.

- **Northbound weaving** – On NB I-39/90/94, between the I-94/WIS 30 (Badger) and US 151 interchanges, high-volume entering and exiting traffic creates weaving conflicts that can lead to traffic slow-downs and crashes. Northbound weaving movements are shown in Figure 10. Going northbound on I-39/90/94, approximately 50% (AM Peak) of the WIS 30 traffic, which enters I-39/90/94 on the left, exits on the right at the US 151 / High Crossing exit, requiring 3 to 4 lane changes. Approximately 40% of northbound I-39/90 traffic from south of the I-39/90 & I-94 interchange, exits at the US 151 / High Crossing interchange during the weekday and Friday PM peaks, requiring up to 3 lane changes.

- **Southbound weaving** – Similar to the northbound weaving described above, SB I-39/90/94 also experiences weaving conflicts between the US 151 and the Badger interchange due to high volume traffic from SB US 151 destined for I-94 conflicting with SB I-39/90/94 traffic destined for WIS 30. Southbound weaving movements are shown in Figure 10. Weaving between the two interchanges can involve up to 3 or 4 lane changes, depending on the origin and destination.

Figure 9. I-39/90/94 Looking South from High Crossing Blvd.

Figure 10. Weaving Movements between the I-94/WIS 30 and US 151 Interchanges



Wisconsin River Section Traffic

The Wisconsin River section represents the shift from urban to rural areas which changes the desirable LOS from D to C. This section has a few locations with undesirable operations in the existing conditions, but backups from the Madison area will stretch back into this section in the future causing LOS two levels below desirable on the weekend summer peaks. This can be seen in Table 2. The level of service reported from HCS for this section of I-39/90/94 is generally under reported compared to what driver experience due to uneven lane utilization by cars and trucks.

Table 2. HCS LOS in Wisconsin River Section[3]

	Existing Year 2019								Future Year 2050							
	AM		PM		SUN		FRI		AM		PM		SUN		FRI	
Segment	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB
I-39 north of WIS 16	A	A	A	A	B	A	A	B	A	A	A	A	C	A	A	B
WIS 33 - WIS 16	A	A	A	A	C	A	A	B	A	A	A	B	C	A	A	B
Cascade Mtn - WIS 33	A	A	A	A	C	A	A	B	A	A	A	B	C	A	A	B
WIS 33 - Cascade Mtn (3 lanes)	A		A		B		A		A		A		C		A	
I-90/94 - Cascade Mtn (2 lanes)		A		B		A		C		A		B		A		C
I-90 NB - WIS 78 on	A		A		B		A		A		A		B		A	
I-39 Diverge	A	A	A	A	B	A	A	B	A	A	A	B	B	A	A	B
I-90 NB - WIS 78	A		A		A		A		A		A		A		A	
WIS 78 - SB I-90	A	A	A	A	B	A	A	A	A	A	A	A	B	A	A	A
I-39 split - County CS	A	A	B	B	D	B	B	D	B	B	B	C	E	C	C	D
County CS - WIS 60	B	A	B	B	C	B	B	C	B	B	B	C	E	C	C	D
WIS 60 - County V	B	B	B	B	C	B	B	C	B	B	B	C	E	C	C	D

While the Madison Section to the south has congestion during all 4 peaks evaluated (Weekday AM, Weekday PM, Summer Friday PM, and Summer Sunday PM), this section typically only experiences recurring congestion during the Summer Friday and Sunday peaks.

Wisconsin Dells Section Traffic

The Wisconsin Dells section is a rural freeway with a desirable LOS of C or better. The Wisconsin Dells is a premier destination for recreational traffic and in the existing conditions this already causes LOS levels below desirable in the summer weekend peak periods. As the Wisconsin Dells area continues to grow, this congestion will only worsen in the future. In the future, nearly the entire section is operating below desirable levels, and in a few locations, it is operating two levels

[3] Blank boxes represent influence areas that are not present in that directional model.

below desirable. The section is already operating at undesirable levels of LOS D in the existing year and is expected to reach LOS E by 2050. These results can be seen in Table 3. For more information about the interim LOS analysis see Appendix III.

Table 3. HCS LOS Results for Wisconsin Dells Section

	Existing Year 2019								Future Year 2050							
	AM		PM		SUN		FRI		AM		PM		SUN		FRI	
I-90/94 Segment	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB
US 12/WIS 16- WIS 13	A	A	B	B	D	C	C	C	A	A	B	C	D	C	D	D
WIS 13 - WIS 23	A	A	B	C	D	C	C	D	A	A	B	C	E	D	D	D
WIS 23 - US 12	A	A	B	B	D	C	C	D	B	A	B	C	E	D	D	E
US 12 - WIS 33	A	A	B	B	D	C	C	D	A	A	B	B	D	D	C	D
WIS 33 - I-39	A	A	B	B	C	C	C	C	A	A	B	B	D	D	C	D

This increased congestion and traffic may ultimately hurt the tourist economy in the Wisconsin Dells area.

Cranberry Section Traffic

The Cranberry section has less traffic operations needs in comparison to the other sections. There are minor issues in the existing conditions, but the future conditions experience LOS below desirable in the southbound direction though the vast majority of the section on summer Sundays. These results can be seen in Table 4. This section has the highest truck percentage of any of the sections, and the amount of trucks is expected to continue to grow into the future.

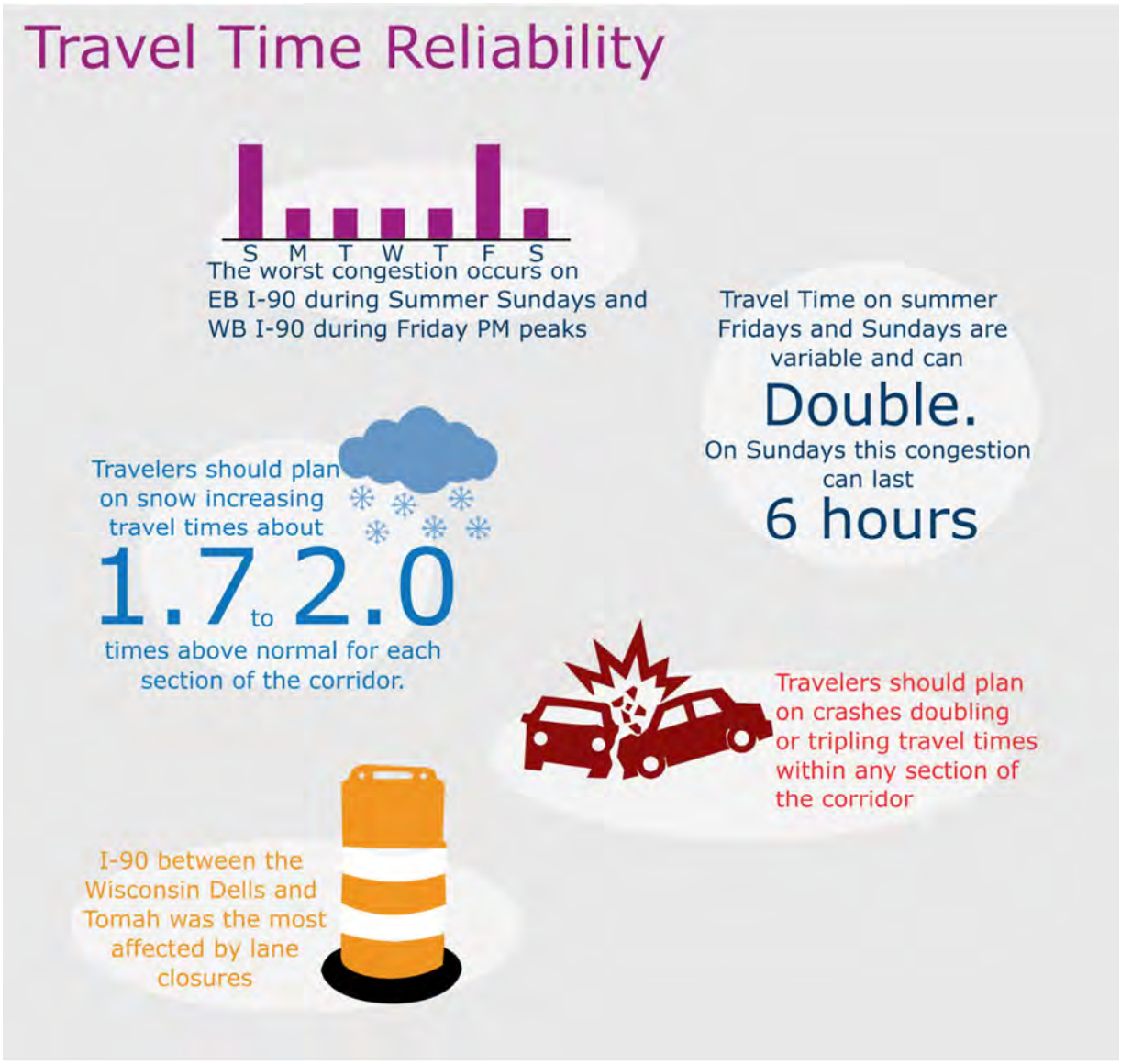
Table 4. Existing HCS LOS Results for Cranberry Section

	Existing Year 2019								Future Year 2050							
	AM		PM		SUN		FRI		AM		PM		SUN		FRI	
I-90/94 Segment	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB	SB	NB
I-90 SB/I-90 NB	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
I-90/94 SB/I-90/94 NB	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A	A
I-94 EB/WB	A	A	A	B	C	B	B	B	A	A	B	B	C	B	B	B
I-90 - County PP	A	A	B	B	C	C	C	C	A	A	B	B	D	C	C	C
County PP - County C	A	A	B	B	C	C	C	C	A	A	B	B	D	C	C	C
County C - WIS 80	A	A	B	B	C	C	C	C	A	A	B	B	D	C	C	C
WIS 80 - WIS 82	A	A	B	B	C	C	C	B	A	A	B	B	D	C	C	C
WIS 82 - County HH	A	A	B	B	C	C	C	C	A	A	B	B	D	C	C	C
County HH -US 12/WIS 16	A	A	B	B	D	C	C	C	A	A	B	B	D	C	C	C

Travel Time Reliability

The existing Friday and Sunday peaks have unreliable travel times. Drivers value consistent trips without unexpected delays. However, travel times on I-90 vary day-to-day due to crashes, lane closures, high volume recreational peak periods, and weather. The least reliable travel times tend to occur on EB I-90 summer Sundays in the Wisconsin Dells section between US 12/WIS 16 and the I-39 & I-90/94 Split. The normal ~20 minute travel time in this section can more than double due to crashes or congestion. Unreliable travel makes trip planning difficult and leads to driver frustration. Figure 11 shows the causes and effects of unreliable travel. As traffic volumes increase, travel times may become increasingly unreliable because there would be less capacity to absorb the effects of congestion causing events. For more details about the reliability analysis see Appendix V.

Figure 11. Reliability Summary

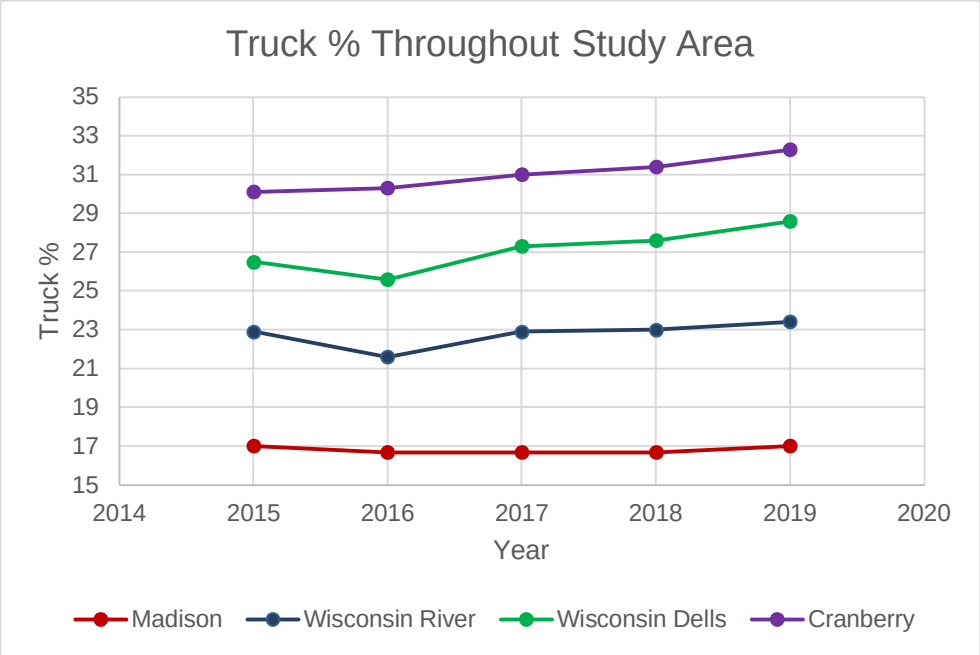


Freight

I-90 carries over $116 billion total value of freight annually[4]. Figure 12 shows the historic percentage of trucks trends over the past four years. These truck percentages are taken from historic ATR counts in each section throughout the corridor. The upward trajectory of truck percentage in the corridor implies that the number of trucks on the road is growing faster than the number of passenger cars. In the Madison section there were 15,750 trucks per day in 2015 and in 2019 there are 16,600 trucks per day resulting in a 5% increase of 850 trucks per day. The Wisconsin River section increased from 12,450 to 13,300 for a 7% increase in trucks per day. Both the Cranberry and the Wisconsin Dells sections have experienced an 11% increase of 1,100 trucks per day from 2015 to 2019.

Freight impacts traffic operations, but also increases wear of the pavement. In the Cranberry section, where the truck percentage is the highest in the corridor, the pavement has generally required more and earlier maintenance than the FDM life-cycle recommends. For more details on the pavement condition in the Cranberry section see the Cranberry Section Pavement section of this report.

Figure 12. Historic Truck Percentage Trends

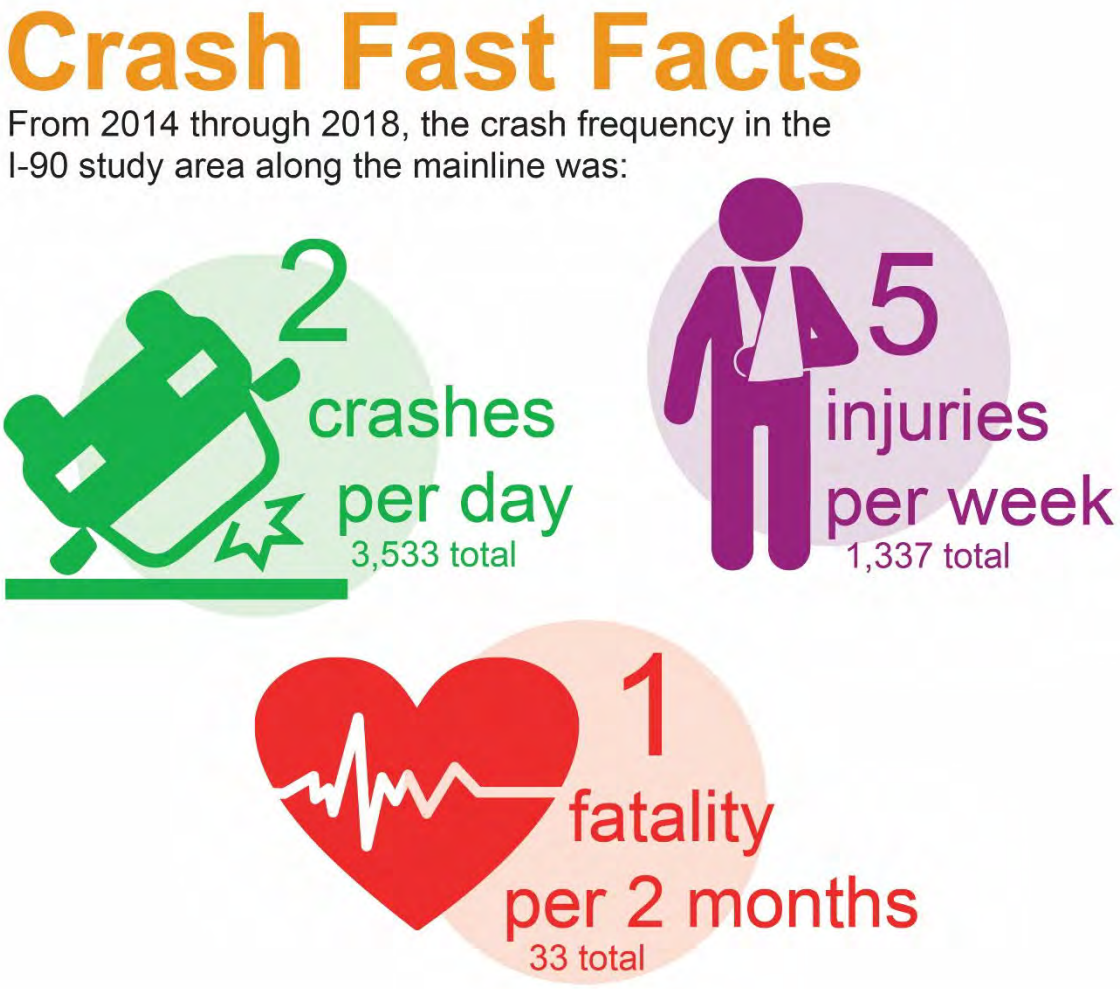


[4] Source: 2017 Transearch Data

SAFETY

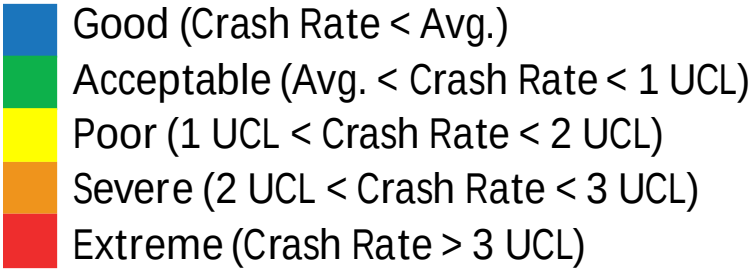
The existing safety conditions throughout the corridor were evaluated to find general trends and identify high crash locations potentially needing correction. Historical crash data was obtained from the University of Wisconsin-Madison Traffic Operations and Safety Laboratory between the years of 2014 – 2018. During this time there were 4,096 non-deer related crashes within the study area, 3,533 of which were located on the mainline. For the mainline, this equates to an average of 707 crashes per year, or approximately 2 crashes per day. Figure 13 shows frequency and injury statistics about the mainline crashes.

Figure 13. Mainline Crash Overview Facts



These crashes were assigned to the corridor geographically in order to calculate a crash rate for each influence area throughout the corridor. Influence areas are small contiguous sections of the corridor used to compare similar sections. The six types of influence areas are merge, diverge, basic freeway, weave, ramp, and ramp terminal. For more information on how these crash rates and influence areas were determined, see Appendix I. These crash rates were then compared to the WisDOT statewide average crash rates in order to give a crash condition rating to each section. These ratings are based on how close or far away the WisDOT statewide average measured by the upper control limit (UCL), a unit similar to a standard deviation, also published by WisDOT. Figure 14 shows the different ratings.

Figure 14. Crash Condition Ratings



Each influence area throughout the corridor was assigned a crash condition rating, and these ratings were used to evaluate the safety needs of the corridor. The crash condition ratings can be found in Appendix II. A summary of the crash rating results can be seen in Table 5. Table 5 where the portion of each section with safety issues, defined as having a rating of poor or worse, is listed.

Table 5. Percentage of Each Section with Safety Issues

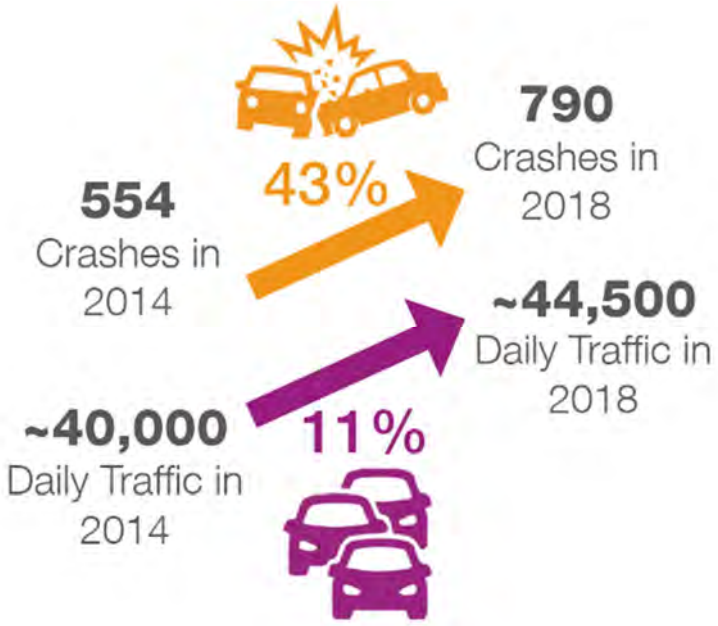
	Madison	Wisconsin River	Wisconsin Dells	Cranberry
Percent of section with Safety Issues	19.6% of 15 miles	4.6% of 24 miles	19.0% of 22 miles	6.8% of 40 miles

The Madison and Wisconsin Dells sections have by far the highest percentage of their length with safety issues. While Wisconsin River and Cranberry have longer lengths, they have small percentages of those lengths with issues.

Congestion Related Crashes

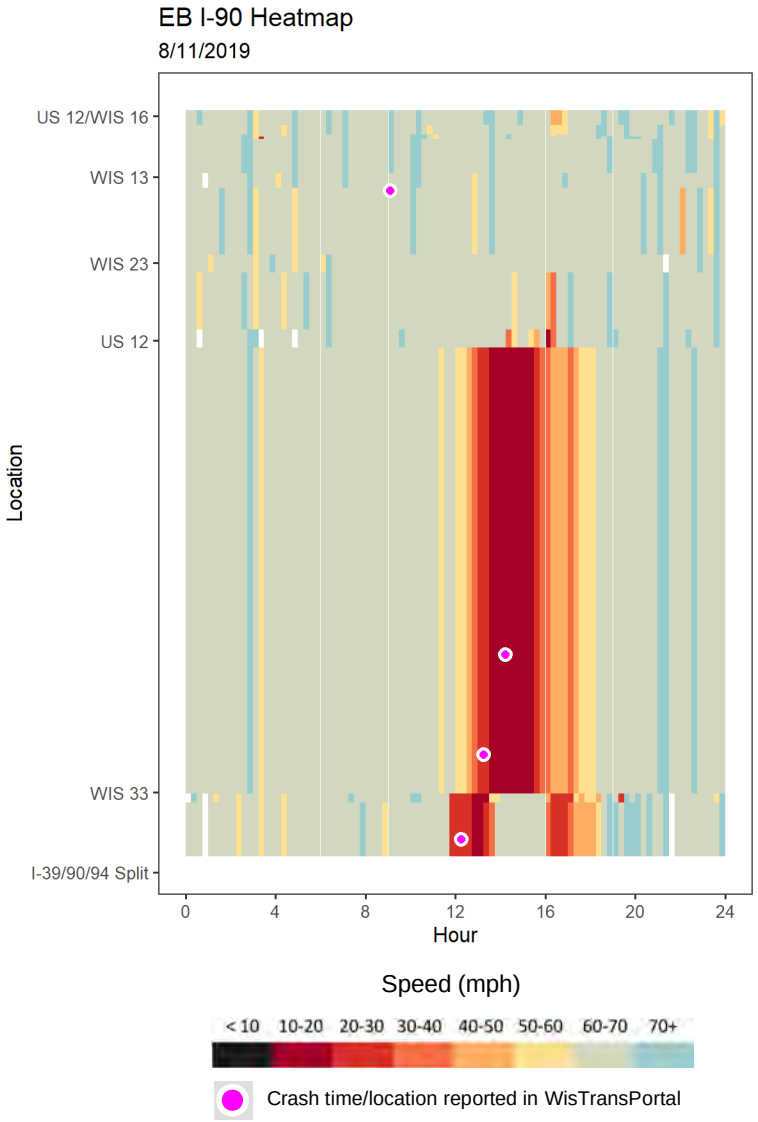
As traffic volumes continue to increase, the number of congestion related crashes is also expected to increase. Figure 15 shows the increase in total crashes compared to the increase in traffic volumes. Congestion related crashes typically involve more than one vehicle and are typically defined as rear end crashes or sideswipe same direction crashes. Congestion related crashes account for almost half of the total crashes in the corridor (1,664 of 3,533 mainline crashes). On I-90, 42% of congestion related crashes occur during the peak travel periods. The peak travel periods include a 3 hour period for the AM & PM peaks, a 4 hour period for the Friday peak and a 6 hour period for the Sunday peak.

Figure 15. The Number of Crashes Increase with Increased Traffic



Crashes during congested periods are more likely to lead to secondary crashes. Secondary crashes occur after a traffic backup is formed from an initial crash. Drivers approaching the end of the backup at a high speed may not expect the slowed or stopped traffic and may not be able to stop in time. Because of the potential speed differential, drivers are 70% more likely to be injured in a secondary crash compared to all other crashes. In 2019, there were 28 days with secondary crashes out of the 281 days with crashes. 88% of the secondary crashes occurred during peak travel periods, with about half occurring during the Sunday recreational peak. As traffic volumes increase during peak travel periods, secondary crash events are also expected to increase. An example of this can be seen in Figure 16. This heat map shows reduced speeds through darker red colors and crashes through pink circles. Distance along the corridor is shown vertically and time is shown horizontally.

Figure 16. Secondary Crash Heat Map



There is an initial crash, and then two more crashes as the traffic slows and queues start backing up. The second and third crashes shown here both involved injuries.

Top Twenty Safety Locations

One of the project objectives was to identify 20 high crash rate locations and evaluate the potential cause of crashes at these locations. The following criteria was used to identify the top 20 crash locations:

1. Two or more fatal crashes occurring in 2014 to 2018.
2. A crash condition rating of Extreme for either total crash rates or KAB crash rates.
3. A combination of either extreme/severe or severe/severe crash condition ratings between total crashes and KAB crashes.
4. Additional assessment of crash trends and statistics.

The top 20 high crash rate locations are shown in Figure 17 in order of their relative ranking (rank 1 being highest priority and rank 20 being lowest priority). Table 6 identifies each high crash location and the primary safety issue at each location. Detailed descriptions of the issues at each location are included in the following sections.

Figure 17. Top 20 Crash Locations

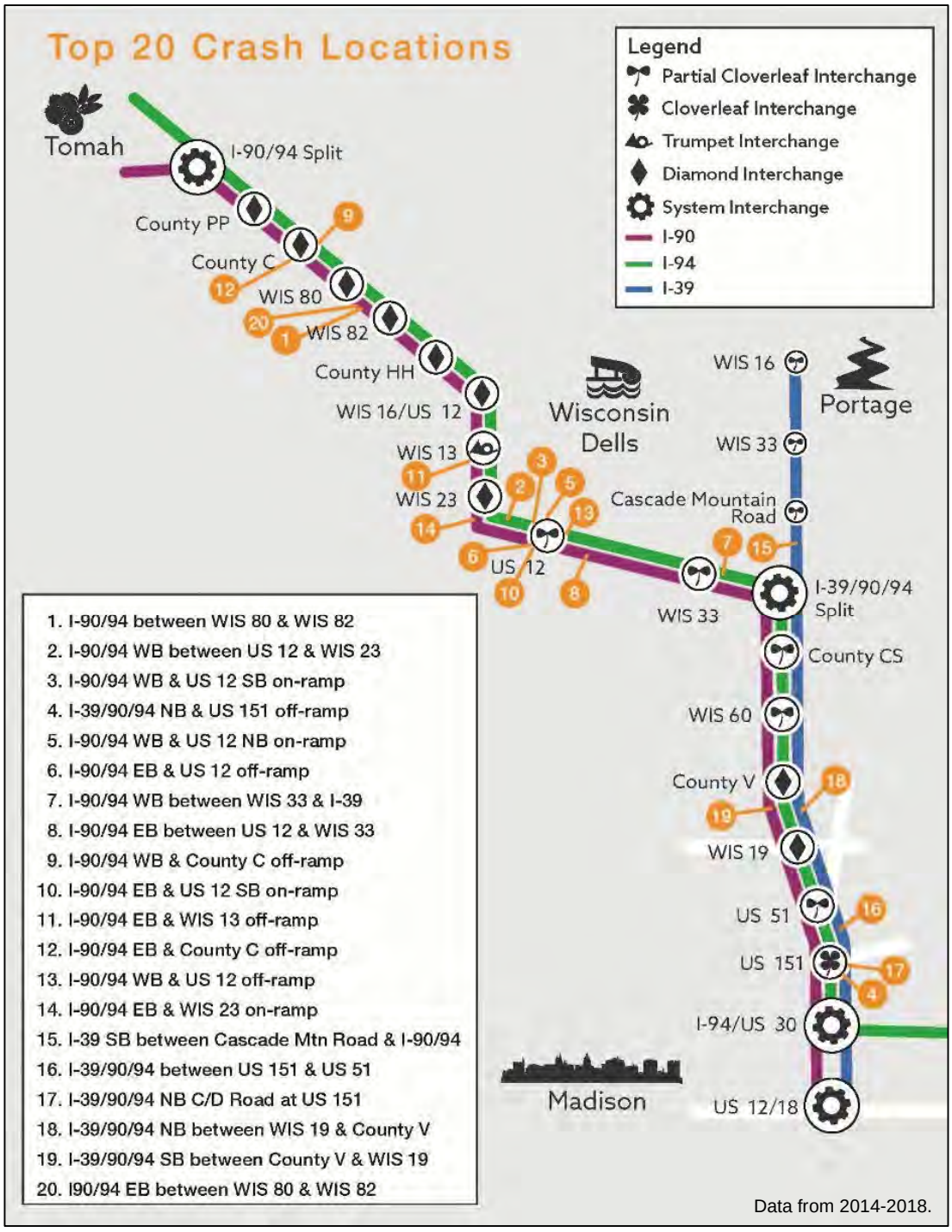


Table 6. Top 20 Safety Locations

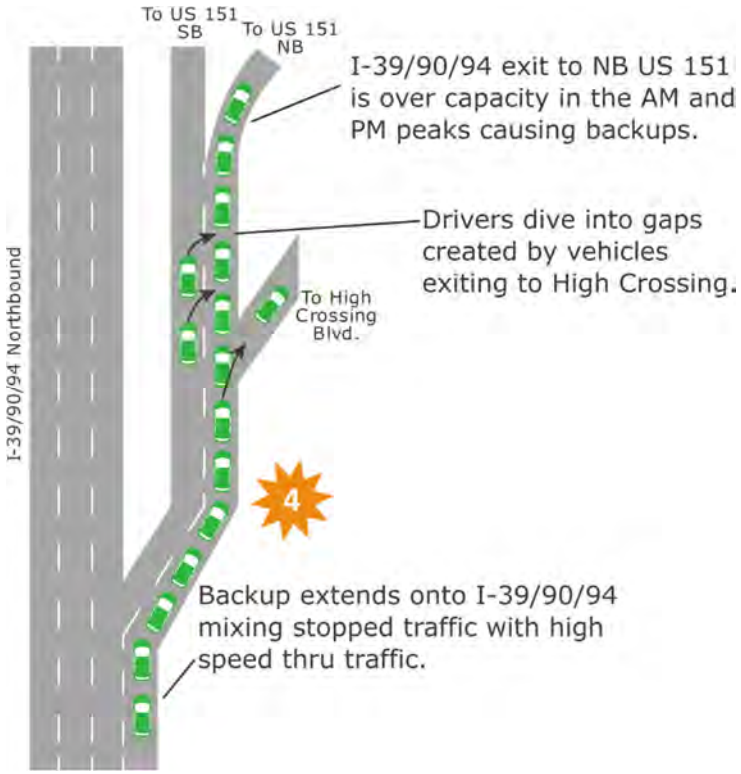
Rank	Location	Issue
1	I-90/94 between WIS 80 & WIS 82	Two fatal crashes at the Welch Prairie Rd. overpass.
2	I-90/94 WB between US 12 & WIS 23	Difficult curve to navigate for unfamiliar drivers.
3	I-90/94 WB & US 12 SB on Ramp	Drivers must merge two lanes onto I-90/94 from ramp.
4	I-39/90/94 NB & US 151 off-ramp	Congestion and poor lane utilization cause backups and rear end crashes.
5	I-90/94 WB & US 12 NB on-ramp	Drivers merge at low speed from loop ramp, but don't always see other drivers merging from their right.
6	I-90/94 EB & US 12 off-ramp	Unfamiliar drivers have difficult navigating exit curves on congested summer weekends.
7	I-90/94 WB between WIS 33 & I-39	Low speed loop exit ramp with inadequate deceleration.
8	I-90/94 EB between US 12 & WIS 33	Drivers must merge two lanes onto I-90/94.
9	I-90/94 WB & County C off-ramp	This is a taper style ramp in a mainline curve that is difficult for drivers to navigate especially in slippery conditions.
10	I-90/94 EB & US 12 SB on-ramp	Drivers merge at low speed from loop ramp, but don't always see other drivers merging from their right.
11	I-90/94 EB & WIS 13 off-ramp	Low speed loop exit with narrow right shoulder and limited sight distance to the exit curve.
12	I-90/94 EB & County C off-ramp	This is a taper style ramp in a mainline curve that is difficult for drivers to navigate especially in slippery conditions.
13	I-90/94 WB & US 12 off-ramp	Unfamiliar drivers have difficult navigating exit curves on congested summer weekends. This is the first exit in 13 miles.
14	I-90/94 EB & WIS 23 on-ramp	Short acceleration lane with guardrail/bridge pier preventing escape.
15	I-39 SB between Cascade Mtn Rd. & I-90/94	Confusing weaving movement near I-39 and I-90/94 split causing safety issues.
16	I-39/90/94 between US 151 & US 51	Flat grades in these areas cause hydroplaning in wet weather and slippery spots.[7]
17	I-39/90/94 NB C/D Road at US 151	Short distance between loop ramps causing safety issue because of speed differentials.
18	I-39/90/94 NB between WIS 19 & County V	Flat grades in these areas cause hydroplaning in wet weather and slippery spots.[5]
19	I-39/90/94 SB between County V & WIS 19	Flat grades in these areas cause hydroplaning in wet weather and slippery spots.[7]
20	I-90/94 EB between WIS 80 & WIS 83	Platooning vehicles limit gaps for merging vehicles.

[5] FIIPS programmed project to address this issue.

Madison Section Safety

The US 151 interchange contains two of the top 20 crash locations, and these issues are a result of both congestion and geometry. As can be seen in Figure 18, although the northbound exit to the US 151 CD road is a two lane exit the left lane is under-utilized as the vast majority of traffic is taking either of the first two ramps to High Crossing Blvd. or northbound US 151. The ramp to northbound US 151 is over capacity during the AM and PM peaks due to the high volume of commuter traffic between Sun Prairie and Madison. This creates a large back up that extends back onto I-39/90/94 and causes a large number of rear end crashes. The queue causes more safety concerns as it mixes stopped vehicles with high speed vehicles on the freeway.

Figure 18. Northbound I-39/90/94 Exit to US 151 CD Road

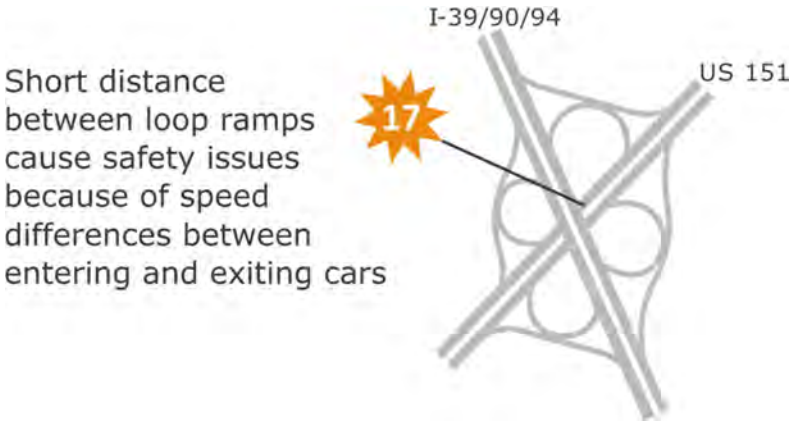


There are also concerns with traffic attempting to merge in small gaps between the exit to High Crossing Blvd, and the exit to northbound US 151. Aggressive drivers use the left lane of the CD road to try to bypass the queue in the right lane, hoping some of the vehicles will exit to High Crossing Blvd. These drivers will force their way into the right lane causing sharp braking and further delay for vehicles behind.

In addition to these congestion issues, there is also not adequate distance between the loop ramps on each of the legs of the interchange. This lack of distance prevents cars from accelerating or decelerating effectively, causing dangerous speed differentials between the weaving movements with the loop ramps and the mainline

or CD road. This creates a large number of sideswipe and rear end crashes as cars attempt to change lanes and speeds.

Figure 19. Short Distance Between Loops Ramps US 151

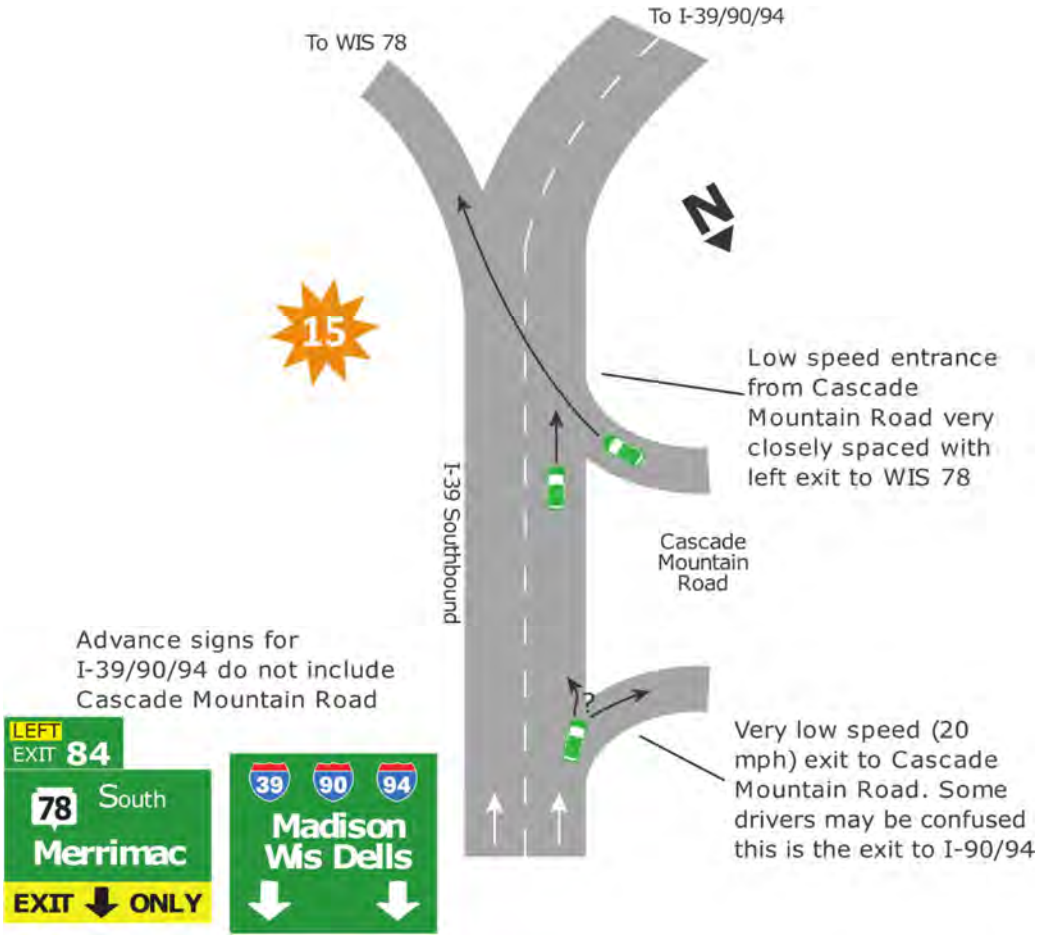


The other three locations in the Madison area within the top twenty are mainline sections along northbound I-39/90/94 between US 151 and US 51, and between County V and WIS 19 in both directions. These safety issues are caused by drainage issues due to the highway here having a flat grade and cross slope. This flat grade causes water to pool on the roadway creating slippery conditions. These slippery spots lead to hydroplaning in wet weather, and ice patches in the winter. There is a WisDOT project to address these hydroplaning issues that was completed in 2020 (WisDOT project I.D. 1011-01-34). See Appendix II for more details.

Wisconsin River Section Safety

The only top 20 location in the Wisconsin River section is between Cascade Mountain Rd. and the I-39 & I-90/94 split interchange. The I-39 southbound exit ramp to Cascade Mountain Road has the highest number of total crashes and KAB crashes in the corridor amongst service ramps despite its very low AADT relative to other service ramps. This could be due to confusion of signage for exits to Cascade Mountain Rd and I-90/94. The advanced signing for I-39/90/94 does not show Cascade Mountain Rd, nor does it specify distance to the exit. The ramp to southbound I-39/90/94 is a high speed ramp, but the Cascade Mountain Rd. exit is a very low speed 20-mph ramp. Many of the crashes could be the result of drivers, believing they are going to I-39/90/94, taking the Cascade Mountain Rd. exit at a far higher speed than the ramp is designed for. This can be seen in Figure 20.

Figure 20. I-39 between Cascade Mountain Road and I-90/94



On the southside of the Cascade Mountain interchange there are also safety concerns dealing with speed differentials and geometry. There is not adequate space between the on ramp from Cascade Mountain Rd. and the off ramps to both WIS 78 and I-39/90/94. All of these ramps are spaced very closely together requiring vehicles to make lane changes in a small amount of space in order to take their desired routes. This combined with the slow speeds required by the geometry of the Cascade Mountain Rd. on ramp create conditions with large speed differentials, and many lane changes.

WisDOT also has a planned project (WisDOT project ID 1161-00-36) to improve the safety conditions in the northern stretch of I-39 in this section. The project will install new median cable barrier in response to a cross median crash analysis. This project began in 2021.

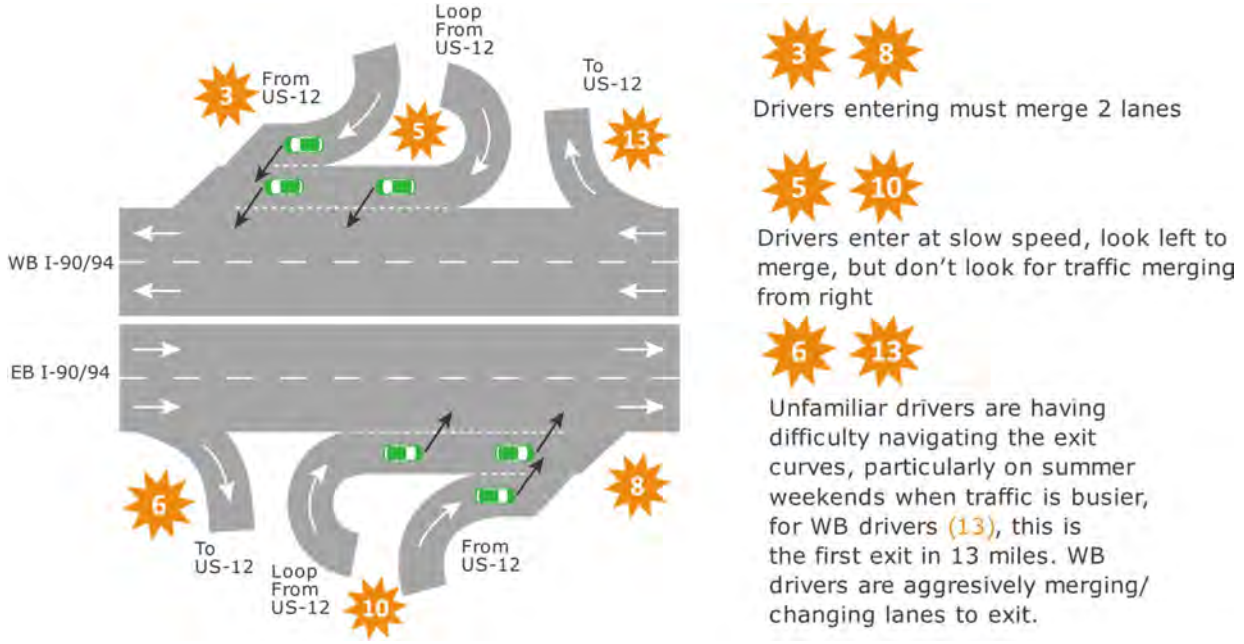
Wisconsin Dells Section Safety

All of the ramps at the US 12 interchange on the south side of the Wisconsin Dells are in the top twenty crash locations.

Drivers traveling both directions have trouble navigating the off ramp curvature, particularly on summer weekends when this interchange is busier. For westbound drivers on I-90/94, US 12 is the first exit in thirteen miles, causing some inattentive drivers to change lanes aggressively in order to exit. For the eastbound drivers on I-90/94, 75% of the crashes at the US 12 exit ramp happened during the Sunday peak, likely because of increased congestion and unfamiliar drivers. These eastbound drivers have to navigate the mainline curve between WIS 23 and US 12 as well as the curving off ramp. Both US 12 off-ramps have a total crash rate more than 3 upper control limits above the statewide average crash rate.

The geometry of how the US 12 on ramps merge causes safety issues as well. Vehicles merging from the slow speed loop ramps are attempting to accelerate up to speed while looking to their left in order to merge onto the mainline. They are not looking right for the second on ramp traffic merging into their lane from the right. This blind spot can cause problems. Drivers in the second on ramp have to merge two lanes, while watching for the loop ramp vehicles getting up to speed and looking to their left. This results in a high number of sideswipe and multi-vehicle crashes and an extreme rating for total crashes This happens on both sides of the freeway. The geometry and movements can be seen in Figure 21.

Figure 21. I-90/94 at the US 12 Interchange



In addition to US 12, this section also has top twenty locations at the WIS 33 interchange, WIS 23 interchange, WIS 13 interchange, and on the mainline between US 12 and WIS 23 interchanges.

WB I-90/94 south of the WIS 33 interchange experiences a high number of sideswipe crashes that could be due to the horizontal curve just downstream of a lane change reduction leading up to the WIS 33 interchange.

WIS 23 has an inadequate acceleration lane for its eastbound on ramp that is bordered by guardrail and a bridge pier which remove any shoulder refuge available once merging.

The I-90/94 eastbound exit to WIS 13 is a low speed loop exit with a narrow right shoulder. This combined with limited sight distance around the exit curve due to trees in the middle of the loop ramp creates difficult conditions for a driver to see a slow-moving vehicle in front of them.

The stretch between WIS 23 and US 12 is on a rather sharp turn for the interstate, and this combined with a high volume of unfamiliar drivers during the peak congestion times leads to high crash rates. This stretch is rated severe for total crashes and has a large percentage of them during the weekend. This section also includes the I-90/94 bridges over Mirror Lake.

Mirror Lake Bridge Crashes

The I-90/94 bridges over Mirror Lake are a narrow, high traffic crossing between the US 12 and WIS 23 interchanges. There have been 24 crashes within 500 feet of the bridge between 2014 and 2018, resulting in a crash rate that is 2.5x the state average for 4-lane freeways. The increased crash rate is due to the narrow 32’ clear width on the bridge, reducing space for driver errors. The bridges have also been the site of three crashes since 2011 where vehicles left the roadway and fell the ~100 ft to the lake below. Two of these crashes resulted in three fatalities. Figure 22 shows an image from one of the crashes.

Figure 22. Fatal Crash at the Mirror Lake Bridges

Cranberry Section Safety

The number one crash location is located on eastbound I-90/94 between WIS 80 and WIS 82 at the Welch Prairie Rd. bridge. This bridge is protected on both sides with guardrail but has a narrowing of the shoulders on both sides as can be seen in Figure 23. There have been multiple instances of vehicles leaving the road to the left of the guardrail and hitting the pier of this bridge, resulting in two fatalities.

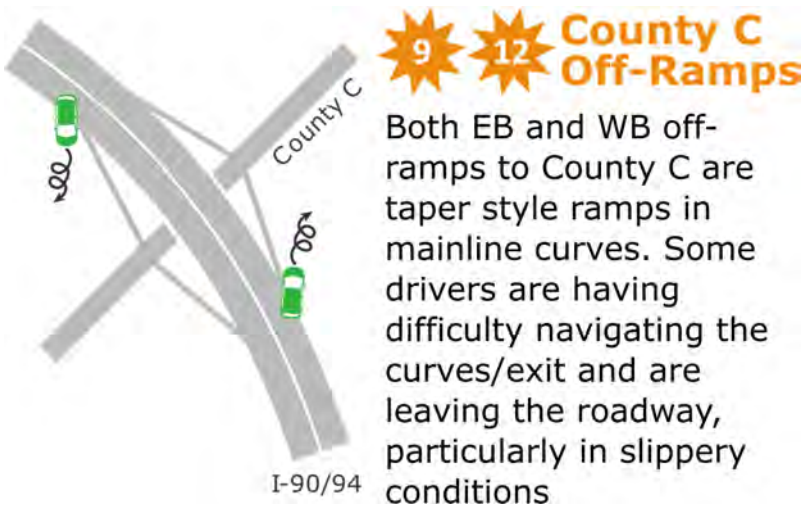
Figure 23. Welch Prairie Road Bridge over EB I-90/94

1 **Welch Prairie Overpass**

I-90 EB is constricted by the guardrail and bridge piers at the Welch Prairie Road. Multiple instances of vehicles leaving road to the left of the guardrail and hitting the bridge including two fatal crashes

In addition to this location there are also top twenty locations at the County C interchange. The County C interchange is a diamond interchange with taper ramps, but it is along a curve in the mainline of I-90/94. This results in both the eastbound and westbound off ramps being difficult for drivers to navigate especially during wet or slippery conditions. Both of these areas are rated extreme for total crash rating and run off the road crashes. The geometry can be seen in Figure 24.

Figure 24. County Rd. C Interchange



The final top twenty location is on I-90/94 eastbound between WIS 80 and WIS 82. This area experiences a high percentage of rear end crashes. These may be the results of platooning vehicles from the upstream WIS 80 on ramp. Merging drivers tend to take smaller gaps and then space themselves out farther down the road. Fifty percent of these crashes resulted in serious injuries.

Refer to Appendix II for more information regarding the high crash rate locations including detailed summaries of crash statistics for each of the twenty locations, notes regarding relative ranking, and key findings for each location.

PAVEMENT

The existing pavement history and future planned maintenance projects were documented for the study corridor as provided by the WisDOT SW Region Programming section. These projects represent the pavement condition, and the amount of pavement work that is anticipated in the corridor before 2050.

There are four types of projects documented by this study:

Concrete repair addresses only the repair of distressed areas with severe cracks and spalling. This includes the full depth saw cut and removal of a full lane width and minimum of 6 ft length but should be extended to encapsulate all of the stressed area. This panel is then replaced with new concrete. The top surface is ground to match the texture of surrounding concrete (FDM 14-25 Exhibit 10.1).

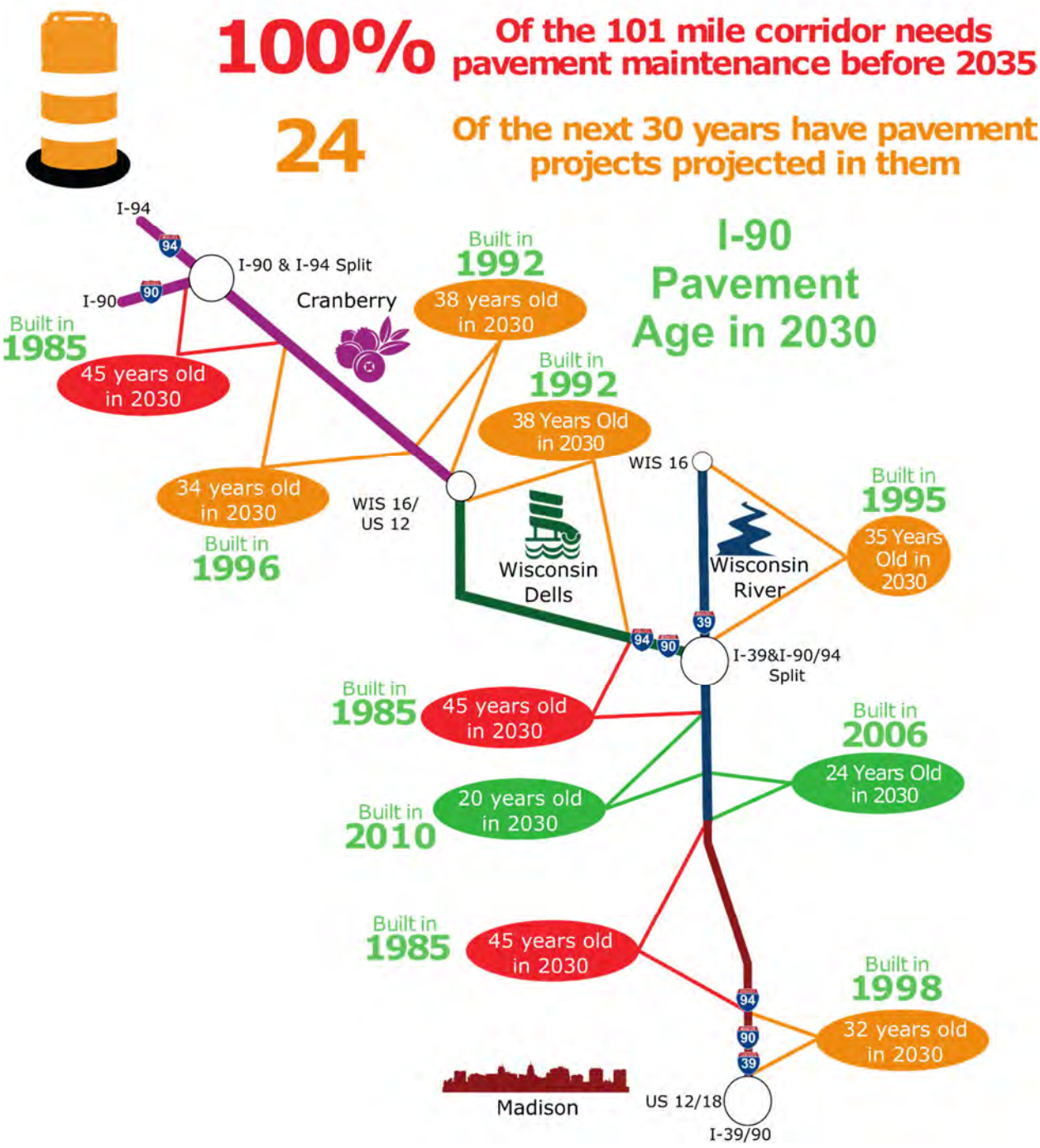
1st Pavement Overlay includes any needed concrete repair as a first step, and then adds a layer of hot mix asphalt (HMA) over the top to improve ride quality and prevent deterioration in the underlying concrete (FDM 14-25 Exhibit 10.1)

2nd Pavement Overlay includes all the same steps as the 1st overlay but has a lesser impact. Some sections include a 3rd pavement overlay that is designated with this icon. In general, consecutive overlays have a diminishing effect on the pavement life span.

Concrete Reconstruction includes a complete removal and replacement of the existing concrete pavement. This action resets the pavement maintenance life cycle.

At least one of these pavement maintenance projects is anticipated in 24 of the next 30 years somewhere in the corridor. Many sections of pavement are reaching the end of the expected life cycle and will require more frequent maintenance in the form of significant pavement repair and overlay projects. The entire 101 mile corridor will require some form of pavement maintenance before 2035. The pavement age is shown in Figure 25.

Figure 25. Pavement Age Summary



In addition, a work zone delay analysis was performed to estimate the amount of delay to the normal traffic a pavement maintenance work zone would cause. Work zone delay was estimated using planning-level methods as implemented in a spreadsheet tool developed by the WisDOT Bureau of Traffic Operations. This tool gives results in terms of average minutes of delay for each work zone, and location.

To present a range of work zone restrictions, several different work zone schedules were considered in this analysis. The restrictions defined when a single lane closure would occur for pavement or bridge maintenance work. The five different restrictions considered are:

No Restrictions: Work is allowed at any point during the week and throughout the construction season months (April through November).

No Summer Work: Work is allowed at any point during the week, but not during the high recreational traffic summer months of June through August.

No Weekend Work: Work is allowed from Monday morning to Thursday at noon during all construction season months, but not during the weekends.

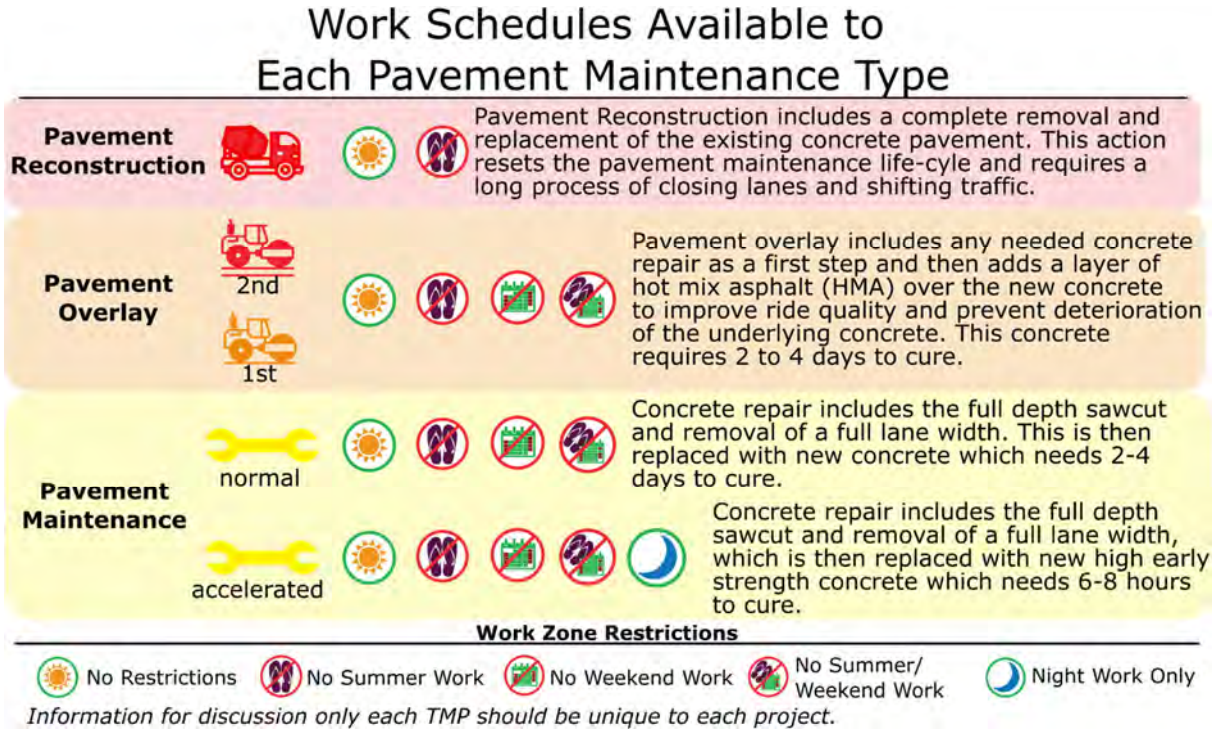
No Weekend/No Summer Work: Work is allowed from Monday morning to Thursday at noon during the week during the months of April, May, and September through November.

Night Work Only: Work is allowed only at night from 8:00 pm to 5:00 am Monday through Thursday, and Saturdays, and then from 10:00 pm to 5:00 am Friday and Sunday nights throughout the construction season months (April through November).

The goal of these different schedules is to show how restricting the construction hours has an impact on construction cost and time, and queues and delays on the interstate. The WisDOT Traffic Engineering, Operations & Safety Manual (TEOpS) defines the desirable delay from work zones not to exceed 15 minutes.

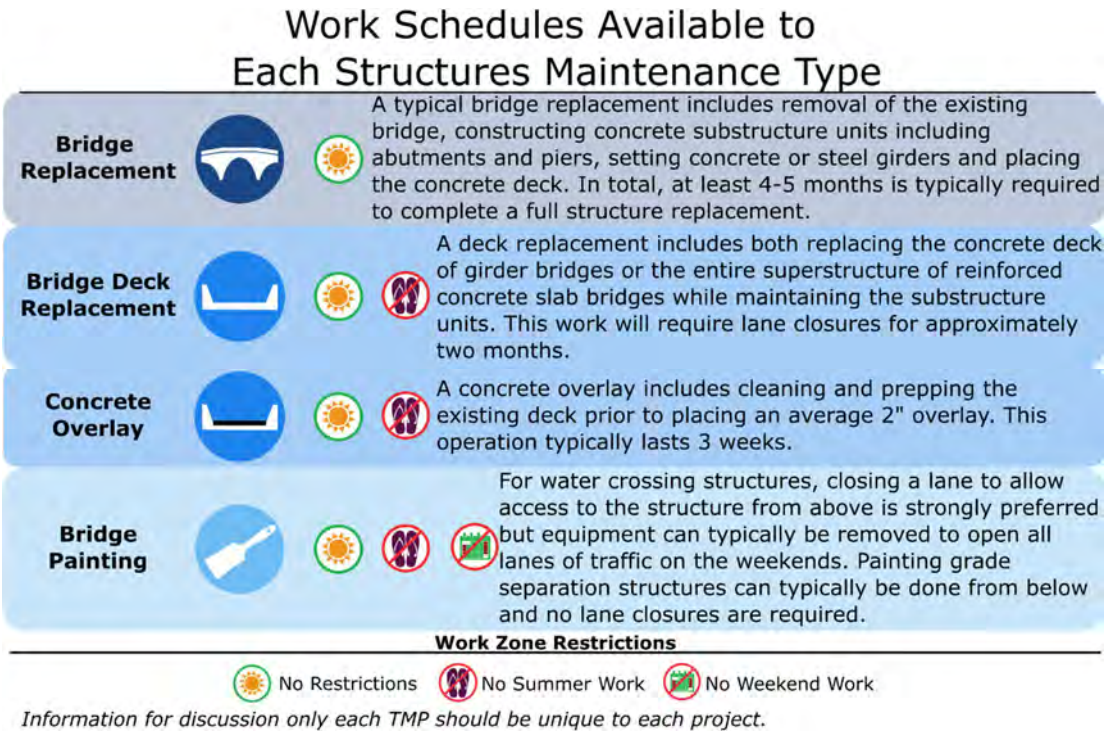
Not all of the pavement project types are possible to be completed within all of the work zone schedules. Several of the projects require longer periods of work to complete and so are unable to be completed with No Weekend Work, or Night Work Only schedules. Figure 26 shows the different schedules possible for each pavement maintenance project.

Figure 26. Pavement Maintenance Projects Compared to Work Zone Schedules



A work zone delay analysis was performed for each section for future structures projects as well. The difference between the pavement and structure evaluations is the adjustment used for workzone barrier type. The pavement workzone assumes work can be completed with barrels and the structure work zone assumes a concrete barrier. The structure work zones require longer work windows to account for concrete cure times. The possible work schedules for each type of structure maintenance project are shown in Figure 27.

Figure 27. Structures Maintenance Projects Compared to Work Zone Schedules



Madison Section Pavement

The Madison section pavement was generally constructed in 1985, when I-39/90/94 was widened from 4 to 6 lanes. Table 7. Madison Area Section Pavement Maintenance Dates shows the pavement history of the Madison Section, along with the anticipated future maintenance through the year 2050.

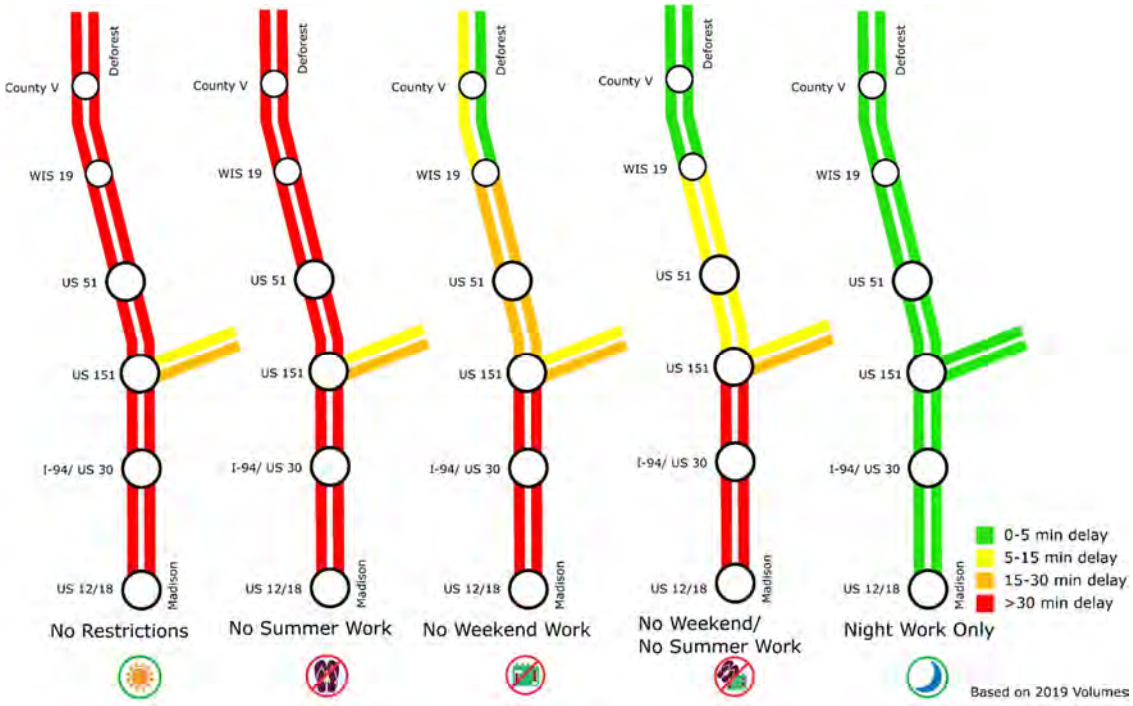
Table 7. Madison Area Section Pavement Maintenance Dates

Segments	Previous Construction	Current Construction	Date of Rehabilitation			
			1st	2nd	3rd	4th
US 51 to County V	1964	1985	2013	2029	2041	-
I-94 to US 51	1964	1985	2013	2027	2039	-
US 12/18 to I-94	1964	1998	2015	2027	2037	2045

In the next thirty years there is an anticipated seven projects occurring in six different years. These work zones require restrictions to reduce construction delays in the Madison section. The

estimated delay based on 2019 traffic volumes for various work zone restrictions can be seen in Figure 28.

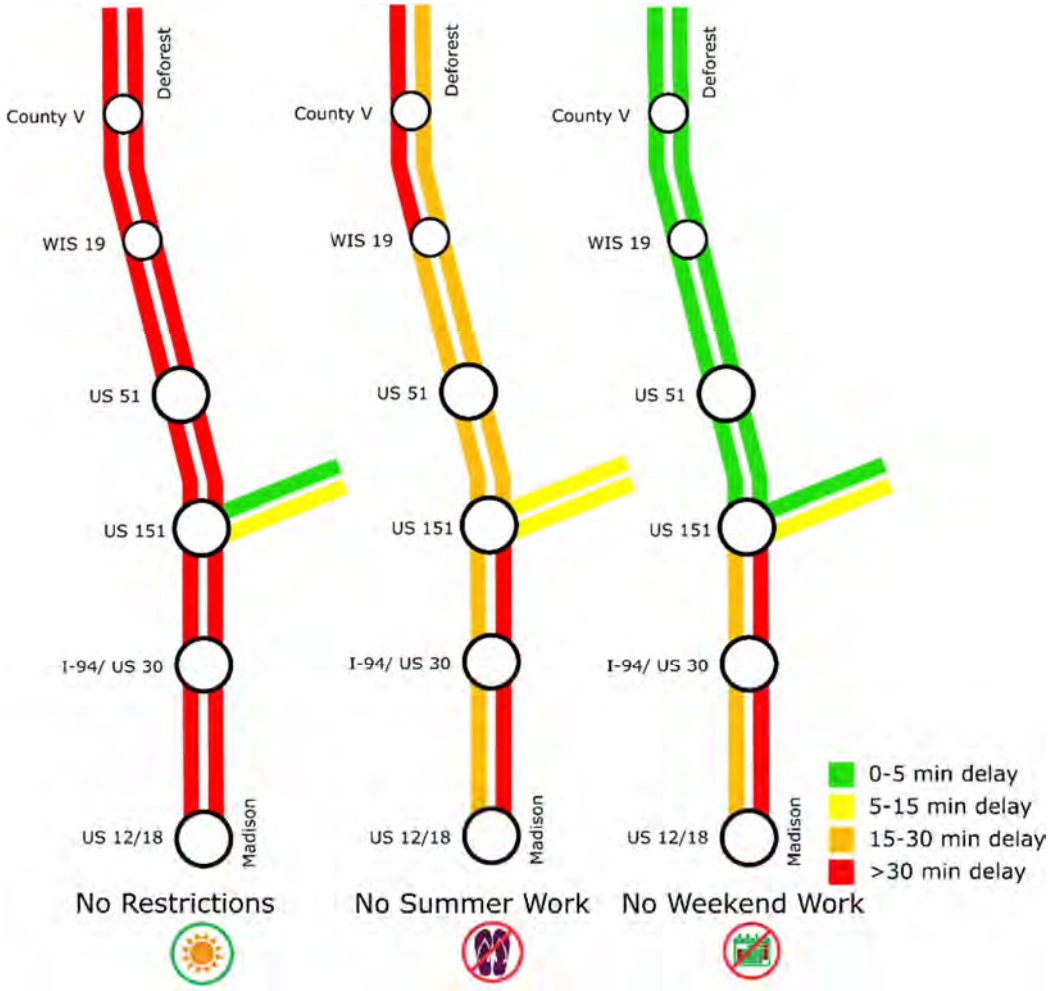
Figure 28. Madison Area Pavement Project Lane Closure Delay Maps



South of US 151, the delay from lane closures is greater than the goal of 15 minutes for all of the work zone schedules except for the Night Work Only schedule. North of US 151, the delay from lane closures is within the goal for the No Weekend/No Summer and Night Work Only schedules. The No Weekend work schedule is near the desirable level. This correlates to the traffic patterns that we see with the heavy recreational traffic north of US 151 occurring on the weekends. South of US 151 has both heavy commuting affecting travel during the weekdays and recreational peaks affecting travel on the weekends.

Figure 29 shows the estimated delay for each of the work zone schedules for structures projects.

Figure 29. Madison Area Section Bridge Delay Maps



Wisconsin River Section Pavement

The Wisconsin River section has some of the newest pavement in the I-90 study area. New pavement was constructed on I-39/90/94 in 2006 and 2010 between County V and County CS. Pavement from County CS to the I-39 & I-90/94 split was constructed when I-39/90/94 was widened from 4 to 6 lanes in 1985. Pavement on I-39 north of the I-39 & I-90/94 split was constructed in 1995 when I-39 was converted to an interstate.

Table 8 shows the pavement history of the Wisconsin River Section, along with the anticipated future maintenance through the year 2050.

Table 8. Wisconsin River Section Pavement Maintenance Dates

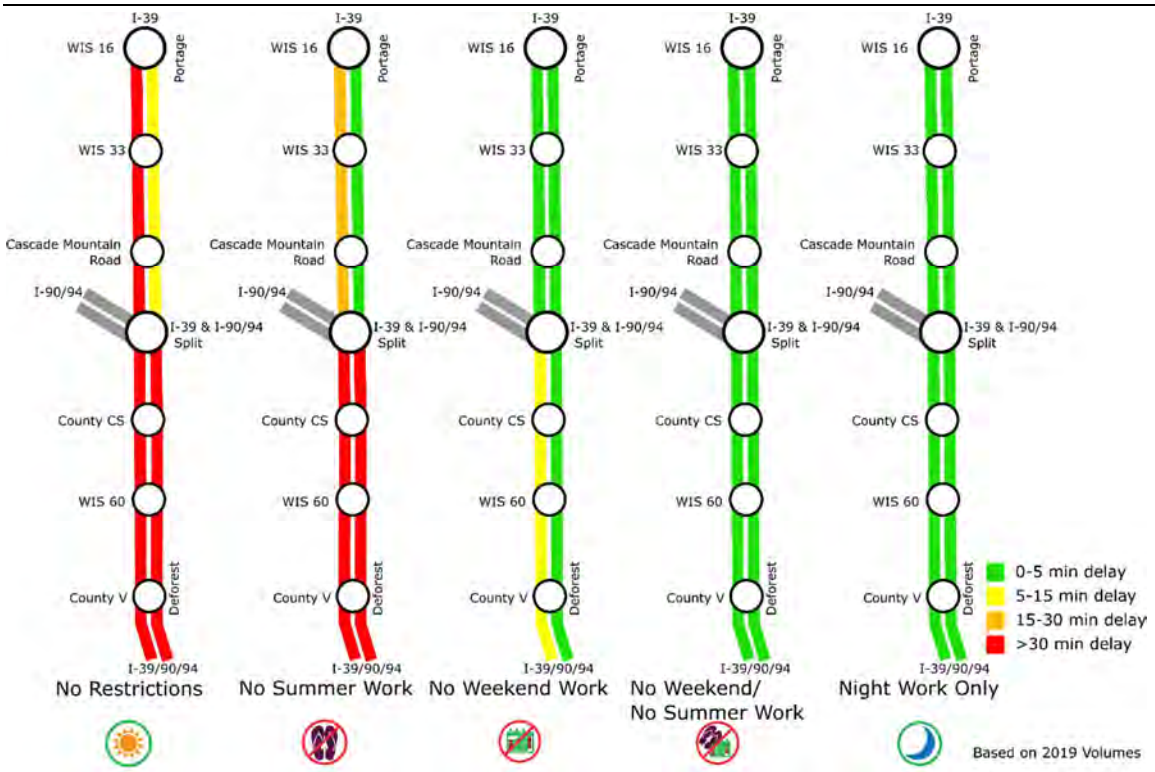
Segment	Previous Construction	Current Construction	Date of Rehabilitation		
			1st	2nd	3rd
I-39 from I-39 & 90/94 Split to WIS 16	1964	1995	2017 SB 2022 NB	2027 SB 2032 NB	2042 SB 2047 NB
I-39/90/94 from County CS to WIS 33 (I-90/94)	1964	1985	2018	2033	2048
I-39/90/94 from Dane/Columbia Co. Line to County CS	1985 1964	2010	2030	2040	2050
I-39/90/94 County V to Dane/Columbia Co. Line	1985 1964	2006	2027	2039	2047

The I-39/90/94 segment between Dane/Columbia Co. line to County CS is the newest section of pavement in the entire I-90 study area corridor. The new pavement is experiencing cracking and joint problems and is anticipated to need early maintenance. This early maintenance may mean the future pavement maintenance will also need to be done early, and this segment may not reach the expected life-span.

The I-39/90/94 segment between County V to the Dane/Columbia County line was reconstructed in 2006. There is a one-mile section that has begun to exhibit symptoms of failing pavement and it has prompted a WisDOT project, scheduled for 2022. Instead of lasting the expected 25 years before maintenance, this pavement lasted only 14 years. This example illustrates the difficulty of pavement projects in this corridor. Due to the large increases in traffic during the summer months, construction operations requiring daytime lane closures is limited during the prime summer construction season. The resulting traffic staging restrictions during typical high-volume summer peaks, WisDOT may incur higher costs to accelerate construction schedules for future maintenance and it may not last as long as expected.

The estimated delay for various work zone restrictions based on 2019 traffic volumes is shown in Figure 30.

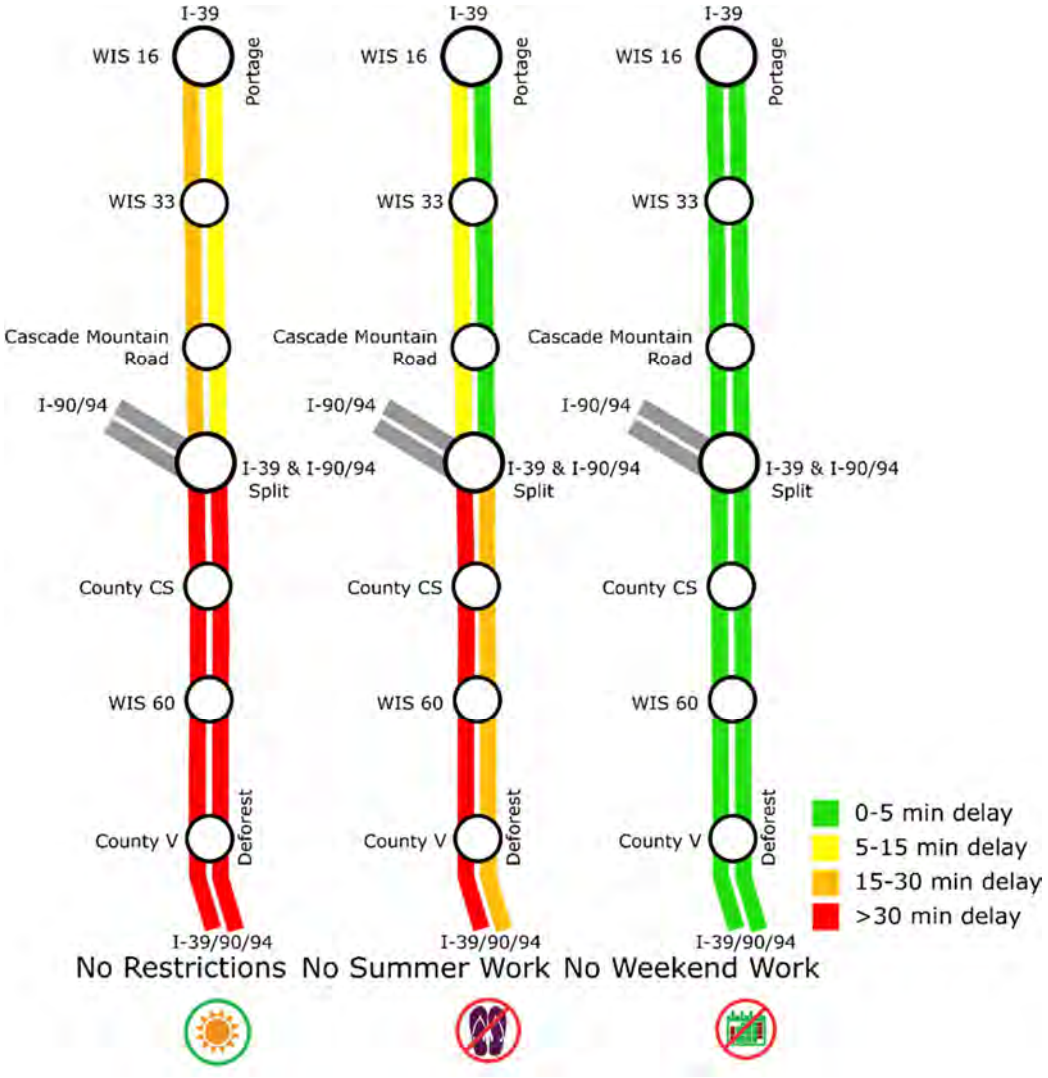
Figure 30. Wisconsin River Area Pavement Project Lane Closure Delay Maps



The Wisconsin River section has two distinct areas for work zone lane closure delay results: north and south of the I-39 & I-90/94 split interchange. I-39/90/94 south of the I-39 & I-90/94 split does not meet the 15 minute goal for lane closures with the No Restrictions and No Summer Work schedules, but does for the No Weekend, No Weekend/No Summer, and Night Only schedules. I-39 north of the I-39 & I-90/94 split lane closures perform better due to the much lower traffic volumes in this portion of the study area. Outside of the summer months, lane closures can occur with minimal work zone delay on I-39 north of the I-39 & I-90/94 split.

Figure 31 shows the estimated delay for each of the work zone schedules for structures projects.

Figure 31. Wisconsin River Section Area Bridge Delay Maps



In order to meet the goal of less than 15 min of delay No weekend work is required. However, only painting maintenance projects can be performed with no weekend work which accounts for only two of the thirty-seven projects recommended in this section. Combining bridge projects and the possibility of temporary bridge widening needs to be considered for this section to minimize disruptions to traffic flow.

Wisconsin Dells Section Pavement

The Wisconsin Dells Section pavement was constructed in 1992. Table 9 shows the pavement history of the Wisconsin Dells Section, along with the anticipated future maintenance through the year 2050.

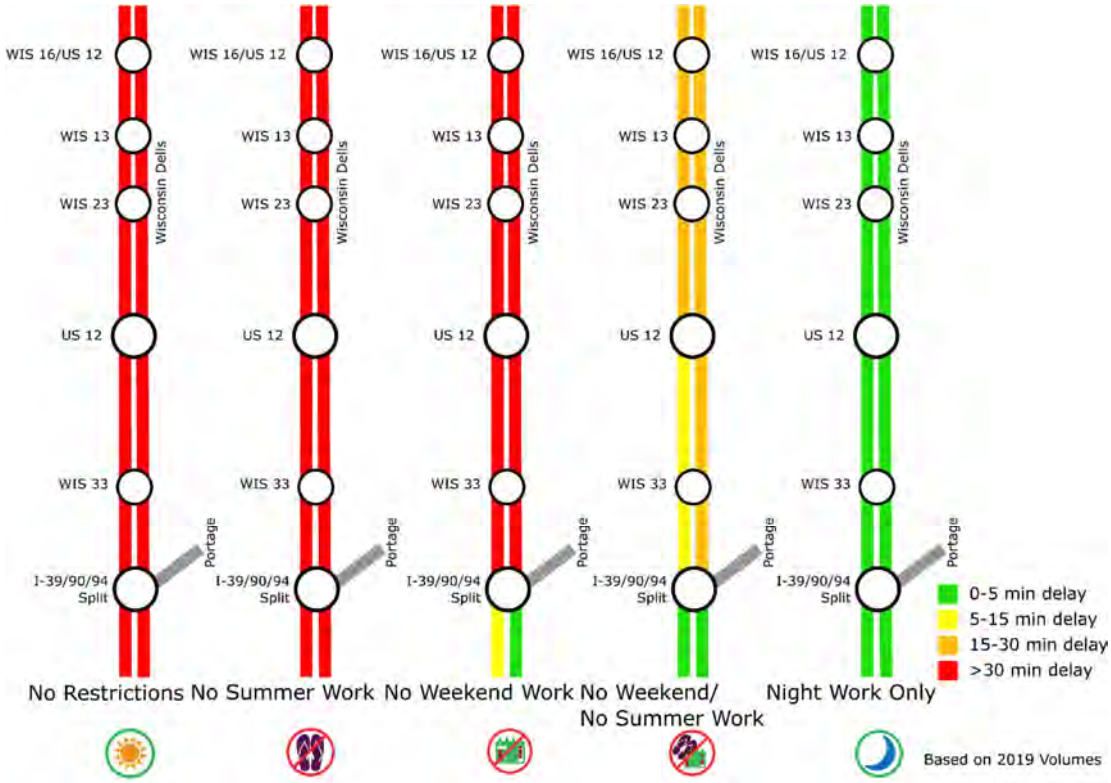
Table 9. Wisconsin Dells Section Pavement Maintenance Dates

Segment	Previous Construction	Current Construction	Date of Rehabilitation			
			1st	2nd	3rd	4th
US 12 to Sauk/Juneau County Line	1964	1992	2017	2023/ 2025	2031	2043
WIS 33 to US 12	1974 1961	1992	2017	2023	2031	2039
I-39 & I-90/94 Split to WIS 33	1964	1985	2018	2033	2048	-

There are nine projects anticipated within the next thirty years taking place in seven of those thirty years. The Wisconsin Dells are a premier destination for recreational traffic meaning the greatest traffic volumes occur during the summer and peak construction season. This section also contains the longest stretch of mainline without an interchange in the study area, stretching over 13 miles. This severely limits construction detour options and increases mobilization costs, as it is more difficult to get workers and equipment to the project site.

The estimated delay for various work zone restrictions based on 2019 traffic volumes is shown in Figure 32.

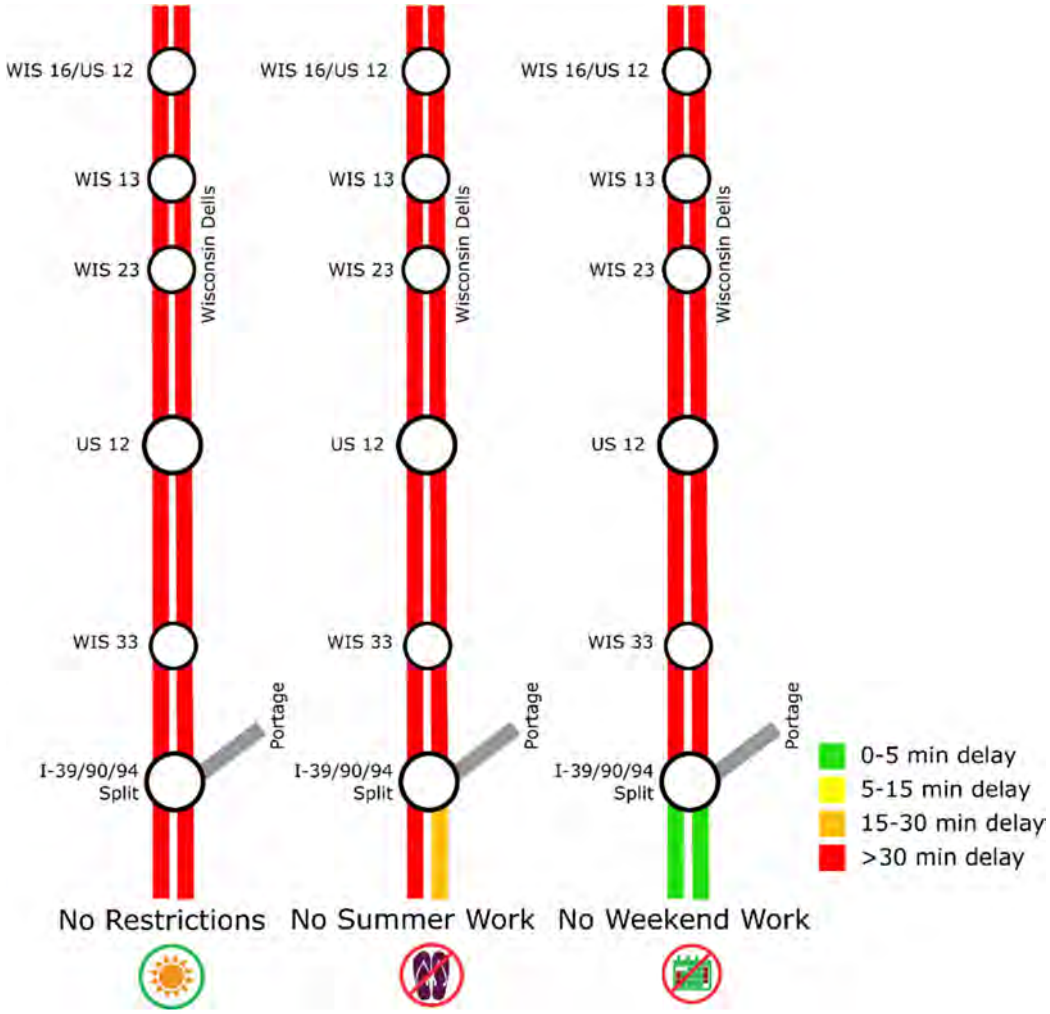
Figure 32. Wisconsin Dells Area Pavement Project Lane Closure Delay Maps



The Wisconsin Dells section has undesirable delay from lane closures in all schedules except for the Night Only schedule and the No Weekend/No Summer Work in the southbound direction from US 12 to the I-39 & I-90/94 split. I-90/94 has two lanes in each direction and a single lane closure leaves only one lane in open in each direction. Traffic volumes are high enough in the Wisconsin Dells area that it will experience work zone lane closure congestion even if construction is restricted to non-summer months.

Figure 33 shows the estimated delay for each of the work zone schedules for structures projects.

Figure 33. Wisconsin Dells Section Bridge Delay Maps



There are no bridge work restriction plans that have delay less than 30 minutes. With the large amount of recreational summer traffic during prime construction season, it is likely that temporary bridge widening will be needed to minimize disruptions to traffic flow.

Cranberry Section Pavement

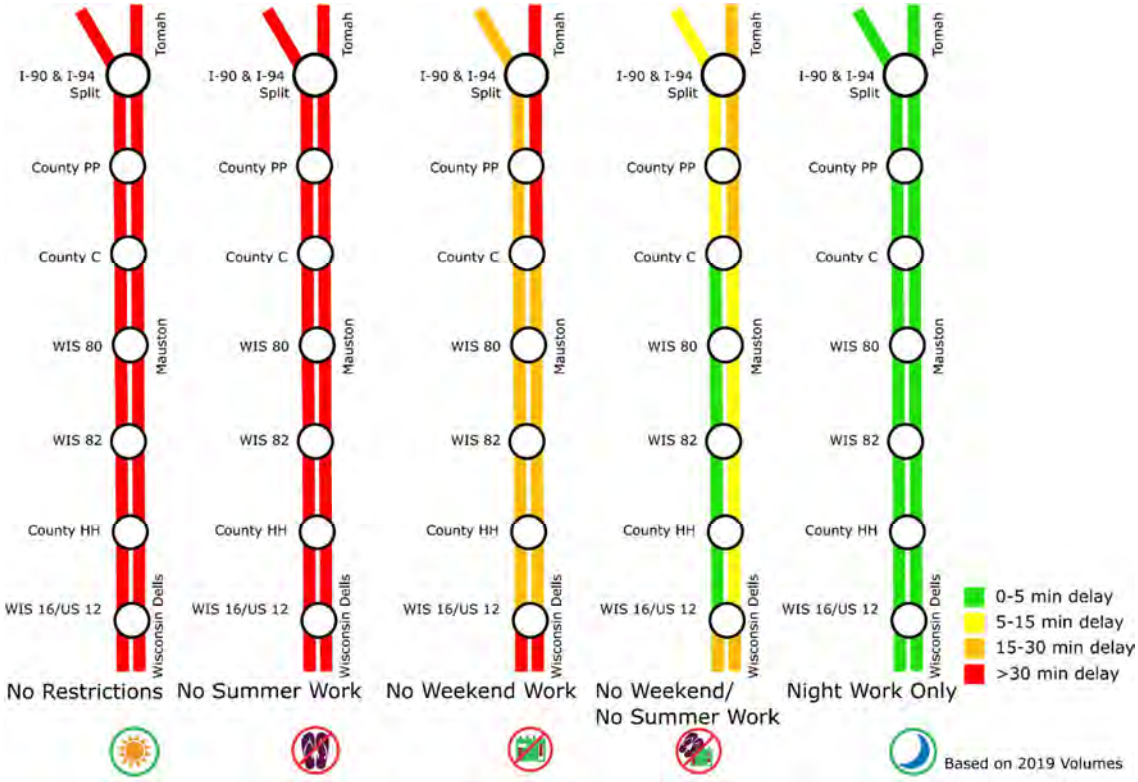
The Cranberry Section pavement was constructed between 1985 and 1996. Table 10 shows the pavement history of the Cranberry Section, along with the anticipated future maintenance through the year 2050.

Table 10. Cranberry Section Pavement Maintenance Dates

Section	Previous Construction	Current Construction	Date of Rehabilitation				
			1st	2nd	3rd	4th	5th
County C to I-90 & I-94 Split	1966	1985	2010	2024 EB 2027 WB	2036 EB 2037 WB	2046 EB 2047 WB	-
WIS 80 to County C	1966	1996	2023	2026	2030	2042	-
WIS 82 to WIS 80	1966	1996	2015	2023 WB	2026 WB	2030 WB	2042 WB
County HH to WIS 82	1966	1996	2015	2032	2044	-	-
WIS 16/US 12 to County HH	1966	1992	2017	2023	2027	2031	2043

The Cranberry section has an anticipated 20 projects taking place in 14 of the next 30 years. This is the most of any section and construction may cause disruptions to the traffic for most of the next three decades. This is also the only section with a full pavement reconstruction planned which will require more significant traffic management. Figure 34 shows the estimated delay for each work zone schedule based on 2019 traffic volumes.

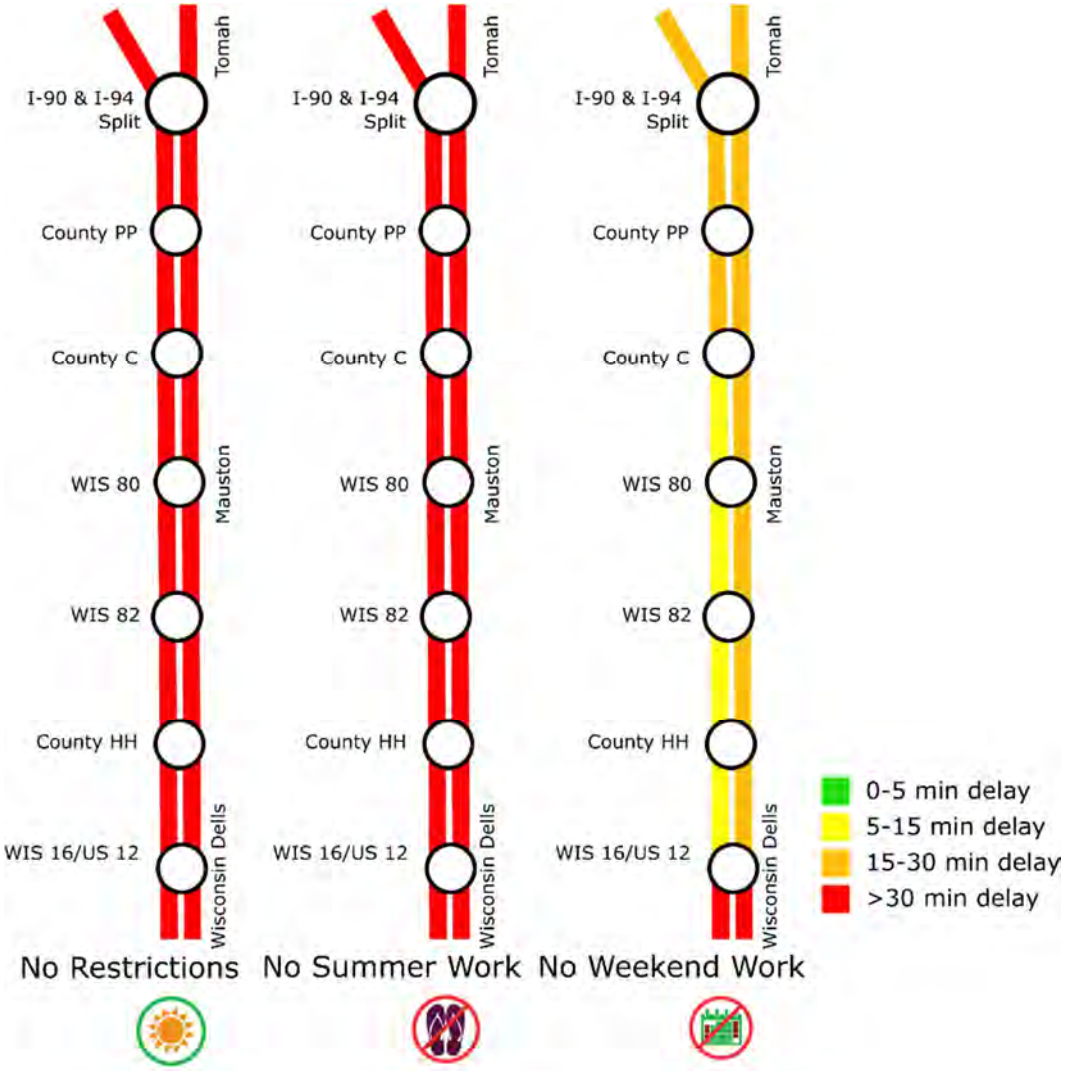
Figure 34. Cranberry Area Pavement Project Lane Closure Delay Maps



A large amount of delay is estimated for the No Restrictions and No Summer Work schedules. Temporary widening or other methods should be considered in the future especially for the pavement reconstruction.

The estimated delay for each of the work zone schedules for structures projects can be seen in Figure 35.

Figure 35. Cranberry Section Bridge Delay Maps



The No Restrictions and No Summer Work. schedules will have lane closure delays greater than 30 minutes. These two schedules are also the only ones possible with the types of projects recommended in this section. Temporary widening and temporary bridges should be considered in order to not negatively affect the large amount of freight traffic that flows through this section.

STRUCTURES

The structure needs and existing conditions were analyzed and catalogued. A variety of data sources and tools were used to evaluate the existing condition of the structures within the project area. These include the WisDOT Highway Structures Information System (HSIS), SW Region 2019 Deck Scan Report, and WisDOT Facilities Development Manual. These data sources inform future projects that are planned in the corridor. The WisDOT Bureau of Structures (BOS) has developed an asset management tool named the Wisconsin Structures Asset Management System (WiSAMS). WiSAMS produces recommended maintenance projects for all of the structures throughout the corridor. There are four types of bridge maintenance recommended by WiSAMS focused on for this study:

A structure replacement project is a complete removal and replacement of the existing structure.

A bridge deck replacement for a girder bridge replaces only the deck of the bridge and maintains the existing superstructure and substructure. A deck replacement for a reinforced concrete slab bridge replaces the full bridge superstructure and maintains the existing substructure units.

A bridge painting requires the removal of old paint, and cleaning of the steel structure before the new paint can be applied.

A bridge deck concrete overlay includes cleaning and prepping the existing deck prior to placing an average 2” concrete overlay over the deck.

In addition to the projects recommended by WiSAMS, projects in the Financial Integrated Improvement Program (FIIPS) were also included. Projects within FIIPS are already planned, but FIIPS does not extend farther than 7 years into the future.

Eighty-five concrete overlays are recommended between now and 2050 along the corridor. In total, 170 work actions were identified either by WiSAMS or are currently planned in FIIPS. As part of this analysis, the focus for structures was on the major work actions that have the largest impact on cost, traffic management, and service life extension of a structure. Programmed or recommended polymer overlays were not included in this analysis as they provide minimal additional service life to the structure (7-15 years) and for typical structures this work action can be completed in less than one week and is a relatively inexpensive maintenance project compared to deck and full replacement projects.

Madison Section Structures

There are 29 structure maintenance projects recommended before 2050 in the Madison Section. This is counting paired structures as one project. Structure projects are recommended in 12 of the next 30 years. Table 11 through Table 13 shows the recommended projects broken out by decade.

Table 11. Madison Area Section Structure Projects - 2020's

Decade		Structure Number	Facility On	Facility Below	Year	Work Action
2020's		B-13-100	Hoepker Rd	I-39/90/94	2028	Replace Structure
		B-13-540	Hanson Rd.	I-39/90/94	2028	Concrete Overlay
		B-13-477	Milwaukee St	I-90 EB	2030	Replace Deck

Table 12. Madison Area Section Structure Projects - 2030's

Decade		Structure Number	Facility On	Facility Below	Year	Work Action
2030's		B-13-438	I-94 EB	I-90 WB	2030	Concrete Overlay
		B-13-450	I-94 EB	County T	2030	Concrete Overlay
		B-13-87	I-39/90/94	Cuba Valley Rd	2036	Replace Structure
		B-13-88	I-39/90/94	Cuba Valley Rd	2036	Replace Structure
		B-13-112	Cottage Grove Rd	I-39/90/94	2037	Replace Structure
		B-13-118	I-39/90/94	Starkweather Creek	2037	Replace Structure
		B-13-90	I-39/90/94	Yahara River	2037	Replace Structure
		C-13-42	I-39/90/94	Drainage	2037	Replace Structure
		B-13-89	Windsor Rd.	I-39/90/94	2038	Concrete Overlay
		B-13-95	I-39/90/94	Token Creek	2038	Replace Structure
		B-13-448	I-39/90/94	Commercial Ave	2039	Replace Deck

Table 13. Madison Area Section Structure Projects - 2040's

Decade		Structure Number	Facility On	Facility Below	Year	Work Action
2040's		B-13-99	I-39/90/94	US 51	2043	Replace Deck
		B-13-131	Milwaukee St	I-39/90	2043	Concrete Overlay
		B-13-334	I-39/90	WIS 30	2045	Concrete Overlay
		B-13-400	WIS 30 Ramp	I-39/90	2045	Concrete Overlay
		B-13-540	Hanson Rd	I-39/90/94	2045	Concrete Overlay
		B-13-541	I-39/90/94	Lien Rd	2046	Concrete Overlay
		B-13-542	I-39/90/94	Lien Rd	2046	Concrete Overlay
		B-13-544	Buckeye Rd	I-39/90/94	2046	Concrete Overlay
		B-13-307	I-39/90	WIS 30	2046	Concrete Overlay
		B-13-458	I-39/90	CNW RR	2046	Concrete Overlay
		B-13-309	I-39/90	WIS 30	2046	Concrete Overlay
		B-13-308	I-39/90	I-94 Ramp	2047	Concrete Overlay
		B-13-459	I-39/90	CNW RR	2047	Concrete Overlay
		B-13-453	High Crossing Blvd	I-39/90/94	2047	Concrete Overlay
		B-13-438	I-94 EB	I-39/90	2049	Replace Structure
		B-13-452	I-39/90/94	US 151	2049	Replace Structure
		B-13-103	I-39/90/94	US 151	2050	Replace Structure

There are a large number of concrete overlays from 2043 to 2047 that will cause a lot of disruption to the normal traffic patterns in the Madison Section. There are also a number of larger projects between 2036 and 2038 that will cause a lot of delay

There is a large amount of bridge work needed in the Madison within the next thirty years and careful planning is needed to maximize the efficiency of work actions and minimize the delay and driver frustration.

Wisconsin River Section Structures

There are 37 structures projects recommended through the year 2050, including projects taking place in 15 of those 30 years. This is counting paired structures as one project. Table 14 through Table 16 shows the structures projects recommended in the Wisconsin River Section through the year 2050.

Table 14. Wisconsin River Section Structure Projects - 2020's

Decade		Structure Number	Facility On	Facility Below	Year	Work Action
2020's		B-11-18	Patton Road	I-90/94	2020	Concrete Overlay
		B-11-57	County O	I-39	2021	Replace Deck
		B-11-15	I-39/90/94	WIS 60	2023	Replace Structure
		B-11-16	I-39/90/94	WIS 60	2023	Replace Structure
		B-11-40	I-39/90/94	Rowan Creek	2027	Replace Deck
		B-11-22	I-90/94 EB	Wisconsin River	2028	Replace Structure
		B-11-23	I-90/94 WB	Wisconsin River	2028	Replace Structure
		B-11-35	County U	I-39/90/94	2028	Replace Structure
		B-11-37	County V	I-39/90/94	2028	Replace Structure
		B-11-55	I-39	Wisconsin River	2028	Replace Deck
		B-11-56	I-39	Wisconsin River	2028	Replace Deck
		B-11-54	WIS 33	I-39	2029	Replace Deck

Table 15. Wisconsin River Section Structure Projects - 2030's

Decade		Structure Number	Facility On	Facility Below	Year	Work Action
2030's		B-11-99	I-39 SB	WIS 78	2030	Paint
		B-11-98	I-39 SB	I-90/94	2031	Paint
		B-11-99	I-39 SB	WIS 78	2036	Concrete Overlay
		C-11-10	I-39/90/94	Creek	2036	Replace Structure
		C-11-11	I-39/90/94	Creek	2036	Replace Structure
		C-11-8	I-39/90/94	Drainage Way	2036	Replace Structure
		B-11-14	Richards Rd	I-39/90/94	2037	Replace Structure
		B-11-17	County K	I-39/90/94	2037	Concrete Overlay
		B-11-18	Patton Rd.	I-39/90/94	2037	Concrete Overlay
		C-11-25	I-39	Creek	2037	Replace Structure
		B-11-59	I-39	CMSTPP RR	2037	Concrete Overlay
		B-11-64	I-39	Levee Rd	2037	Replace Structure
		B-11-58	I-39	CMSTPP RR	2038	Concrete Overlay
		B-11-39	Kent Rd.	I-39/90/94	2038	Concrete Overlay
		B-11-43	I-39/90/94	Rowan Creek	2038	Replace Structure
		B-11-45	I-39/90/94	Rowan Creek	2038	Replace Structure
		B-11-51	Cascade Mountain Rd	I-39	2039	Replace Structure
		B-11-41	I-39/90/94	Rowan Creek	2039	Replace Deck

Table 16. Wisconsin River Section Structure Projects - 2040's

Decade		Structure Number	Facility On	Facility Below	Year	Work Action
2040's		B-11-65	I-39	Levee Rd	2043	Replace Structure
		B-11-100	I-39	I-90/94 Ramp	2045	Concrete Overlay
		B-11-102	WIS 78/I-39	I-90/94	2045	Concrete Overlay
		B-11-98	I-90/94 Ramp	I-90/94	2045	Concrete Overlay
		B-13-517	County V	I-39/90/94	2047	Concrete Overlay
		B-11-101	WIS 78	I-90/94	2047	Concrete Overlay
		B-11-140	Black Rd	I-39/90/94	2047	Concrete Overlay
		B-11-151	County CS	I-39/90/94	2047	Concrete Overlay
		B-11-25	Smokey Hollow Rd	I-39/90/94	2047	Concrete Overlay
		B-11-52	I-39	Baraboo River	2047	Concrete Overlay
		B-11-53	I-39	Baraboo River	2047	Concrete Overlay
		B-11-116	I-39	WIS 16	2049	Replace Structure
		B-11-117	I-39	WIS 16	2049	Replace Structure
		B-11-24	I-39/90/94	Smokey Hollow Rd.	2049	Replace Structure

The Wisconsin River Section is named for its multiple bridges crossing the Wisconsin River. These are large high capacity bridges that will be needing maintenance before 2050. The crossing south of the I-39 & I-90/94 split (B-11-22/23) is scheduled to be replaced in 2028 and will impact the surrounding structures because of the size and scope of the replacement. The crossing north of the I-39 & I-90/94 split is anticipated to need a deck replacement in 2028, which may affect adjacent structures.

Wisconsin Dells Section Structures

The Wisconsin Dells section has 30 recommended structures maintenance projects in ten different years before 2050. This is counting paired structures as one project. These projects are shown in Table 17 through Table 19.

Table 17. Wisconsin Dells Section Structure Projects - 2020's

Decade		Structure Number	Facility On	Facility Below	Year	Work Action
2020's		B-11-33	Cascade Mountain Rd.	I-90/94	2021	Replace Deck
		B-56-26	Van Hoosen Rd	I-90/94	2021	Replace Deck
		B-56-24	I-90/94 EB	Schepp Road	2027	Concrete Overlay
		B-56-25	I-90/94 WB	Schepp Road	2027	Concrete Overlay
		B-56-30	I-90/94 EB	US 12	2027	Concrete Overlay
		B-56-31	I-90/94 WB	US 12	2027	Concrete Overlay
		B-56-37	I-90/94 EB	County H	2027	Concrete Overlay
		B-56-38	I-90/94 WB	County H	2027	Concrete Overlay
		B-56-39	I-90/94 EB	WIS 13	2027	Concrete Overlay
		B-56-40	I-90/94 WB	WIS 13	2027	Concrete Overlay
		B-56-41	Trout Rd	I-90/94	2027	Replace Deck
		B-56-42	I-90/94 EB	Spring Brook	2027	Concrete Overlay
		B-56-43	I-90/94 WB	Spring Brook	2027	Concrete Overlay
		B-56-44	I-90/94 EB	WIS 23	2027	Concrete Overlay
		B-56-45	I-90/94 WB	WIS 23	2027	Concrete Overlay
		B-56-47	I-90/94 EB	Mirror Lake	2027	Paint
		B-56-48	I-90/94 WB	Mirror Lake	2027	Paint
		B-56-49	I-90/94 EB	Ishnala Road	2027	Concrete Overlay
		B-56-50	I-90/94 WB	Ishnala Road	2027	Concrete Overlay
		B-56-34	County A	I-90/94	2028	Replace Structure

Table 18. Wisconsin Dells Section Structure Projects - 2030's

Decade		Structure Number	Facility On	Facility Below	Year	Work Action
2030's		B-11-30	WIS 33	I-90/94	2036	Replace Structure
		B-56-28	County T	I-90/94	2037	Replace Structure
		B-56-47	I-90/94	Mirror Lake	2037	Replace Structure
		B-56-48	I-90/94	Mirror Lake	2037	Replace Structure
		B-56-29	Gillem Rd	I-90/94	2037	Concrete Overlay

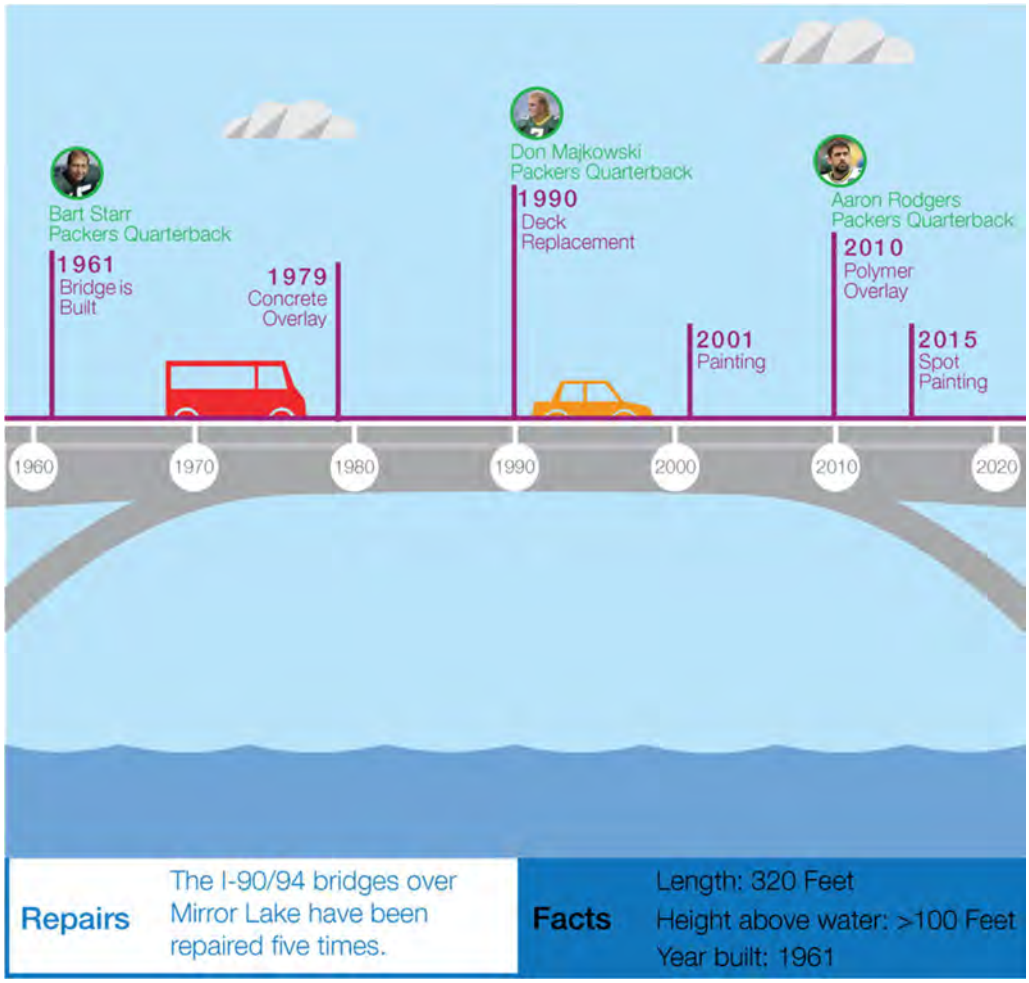
Table 19. Wisconsin Dells Section Structure Projects - 2040's

Decade		Structure Number	Facility On	Facility Below	Year	Work Action
2040's		B-56-24	I-90/94	Schepp Rd	2043	Replace Structure
		B-56-30	I-90/94	US 12	2043	Replace Structure
		B-56-43	I-90/94	Spring Brook	2043	Replace Structure
		B-56-50	I-90/94	Ishnala Rd	2044	Replace Structure
		B-56-44	I-90/94	WIS 23	2044	Replace Structure
		B-56-45	I-90/94	WIS 23	2046	Concrete Overlay
		B-56-25	I-90/94	Schepp Rd	2046	Concrete Overlay
		B-56-49	I-90/94	Ishnala Rd	2046	Concrete Overlay
		B-56-38	I-90/94	County H	2047	Concrete Overlay
		B-56-39	I-90/94	WIS 13	2047	Replace Structure
		B-56-42	I-90/94	Spring Brook	2047	Concrete Overlay
		B-11-137	I-90/94	Baraboo River	2047	Concrete Overlay
		B-56-40	I-90/94	WIS 13	2049	Replace Structure
		B-56-46	Xanadu Rd	I-90/94	2049	Replace Structure
		B-56-31	I-90/94	US 12	2049	Replace Structure
		B-56-37	I-90/94	County H	2049	Replace Structure

Mirror Lake Bridge

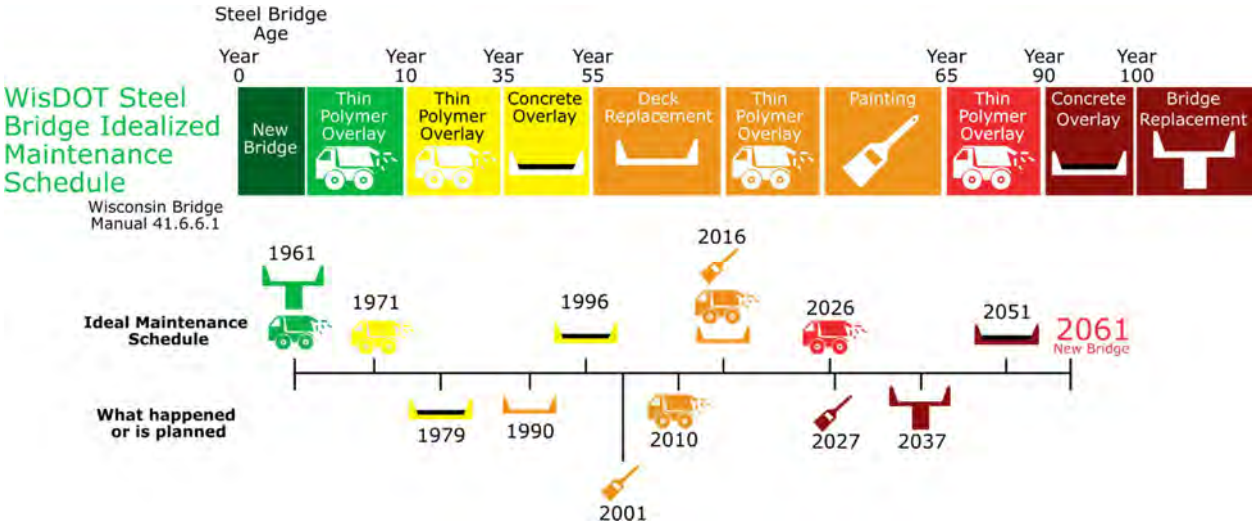
The I-90/94 bridges over Mirror Lake are reaching the end of their useful life and will likely need to be replaced in the mid 2030's without significant rehabilitation work. The existing 320 foot long K-frame structures were constructed in 1961 and are fracture critical. WisDOT's standard concrete girders cannot span this length, so an alternate structure type is needed to cross Mirror Lake. The narrow 32 foot clear width on each structure makes traffic control challenging for maintenance activities. It is not possible to maintain two lanes of traffic in each direction during construction. Lane closure queues and delays during the high recreational traffic volumes in the summer limit the duration of maintenance activities. The over 100 foot drop from the bridge to the water has also been a crash severity issue. In the past 10 years three vehicles have left the roadway near the bridge and dropped into the lake below, resulting in three fatalities.

Figure 36. Mirror Lake Summary



The Mirror Lake bridges have been repaired five times over their lifespan consistently needing maintenance before the scheduled time and will need continuing maintenance to extend their life. In the ideal bridge life, a new bridge deck will last 45 years until a new bridge is needed. The Mirror Lake bridge deck was replaced in 1990. Using the ideal maintenance schedule, the existing bridge deck is expected to last until approximately 2035. Regular inspections of the structure will refine the expected lifespans as it reaches the end of its useful life. Because of the narrow width and high recreational traffic volumes in the summer, a project to replace the Mirror Lake bridge deck would likely require a temporary structure to maintain traffic. It may be more cost effective to replace the structure rather than the continued maintenance projects. The comparison between the expected maintenance cycle and the actual maintenance cycle for the Mirror Lake Bridges can be seen in Figure 37.

Figure 37. Mirror Lake Work Action Summary



Because of the complexity of the traffic management needed for the Mirror Lake bridges maintenance and the timing of the next recommend project as overlapping with many other projects, these bridges will likely control the section in terms of timing of improvements for adjacent needs.

Cranberry Section Structures

The Cranberry section has the greatest number of structure projects in the next thirty years. This is counting paired structures as one project. There are 42 projects recommended in 17 of the next 30 years. The recommended projects are shown in Table 20 through Table 22.

Table 20. Cranberry Section Structure Projects - 2020's

Decade		Structure Number	Facility On	Facility Below	Year	Work Action
2020's		B-29-27	19th Ave	I-90/94	2021	Concrete Overlay
		B-29-28	19th Ave	I-90/94	2021	Concrete Overlay
		B-29-54	I-90/94	County H	2021	Replace Deck
		B-29-32	I-90/94 EB	Lemonweir River	2022	Replace Structure
		B-29-33	I-90/94 WB	Lemonweir River	2022	Replace Structure
		B-29-34	I-90/94 EB	WIS 82	2022	Replace Structure
		B-29-35	I-90/94 WB	WIS 82	2022	Replace Structure
		B-29-36	I-90/94 WB	County G	2022	Concrete Overlay
		B-29-37	I-90/94 WB	County G	2022	Replace Structure
		B-29-41	Welch Prairie Road	I-90/94 EB	2025	Concrete Overlay
		B-29-42	Welch Prairie Road	I-90/94 WB	2025	Concrete Overlay
		B-29-48	County M	I-90/94	2025	Concrete Overlay
		B-29-49	County M	I-90/94 EB	2025	Concrete Overlay

Table 21. Cranberry Section Structure Projects - 2030's

Decade		Structure Number	Facility On	Facility Below	Year	Work Action
2030's		B-29-20	63rd St	I-90/94	2030	Replace Deck
		B-29-49	County M	I-90/94	2033	Concrete Overlay
		B-41-44	I-94	I-90	2034	Replace Deck
		C-29-41	I-90/94	Lemonweir River	2035	Replace Structure
		C-29-47	I-90/94	Drainage Ditch	2035	Replace Structure
		B-29-43	County A	I-90/94	2036	Concrete Overlay
		B-41-39	County N	I-90/94	2037	Concrete Overlay
		B-29-58	I-90/94	Lemonweir River	2037	Replace Structure
		B-29-26	55th St	I-90/94	2037	Concrete Overlay
		B-41-46	I-90/94	Allen Creek	2037	Replace Structure
		B-29-44	I-90/94	N 8th Ave	2037	Concrete Overlay
		B-29-50	6th Ave	I-90/94	2037	Concrete Overlay
		B-29-53	I-90/94	County H	2037	Concrete Overlay
		B-29-55	Keichinger Rd	I-90/94	2037	Concrete Overlay
		B-29-45	I-90/94	N 8th Ave	2038	Concrete Overlay
		B-29-27	19th Ave	I-90/94	2038	Concrete Overlay
		B-29-28	19th Ave	I-90/94	2038	Concrete Overlay
		B-41-24	I-94	I-90	2038	Replace Structure
		B-29-39	Meyer Rd	I-90/94	2038	Concrete Overlay
		C-29-27	I-90/94	Lyndon Creek	2038	Replace Structure
		C-29-28	I-90/94	Lyndon Creek	2038	Replace Structure
		C-29-29	I-90/94	Lyndon Creek	2038	Replace Structure
		B-29-24	24th Ave	I-90/94	2038	Concrete Overlay
		B-29-23	County HH	I-90/94	2040	Replace Structure

Table 22. Cranberry Section Structure Projects - 2040's

Decade		Structure Number	Facility On	Facility Below	Year	Work Action
		B-29-23	County HH	I-90/94	2040	Replace Structure
2040's		B-29-36	I-90/94	51st St	2043	Replace Structure
		B-29-48	County M	I-90/94	2044	Concrete Overlay
		B-41-274	Funnel Rd	I-90/94	2046	Concrete Overlay
		B-41-275	I-90/94	Funnel Rd	2046	Concrete Overlay
		B-41-276	Grover Rd	I-90/94	2046	Concrete Overlay
		B-41-277	Grover Rd	I-90/94	2046	Concrete Overlay
		B-29-142	I-90/94	County C	2046	Concrete Overlay
		B-29-143	I-90/94	County C	2046	Concrete Overlay
		B-29-31	County N	I-90/94	2046	Concrete Overlay
		B-29-38	WIS 58	I-90/94	2047	Replace Structure
		B-29-22	Koval Rd	I-90/94	2048	Replace Structure
		B-29-41	Welch Prairie Rd	I-90/94	2049	Replace Structure
		B-29-42	Welch Prairie Rd	I-90/94	2049	Replace Structure
		B-29-49	County M	I-90/94	2049	Concrete Overlay
		B-29-25	County N	I-90/94	2049	Replace Structure
		B-41-43	I-94	I-90	2049	Replace Structure

There are a large number of projects between 2035 and 2038. These projects could have a large disruptive effect on the traffic. Combining traffic management for these projects could be a cost saving measure, and a way of minimizing construction delay over several years.

OTHER CONSIDERATIONS

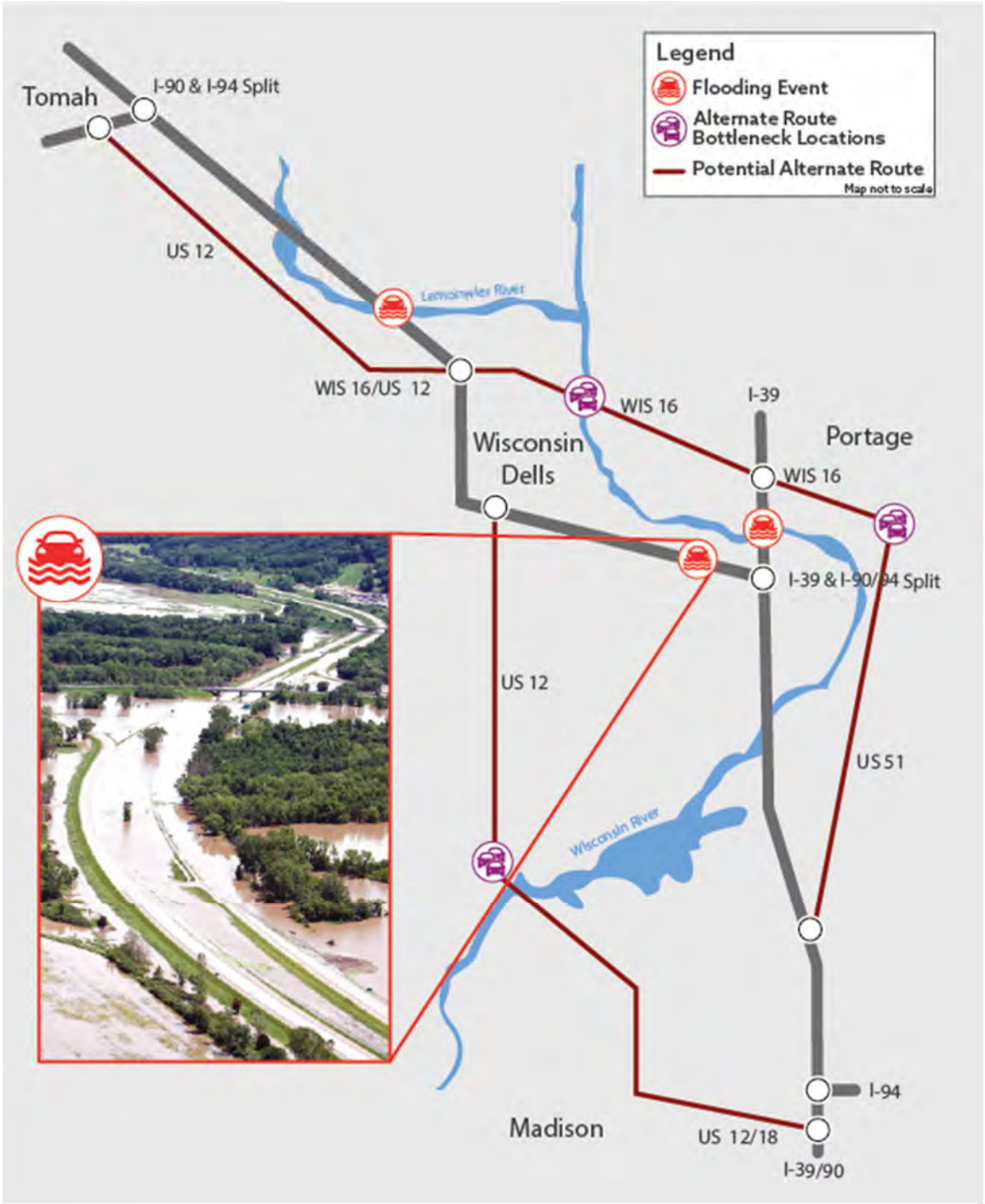
Corridor Resiliency

There have been 4 major flooding events that resulted in partial or full closures of the interstate in this corridor since 2008. The Baraboo River near the I-39 & I-90/94 split flooded in 2008, closing both I-39 and I-90/94 for multiple days. The Baraboo River experienced major flooding again in 2018, which resulted in lane and shoulder closures. The Lemonweir River, near the I-90/94 and WIS 82 interchange, flooded in 2008 and 2018, causing full interstate closures.

The Baraboo River flooding is very problematic because it affects both I-90/94 and I-39, potentially closing a vital interstate corridor that could have significant impacts to both state and national commerce. During the 2008 closures, the alternate route was WIS 29 and I-43 from Eau Claire to Green Bay to Milwaukee, a substantial increase in travel distance and time.

The alternate routes to I-90 have geographic barriers, delays, and bottlenecks. From Madison to Wisconsin Dells, the Wisconsin River is a geographic barrier to alternate routes. There are no high capacity crossings of the Wisconsin River other than the interstate crossings. US 12, US 51 and WIS 16, are not adjacent to the interstate, increasing travel time to access the alternate route. The alternate routes also have bottlenecks in the communities they pass through with traffic signal delay, slower speed limits, and many intersections, including the communities of Sauk City, Portage, and Wisconsin Dells. The flooding locations, potential alternate routes, and alternate route bottleneck locations are shown on Figure 38. Corridor Resiliency Summary

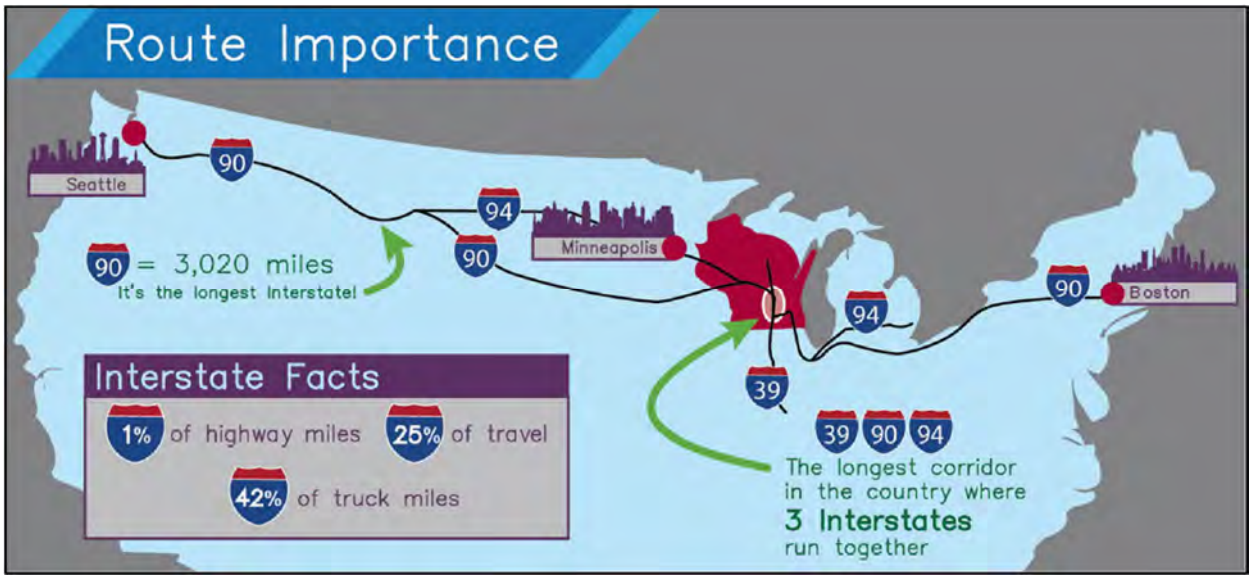
Figure 38. Corridor Resiliency Summary



Route Importance

The I-90 corridor is a very important nation and state route. I-90 is the longest interstate in the country traveling over 3,000 miles from Boston to Seattle. Interstates are critical to nation mobility and although interstates account for 1% of highway miles in the United states, they account for 25% of the travel and 42% of truck miles. This can be seen in Figure 39.

Figure 39. I-90 Route Importance



I-90 is very important to Wisconsin's freight economy carrying over $116 billion of freight each year. I-90 freight volume has grown by about 1,000 trucks per day on I-90 from 2015 to 2019. Some of the top products moving through the I-90 corridor can be seen in Figure 40.

Figure 40. I-90 Freight Importance

I-90 also supports the Wisconsin Tourism economy. The five counties in the I-90 study area accounted for over $4 billion in tourism business sales in 2018, and about 20% of the state's total tourism. I-90 also serves as a gateway to other recreational destinations in northern Wisconsin beyond the five counties in the corridor. This can be seen in Figure 41.

Figure 41. I-90 Tourism

The I-90 corridor has huge importance in moving people and good through and within Wisconsin. Failing to meet the rising needs within the corridor could have negative effects on both the freight and tourism industries.

CONCLUSION

The I-90 Madison to Tomah corridor was evaluated to determine existing and future needs associated with traffic operations, safety, pavement, and structures and other key considerations. The following sections provide a summary of the key analysis findings.

Madison Section Summary

Traffic

- The Madison section carries the highest traffic volumes in the study area, with a mix of both commuting and recreational traffic.
- The segment operates at LOS D in the existing year and is anticipated to reach LOS E in at least one peak by 2030 and may reach LOS F by year 2046.
- The worst congestion occurs between US 12/18 and US 151.
- The US 151 interchange has operational issues that cause backups on both I-39/90/94 and US 151.
  - Two ramps have existing traffic demand that exceeds capacity: NB I-39/90/94 to NB US 151 and SB US 151 to SB I-39/90/94.
  - Both over-capacity ramps are single lane, low-speed connections that cause queues to extend onto NB I-39/90/94 and SB US 151.
- High entering and exiting traffic volumes between the I-94/WIS 30 and US 151 interchanges, combined with left-side on- and off-ramps at the I-94/WIS 30 interchange create weaving conflicts that cause traffic slow-downs and crashes.
  - Along NB I-39/90/94, traffic from WIS 30, who enter on the left, and NB I-39/90/94 who want to exit at US 151/High Crossing Blvd conflict with traffic from I-94 who want to continue on NB I-39/90/94.
  - Along SB I-39/90/94, traffic from US 151 and High Crossing Blvd destined for I-94 conflict with SB I-39/90/94 traffic destined for WIS 30.

Safety

- Approximately 19.6% of the 15-mile segment received a crash rating of poor, severe, or extreme, correlating to crash issues in these locations.
- Of the top 20 crash locations within the corridor, 5 are located within the Madison section.
  - Two of the top 20 crash locations are located within the US 151 interchange.
    - A large number of crashes, particularly rear-end crashes, have occurred along the NB CD road with exits to High Crossing Blvd and NB US 151. The off-ramp to NB US 151 is over capacity and creates large queues that extend onto NB I-39/90/94. The queue causes safety concerns as it mixes stopped vehicles with high speed vehicles on the freeway.
    - There is inadequate distance between the loop ramps on each leg of the interchange, preventing cars from accelerating or decelerating effectively. This creates a large number of sideswipe and rear end crashes as cars attempt to change lanes and speeds.
  - The other three locations are along NB I-39/90/94 between US 151 and County V. These safety issues are caused by drainage issues due to the highway here having a flat grade and cross slope. Pooling water on the roadway leads to hydroplaning in wet weather, and ice patches in the winter.

Pavement and Structures

- There are 7 pavement projects anticipated before the year 2050, occurring in 6 different years.
- There are 29 structure maintenance projects anticipated within the Madison section before 2050, with projects occurring in 12 of the next 30 years.
- Lane closures associated with construction projects are anticipated to create over 30 minutes of delay for the segment between US 12/18 and US 151 unless work is only completed at night. North of US 151, delays will be under 30 minutes if lane closures are avoided on weekends.

Wisconsin River Section Summary

Traffic

- The Wisconsin River section is a shift from urban to rural area. This section typically only experiences recurring congestion during the Summer Friday and Sunday peaks.
- Backups from the Madison area will stretch back into this section in the future causing LOS two levels below desirable on the weekend summer peaks.
- In the year 2050, traffic from County V to the I-39 & I-90/94 interchange is anticipated to operate at LOS D on Friday and LOS E on Sunday.

Safety

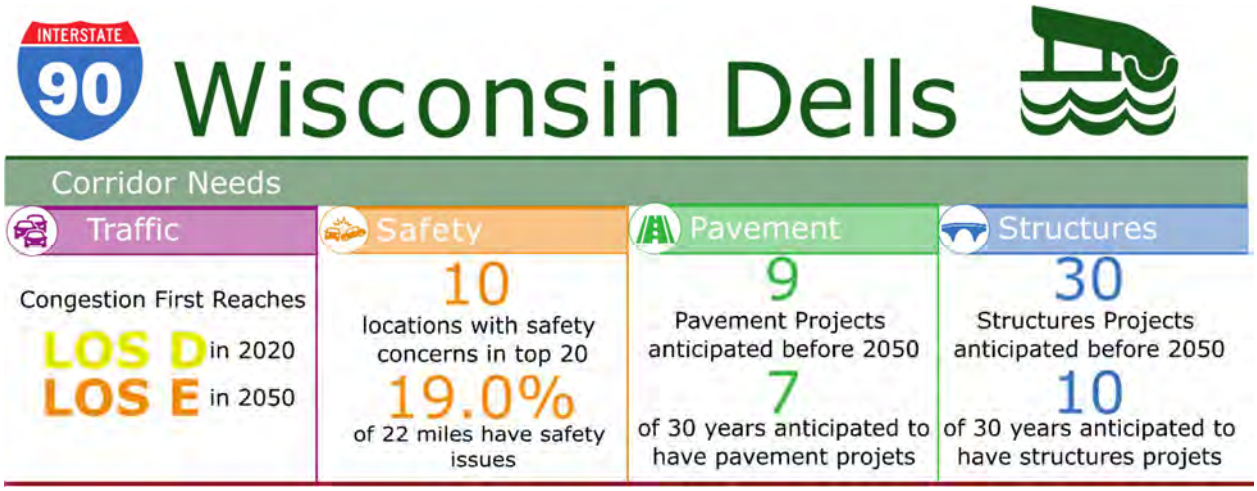
- Approximately 4.6% of the 24-mile segment received a crash rating of poor, severe, or extreme, correlating to crash issues in these locations.
- Of the top 20 crash locations within the corridor, 1 of these is located within the Wisconsin River section.
  - High crash rate and KAB crashes were found along SB I-39 between Cascade Mountain Road and I-90/94. This could be due to confusion of signage for exits to Cascade Mountain Road and I-90/94. Many of the crashes could be the result of drivers, believing they are going to I-39/90/94, taking the 20 mph Cascade Mountain Road exit at a far higher speed than the ramp is designed for.

Pavement and Structures

- There are 13 pavement projects anticipated before the year 2050, occurring in 10 different years.
- There are 37 structure maintenance projects anticipated within the Wisconsin River section before 2050, with projects occurring in 15 of the next 30 years.
- Weekend lane closures associated with construction projects are anticipated to create over 30 minutes of delay along I-39/90/94 for the segment between County V and the I-39 & I-90/94

split interchange. Delays along I-39 north of the I-39 & I-90/94 split interchange should remain under 30 minutes for most lane closure scenarios.

Wisconsin Dells Section Summary



Traffic

- The Wisconsin Dells section is a rural freeway. Majority of the section is currently operating at LOS D during the summer Friday (WB I-90/94) and Sunday (EB I-90/94) peak periods.
- In the year 2050, traffic is anticipated to operate at LOS D or LOS E in both directions on summer Friday's and Sunday's.
- This increased congestion and traffic may ultimately negatively impact the tourist economy in the Wisconsin Dells area.

Safety

- Approximately 19.0% of the 22-mile segment received a crash rating of poor, severe, or extreme, correlating to crash issues in these locations.
- Of the top 20 crash locations within the corridor, 10 of these are located within the Wisconsin Dells section.
  - Six of the top 20 crash locations are located at the US 12 interchange on the south side of Wisconsin Dells, corresponding to each of the 6 ramps at the interchange. Majority of crashes are occurring on weekends, when the number of unfamiliar drivers increases due to recreational traffic. Increased congestion on weekends, along with tight ramp curvature and slow speed loop ramps contribute to the crash issues.
  - The WB I-90/94 lane drop and roadway curvature between the I-39 & I-90/94 split interchange and WIS 33 causes a high number of sideswipe crashes.
  - EB I-90/94 on-ramp from WIS 23 has an inadequate acceleration lane that is bordered by guardrail and a bridge pier which removes any shoulder refuge available once merging.

  - The I-90/94 eastbound exit to WIS 13 is a low speed loop exit with a narrow right shoulder. This combined with limited sight distance around the exit curve due to trees in the middle of the loop ramp creates difficult conditions for a driver to see a slow-moving vehicle in front of them.
  - The stretch between WIS 23 and US 12 is on a curve on the interstate, and this combined with a high volume of unfamiliar drivers during the peak congestion times leads to high crash rates.
- The Mirror Lake bridges are not included in the top 20 crash locations but has a crash rate 2.5x the statewide average. The increased crash rate is due to the narrow 32' clear width on the bridge, reducing space for driver errors. Since 2011, three crashes have resulted in vehicles leaving the roadway and falling ~100 feet into the lake below.

Pavement and Structures

- There are 9 pavement projects anticipated before the year 2050, occurring in 7 different years.
- There are 30 structure maintenance projects anticipated within the Wisconsin Dells section before 2050, with projects occurring in 10 of the next 30 years.
- The I-90/94 bridges over Mirror Lake have been repaired five times over their lifespan consistently needing maintenance before the scheduled time. The Mirror Lake bridge deck was replaced in 1990 and is anticipated to last until approximately 2035. Replacement of the Mirror Lake bridges is recommended in 2037.
- Lane closures associated with the construction projects are anticipated to create over 30 minutes of delay throughout the section unless they avoid both weekend and summer lane closures.

Cranberry Section Summary

Traffic

- The Cranberry section is a rural freeway and has less traffic operations issues in comparison to the other sections.
- There are minor issues in the existing conditions, but in 2050, most of the section is anticipated to operate at LOS D during the summer Sunday peak.

Safety

- Approximately 6.8% of the 40-mile segment received a crash rating of poor, severe, or extreme, correlating to crash issues in these locations.
- Of the top 20 crash locations within the corridor, 4 of these are located within the Cranberry section.
  - On EB I-90/94 between WIS 80 and WIS 82, the Welch Prairie Road bridge is the site of multiple instances of vehicles leaving the road to the left of the guardrail and hitting the pier of this bridge.
  - The County C interchange has 2 top 20 crash locations. The County C interchange is located along a mainline curve and both the EB and WB off-ramps are difficult for drivers to navigate, especially during wet or slippery conditions.
  - The EB I-90/94 segment between WIS 80 and WIS 82 sees a high percentage of rear end crashes. These may be the results of platooning vehicles from the upstream WIS 80 on ramp.

Pavement and Structures

- There are 20 pavement projects anticipated before the year 2050, occurring in 14 different years.
- There are 42 structure maintenance projects anticipated within the Cranberry section before 2050, with projects occurring in 17 of the next 30 years.
- Weekend lane closures associated with the pavement projects are anticipated to create over 30 minutes of delay throughout the section. Delays in general will be under 15 minutes if lane closures are avoided on weekends and through the summer.