LOWER MINNESOTA RIVER
WATERSHED DISTRICT

Executive Summary for Action

Lower Minnesota River Watershed District Board of Managers Meeting
Wednesday, May 18, 2022

Agenda Item
Item 6. H. – LMRWD Projects

Prepared By
Linda Loomis, Administrator

Summary

i. **Trout Streams Gaps Analysis and Management Plan**
Managers have received report for this project as certain milestones were reached. This is the final report. The report is lengthy and therefore, a link has been included rather than attaching the report in its entirety.

ii. **Lower Minnesota River Floodplain Model Feasibility Study**
In 20024, the Minnesota River flood plain model was developed by the US Army Corps of Engineers, the MN Department of Natural Resources and the LMRWD. There has been lots of development that has occurred since the Model was developed and the LMRWD was concerned that flood elevations may have increased. Young Environmental Consulting Group, on behalf of the LMRWD, reviewed the model taking into consideration all the developments that has occurred since the model was developed. The attached report is the result of that review

Attachments
Trout Streams Gaps Analysis and Management Plan
Lower Minnesota River Floodplain Model Feasibility Study

Recommended Action
Receive and file Trout Streams Gaps Analysis and Management Plan and Lower Minnesota River Floodplain Model Feasibility Study

LOWER MINNESOTA RIVER FLOODPLAIN MODEL FEASIBILITY STUDY

May 12, 2022
FINAL

PREPARED FOR:
Lower Minnesota River Watershed District
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WATERSHED DISTRICT

Young Environmental Consulting
Group, LLC

EXECUTIVE SUMMARY

The Lower Minnesota River Watershed District (LMRWD) requested Young Environmental Consulting Group, LLC (Young Environmental), to investigate the effectiveness of LMRWD Rule C—Floodplain and Drainage Alteration, adopted in February 2020. The LMRWD is interested in determining if Rule C is functioning as intended to prevent floodplain encroachment from industrial, commercial, transportation, or residential development activities from adversely affecting flood elevations on the Minnesota River. The LMRWD is also interested in determining if the accumulated effects of multiple no-rise certified developments would have a more significant impact on the river, and if not, if Rule C is too stringent without benefit.

This study relied on permit information provided by municipal partners, previous LMRWD project reviews, and the U.S. Army Corps of Engineers (USACE) St. Paul District hydraulic model of the Lower Minnesota River. The Minnesota Department of Natural Resources (MnDNR) and municipal partners were consulted in the development of this study.

Young Environmental compiled available hydraulic modeling and floodplain permit documentation to analyze the impacts of these developments on the flood elevations of the Minnesota River. During the data review process, it became apparent that there was a gap in floodplain permit documentation due to the overlapping regulatory authorities and lack of data sharing. This is reflected by the number of floodplain revisions (Letter of Map Amendments or Letter of Map Revisions) that were not reviewed by the LMRWD nor were incorporated into the effective Minnesota River hydraulic model developed in 2004 by the USACE and the United States Geological Survey (USGS). In addition, even with the Federal Emergency Management Agency's (FEMA's) recent Flood Insurance Study (FIS) updates in Carver, Dakota, Hennepin, and Scott counties, there are discrepancies and differences in elevations on the north and south sides of the river.

With the few hydraulic models we were able to obtain for this project, the 2004 USACE model was updated to incorporate new cross-sections and development that had previously been approved with a no-rise certificate. The updated model was run for both the 100-year and floodway conditions to evaluate the effects of the no-rise developments. The modeled results did show increases in flood elevations of 0.28 feet and provided conclusive evidence that no-rise developments can affect the flood elevations on the Minnesota River.

In discussions with the MnDNR, staff noted that the LMRWD Rule C is more stringent than the state's requirements because Rule C prohibits floodplain fill in the flood fringe. The state allows this to occur so long as the flood elevation does not increase by more than 0.5 feet. Because the no-rise permits increased the flood elevations by more than half of the allowable increase, we recommend enforcing Rule C as it currently stands, along with the following recommendations:

- Develop a district-wide hydrologic model to allow for better predictions of discharge rates, velocities, and flood elevations within LMRWD, as well as aid in evaluating the effects of full build-out and climate change on the river's hydrology.
- Update the 2004 USACE hydraulic model of the Minnesota River to incorporate all identified floodplain projects; complete a data request through FEMA if necessary to obtain this information.
- Coordinate with neighboring watershed districts, Minnesota Department of Transportation (MnDOT), and the MnDNR, and share any revised modeling with partner communities for their use.
- Develop an accounting and data-sharing system for floodplain development to aid local municipalities in tracking floodplain development for future map updates. Utilize the annual meetings to share this information and ask for feedback.

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1 INTRODUCTION

As one of its management policies and rules, the Lower Minnesota River Watershed District (LMRWD) regulates land development and activities in the floodplain within its boundaries. Floodplains are an important part of the natural environment because they provide flood protection for natural resources, permanent structures, and private lands by allowing floodwaters to safely move downstream. In this report, floodplain development refers to the human development that has the potential to alter the floodplain and dynamics of flooding, such as bridge or culvert crossings, as well as the conversion of land from its presettlement state to the present land uses, not the creation or production of a new floodplain.

Floodplains are regulated by multiple agencies, including the Federal Emergency Management Agency (FEMA), the U.S. Army Corps of Engineers (USACE), the Minnesota Department of Natural Resources (MnDNR), watershed districts, counties, and municipalities. These entities share a similar goal: to maintain the hydraulic capacity of the waterway system and prevent flooding caused by human activities in the floodplain.

In 2018, Young Environmental produced a white paper on the LMRWD floodplain and drainage alteration standard, defining the standard, recommending revisions, and explaining how it affected floodplain development. The previous standard required only a no net loss of natural floodplain storage, demonstrated by providing an equal volume of excavation as floodplain fill (i.e., compensatory storage). The paper recommended the floodplain standard be revised to include an additional requirement that no grading or filling be allowed in the floodplain if it reduces the flood-carrying capacity of the watercourse. This was added to better align with FEMA and state regulations and included an additional safety requirement that basements and lowest floors of new residential and commercial structures must be at least two feet above the flood elevation.

1.1 Purpose

The purpose of this study is to evaluate the effectiveness of LMRWD Rule C—Floodplain and Drainage Alterations mitigating the impacts of floodplain development. The intent of Rule C is to regulate alterations within the floodplain, preserve existing water storage capacity below the 100-year flood elevation to minimize the frequency and severity of high water, and allow development in the floodplain, in accordance with local regulations, that will not have an adverse impact on flood elevations.

1.2 Floodplain Terminology

The natural functions of river and stream floodplains are to carry or hold excess water during times of flooding, provide natural habitat, and protect water quality. The placement of fill or other obstructions within the floodplain can create channel restrictions and floodplain encroachments that impair its natural functions and amplify the tendency of the river to flood and cause damage. Figure 1 presents a simple representation of a floodplain system.

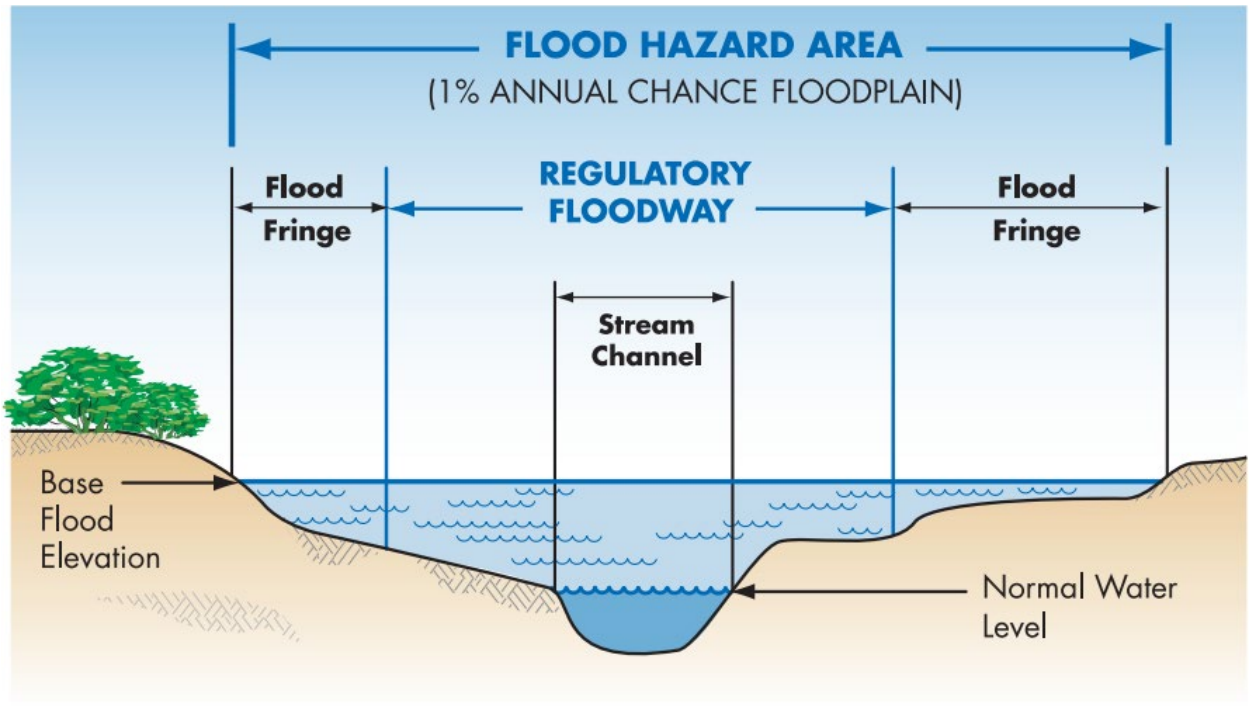


Figure 1. Riverine Floodplain Terminology (Minnesota Department of Natural Resources 2020).

100-Year Flood: The flood event having a probability of 1 in 100 (or a 1 percent chance) of being equaled or exceeded in a given year. Because of confusion over the term leading many to believe a flood of this magnitude only occurs once every 100 years, FEMA has started using "1 percent annual chance flood" or "base flood event" terminology.

Base Flood Elevation (BFE): The water surface elevation of the 100-year event flood. This elevation is determined by detailed flood studies and is commonly known as the 100-year flood level.

Flood Insurance Rate Map (FIRM): County or community-specific maps that delineate the flood risk developed as part of FEMA's Flood Insurance Studies.

Special Flood Hazard Area (SFHA): The portion of the floodplain subject to flooding from the base flood event and/or flood-related erosion hazards. On the FIRMs and in Minnesota, these are commonly identified as Zones A, AE, and AH.

Zone A: The approximate 1 percent annual chance flood hazard area when a detailed flood study has not been conducted and the BFEs have not yet been determined. Despite the lack of BFE information, these areas are considered high risk.

Zone AE: The areas subject to flooding by the 1 percent annual chance floodplain with BFEs. Like a Zone A, these are considered high-risk areas.

Zone AH: The areas subject to inundation by the 1 percent annual chance shallow flooding (usually areas of ponding), where average depths are between one and three feet.

Regulatory Floodway: The channel of a river or watercourse and the adjacent land areas that must be reserved in order to pass the 100-year flood without cumulatively increasing flood elevations by more than a designated height. The floodway is intended to be a tool to assist local communities with floodplain management.

Flood Fringe: The remainder of the SFHA after the floodway has been determined. This area is generally associated with slow-moving or standing water rather than flowing water. Under FEMA and Minnesota floodplain standards, when defined, these areas may be developed provided structures are elevated above the base flood elevation.

Floodplain: The extents of both the regulatory floodway and the flood fringe, which when combined, encompass the entirety of the areas inundated by the 100-year flood. In Figure 1, it is represented by the Flood Hazard Area.

Floodplain Development: In this document, floodplain development refers to the human development that has the potential to alter the floodplain and dynamics of flooding, such as bridge or culvert crossings, as well as the conversion of land from its presettlement state to the present land uses, not the creation of new floodplain. This is consistent with the federal definition of "development" under 44 CFR 59.1, which "means any man-made change to improved or unimproved real estate, including buildings or other structures, mining, dredging, filling, grading, paving, excavation or drilling operations, or storage of equipment or materials."

1.3 Floodplain Development in the LMRWD

Historically, the Minnesota River floodplain was home to at least six permanent Dakota villages and settlements (Shakopee Mdewakanton Sioux Community 2002) that were farmed in the summer months (Minnesota Humanities Center 2010). With the construction of Fort Snelling and European settlement in the region, railroads were constructed in the floodplain in the 1860s as the Minnesota Territory worked toward statehood (Gale Family Library 2021). In 1892, Congress passed the River and Harbor Act, which authorized the maintenance of a four-foot navigation channel in the river from the confluence with the Mississippi to river mile 25.6, which was then increased to 9 feet in depth and 100 feet wide by 1968 (US Army Corps of Engineers, St. Paul District 2007).

The construction of railroads and the dredged channel on the river paved the way for more intensive agricultural practices centered around cash crops, such as onions, and the extraction of raw natural materials, such as sand and gravel, in the floodplain. These activities supported the growth of the towns in the river valley (Dakota County Historical Society 1989). By the 1950s, traditional suburban developments were common, and new highways and bridges were constructed over the river, further changing the landscape.

Figures 2 through 7 show the change in the landscape and the development within the Minnesota River floodplain.

Figure 2. Painting of Fort Snelling and Pike Island from Mendota in the late 1800s (Minnesota Humanities Center 2010)

Figure 3. Present-day Minnesota River confluence with the Mississippi River at Fort Snelling (Minnesota Historical Society n.d.)

Figure 4. Watercolor of Pilot Knob from below Fort Snelling (Eastman 1846)

Figure 5. Present-day view of Pilot Knob from Fort Snelling. The knob was removed in 1925 as part of the Acacia Park Cemetery development (Adler 2020).

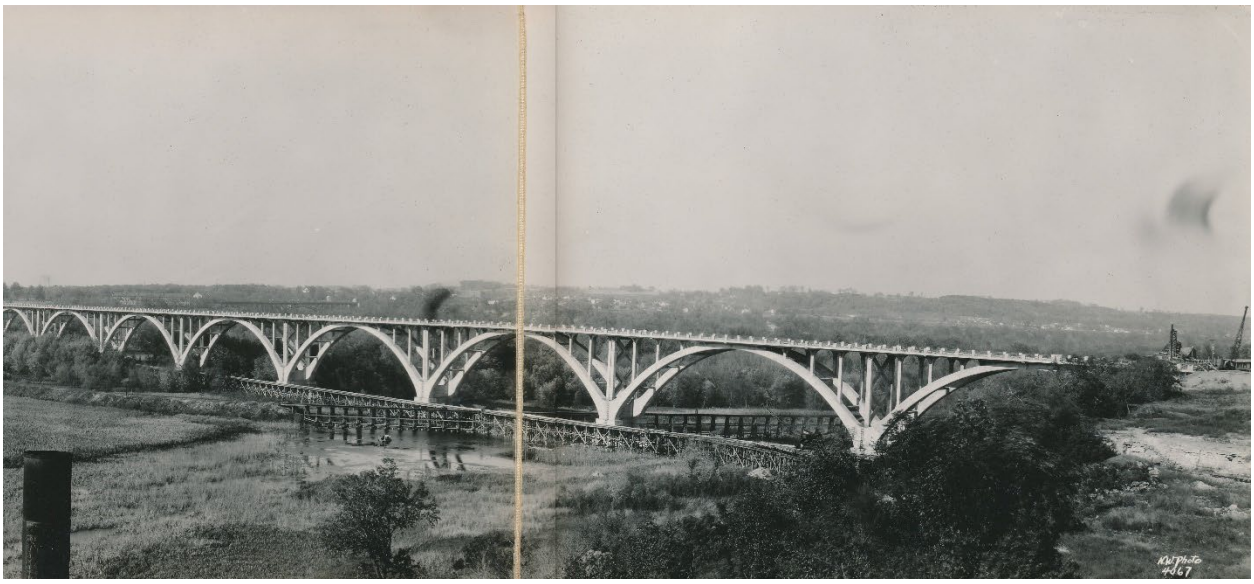


Figure 6. Newly constructed Mendota Bridge in 1926 by the Koss Construction Company from Pilot Knob (Holth 2013)

Figure 7. Present-day view of Fort Snelling from Pilot Knob (Crouser 2022)

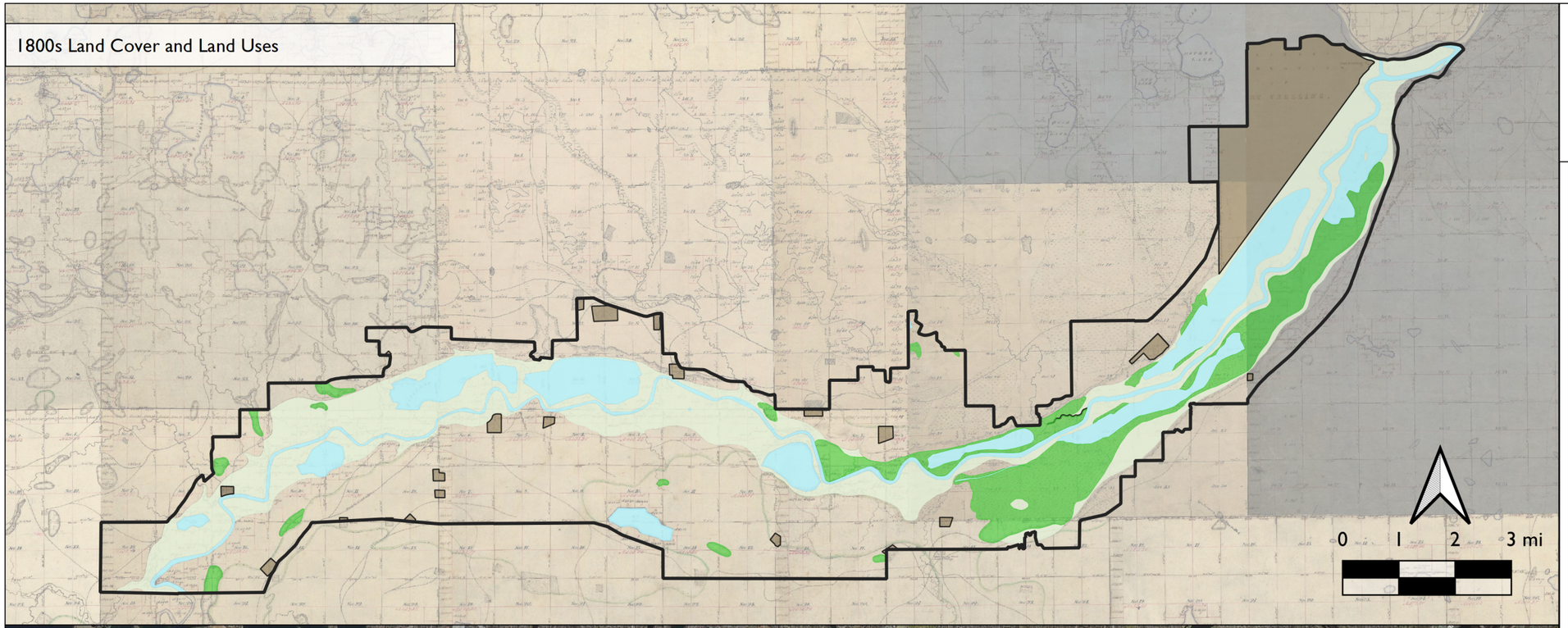
Per the Minnesota Department of Transportation (MnDOT) records, since the Mendota Bridge, 10 other active bridge crossings have been constructed across the Minnesota River channel and 11 other crossings in the Minnesota River floodplain. In addition to the crossings impeding river flows, the land within the floodplain has undergone drastic changes from the relatively undeveloped conditions in the 1880s to today (Figure 8).

Today, approximately 49 percent of the LMRWD watershed has been developed, compared to approximately 8 percent in the 1880s. However, much of the development has occurred outside of the floodplain. A summary of the land uses within the Minnesota River 100-year floodplain is provided in Table 1. It should be noted that for 2020, "Undeveloped" includes parks, recreation areas, and preserved areas. Despite this inclusion, undeveloped areas in the floodplain decreased by 7 percent, while agricultural and urbanized land uses exploded. Within the floodplain, the majority of urban land uses include industrial, extractive, transportation, and some commercial uses.

Table 1. Summary of Land Use Change within the Minnesota River Floodplain from the 1880s to 2020

Land Use	1880s Area (ac)	2020 Area (ac)	Percent Change
Undeveloped	12,675	11,779	-7%
Agricultural	2	747	40,755%
Urbanization	114	1,326	1,064%
Open Water	6,227	5,166	-17%

1800s Land Cover and Land Uses



2020 Land Cover and Land Uses

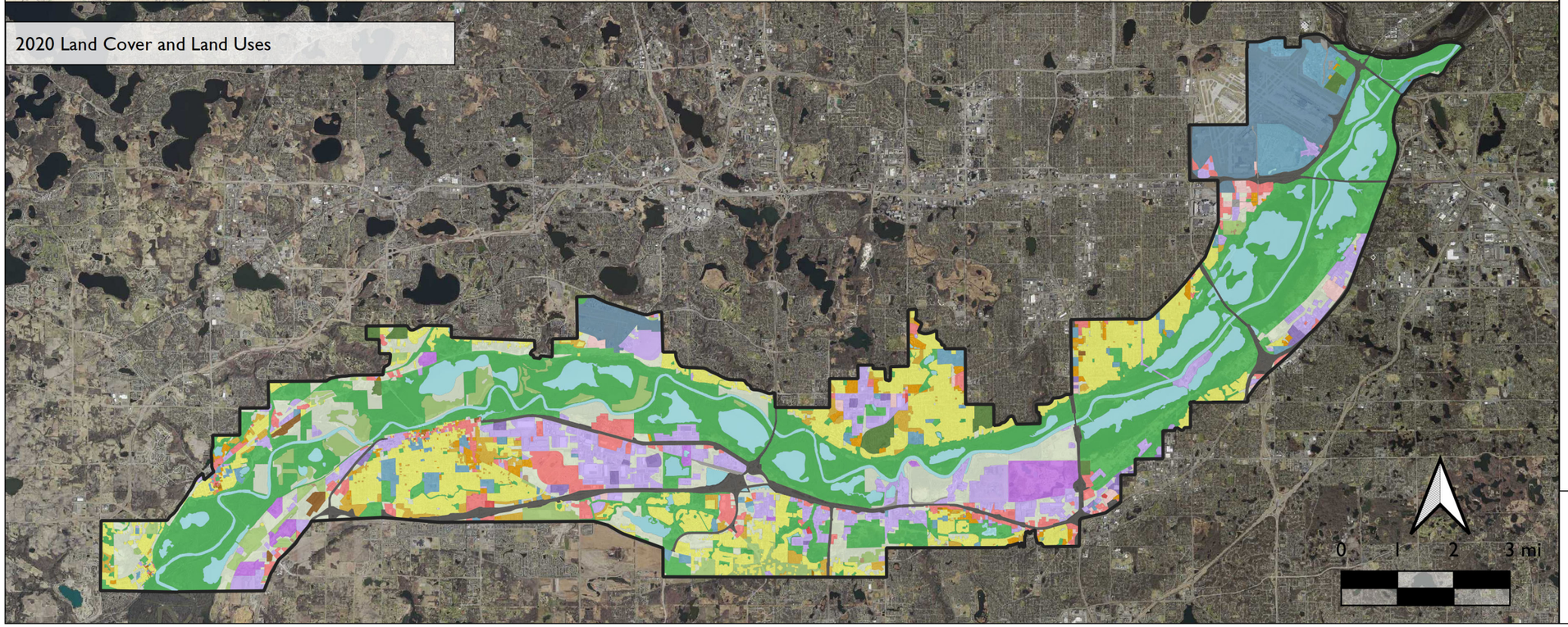


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Figure 8: Land Cover and Development in the LMRWD

LEGEND

Survey Plat Land Uses (1847-1855)

- Military, Towns, and Farmsteads
- Wetland
- Undeveloped River Bottom
- Open Water

Metropolitan Council Generalized Land Use (2020)

- Farmstead
- Single Family Detached
- Manufactured Housing Park
- Single Family Attached
- Multifamily
- Retail and Other Commercial
- Office
- Mixed Use Residential
- Mixed Use Industrial
- Mixed Use Commercial
- Industrial or Utility
- Extractive
- Institutional
- Park, Recreational, or Preserve
- Golf Course
- Major Highway
- Major Railway
- Airport or Airstrip
- Agricultural
- Undeveloped
- Open Water

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1.4 Flood History

The Minnesota River is known for its floods. Deep winter snowpack in the western part of the state can lead to substantial spring flooding, and heavy summertime downpours can create flash floods. The United States Geological Survey (USGS) has maintained a streamgage at Jordan since 1935, which is used to predict when the river will crest in the LMRWD (Figure 9).

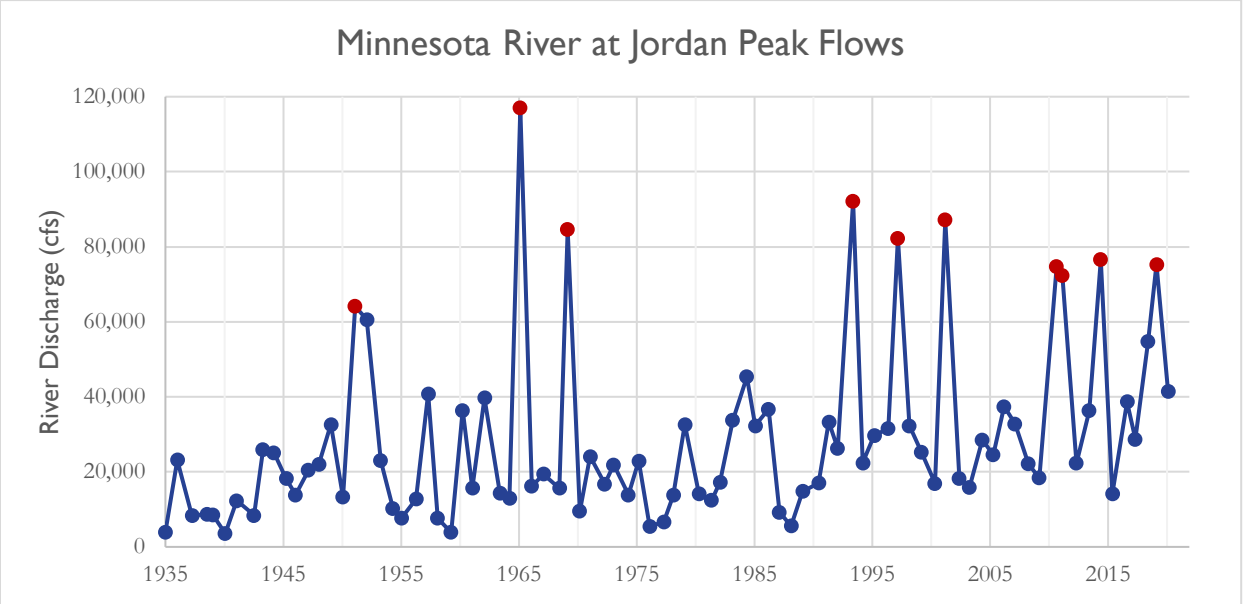


Figure 9. Minnesota River at Jordan, MN, peak flows (red indicates a top 10 flood of record)

The largest flood on record was in 1965, but five of the top 10 floods at Jordan have occurred in the past 20 years, indicating that the river is experiencing more frequent flooding. Given the size of the Minnesota River watershed, several factors are likely at play. However, the trend in more frequent and intense flooding follows similar patterns across the state caused by climate change.

Finally, the timing of the Minnesota River flooding appears to be shifting to later in the season, with peak annual floods now regularly occurring in September. Figure 10 shows the seasonal patterns of flooding on the Minnesota River at Jordan for two decades, from 1935 to the present. Prior to the 1980s, the most frequent month for flooding on the Minnesota River was April; however, this appears to have shifted to June in recent decades.

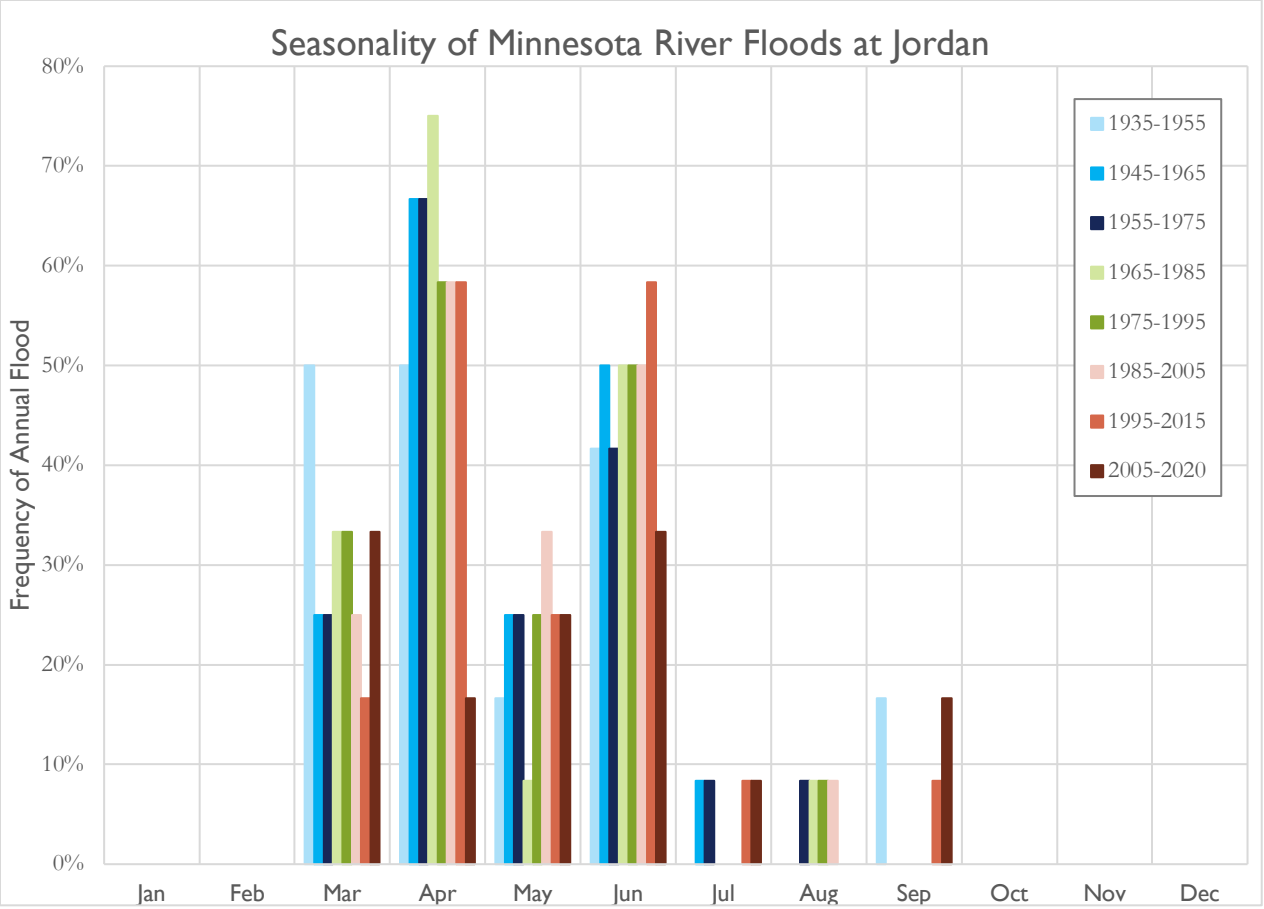


Figure 10. Frequency of annual floods per month

1.5 Flooding Impacts

With a more developed watershed experiencing more frequent flooding, the impacts of flooding will be more widespread. The following sections discuss the impacts of flooding on residents of the district, critical infrastructure, vulnerable populations, and regulated sites.

1.5.1 Residential Impacts

The growing population has increased the need for residential housing and pressure to develop marginal areas such as the floodplain. In the five counties within LMRWD, there are nearly 1,600 parcels within the floodplain. Of these parcels, about 9 percent are homesteads (Table 2). Homeowners on these parcels have a one-in-four chance of experiencing flooding during a 30-year mortgage.

Table 2. Summary of Parcels and Homesteads in LMRWD Floodplain

County	Number of Parcels in the Floodplain	Number of Homesteads in Floodplain
Carver	330	73
Dakota	496	0
Hennepin	250	59
Ramsey	1	0
Scott	522	19

1.5.2 Critical and Vulnerable Facilities

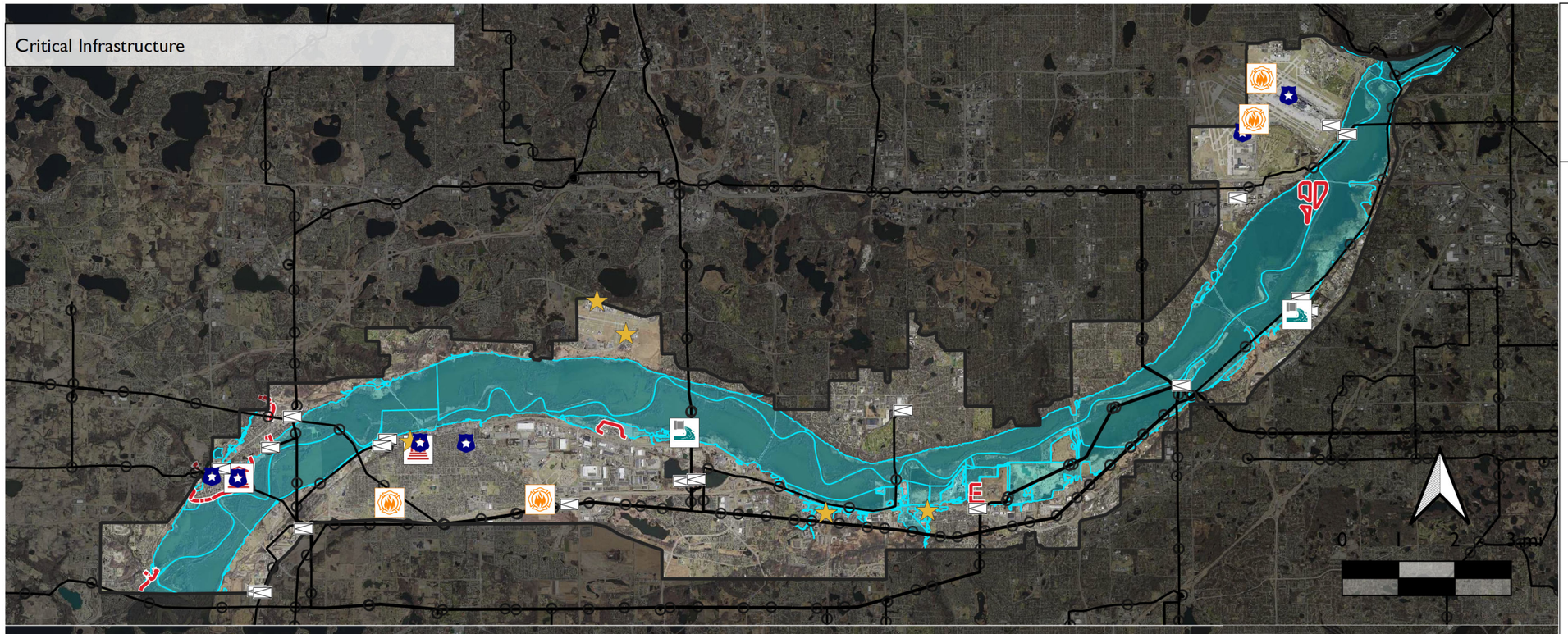
As discussed in the previous sections, the increased development and urbanization of the LMRWD has led to extensive public infrastructure in the floodplain to support the development, including electrical transmission lines, gas and petroleum lines, and sanitary sewer and wastewater treatment plants (WWTPs). To protect the infrastructure from catastrophic floods, flood protection systems, such as levees, have been constructed in the cities of Carver and Chaska and around critical infrastructure, such as the Blue Lake WWTP.

Figure 11 shows data from the Homeland Infrastructure Foundation-Level Data database, showing critical infrastructure and facilities with vulnerable populations, such as eldercare. Critical infrastructures are the pieces of government and public works that need to continue functioning in the event of a disaster to provide emergency response services and basic needs to residents. Vulnerable populations are those who cannot quickly evacuate in a disaster, such as eldercare, day-care centers, and schools.

1.5.3 Environmental Contamination

Finally, another concern with floodplain development is the potential for hazardous materials to become dispersed during flood events. The Minnesota Pollution Control Agency (MPCA) maintains a database of environmentally permitted facilities and potentially contaminated sites in the state called What's In My Neighborhood. In addition, the MPCA also maintains a database of the Permanent List of Priorities (PLP), also known as the Minnesota Superfund Sites. There are three Superfund sites in the LRMWD: Pollution Controls Inc. (PCI), Riverland Ag/Minnesota Valley Landfill in Savage, and Old Freeway Dump in Burnsville. Both the Minnesota Valley Landfill and Old Freeway Dump are in the Minnesota River floodplain.

Critical Infrastructure



Vulnerable Populations

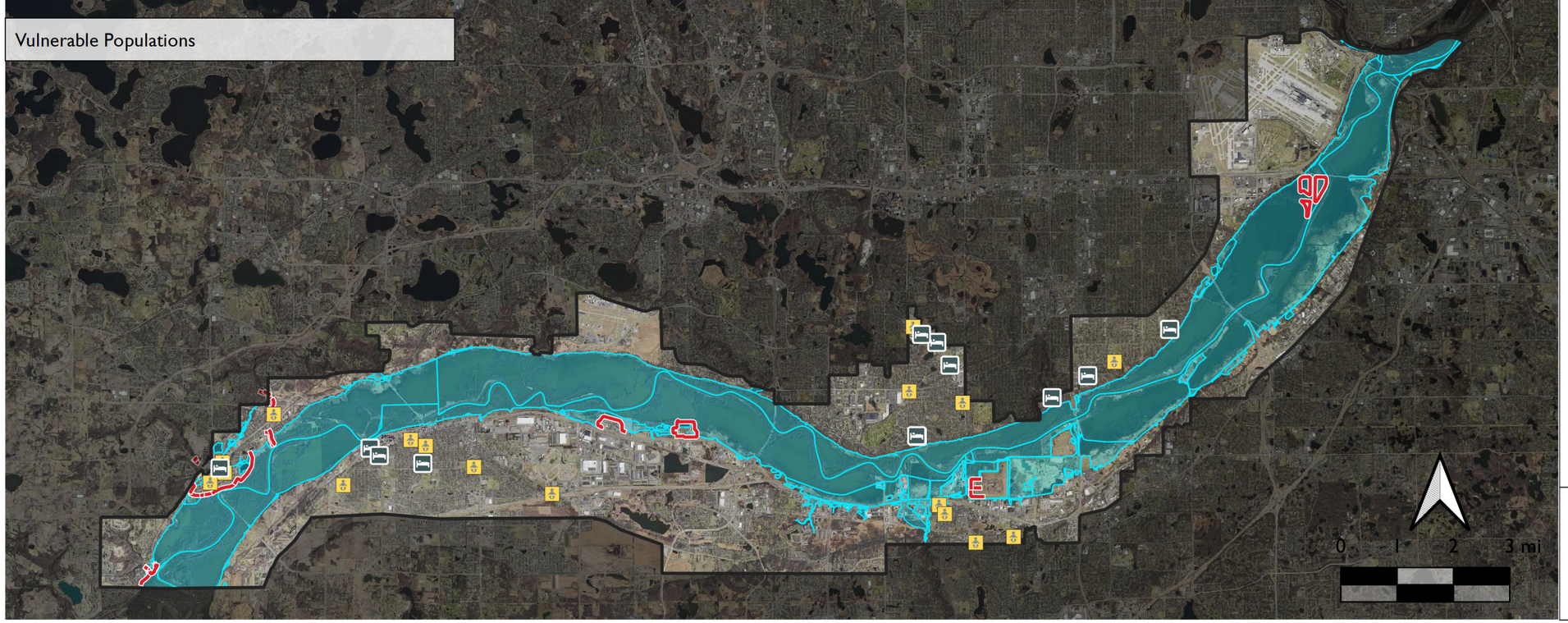


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Figure 11: Critical Infrastructure & Vulnerable Populations within LMRWD

LEGEND

- FEMA-Certified Levees
- FEMA Floodplain in LMRWD

Critical Infrastructure

- Courthouses
- Law Enforcement
- Fire Stations
- EMS Stations
- Substations
- Electric Transmission Lines
- Wastewater Treatment Plants

Vulnerable Populations

- Eldercare
- Child Care Facilities

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Figure 12: MPCA-Regulated Sites in the LMRWD

LEGEND

- FEMA-Certified Levees
- FEMA Floodplain in LMRWD

MPCA What's In My Neighborhood Active Sites

- Aboveground Tanks
- Brownfields
- Construction Stormwater
- Hazardous Waste
- Industrial Stormwater
- Multiple Activities
- Petroleum Remediation, Leak Site
- Site Assessment
- Underground Tanks
- Wastewater
- MPCA Superfund Sites
- LMRWD Boundary

0 1 2 3 mi

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The What's in My Neighborhood dataset lists 108 currently active sites within the 100-year floodplain in the LMRWD. Of these sites, 36 are listed as "Multiple Activities," meaning they have more than one category. Each of their categories is included in the summary shown in Table 3.

Table 3. MPCA What's In My Neighborhood Summary for LMRWD Floodplain

MPCA-Regulated Activity	Number of Active Sites per Activity[1]
Aboveground Tanks	22
Brownfields	12
Construction Stormwater	30
Hazardous Waste	41
Industrial Stormwater	17
Petroleum Remediation Sites	9
Site Assessment	15
Underground Tanks	10
Wastewater Discharges	7

[1] *Because the multiple activity sites are included in this summary, the total number of sites may appear to be greater than the total in the What's in My Neighborhood dataset.*

2 FLOODPLAIN REGULATION

Floodplain development is regulated by many layers of government, from federal to local entities, complicated by the type of floodplain affected, as discussed in Section 1. The following section outlines these agencies and their roles in regulating development in the floodplain.

2.1 FEMA

FEMA is responsible for coordinating the federal government's role in preparing for, preventing, and mitigating the effects of, responding to, and recovering from all domestic disasters, whether natural or human caused. FEMA also oversees the National Flood Insurance Program (NFIP), which allows residents in participating communities to purchase flood insurance and be eligible for disaster relief.

The NFIP was established in 1968 by the United States Congress in response to 1965 Hurricane Betsy, which hit Louisiana and caused $1.42 billion in damages and 81 deaths. Prior to the National Flood Insurance Act of 1968, flood insurance was nearly nonexistent, and like today, a standard homeowners insurance policy did not cover flood damages. Private insurers found offering flood insurance policies unattractive because of the potential for high concentrations of catastrophic losses.

The NFIP was designed as a voluntary partnership between the federal government and local communities. The overall goal of the NFIP was to make flood insurance more widely available (Michel-Kerjan 2010). Table 4 provides the most recent NFIP data for the top five and upper Midwest states.

Table 4. NFIP Policies, Losses, and Claims of Selected States (FEMA 2022)

State	Number of Policies	Policy Rank	Number of Losses	Loss Rank	Total Claims Paid ($)	Claim Rank
Florida	1,642,846	1	306,625	3	$5,803,957,825	4
Texas	756,000	2	385,270	2	$17,021,393,803	2
Louisiana	493,287	3	480,707	1	$20,707,441,815	1
New Jersey	205,945	4	200,116	4	$6,380,577,975	3
South Carolina	197,526	5	46,828	13	$945,208,964	10
New York	162,490	7	172,569	5	$5,583,809,518	5
Illinois	34,418	17	51,872	9	$578,747,135	14
Michigan	19,353	25	14,211	28	$134,630,126	31
Wisconsin	11,330	32	8,765	33	$116,846,586	34
Iowa	11,107	33	14,381	27	$339,359,157	22
North Dakota	7,708	40	13,261	29	$258,901,813	26
Minnesota	**7,672**	**41**	**12,180**	**31**	**$148,443,123**	**30**
South Dakota	2,875	49	3,920	44	$56,054,991	43

The other major component of the NFIP is the floodplain mapping FEMA provides to local communities. FEMA develops Flood Insurance Studies (FIS) and flood maps, called Flood Insurance Rate Maps (FIRMs), for participating communities to delineate the risk of different flood zones. The first flood hazard maps of the Minnesota River were created in the early 1970s for Eden Prairie and Bloomington (FEMA 2022). Since then, all communities within the LMRWD have been mapped by FEMA and have joined the NFIP.

Additionally, the Minnesota River is now clearly mapped for the entirety of its reach within LMRWD, complete with a delineated floodway and 100-year flood elevations.

Under the NFIP, development is allowed within the flood fringe so long as flood heights are not increased by more than one foot and do not increase the flood hazard on other properties. The floodway delineated on the FIRMs designated the areas where flood flows are most sensitive to change and that must remain free and open to floodwaters to avoid an increase in excess of one foot (Figure 13).

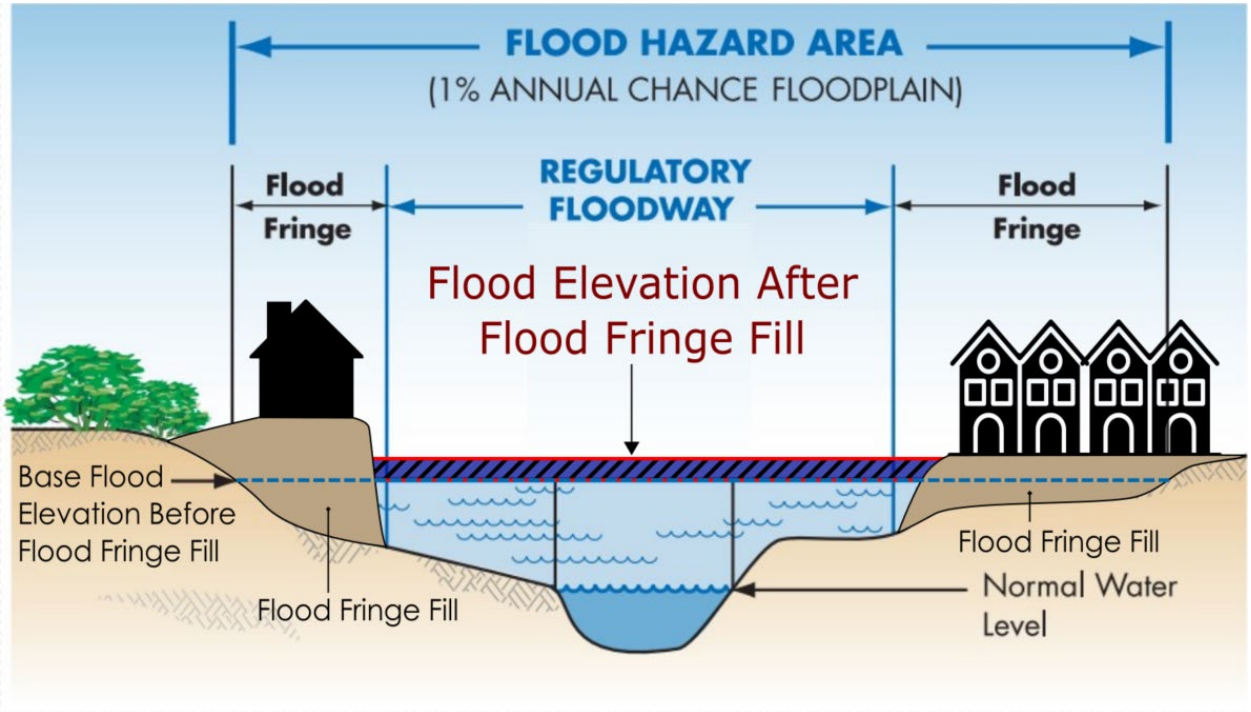

Figure 13. Conceptual example of flood fringe development and impact on flood elevations

To demonstrate that a proposed development will not affect flood elevations, the industry standard promoted by FEMA has been to develop a hydraulic model of the system and compare the before and after project high water elevations. If the proposed development can demonstrate to the 0.00 foot that there is no change in flood elevations, a professional engineer can sign a No-Rise Certificate, which is to be submitted to FEMA by the local floodplain authority within six months of project completion.

2.2 MnDNR

Major floods in 1965 and 1969 and the passage of the National Flood Insurance Act led to the passing of the state Floodplain Management Act of 1969, which established a framework for the MnDNR to enforce floodplain regulations. Even prior to 1969, Minnesota had more stringent regulatory standards for the protection of local communities. Floodplain management in Minnesota focuses on several tenets:

- Preserving flood-prone areas as public open spaces
- Adopting more protective regulatory standards
- Implementing flood risk reduction projects

The MnDNR is the liaison between FEMA and local communities. It oversees floodplain management programs, approves floodplain ordinances, and provides technical assistance and training for local officials (Minnesota Department of Natural Resources 2022). In this capacity, the MnDNR is responsible for

establishing minimum state NFIP standards; ensuring participating communities have the legal authority to adopt and enforce floodplain management regulations; and providing hydraulic reviews, modeling assistance, and recommendations to local officials (FEMA 2005).

The MnDNR has adopted and enforces more stringent regulatory standards than FEMA and limits the type of floodplain development and encroachment that is allowed under the NFIP. In Minnesota, floodplain development projects are allowed to increase flood elevations by up to 0.5 feet through the MnDNR's standard review process. With the approval of the MnDNR commissioner, projects that have a large flood reduction benefit are sometimes allowed to locally increase flood elevations in excess of 0.5 feet. Furthermore, on rivers like the Minnesota River where communities exercise control on only one bank of the river, the allowable increase in flood elevations should be limited to 0.25 feet, reserving the other 0.25 feet for their neighboring community across the river.

2.3 LMRWD

The LMRWD has had a floodplain alteration standard since 2011, which requires that no filling be allowed in the floodplain that causes a rise in the base flood elevation without providing compensatory floodplain storage. The current Rule C—Floodplain and Drainage Alteration goes further and requires that any grading or placement of fill within the floodplain, inclusive of both the floodway and flood fringe, be certified by a professional engineer that it will not cause an increase in water surface elevations. This certification is commonly referred to as a No-Rise Certificate, which states that the proposed development, if constructed as proposed, will not increase the flood elevations by more than 0.00 feet.

2.4 Local Governments

To be eligible to participate in the NFIP, communities must adopt minimum floodplain standards, including ordinances regulating development in the floodplain and issuing or denying floodplain development and building permits; maintain records of floodplain development; and participate in floodplain map updates (FEMA 2005).

All of the LMRWD local government units (LGUs) have adopted both the state and federal minimum requirements of the NFIP. By doing so, their residents can purchase government-backed flood insurance and are eligible for federal disaster assistance, and the community is eligible for flood mitigation grants. Communities may adopt even more stringent floodplain development and risk management procedures as part of FEMA's Community Rating System (CRS) program, which offers residents a reduction of up to 45 percent on flood insurance premiums. Within LMRWD, the City of Carver is a CRS city with a rating of 6, which affords its residents in the floodplain a 20 percent reduction on their premiums.

2.5 Other Entities

The USACE works closely with FEMA to develop and implement flood risk reduction projects and provides assistance with flood risk mapping efforts. In 2004, USACE partnered with USGS and LMRWD to develop a hydraulic model of the Lower Minnesota River from its confluence with the Mississippi River to 36 miles upstream. This model has been used as the best available data for floodplain development in the region.

In addition to the sources discussed previously, several private entities provide flood risk information to real estate companies to aid potential home buyers in determining their flood risk. Unfortunately, many of these models are often proprietary, rely on generalized data, and are not affiliated with the NFIP. As a result, these sources may serve to cause more fear than provide accurate information on individual flood risk.

3 METHODOLOGY

This study reviewed the 2004 modeling, reached out to the LMRWD partner municipalities, reviewed district project reviews, and reviewed FEMA map change information to determine the areas of floodplain development within LMRWD and determine where no-rise developments were constructed.

3.1 2004 Flood Study

In 2004, the USACE and USGS partnered to develop a flood study of the Minnesota River until FEMA was able to produce new FIS maps for the affected communities. This study was built on a 1973 USGS hydraulic report of the Lower Minnesota River and used a 2001 USACE hydrologic analysis of the USGS streamgage near Jordan, Minnesota (USGS Gage 0533000), for inflows into the hydraulic model.

Because the MnDNR is the FEMA liaison, the 2004 hydraulic model files were provided by the MnDNR for use in this study. The USACE was also contacted to confirm if updates had been made to the model; however, this request is still pending.

3.2 Municipal Data Requests

All communities within the district have floodplain ordinances that are approved by the MnDNR. Adoption of those ordinances regulates floodplain activities unless the LGUs have given the authority to the district. At this time, the cities of Bloomington, Carver, Eden Prairie, and Shakopee have given authority for Rule C to the district.

During our annual coordination meetings with the LMRWD partner municipalities in 2021, the LMRWD requested floodplain development records from 2004 to the present. The results of this outreach are provided in Table 5.

Table 5. Municipal Development in Minnesota River Floodplain

City	Floodplain Development
Bloomington	Old Cedar Avenue bridge parking lot, Stump Road
Burnsville	Xcel Energy and MnDOT projects
Carver	No floodplain development information because much of downtown is protected by the levee system
Chanhassen	Not aware of any no-rise development
Chaska	No floodplain development information because downtown is protected by the levee system
Eagan	No floodplain development permits issued by city because most of the lands are state park
Eden Prairie	City was unaware of any floodplain development applications on the Minnesota River
Mendota Heights	No floodplain development permits issued by city because most of the lands are state park
Savage	LMRWD Dredge Site, Valley Oil Development, Port Cargill/Mosaic Savage Facility Levee
Shakopee	US Game and Fish wetland work, Memorial Park Bridge, Valley Fair Expansion, Memorial Park Mill Pond

In general, the developments identified by the community aligned with the LMRWD permit records discussed below.

3.3 LMRWD Project Reviews

Prior to the adoption of rules in 2020, the LMRWD was not a regulatory entity and relied on its partner communities to enforce its standards to protect the natural resources within the district. Since 2014, the LMRWD has reviewed or permitted at least 38 projects within the floodplain, as shown in Figure 14.

Unfortunately, for most of these projects, no floodplain modeling was available to evaluate the cumulative effects of these developments. Hydraulic model files available for six of the projects shown in Figure 14 were incorporated into the 2004 model.

3.4 FEMA Data Review

FEMA maintains an online data library of floodplain maps and changes through its Flood Map Service Center. This data includes records of map changes that individual property owners or land developers submit to FEMA to change the designation of the floodplain on their parcel or remove the floodplain encumbrance entirely. These changes are documented by FEMA in a short letter, sometimes called a Letter of Map Change (LOMC), which encompasses all revisions (LOMRs) and amendments (LOMAs) to the FIS and FIRMs. Data for each of the LMRWD counties were downloaded and reviewed for comparison against the municipal data received. The following table presents the floodplain development records FEMA has on file within the LMRWD.

Table 6. FEMA Floodplain Development History within the LMRWD

City	Year	Type
Burnsville	2018	Port Cargill East LOMR
Carver	2014	LOMA to remove a structure from floodplain
Carver	2018	LOMA to remove a structure from floodplain
Chanhassen	2020	LOMA at 850 Flying Cloud Drive
Eden Prairie	2001	LOMA at 11451 Landing Road
Savage	2002	12461 Rhode Island Avenue Letter of Map Revision Based on Fill (LOMR-F)
Savage	2005	Steiner Industrial Development LOMR-F
Savage	2006	12520 Quentin Avenue LOMA
Savage	2011	8012 West 124th Street LOMA
Savage	2013	12493 Pennsylvania Avenue LOMA
Savage	2015	12051 Yosemite Avenue LOMA
Savage	2017	8550 126th Street LOMA
Savage	2019	12520 Nevada Avenue South LOMA
Savage	2020	7369 Highway 13 West LOMR-F
Shakopee	2005	721 Brook Lane LOMR-F
Shakopee	2018	1001 Bluff Avenue East LOMA

The sixteen FEMA LOMCs were not included in the data provided by the LGUs and represent a data gap between the communities, LMRWD, MnDNR, and FEMA.

LOWER MINNESOTA RIVER
WATERSHED DISTRICT

Figure 14: LMRWD Project Reviews in the Floodplain (2014-2022)

LEGEND

- LMRWD Floodplain Reviews
- LMRWD Boundary
- FEMA Floodplain in LMRWD
- FEMA-Certified Levees
- MnDOT Trunk Highways
- Railroad
- State Park Trails

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In addition to reviewing floodplain development records, Young Environmental reviewed the FIS for Carver, Dakota, Hennepin, and Scott counties. The FIS also documents the methodology used to develop the FIRM panels used in the NFIP.

Table 7. FEMA Flood Insurance Studies for LMRWD

County	Initial FIS (for LGUs in LMRWD)	Effective FIS
Carver	1979 (Chanhassen)	2018
Dakota	1977 (Burnsville)	2011
Hennepin	1980 (Bloomington)	2016
Scott	1974 (Savage and Shakopee)	2021

In reviewing the effective FIS reports, inconsistencies were discovered in the Minnesota River hydrology used in the various studies, despite using the same dataset from the USGS gage at Jordan (USGS 05330000). The Minnesota River flows from these analyses are summarized in Table 8.

Table 8. Base Flood Discharges for the Minnesota River at Jordan

Agency	Source Document	Year	100-Year Discharge (cfs)
USGS	Flood-plain Areas of the Lower Minnesota River	1973	115,000
USACE	Section 22 Study: Minnesota River Main Stem Hydrologic Analysis	2001	103,000
FEMA	Carver County FIS	2018	101,000
FEMA	Dakota County FIS	2011	103,000
FEMA	Hennepin County FIS	2016	103,000
FEMA	Scott County FIS	2021	115,000

While the differences in 100-year flows may be relatively minor for a river of this magnitude, they do speak to the need for a consistent methodology to be used and updated as new data is available. It was not readily apparent from the more recent FIS reports whether or not the hydrology has been updated or whether the 1973 and 2001 values continue to be used. This should be further investigated by completing a statistical analysis of the USGS gage at Jordan with the most recent flow data and calibrated with more recent floods of record, such as 2010 and 2016.

Another discrepancy noted during the FIS review was that the flood elevations from one study did not appear to translate to other studies. For example, Hennepin and Scott counties are neighbors and share cross-sections in the 2004 model, but those same cross-sections have slightly different elevations in the effective FIS, despite coming from the same data source (Figure 15).

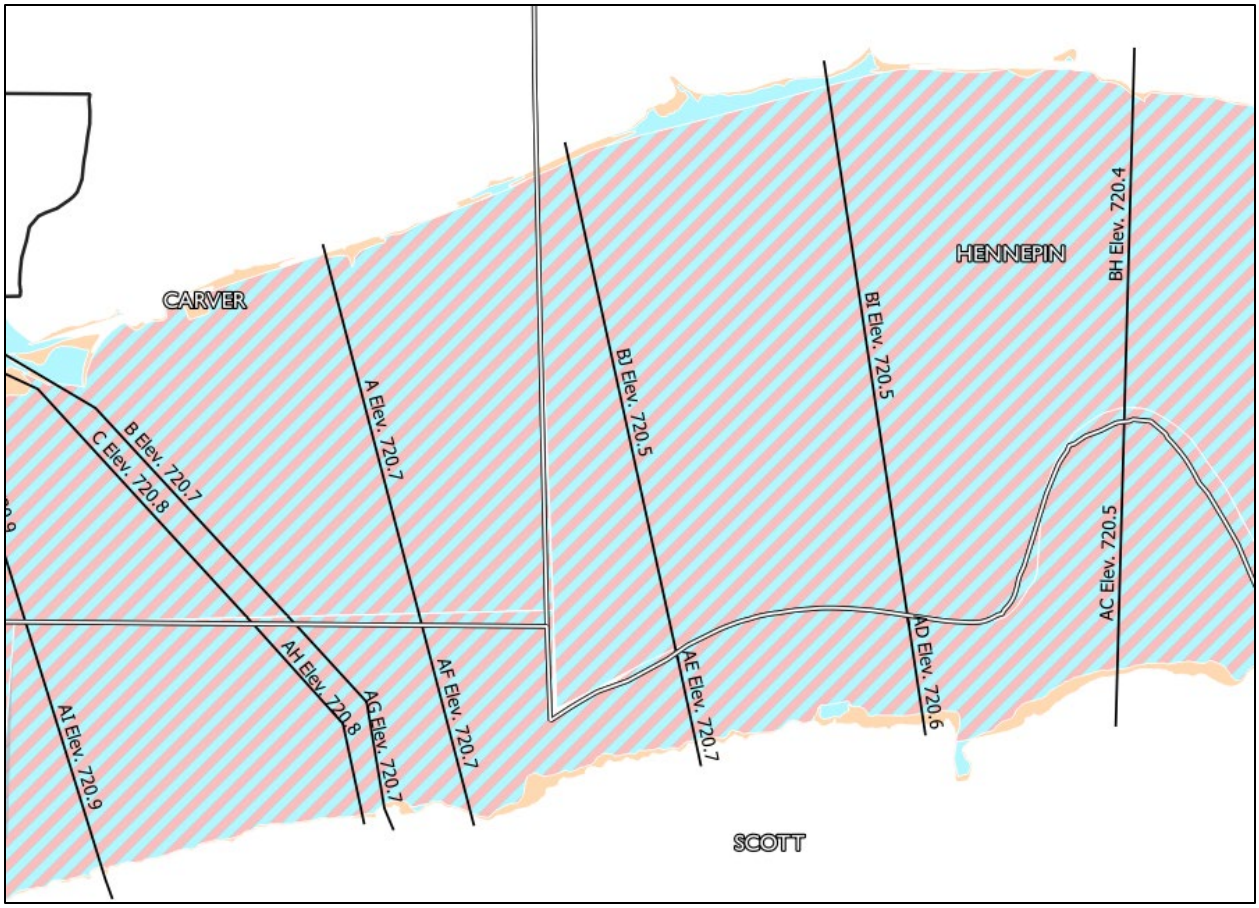

Figure 15. FEMA FIS base flood elevation discrepancies

Similar issues occur at the boundaries between Dakota, Hennepin, and Scott counties.

3.5 MnDNR Discussions

Because the MnDNR administers the floodplain program for FEMA in the state, Young Environmental contacted the Floodplain Unit to discuss if it had records of no-rise permits and how it requests communities track this information. Two items became apparent from these discussions:

1. The MnDNR does not generally keep track of no-rise permits because it believes that under the NFIP requirements, it is the responsibility of the community to maintain these records and provide them to FEMA for map updates.
2. The LMRWD Rule C is more stringent than the state's higher standards because it does not allow any fill in the flood fringe, whereas the MnDNR standard ordinance allows fill in the flood fringe because the 2004 study had completed an encroachment analysis.

The MnDNR was able to provide documentation for three projects within the LRMWD floodplain:

1. 2018 Minnesota Valley State Trail in Bloomington, which caused a 0.01-foot rise at two locations
2. 2019 Cedar Avenue Water Access Site in Burnsville, which caused a 0.01-foot rise at two locations
3. Merriam Junction Trail, a project that is not yet constructed

In conversation with MnDNR staff (S. Jiwani, personal conversation, July 21, 2020), they noted that tracking floodplain development permits is a problem across the state, especially when no-rise certificates are involved

because these are often not submitted to FEMA as new and better information. Staff mentioned they would be interested in working together on a pilot project to better track floodplain development permits and no-rise projects (C. Strauss, personal communication, April 20, 2022).

3.6 MnDOT Discussions

Given the 29 bridge crossings in the Minnesota River floodplain for major highways, the MnDOT was contacted to request hydraulic data used in the bridge design to confirm the 2004 model had the best information available. Unfortunately, this request is still pending; however, the MnDOT confirmed that it does not have hydraulic design information for locally owned bridges. Information on these bridges will have to be coordinated at a private, local, or county level.

4 RESULTS

Using the data collected from the various municipalities and agencies discussed in Section 3, the 2004 model was updated to review the changes in the no-rise developments that we were able to confirm:

- 2017 Port Cargill LOMR
- 2018 Valley Oil in Savage
- 2018 Cargill East River Dredge Material Site in Savage
- 2020 Memorial Park Bridge in Shakopee

Comparing the updated model results to the 2004 results showed a maximum of a 0.28-foot rise in 100-year flood elevations near Port Cargill and the Dredge Site. This makes sense because the majority of the changes to the model were located in this area.

With only one exception, every location in the model showed an increase in flood elevations of at least 0.02 feet. The one exception is the Soo Line Railroad bridge upstream of the Dredge Site, which has a decrease of 0.33 feet. The complete hydraulic results are provided in Appendix A.

5 DISCUSSION

Using the data collected, Young Environmental reviewed the completeness of the floodplain development records and the impacts they may have on water surface elevations in the Minnesota River.

The 2004 model has not been comprehensively updated since its creation, and floodplain development within the Minnesota River does not seem to have been incorporated into the most recent 2021 Scott County FIS. All of the FIS appears to reference the 2004 study; however, there are slight differences in flows and BFEs reported for each study.

The results of the no-rise model update indicate that even though projects are certified as no rise, the cumulative impact is causing increases in water surface elevations. Additional effort should be put into obtaining the hydraulic models for the previous permit and project reviews and incorporating these and the outstanding data requested into an updated HEC-RAS model.

Given the discrepancies in BFEs across county boundaries, further discussion should be held with the MnDNR to determine the correct elevations to use when enforcing Rule C. Consideration should also be made to the hydrologic inputs for the HEC-RAS model; because nearly 20 years have passed since it was last updated, a review of the gage data may be warranted.

It was difficult to find information for development projects in the floodplain because of the overlapping regulations and to determine how neighboring communities are using the same data. A standard model for floodplain elevations and a structure for sharing this information are needed to avoid confusion and potential overdevelopment in floodplains. As a regional authority, the LMRWD should regulate the floodplain fairly and effectively. An updated HEC-RAS model must be developed that includes the most recent data available and documents where the available surcharge has already been exceeded (such as near the Dredge Site in Scott County).

The annual municipal meetings provide an opportunity to discuss floodplain development and encroachment and facilitate open communication. In 2021 several communities noted it is difficult to predict local flood crests with the only gage so far upstream in Jordan. A hydrologic model of the LMRWD may be beneficial in evaluating and predicting flash floods from heavy rain events in the summer and fall, rather than the traditional snowmelt floods in the spring.

Finally, while no-rise certificates are supposed to be submitted to FEMA within six months of completion, in our review and discussions, it is clear that these are often not filed with FEMA nor shared with the LMRWD or the MnDNR. This is not a problem unique to LMRWD; the MnDNR indicated that this disconnect is a statewide problem and that it would be interested in developing a pilot program to track no-rise and floodplain development permits.

Having both a comprehensive hydraulic model and tracking system would fill this gap in floodplain development enforcement and would also provide a useful product to communities and the MnDNR for use in future map updates.

6 RECOMMENDATIONS

Based on our review of the 2004 model and recent land development within the watershed, we can make the following recommendations:

- Review the USGS Jordan gage and complete a statistical analysis to include the most recent peak flow data from 2001 to the present and confirm if the flows assumed for the 2004 model are still valid.
- Develop a district-wide hydrologic model to supplement the data from the USGS Jordan gage and allow for better predictions of flood stages within LMRWD and better input to evaluate the effects of full build-out and climate change on the river's hydrology.
- Update the 2004 hydraulic model of the Minnesota River to incorporate recent developments and survey data.
- Coordinate with neighboring watershed districts, MnDOT, MnDNR, and USACE to share any revised mapping with partner communities.
- Develop an accounting system for floodplain development to aid local municipalities in tracking floodplain developments for future map updates and share this information with the LMRWD, the MnDNR, and FEMA.

Given the number of communities and regulatory agencies reviewing floodplain development but not fully sharing the information, Rule C appears to be fulfilling its intended purpose of reducing flood elevation increases caused by floodplain development. While the Rule is more stringent than local and state requirements, it ensures that despite the lack of communication and consistent floodplain information, the floodplain development that has occurred has only caused increases in flood elevations.

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