Weathering Climate Change

A VULNERABILITY ASSESSMENT OF ROAD, BRIDGE, AND RAIL INFRASTRUCTURE

La Crosse Area Planning Committee

Completed December 2018

Weathering Climate Change:

A Vulnerability Assessment of Road, Bridge, and Rail Infrastructure

This document was prepared by staff of the La Crosse Area Planning Committee (LAPC), the bi-state metropolitan planning organization for the La Crosse, WI – La Crescent, MN urbanized area. It and other LAPC studies, plans, and programs can be obtained on our website at www.lapc.org.

La Crosse Area Planning Committee

....creating quality choices for the Coulee Region

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SECTION 1: INTRODUCTION

GENERAL PURPOSE

Although the effects of climate change are far-reaching and affect sectors beyond the transportation sector such as water resources, energy production and use, agriculture, forests, human health, and ecosystems and biodiversity, the focus of this assessment is on the effects of climate change on the transportation sector.

Extreme weather events such as flooding, severe heat, and intense storms threaten the long-term investments that Federal, State, and local governments have made in transportation infrastructure. Transportation systems are already experiencing costly climate-related impacts, leading to disruption and damaged roads, bridges, rail systems, and other transportation infrastructure. In the future, these impacts are projected to intensify in magnitude, duration, and frequency across the United States. Assessing and addressing vulnerabilities allows agencies to build their resilience, or the ability to anticipate, prepare for, and adapt to changing conditions and to withstand, respond to, and recover rapidly from disruptions.

REGULATORY AUTHORITY

Congress addressed the issue of improving the condition and resilience of transportation assets in the past two transportation authorization bills.

The Moving Ahead for Progress in the 21st Century Act (MAP-21, 2012) required each State to develop a risk-based asset management plan for the National Highway System (NHS) to improve or preserve the condition and performance of transportation assets. MAP-21 also established the National Highway Performance Program (NHPP) as funding support for those improvements and allowed the FHWA to provide Federal aid funds for construction, replacement, rehabilitation, preservation, and protection (including protection against extreme events) of bridges and tunnels on the NHS and other public roads.

The Fixing America's Transportation System (FAST) Act of 2015 continued the NHPP and expanded funding eligibility specifically to projects that reduce the risk of failure of critical NHS infrastructure. In addition, the FAST Act requires transportation agencies to take resilience into consideration during transportation planning processes. The updated metropolitan and statewide transportation planning regulations include a requirement that the metropolitan transportation plan assess capital investment and other strategies that reduce the vulnerability of the existing transportation infrastructure to natural disasters.

In 2014, the FHWA established a policy on preparedness and resilience to climate change and extreme weather events through FHWA Order 5520. This order states that it is FHWA policy to strive to identify the risks of climate change and extreme weather events to current and planned transportation systems, and to integrate consideration of these risks into its planning, operations, policies, and programs in order to promote preparedness and resilience.

PLANNING ASSISTANCE

To help transportation agencies and their partners assess the vulnerability of their transportation infrastructure and systems to extreme weather and climate effects, the FHWA developed the *Vulnerability Assessment and Adaptation Framework, 3rd Edition*. The Framework, which is designed to be flexible and applicable to an agency's individual needs and abilities, provides a seven-step process that includes:

1. Articulating objectives and defining the study scope.
2. Obtaining asset data.

3. Obtaining climate data.
4. Assessing vulnerability.
5. Identifying, analyzing, and prioritizing adaptation options.
6. Incorporating assessment results in decision-making.
7. Monitoring and revisiting.

PURPOSE AND SCOPE

The importance of our transportation infrastructure to the economic and safe well-being of our region and its citizens cannot be over-stated. We need to be effective in the prioritization and programming of projects so as to better address the effects of the extreme weather events projected to worsen over time. But because the LAPC is a small MPO with significantly fewer resources than States and other MPOs, the scope of our vulnerability assessment concentrates on the first four steps in the Framework, with our objectives being to:

1. Conduct an inventory of the transportation infrastructure (roads, bridges, rail lines) in our planning area;
2. Assess the condition of the infrastructure using existing data sources;
3. Summarize the climatological trends in our region;
4. Conduct a high-level assessment of vulnerability;
5. Use the information to inform the Surface Transportation Block Grant (STBG) program project prioritization processes; and,
6. Share this information with our public works and highway departments to aid them in their own project prioritization and selection processes.

DOCUMENT CONTENTS

With this first section having presented the regulatory authority, the basic framework for conducting a vulnerability assessment, and the purpose and scope of the vulnerability assessment for the LAPC, Section 2 will present an overview of climate change and climatological trends in and projections (when available) for the region, including a discussion of the extreme weather events we've experienced over the last decade.

As a bi-state MPO whose planning area encompasses the western two-thirds of La Crosse County in Wisconsin and three communities in Houston County (two communities) and Winona County (one community) in Minnesota, we will limit our discussion of climate change and its effects to the Midwest, the states of Wisconsin and Minnesota, and the communities in our planning area. The climate variables of interest include precipitation (to include extreme events) and temperature as they are the most applicable to our region.

Section 3 provides an inventory of our road and rail infrastructure and identifies the road structures and pavements that are the most vulnerable to extreme weather events. Because condition information for rail assets is not available through public sources, rail infrastructure is mapped and discussed in far less detail. All infrastructure is mapped alongside flood hazard areas and steep slopes (over 30 percent), which are the source of slope failures and mud slides. Because this is only a high-level assessment, more specific information regarding hydrography and soils for assessing slope stability is not included.

And finally Section 4 summarizes the negative impacts of climate change on our transportation infrastructure, offers general adaptation and mitigation strategies to address the impacts of climate change, and concludes with a recommendation for local municipalities to use the Framework to develop their own plan for building resiliency and sustainability into their development, construction, and maintenance practices, and some online resources to aid in that process.

SECTION 2: CHARACTERISTICS OF CLIMATE CHANGE

TERMS DEFINED

The terms "weather" and "climate" are often confused to be one and the same, but they are quite different because they have different timelines and geographic scope. Whereas, "weather" is local and short-term (minutes, hours, or days), "climate" is regional or global and long-term (seasons, years, or decades).

This definition of climate is integral to the definition of "climate change," which is often confused to be one and the same with "global warming." Global warming refers to the long-term warming of the Earth; "climate change" encompasses global warming as well as additional global phenomena like rising sea level, shrinking glaciers, accelerated ice melt, shifts in flower/plant blooming, and extreme weather events.

PRECIPITATION, TEMPERATURE, AND EXTREME WEATHER EVENTS

PRECIPITATION

The Environmental Protection Agency (EPA) reports in its climate fact sheets that the average annual precipitation in most of the Midwest has increased by 5%-10% over the last half-century, with rainfall during the four wettest days of the year having increased about 35%.

The Midwestern Regional Climate Center (MRCC) illustrates this trend in Figure 1[1] as inches per century for the years 1895-2016. Wisconsin averaged 31.51 inches per year and trended 2.83 inches per century; Minnesota averaged 26.33 inches per year and trended 2.81 inches per century.

Figure 1 also illustrates the climate divisions, which reflect local values for precipitation, and the general location of the planning area within two climate divisions. The trend for annual precipitation in the planning area ranges between 31.51 inches per year and 4.83 inches per century for the Minnesota division and 31.80 inches per year and 2.87 inches per century for the Wisconsin division.

Figure 2 illustrates the difference between the projected future (2041-2069 average) and current (1971-1999 average) annual precipitation as estimated by the North American Regional Climate Change Assessment Program.

The average annual precipitation is projected to increase 5.12 inches in Wisconsin and 3.55 inches in Minnesota. The northern part of Wisconsin is projected to be especially hard hit as illustrated by the dark green climate division in Figure 2. This climate division includes Ashland County, which has already been experiencing extreme rainfall events, severe flooding, and collapsing roads and bridges. Annual precipitation in the climate divisions of the planning area is projected to be 4.76 inches greater in the Wisconsin division and 4.55 inches greater in the Minnesota division.

The negative impacts of excessive rainfall and flooding on our transportation infrastructure can include the weakening and collapse of roads, tunnels, and bridges—examples of which are provided in the next section on extreme rainfall events.

[1] Source: cli-MATE, Midwestern Regional Climate Center. Illinois State Water Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign. http://mrcc.illinois.edu/CLIMATE.

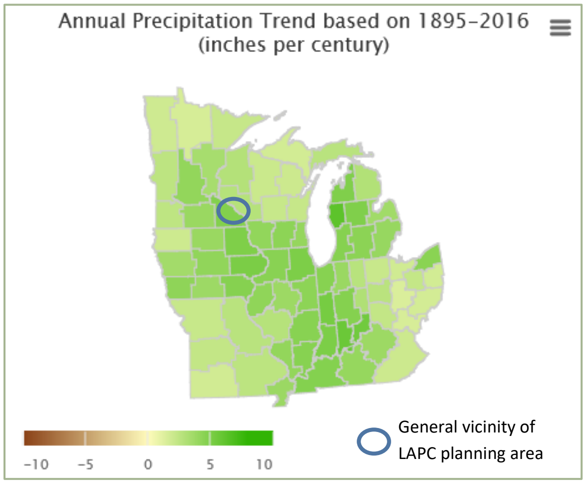

Figure 1: Annual precipitation trend in the Midwest by climate division for 1895-2016 as inches per century. Source: cli-MATE, Midwestern Regional Climate Center. Illinois State Water Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign. http://mrcc.illinois.edu/CLIMATE; accessed on: 16/06/2018.

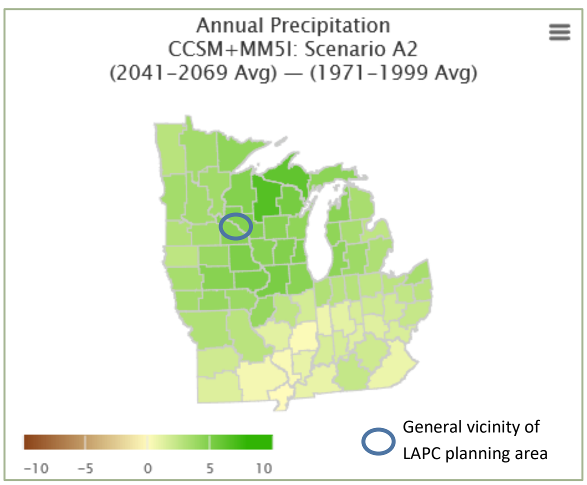

Figure 2: Difference in annual precipitation between the future and current averages in the Midwest by climate division. Source: cli-MATE, Midwestern Regional Climate Center. Illinois State Water Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign. http://mrcc.illinois.edu/CLIMATE; accessed on: 16/06/2018.

EXTREME RAINFALL EVENTS

Among the many effects of climate change reported by the EPA, the U.S. Global Change Research Program, and other research organizations, the one with the greatest impact on our transportation infrastructure is extreme rainfall events.

In *Climate Change Impacts in the United States*, the U.S. Global Change Research Program reports for the Midwest that “extreme rainfall events and flooding have increased during the last century, and these trends are expected to continue, causing erosion, declining water quality, and negative impacts on **transportation** [bold text added for emphasis], agriculture, human health, and infrastructure.”

MINNESOTA AND WISCONSIN RAIN EVENTS

One example of an extreme rainfall event in the Midwest has just occurred within a few days of this writing on June 16-17, 2018. Minnesota and Wisconsin were hit with a line of thunderstorms that dumped over 6 inches of rain on northwest Wisconsin. The Multi-Sensor Precipitation map from the MRCC shown in Figure 3 shows the line of thunderstorms and the distribution of rainfall for the 24-hr period ending the morning of June 17, 2018. On June 18, 2018, Governor Scott Walker declared a State of Emergency for Ashland, Bayfield, Burnett, Douglas, and Iron Counties.

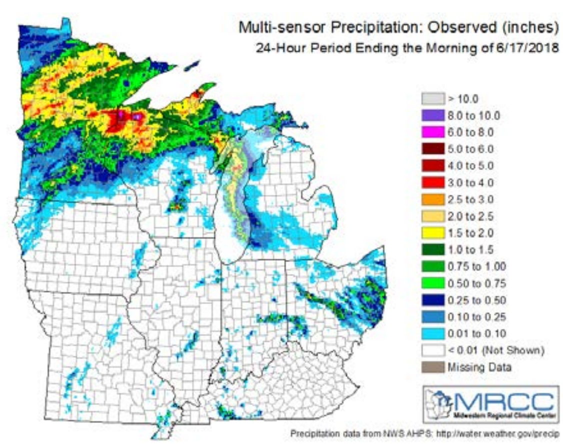

Figure 3: Multi-sensor precipitation for the observed 24-hour period ending the morning of 6/17/2018 for the Midwest. Source: cli-MATE, Midwestern Regional Climate Center. Illinois State Water Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign. http://mrcc.illinois.edu/CLIMATE; accessed on: 19/06/2018.

Figures 4 and 5 show flood damage of MN 23 in Carlton County, MN and STH 35 in Pattison State Park in Douglas County, WI, respectively. Both of these counties received a three-day rain total (June 15-17) over 6 inches. Areas of Bayfield County received upwards of 15 inches.

Figure 4: Damage to MN 23 in Duluth, MN from extreme rainfall event, June 18, 2018. Source: Carlton County Sherriff's Office.

Figure 5: Damage to STH 35 in Pattison State Park, Douglas County, WI from extreme rainfall event, June 18, 2018. Source: Wisconsin Department of Transportation.

Unfortunately, this rain event resulted in the death of an elderly man in White River, Ashland County, WI.

Last year in May 2017, a man lost his life while driving on STH 82 between Lansing, IA and Wisconsin after the road collapsed under his vehicle.

LOCAL RAIN EVENTS

The National Oceanic and Atmospheric Administration (NOAA) reports from its storm events database 36 flood events in La Crosse County to date (June 19, 2018) since January 1, 2000, with Federal disaster declarations issued in 2001, 2007, 2016, and 2017. One example from 2017, the collapse of Breidel Coulee Rd in the Town of Shelby, is shown in Figure 4. Storm damage to roads and bridges in La Crosse County were estimated at over $1.5M.

Fifteen flood events occurred in Houston County during the same time period (one in La Crescent in the planning area) and 34 events occurred in Winona County (none in Dresbach in the planning area).

Figure 6: Washout of Breidel Coulee Rd, Town of Shelby, La Crosse County, July 2017. Source: La Crosse County Emergency Management.

TEMPERATURE

According to the EPA, Minnesota's temperature has increased 1°F-3°F over the past century, with northern Minnesota warming twice as much as southern Minnesota. Most of Wisconsin has warmed about 2°F.

The annual average temperature trend shown in Figure 7 has the Midwest trending higher, with the greatest temperature increases occurring in the northern climate divisions of Minnesota (2.92°F in north-central division), Wisconsin (2.29°F in northeast division), and Michigan (3.84°F in northwest division south of the Upper Peninsula).

The climate divisions for the planning area are trending at an increase of 1.53°F for the Minnesota division and at 1.56°F for the Wisconsin division.

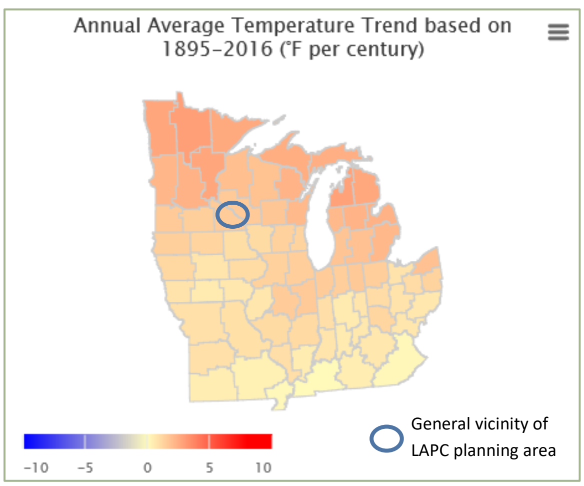

Figure 7: Annual average temperature trend in the Midwest by climate division for 1895-2016 as degrees Fahrenheit per century. Source: cli-MATE, Midwestern Regional Climate Center. Illinois State Water Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign. http://mrcc.illinois.edu/CLIMATE; accessed on: 16/06/2018.

The annual average temperature projected for the Midwest (Figure 8) is expected to increase from a low of 3.57°F in west-central Minnesota to a high of 4.24°F in west-central Illinois. The climate divisions for the planning area (general vicinity circled in blue) are projected to experience average annual temperature increases of 3.64°F (Wisconsin division) and 3.66°F (Minnesota division).

The future change in temperature shown in Figure 8 suggests even greater temperature impacts when compared to the annual average temperature trend shown in Figure 7 where the temperatures are already trending higher along the Great Lakes.

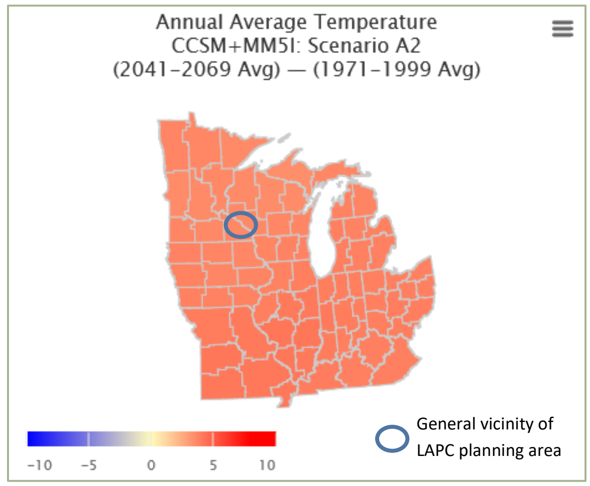

Figure 8: Difference in annual average temperature between the future and current averages for the Midwest by climate division. Source: cli-MATE, Midwestern Regional Climate Center. Illinois State Water Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign. http://mrcc.illinois.edu/CLIMATE; accessed on: 16/06/2018.

EXTREME HEAT EVENTS

The U.S. Global Change Research Program reports in *Climate Change Impacts in the United States* that the Midwest will experience increased heat wave intensity and frequency and increased humidity. The Midwest Economic Policy Institute in its report, *Climate Change and Its Impact on Infrastructure Systems in the Midwest*, states that "increased heat will reduce the life of asphalt, add stress to expansion joints for bridges and highways, cause pavements and railways to buckle, and affect aircraft performance."

MINNESOTA AND WISCONSIN EXTREME HEAT EVENTS

The same system that ushered in the heavy rains in northeast Minnesota and northwest Wisconsin on June 16 and 17 sent temperatures soaring into the 90's with high humidity and breaking high temperature records throughout the Midwest. Figure 9 from the MRCC illustrates the maximum temperature for the 24-hour period ending the morning of June 18, 2018. You can see by the temperature gradient where the cold front sits across Minnesota and Wisconsin

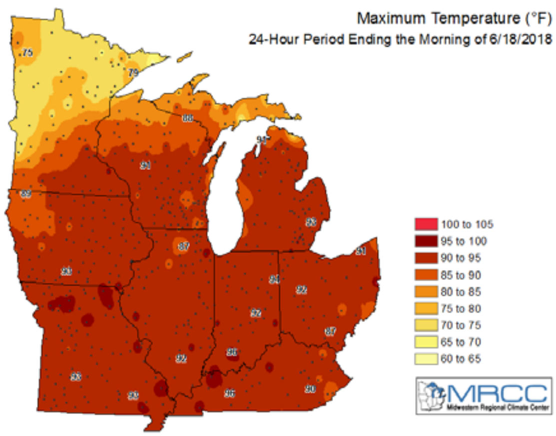

Figure 9: Maximum temperature for the 24-hour period ending the morning of June 18, 2018 for the Midwest. Source: cli-MATE, Midwestern Regional Climate Center. Illinois State Water Survey, Prairie Research Institute, University of Illinois at Urbana-Champaign. http://mrcc.illinois.edu/CLIMATE; accessed on: 21/06/2018.

Several days of 90°F-and-higher temperatures in Minnesota in June of 2016 caused roads to buckle all over the state. Buckles, often called "blow-ups," occur during extended periods of high temperature when two sections of concrete expand and push against each other, buckling upward. The Minnesota Department of Transportation took the picture in Figure 10 of one of several blow-ups on I-90 that occurred along the interstate.

Figure 10: One of several "blow-ups" that occurred along I-90 in Minnesota in June 2016. Source: Minnesota Department of Transportation.

FOX6NOW.com reported a buckle on USH 41/45 in Milwaukee County in July 2016 (Figure 11) that shut down two lanes of northbound traffic for over five hours as county crews worked to remove the concrete slabs and fill the space with hot asphalt.

Figure 11: Buckle on USH 41/45 in Milwaukee County, July 27, 2016. Source: FOX6NOW.com.

LOCAL EXTREME HEAT EVENTS

According to the National Weather Service, La Crosse averages two to five degrees warmer than other cities in Wisconsin because it is closer to the warmer weather of the plains states and farther away from the cooler weather of the Great Lakes. During a typical summer, La Crosse experiences 17 days (1981-2010) where the temperatures reach or exceed 90°F, averaging 4 in June, 7 in July, and 5 in August.

The Wisconsin State Climatology Office charted the number of days with temperatures equal to or exceeding 90°F per year from 1938-2017 for the La Crosse Airport. The data from this chart are reproduced in Figure 12 for 1960-2017. The trend line for this time period shows how the number of 90-degree-days is slowly increasing over time.

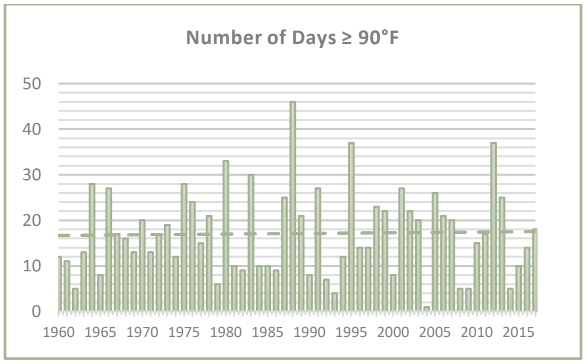

Figure 12: Number of 90-degree-days at the La Crosse Airport, 1960-2017. Data source: Wisconsin State Climatology Office, http://www.aos.wisc.edu/~sco/clim-history/stations/lse/LSE-ap-90degdays-ann.gif.

The weekend of the extreme rainfall event discussed under the section on precipitation also experienced some of the highest temperatures recorded in the La Crosse area. On Saturday, June 16, 2018 and Sunday, June 17, 2018 the La Crosse Regional Airport tied or broke three temperature records for those days as illustrated in Figure 9 from WKBT News8000.

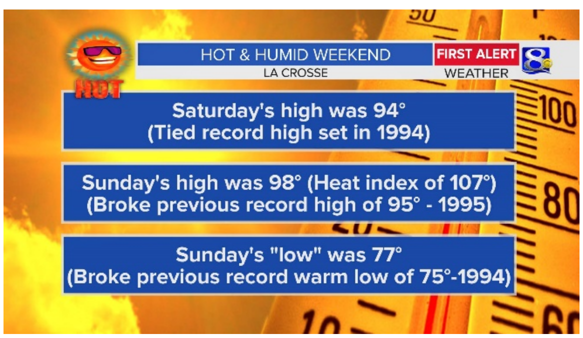

Figure 13: Record highs for June 16 and June 17, 2018. Source: News 8000 First Alert Weather.

WHAT DOES THIS MEAN FOR US?

Trends are showing that our area is warming and that we are experiencing more frequent and severe heavy rainfall and heat events.

For example, Figure 14 shows the costs to La Crosse County for 2013-2017 on emergency repairs from blow-ups (buckles) and flooding on State and County roads and bridges[2] in La Crosse County. Over 95% of the costs were attributable to flood damage from only two storm events (one each in 2016 and 2017). The effects of extreme heat events are significantly less costly, but they tend to occur annually.

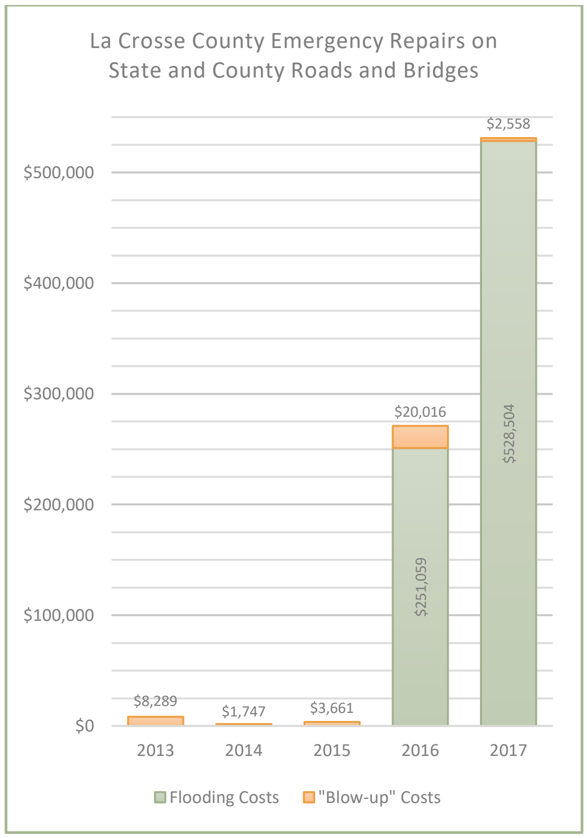

Figure 14: Costs to La Crosse County for flood and "blow-up" repairs to State and County roads and bridges. Source: La Crosse County Highway Department.

[2] Excludes County facilities that have been turned over to the local municipality and State connecting highways (State roads within a city or village).

SECTION 3: INVENTORY AND ASSESSMENT OF ROAD AND RAIL INFRASTRUCTURE

INVENTORY OF ROAD STRUCTURES & ROADS

The LAPC planning area has 174 bridges, 22 culverts, and more than 1,128 miles of roads. Road structures like bridges allow for roads to travel over large barriers like rivers, valleys, railroads, and other roads. Road structures like culverts allow for smaller barriers like brooks and streams to flow under the road. Table 1 summarizes the number of bridges and culverts (road structures) and the centerline miles of roads by their highest class of highway type: Interstate (IH), U.S. (USH), State (STH), County (CTH), local, or private/access.

Just under half (96 or 49.0%) of the road structures in the planning area carry Interstate, U.S., and State highways (14 carry more than one highway type: 4 carry IH and USH, 9 carry USH and STH, and 1 carries IH and local road). The States (Minnesota and Wisconsin) own 99 road structures (91 bridges and 8 culverts), including six that carry a County highway, one that carries a local road, and two that carry access roads. Four of the bridges span the Minnesota-Wisconsin State Line, with each state bearing 50 percent of the responsibility for maintaining the structure.

The Counties own 47 road structures (38 bridges and 9 culverts), with La Crosse County owning 41, Vernon County owning 1, Houston County owning 5, and Winona County owning none. Local municipalities (cities, villages, and towns) own the balance of the road structures in the planning area (45 bridges and 5 culverts), including five that carry U.S. and/or State highways.

Local municipalities maintain the majority of roads at 688 centerline miles of local roads—61.0% of all centerline miles—followed by counties with nearly 187 miles or 16.6% of all miles.

Under intergovernmental agreements, the State-owned facilities in the Wisconsin portion of the planning area are maintained by either the County or a local municipality. The Minnesota-owned facilities are maintained by the Minnesota Department of Transportation (MnDOT).

Table 1: LAPC Planning Area Road Structures and Centerline Miles by Highway Type

Highway Type	Road Structures*	Centerline miles
Interstate	33	49.34
U.S.	36	72.75
State	27	74.35
County	55	186.89
Local	43	688.25
Private/Access	2	56.71
Total	196	1,128.29

***Road structures include bridges and culverts.**

***Sources:* National Bridge Inventory (NBI); LAPC and La Crosse County GIS.**

With the local governments in Wisconsin agreeing to maintain facilities owned by the Wisconsin Department of Transportation (WisDOT), the cost for routine maintenance (i.e. snow plowing) and emergency repairs is reimbursed to the maintaining entity. Addressing the upfront and likely unbudgeted expense of emergency repairs for such severe and unpredictable weather events like heavy rains and flooding can be challenging, however.

CONDITION OF ROAD STRUCTURES & ROADS

The National Bridge Inventory (NBI) provides the source of condition information for the road structures (bridges and culverts) in the planning area. The data used here were downloaded from the Bridges & Structures page of the Federal Highway Administration's (FHWA) website and represent structure conditions in 2017.

Pavement condition information for the Interstate and the National Highway System was provided by the Wisconsin and Minnesota DOTs and sourced from the Highway Performance Monitoring System (HPMS). The data represent pavement conditions in 2016. With the exception of La Crescent, MN, condition information for the roads under local jurisdiction came from the WisDOT as extracted from the Wisconsin Information System for Local Roads (WISLR) database. These data represent conditions in 2017.

CONDITION OF ROAD STRUCTURES

Extreme weather events can undermine the integrity of any structure, but they can especially take advantage of compromised structures, resulting in real safety concerns. To assess the vulnerability of road structures to extreme weather events, the structures are evaluated on their:

- **Superstructure condition.** This describes the physical condition of all structural members of a bridge. It, along with substructure condition, determines a bridge's structural adequacy and safety rating.
- **Substructure condition.** This describes the physical condition of piers, abutments, piles, fenders, footings, and other components. It, along with superstructure condition, determines a bridge's structural adequacy and safety rating.
- **Deck condition.** This applies only to bridges.
- **Channel and channel protection.** This describes the physical conditions associated with the flow of water through the bridge or culvert such as stream stability, and the condition of the channel, riprap, slope protection, or stream control devices, including spur dikes.
- **Culvert condition.** This item evaluates the alignment, settlement, joints, structural condition, scour, and other items associated with culverts.

Although other conditions of road structures are included in the NBI, the aforementioned conditions are most relevant to the ability of a structure to withstand extreme weather events.

STRUCTURE CONDITION

The physical condition of the superstructure and substructure affect the structural adequacy and safety of a structure. If members of the physical structure are compromised from wear and aging or from previous weather events, the structure may be at risk of collapse.

Table 2 reports the number of road structures by structure condition and ownership for the structures in the planning area. Structures are categorized as "good," "fair," or "poor" as determined by the lowest NBI rating from the superstructure and substructure ratings for bridges or from the culvert rating for culverts. (See Appendix A for the NBI condition ratings and how they're categorized.)

Of the 196 structures reported in the 2017 NBI, 5 (4 bridges and 1 culvert) or 2.6% of structures are rated as "poor," 67 (54 bridges and 13 culverts) or 34.2% are rated as "fair," and 124 (116 bridges and 8 culverts) or 63.3% are rated as "good." No structures are failing. Most of the State- and city/village/town-owned structures are in good condition (69.7% and 72.0%, respectively); whereas, most of the County bridges are in fair condition (51.1%). La Crosse County does, however, own 80% of the structures in poor condition.

Table 2: Structure Condition by Ownership, 2017

Structure Condition	State	County	City/Village/ Town
Good	69	19	36
Fair	30	24	13
Poor	0	4	1
Total	99	47	50

***Source:* National Bridge Inventory, 2017.**

Table 3 identifies the five road structures whose structural condition is rated poor or worse in the 2017 NBI. Four of the five structures in poor condition are owned by La Crosse County (B320099, rated in serious condition, was replaced in 2017); the fifth (P320923) is owned by the Town of Onalaska.

Table 3: Road Structures with Poor Structural Condition

Structure Number	Description
B320010	CTH M over Mormon Creek (bridge)
B320099	CTH B over Bostwick Creek (bridge)
P320055	CTH D over Halfway Creek (bridge)
P320100	CTH M over Halfway Creek (bridge)
P320923	Mohican Rd over Sand Lake Coulee Creek (culvert)
Source: National Bridge Inventory, 2017.	

DECK CONDITION

The deck condition rating refers to the condition of the bridge deck with respect to cracking, scaling, spalling, leaching, chloride contamination, potholing, delamination, and full or partial depth failures for concrete decks; broken welds, broken grids, section loss, and growth of filled grids from corrosion for steel grid decks; and splitting, crushing, fastener failure, and deterioration from rot for timber decks.

Table 4 identifies the five road structures (all bridges) that have poor deck conditions. The first two (B320038 and B320069) are owned by the State of Wisconsin; the other three are owned by La Crosse County (B320099 is rated in serious condition). Bridge P320098 is programmed in the regional transportation improvement program (TIP) for replacement at a yet-to-be-disclosed date; bridge B320099 was replaced in 2017. All of the bridges are proposed in the NBI for replacement because of substandard load carrying capacity or substandard bridge roadway geometry.

Table 4: Bridge Structures with Poor Deck Condition

Structure Number	Description
B320038	USH 53 S over STH 35
B320069	CTH C over CTH B and CP railroad
B320099	CTH B over Bostwick Creek
P320077	CTH NN over Mormon Creek
P320098	CTH V over Long Coulee Creek
Source: National Bridge Inventory, 2017.	

CHANNEL AND CHANNEL PROTECTION

With poor channel condition, four of the road structures—two culverts and two bridges—would be highly susceptible to a flooding event. They have bank protection that is being eroded, the river control devices and/or embankment have major damage, and trees and brush restrict the channel (rate code 5). These structures are listed in Table 5. None of the road structures are rated lower than a 5.

As reported in the previous section on deck condition, structure P320098 CTH V over Long Coulee Creek, which also possesses a deck in poor condition and a structure in fair condition, is programmed in the TIP for replacement.

Table 5: Road Structures with Poor Channel and Channel Protection Condition

Structure Number	Description
B320095	Casberg Coulee Rd over Long Coulee Creek (culvert)
B320104	CTH OT over Sand Lake Creek (culvert)
B320161	CTH DH Main St over Halfway Creek (bridge)
P320098	CTH V over Long Coulee Creek (bridge)
Source: National Bridge Inventory, 2017.	

SUMMARY OF CONDITION OF ROAD STRUCTURES

Table 6 summarizes the road structures that have been identified as being in poor condition for structure, deck, and/or channel and channel protection. Bridge B320099, which is rated in serious condition for both structure and deck in the 2017 NBI, was replaced in 2017 (not reflected in the 2017 NBI dataset).

As of the 2019-2022 TIP, none of the other structures rated "poor" for structure have been programmed for replacement. P320098, which is rated poor for deck condition and channel and channel protection condition (and fair for structure), is programmed for bridge replacement at an undetermined future date.

Table 6: Summary of Road Structures with Poor Conditions

Structure Number	Structure Type	Conditions Rated Poor
B320010	Bridge	Structure
B320038	Bridge	Deck
B320069	Bridge	Deck
B320095	Culvert	Channel/Protection
B320099*	Bridge	Structure; deck
B320104	Culvert	Channel/Protection
B320161	Bridge	Channel/Protection
P320055	Bridge	Structure
P320077	Bridge	Deck
P320098	Bridge	Deck; Channel/Protection
P320100	Bridge	Structure
P320923	Culvert	Structure

*Bridge replaced in 2017.

Source: National Bridge Inventory, 2017.

CONDITION OF ROADS

Road condition is evaluated by road pavement condition, which is rated by its lowest rating for degree of roughness, rutting, faulting, and cracking.

As discussed earlier, the DOTs use HPMS to rate Interstate and NHS facilities. Other roadway facilities are rated through the PACER system.

The HPMS provides data that reflect the extent, condition, performance, use, and operating characteristics of the Nation's highways. It includes limited data on all public roads, more detailed data for a sample of the arterial and collector functional systems, and certain statewide summary information. Because the data are limited, not all roads or even all segments of roads in the planning area are rated.

The PASER rating system is the predominant pavement rating system used in Wisconsin. The data are managed through the WISLR data management tool. Municipalities and counties are required to submit pavement ratings to the WisDOT every two years by editing directly within WISLR online, sending a file of rating updates electronically or by mail, or by filling out paper forms. The City of La Crescent, MN also uses the PASER rating system to rate its own roads.

PAVEMENT CONDITION

Figure 17 illustrates the road structures rated as "poor" discussed in the previous sections and the road pavements rated as "poor," "very poor," or "failed" (all categorized as "poor") by the most recent year data were available for use in this assessment (2017 for NBI, 2017 for WISLR, 2016 for HPMS, and 2015 for the City of La Crescent).[3] The figure shows the structures and pavements alongside flood hazard areas and steep slopes to help identify compromised infrastructure that is

[3] The extensive list of local roads identified as having poor pavement is provided in Appendix B. Segments that have been or are currently being resurfaced, rehabilitated, or reconstructed in 2018 are identified with an asterisk.

highly vulnerable to flooding, slope failures, and mud slides.

Over 65 lane miles of roads in the planning area are rated to be in "poor" condition—nearly 49 miles of local roads (includes County roads) and nearly 17 miles of State and Federal roads. Road segments for local roads in poor condition that could be impacted by flood hazard areas are highlighted in Appendix B.

INVENTORY OF RAIL STRUCTURES & LINES

The planning area for the LAPC includes rail lines owned by the freight railway companies Burlington Northern and Santa Fe (BNSF) and Canadian Pacific (CP). Passenger rail service provided by Amtrak also occurs on CP rail.

As illustrated in Table 7, the planning area includes nearly 100 miles of track used by BNSF, CP, or local industry for the transport, transfer, and temporary storage of commodities. Nearly 61 miles of track is owned by BNSF, with an additional half-mile of track used for local industry. BNSF's Heileman Spur serves City Brewing, Gundersen Health System, Pepsi Cola Bottling, and Trane Co.

Over 35 miles of track is within CP right-of-way, with an additional two-thirds of a mile devoted to sidings and spurs for Midwest Industrial Fuels, Hydrite Chemical, Waste Management, F. J. Robers (transload facility), River Steel, and Select Trusses.

The BNSF and CP rail yards reside in north La Crosse in an area known as Grand Crossing. They are illustrated in Figure 18.

Table 7: Estimated Track Miles for Railroads Operating in the Planning Area.

Track	CP (miles)	BNSF (miles)
Main Line	31.86	55.25
Spurs & Sidings	4.94	6.21
Total	36.81	61.45
Source: LAPC and La Crosse County GIS		

CONDITION OF RAIL INFRASTRUCTURE

Because condition of rail infrastructure is unknown (private companies do not make such information public), Figure 18 is limited to illustrating only the location of rail lines and at-grade and grade-separated crossings, and their proximity to flood hazard areas and steep slopes. From projects listed in the TIP and reports in the media, we do know some of the major improvements that have been made in recent years and what damage was inflicted during some of our major storm events.

DAMAGE TO RAIL INFRASTRUCTURE

As illustrated in Section 2, 2016 and 2018 have proven to be destructive years for roads and bridges in Minnesota and Wisconsin as extreme weather events caused blow-ups, washouts, and bridge collapses. Rail infrastructure, too, experienced damage as the result of flooding. The most recent event occurred on August 29, 2018 when BNSF experienced a washout (Figure 15) just south of the planning area near Stoddard in Vernon County.

Figure 15: Crews work to repair washout damage near Stoddard, August 29, 2018. *Source:* Erik Daily, La Crosse Tribune.

In 2016, BNSF experienced a washout and derailment in Ferryville in Crawford County (Figure 16)—just two counties south of and on the same rail line that serves our planning area.

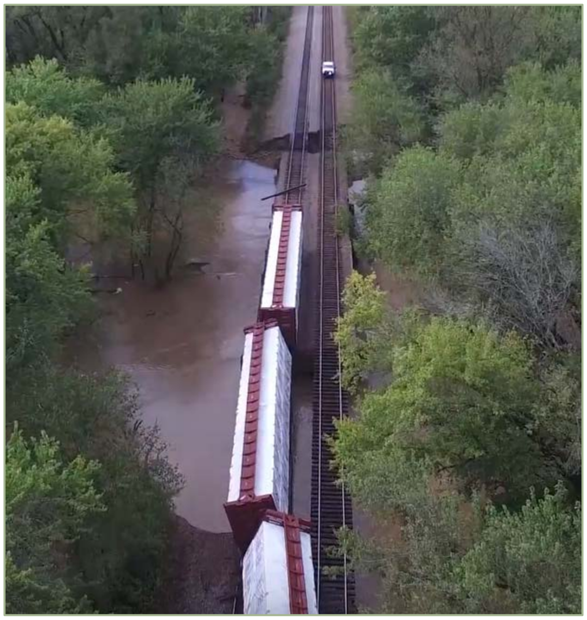

Figure 16: Derailment of BNSF train from washout of bridge over Rush Creek south of Ferryville, WI, September 22, 2016. *Source:* Snapshot from YouTube video, DOT-111.info.

IMPROVEMENTS TO RAIL INFRASTRUCTURE

Major improvements to rail infrastructure in the area have included additional mainline track, sidings, and spurs.

Mainline track was added by BNSF in 2015 with the construction of a second track along a four-mile stretch between Farnam St just north of STH 33 and Grand Crossing in north La Crosse. The project removed over six acres of wetland to alleviate a bottleneck of single-track between two segments of double-track.

CP added a third track between the Black River and its switch yard in 2015 to increase switching capacity and to allow trains to pass more freely on its Chicago-Twin Cities corridor.

Although the purpose for the improvements was to improve train capacity, upgraded infrastructure can help protect against or reduce the severity of damage from extreme weather events. In the case of the BNSF expansion, however, the loss of wetlands also means the loss of wetland capacity to deal with extreme rain events.

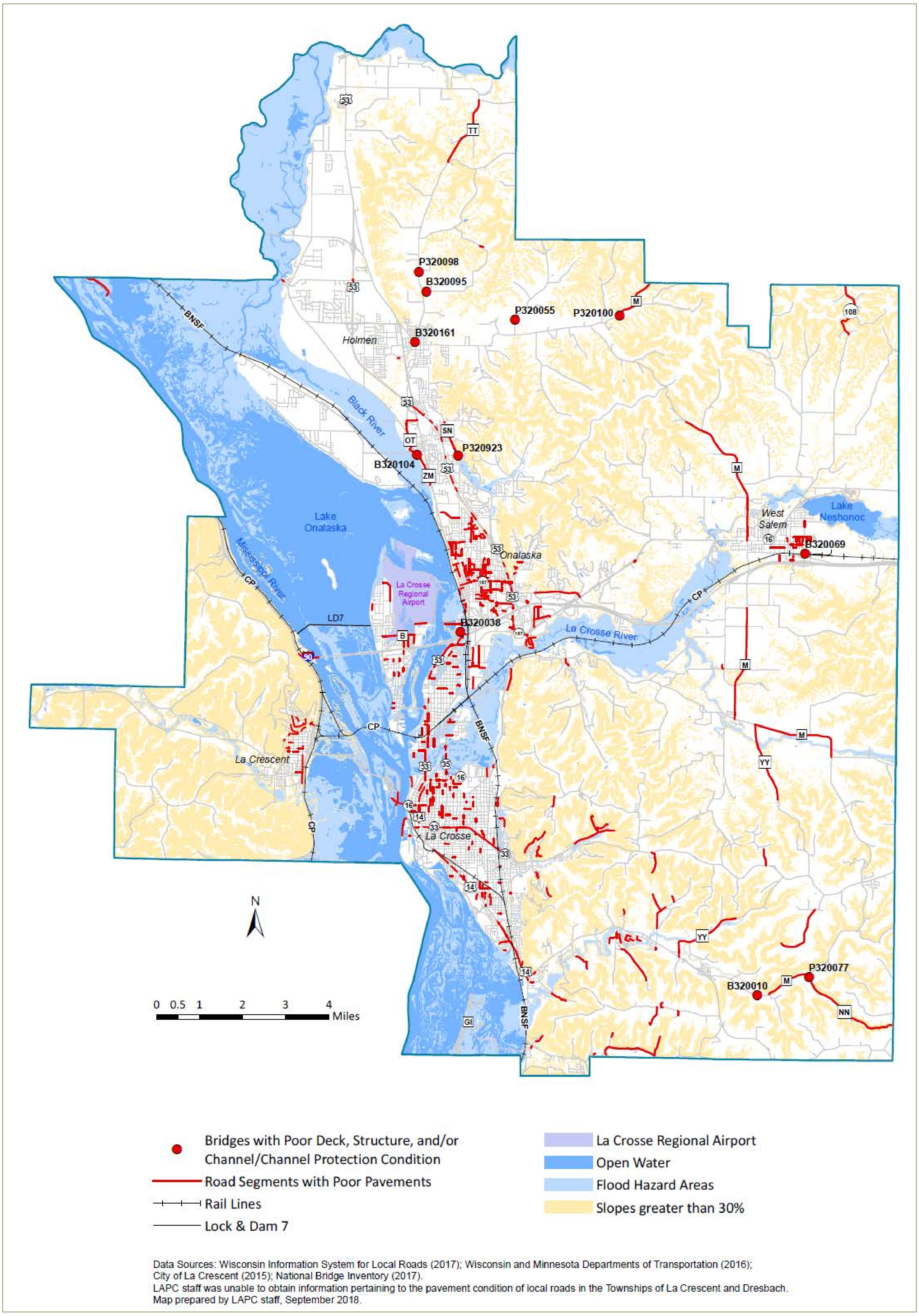

Figure 17: Road structures and pavements in "poor" condition.

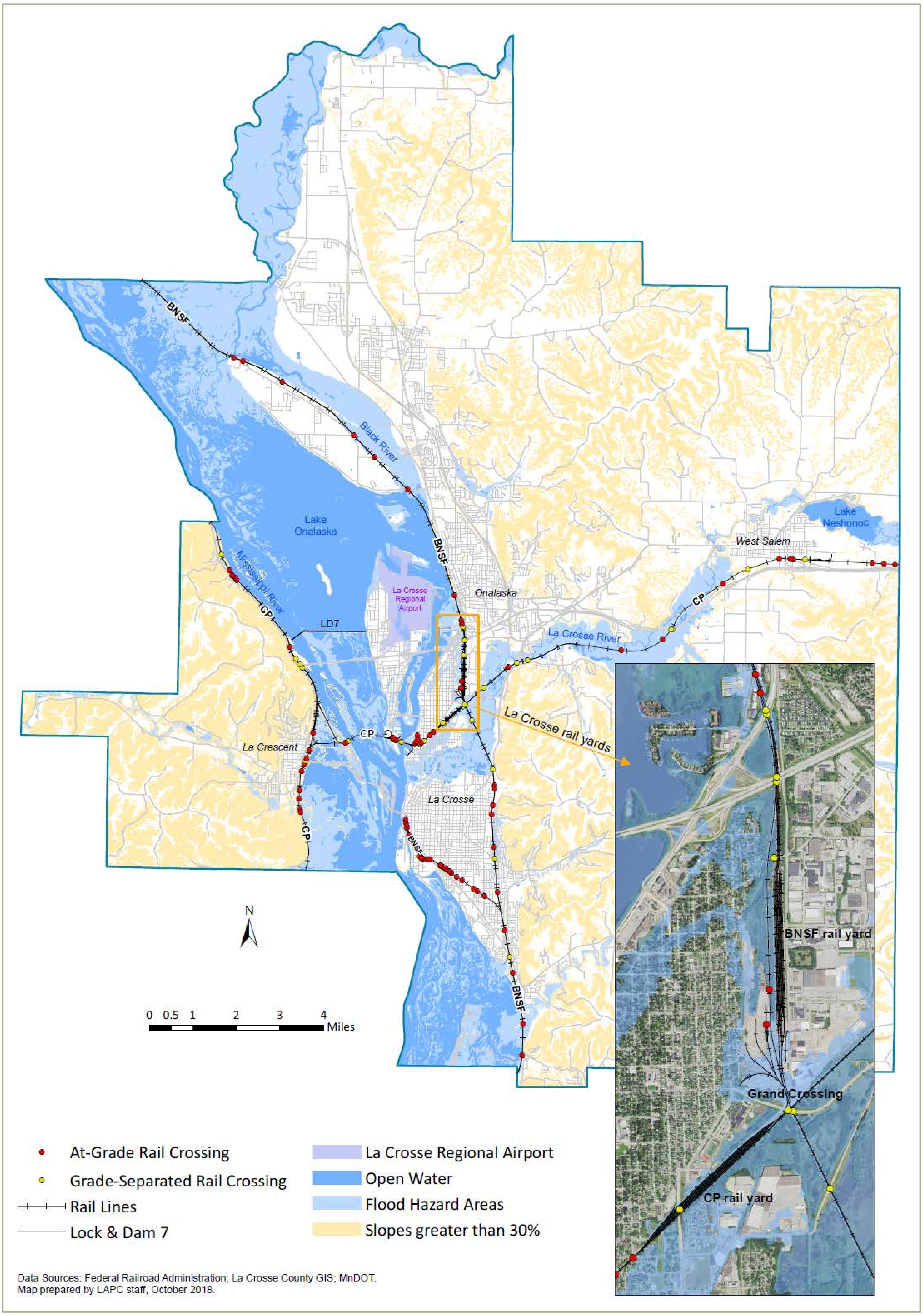

Figure 18: Inventory of rail infrastructure and crossings

SECTION 4: WEATHERING CLIMATE CHANGE

SUMMARY OF NEGATIVE IMPACTS

As illustrated in the previous sections, extreme weather events can negatively impact the physical condition of existing transportation infrastructure.

Extreme heat reduces the life of asphalt and adds stress to expansion joints, causing pavements and rails to buckle. Extreme rain events causes flooding, which weakens structural supports for bridges; promotes deterioration of soil that supports roads, tunnels, and bridges; shortens the life-expectancy of pavement; and increases sedimentation in water channels. Extreme weather events will also exacerbate the more frequent freeze-thaw cycles common to the Midwest, adding stress to pavements.

Those physical damages in turn can impact the safety of residents and the traveling public as well as impact the economy.

Figure 19 illustrates a range of negative impacts from extreme weather events by increasing magnitude. At the lowest level of impact, only transportation infrastructure is affected—no one has been hurt and the major movement of goods has not been disrupted. An example of this would be the flood damage incurred in 2017 by a large drainage structure running under STH 157 in Onalaska. Work to repair the structure was funded with Emergency Relief funds. If this structure had not been repaired in a timely manner as it was, the damage would worsen, posing a safety hazard to the traveling public using this section of STH 157.

As the magnitude of the impact increases, the flow of goods is disrupted and product may be lost, resulting in additional costs both immediate (i.e. shipper; receiver) and downstream (i.e. consumers). The events discussed previously in the section on damage to rail infrastructure illustrate the impact to BNSF freight service from washouts and their resultant derailments.

The most severe impacts are those that threaten human safety. The potential threat to safety occurs when populated areas have only one or two access/egress points (i.e. Brice Prairie, Town of Onalaska and Rivercrest Village, La Crosse) and, for example, a train derails or a bridge collapses, isolating the population from emergency services. The most extreme consequences occur when there are injuries or loss of life like those reported in the discussion of Minnesota and Wisconsin Rain Events in Section 2.

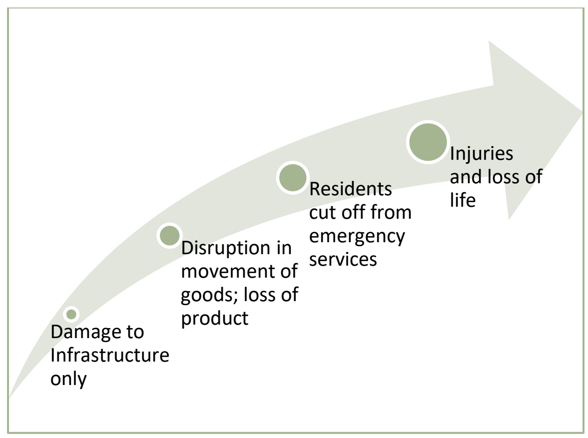

Figure 19: Range of negative impacts from extreme weather events by increasing magnitude.

ADAPTATION AND MITIGATION STRATEGIES

According to the Environmental Protection Agency (EPA), burning fossil fuels like gasoline and diesel releases carbon dioxide into the atmosphere. The buildup of this and other greenhouse gases is causing the Earth's atmosphere to warm, resulting in the climate changes and the extreme weather events discussed in this report.

The transportation sector was responsible for the largest portion (28%) of total U.S. GHG emissions in 2016 and experienced the greatest absolute increase in emissions than any other sector (1990-2015). Within the transportation sector in 2016, light-duty vehicles were responsible for 60% of the emissions, with medium- and heavy-duty trucks coming in a distant second at 23%. Aircraft contributed 9%; rail, 2%; ships and boats, 2%; and buses, motorcycles, pipelines, and lubricants collectively contributed 4%.

The National Aeronautics and Space Administration (NASA) recommends a two-prong approach to responding to climate change:

1. Adapting to the climate change already occurring; and,
2. Reducing emissions of and stabilizing the levels of heat-trapping greenhouse gases like carbon dioxide in the atmosphere.

ADAPTATION STRATEGIES

Adaptation strategies involve reducing our vulnerability to the harmful effects of climate change. Such strategies might include building flood defenses, installing water-permeable pavements, and improving water storage through wetland protection and stormwater drainage facilities like ditches, swales, and ponds.

Adaptation strategies can build resiliency to the effects of climate change, but will not, however, affect the contribution the transportation sector is making to climate change. This requires developing strategies that mitigate the emission of greenhouse gases.

MITIGATION STRATEGIES

Mitigation strategies involve actively reducing the release of greenhouse gas emissions. Through transportation planning and policies, we can reduce the impact transportation has on the atmosphere through such objectives as reducing single-occupancy vehicles and vehicle miles traveled, providing additional and improving existing networks for non-motorized travel, improving transit service, encouraging the purchase of fuel-efficient vehicles, and shifting the movement of commodities from truck to rail or barge.

CONCLUSION AND RESOURCES

Although this assessment only completed the first four steps of the Framework, it should instill an awareness that climate change is real and it has a significant impact on our transportation infrastructure. LAPC staff recommends that our local municipalities conduct their own assessment, using the Framework as a guide, to build resiliency and sustainability into their own development, construction, and maintenance practices. A few online resources that can aid in the process include:

- *Climate Change Adaptation Guide for Transportation Systems Management, Operations, and Maintenance*, FHWA.
- Government Resources, NASA.
- Policy and Guidance for State and Local Transportation, EPA.

As the long-range transportation planning agency for the urbanized area, the LAPC is committed to incorporating climate change considerations and adaptation and mitigation strategies into the update of its long-range transportation plan, which is scheduled for completion and adoption in September 2020.

APPENDIX A: CONDITION RATINGS

The National Bridge Inventory (NBI) uses the following codes to rate superstructure, substructure, and deck conditions:

Code	Description
N	Not Applicable.
9	Excellent Condition.
8	Very Good Condition—no problems noted.
7	Good Condition—some minor problems.
6	Satisfactory Condition—structural elements show some minor deterioration.
5	Fair Condition—all primary structural elements are sound, but may have minor section loss, cracking, spalling, or scour.
4	Poor Condition—advanced section loss, deterioration, spalling, or scour.
3	Serious Condition—loss of section, deterioration, spalling or scour have seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
2	Critical Condition—advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored, it may be necessary to close the bridge until corrective action is taken.
1	“Imminent” Failure Condition—major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic but corrective action may put back in light service.
0	Failed Condition—out of service—beyond corrective action.

For discussion purposes, the ratings were grouped into categories for “poor” (0-4), “fair” (5-6), and “good” (7-9). These categories are consistent with those the Minnesota and Wisconsin Departments of Transportation use to rate their bridges and structures.

The NBI uses the following codes to rate channel and channel protection condition:

Code	Description
N	Not Applicable. Use when bridge is not over a waterway (channel).
9	There are no noticeable or noteworthy deficiencies which affect the condition of the channel.
8	Banks are protected or well vegetated. River control devices such as spur dikes and embankment protection are not required or are in a stable condition.
7	Bank condition is in need of minor repairs. River control devices and embankment protection have a little minor damage. Banks and/or channel have minor amounts of drift.
6	Bank is beginning to slump. River control devices and embankment protection have widespread minor damage. There is minor streambed movement evident. Debris is restricting the channel slightly.
5	Bank protection is being eroded. River control devices and/or embankment have major damage. Trees and brush restrict the channel.
4	Bank and embankment protection is severely undermined. River control devices have severe damage. Large deposits of debris are in the channel.

3	Bank protection has failed. River control devices have been destroyed. Streambed aggradation, degradation, or lateral movement has changed the channel to now threaten the bridge and/or approach roadway.
2	The channel has changed to the extent the bridge is near a state of collapse.
1	Bridge closed because of channel failure. Corrective action may put back in light service.
0	Bridge closed because of channel failure. Replacement necessary.

For discussion purposes, the ratings were grouped into categories for “poor” (0-5), “fair” (6-7), and “good” (8-9).

The NBI uses the following codes to rate culvert condition:

Code	Description
N	Not Applicable. Use if structure is not a culvert.
9	No deficiencies.
8	No noticeable or noteworthy deficiencies which affect the condition of the culvert. Insignificant scrape marks caused by drift.
7	Shrinkage cracks, light scaling, and insignificant spalling which does not expose reinforcing steel. Insignificant damage caused by drift with no misalignment and not requiring corrective action. Some minor scouring has occurred near curtain walls, wingwalls, or pipes. Metal culverts have a smooth symmetrical curvature with superficial corrosion and no pitting.
6	Deterioration or initial disintegration, minor chloride contamination, cracking with some leaching, or spalls on concrete or masonry walls and slabs. Local minor scouring at curtain walls, wingwalls, or pipes. Metal culverts have a smooth curvature, non-symetrical shape, significant corrosion or moderate pitting.
5	Moderate to major deterioration or disintegration, extensive cracking and leaching, or spalls on concrete or masonry walls and slabs. Minor settlement or misalignment. Noticeable scouring or erosion at curtain walls, wingwalls, or pipes. Metal culverts have significant distortion and deflection in one section, significant corrosion or deep pitting.
4	Large spalls, heavy scaling, wide cracks, considerable efflorescence, or opened construction joint permitting loss of backfill. Considerable settlement or misalignment. Considerable scouring or erosion at curtain walls, wingwalls, or pipes. Metal culverts have significant distortion and deflection throughout, extensive corrosion or deep pitting.
3	Any condition described in Code 4 but which is extensive in scope. Severe movement or differential settlement of the segments, or loss of fill. Holes may exist in walls or slabs. Integral wingwalls nearly severed from culvert. Severe scour or erosion at curtain walls, wingwalls, or pipes. Metal culverts have extreme distortion and deflection in one section, extensive corrosion, or deep pitting with scattered perforations.
2	Integral wingwalls collapsed, severe settlement of roadway due to loss of fill. Section of culvert may have failed and can no longer support embankment. Complete undermining at curtain walls and pipes. Corrective action required to maintain traffic. Metal culverts have extreme distortion and deflection throughout with extensive perforations due to corrosion.
1	Bridge closed. Corrective action may put back in light service.
0	Bridge closed. Replacement necessary.

For discussion purposes, the ratings were grouped into categories for “poor” (0-4), “fair” (5-6), and “good” (7-9).

APPENDIX B: ROAD SEGMENTS RATED IN POOR OR FAILING CONDITION

The following list of road segments includes all of the segments listed in the 2017 WISLR for local roads or the 2016 HPMS for State and Federal roads as having "poor," "very poor," or "failed" pavements. Roads identified with an asterisk are known to have had some or all of the segment resurfaced, rehabilitated, or reconstructed in 2018, but it is likely that not all segments have been identified. Roads with segments that could be impacted by flood hazard areas are highlighted.

Jurisdiction	Road	From	To
West Salem (V)	East Ave	Mill St	Quinn Ave
West Salem (V)	Franklin St	Leonard St	Mill St
West Salem (V)	Franklin St	Rose St	Dead end
West Salem (V)	Garland St	Termini	West Ave
West Salem (V)	Hamilton St	Rose St	Mill St
West Salem (V)	Hamilton St	Harmony St	West Ave
West Salem (V)	Heritage Ln	Crossover STH 16	CTH MW
West Salem (V)	Lincoln Ave	East Ave	CTH C/Garland St
West Salem (V)	Mark St	Hamlin St	Tilson St
West Salem (V)	Mill St	CTH B/Jefferson St	82 ft S of Jefferson St
West Salem (V)	Neshonoc Rd	East Ave	CTH C/Garland St
West Salem (V)	Oak Ave	CTH B/Jefferson St	Dead end
West Salem (V)	Quinn Ave	Garland St	East Ave
West Salem (V)	Rays Pl	Neshonoc Rd	Quinn Ave
West Salem (V)	Rhyme St	Mill St	118 ft W of Mill St
West Salem (V)	Rose St	East Ave	CTH C/Garland St
West Salem (V)	Van Ness St	East Ave	CTH C/Garland St
West Salem (V)	Youlan St	Garland St	137 ft N of Garland St
Holmen (V)	Hollis St	South Star Rd	Dead end
La Crosse (C)	10th St N	Badger St	Pine St
La Crosse (C)	10th St S	Division St	Ferry St
La Crosse (C)	11th St N	Vine St	State St
La Crosse (C)	11th St S	Cass St	Market St
La Crosse (C)	12th St N	Badger St	Dead End S
La Crosse (C)	13th St N	Pine St	Vine St
La Crosse (C)	14th St N	State St	Main St
La Crosse (C)	14th St N	Farwell St	Badger St
La Crosse (C)	15th St S	Jackson St	Johnson St
La Crosse (C)	17th St N	State St	Main St
La Crosse (C)	17th St S	Winnebago St	Mississippi St
La Crosse (C)	17th St S	Thompson St	South Ave
La Crosse (C)	17th St S	Ferry St	Market St

Jurisdiction	Road	From	To
La Crosse (C)	19th St S	Redfield St	Green Bay St
La Crosse (C)	20th St S	Mormon Coulee Road	Dead-end S
La Crosse (C)	20th St S	Park Ave	Denton St
La Crosse (C)	20th St S	Main St	Cass St
La Crosse (C)	21st St S	State Rd	Adams St
La Crosse (C)	21st St S	Market St	Winnebago St
La Crosse (C)	21st Terr	Ward Ave	Garden St
La Crosse (C)	22nd Dr*	Johnson St	State Rd
La Crosse (C)	22nd St S	Victory St	Dead-end S
La Crosse (C)	22nd St S	Green Bay St	Hyde Ave
La Crosse (C)	22nd St S	Diagonal Rd	Garden St
La Crosse (C)	23rd St S	Victory St	Dead-end S
La Crosse (C)	24th St N	Park Dr	La Crosse St
La Crosse (C)	25th St S	Hewitt St	Hass St
La Crosse (C)	25th St S	Hass St	Highland St
La Crosse (C)	26th St S	Farnam St	Dead-end S
La Crosse (C)	28th St S	W Fairchild St	E Fairchild St
La Crosse (C)	28th St S	Main St	Cass St
La Crosse (C)	6th St N *	Vine St	State St
La Crosse (C)	7th St S*	Cass St	Division St
La Crosse (C)	8th St N	Pine St	State St
La Crosse (C)	8th St S	Main St	Cass St
La Crosse (C)	9th St N	Zeisler St	Grove St
La Crosse (C)	Airport Rd	Lakeshore Dr	Breezy Point Rd
La Crosse (C)	Avon St	Gould St	Monitor St
La Crosse (C)	Badger St	14th St	End of public street
La Crosse (C)	Barlow St	15th St	14th St
La Crosse (C)	Birch St	29th St	28th St
La Crosse (C)	Buchner Pl	Copeland Ave	Milwaukee St
La Crosse (C)	Cameron Ave	19th St	17th St
La Crosse (C)	Car St	Copeland Ave	Sumner St
La Crosse (C)	Cliffwood Ln	29th St	Jackson St
La Crosse (C)	Commerce St	Enterprise Ave	Cunningham St
La Crosse (C)	Copeland Park Dr	Gold St	Clinton St
La Crosse (C)	Cunningham St	Wood St	George St
La Crosse (C)	Denton St	West Ave	Second Alley E
La Crosse (C)	Division St	Front St	Dead-end W
La Crosse (C)	Ferry St	13th St	West Ave
La Crosse (C)	Ferry St	10th St	9th St

Jurisdiction	Road	From	To
La Crosse (C)	Fisherman's Rd	Fanta Reed Rd	Dead-end N
La Crosse (C)	Garden St	Losey Blvd	21st Terr.
La Crosse (C)	George St	Stoddard St	Salem Rd
La Crosse (C)	George St	Wittenberg Pl	Onalaska Ave
La Crosse (C)	Gillette St	Loomis St	Wood St
La Crosse (C)	Gohres St	Credit Union Ct	Onalaska Ave
La Crosse (C)	Hood St	Marco Dr	Isle La Plume Dr
La Crosse (C)	IGA Ct	St James	Dead end
La Crosse (C)	Island St	Loomis St	George St
La Crosse (C)	Joseph Houska Dr	Market St	Isle La Plume Dr
La Crosse (C)	Kraft St	Dead-end N	Dead-end S
La Crosse (C)	Kramer St	Kwik Trip Way	Rublee St
La Crosse (C)	Larson St	Hauser St	Palace St
La Crosse (C)	Lauderdale Pl	George St	Lauderdale Ct
La Crosse (C)	Livingston St	Avon St	Caledonia St
La Crosse (C)	Marion Rd N	Mormon Coulee Rd	Robinhood Dr
La Crosse (C)	Marion Rd S	Nottingham Ave	Kings Ct
La Crosse (C)	Market St*	14th St	15th St
La Crosse (C)	Moore St	Onalaska Ave	Dead end E
La Crosse (C)	N Salem Rd	Prospect St	Loomis St
La Crosse (C)	Oakland St	Dead end N	La Crosse St
La Crosse (C)	Old Town Rd	Laurel St	Robil Ct E
La Crosse (C)	Palace St	Onalaska Ave	Loomis St
La Crosse (C)	Palace St	River Valley Dr	Larson St
La Crosse (C)	Palace St	Larson St	Oak St
La Crosse (C)	Park Ln Dr	33rd St	Dead end W
La Crosse (C)	Pettibone Dr S	Pettibone Dr N	505 ft S of Pettibone Dr N
La Crosse (C)	Pine St	9th St	10th St
La Crosse (C)	Pine St	15th St	14th St
La Crosse (C)	Quarry Rd	STH 16	Dead end W
La Crosse (C)	Rublee St	George St	Liberty St
La Crosse (C)	Smith Valley Rd	CTH B	Smith Valley Ct
La Crosse (C)	St Cloud St	Rose St	Copeland Ave
La Crosse (C)	St James St	Winneshiek Rd	Dead-end E
La Crosse (C)	St James St	Rose St	Copeland Ave
La Crosse (C)	Smith Valley Rd	CTH B	84 ft S of Glenwood Pl
La Crosse (C)	Sumner St	Hagar St	Dead-end S

Jurisdiction	Road	From	To
La Crosse (C)	Sunset Ln	STH 16 Frontage Rd	Gillette St
La Crosse (C)	Taylor St	Hamilton St	Onalaska Ave
La Crosse (C)	Thompson St	14th St	13th Pl
La Crosse (C)	Veterans Memorial Dr	E Side of Loop	State St
La Crosse (C)	Wood St	Wall St	St James St
La Crosse (C)	Zion Rd	Dead-end N	Garner Pl
La Crosse County	CTH B/Fanta Reed Rd	Lakeshore Dr	CTH B/Dawson Ave
La Crosse County	CTH B /Dawson Ave	CTH B/Fanta Reed Rd	I90 ramp
La Crosse County	CTH GI	CTH GI	99 ft N of CTH GI
La Crosse County	CTH M	Planning area boundary	Halfway Creek Bridge
La Crosse County	CTH M	Nelson Rd	STH 16
La Crosse County	CTH M	CTH B	CTH O
La Crosse County	CTH M	CTH YY	CTH I
La Crosse County	CTH M	Roessler Rd	CTH NN
La Crosse County	CTH NN	CTH M	Planning area boundary
La Crosse County	CTH OT	STH 35	CTH ZM
La Crosse County	CTH SN	Reef Rd	Laurel Pl
La Crosse County	CTH TT	CTH V	CTH T
La Crosse County	CTH YY	USH 14/61	611 ft E of Schieche Rd
La Crosse County	CTH YY	CTH M	86 ft N of Dummer Valley Dr
La Crosse County	CTH ZM	CTH Z	CTH OT
La Crescent (C)	Beacon Valley Rd	McIntosh Rd E	N to middle of McIntosh Rd
La Crescent (C)	Jonathan Ln	N Elm St	N Elm St
La Crescent (C)	Fireside Dr	N Elm St	McIntosh Rd E
La Crescent (C)	Fireside Ct	Foreside Dr	Dead end
La Crescent (C)	Hillview Blvd	W of N Chestnut St	Riverview Ave
La Crescent (C)	Park St	West side of Loop	N 4th St
La Crescent (C)	N 4th St	McIntosh Rd	N Elm St
La Crescent (C)	N 3rd St	N Hill St	N Elm St
La Crescent (C)	N 1st St	W of west property	Stoney Point Rd
La Crescent (C)	Main St	N Hill St	N Maple St
La Crescent (C)	S 2nd St	S Hill St	Dead end
La Crescent (C)	S Hill St	S 2nd St	Dead end
La Crescent (C)	S 2nd St	S Elm St	S Oak St
La Crescent (C)	S Oak St	S 1st St	S 2nd St
La Crescent (C)	S 3rd St	S Hill St	Dead end
La Crescent (C)	S 3rd St	S Maple St	S Elm St
La Crescent (C)	S Oak St	S 4th St	S 14th St

Jurisdiction	Road	From	To
La Crescent (C)	S 10th St	Cedar Dr	S Oak St
Onalaska (C)	10th Ave N	Well St	Monroe St
Onalaska (C)	10th Ave S	Schafer St	Green St
Onalaska (C)	10th Ct	Quincy St	Dead end
Onalaska (C)	10th Pl	Lake St	Well St
Onalaska (C)	11th Ave N	Pierce St	195 ft S of Pierce St
Onalaska (C)	11th Ave N	Monroe St	Main St
Onalaska (C)	11th Ave N	Lake St	Well St
Onalaska (C)	12th Ave N	Quincy St	Lake St
Onalaska (C)	12th Ave S	Main St	Green St
Onalaska (C)	13th Ave S	Pinecrest Ln	Oak Forest Dr
Onalaska (C)	16th Ave S	Main St	Kingswood Ln
Onalaska (C)	16th Ave S	Cedar Pl	Hickory St
Onalaska (C)	1st Ave	Irvin St	Dead end
Onalaska (C)	2nd Ave SW	12 ft W of 2nd Ave S (STH 35)	Railroad crossing
Onalaska (C)	3rd Ave N	Poplar St	Dead end
Onalaska (C)	4th Ave N	Troy St	Spruce St
Onalaska (C)	4th Ave N	Quincy St	115 ft N of Royal St
Onalaska (C)	5th Ave N	Pearl St	Locust St
Onalaska (C)	6th Ave N	Pearl St	Locust St
Onalaska (C)	6th Ave N	King St	Main St
Onalaska (C)	7th Ave N	Well St	Madison St
Onalaska (C)	8th Ave N	Lake St	Well St
Onalaska (C)	Beech St	2nd Ave SW	Dead end
Onalaska (C)	Bluebird Ct	Pearl St	Dead end
Onalaska (C)	Braund St*	STH 16	65 ft W Lester Ave
Onalaska (C)	Coulee Ct	Ironwood Pl	Dead end
Onalaska (C)	County Road OS/Main St*	Theater Rd	STH 16
Onalaska (C)	County Road PH*	Braund St	STH 16
Onalaska (C)	Elm St	1st Ave S	2nd Ave S
Onalaska (C)	Fairfield St	12th Ave S	60 ft W 12th Ave S
Onalaska (C)	Fairfield Pl	12th Ave S	Dead end
Onalaska (C)	Germann Ct	Pralle Rd	49 ft E Pralle Rd
Onalaska (C)	Green Bay St	9th Ave S	11th Ave S
Onalaska (C)	Green St	10th Ave S	11th Ave S
Onalaska (C)	Greenridge Dr	10th Ave N	Westwood Dr
Onalaska (C)	Grove St	Cliffview Ave	Oak Ave N
Onalaska (C)	Hickory St	10th Ave S	12th Ave S

Jurisdiction	Road	From	To
Onalaska (C)	Hickory St	12th Ave S	16th Ave S
Onalaska (C)	Hoffman Pl*	Young Dr W	Dead end
Onalaska (C)	Hope Ct	Spruce St	Monica Ln
Onalaska (C)	Ironwood Pl	Green Coulee Rd	Dead end
Onalaska (C)	Irvin St	2nd Ave S	3rd Ave S
Onalaska (C)	John St	2nd Ave N	3rd Ave N
Onalaska (C)	Johnson Dr	Wilson St	Lincoln St
Onalaska (C)	King St*	5th Ave N	Oak Ave N
Onalaska (C)	La Crosse St	9th Ave S	11th Ave S
Onalaska (C)	Lake St	12th Ave N	10th Pl N
Onalaska (C)	Lake St	Oak Ave N	8th Ave N
Onalaska (C)	Larch Ave	Pierce St	Monroe St
Onalaska (C)	Lester Ave	Rudy St	County Road PH
Onalaska (C)	Lincoln St*	Johnson Dr	39 ft E of Tillman Dr
Onalaska (C)	Maplewood Pl	Green Coulee Rd	Dead end
Onalaska (C)	Medary Ln	129 ft W Young Dr W	51 ft N 12th Ave S
Onalaska (C)	Medary Ln*	Young Dr E	145 ft W of Young Dr E
Onalaska (C)	Michael Ct	La Crosse St	Dead end
Onalaska (C)	Monica Ln	East Ave N	Hope Ct
Onalaska (C)	Monroe St	Larch Ave	Dead end
Onalaska (C)	Monroe St	11th Ave N	Dead end
Onalaska (C)	Oak Ave N	Riders Club Rd	Troy St
Onalaska (C)	Oak Ave N	Quincy St	Madison St
Onalaska (C)	Oak Forest Dr	17th Ave S	21 ft E of 17th Ave S
Onalaska (C)	Park Ave	Troy St	Royal St
Onalaska (C)	Park Ave W	Troy St	Park Ave
Onalaska (C)	Partridge Dr	Vilas St	Oak Ave N
Onalaska (C)	Parkridge Pl	Oak Ave N	Dead end
Onalaska (C)	Pierce St	Oak Ave N	8th Ave N
Onalaska (C)	Pierce St	10th Ave N	Sand Lake Rd
Onalaska (C)	Pinecrest Ln	12th Ave S	13th Ave S
Onalaska (C)	Pinecrest Ln	Oak Forest Dr	135 ft W of Oak Forest Dr
Onalaska (C)	Placid Ct	Green St	La Crosse St
Onalaska (C)	Poplar St	2nd Ave N	4th Ave N
Onalaska (C)	Pralle Rd	Esther Dr	60 ft N of Esther Dr
Onalaska (C)	Putter Ct	Green Coulee Rd	Dead end
Onalaska (C)	Riders Club Rd*	East Ave N	79 ft E of STH 35
Onalaska (C)	Rosewood Trl	13th Ave S	26 ft E of 13th Ave S

Jurisdiction	Road	From	To
Onalaska (C)	Royal St	West Ave N	East Ave N
Onalaska (C)	Rudy St	Theater Rd	Lester Ave
Onalaska (C)	Schroeder Rd	Crossing Meadows Dr	Dead end
Onalaska (C)	Sunrise Ct	Vilas St	Dead end
Onalaska (C)	Sunset Pl	10th Ave N	Dead end
Onalaska (C)	Terrace Dr	10th Ave N	10th Ave N
Onalaska (C)	Troy St	West Ave	6th Ave N
Onalaska (C)	Vaaler Ct	Quincy St	Dead end
Onalaska (C)	Valley Ct	Dead end	Dead end
Onalaska (C)	Well St	Oak Ave N	11th Ave N
Onalaska (C)	West Ave	Troy St	Royal St
Onalaska (C)	Westwood Dr	Greenridge Dr	Pine St
Onalaska (C)	Wilson St	13th Ave S	Oak Forest Dr
Onalaska (C)	Young Dr E*	Medary Ln	Hoffman Pl
Onalaska (C)	Young Dr W*	Hoffman Pl	Young Dr E
Barre (T)	E Bridge Rd	Swamp Rd	Dead end
Campbell (T)	2nd Ave E	Fanta Reed Rd	Mitchell St
Campbell (T)	Bainbridge Pl	Hinkley Rd	Dead End
Campbell (T)	Bainbridge St	Fanta Reed Rd	Dead end
Campbell (T)	Bainbridge St	Sky Harbour Dr	Dead end
Campbell (T)	Bayshore Dr	Breezy Point Rd	673 ft S of Breezy Point Rd
Campbell (T)	Caroline St	Olivet St	Church Dr
Campbell (T)	Caroline St	Tellin Ct	336 ft N of Tellin Ct
Campbell (T)	La Crescent St	Olivet St	Church Dr
Campbell (T)	Olivet St	Sharon St	Dead end
Campbell (T)	Tellin Ct (2)	Tellin Ct	Tellin Ct
Campbell (T)	Washburn St	La Crescent Pl	La Crescent St
Campbell (T)	William St	La Crescent Pl	La Crescent St
Greenfield (T)	Bahr Rd	STH 33	2,053 ft N of STH 33
Greenfield (T)	Wuensch Rd	Wuensch Rd	Dead end
Holland (T)	Erickson Rd (private)	Dead end	Planning area boundary
Holland (T)	Main St	Jelle St	Dead end
Holland (T)	Lake Rd	Planning area boundary	Dead end
Medary (T)	Pierce Rd	568 ft E of East Plaza Park	777 ft E of East Plaza Park
Shelby (T)	Birchview Rd	Cedar Rd	Paris Angel Dr
Shelby (T)	Birchwood Ln	Willow Way E	Pammel Pass W
Shelby (T)	Bloomer Mill Rd	Kearns Ct	Park Dr W
Shelby (T)	Bloomer Mill Rd	Mormon Dr	5,095 ft E of Mormon Dr

Jurisdiction	Road	From	To
Shelby (T)	Boma Rd	Eagle Point Dr	Dead end
Shelby (T)	Breidel Coulee Rd	Le Jeune Rd	Evergreen Ln
Shelby (T)	Briarwood Ave	Thistledown Dr	Bliss Rd
Shelby (T)	Brickyard Ln	140 ft W of Fireclay Ct	235 ft W of Fireclay Ct
Shelby (T)	Center St	Park Dr	Hoeth St
Shelby (T)	Circle Pl	Bloomer Mill Rd	Dead end
Shelby (T)	Crestview Pl	Hickory Ln	Dead end
Shelby (T)	Crystal Dr	Mill St	Hoeth St
Shelby (T)	Dengel Rd	CTH MM	Dead end
Shelby (T)	Diagonal Rd	Losey Blvd	333 ft E of Losey Blvd
Shelby (T)	Forest Ridge Dr	STH 33	Dead end
Shelby (T)	Glenn Dr	Breidel Coulee Rd	Dead end
Shelby (T)	Gronemus Rd	CTH MM	Dead end
Shelby (T)	Hickory Ln	Wedgewood Dr	Dead end
Shelby (T)	Highland Pl	Red Oaks Dr	Dead end
Shelby (T)	Hoeschler Ct	Bloomer Mill Rd	120 ft E of Bloomer Mill Rd
Shelby (T)	Hoeth St	Crystal Dr	Park Dr
Shelby (T)	Johnson Rd	Chipmunk Rd N	Dead end
Shelby (T)	Joy Ln	Orchard Valley Dr	Dead end
Shelby (T)	Justin Rd	Entrance to Guadalupe Shrine	Dead end
Shelby (T)	Kearns Ct	Bloomer Mill Rd	Dead end
Shelby (T)	Le Jeune Rd	Breidel Coulee Rd	Dead end
Shelby (T)	Mill St	Crystal Dr	Park Dr
Shelby (T)	Mill St	Raatz Rd	Dead end
Shelby (T)	North Chipmunk Rd	R Herold Rd	Johnson Rd
Shelby (T)	Old Highway 35	CTH K	Cotton Wood Dr
Shelby (T)	Old Town Hall Rd	377 ft W of E Helke Rd	Dead end
Shelby (T)	Orchard Valley Dr	Vista Dr	Joy Ln
Shelby (T)	Park Dr W	Bloomer Mill Rd	Dead end
Shelby (T)	Pineview Dr	Sprig St	Dead end
Shelby (T)	R Herold Rd	North Chipmunk Rd	170 ft S of N Chipmunk Rd
Shelby (T)	Raatz Rd	Harvest Ln	Mill St
Shelby (T)	Roesner Rd	CTH MM	503 ft S of CTH MM
Shelby (T)	Rosewood Ln	North Chipmunk Rd	Dead end
Shelby (T)	Skyline Blvd	Hypoint Dr	Dead end
Shelby (T)	Valley Rd	Vista Dr	Dead end
Shelby (T)	Vanity Dr	Lisa Ln	Dead end
Shelby (T)	Vista Dr	Valley Rd	Orchard Valley Dr

Jurisdiction	Road	From	To
Shelby (T)	W Werner Rd	160 ft S of dead end	Dead end
Shelby (T)	Ward Ave	Losey Blvd	373 ft W of Losey Blvd
Shelby (T)	Ward Ave	28th St	Municipal Boundary
Shelby (T)	Willow Way E	Boma Rd	Birchwood Ln
Shelby (T)	Willow Way W	Willow Way E	Willow Way E
Minnesota	IH 90	0.145 mi E of bridge over 61	Merge with USH 14
Wisconsin	USH 53 (segments)	Holmen Dr	STH 157/Main St
Wisconsin	USH 53	STH 157/Main St	IH 90
Wisconsin	USH 53/3rd St	Badger St	State St
Wisconsin	USH 53/4th St	King St	Pine St
Wisconsin	USH 53/Copeland Ave**	La Crosse St	Buchner Pl
Wisconsin	USH 53/Rose St**	Monitor St	St Cloud St
Wisconsin	USH 53/Rose St**	St James St	St Paul St
Wisconsin	USH 53/Rose St**	Logan St	Sill St
Wisconsin	USH 53/Rose St* **	Livingston St	IH 90
Wisconsin	STH 16/La Crosse St**	8th Pl N	West Ave
Wisconsin	STH 16/La Crosse St**	7th St	108 ft E of 7th St
Wisconsin	STH 16/7th St**	Badger St	Vine St
Wisconsin	STH 16/7th St**	324 ft N of King St	Cass St
Wisconsin	STH 16/Cass St* **	USH 14/4th St	6th St S
Wisconsin	STH 16	160 ft W of West Ave	159 ft E of West Ave
Wisconsin	STH 33**	USH 14/3rd St	32nd St S
Wisconsin	STH 35 N/Lang Dr**	N of La Crosse St	S of La Crosse River
Wisconsin	STH 35 S	N of USH 14/61	Old Town Hall Rd
Wisconsin	STH 157/Main St**	2nd Ave N	USH 53 ramp
Wisconsin	USH 157	Main St exit	STH 16
Wisconsin	USH 14/South Ave**	Green Bay St	Ward Ave
Wisconsin	USH 14/Mormon Coulee Rd **	312 ft N of Shelby Rd	632 ft E of STH 35
Wisconsin	USH 14/Cass St**	2nd St	3rd St
Wisconsin	USH 14/Cass St	E span touchdown	W span touchdown

*Roads known to have had some or all of the segment resurfaced, rehabilitated, or reconstructed after the relevant data set was released.
**Connecting highway. Local municipalities are responsible for maintenance, but not reconstruction, etc.
Roads with segments that could be impacted by flood hazard areas are highlighted.
Source: Highway Performance Monitoring System (HPMS), 2016 data set; Wisconsin Information System for Local Roads (WISLR), 2017 data set; City of La Crescent, 2015 map. Data were obtained from MnDOT, WisDOT, and La Crescent in 2018.