MEMORANDUM REPORT NO. 259

A WATERCOURSE SYSTEM PLAN FOR HONEY CREEK

MILWAUKEE COUNTY, WISCONSIN

SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

Special acknowledgement is due to Laura K. Herrick, PE, CFM, Chief Environmental Engineer; Zijia Li, PE, Engineer; Karin M. Hollister, PE, Principal Engineer; Aaron W. Owens, Senior Planner; James M. Mahoney, PE, Engineer; Alexa Carzoli, Administrative Assistant, and Timothy R. Gorsegner, GIS Specialist for their contributions to the conduct of this study and the preparation of this report.

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NUMBER 259

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EXECUTIVE SUMMARY

INTRODUCTION AND BACKGROUND

This report summarizes the Southeastern Wisconsin Regional Planning Commission's (SEWRPC) effort to evaluate existing flood risk along Honey Creek and to develop six alternative floodland management plans to mitigate flood risks for 16 insurable structures[1] within the existing conditions 1-percent-annual-probability floodplain.[2] The alternatives were developed by SEWRPC in coordination with the Milwaukee Metropolitan Sewage District (MMSD), Milwaukee County, and the Cities of Greenfield, Milwaukee, Wauwatosa, and West Allis. Alternatives evaluated in this study include structure acquisition and demolition, structure elevation, bridge improvements, and channel rehabilitation.

Honey Creek is an 8.7-mile-long tributary of the Menomonee River that extends from S. 43rd Street just north of W. Edgerton Avenue downstream to its confluence with Menomonee River. It flows through four urban communities which include the Cities of Greenfield, Milwaukee, West Allis, and Wauwatosa. The majority of Honey Creek is channelized and has a concrete lining, while approximately 2.4 miles of the channel is enclosed in pipes between McCarty Park and I-94. The Honey Creek watershed is highly urban and fully built out with approximately 30-percent of the land cover being impervious. The land use in the watershed is predominantly residential.

ANALYSIS

To estimate flooding impacts under existing 2020 conditions and the proposed alternatives, hydrologic and hydraulic models were utilized. The U.S. EPA Hydrologic Simulation Program – Fortran was used for the hydrologic modeling to develop flows along Honey Creek. The U.S. Army Corps of Engineers HEC-RAS model was used for the hydraulic modeling to compute flood stages along Honey Creek. The existing conditions 1-percent-annual-probability floodplain impacted 11 insurable structures near S. 72nd Street in the City of Milwaukee, and five insurable structures near W. Loomis Road and S. 43rd Street in the City of Greenfield. The total expected damages for buildings impacted by the 1-percent-annual-probability flood event were estimated to be $313,000 and the expected annual flood damage was estimated to be $76,700 (2020 dollars). The existing conditions 1-percent-annual-probability floodplain mapping also identified 14 roadway flooding locations as well as five potential street flooding locations caused by storm sewer surcharge out of manholes above the enclosed section of Honey Creek.

SUMMARY OF ALTERNATIVES

Six alternatives were developed and summarized in this report. Alternative Plans No. 1 and No. 2 mitigate flooding for each insurable structure in the 1-percent-annual-probability floodplain using voluntary acquisition/demolition and voluntary elevation of structures, respectively. Alternative Plans No. 3 and No. 4 mitigate structure flooding using W. Oklahoma Avenue and S. 76th Street bridge improvements in combination with voluntary acquisition and demolition of select structures. Alternative Plans No. 5 and No. 6 mitigate structure flooding using concrete lined channel rehabilitation[3] in combination with voluntary acquisition and demolition of select structures.

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[1] *Insurable structures were assumed to include the primary building(s) on a given property that would be covered by insurance. The 16 structures do not include detached garages or sheds.*

[2] *The existing conditions 1-percent-annual-probability floodplain was developed by SEWRPC and is currently under the regulatory review and approval process.*

[3] *Channel rehabilitation includes removal of the existing concrete channel and the implementation of a bioengineered "natural" channel.*

Additionally, green infrastructure components were evaluated. The green infrastructure practices of rain barrels and cisterns were viable to supplement the evaluated alternatives but would not solely be able to relieve flooding on Honey Creek. A W. Wisconsin Avenue bridge improvement was also evaluated to address roadway flooding at that location. The bridge improvement was deemed feasible, and the City of Wauwatosa is currently working on detailed design and construction.

EVALUATION OF THE ALTERNATIVES

The six alternatives were compared for construction cost, flood reduction impacts, construction timing, implementation factors, and natural habitat enhancement. Planning level construction and maintenance costs were developed for each alternative. Planning level capital costs for the six alternatives ranged from $4.03 million to $36.47 million and are included in Table ES.1. Alternative Plan No. 2 had the lowest capital and average annual costs; however, the total capital cost does not include costs associated with providing dryland access. Discussions regarding providing dryland access to be able to implement Alternative Plan No. 2 would be needed between the impacted communities, WDNR, and the appropriate local emergency services.

A comparison of the total number of flooded structures and flood damages during the 0.2-percent-annual-probability flood event for the alternatives was completed as a resiliency check. Roadway flooding reductions for each of alternatives were also compared. Although all the alternatives provide flood protection for the 16 structures identified within the 1-percent-annual-probability floodplain, Alternative Plan No. 5 would provide the greatest degree of flood protection with respect to the 0.2-percent-annual-probability flood and road overtopping.

Implementation factors including construction issues, voluntary acquisition requirements, and maintenance needs were also evaluated for each alternative. Table ES.2 summarizes the implementation factor ratings for each alternative. Alternative Plan No. 1 and No. 2 were rated lowest for construction issues and maintenance requirements.

Wildlife habitat enhancements provide additional benefits for each of the alternatives to varying degrees. Alternative Plan No. 1 provides some opportunities for habitat with the removal of structures from the properties. Alternative Plans No. 2, 3, and 4 do not provide much space for habitat enhancements. Alternative Plans No. 5 and 6, which incorporate rehabilitation of the existing concrete channels, could be designed to significantly improve wildlife habitat along the Honey Creek open channel corridor.

All 16 insurable structures identified within the 1-percent-annual-probability floodplain were protected under each of the six alternative plans. No ranking or specific alternative recommendations were made in this report to allow stakeholders the flexibility to potentially implement a combination of these alternatives or to make refinements.

FUTURE WORK

Elected officials, staff, and residents of Milwaukee County and the Cities of Greenfield, Milwaukee, Wauwatosa, and West Allis will need to work together to determine which of the six alternatives presented in this report to pursue. The preferred alternative(s) should be further refined and more detailed study of their expected costs and impacts should be conducted.

Table ES.1
Comparison of Estimated Costs[a] of Alternative Plans

Alternative	Total Capital Cost ($)	Annual Operation and Maintenance ($)	Average Annual Cost[b] ($)
Alternative Plan No. 1 – Voluntary Acquisition and Demolition	6,325,000	--	401,000
Alternative Plan No. 2 – Voluntary Elevation	4,026,000	--	255,000
Alternative Plan No. 3 – W. Oklahoma Avenue Bridge Opening Modification and S. 76th Street Bridge Replacement	5,321,000	--	338,000
Alternative Plan No. 4 – W. Oklahoma Avenue and S. 76th Street Bridge Replacement	6,842,000	--	434,000
Alternative Plan No. 5 – Entire Concrete Channel Rehabilitation[c]	36,472,000	29,000	2,210,000
Alternative Plan No. 6 – Partial Concrete Channel Rehabilitation[d]	15,904,000	11,500	1,021,000
Alternative Plan No. 7 – No Action	--	--	76,700[e]

[a] *Flood damages are reported in year 2020 dollar values*

[b] *Amortized capital cost is based on an interest rate of 6 percent and a project life of 50 years*

[c] *Approximately 21,000 feet of concrete channel from I-894 to downstream of W. Wisconsin Avenue are rehabilitated under this alternative*

[d] *Approximately 8,400 feet of concrete channel from downstream of W. Morgan Avenue through McCarty Park are rehabilitated under this alternative*

[e] *Equal to average annual damages*

Source: SEWRPC

Table ES.2
Honey Creek Alternative Plans - Implementation Summary

	Construction Issues[a]			Acquisitions		
Alternative	Disruptions During Construction	Utility Conflict Potential	Land Disturbance	Number of Properties Voluntarily Acquired	2020 Total Assessed Value of Acquired Properties[c] ($)	Maintenance Requirements
Alternative Plan No. 1 – Voluntary Acquisition and Demolition	Low	Low	Low	16	2,582,000	Low
Alternative Plan No. 2 – Voluntary Elevation	Low	Low	Low	--[b]	--	Low
Alternative Plan No. 3 – W. Oklahoma Avenue Bridge Opening Modification and S. 76th Street Bridge Replacement	Medium	Medium	Low	7	1,199,000	Low
Alternative Plan No. 4 – W. Oklahoma Avenue and S. 76th Street Bridge Replacement	Medium	Medium	Low	6	1,041,000	Low
Alternative Plan No. 5 – Entire Concrete Channel Rehabilitation	High	High	High	5	872,000	High
Alternative Plan No. 6 – Partial Concrete Channel Rehabilitation	High	High	High	5	872,000	Medium

[a] *Construction issues ratings are based on the size and distance of the construction impacted area.*

[b] *Alternative Plan No. 2 in this report assumed elevation of all 16 insurable structures in the 1-percent-annual-probability floodplain. No property was assumed to be acquired and demolished. However, due to the MMSD floodproofing funding structure (Section 3.4.3) and potential challenges in meeting regulatory requirements, municipalities may choose to pursue acquisition and demolition with willing landowners instead.*

[c] *2020 assessed value of land and improvements by the communities.*

Source: SEWRPC

TABLE OF CONTENTS

LIST OF FIGURES

Chapter 3

LIST OF MAPS

Chapter 1

Chapter 2

Chapter 3

LIST OF TABLES

Chapter 2

1 INTRODUCTION AND BACKGROUND

Credit: SEWRPC Staff

On December 22, 2010, the Milwaukee Metropolitan Sewerage District (MMSD) requested that the Southeastern Wisconsin Regional Planning Commission (SEWRPC) perform hydrologic and hydraulic analyses and evaluate alternative floodland management plans for Honey Creek, a tributary of the Menomonee River, in the 8.7-mile-long reach from S. 43rd Street just north of W. Edgerton Avenue downstream to its confluence with the Menomonee River.

Commission staff have recently completed mapping the Honey Creek floodplain for planned land use[1] and existing channel conditions under a program funded by MMSD, the Milwaukee County Automated Mapping and Land Information System (MCAMLIS) Steering Committee[2], and SEWRPC.[3] Under that program, the 10-percent-annual-probability (10-year recurrence interval), 2-percent-annual-probability (50-year recurrence interval), 1-percent-annual-probability (100-year recurrence interval), and 0.2-percent-annual-probability (500-year recurrence interval) flood profiles were determined, and the corresponding flood inundation areas were digitally mapped.

The MCAMLIS Honey Creek floodplain mapping and associated hydrologic and hydraulic models were reviewed and approved by the Wisconsin Department of Natural Resources (WDNR) on April 6, 2021. These maps have been reviewed by all affected communities in Milwaukee County and form the basis for the analyses contained in this plan. The WDNR approved analyses and mapping are expected to be submitted to the Federal Emergency Management Agency (FEMA) under their Letter of Map Revision (LOMR) process in 2022 to be incorporated into the effective Digital Flood Insurance Rate Maps (DFIRMs) for Milwaukee County. It is anticipated that the DFIRMs will be adopted by all affected communities for local floodplain zoning purposes.

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[1] *Planned land use was developed as part of the* Regional Water Quality Management Plan *(SEWRPC Planning Report No. 50) and the MMSD 2020 Facilities Plan.*

[2] *MCAMLIS is now called the Milwaukee County Land Information Office (MCLIO).*

[3] *This floodplain study updates past analyses used for local zoning and Federal Emergency Management Agency (FEMA) flood insurance purposes.*

1.1 PLAN GOALS AND MAJOR TASKS

The primary goal for this planning study is to mitigate flood damages to insurable[4] buildings located within the 1-percent-annual-probability (100-year recurrence interval) floodplain of Honey Creek in the Cities of Milwaukee and Greenfield. Alternatives explored in this study include voluntary acquisition and demolition of flooded insurable structures, voluntary elevation of flooded insurable structures, and bridge improvements. The feasibility of channel rehabilitation, including the removal of the concrete channel and the implementation of a bioengineered "natural" channel, was also assessed for its impact on flooded structures. Historically, sections of urban watercourses within the MMSD jurisdiction were channelized and lined with concrete to improve conveyance capacity. This practice has caused negative impacts including increases to flow velocities, increases to the severity of flooding downstream, reductions in flood storage, streambed, and streambank erosion, decreases in water quality, and the loss of riverine and riparian habitat. In response to such drawbacks of concrete channelization, channel rehabilitation was a major reason for this study. Although currently the concrete lined sections of Honey Creek are in relatively good condition[5], channel rehabilitation alternatives were evaluated in anticipation for when the concrete channel lining reaches its design life.

The following tasks were performed under this study which include and expand upon those identified in the project agreement between the MMSD and SEWRPC.

- Review the storm sewers discharging to the enclosed section of Honey Creek from S. 82nd Street and W. Arthur Avenue to the north side of Interstate 94 (I-94). Determine the flood extents due to high water levels in the enclosure extending up into connecting storm sewers and surcharging from manholes on the land surface.

- Identify insurable structures flooded during floods with annual probabilities of up to 1 percent and estimate event and average annual flood damages for those structures.

- Identify critical use facilities located within the 0.2-percent-annual-probability floodplain.

- Identify arterial roads and freeways that would be inundated during the 1-percent-annual-probability floodplain.

- Evaluate green infrastructure implementation as a flood management strategy, specifically rain barrels and rainwater cisterns.

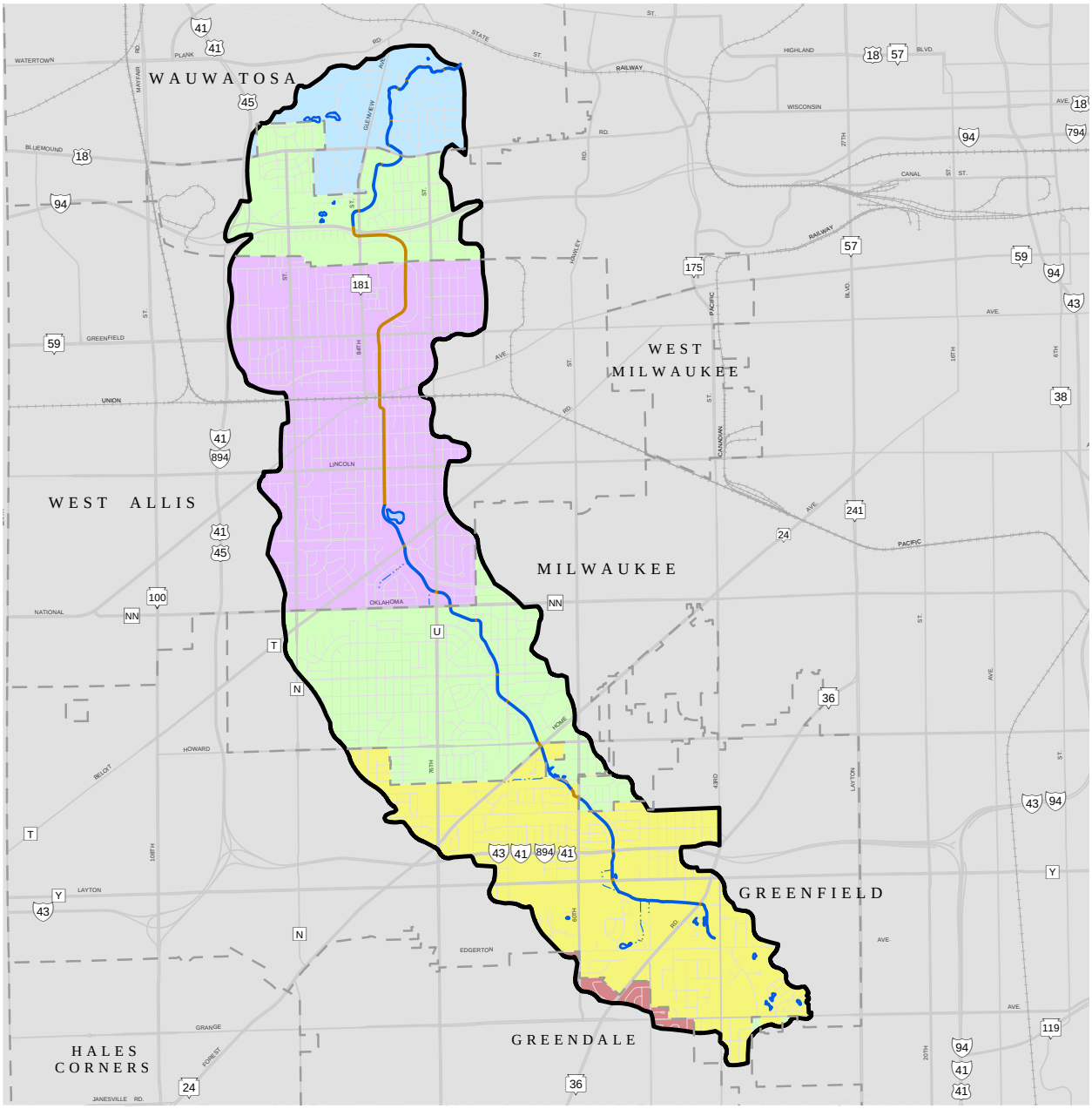
- Develop a conceptual alternative for the Wisconsin Avenue bridge in order to prevent the 1-percent-annual-probability flood from overtopping the bridge.

- Develop up to six comprehensive alternative plans to mitigate flood problems during events with annual probabilities of 1 percent or more frequent, including the development of planning level total capital costs, annual operation and maintenance costs, and average annual costs for each alternative plan. The flood management alternatives should include evaluation of acquisition and elevation of flooded structures, bridge improvements, and channel rehabilitation on the concrete sections of Honey Creek.

[4] *Insurable structures were assumed to include the primary building(s) on a given property that would be covered by insurance. The 16 structures do not include detached garages or sheds.*

[5] *No significant concrete channel degradation and no structural failures has been observed to date.*

Map 1.1
Civil Divisions Within the Honey Creek Watershed



Source: SEWRPC

1.2 DESCRIPTION OF STUDY AREA

The Honey Creek watershed is approximately 11 square-miles in area within Milwaukee County and includes the Cities of Greenfield, Milwaukee, Wauwatosa, and West Allis (Map 1.1). This study considered the effects of runoff from the entire watershed. The hydraulic analysis was completed for the entire 8.7-mile-long reach of Honey Creek from S. 43rd Street just north of W. Edgerton Avenue downstream to the confluence with the Menomonee River. Approximately 2.4 miles of the channel are enclosed between McCarty Park and I-94. Approximately 4.4 miles of the Honey Creek channel are concrete lined between I-894 and McCarty Park upstream of the enclosure and between I-94 and north of Wisconsin Avenue downstream of the enclosure.

HYDROLOGIC AND HYDRAULIC ANALYSIS 2

Credit: SEWRPC Staff

This section discusses the MCAMLIS Honey Creek existing conditions modeling effort as the basis for the floodland management alternatives analyses. Flood flows were developed using a hydrologic model and then a hydraulic model was used to delineate the existing 0.2-, 1-, 2-, and 10-percent-annual-probability floodplains for the open channel and enclosed section of Honey Creek. Areas of flooding due to surcharge of storm sewers connected to the enclosed section of Honey Creek were also delineated. Roadways inundated under the 1-percent-annual-probability flood were identified. Insurable structures impacted by the delineated floodplains were also identified and flood damages were estimated.

Throughout this plan the storm and flooding events will be described by a percent-annual-probability, which represents the percent chance the event will occur in any single year. Storm events can also be described by year recurrence interval and the relationship between the two descriptions are included below for reference.

- 0.2-percent-annual-probability event is equivalent to the 500-year recurrence interval event
- 0.5-percent-annual-probability event is equivalent to the 200-year recurrence interval event
- 1-percent-annual-probability event is equivalent to the 100-year recurrence interval event
- 2-percent-annual-probability event is equivalent to the 50-year recurrence interval event
- 4-percent-annual-probability event is equivalent to the 25-year recurrence interval event
- 10-percent-annual-probability event is equivalent to the 10-year recurrence interval event
- 50-percent-annual-probability event is equivalent to the 2-year recurrence interval event

2.1 EXISTING CONDITIONS HYDROLOGIC ANALYSIS

The U.S. EPA Hydrologic Simulation Program – Fortran (HSPF) version 11.1 was used for the hydrologic analysis. The model was used to simulate streamflow throughout the entire Menomonee River Watershed on a continuous basis for the period 1940 to 2004. The model reflected planned development and existing channel and floodplain conditions within the watershed. Simulated annual peak discharges from the HSPF model were fitted to a Log Pearson Type III distribution using the U.S. Army Corps of Engineers HEC-FFA software to obtain flow-frequency relationships. Desired flood probabilities for Honey Creek were obtained for use in the hydraulic model. The enclosed section of Honey Creek was modeled separately using EPA SWMM 5.0 to determine the maximum flow capacity. Final flows used for this evaluation are summarized in Table 2.1.

The original Menomonee River HSPF hydrologic model was developed by consultants for the MMSD Phase 1 and Phase 2 Menomonee River Watercourse Management Plans.[6,7] That model was based in part on the SEWRPC Menomonee River watershed Hydrocomp hydrologic model developed for a stormwater drainage and flood control system plan for MMSD.[8] The MMSD Menomonee River Phase 2 Watercourse Management Plan HSPF model was refined and recalibrated for the SEWRPC/MMSD/WDNR Water Quality Initiative which was used for the MMSD 2020 Facilities Plan and the Regional Water Quality Management Plan Update.[9] This HSPF model was further refined by Commission staff for the MCAMLIS project.

The MCAMLIS HSPF model was used for the 2014 Conditional Letter of Map Revision (CLOMR) submittal to FEMA for the Menomonee River (FEMA Case #15-05-1919R). It was also used by WDNR to develop updated floodplains for several Menomonee River tributaries as part of the Milwaukee River basin RiskMAP program.

2.2 EXISTING CONDITIONS HYDRAULIC ANALYSES

The effective Honey Creek U.S. Army Corps of Engineers (USACE) HEC-2 hydraulic model was developed for the original Commission study of the Menomonee River watershed.[10] The HEC-2 model was converted to a HEC-RAS model and updated by CDM and Tetra Tech respectively for the MMSD Phase 1 and Phase 2 Menomonee River Watercourse Management Plan.[11] The Phase 2 HEC-RAS model was refined by Commission staff for the MCAMLIS project as discussed below.

The USACE HEC-RAS model version 4.1.0 was used for this hydraulic analysis. The 50-percent-annual-probability through 0.2-percent-annual-probability flood profiles for Honey Creek were computed using this software package. Cross section geometry was obtained from available large-scale Milwaukee County topographic mapping from 2004 to 2005 with contour intervals of 2 feet. Model cross sections were located to match those in the effective model as much as possible. Additional cross sections were added to incorporate survey data or to provide a smoother transition in flood profile computation. Hydraulic structures including bridges, culverts, enclosures, drop structures and concrete channels were modeled based on available plan sets and survey. The detailed hydraulic model development memoranda are found in Appendix A.

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[6] *MMSD (Prepared by CDM),* Menomonee River Phase 1 Watercourse Management Plan*, August 2000*.

[7] *MMSD (Prepared by Tetra Tech MPS),* Menomonee River Phase 2 Watercourse Management Plan*, July 2002*.

[8] *SEWRPC Community Assistance Planning Report No. 152,* A Stormwater Drainage and Flood Control System Plan for the Milwaukee Metropolitan Sewerage District*, December 1990*.

[9] *SEWRPC Planning Report No. 50,* A Regional Water Quality Management Plan Update for the Greater Milwaukee Watersheds*, December 2007, May 2013*.

[10] *SEWRPC Planning Report No. 26,* A Comprehensive Plan for the Menomonee River Watershed*, October 1976*.

[11] Ibid.

Table 2.1
Honey Creek Peak Flow Rates - Planned Land Use, Existing Channel Conditions

River Mile[a]	Location	Annual Probability Peak Flow (cfs)			
		10-percent	2-percent	1-percent	0.2-percent
0.878	Downstream of W. Wisconsin Avenue	2,440	3,380	3,470	3,660
1.935	Downstream of I-94	2,350	3,040	3,090	3,210
3.044	State Fair Park Enclosure Downstream of W. Greenfield Avenue	2,140	2,340	2,340	2,340
4.2813	State Fair Park Enclosure Inlet at McCarty Park	1,990	2,340	2,340	2,340
5.002	Downstream of S. 76th Street	1,600	2,450	2,850	3,860
5.227	Upstream of W. Oklahoma Avenue	1,340	2,090	2,450	3,380
6.389	Downstream of W. Forest Home Avenue / W. Howard Avenue	1,170	1,850	2,180	3,060
7.449	Downstream of I-894	970	1,580	1,880	2,700
7.669	Downstream of W. Layton Avenue	495	821	988	1,460
8.020	Konkel Park pedestrian bridge	374	620	746	1,100
8.666	Upstream end at S. 43rd Street	316	524	631	932

[a] *The measure of distance in miles along Honey Creek from its mouth at the Menomonee River*

Source: SEWRPC

2.3 EXISTING CONDITIONS FLOODPLAIN

The 10-, 2-, 1-, and 0.2-percent-annual-probability floodplain mapping was delineated manually by hand and then digitized according to the 2004 to 2005 Milwaukee County topographic contours. Flooding due to storm sewer surcharge out of manholes along the enclosed section of Honey Creek was also delineated using storm sewer network maps provided by MMSD. All floodplain and floodway boundaries were delineated using flood profiles determined for planned land use and existing channel conditions. The 10-, 2-, 1-, and 0.2-percent-annual-probability existing conditions flood elevations are set forth in Appendix B. Elevations utilize the National Geodetic Vertical Datum of 1929. The Honey Creek 1-percent-annual-probability floodplain boundaries are included in Maps 2.1 to 2.7.

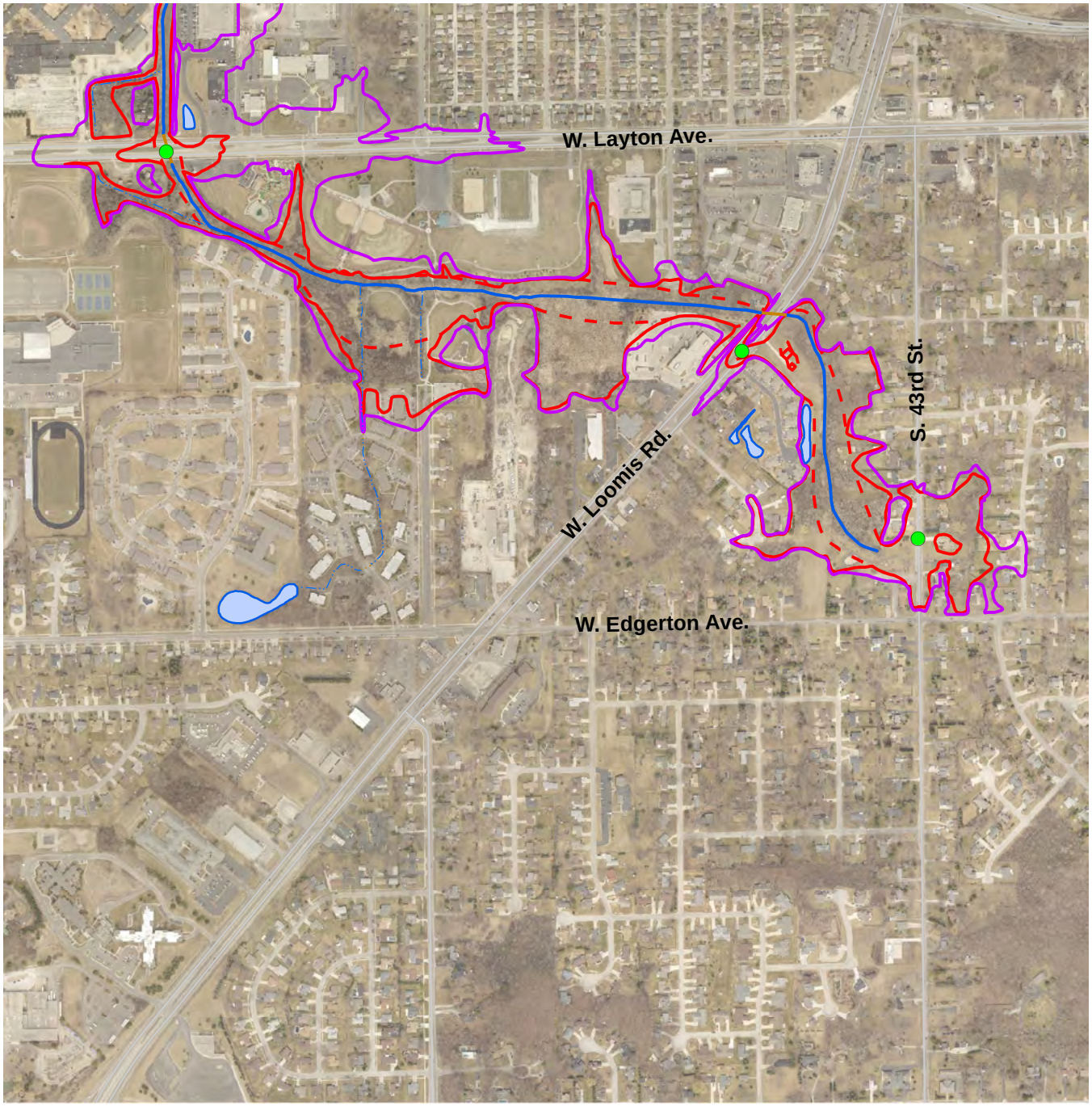
2.4 ESTIMATION OF POTENTIAL FLOOD DAMAGES

Flooding of Roadways

Maps 2.1 to 2.7 identify the locations where the public roadway is expected to flood during the 1-percent-annual-probability flood event. These overtopping locations assume the bridges are not obstructed by debris or ice. Potential roadway flooding locations and estimated maximum flooding depths are listed below from upstream to downstream on Honey Creek. The maximum flooding depths are based on the 1-percent-annual-probability flood elevation and the 2-foot topographic contours.

- City of Greenfield, 630-foot-long stretch of S. 43rd Street, just north of W. Edgerton Avenue, approximately 2-foot maximum depth (Map 2.1)
- City of Greenfield, W. Loomis Road crossing, less than 6-inch maximum depth (Map 2.1)
- City of Greenfield, W. Layton Avenue crossing, less than 6-inch maximum depth (Map 2.1)
- City of Greenfield, west of the Creek on S. Placid Drive just south of W. Allerton Avenue, approximately 1-foot maximum depth (Map 2.2)
- City of Greenfield, east of the Creek on W. Allerton Avenue just west of S. Honey Creek Drive, approximately 2-foot maximum depth (Map 2.2)
- City of Milwaukee, W. Ohio Avenue east and west of Honey Creek, approximately 1-foot maximum depth (Map 2.3)

Map 2.1
Honey Creek Floodplain - S. 43rd Street to W. Layton Avenue



0.2-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL PROBABILITY FLOODWAY BOUNDARY

LOCATIONS OF 1-PERCENT-ANNUAL-PROBABILITY ROADWAY FLOODING

PERENNIAL STREAM

PERENNIAL STREAM (ENCLOSED)

INTERMITTENT STREAM

INTERMITTENT STREAM (ENCLOSED)

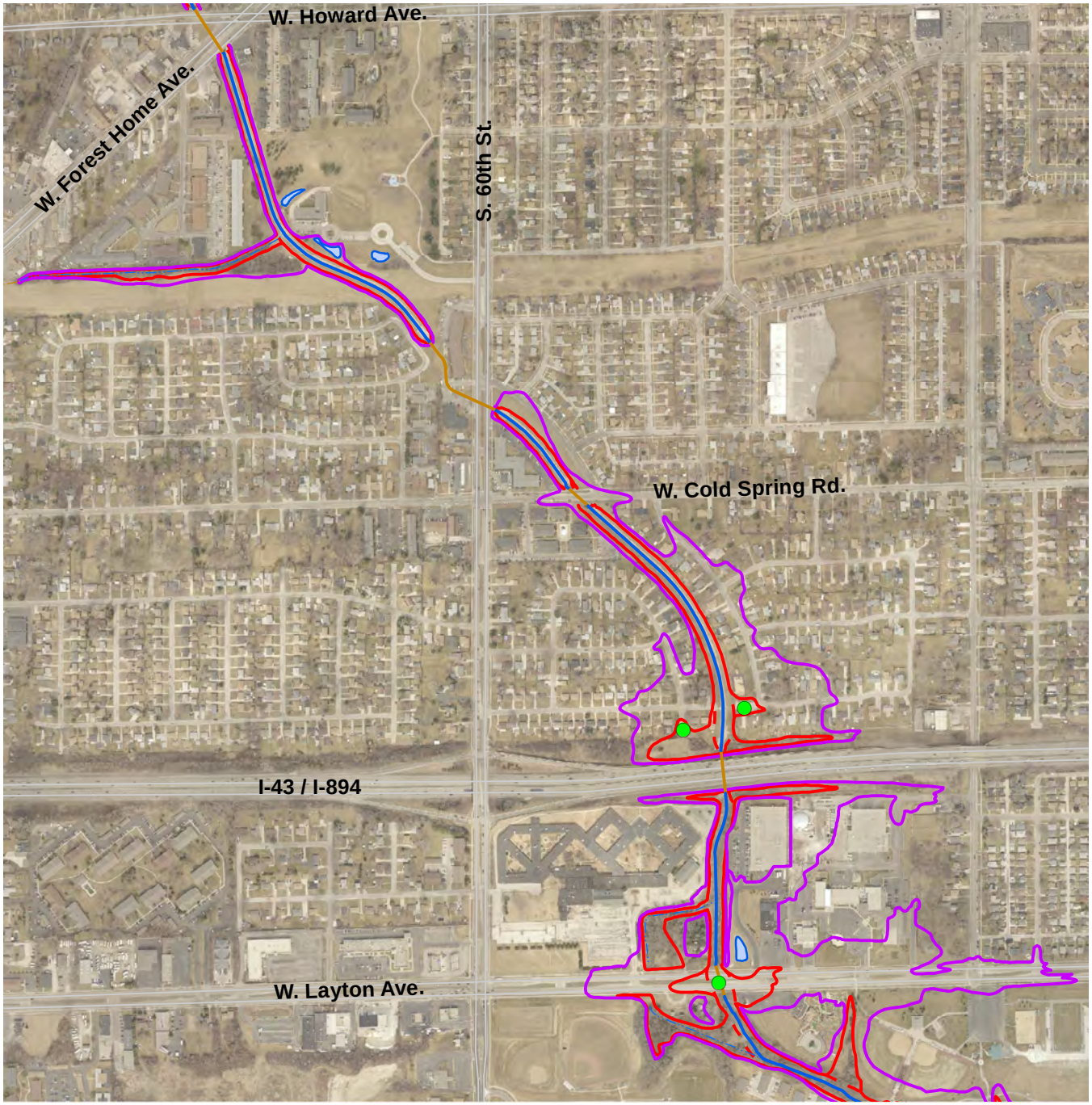
SURFACE WATER

N

0 225 450 675 900 Feet

Source: SEWRPC

Map 2.2
Honey Creek Floodplain - W. Layton Avenue to W. Forest Home Avenue



0.2-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL PROBABILITY FLOODWAY BOUNDARY

LOCATIONS OF 1-PERCENT-ANNUAL-PROBABILITY ROADWAY FLOODING

PERENNIAL STREAM

PERENNIAL STREAM (ENCLOSED)

INTERMITTENT STREAM

INTERMITTENT STREAM (ENCLOSED)

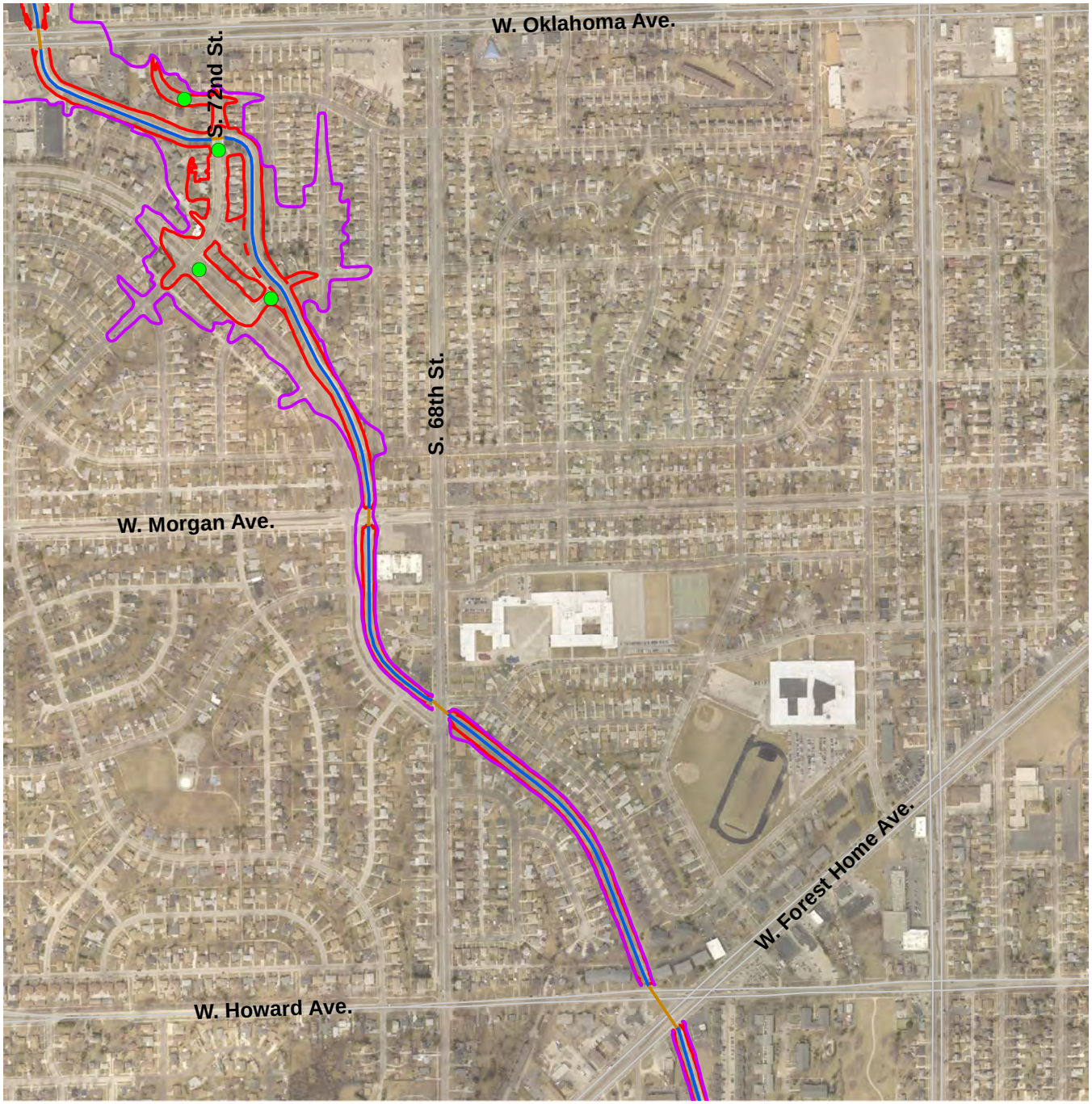
SURFACE WATER

N

0 225 450 675 900 Feet

Source: SEWRPC

Map 2.3
Honey Creek Floodplain - W. Forest Home Avenue to S. 72nd Street



0.2-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL PROBABILITY FLOODWAY BOUNDARY

LOCATIONS OF 1-PERCENT-ANNUAL-PROBABILITY ROADWAY FLOODING

PERENNIAL STREAM

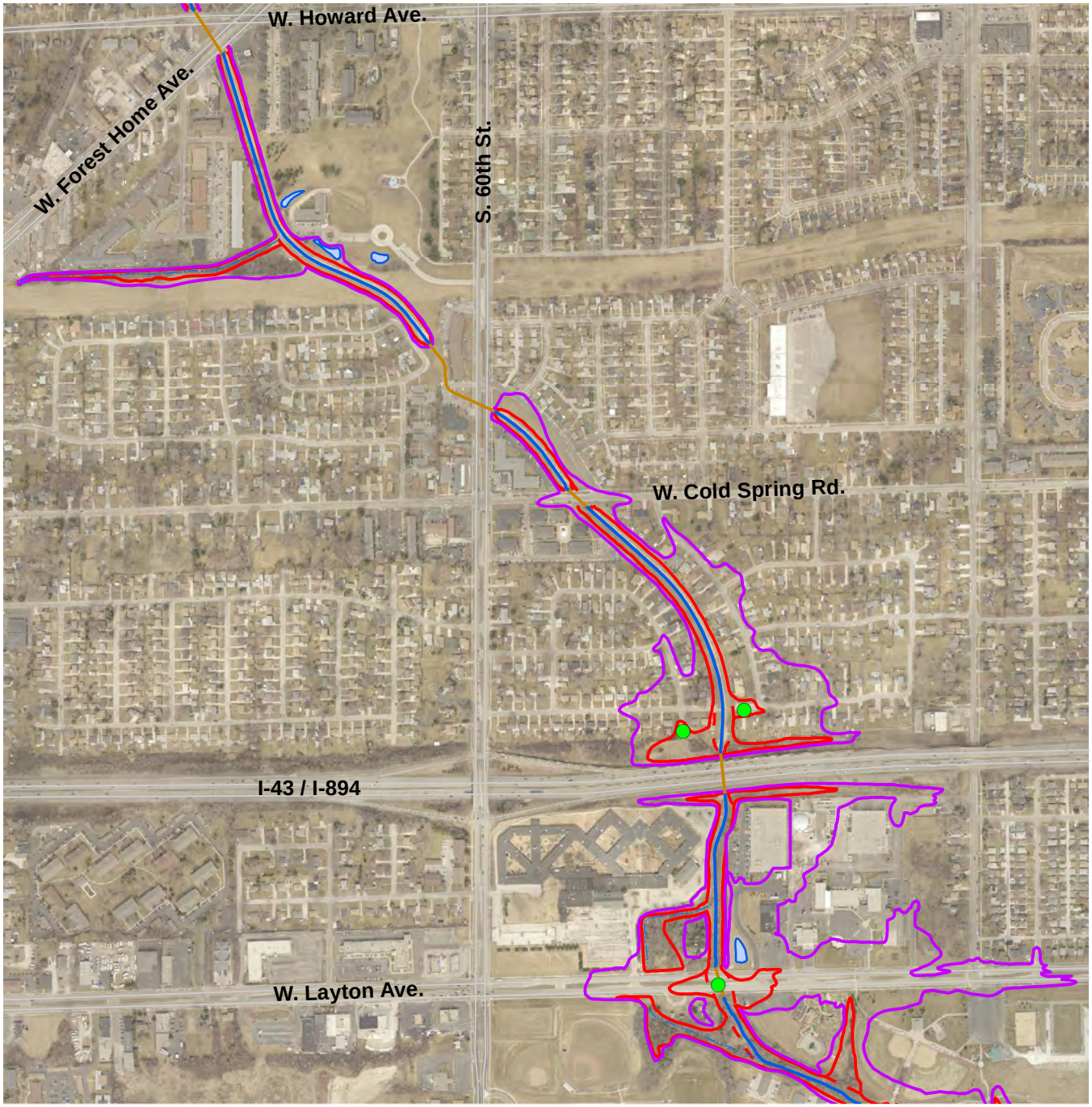
PERENNIAL STREAM (ENCLOSED)

N

0 225 450 675 900 Feet

Source: SEWRPC

Map 2.4
Honey Creek Floodplain - S. 72nd Street to W. Arthur Avenue



0.2-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL PROBABILITY FLOODWAY BOUNDARY

LOCATIONS OF 1-PERCENT-ANNUAL-PROBABILITY ROADWAY FLOODING

PERENNIAL STREAM

PERENNIAL STREAM (ENCLOSED)

INTERMITTENT STREAM

INTERMITTENT STREAM (ENCLOSED)

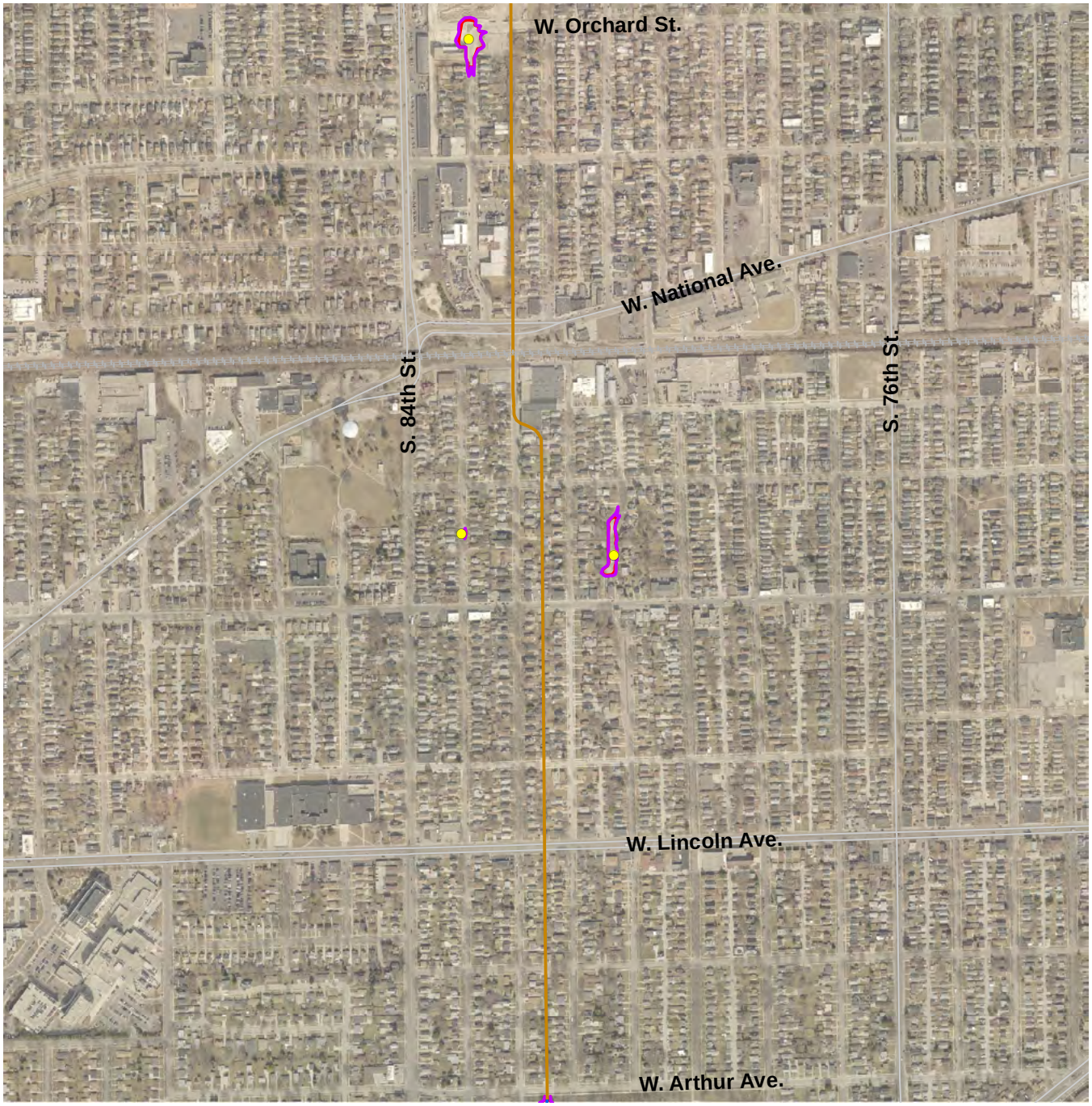
SURFACE WATER

N

0 225 450 675 900 Feet

Source: SEWRPC

Map 2.5
Honey Creek Floodplain - W. Arthur Avenue to W. Orchard Street



0.2-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL PROBABILITY FLOODWAY BOUNDARY

LOCATIONS OF FLOODING DUE TO STORM SEWER SURCHARGE

PERENNIAL STREAM

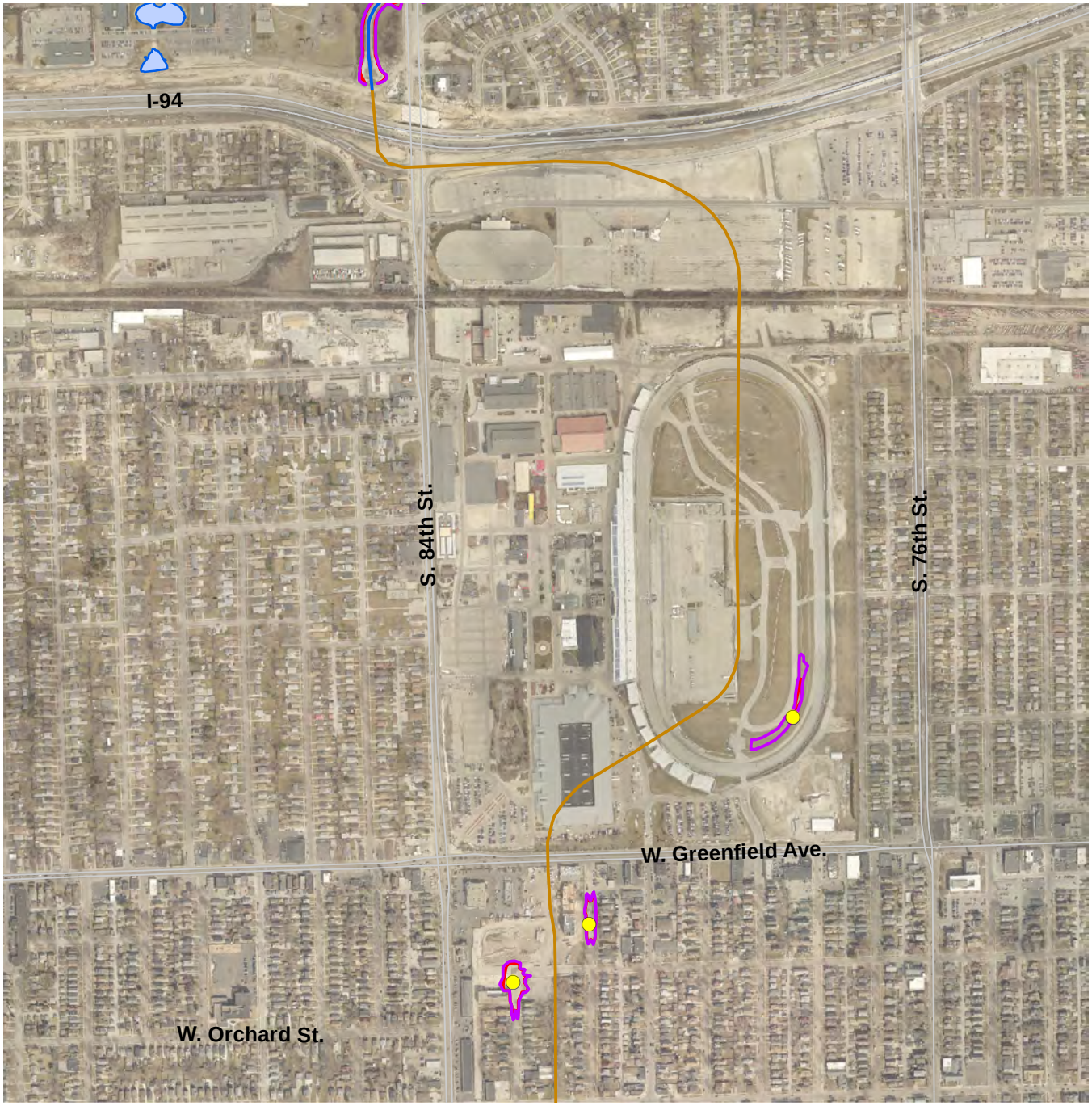
PERENNIAL STREAM (ENCLOSED)

N

0 225 450 675 900 Feet

Source: SEWRPC

Map 2.6
Honey Creek Floodplain - W. Orchard Street to I-94



0.2-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL PROBABILITY FLOODWAY BOUNDARY

LOCATIONS OF FLOODING DUE TO STORM SEWER SURCHARGE

PERENNIAL STREAM

PERENNIAL STREAM (ENCLOSED)

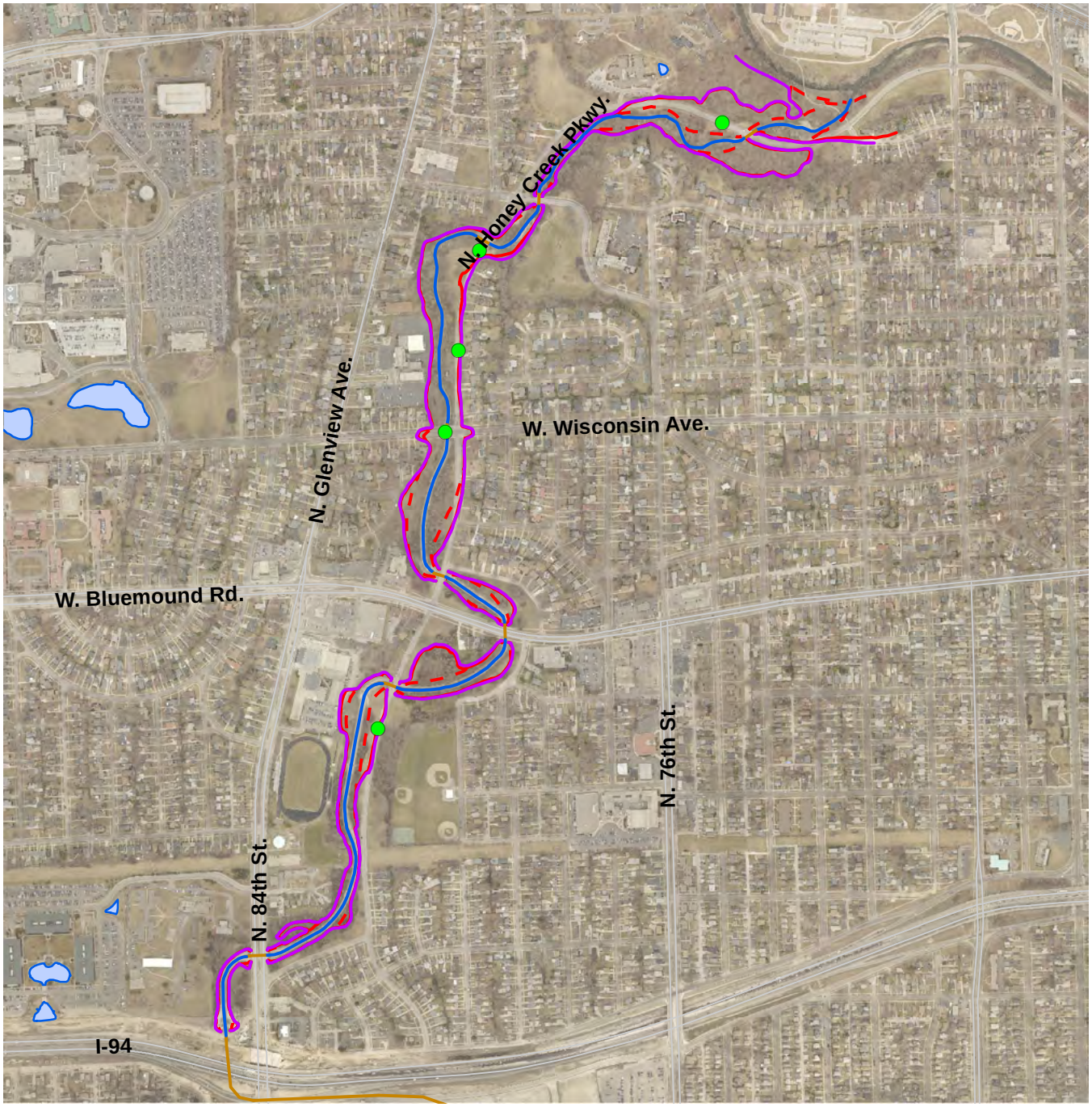
SURFACE WATER

N

0 225 450 675 900 Feet

Source: SEWRPC

Map 2.7
Honey Creek Floodplain - I-94 to Mouth



0.2-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL PROBABILITY FLOODWAY BOUNDARY

LOCATIONS OF 1-PERCENT-ANNUAL-PROBABILITY ROADWAY FLOODING

PERENNIAL STREAM

PERENNIAL STREAM (ENCLOSED)

SURFACE WATER

N

0 250 500 750 1,000 Feet

Source: SEWRPC

- City of Milwaukee, 200-foot-long stretch of W. Honey Creek Drive and 500-foot-long stretch of S. Honey Creek Drive southwest of Honey Creek near S. 72nd Street, approximately 1.5-foot maximum depth (Map 2.3)

- City of Milwaukee, 1,170-foot-long stretch of S. 72nd Street intersecting Honey Creek, approximately 1.5-foot maximum depth (Map 2.3)

- City of Milwaukee, 600-foot-long stretch of W. Lakefield Drive north of Honey Creek, approximately 1-foot maximum depth (Map 2.4)

- City of Milwaukee, 490-foot-long stretch of N. Honey Creek Parkway east of Honey Creek, 610 feet south of W. Bluemound Road, less than 6-inch maximum depth (Map 2.7)

- City of Wauwatosa, W. Wisconsin Avenue intersecting Honey Creek, approximately 3-foot maximum depth (Map 2.7)

- City of Wauwatosa, 1,490-foot-long stretch of N. Honey Creek Parkway east of Honey Creek, 670 feet southwest of Portland Avenue, approximately 3-foot maximum depth (Map 2.7)

- City of Wauwatosa, N. Honey Creek Parkway crossing, 250 feet southwest of Portland Avenue, approximately 1-foot maximum depth (Map 2.7)

- City of Wauwatosa, 860-foot-long stretch of W. Honey Creek Parkway north of Honey Creek, 1,400 feet west of N. 70th Street, approximately 1-foot maximum depth (Map 2.7)

Several streets and the Milwaukee Mile Speedway racetrack in the area adjacent to the enclosed section of Honey Creek are also expected to flood due to high water levels in the enclosure that cause storm sewer surcharge out of manholes. Potential enclosure flooding locations and estimated maximum flooding depths based on 2-foot topographic contours during a 0.2-percent-annual-probability flood from upstream to downstream are:

- City of West Allis, 330-foot-long stretch of S. 80th Street, 160 feet south of W. Rogers Street, approximately 1-foot maximum depth (Map 2.5)

- City of West Allis, 50-foot-long stretch of S. 83rd Street, 220 feet south of W. Rogers Street, approximately 6-inch maximum depth (Map 2.5)

- City of West Allis, 280-foot-long stretch of S. 83rd Street, 450 feet north of W. Latham Street, approximately 1-foot maximum depth (Map 2.6)

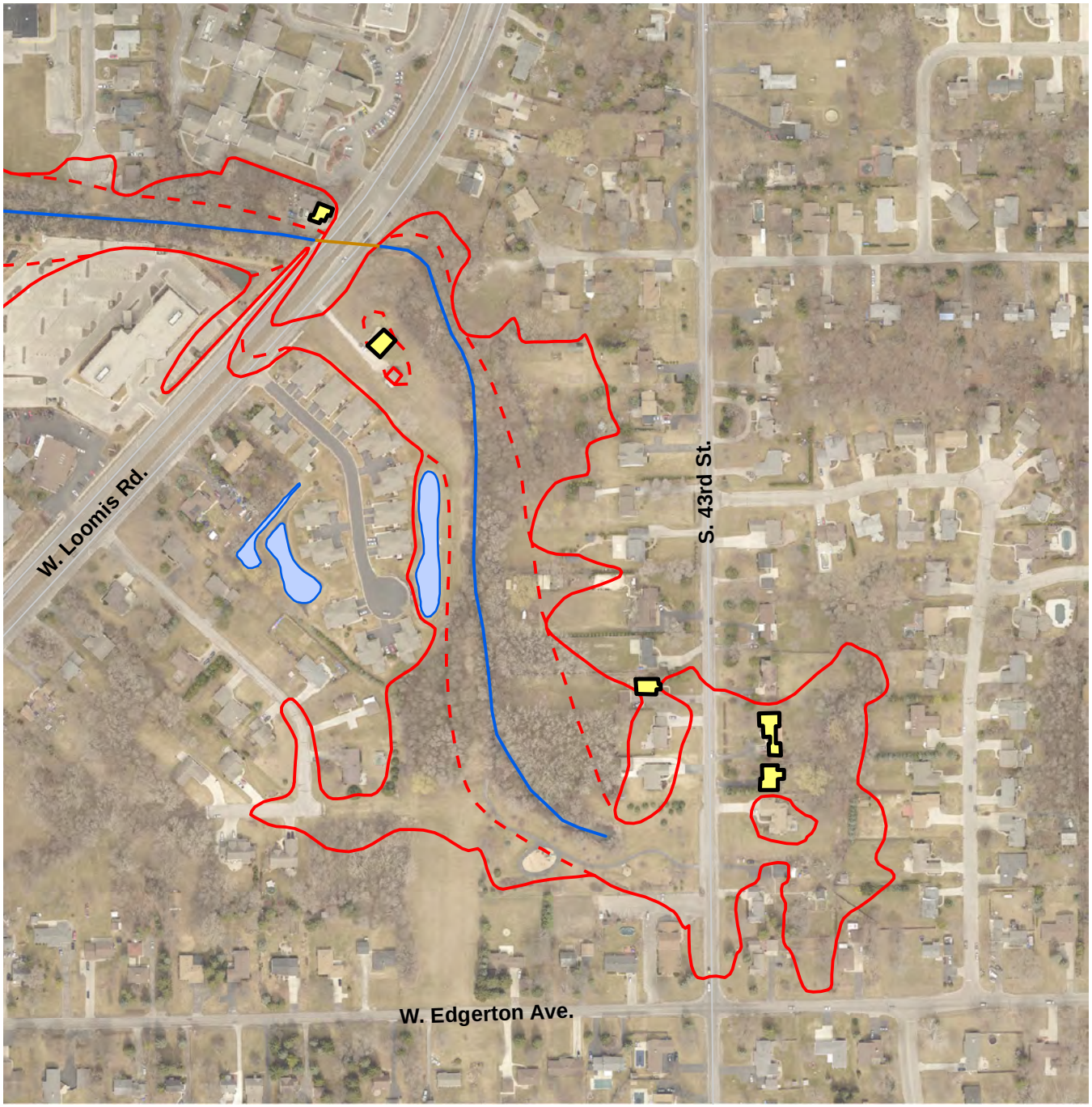
- City of West Allis, 280-foot-long stretch of S. 82nd Street, 120 feet north of W. Orchard Street, approximately 6-inch maximum depth (Map 2.6)

- City of West Allis, southeastern portion of Milwaukee Mile Speedway racetrack, approximately 1-foot maximum depth (Map 2.6)

Flooding of Buildings

Sixteen (16) insurable residential structures are impacted by the Honey Creek 1-percent-annual-probability floodplain. Five of the 16 insurable structures are in the upper reaches of Honey Creek in the City of Greenfield near W. Loomis Road and S. 43rd Street, and henceforth will be referred to as the City of Greenfield impacted area. Eleven (11) of the 16 flooded insurable structures are located on and near S. 72nd Street in the City of Milwaukee, which will be referred to for the rest of this document as the City of Milwaukee impacted area. The locations of the impacted structures in the City of Greenfield and the City of Milwaukee are included in Maps 2.8 and 2.9, respectively. The estimated number and types of buildings in each municipality that would be flooded during the 10-, 2-, 1-, and 0.2-percent-annual-probablity floods on Honey Creek are included in Table 2.2. One residential structure is impacted by the 10-percent-annual-probability floodplain

Map 2.8
Structures Flooded for the 1-Percent-Annual-Probability Honey Creek Floodplain in the City of Greenfield



1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL PROBABILITY FLOODWAY BOUNDARY

INSURABLE STRUCTURES IN THE 1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN

PERENNIAL STREAM

PERENNIAL STREAM (ENCLOSED)

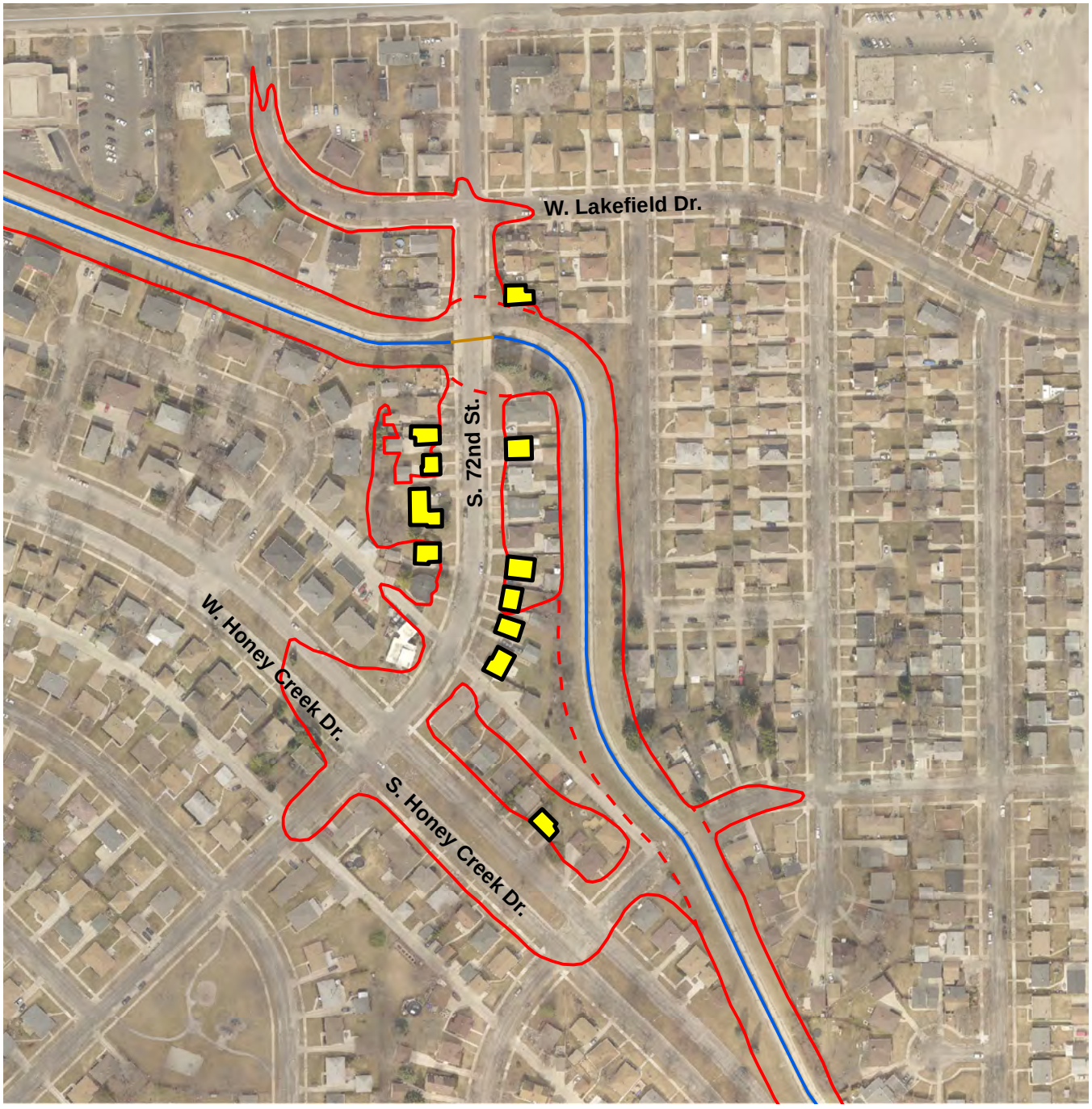
SURFACE WATER

N

0 75 150 225 300 Feet

Source: SEWRPC

Map 2.9
Structures Flooded for the 1-Percent-Annual-Probability Honey Creek Floodplain in the City of Milwaukee



1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL PROBABILITY FLOODWAY BOUNDARY

INSURABLE STRUCTURES IN THE 1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN

PERENNIAL STREAM

PERENNIAL STREAM (ENCLOSED)

N

0 75 150 225 300 Feet

Source: SEWRPC

Table 2.2
Inventory of Buildings Within 10-Through 0.2-Percent-Annual-Probability Floodplains

	Number of Buildings Located Within:											
	10-Percent-Annual-Probability Floodplain			2-Percent-Annual-Probability Floodplain			1-Percent-Annual-Probability Floodplain			0.2-Percent-Annual-Probability Floodplain		
Municipality	Commercial	Institutional	Residential	Commercial	Institutional	Residential	Commercial	Institutional	Residential	Commercial	Institutional	Residential
City of Greenfield	0	0	1	0	0	4	0	0	5	1	0	58
City of Milwaukee	0	0	0	0	0	1	0	0	11	1	1	83
City of Wauwatosa	0	0	0	0	0	0	0	0	0	0	0	0
City of West Allis	0	0	0	0	0	0	0	0	0	2	1	7
Total	0	0	1	0	0	5	0	0	16	4	2	148

Source: SEWRPC

and five residential structures are impacted by the 2-percent-annual-probability floodplain. Sixteen (16) insurable structures are impacted by the Honey Creek 1-percent-annual-probability floodplain and 154 insurable structures are impacted by the 0.2-percent-annual-probability floodplain. No insurable critical use facilities were located within the Honey Creek 1-percent or 0.2-percent-annual-probability floodplain.

The 16 identified structures are not located within the effective FEMA floodplain. Once the Honey Creek MCAMLIS floodplain is submitted and approved by FEMA, it will replace the current FEMA floodplain and become the new regulatory floodplain. At such time, all 16 structures would be considered legal, nonconforming structures under Chapter NR 116, "Wisconsin's Floodplain Management Program", of the *Administrative Code* (NR 116). Legal nonconforming structures in the floodplain are subject to regulations that limit improvements, additions, and other modifications to the structure.

SEWRPC staff conducted a parcel-based analysis to estimate the damages that would be sustained by buildings as a result of the 10-, 2-, 1-, and 0.2-percent-annual-probability flood events. GIS was used to identify those parcels that are wholly or partially located within each of the floodplains, and then the structures were examined using 2010 aerial photographs to determine whether a principal building, such as a house, a commercial building, or an industrial building was located within each floodplain. For those parcels in which a principal building was located wholly or partially in the floodplain, the 2020 assessed value of improvements was obtained from the Cities of Greenfield, Milwaukee, Wauwatosa, and West Allis. Assessment data was used to classify each principal building as residential, commercial, industrial, governmental, or other. For each principal building, the lowest elevation of the ground at the building was estimated from the 2004-2005 Milwaukee County 2-foot contours. Lowest Adjacent Grade (LAG) surveys were conducted at 52 select buildings in 2014 and 2021 to verify the flood hazard.

An assumption was made for the elevation of the first floors of the principal buildings for the Honey Creek damage calculation. For all building types, it was assumed that the first floor was one foot above the lowest adjacent ground elevation. Flood elevations for the 10-, 2-, 1-, and 0.2-percent-annual-probability flood events were derived from the floodplain hydraulic modeling described previously. Due to the recent rapid growth in property values, the 2020 assessed values were consistently low compared to the current market values for all the communities. An assumed 35-percent increase[12] was applied to the 2020 assessed value of improvements to estimate the market value. Total market value of improvements plus contents was assumed to be the total market values of improvements times 1.5 if the depth of flooding was above the first-floor elevation, or times 1.15 if the depth of flooding was below the first-floor elevation (basement flooding only).

For each building, the first-floor elevation was compared to the appropriate modeled flood elevation. The extent of direct damage, such as the costs associated with cleaning, repairing, or replacing the structure and its contents, for each principal building was estimated as a percent of the total market value plus contents, based on standardized flood loss depth-damage curves prepared by FEMA, USACE, and SEWRPC. Indirect damages, such as the costs associated with temporary evacuations, relocations, lost wages, lost production and sales, and the incremental costs of traffic detours, were estimated to be a percentage of direct damages, with indirect damages representing 15 percent of direct damages for residential buildings and 40 percent of direct damages for commercial and industrial buildings. The total damage for each flood event was the sum of direct and indirect damages.

The resulting total flood damages by municipality for insurable structures are presented in Table 2.3. Total expected damages caused by the 10-, 2-, 1-, and 0.2-percent-annual-probability flood events for Honey Creek are $15,400, $84,000, $313,000, and $10.03 million, respectively.

[12] *The assumption of 35-percent increase to the property assessed values was a conservative estimate of the property market values. The assumption was based on a comparison of recently sold residential home prices with the values assessed by the communities for select homes.*

Table 2.3
Honey Creek Mainstem in Milwaukee County – Total Flood Damages[a]

Municipality	10-Percent-Annual-Probability (10-year recurrence interval) Total Flood Damages ($)	2-Percent-Annual-Probability (50-year recurrence interval) Total Flood Damages ($)	1-Percent-Annual-Probability (100-year recurrence interval) Total Flood Damages ($)	0.2-Percent-Annual-Probability (500-year recurrence interval) Total Flood Damages ($)
City of Greenfield	15,400	78,800	117,300	2,114,000
City of Milwaukee	0	5,200	195,400	5,737,000
City of Wauwatosa	0	0	0	0
City of West Allis	0	0	0	2,177,000
Total	15,400	84,000	312,700	10,028,000

[a] *Flood Damages are reported in year 2020 dollar values*

Source: SEWRPC

Table 2.4
Honey Creek Mainstem in Milwaukee County Average Annual Flood Damages[a]

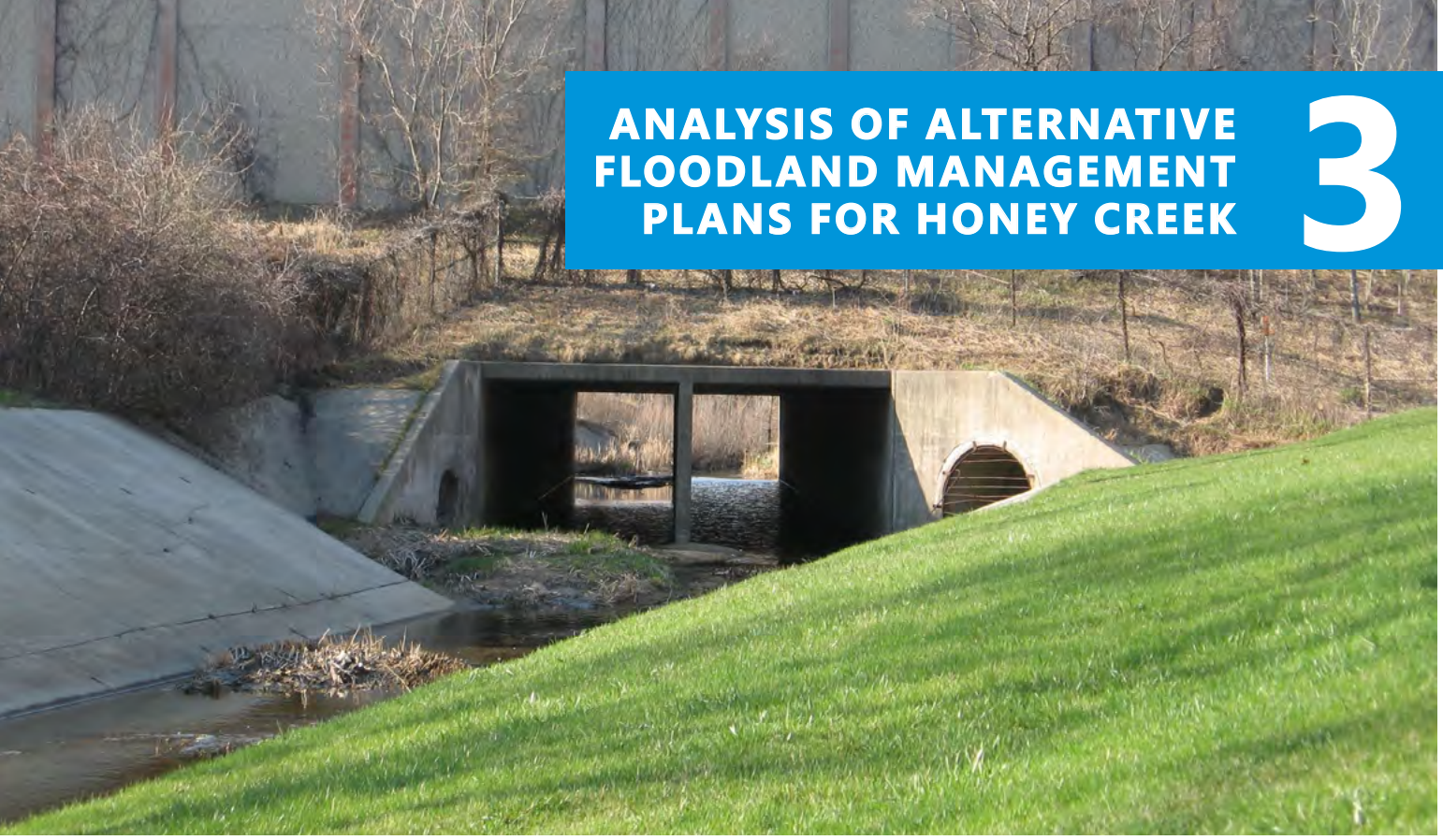
Municipality	Average Annual Flood Damages ($)
City of Greenfield	25,300
City of Milwaukee	37,800
City of Wauwatosa	0
City of West Allis	13,600
Total	76,700

[a] *Flood Damages are reported in year 2020 dollar values*

Source: SEWRPC

Expected Annual Flood Risks

The expected annual flood damage risk for a stream reach is defined as the sum of the insurable structure direct and indirect monetary flood losses resulting from floods of all probabilities, each weighted by its probability of occurrence or exceedance in any year. This methodology was used to compute expected annual flood risks for Honey Creek under existing channel and planned land use conditions. The inventory of buildings in the 10-, 2-, 1-, and 0.2-percent-annual-probability floodplains is set forth in Table 2.2. The expected annual flood risks by municipality are presented in Table 2.4. The average annual flood damage for Honey Creek was estimated to be $76,700 total, with $25,300 in the City of Greenfield, $37,800 in the City of Milwaukee, and $13,600 in the City of West Allis.



ANALYSIS OF ALTERNATIVE FLOODLAND MANAGEMENT PLANS FOR HONEY CREEK 3

Credit: SEWRPC Staff

3.1 FORMULATION OF ALTERNATIVE FLOOD CONTROL MEASURES

Alternative flood control measures were carefully formulated by first examining flood prone locations and structures and determining the size and cause of the flood problems. Then multiple flood protection techniques were evaluated to address the flood problems. Flood control measures were primarily formulated to address damages caused by the 1-percent-annual-probablity flood. Some degree of flood damage potential remains for floods of greater magnitude.

The alternative plans described below incorporate alone, or in combination:

- Voluntary acquisition and removal of flood prone structures
- Voluntary structure elevation
- Bridge improvements
- Channel rehabilitation and modification including the removal of the concrete sections of Honey Creek and the construction of a bioengineered natural channel

Other flood control measures including levees, detention storage, and secondary channels were also considered to protect the flooded structures in the City of Milwaukee impacted area. However, these measures for flood relief are not likely to be feasible or effective due to the following reasons:

- The high complexity and cost of construction and maintenance for a levee or a secondary channel did not justify the anticipated small improvement in flood protection
- Implementing such control measures could involve substantial modification to the land surface and disruption of existing neighborhoods through acquisition and demolition of buildings both inside and outside of the floodplain

- The narrow configuration of the Honey Creek watershed, as well as the lack of available open space, eliminated investigating a large flood storage facility as an alternative

Consistent with MMSD watercourse system planning criteria and standard flood control practice, the alternative plans are designed to alleviate flood damages during floods with annual probabilities of occurrence of 1-percent or greater. The alternative plans were generally designed to avoid increases in the 1-percent-annual-probability flood profile relative to planned land use and existing channel conditions.

3.2 GREEN INFRASTRUCTURE CONSIDERATIONS

Green infrastructure practices were also considered for flood management. As the watershed is predominantly residential, rain barrels and rainwater cisterns were evaluated for their effectiveness in reducing stormwater runoff. The evaluation assumed an optimistic installation of either two 50-gallon capacity rain barrels per house or one 200-gallon capacity rainwater cistern per house for every home in the Honey Creek watershed. A recent large storm event on August 2, 2020, produced 4.49 inches of rainfall within a 3-hour duration in proximity to the Honey Creek watershed.[13] This rainfall intensity corresponds to a 1- to 0.5-percent-annual-probability storm event. Calculations for full implementation of rain barrels or cisterns, based on representative subbasins within the Honey Creek watershed for the August 2020 storm event, yielded a rainfall capture of 0.01 inches and 0.02 inches, respectively. This level of capture equates to less than a 1 percent reduction of the storm rainfall total.

Based on the results of this analysis, the rainfall captured by rain barrels or rainwater cisterns would have a minimal impact on reducing Honey Creek flood flows. Green infrastructure can be a viable complement to the alternatives discussed within this study but would not solely be able to relieve flooding on Honey Creek.

3.3 W. WISCONSIN AVENUE BRIDGE ALTERNATIVE TO ADDRESS ROADWAY FLOODING

Due to the overtopping of W. Wisconsin Avenue by the Honey Creek 1-percent-annual-probability flood event, the City of Wauwatosa requested an evaluation for a W. Wisconsin Avenue bridge replacement alternative. Bridge structure alternatives were evaluated to determine the feasibility of a replacement structure that could prevent flooding over the road. The following conceptual bridge modifications were evaluated in the hydraulic model:

- Raise the top of road elevation by a minimum of 2 feet,
- Widen the bridge span from 24.6 feet to 71.5 feet, and
- Raise the bridge low chord by 2.2 feet

The above conceptual design would also require raising the bridge deck and raising the adjacent road profiles for W. Wisconsin Avenue and N. Honey Creek Parkway. The hydraulic analysis of the bridge alternative with the above dimensions indicates no flood overtopping of W. Wisconsin Avenue for the 1-percent-annual-probability event. However, improvements at the W. Wisconsin Avenue bridge will not mitigate flooded structures upstream of the enclosure in the City of Milwaukee impacted area.

The City of Wauwatosa has decided to pursue detailed design and construction of a W. Wisconsin Avenue bridge replacement to mitigate flooding of the roadway at Honey Creek. The City has received $2.8 million in funding from the Wisconsin Department of Transportation (WisDOT) for this project. The total cost of the project is $4 million. Construction is not expected to begin until 2025.

[13] *Precipitation data was obtained from the MMMSD Rain Gauge WS1216 at 3563 S. 97th Street, Milwaukee, WI, which is approximately 1.5 miles southwest of McCarty Park.*

3.4 FLOODED BUILDINGS ALTERNATIVES

The first two alternatives evaluated to mitigate the flood impact to insurable structures in the 1-percent-annual probability floodplain include voluntary acquisition/demolition and voluntary floodproofing by elevation of the structure. No additional hydrologic or hydraulic analysis were required to evaluate these alternatives. Planning level costs were also developed for both alternatives.

Alternative Plan No. 1 – Voluntary Acquisition and Demolition

Under this alternative plan, each of the 16 insurable residential buildings within the 1-percent-annual-probability floodplain would be voluntarily purchased, demolished, and removed from the floodplain.[14] The open space that would be created would remain in public ownership and would be prohibited from future development. The two areas in which buildings would be purchased under this alternative are shown on Maps 2.8 and 2.9.

The costs for acquisition of land and buildings were estimated based on year 2020 fair market values for each municipality. Due to the recent rapid growth in property values, the 2020 assessed values were consistently low compared to the market values for all the communities. An assumed 35-percent increase was applied to the 2020 assessed value of land and improvements to estimate the total current market value of each property. Costs of demolition, relocation assistance, moving expenses, title insurance, closing costs, appraisal, surveys, property taxes, and miscellaneous fees were estimated to average $75,000 per property. Those cost estimates include the $30,000 residential relocation reimbursement consistent with Chapter Adm 92, "Relocation Assistance," of the *Administrative Code*. The additional costs are consistent with actual costs for recent floodplain building acquisition and demolition projects undertaken by MMSD. As set forth in Table 3.1, the estimated planning level total cost to implement this alternative plan is $6.32 million. The Alternative Plan No. 1 cost includes $2.10 million to acquire and demolish five buildings in the City of Greenfield and $4.23 million to acquire and demolish 11 buildings in the City of Milwaukee. Based on a project life of 50 years and an interest rate of 6 percent, the average annual cost of this alternative is estimated to be $401,000.

Alternative Plan No. 2 – Voluntary Elevation

Under this alternative plan, each of the 16 insurable residential buildings within the 1-percent-annual-probability floodplain would be voluntarily elevated.[15] The two areas in which buildings would be elevated under this alternative are shown on Maps 2.8 and 2.9.

To comply with floodplain zoning requirements, it was assumed that the structures would be elevated two feet above the 1-percent-annual-probability flood stage with placement of fill around the structures to bring the surrounding grade one foot above the 1-percent-annual-probability flood stage 15 feet beyond the limits of the structure (consistent with Chapter NR 116, "Wisconsin's Floodplain Management Program," of the *Administrative Code*). If a structure would have to be elevated more than four feet above grade to achieve the desired two feet of freeboard above the 1-percent-annual-probablity flood, it was assumed unfeasible. All 16 structures within the 1-percent-annual-probability floodplain of Honey Creek required less than four feet of elevation, therefore all were elevated for Alternative Plan No. 2.[16]

As set forth in Table 3.2, to elevate all 16 structures, the estimated planning level total capital cost would be $4.03 million. Based on a project life of 50 years and an interest rate of 6 percent, the average annual cost of the alternative is estimated to be $255,000.

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[14] *Acquisition and demolition of residential properties would be voluntary based on each property owner's decision in coordination with the local municipality. Alternatives discussed in this report that require acquisition and demolition of structures assume the willing participation of homeowners.*

[15] *Elevation of insurable residential structures would be voluntary based on each property owner's decision in coordination with the local municipality. Alternative Plan No. 2 assumes the willing participation of homeowners to elevate their structures.*

[16] *The general feasibility to meet elevation and fill placement requirements under NR 116 was assumed for all 16 insurable buildings for this study. A detailed structural analysis of each building would be required if implementation of Alternative Plan No. 2 is pursued.*

Table 3.1
Honey Creek Mainstem in Milwaukee County – Cost Analysis
Alternative No. 1 – Voluntary Building Acquisition and Demolition

Municipality	Number of Properties Considered for Voluntary Acquisition and Demolition	Acquisition Cost[a] ($)	Average Annual Cost[b] ($)
City of Greenfield	5	2,096,000	133,000
City of Milwaukee	11	4,229,000	268,000
City of Wauwatosa	0	0	0
City of West Allis	0	0	0
Total	16	6,325,000	401,000

[a] *Costs are in year 2020 dollar values. Estimated based on year 2020 fair market value of improvements and land plus $75,000 per residential structure for demolition, relocation assistance, moving expenses, title insurance, closing costs, appraisal, surveys, property taxes, and miscellaneous fees, plus 35 percent contingency.*

[b] *Amortized capital cost is based on an interest rate of six percent and a project life of 50 years.*

Source: SEWRPC

Table 3.2
Honey Creek Mainstem in Milwaukee County – Cost Analysis
Alternative No. 2 – Voluntary Building Elevation

Municipality	Number of Buildings Considered for Voluntary Elevation	Elevation Cost[a] ($)	Average Annual Cost[b] ($)
City of Greenfield	5	1,527,000	97,000
City of Milwaukee	11	2,499,000	158,000
City of Wauwatosa	0	0	0
City of West Allis	0	0	0
Total	16	4,026,000	255,000

[a] *Costs are in year 2020 dollar values. Estimated based on total construction cost including structure lifting/wall extension, slurry backfill, utility modifications, new equipment room, earthwork, driveway, walkways/patios, sod, other improvements, plus 20 percent contingency, 15 percent engineering/planning, compensation for lost basement (13 percent of year 2020 market value of structure), and $30,750 per residential structure for temporary housing/moving.*

[b] *Amortized capital cost is based on an interest rate of six percent and a project life of 50 years*

Source: SEWRPC

In addition to structural elevation, contiguous dryland vehicle access is also required for each elevated structure to become a conforming structure under NR 116. If contiguous dryland access is not feasible, the community must have an approved natural disaster plan or written assurance from the appropriate agencies that emergency services can be provided to the structure during the regional flood. The cost to provide dryland access was not included in the above cost estimate for Alternative Plan No. 2. The affected communities should further evaluate the dryland access requirement for each of the 16 structures. If providing dryland access is necessary, significant additional cost may be incurred for raising of roadways and driveways, placing of additional fill, and addressing utility conflicts.

MMSD Funding for Acquisition or Elevation

The current MMSD Flood Risk Reduction Policy documents MMSD's funding structure for voluntary acquisition and floodproofing. While the decision to pursue voluntary acquisition or voluntary structure elevation are entirely dependent on the preferences of and mutual agreement between the homeowners and the municipalities, the Policy establishes thresholds for potential MMSD funding amounts. The Policy states that MMSD would fund the full cost of elevation of a residential structure if the cost of elevation is less than 50 percent of the cost of acquisition, which also includes demolition and removal. If the cost to elevate a residential structure exceeds 50 percent of the cost to acquire, then MMSD would fund the full cost of acquisition of the structure. In the case of the 16 residential buildings within the 1-percent-annual-probability floodplain of Honey Creek, the elevation cost is less than 50 percent of the acquisition cost for

only two of the 16 structures. For those two structures, MMSD would fully fund voluntary structure elevation or partially fund voluntary acquisition and removal up to the full cost of structure elevation. For the remaining 14 structures which the elevation cost exceeds 50 percent of the acquisition cost, MMSD would fully fund voluntary acquisition. However, if the homeowners and municipality decide to pursue elevation of a certain structure despite the cost to elevate being higher than 50 percent of the cost to acquire and remove, MMSD would partially fund the cost to elevate a structure (up to 50 percent of acquisition cost), while the homeowner or the municipality would provide the remaining funding to implement structure elevation. The MMSD Policy also requires that the elevated structure be a conforming structure, thus dryland access must also be addressed for MMSD to fund structure elevation.

3.5 BRIDGE IMPROVEMENT ALTERNATIVES

Bridge improvements over Honey Creek at W. Oklahoma Avenue, S. 76th Street, and S. 72nd Street were considered to address flooding during the 1-percent-annual-probability flood event in the City of Milwaukee impacted area. The five insurable structures within the 1-percent-annual-probability floodplain in the City of Greenfield would be voluntarily acquired and demolished for each feasible bridge modification alternative. Any insurable structures in the City of Milwaukee that were unable to be protected by the proposed bridge improvements would also be voluntarily acquired and demolished as discussed below. Modifications were also evaluated at the S. 72nd Street bridge but were not carried through as an alternative, which is discussed at the end of this section.

The existing condition flows were used with the hydraulic models developed for each of these alternatives. A revised hydrologic analysis was not required as the bridge improvements alone would not sufficiently impact the hydrologic conditions of the Honey Creek watershed. The alternative HEC-RAS models were developed according to the bridge improvements detailed in each of the following alternative descriptions. The modeled water levels were used to evaluate potential flood protection for each alternative.

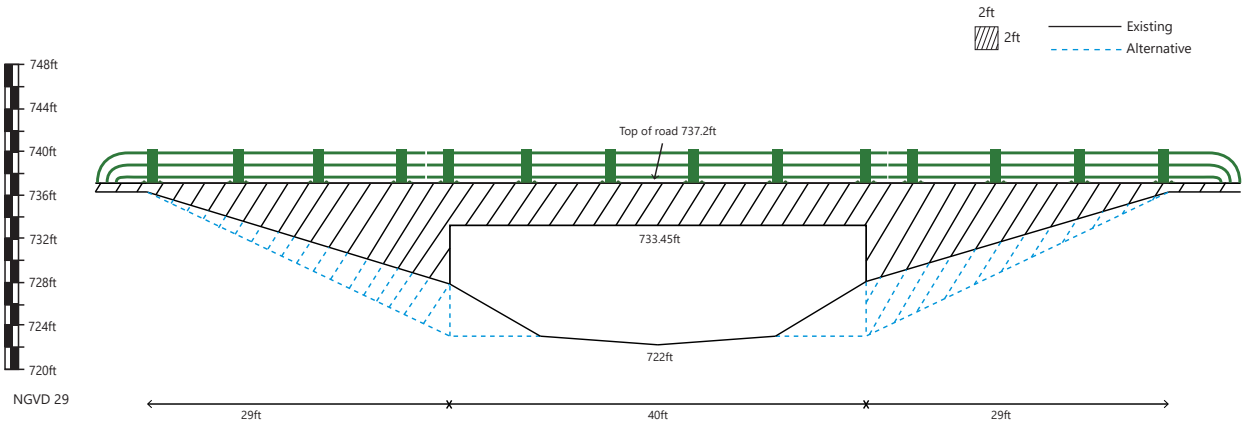
Hydraulic changes due to modifications to each of the remaining two individual bridges were also evaluated independently. Modifications to either the W. Oklahoma Avenue bridge or the S. 76th Street bridge alone would not provide sufficient flood protection for structures within the 1-percent-annual-probablity floodplain in the City of Milwaukee impacted area. Therefore, the following two feasible alternatives evaluate modifications and replacements to both bridges.

Alternative Plan No. 3 – W. Oklahoma Avenue Bridge Opening Modification and S. 76th Street Bridge Replacement

Alternative Plan No. 3 evaluates a modification to the W. Oklahoma Avenue bridge opening and the replacement of the S. 76th Street bridge to improve flood conveyance and remove structures from the 1-percent-annual-probability floodplain in the City of Milwaukee impacted area. The concrete channel banks under the W. Oklahoma Avenue bridge are proposed to be lowered and flattened to the same elevation as the top of the existing concrete cunette, thereby increasing the flow area under the bridge. The lowered channel banks would be lined with concrete. A section render of the existing bridge and the proposed modification can be found in Figure 3.1. The existing bridge structure at W. Oklahoma Avenue was built in 2009 and is in very good condition. Based on planning level analysis and consultation with the Milwaukee County bridge engineering staff, this modification is structurally feasible. The overturning stability should be minimally impacted by the modification and an adequate cover over the existing bridge footing would be maintained. However, a detailed engineering analysis would still be required in the design phase for this modification.

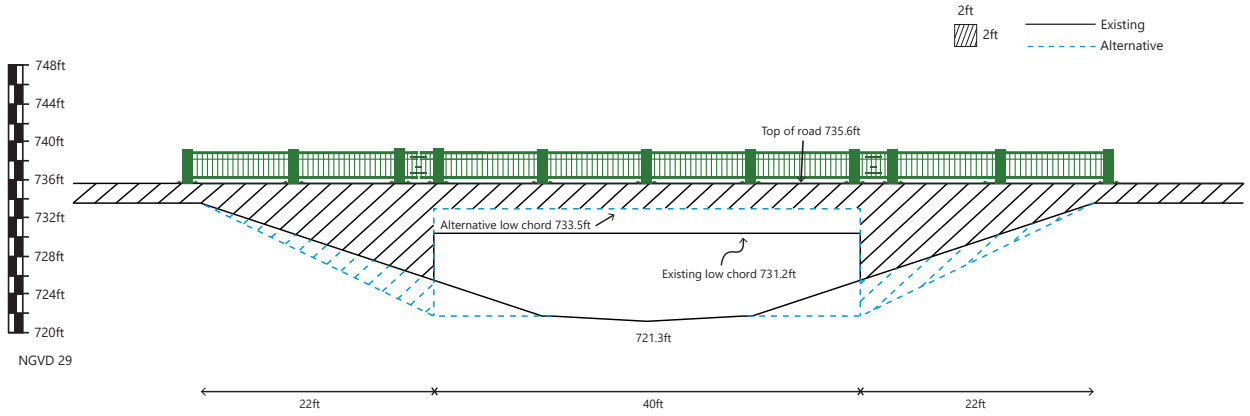
A similar channel modification was evaluated for the S. 76th Street bridge which was built in 1959 and has undergone two recent refurbishings in 2015 and 2018. Upon discussion with the City of West Allis engineering staff, it was determined that due to the age of the S. 76th Street bridge, it will not be feasible to accommodate modifications to the bridge or the channel underneath. It is proposed under Alternative Plan No. 3 that the S. 76th Street bridge be demolished and replaced with a reinforced concrete slab bridge structure and the bridge opening be redesigned to improve flood conveyance. Like the proposed W. Oklahoma Avenue bridge modification discussed above, the concrete channel banks under the S. 76th Street bridge are proposed to be lowered and flattened to the same elevation as the top of the existing concrete cunette. The new replacement bridge design would also raise the low chord by 2.3 feet. The

Figure 3.1
W. Oklahoma Avenue Bridge Channel Modification Cross-Section View



Source: SEWRPC

Figure 3.2
S. 76th Street Bridge Replacement Cross-Section View



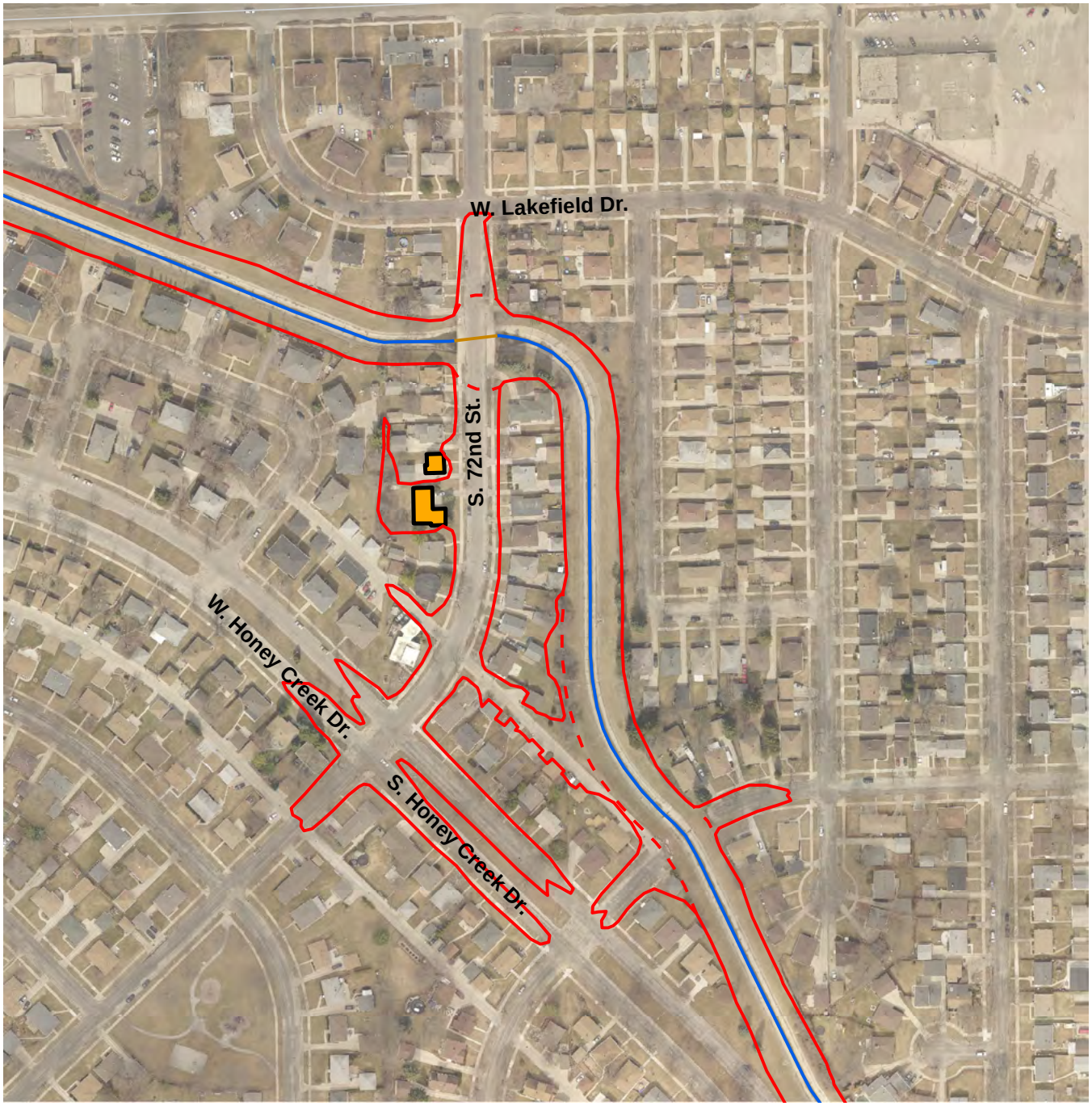
Source: SEWRPC

resulting new bridge deck thickness of 2.1 feet would be feasible, through use of a reinforced concrete slab superstructure design and would not require freeboard according to Chapter 8 of the WisDOT Bridge Manual.[17] A section render of the existing bridge and the proposed bridge replacement at S. 76th Street can be found in Figure 3.2. A detailed engineering analysis will be required in the design phase of this modification and should include an evaluation of utilities near the bridge structure.

The bridge improvements proposed under Alternative Plan No. 3 would remove nine out of the 11 flooded structures in the City of Milwaukee impacted area from the 1-percent-annual-probability floodplain. Two buildings on S. 72nd Street in the City of Milwaukee would remain in the 1-percent-annual-probability floodplain and would be voluntarily acquired and demolished as part of Alternative Plan No. 3. The proposed bridge improvements have little impact on flood stages upstream of W. Morgan Avenue. The five flood impacted buildings in the City of Greenfield would remain in the 1-percent-annual-probability floodplain and would be voluntarily acquired and demolished as part of this alternative. The open space created with structure acquisition would remain in public ownership and would be prohibited from future development. The floodplain map for Alternative Plan No. 3 near S. 72nd Street with the location of the two buildings to be voluntarily acquired and demolished can be found on Map 3.1.

[17] *WisDOT Bridge Manual, Section 8.3.1.5, January 2021.*

Map 3.1
Alternative Plan No. 3 – 1-Percent-Annual-Probability Floodplain and Flooded Structures



1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL PROBABILITY FLOODWAY BOUNDARY

INSURABLE STRUCTURES IN THE 1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN TO BE ACQUIRED AND DEMOLISHED

PERENNIAL STREAM

PERENNIAL STREAM (ENCLOSED)

N

0 75 150 225 300 Feet

Source: SEWRPC

As set forth in Table 3.3, the estimated planning level costs are 1) $272,000 to modify the W. Oklahoma Avenue bridge opening; 2) $2.16 million to replace the S. 76th Street bridge and modify the concrete channel underneath the bridge; and 3) $2.89 million to acquire and demolish five buildings in the City of Greenfield impacted area and two buildings on S. 72nd Street in the City of Milwaukee. The planning level costs of acquisition of land and buildings were estimated in the same manner as for Alternative Plan No. 1. Bridge construction includes costs of final design, construction engineering, bridge aesthetics, demolition, and bridge installation, plus a 25-percent contingency. Channel modifications include costs of earth and concrete excavation, hauling and disposal of materials, soil stabilization, topsoil placement and grading, grass seeding to match existing channel aesthetics, and dewatering, plus a 35-percent contingency. The total planning level capital cost of Alternative Plan No. 3 is $5.32 million. Milwaukee County and the City of West Allis would continue to be responsible for standard annual inspections and maintenance of the W. Oklahoma Avenue bridge and the S. 76th Street bridge, respectively. Based on a project life of 50 years and an interest rate of 6 percent, the average annual cost of Alternative Plan No. 3 is estimated to be $338,000.

Alternative Plan No. 4 – W. Oklahoma Avenue Bridge and S. 76th Street Bridge Replacements

Alternative Plan No. 4 evaluates the replacement of both the W. Oklahoma Avenue and the S. 76th Street bridges to improve flood conveyance and remove structures from the 1-percent-annual-probability floodplain in the City of Milwaukee impacted area. The S. 76th Street bridge replacement is the same as discussed under Alternative Plan No. 3. Alternative Plan No. 4 also includes a complete replacement of the W. Oklahoma Avenue bridge. It is proposed that the W. Oklahoma Avenue bridge be demolished and replaced with a reinforced concrete slab bridge structure and the bridge opening be redesigned to improve flood conveyance. The new replacement bridge design would raise the low chord by 0.75 feet. The resulting new bridge deck thickness of 3.0 feet would be feasible, through use of a reinforced concrete slab superstructure design and would not require freeboard according to the WisDOT Bridge Manual.[18] A section render of the existing bridge and the proposed bridge replacement can be found in Figure 3.3. A detailed engineering analysis will be required in the design phase of this project and include an evaluation of utilities near the bridge structure.

The bridge improvements proposed under Alternative Plan No. 4 would remove 10 out of the 11 flooded structures in the City of Milwaukee impacted area from the 1-percent-annual-probability floodplain. One building on S. 72nd Street in the City of Milwaukee would remain in the 1-percent-annual-probability floodplain and would be voluntarily acquired and demolished as part of Alternative Plan No. 4. The bridge improvements have little impact on Honey Creek flood stages upstream of W. Morgan Avenue. The five flood impacted buildings in the City of Greenfield would remain in the 1-percent-annual-probability floodplain and would be voluntarily acquired and demolished as part of this alternative. The open space created with structure acquisition would remain in public ownership and would be prohibited from future development. The floodplain map for Alternative Plan No. 4 near S. 72nd Street with the location of the one building to be voluntarily acquired and demolished can be found on Map 3.2.

As set forth in Table 3.4, the estimated planning level costs are 1) $2.18 million to replace W. Oklahoma Avenue bridge and modify the concrete channel underneath the bridge; 2) $2.16 million to replace S. 76th Street bridge and modify the concrete channel underneath the bridge; and 3) $2.50 million to acquire and demolish five buildings in the City of Greenfield impacted area and one building on S. 72nd Street in the City of Milwaukee. The costs of acquisition of land and buildings were estimated in the same manner as for Alternative Plan No. 1. Bridge construction costs include final design, construction engineering, bridge aesthetics, demolition, and bridge installation, plus a 25-percent contingency. Channel modifications include costs of earth and concrete excavation, hauling and disposal of materials, soil stabilization, topsoil placement and grading, grass seeding to match existing channel aesthetics, and dewatering, plus a 35-percent contingency. Total planning level capital cost of Alternative No. 4 is $6.84 million. Milwaukee County and the City of West Allis would continue to be responsible for standard annual inspections and maintenance of the W. Oklahoma Avenue bridge and the S. 76th Street bridge, respectively. Based on a project life of 50 years and an interest rate of 6 percent, the average annual cost of this alternative is estimated to be $434,000.

[18] Ibid.

Table 3.3
Honey Creek Mainstem in Milwaukee County – Cost Analysis
Alternative No. 3 – Bridge Modification and Replacement with Voluntary Building Acquisition

Governmental Jurisdiction	Number of Buildings that Would be Protected by Bridge Improvement During the 1 Percent-Annual-Probability (100-year recurrence interval) Flood	Number of Properties Considered for Voluntary Acquisition and Demolition	Capital Cost of W. Oklahoma Avenue Bridge Opening Modification[a] ($)	Capital Cost of S. 76th Street Bridge Replacement[b] ($)	Acquisition and Demolition Cost[c] ($)	Total Capital Cost ($)	Average Annual Cost[d] ($)
City of Greenfield	--	5	--	--	2,096,000	2,096,000	133,000
City of Milwaukee	9	2	--	--	797,000	797,000	51,000
City of Wauwatosa	--	--	--	--	--	--	--
City of West Allis	--	--	--	2,156,000	--	2,156,000	137,000
Milwaukee County	--	--	272,000	--	--	272,000	17,000
Total	9	7	272,000	2,156,000	2,893,000	5,321,000	338,000

Note: Capital construction costs based upon year 2020 conditions, Engineering News-Record Construction Cost Index = 15,009.
Building fair market values are for year 2020.

[a] *Estimated based on costs of channel excavation, hauling earthwork and concrete, concrete channel bench construction, geotextiles, topsoil placement and grading, seeding, and dewatering, plus 35 percent contingency. No contaminated soils and utility conflicts were assumed.*

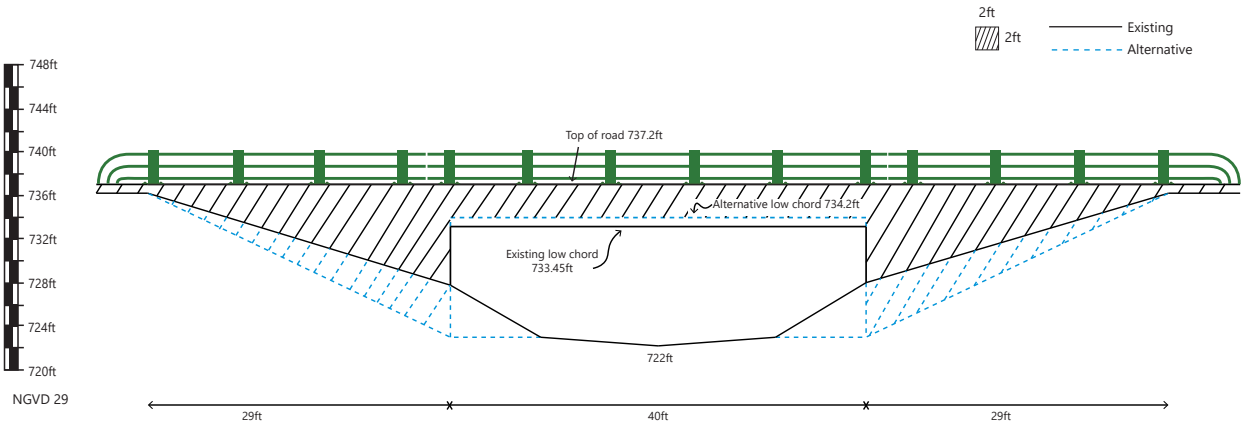
[b] *Estimated based on costs of bridge demolition, replacement bridge design and construction, replacement bridge aesthetics, bridge construction engineering, channel excavation, hauling earthwork and concrete, concrete channel bench construction, geotextiles, topsoil placement and grading, seeding, and dewatering, plus 35 percent contingency for channel modification, 25 percent contingency for bridge replacement. No contaminated soils and utility conflicts were assumed.*

[c] *Estimated based on year 2020 fair market value of improvements and land plus $75,000 per residential structure for demolition, relocation assistance, moving expenses, title insurance, closing costs, appraisal, surveys, property taxes, and miscellaneous fees, plus 35 percent contingency.*

[d] *Amortized capital cost is based on an interest rate of six percent and a project life of 50 years.*

Source: SEWRPC

Figure 3.3
W. Oklahoma Avenue Bridge Replacement Cross-Section View



Source: SEWRPC

S. 72nd Street Bridge Modifications

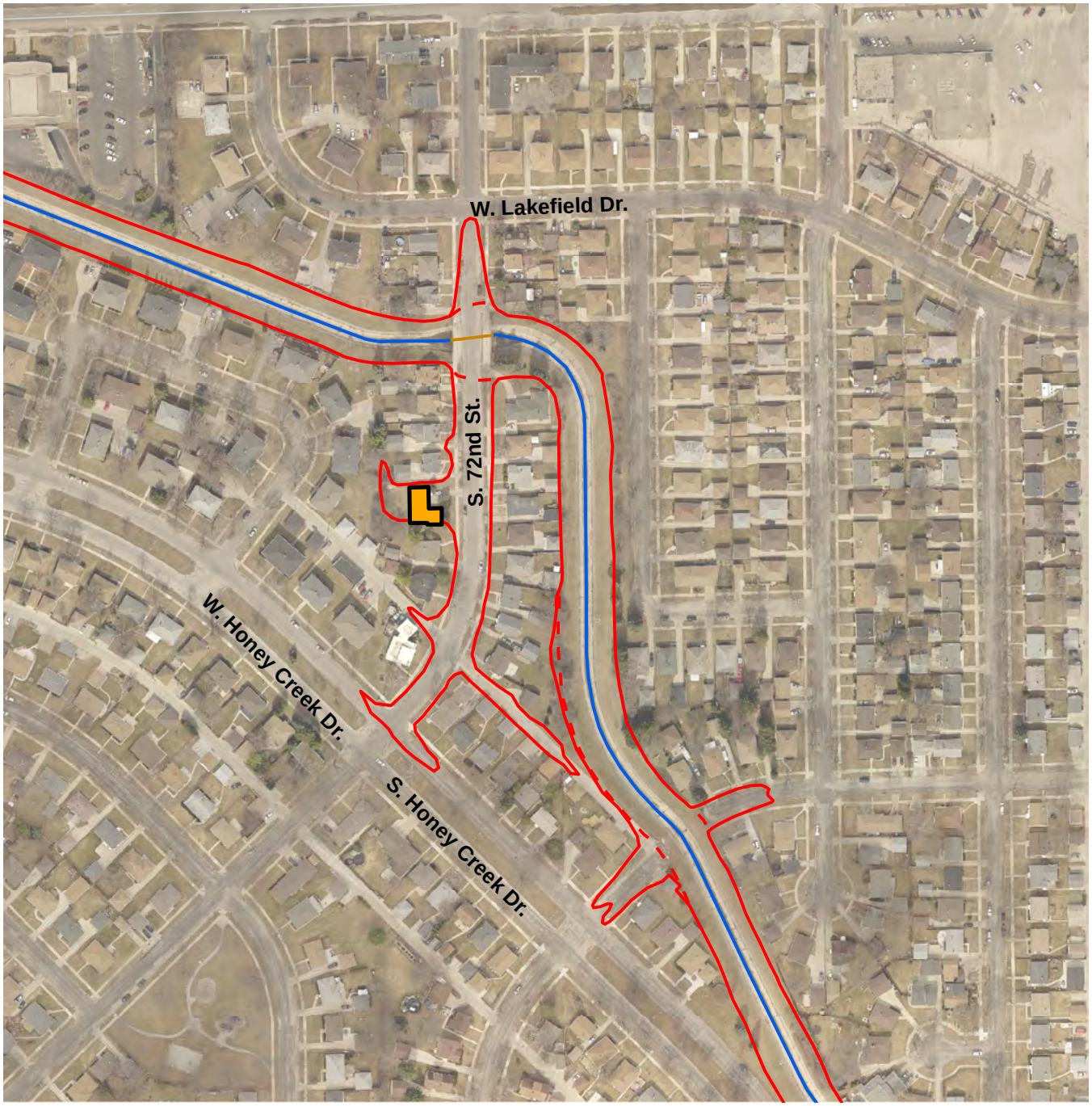
Two types of modifications for the S. 72nd Street bridge over Honey Creek were also considered to reduce flooding in the City of Milwaukee impacted area. The first modification considered was to replace the existing bridge with a vehicular bridge of different dimensions to improve flood conveyance. Hydraulic analyses of several different S. 72nd Street vehicular bridge configurations were evaluated including raising and lowering the bridge deck, raising the bridge low chord, and widening the bridge span. All the evaluated S. 72nd Street vehicular bridge alternative designs failed to provide sufficient flood protection benefits to remove flooded residential structures, therefore a new vehicular bridge at S. 72nd Street was removed from further consideration.

The second type of bridge improvement considered for the S. 72nd St bridge over Honey Creek was to demolish the existing vehicular bridge and install a high arch pedestrian bridge. The existing bridge would be completely removed including the bridge deck and abutments. The Honey Creek channel under the bridge would be restored to match the existing concrete channel upstream and downstream of the S. 72nd Street Honey Creek crossing. The pedestrian bridge replacement would be designed to arch over Honey Creek without impacting the 1-percent-annual-probability flood. This bridge change would protect seven out of the 11 flooded structures within the 1-percent-annual-probability floodplain in the City of Milwaukee impacted area, and with the lowest cost compared to the other bridge improvements considered above. However, after discussions between the City of Milwaukee staff and elected officials, the City of Milwaukee decided against the pedestrian bridge alternative at S. 72nd Street as the City would like to maintain this road for vehicular traffic. Therefore, a new S. 72nd Street pedestrian bridge was eliminated as a viable alternative for this analysis.

3.6 CHANNEL REHABILITATION ALTERNATIVES

Under the final two alternatives for this study, rehabilitation of the concrete sections of Honey Creek were evaluated along with select voluntary acquisition and demolition of structures remaining in the 1-percent-annual-probability floodplain. Both the hydrologic and hydraulic models were used to evaluate these two alternatives. The existing conditions HSPF hydrologic model was revised to account for the channel modifications for each alternative. Flood flows were recomputed and were used in the alternative HEC-RAS hydraulic models. Table 3.5 summarizes the streamflow changes under Alternative Plans No. 5 and No. 6. Importantly, the hydrologic changes due to channel rehabilitation on Honey Creek have little to no impact to flows on the Menomonee River mainstem. All flow changes on the Menomonee River mainstem, immediately downstream of its confluence with Honey Creek are within five percent of its existing flows. The alternative HEC-RAS models were developed according to the channel modifications detailed in each of the following sections. The resulting flood stages were used to evaluate potential flood protection for each alternative.

Map 3.2
Alternative Plan No. 4 – 1-Percent-Annual-Probability Floodplain and Flooded Structure



1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL PROBABILITY FLOODWAY BOUNDARY

INSURABLE STRUCTURES IN THE 1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN TO BE ACQUIRED AND DEMOLISHED

PERENNIAL STREAM

PERENNIAL STREAM (ENCLOSED)

N

0 75 150 225 300 Feet

Source: SEWRPC

Table 3.4
Honey Creek Mainstem in Milwaukee County – Cost Analysis
Alternative No. 4 – Bridge Replacement and Voluntary Building Acquisition

Governmental Jurisdiction	Number of Buildings that Would be Protected by Bridge Improvement During the 1 Percent-Annual-Probability (100-year recurrence interval) Flood	Number of Properties Considered for Voluntary Acquisition and Demolition	Capital Cost of W. Oklahoma Avenue Bridge Replacement[a] ($)	Capital Cost of S. 76th Street Bridge Replacement[a] ($)	Acquisition and Demolition Cost[b] ($)	Total Capital Cost ($)	Average Annual Cost[c] ($)
City of Greenfield	--	5	--	--	2,096,000	2,096,000	133,000
City of Milwaukee	10	1	--	--	409,000	409,000	26,000
City of Wauwatosa	--	--	--	--	--	--	--
City of West Allis	--	--	--	2,156,000	--	2,156,000	137,000
Milwaukee County	--	--	2,181,000	--	--	2,181,000	138,000
Total	10	6	2,181,000	2,156,000	2,505,000	6,842,000	434,000

Note: Capital construction costs based upon year 2020 conditions, Engineering News-Record Construction Cost Index = 15,009.
Building fair market values are for year 2020.

[a] *Estimated based on costs of channel excavation, hauling earthwork and concrete, concrete channel bench construction, geotextiles, topsoil placement and grading, seeding, and dewatering, plus 35 percent contingency. No contaminated soils and utility conflicts were assumed.*

[b] *Based on year 2020 fair market value of improvements and land plus $75,000 per residential structure for demolition, relocation assistance, moving expenses, title insurance, closing costs, appraisal, surveys, property taxes, and miscellaneous fees, plus 35 percent contingency.*

[c] *Amortized total capital cost, based on an interest rate of 6 percent and a project life of 50 years.*

Source: SEWRPC

Table 3.5
Honey Creek Peak Flow Rates – Existing Conditions, Alternative Plan No. 5, and Alternative Plan No. 6 Comparison

River Mile	Location[a]	Annual Probability Peak Flow (cfs)											
		10-percent			2-percent			1-percent			0.2-percent		
		Existing Conditions	Alternative Plan No. 5	Alternative Plan No. 6	Existing Conditions	Alternative Plan No. 5	Alternative Plan No. 6	Existing Conditions	Alternative Plan No. 5	Alternative Plan No. 6	Existing Conditions	Alternative Plan No. 5	Alternative Plan No. 6
0.878	DS of W. Wisconsin Avenue	2,440	2,080	2,290	3,380	3,120	3,380	3,470	3,210	3,470	3,660	3,390	3,660
1.935	DS of I-94	2,350	2,010	2,190	3,040	2,880	3,040	3,090	2,940	3,090	3,210	3,070	3,210
3.044	State Fair Park Enclosure DS of W. Greenfield Avenue	2,140	1,940	1,990	2,340	2,340	2,340	2,340	2,340	2,340	2,340	2,340	2,340
4.2813	State Fair Park Enclosure Inlet at McCarty Park	1,990	1,720	1,790	2,340	2,340	2,340	2,340	2,340	2,340	2,340	2,340	2,340
5.002	DS of S. 76th Street	1,600	1,290	1,370	2,450	2,190	2,260	2,850	2,640	2,710	3,860	3,840	3,860
5.227	US of W. Oklahoma Avenue	1,340	1,122	1,204	2,090	1,903	1,977	2,450	2,295	2,365	3,380	3,366	3,380
6.389	DS of W. Forest Home Avenue / W. Howard Avenue	1,170	1,012	1,095	1,850	1,715	1,792	2,180	2,068	2,138	3,060	3,055	3,060
7.449	DS of I-894	970	887	971	1,580	1,500	1,580	1,880	1,810	1,880	2,700	2,680	2,700
7.669	DS of W. Layton Avenue	495	504	494	821	841	820	988	1,010	988	1,460	1,500	1,460
8.020	Konkel Park pedestrian bridge	374	374	373	620	620	619	746	746	746	1,100	1,100	1,100
8.666	US end at S. 43rd Street	316	316	315	524	524	524	631	631	631	932	932	932

[a] *DS refer to Downstream. US refer to Upstream*

Source: SEWRPC

The concrete channel rehabilitation designs were constrained by the existing public right-of-way (ROW) of Honey Creek. To provide the greatest flood storage and conveyance capacity potential, excavation of the floodplain with the use of retaining walls was required. A vertical retaining wall configuration was evaluated and would provide the greatest flood storage and conveyance capacity for Honey Creek. However due to public safety concerns with the required wall height in some reaches, the vertical retaining wall design was eliminated from further consideration. Therefore, the two alternatives presented below utilized a stair-step retaining wall design for the rehabilitated channel cross section.

Alternative Plan No. 5 – Entire Concrete Channel Rehabilitation

Under this alternative plan, all the concrete sections of Honey Creek, approximately 21,000 feet from I-894 to downstream of W. Wisconsin Avenue, would be removed and replaced with a bioengineered channel. The proposed extent of channel work can be found on Map 3.3. The bioengineered channel would include a meandering rock-lined low-flow channel for base-flow conditions. The stream rocks in the low-flow channel were required for streambed erosion protection. A lowered floodplain with native riparian vegetation was included in the design to offset the low-flow channel and increase flood storage and conveyance capacity during large storm events. The excavated floodplain, in most cases, includes the entire width of the public ROW to deliver the greatest amount of flood storage and conveyance in tight residential areas. An exception to this is in the public parks and parkways where the proposed floodplain excavation is not as constrained by the public ROW.[19] In McCarty Park, the southern bank of the pond would also be excavated and lowered by a maximum of 4.3 feet to allow flood waters to utilize the pond for flood storage as well as flood conveyance at a lower elevation. The outer boundary of the excavated floodplain for all Honey Creek reaches would be stabilized using concrete block retaining walls. The retaining walls would have a 1-to-1 slope and be constructed of wet-cast concrete blocks. The retaining walls would be five feet in total height in tight public ROW locations and three feet in total height in the park locations. A digitally rendered comparison of the existing channel verses the proposed bioengineered channel with stair-step retaining walls can be found in Figures 3.4 and 3.5, respectively. A representative cross-sectional render of the existing and proposed channel can be found in Figure 3.6.

The channel rehabilitation proposed under Alternative Plan No. 5 would protect 11 of the 16 buildings in the 1-percent-annual-probability floodplain. All 11 structures in the City of Milwaukee impacted area would be removed from the 1-percent-annual-probability floodplain. The channel rehabilitation does not affect Honey Creek floodplains upstream of I-894 in the City of Greenfield. Therefore, the five buildings in the City of Greenfield in the 1-percent-annual-probability floodplain would be voluntarily acquired and demolished as part of this alternative. The open space created by structure acquisition would remain in public ownership and would be prohibited from future development. Flood elevations would be lowered along the Alternative Plan No. 5 rehabilitated channel reaches as compared to the existing flood elevations. The floodplain map for Alternative Plan No. 5 near S. 72nd Street can be found on Map 3.4.

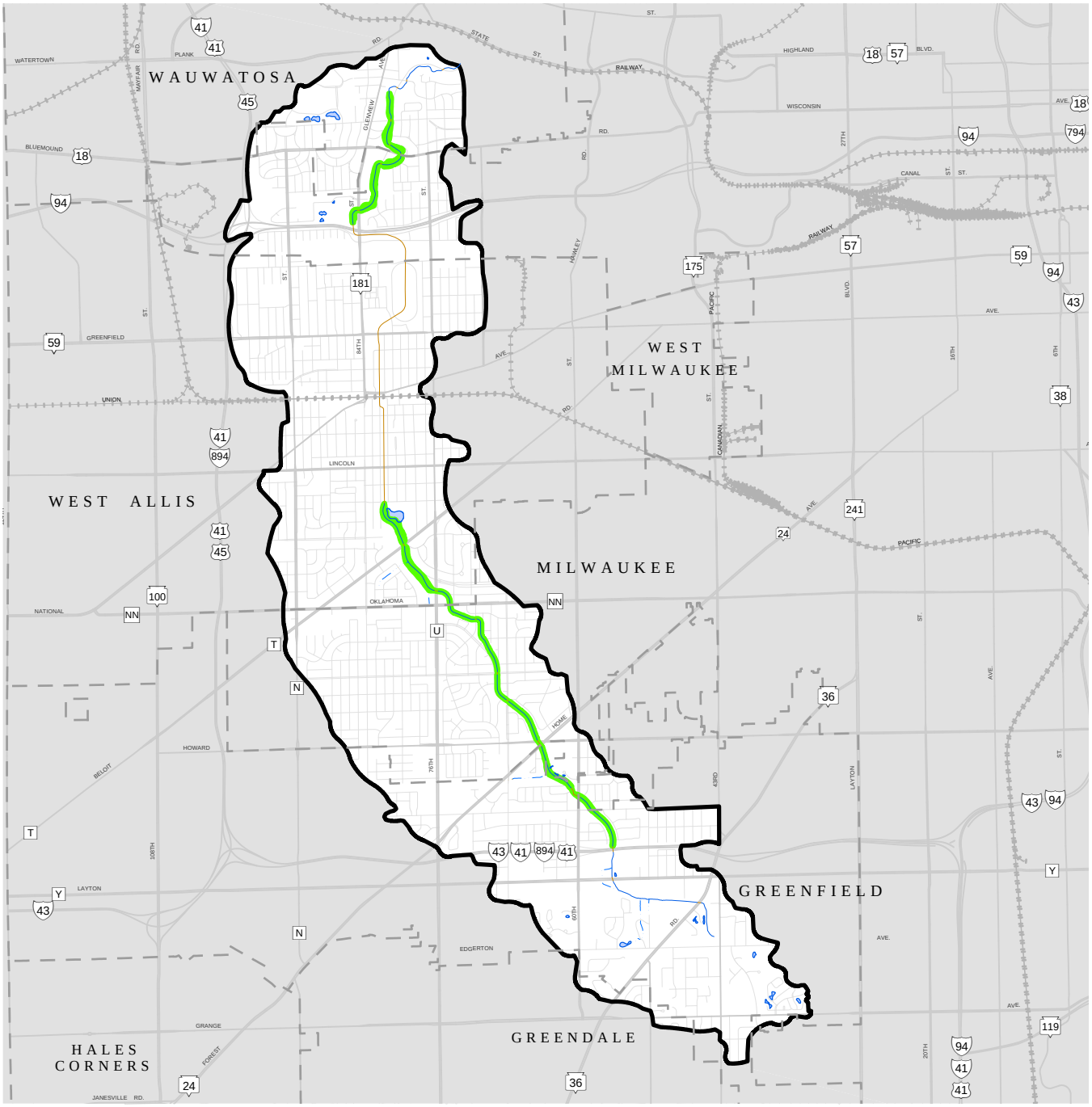
As set forth in Table 3.6, the estimated planning level costs for Alternative Plan No. 5 are 1) $34.38 million to rehabilitate the entire Honey Creek concrete lined channel; and 2) $2.10 million to acquire and demolish five buildings in the City of Greenfield impacted area. The costs of acquisition of land and buildings were estimated in the same manner as for Alternative Plan No. 1. Channel rehabilitation includes costs of earth and concrete excavation, hauling of excavated material, retaining wall construction, low-channel construction, clearing and grubbing of existing vegetation, topsoil borrow and placement, seeding with native floodplain vegetation, and dewatering activities plus a 35-percent contingency. The total planning level capital cost of Alternative Plan No. 5 is $36.47 million. Annual operation and maintenance cost for the naturalized channel and floodplain is estimated to be $29,000 for inspections, mowing, and debris and graffiti removal. Based on a project life of 50 years and an interest rate of 6 percent, the average annual cost of Alternative Plan No. 5 is estimated to be $2.21 million.

Alternative Plan No. 6 – Partial Concrete Channel Rehabilitation

Under this alternative plan, only a partial section of the concrete channel of Honey Creek would be removed and replaced with a bioengineered channel. Due to the significant cost of rehabilitating the entire concrete channel, Alternative Plan No. 6 proposes the rehabilitation of approximately 8,400 feet of the concrete channel from downstream of W. Morgan Avenue through McCarty Park only. The proposed extent of

[19] *The proposed floodplain excavation within public parks and parkways may require significant tree removal.*

Map 3.3
Alternative Plan No. 5 – Extent of Channel and Floodplain Excavation



Source: SEWRPC

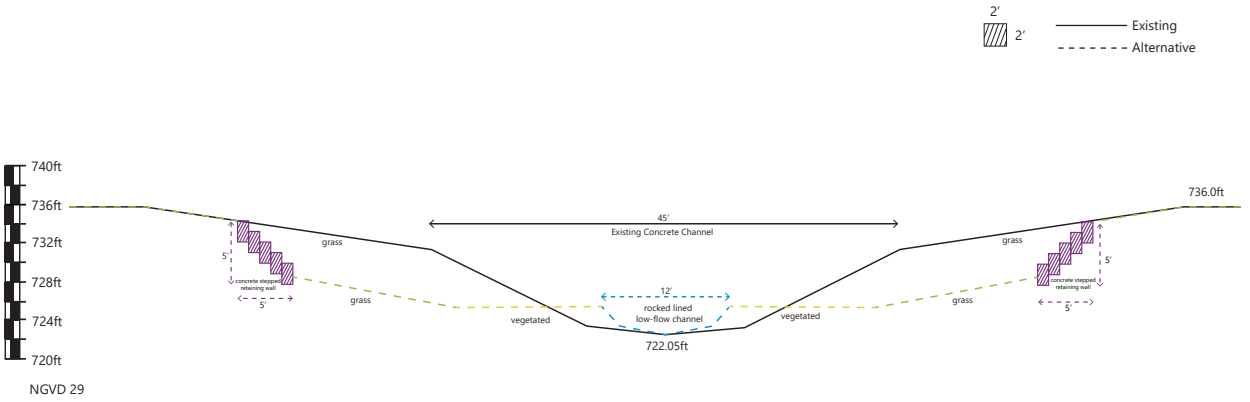
Figure 3.4
Honey Creek Existing Channel Render

Source: SEWRPC

Figure 3.5
Honey Creek Rehabilitated Channel Render

Source: SEWRPC

Figure 3.6
Honey Creek Existing and Alternative
Channel Cross-Section View Upstream of W. Oklahoma Avenue



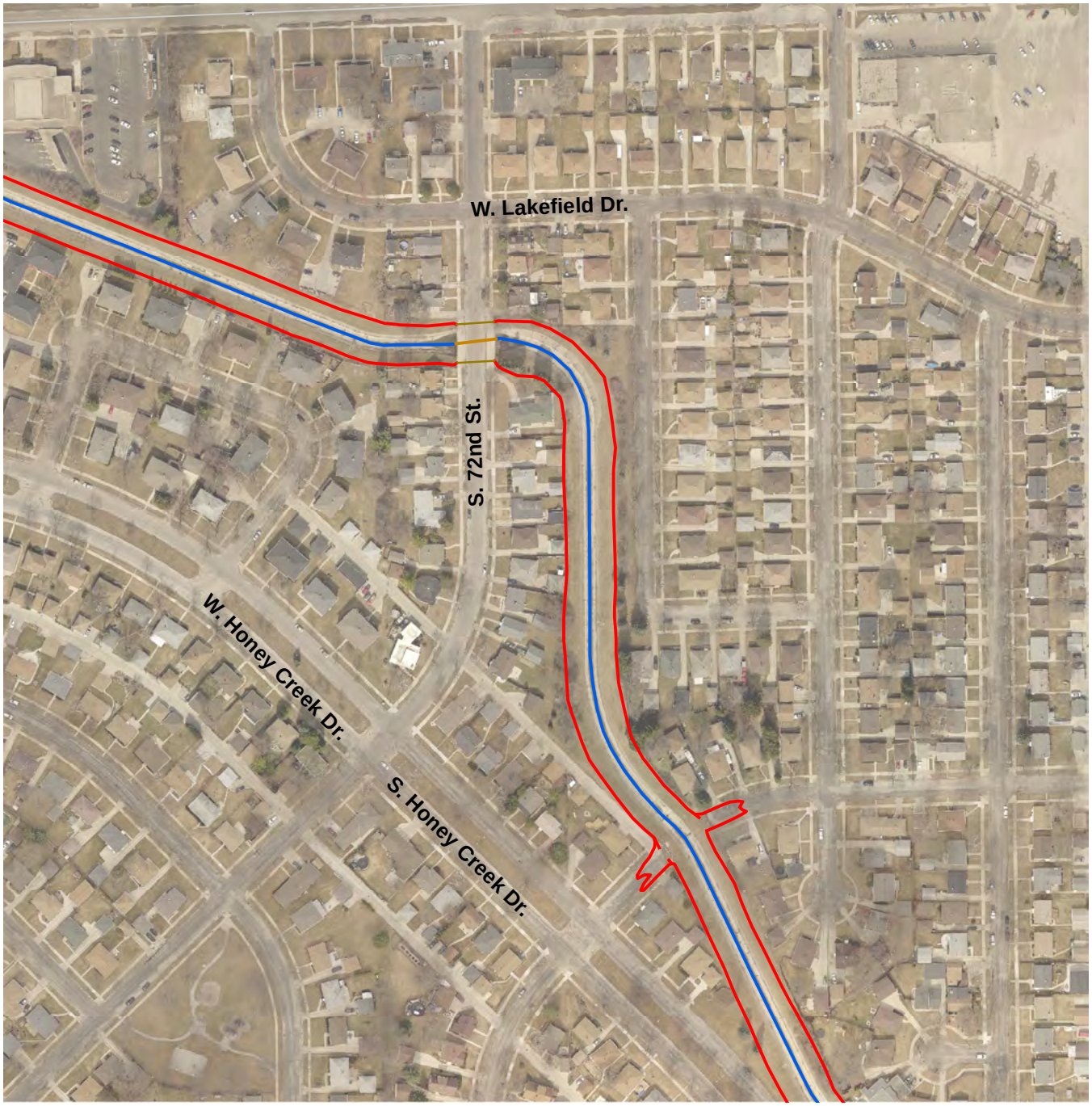
Source: SEWRPC

excavation can be found on Map 3.5. The remaining concrete channel sections of Honey Creek concrete channel would stay in place for this alternative. The bioengineered channel would include a meandering rock-lined low-flow channel for base-flow conditions and an excavated floodplain to provide an increased flood storage and conveyance capacity. The rehabilitated channel design is the same as Alternative Plan No. 5 for the stretch of concrete channel from W. Morgan Avenue through McCarty Park. A digitally rendered comparison of the existing channel verses the proposed bioengineered channel with the stair-step retaining walls can be found in Figures 3.4 and 3.5, respectively. A representative cross-sectional render of the existing and proposed channel can be found in Figure 3.6.

Rehabilitation of the section of Honey Creek concrete channel from W. Morgan Avenue through McCarty Park would lower flood elevations compared to existing conditions. As a result, 11 of the 16 buildings in the 1-percent-annual-probability floodplain would be protected from flood damage for Alternative Plan No. 6. All 11 structures in the floodplain in the City of Milwaukee impacted area would be removed from the 1-percent-annual-probability floodplain. The channel rehabilitation does not affect Honey Creek floodplains upstream of I-894 in the City of Greenfield. Therefore, the five flood impacted buildings in the City of Greenfield would remain in the 1-percent-annual-probability floodplain and would be voluntarily acquired and demolished as part of Alternative Plan No. 6. The open space created by structure acquisition would remain in public ownership and would be prohibited from future development. The floodplain map for Alternative Plan No. 6 near S. 72nd Street can be found on Map 3.6.

As set forth in Table 3.7, the estimated planning level costs for Alternative Plan No. 6 are 1) $13.81 million to rehabilitate the Honey Creek concrete lined channel from W. Morgan Avenue through McCarty Park; and 2) $2.10 million to acquire and demolish five buildings in the City of Greenfield impacted area. The costs of acquisition of land and buildings were estimated in the same manner as for Alternative Plan No. 1. Channel rehabilitation includes costs of earth and concrete excavation, hauling of excavated material, retaining wall construction, low-channel construction, clearing and grubbing of existing vegetation, topsoil borrow and placement, seeding with native floodplain vegetation, and dewatering activities plus a 35-percent contingency. The total planning level capital cost of Alternative Plan No. 6 is $15.90 million. Annual operation and maintenance cost for the naturalized channel and floodplain is estimated to be $11,500 for inspections, mowing, and debris and graffiti removal. Based on a project life of 50 years and an interest rate of 6 percent, the average annual cost of the alternative is estimated to be $1.02 million.

Map 3.4
Alternative Plan No. 5 – 1-Percent-Annual-Probability Floodplain Near S. 72nd Street



1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL PROBABILITY FLOODWAY BOUNDARY

PERENNIAL STREAM

PERENNIAL STREAM (ENCLOSED)

N

0 75 150 225 300 Feet

Source: SEWRPC

Table 3.6
Honey Creek Mainstem in Milwaukee County – Cost Analysis
Alternative No. 5 – Entire Concrete Channel Rehabilitation

Municipality	Number of Buildings that Would Be Protected by Channel Rehabilitation During the 1 Percent-Annual-Probability (100 year recurrence interval) Flood	Number of Properties Considered for Voluntary Acquisition and Demolition	Capital Cost of Channel Rehabilitation Construction[a] ($)	Acquisition and Demolition Cost[b] ($)	Total Capital Cost ($)	Total Annual O & M Cost[c] ($)	Average Annual Cost[d] ($)
City of Greenfield	--	5	4,486,000	2,096,000	6,582,000	3,800	289,000
City of Milwaukee	11	--	19,248,000	--	19,248,000	16,200	1,237,000
City of Wauwatosa	--	--	3,754,000	--	3,754,000	3,200	241,000
City of West Allis	--	--	6,888,000	--	6,888,000	5,800	443,000
Total	11	5	34,376,000	2,096,000	36,472,000	29,000	2,210,000

Note: Capital construction costs based upon year 2020 conditions, Engineering News-Record Construction Cost Index = 15,009.
Building fair market values are for year 2020.

[a] *Estimated based on costs of channel excavation, hauling earthwork and concrete, concrete channel bench construction, geotextiles, topsoil placement and grading, seeding, and dewatering, plus 35 percent contingency. No contaminated soils and utility conflicts were assumed.*

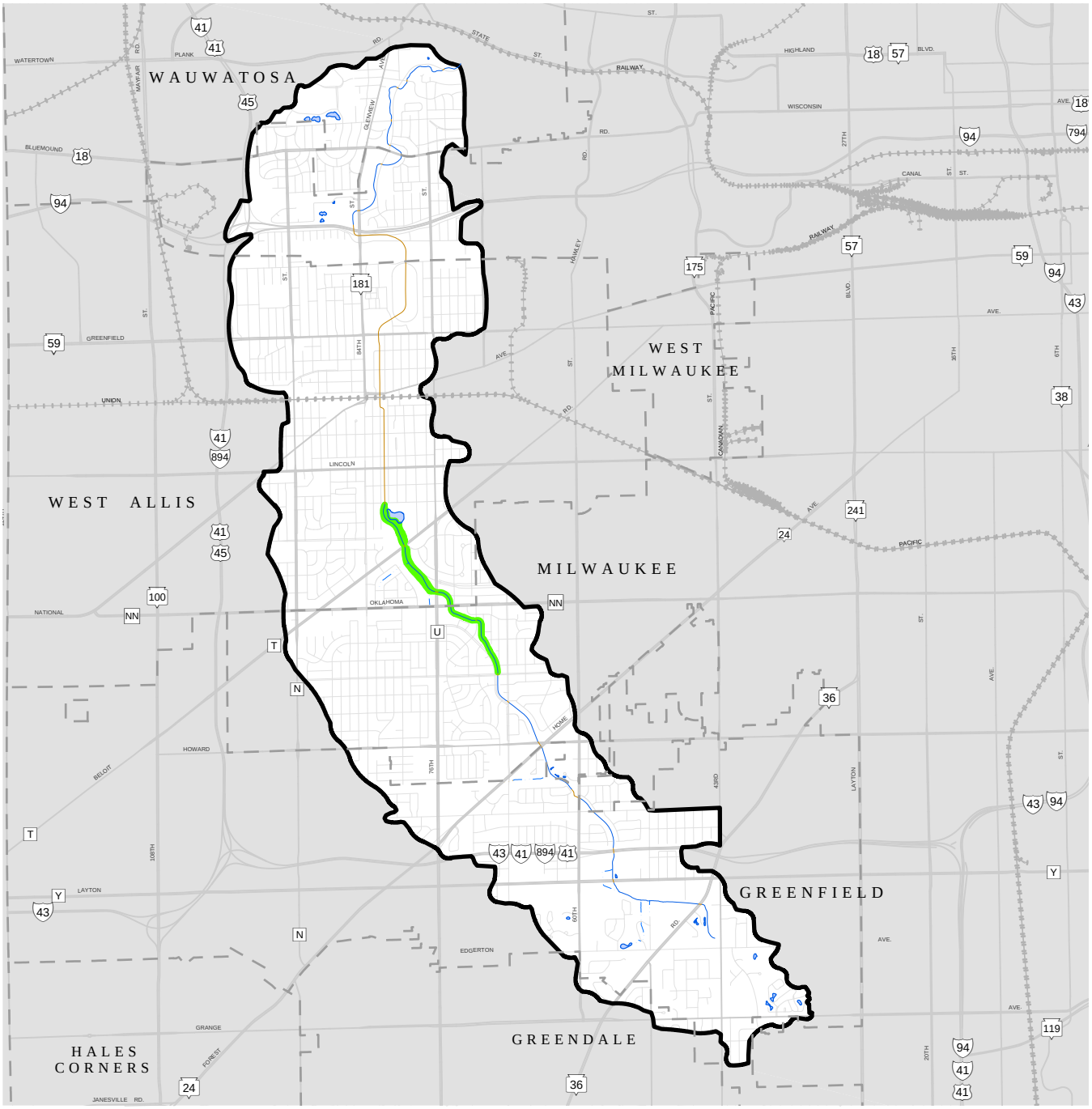
[b] *Based on year 2020 fair market value of improvements and land plus $75,000 per residential structure for demolition, relocation assistance, moving expenses, title insurance, closing costs, appraisal, surveys, property taxes, and miscellaneous fees, plus 35 percent contingency.*

[c] *Estimated based on costs of mowing the excavated floodplain four times per year, removing debris once per year, removing graffiti once per year, and inspecting rehabilitated channel once per year.*

[d] *Amortized capital cost is based on an interest rate of six percent and a project life of 50 years, plus total annual O & M costs.*

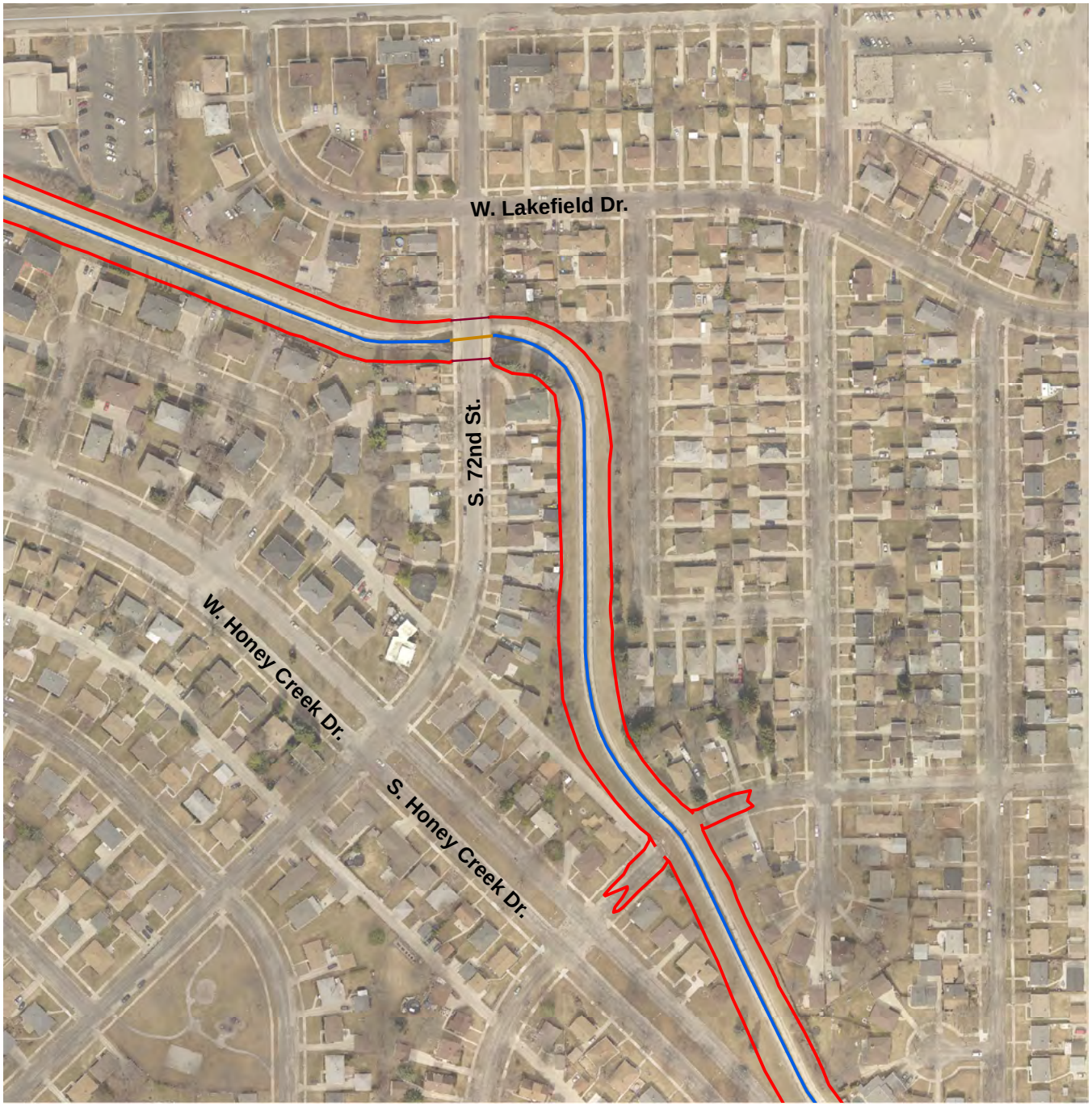
Source: SEWRPC

Map 3.5
Alternative Plan No. 6 – Extent of Channel and Floodplain Excavation



Source: SEWRPC

Map 3.6
Alternative Plan No. 6 – 1-Percent-Annual-Probability Floodplain Near S. 72nd Street



1-PERCENT-ANNUAL-PROBABILITY FLOODPLAIN BOUNDARY

1-PERCENT-ANNUAL PROBABILITY FLOODWAY BOUNDARY

PERENNIAL STREAM

PERENNIAL STREAM (ENCLOSED)

N

0 75 150 225 300 Feet

Source: SEWRPC

Table 3.7
Honey Creek Mainstem in Milwaukee County – Cost Analysis
Alternative No. 6 – Partial Concrete Channel Rehabilitation

Municipality	Number of Buildings that Would Be Protected by Channel Rehabilitation During the 1 Percent-Annual-Probability (100-year recurrence interval) Flood	Number of Properties Considered for Voluntary Acquisition and Demolition	Capital Cost of Channel Rehabilitation Construction[a] ($)	Acquisition and Demolition Cost[b] ($)	Total Capital Cost ($)	Total Annual O & M Cost[c] ($)	Average Annual Cost[d] ($)
City of Greenfield	--	5	--	2,096,000	2,096,000	--	133,000
City of Milwaukee	11	--	6,904,000	--	6,904,000	5,700	444,000
City of Wauwatosa	--	--	--	--	--	--	--
City of West Allis	--	--	6,904,000	--	6,904,000	5,800	444,000
Total	11	5	13,808,000	2,096,000	15,904,000	11,500	1,021,000

Note: Capital construction costs based upon year 2020 conditions, Engineering News-Record Construction Cost Index = 15,009.
Building fair market values are for year 2020.

[a] *Estimated based on costs of clearing and grubbing, excavation, hauling earthwork and concrete, retaining wall construction, topsoil borrow and placement and grading, seeding, low-channel construction, and dewatering, plus 35 percent contingency. No contaminated soils and utility conflicts were assumed.*

[b] *Based on year 2020 fair market value of improvements and land plus $75,000 per residential structure for demolition, relocation assistance, moving expenses, title insurance, closing costs, appraisal, surveys, property taxes, and miscellaneous fees, plus 35 percent contingency.*

[c] *Estimated based on costs of mowing the excavated floodplain four times per year, removing debris once per year, removing graffiti once per year, and inspecting rehabilitated channel once per year.*

[d] *Amortized capital cost is based on an interest rate of 6 percent and a project life of 50 years, plus total annual O & M costs.*

Source: SEWRPC

Rehabilitated Channel Evaluation with Natural Side Slopes

Over 30-percent of the channel rehabilitation costs for Alternative Plans No. 5 and No. 6 were for construction of the retaining walls. To reduce cost, 1-to-3 earthen channel side slopes within the existing public ROW were also evaluated to eliminate the need for retaining wall stabilization for Alternative Plan No. 6. Based on the hydrologic analysis, the 1-to-3 side-slope channel shape increased flood flows by reducing flow conveyance and flood storage capacity. Modeling indicated the 1-percent-annual-probability flood would not be contained within the earthen channel near S. 72nd Street in the City of Milwaukee, which would not provide sufficient flood protection for the 11 flood impacted buildings. Therefore, earthen channel slopes were not pursued further for this planning level analysis. However, channel side slope treatment options could be refined during final design.

EVALUATION OF THE ALTERNATIVE PLANS 4

Credit: SEWRPC Staff

The proposed alternatives to reduce flooding along Honey Creek are evaluated and compared in this section. All the alternatives presented in this report achieved the primary objective of this study to mitigate flood damages to insurable buildings. All 16 insurable structures identified within the MCAMLIS 1-percent-annual-probability floodplain were protected under each of the alternative plans. Although all the alternatives achieved the primary study objective, several differences between the alternative plans exist, with the primary difference being construction costs. A summary of planning level costs for all the alternatives can be found in Table 4.1. Detailed planning level costs for Alternative Plans No. 3 through No. 6 can be found in Appendix C. Alternative Plan No. 2 had the lowest capital and average annual costs, while Alternative Plan No. 5 had the highest capital and average annual costs. However, it is worth noting that Alternative Plan No. 2 did not include costs associated with providing dryland access. Discussions regarding dryland access would be needed between the impacted communities, WDNR, and the appropriate local emergency services. If providing dryland access is required, additional costs would be incurred by Alternative Plan No. 2.

Additional differences between the alternatives are evaluated in the sections below. The differences include:

- Flood impacts beyond the 1-percent-annual-probability event,
- Construction timing,
- Implementation factors including potential construction issues, number of acquisitions and the loss of tax base, and maintenance requirements, and
- Natural habitat enhancement

4.1 FLOOD IMPACTS

Each of the alternative plans was designed to provide flood protection during events with annual probabilities of 1 percent or greater. During larger events, the degree of flood protection afforded by each alternative would vary. A comparison of the total number of flooded structures and flood damages during the 0.2-percent-annual-probability flood event is set forth in Table 4.2. A detailed comparison of

Table 4.1
Comparison of Estimated Costs[a] of Alternative Plans

Alternative	Total Capital Cost ($)	Annual Operation and Maintenance ($)	Average Annual Cost[b] ($)
Alternative Plan No. 1 – Voluntary Acquisition and Demolition	6,325,000	--	401,000
Alternative Plan No. 2 – Voluntary Elevation	4,026,000	--	255,000
Alternative Plan No. 3 – W. Oklahoma Avenue Bridge Opening Modification and S. 76th Street Bridge Replacement	5,321,000	--	338,000
Alternative Plan No. 4 – W. Oklahoma Avenue and S. 76th Street Bridge Replacement	6,842,000	--	434,000
Alternative Plan No. 5 – Entire Concrete Channel Rehabilitation	36,472,000	29,000	2,210,000
Alternative Plan No. 6 – Partial Concrete Channel Rehabilitation	15,904,000	11,500	1,021,000
Alternative Plan No. 7 – No Action	--	--	76,700[c]

[a] *Costs are in year 2020 dollar values*

[b] *Amortized capital cost is based on an interest rate of 6 percent and a project life of 50 years*

[c] *Equal to average annual damages*

Source: SEWRPC

Table 4.2
Building Count and Flood Damages[a] Within the 0.2-Percent-Annual-Probability Floodplain

	0.2-Percent-Annual-Probability Floodplain (500-year Recurrence Interval Floodplain)													
	Alternative Plan No. 1 – Voluntary Acquisition and Demolition		Alternative Plan No. 2 – Voluntary Elevation		Alternative Plan No. 3 – W. Oklahoma Avenue Bridge Opening Modification and S. 76th Street Bridge Replacement		Alternative Plan No. 4 – W. Oklahoma Avenue and S. 76th Street Bridge Replacement		Alternative Plan No. 5 – Entire Concrete Channel Rehabilitation		Alternative Plan No. 6 – Partial Concrete Channel Rehabilitation		Alternative Plan No. 7 – No Action	
Municipality	Number of Buildings in the Floodplain	Flood Damages ($)	Number of Buildings in the Floodplain	Flood Damages ($)	Number of Buildings in the Floodplain	Flood Damages ($)	Number of Buildings in the Floodplain	Flood Damages ($)	Number of Buildings in the Floodplain	Flood Damages ($)	Number of Buildings in the Floodplain	Flood Damages ($)	Number of Buildings in the Floodplain	Flood Damages ($)
City of Greenfield	54	1,953,000	54	1,953,000	54	1,953,000	54	1,953,000	40	1,406,000	54	1,962,000	59	2,114,000
City of Milwaukee	74	5,322,000	74	5,322,000	78	5,328,000	74	5,216,000	78	5,427,000	78	5,493,000	85	5,737,000
City of Wauwatosa	--	--	--	--	--	--	--	--	--	--	--	--	--	--
City of West Allis	10	2,177,000	10	2,177,000	5	1,673,000	5	1,673,000	3	1,456,000	3	1,484,000	10	2,177,000
Total	138	9,452,000	138	9,452,000	137	8,954,000	133	8,842,000	121	8,289,000	135	8,839,000	154	10,028,000

[a] *Flood damages are reported in year 2020 dollar values*

Source: SEWRPC

flood stages for both 1-percent-annual-probability and 0.2-percent-annual-probability events between the existing condition and all the alternatives can be found in Appendix D. Alternative Plan No. 5 would afford the greatest degree of protection during the 0.2-percent-annual-probabilty event, with 33 total insurable structures protected and flood damages reduced by $1.74 million. Alternative Plans No. 3, No. 4, and No. 6 would have similar levels of protection during the 0.2-percent-annual-probability flood event, protecting between 17 and 21 insurable structures and reducing flood damages by between $1.07 million and $1.19 million. Alternative Plans No. 1 and No. 2 would provide the least degree of protection during the 0.2-percent-annual-probability flood event, protecting 16 insurable structures and reducing flood damages by $576,000. Alternative Plan No. 2 would offer less protection compared to Alternative Plan No. 1 since elevation would reduce the hazard during floods larger than the design flood, but acquisition and demolition would eliminate the hazard.

Roadway flooding impacts would also differ between all the alternative plans. Compared to existing conditions (Maps 2.1 to 2.7), Alternative Plan No. 5 would provide the greatest impact with W. Layton Avenue, S. Placid Drive, W. Allerton Avenue, Honey Creek Drive, S. 72nd Street, and W. Lakefield Drive no longer flooding during the 1-percent-annual-probability event. Road overtopping depths were reduced for all the other flooded roadways identified in the MCAMLIS floodplain for Alternative Plan No. 5. Alternative Plan No. 6 would also afford some roadway flooding protection as compared to existing roadway flooding. Alternative Plan No. 6 would eliminate Honey Creek Drive, S. 72nd Street, and W. Lakefield Drive from flooding during the 1-percent-annual-probability flood event. For the bridge modification Alternative Plans No. 3 and No. 4, no roadways were completely protected from flooding during the 1-percent-annual-probability flood event. During the 1-percent-annual-probability flood event, roadway flooding depths would be reduced immediately upstream of S. 72nd Street for Alternative Plans No. 3 and No. 4 by approximately 0.6 feet and 0.8 ft, respectively. Alternative Plans No. 1 and No. 2 would not provide any roadway flooding protection benefits as they addressed the flooded buildings only.

4.2 CONSTRUCTION TIMING

The timing of construction may differ between each of the alternatives, which could be a significant consideration in deciding which alternative to pursue. As was discussed under section 1.1 of this report, the current Honey Creek concrete lined channel is still in relatively good condition. Since there are no apparent structural failures of the concrete lining to date, concrete channel rehabilitation of the entire channel (Alternative Plan No. 5) may not be an immediate priority for MMSD. The remaining alternatives including voluntary acquisition (Alternative Plan No. 1), voluntary elevation (Alternative Plan No. 2), the bridge improvement alternatives (Alternative Plans No. 3 and No. 4) and the partial concrete channel rehabilitation alternative (Alternative Plan No. 6) are more readily implementable. One of these alternatives could be completed first to mitigate flooding in the City of Milwaukee impacted area, and then the entire concrete channel could be rehabilitated at the end of its design life for future flood protection benefits.

Intergovernmental coordination and negotiations would be needed for successful and timely implementation of Alternative Plans No. 3 through No. 6. In particular, the bridge improvement alternatives would require coordination between Milwaukee County, City of Milwaukee, and the City of West Allis. The W. Oklahoma Avenue is bridge is owned by Milwaukee County and the S. 76th Street bridge is owned by the City of West Allis.

4.3 IMPLEMENTATION FACTORS

This section explores the major challenges involved in completing each of the proposed alternatives. This evaluation category is more subjective; however, it is possible to evaluate and compare the relative implementation issues for the six alternative plans. A summary of the implementation factors for each alternative can be found in Table 4.3.

Table 4.3
Honey Creek Alternative Plans – Implementation Summary

Alternative	Construction Issues[a]			Acquisitions		Maintenance Requirements
	Disruptions During Construction	Utility Conflict Potential	Land Disturbance	Number of Properties Voluntarily Acquired	2020 Total Assessed Value of Acquired Properties[c] ($)	
Alternative Plan No. 1 – Voluntary Acquisition and Demolition	Low	Low	Low	16	2,582,000	Low
Alternative Plan No. 2 – Voluntary Elevation	Low	Low	Low	--[b]	--	Low
Alternative Plan No. 3 – W. Oklahoma Avenue Bridge Opening Modification and S. 76th Street Bridge Replacement	Medium	Medium	Low	7	1,199,000	Low
Alternative Plan No. 4 – W. Oklahoma Avenue and S. 76th Street Bridge Replacement	Medium	Medium	Low	6	1,041,000	Low
Alternative Plan No. 5 – Entire Concrete Channel Rehabilitation	High	High	High	5	872,000	High
Alternative Plan No. 6 – Partial Concrete Channel Rehabilitation	High	High	High	5	872,000	Medium

[a] *Construction issues ratings are based on the size and distance of the construction impacted area.*

[b] *Alternative Plan No. 2 in this report assumed elevation of all 16 insurable structures in the 1-percent-annual-probability floodplain. No property was assumed to be acquired and demolished. However, due to the MMSD floodproofing funding structure (Section 3.4.3) and potential challenges in meeting regulatory requirements, municipalities may choose to pursue acquisition and demolition with willing landowners instead.*

[c] *2020 assessed value of land and improvements by the communities.*

Source: SEWRPC

Construction Issues

Disruptions during construction and the potential for utility conflicts can present significant challenges for the proposed alternatives. For Alternative Plans No. 3 and No. 4, W. Oklahoma Avenue and S. 76th Street closures during construction would be a significant disruption. Both roadways are major thoroughfares and alternative routes would need to be established for commuter traffic. There may also be utilities within the bridge project areas that would require relocation during the construction of the new bridges.

For the channel rehabilitation Alternative Plans No. 5 and No. 6, the planning level design did not alter the bridges where most crossing utilities would likely be located. However, any utilities that run underneath or parallel to the Honey Creek concrete lined channels may be impacted during excavation and natural channel construction. The alignments for all utilities would need to be determined and relocated as necessary for the channel rehabilitation alternatives. The primary construction challenges related Alternative Plans No. 5 and No. 6 would likely be construction mobilization, staging, and site preparation. Large sections of the Honey Creek concrete lined channel pass through urban environments and residential neighborhoods. Construction equipment access to the stream may be challenging and road closures may be necessary.

Significant land disturbance to parks and parkways should also be noted for Alternative Plans No. 5 and No. 6. These wider excavation reaches were necessary to add floodplain storage and lower flood elevations. Specifically, a 200-foot-wide reach is proposed in the parkway area downstream of S. 76th Street through McCarty Park, and between a 100- and 250-foot-wide reach is proposed in the parkway from the outlet of the enclosure at I-94 to the end of the concrete lined section downstream of W. Wisconsin Avenue. The construction of this wider bioengineered floodplain would also require removal of many existing trees in the parkways.

Acquisitions

Voluntary acquisition and demolition of homes was included in Alternative Plans No. 1, and No. 3 through No. 6. Alternative Plan No. 1 included the greatest number of acquisitions, with 16 homes being considered for voluntary acquisition and removal. Alternative Plans No. 3 and No. 4 included seven homes and six homes respectively, to be voluntarily acquired and removed. Both Alternative Plans No. 5 and No. 6 included five homes for voluntary acquisition and removal.

Alternative Plan No. 2 assumed voluntary elevation of all 16 homes in the 1-percent-annual-probability floodplain, thus no acquisitions were required. However, due to the MMSD Flood Risk Reduction Policy (see section 3.4.3), the level of potential funding for elevation is limited and dryland access will need to be resolved. Therefore, the extent of implementation of Alternative Plan No. 2 would be dependent on the decisions made by the homeowner and the appropriate municipality for the 16 properties in the 1-percent-annual-probablity floodplain.

Property acquisition and demolition would provide flood resiliency and ecosystem benefits; however, it will also constitute a loss of tax base for the impacted municipality. A summary of the total acquisition count and the total 2020 assessment value of all the properties to be acquired can be found in Table 4.3.

Maintenance Requirements

Differences in post-construction annual maintenance requirements for the alternatives is another implementation factor. Under Alternative Plans No. 5 and No. 6, the rehabilitated sections of Honey Creek would require the greatest amount of maintenance as compared to the other alternatives. These maintenance requirements for the restored channel include annual inspections, quarterly mowing of the grass portions of the excavated floodplain, trash and debris removal, and potential annual graffiti removal from the retaining walls. Inspection, mowing, and debris removal are important to maintain the flood conveyance capacity of the restored channel sections.

Numerous proposed alternatives include voluntary acquisition and removal of flooded structures. Open spaces created from acquisition and removal of structures in the 1-percent-annual-probability floodplain should require minimal maintenance once the vacant land is restored. Exact maintenance requirements would depend on the usage of the open spaces. If the open spaces are converted to grass fields, regular mowing would be required. Native planting can be utilized for the open spaces which may require some

maintenance of invasive plant species. If public recreational facilities such as playgrounds would be built in the open spaces, standard maintenance of the equipment would be needed.

Maintenance of the bridges under Alternative Plans No. 3 and No. 4 should be included in the standard bridge inspection and maintenance currently being performed by Milwaukee County for the W. Oklahoma Avenue bridge and by the City of West Allis for the S. 76th Street bridge. No additional maintenance should be required for the bridge improvements.

4.4 HABITAT ENHANCEMENT

Historically, the prevention of flooding problems had been the major focus of stormwater and floodland management efforts in the Milwaukee urban area. For Honey Creek, this led to channelization (straightening of the stream), placement of concrete on channel beds and banks to promote conveyance of flood flows, and implementation of drop structures and enclosed channels for enhanced conveyance and adjacent development. These channel modifications were implemented without consideration of the negative impacts to instream and riparian habitat conditions. The negative impacts of these man-made modifications to Honey Creek include the following:

- Fragmentation of Honey Creek that limits linear connectivity and the ability of fish and aquatic organisms to move to either upstream or downstream of the enclosure. The connection to the Menomonee River and Lake Michigan is limited to the portion of Honey Creek downstream of I-94.

- Disconnection of the stream from its functional floodplain.[20] This disconnection increases the flashiness of streamflow, increases erosion of downstream streambeds and streambanks, and reduces the suitability of instream and riparian habitat for wildlife.

- Reduced diversity of instream habitat types including pool and riffle structures and course woody habitat that are necessary for survival of aquatic organisms.

- Increased water temperatures and reduced water quality.

The concrete lined channel removal and the construction of a bioengineered natural channel and floodplain proposed under Alternative Plans No. 5 and No. 6 would not only meet flood mitigation requirements, but also have the added benefit of addressing some of the negative impacts to instream habitat that are described above.

It should be noted that any improvements to instream habitat conditions provided in Alternative Plans No. 5 and No. 6 would be limited by the enclosed channel reach between McCarty Park and I-94 that would remain. Upstream of the enclosure channel rehabilitation will enhance habitat for aquatic organisms in that section, and terrestrial animal movement as well along the corridor.

The rehabilitated channel planning level design incorporated several features to improve wildlife habitat, including:

- Naturalized meanders to the low-flow channel to restore pool and riffle habitats,

- River rocks in the low-flow channel for streambed erosion protection,

- Excavated floodplains to restore connectivity with the stream channel,

- Native riparian vegetation in the floodplain for a more naturally functioning floodplain system, and

- Stair-step retaining walls for streambank stabilization and maximizing floodplain size

[20] *It should be noted that "functional floodplain" as referred to when discussing habitat is defined as a relatively flat valley floor or bench that can carry and/or retain some volume of flood water that has overtopped the banks of a stream. The use of the term here is not necessarily referencing the regulatory or any modeled floodplains.*

Restoring a more natural stream and functioning floodplains will help regulate peak flows, provide floodwater storage during heavy rain events, reduce pollutant loads entering streams, prevent downstream erosion, provide recreational benefits, and may contribute to groundwater recharge, all of which will lead to an improvement in aquatic and terrestrial wildlife habitat.

In addition to improvements of instream habitat, alternatives that incorporate the acquisition and demolition of structures within the floodplain would present opportunities to improve riparian habitat. In these cases, formerly developed parcels would be cleared and can be restored using native vegetation and kept in open space uses in perpetuity. Any improvements to riparian areas adjacent to Honey Creek could improve instream water quality, reduce water temperatures, and improve instream and terrestrial habitat conditions. Alternative Plan No. 1 with the greatest number of structures selected for acquisition and demolition would provide some opportunities for this type of riparian habitat improvement. Although other alternatives include some structural acquisition and demolition opportunities, the restricted scale of such projects limits their riparian habitat benefits.

FUTURE WORK 5

Credit: SEWRPC Staff

This plan summarizes the alternatives developed to mitigate flooding in the Honey Creek watershed. Six potentially feasible alternatives were evaluated to reduce flood damages as well as channel rehabilitation. All the presented alternatives reduce flood damages for the 16 structures in the Honey Creek 1-percent-annual-probability floodplain in the vicinity of S. 72nd Street in the City of Milwaukee and at the upstream end of Honey Creek in the City of Greenfield. Alternative Plans No. 1 and No. 2 only mitigate the 16 flood structures directly. Alternative Plans No. 3 and No. 4 address flooding impacts near S. 72nd Street using bridge modifications or replacements. Only Alternative Plans No. 5 and No. 6 address channel rehabilitation in addition to flood protection.

MMSD in coordination with USACE recently began a separate study to rehabilitate Honey Creek for the segment downstream of W. Fairview Avenue to its confluence with the Menomonee River. The channel rehabilitation project would include the removal of the concrete channel and restoring the channel with a bioengineered natural design, streambank stabilization, removal of invasion plants, and planting with native species. The feasibility study has been completed and design work is set to begin in the summer of 2022. It is anticipated this project will not impact the alternatives included in this study to mitigate the flooded structures in the City of Milwaukee impacted area.

The City of Greenfield is also currently working on a Honey Creek channel restoration effort between W. Loomis Road and W. Layton Avenue. One goal of this project is to lower the channel inverts to daylight the existing storm sewers, therefore improving stormwater management in the area. Additional land and habitat enhancements are also anticipated for this project. As of early 2022, this project is in its final design phase and is currently working on permits with the USACE. This phase of the project is not anticipated to impact the five flood impacted homes in the City of Greenfield impacted area.

While taking the two current Honey Creek projects mentioned above into consideration, elected officials, staff, and residents of Milwaukee County and the Cities of Greenfield, Milwaukee, Wauwatosa, and West Allis will need to work together to determine which of the six alternatives documented in this report to evaluate in greater detail. The selected alternative(s) may be refined based on construction timing, the level of flood protection desired, number of acquisitions required, and more detailed designs for channel rehabilitation and bridge modifications, as well as updated construction costs. Refined alternatives may also be a combination of the alternatives evaluated in this plan.

APPENDICES

HYDRAULIC MODEL DEVELOPMENT MEMORANDA

APPENDIX A

MEMORANDUM TO FILE

TO: Water Resources Simulation Project 331 (WRSP 331)

FROM: Laura L. Kletti (LLK)

DATE: December 28, 2009

SUBJECT: HONEY CREEK – MENOMONEE RIVER WATERSHED

The following memorandum sets forth the procedure followed in developing the flood flows and stages for Honey Creek (HC) as part of the floodplain mapping project for the Milwaukee County Automated Mapping and Land Information System (MCAMLIS) steering committee and the Milwaukee Metropolitan Sewerage District (MMSD). Honey Creek has previously been studied by the Commission as part of a flood control system plan for the MMSD (Community Assistance Planning Report No. 152). Additional studies were made by the MMSD as part of its watercourse system planning. The FEMA Flood Insurance Study for Milwaukee County dated 2008 includes detailed study work for this creek (in the City of Milwaukee only) that is based on the original SEWRPC Menomonee River watershed plan (Planning Report No. 26).

1. Starting Models

A. The base hydrologic and hydraulic models for the MCAMLIS effort were taken from the Menomonee River Phase 1 & Phase 2 Watercourse System Management Plans completed for MMSD in 2000 by Camp Dresser McKee (CDM) (Phase 1) and Tetra Tech MPS (Phase 2). These models were based in part on the SEWRPC models developed for CAPR No. 152.

2. Hydrology

A. Flood flows for Honey Creek were determined using the U.S. EPA Hydrologic Simulation Program – Fortran (HSPF) continuous simulation model. Simulated annual peak flows were fitted to a Log Pearson Type III distribution using U.S. Army Corps of Engineers HEC-FFA program.

B. The MMSD Menomonee River Phase 2 Watercourse Management Plan HSPF model was refined and recalibrated by Tetra Tech, Inc. as part of the MMSD 2020 Facilities Plan and Regional Water Quality Management Plan Update water quality modeling effort. Additional updates to the HSPF model that were made as part of the MCAMLIS project include further calibration refinements; reconfiguring subbasins to routing reach assignments; revision of routing reach storage-discharge tables; utilizing a simulation period from 1940 through 2004; and including the 1986 event in the flow frequency evaluation (Exhibit A).

C. Final year 2020 planned land use, existing channel condition peak flow rates included in the WRSP 331 HEC-RAS model are listed in the table below. These were the flows used for mapping the floodplain and floodway boundaries for the MCAMLIS project. Flood profiles were also computed reflecting existing (year 2000) land use and existing channel conditions, but were not used in the mapping.

D. Peak flow rates have changed significantly from the Phase 2 to the MCAMLIS model for the section between I-894 and McCarty Park. This was due to routing corrections in the HSPF model.

E. The peak capacity of the State Fair Park enclosure utilized was 2,340 cfs. This maximum capacity was determined by CDM during the Phase 1 effort and also used in the Phase 2 modeling. For the MCAMLIS modeling, the 2,340 cfs flow rate maximizes the 500-year profile without spilling out onto the ground above the structure. This can be seen in the profile at RM 2.823 which is midway on the 4-9'x13'1" MPPA. Also, an EPA SWMM 5.0 model was created as part of the MCAMLIS effort that confirmed the 2,340 cfs maximum capacity for the enclosure (Exhibit B).

WRSP 331 – Honey Creek
Planned Year 2020 Land Use, Existing Channel Conditions
Peak Flow Rates

River Mile	Location	Peak Flow (cfs)			
		10 - Year	50 - Year	100 - Year	500 - Year
0.878	DS of Wisconsin Avenue	2,440	3,380	3,470	3,660
1.935	DS of I-94	2,350	3,040	3,090	3,210
3.044	State Fair Park Enclosure DS of Greenfield Avenue	2,140	2,340	2,340	2,340
4.2813	State Fair Park Enclosure Inlet at McCarty Park	1,990	2,340	2,340	2,340
5.002	DS of 76th Street	1,600	2,450	2,850	3,860
5.227	US of Oklahoma Avenue	1,340	2,090	2,450	3,380
6.389	DS of Forest Home Avenue / Howard Avenue	1,170	1,850	2,180	3,060
7.449	DS of I-894	970	1,580	1,880	2,700
7.669	DS of Layton Avenue	495	821	988	1460
8.020	Konkel Park pedestrian bridge	374	620	746	1,100
8.666	US end at 43rd Street	316	524	631	932

3. Hydraulics

A. Digital cross sections for HC received from Tetra Tech for Phase 2 did not match model distances well or the original workmaps. Original workmaps from Planning Report No. 26 were used as a starting point to locate the HC cross sections. LLK located the model cross sections on the 2-foot topography completed by Ayres Associates for Milwaukee County (April 2005, 2-ft topography). Adjustments were made to the cross section overbanks to match the 2005 2-ft topography. The MCAMLIS HEC-RAS model includes notes at each cross section on changes made from the Phase 2 model.

B. The MCAMLIS hydraulic profiles for Honey Creek were determined using HEC-RAS Version 4.0. The model was run using a Mixed Flow regime.

C. The downstream boundary condition for the hydraulic model was assumed to be Normal Depth. The upstream boundary condition assumed critical depth.

D. Manning 'n' values were predominantly maintained, with minor tweaks to overbank values based on the MCAMLIS model extent and the 2005 aerial photography.

E. A profile baseline was digitized as part of the Honey Creek mapping. Model channel distances between cross sections were initially measured by hand and then cross checked with distances obtained from the GIS. Only minor adjustments to model distances were required for final mapping as noted in Exhibit GG.

F. Bridge top of deck geometry was updated in the MCAMLIS model to match the 2005 2-ft contour information as required. Bridge distances to the upstream cross section were also modified from the Phase 2 model to allow the model to run in HEC-RAS 4.0. Bridge deck widths were reviewed and updated based on the 1973 and 1988 SEWRPC surveys and 2005 2-ft topography. Full flow cross sections at bridges were checked and if required shifted accordingly to be approximately 1:1 upstream and 2.5:1 downstream of the bridges.

DOWNSTREAM CHANNEL (MOUTH TO I-94)

G. For cross sections RM 0.013 to 0.042 the right overbank (ROB) elevations were updated to reflect the 2002 proposed grading for Honey Creek Park Parkway as part of the Hart Park project (Exhibit C).

H. The Hart Park pedestrian bridge at RM 0.032 was reviewed versus 1996 DOT plans (CA 416-36). Bridge geometry matched well and no changes were made (Exhibit D).

I. The Honey Creek model channel inverts were adjusted from RM 0.042 (Hart Park pedestrian bridge) to RM 0.901 (Wisconsin Avenue) based on the SEWRPC 1973 surveyed structure inverts, 2005 Ayres structure survey as noted below, and the 2005 2-ft topography. Cross section stationing was also adjusted to match distances based on the 2005 2-ft topography. A spreadsheet summary of the invert elevations and stream distances is included in Exhibit E.

J. Two bridges on Honey Creek Parkway (#1 and #2) at RM 0.15 and 0.59 were updated by Ayres Associates to reflect a 2005 survey and 2007 DOT plans. LLK reviewed the revised modeling, imported the bridges into the overall HEC-RAS model, and modified top of rail and low chord as noted in the model to reflect the DOT plans. The bridge plans, notes and correspondence are included in Exhibit F.

K. The Portland Avenue bridge at RM 0.49 was updated to a Manning "n" value of 0.015 to reflect the concrete lining on the arch as observed in 2009 field visits (Exhibit G).

L. At Wisconsin Avenue (RM 0.89) and upstream to I-94 the main channel is lined with concrete. In field visits in 2009 significant vegetation was observed growing in the longitudinal cracks in the concrete, predominantly in the wider sections near structures. Manning "n" values of 0.03 were included in the upper portion of the lined channel to reflect this vegetation.

M. The Honey Creek Parkway bridges (#3 and #4) at RM 1.08 and 1.37 cross sections were modified to reflect the 1973 SEWRPC survey and 2009 field observations (Exhibit H).

N. Upstream of Wisconsin Avenue (RM 0.89) the concrete lined channel cross sections and structure configurations were reviewed versus the Metropolitan Sewerage Commission channelization contracts listed below. Minor changes in open channel cross sections were done as required to match the channelization plans.

Channelization Contract Plan	Date of Plans	Location (Downstream to Upstream)
C-179	1963	Wisconsin Avenue to I-94
C-219	1967	Revised pavement design Wisconsin Avenue to 84th Street
C-194	1963	State Fair Park Structure I-94 to Greenfield Avenue
C-203	1964	Double Box Structure Greenfield Avenue to National Avenue
C-204	1965	Enclosed Structures National Avenue to Becher Street
C-208	1965	Double Box Structure Becher Street to McCarty Park Inlet at Arthur Avenue
C-230	1967	McCarty Park Inlet Grate details
C-209	1966	McCarty Park Inlet to Oklahoma Avenue
C-795	1967	Oklahoma Avenue to Morgan Avenue
C-635	1960	Morgan Avenue to Howard Avenue / Forest Home Avenue
C-236	1971	Forest Home Avenue to I-894

O. The Bluemound Road structure RM 1.187 to 1.206 was changed to a lidded cross section in the MCAMLIS model. This was done to account for the southern extension of the bridge and sloping low chord on the inlet side documented in the 1953 City of Milwaukee plan set (Exhibit I). The sloping low chord was also observed during the 2009 field visits.

P. The abandoned railroad crossing and wall on the right side from RM 1.590 to 1.630 was redone in the MCAMLIS model to reflect the original Planning Report No. 26 cross sections and field observations made in 2009 (Exhibit J).

Q. The 84th Street bridge at RM 1.79 was modified slightly to reflect the original 1973 survey and 2009 field observations. The larger opening was modified to have an arch shape on top, and the channel overbanks and bridge railing were modified to match the survey and 2005 2-ft topography (Exhibit K).

R. An additional cross section was added at the downstream end of the flared end section (FES) at RM 1.939 to model the transition from the FES to the open channel. Cross section data was based on the 1961 Milwaukee County Expressway Commission plans, 2005 2-ft topography, and the 2009 field visit (Exhibit L).

STATE FAIR PARK ENCLOSURE (I-94 TO ARTHUR AVE)

S. The entire State Fair Park enclosure from RM 1.949 to 4.2767 was reviewed versus the original 1961 Milwaukee County Commission plans for the 1-94 crossing and the channelization plans listed in N above. The structure alignment was taken from these plans and placed on the 2005 2-ft topography and very minor adjustments to lengths were made to match the topography. Model structure inverts were adjusted to match the plan set information as required (Exhibit L).

T. The model top of ground for the State Fair Park enclosure was taken from the 2005 2-ft topography.

U. As noted in the model description for each cross section, contraction/expansion values were changed from 0.3/0.5 in the Phase 2 model to 0.1/0.3 where the structure geometry was not

changing between model cross sections. At transitions between structure configurations the contraction/expansion of 0.3/0.5 was retained.

V. The multiple plate pipe arch (MPPA) pipes from RM 2.154 to 3.044 were corrected to be symmetric cross sections and the Manning "n" values were changed to 0.029. Cross section backup is included in Exhibit L.

W. The inlet to the State Fair Park enclosure at Arthur Avenue (RM 4.2769 to 4.283) was corrected per the original MMSD plans listed in N above. Inverts match the plans, and the reduction in flow area for the grate was done by reducing the width of the cross sections 1-foot per side as noted in the model for RM 4.2769 and 4.2813. The reduction of 1-foot in width is based on approximately 32 vertical bars per side at 0.375-inches thick (C-230 plans).

UPSTREAM CONCRETE CHANNEL (McCARTY PARK TO I-894)

X. A pedestrian bridge in McCarty Park at RM 4.515 was added to the MCAMLIS model based on the original channelization plans, 2009 field visit and 2005 2-ft topography. The bridge deck height was estimated from photos and the railings were ignored for modeling purposes.

Y. Concrete cross sections and drop structures Oklahoma Avenue RM 5.20 to Morgan Avenue RM 5.878 were reviewed and modified as necessary to match the 1967 C-795 plans (Exhibit M).

Z. The invert of the Beloit Road bridge at RM 4.62 was adjusted to match the 1973 SEWRPC survey and original 1957 plans. Adjacent channel cross sections at RM 4.592 and 4.645 were adjusted to transition to the bridge (Exhibit N).

AA. Cross section overbanks from Beloit Road RM 4.62 to Morgan Avenue RM 5.878 were expanded using the 2005 2-ft topography. Obstructions were used in the MCAMLIS model to represent buildings in the overbanks as required.

BB. The Oklahoma Avenue bridge at RM 5.20 was updated to reflect the 2007 Milwaukee County DOT plan set. The bridge rehabilitation work began in spring 2009. Changes to the model geometry include updating the low chord and top of rail configuration and elevations (Exhibit O).

CC. The 72nd Street bridge at RM 5.436 was updated to reflect the 1973 SEWRPC survey invert and slope through the structure of the original 1954 City of Milwaukee plans (Exhibit P).

DD. Concrete cross sections Morgan Avenue RM 5.878 to Howard Avenue RM 6.502 were reviewed and modified as necessary to match the 1960 C-635 plans (Exhibit Q).

EE. The Morgan Avenue bridge at RM 5.878 was adjusted slightly to match the 1973 SEWRPC surveyed invert.

FF. Channel inverts from Morgan Avenue RM 5.878 to just upstream of 68th Street at RM 6.224 were adjusted slightly to match the slope listed in the 1960 C-635 plans and the 1973 survey inverts at the bridges.

GG. The 68th Street bridge at RM 6.10 was adjusted slightly to match the 1973 SEWRPC surveyed invert. The structure height was also adjusted to match the 9.75-ft opening height (Exhibit R).

HH. The Howard Avenue / Forest Home Avenue bridge at RM 6.502 was recoded using lidded cross sections in the MCAMLIS model. The cross section was adjusted to match the 1973 SEWRPC survey and 1971 C-236 plans (Exhibit S).

II. Channel cross sections Forest Home RM 6.502 to 60th Street RM 6.972 were adjusted to match the 1971 C-236 plans and transition between the 1973 SEWRPC survey inverts at the structures (Exhibit S).

JJ. The 60th Street bridge RM 6.972 inlet, double box structure, and outlet were recoded using lidded cross sections in the model. Cross sections were adjusted to match the 1973 SEWRPC survey and 1971 C-236 plans (Exhibit T).

KK. Channel cross sections 60th Street RM 7.024 to Cold Spring Road RM 7.125 were adjusted to match the 1971 C-236 plans and transition between the 1973 SEWRPC survey inverts at the structures (Exhibit U).

LL. The Cold Spring Road bridge RM 7.14 was adjusted to match the 1973 SEWRPC survey, 1971 C-236 plans, and 1971 City of Greenfield Plans (Exhibit U).

MM. Channel cross sections Cold Spring Road RM 7.14 to I-894 RM 7.47 were adjusted to match the 1971 C-236 plans and transition between the 1973 SEWRPC survey inverts at the structures (Exhibit V).

NN. The I-894 RM 7.47 inlet, double box structure, and outlet were adjusted to match the 1973 SEWRPC survey, 1971 C-236 plans, and 1964 Milwaukee County Expressway Commission plans (Exhibit V). The structure was also changed to be represented as culverts for modeling purposes.

UPSTREAM NATURAL CHANNEL (I-894 TO 43rd ST)

OO. The HC Phase 2 model included a sheet pile drop structure just upstream of the I-894 bridge. This was removed from the model per the 1992 WisDOT plans 2070-02-70 and 2009 field visit (Exhibit W).

PP. Channel geometry between I-894 and Layton Avenue was redone based on 1) 2005 Biltrite Plans for the upper right bank; 2) WisDOT plans for the low channel geometry and invert; and 3) 2005 2-ft topography for the left bank and mid right bank. Based on the 2005 aerial photos and 2009 field visit there was no evidence of the training dikes noted on the WisDOT plans, thus they were omitted from the model cross sections. Manning "n" values were adjusted based on the 2009 field visit and 2005 aerial photos (Exhibit W).

QQ. The Layton Avenue box culvert was redone using the 1991 WisDOT C-40-72 plans. It was modeled as a 10' x 8' RCP with a Manning "n" value of 0.017 in the MCAMLIS model (Exhibit X).

RR. The drop structure upstream of the Layton Avenue box culvert was modified from the 1991 WisDOT plans. Significant erosion was observed as well as an overall flattening of the drop during the 2009 field visit. Based on the 2009 field visit, 2005 2-ft topography and 2-foot topography completed by Aero-metric Engineering for Milwaukee County (April 1993, 2-ft topography) the upstream edge of the drop structure at RM 7.718 was modeled at elevation 750.0 NGVD29. This elevation correlated with the field estimated 3-ft drop in the sloping concrete drop structure. No flat portion of the drop structure was observed in the field as was

drawn on the WisDOT plans. The drop to the inlet of the Layton Avenue box culvert at RM 7.7113 was measured via tape as 1.5 ft (Exhibit X).

SS. The 1993 2-ft topography was used for the main channel geometry for the cross sections at RM 7.711, 7.7113, 7.718 and 7.792. Overbanks were based on the 2005 2-ft topography (Exhibit Y).

TT. Channel inverts RM 7.792 to 7.946 were interpolated between the top of the concrete drop at RM 7.718 to the 1988 SEWRPC survey of the invert of the Konkel Park CMPA adjusted as noted below. Manning "n" values for both the channel and overbanks were updated to reflect the 2005 aerial photography and 2009 field visits.

UU. The Konkel Park maintenance culvert at RM 7.953 was recoded to be a standard 10'3" x 6'9" CMPA based on the 1988 SEWRPC survey and 2009 field visit. The invert remained 752.5 NGVD29 which matched well with the surveyed obvert and standard arch pipe size. Manning "n" value used was 0.024 (Exhibit Z).

VV. Channel inverts RM 7.975 to 8.349 were interpolated between the invert of the Konkel Park CMPA RM 7.953 to the 1988 SEWRPC survey at Loomis Road RM 8.37. Manning "n" values for both the channel and overbanks were updated to reflect the 2005 aerial photography and 2009 field visits.

WW. The Konkel Park pedestrian bridge at RM 8.021 was added to the model using the 2001 Bonestroo Rosene Anderlik & Associates plans plus notes from the 2009 field visit. The top of rail was modeled per the 2009 field visit. The channel is undefined from the pedestrian bridge upstream to RM 8.153 based on both topography and the 2005 aerial photo. The low channel was assumed to be a triangular shape 10-ft wide at the top and approximately 2-ft deep. The depth of the low channel varied to match the 2005 2-ft topography. Channel inverts at the bridge were based on the interpolation between the CMPA and Loomis Road as previously discussed (Exhibit AA).

XX. The Loomis Road bridge at RM 8.37 was recoded using the 1988 SEWRPC survey adjusted for the 57-degree skew between the centerline of HC and Loomis Road (Exhibit BB).

YY. In 1989 cross sections were surveyed by MMSD upstream of Loomis Road to 43rd Street. As the old Loomis Road crossing was removed, the surveyed cross sections at Phase 2 RM 8.55 and 8.56 were not used for the MCAMLIS model. A new cross section was added at RM 8.388 for the 1:1 transition into the Loomis Road bridge. The RM 8.388 cross section was based on the 2005 2-ft topography and the invert was based on linear interpolation between the Loomis Road invert and surveyed Phase 2 RM 8.56 invert. The 0.7-ft rise to define the low flow channel was based on the RM 8.56 survey (Exhibit CC).

ZZ. The main channel cross sections surveyed at Phase 2 RM 8.59, 8.69, and 8.78 were transferred to the 2005 2-ft topography and coded as RM 8.429, 8.527, and 8.625 respectively. Cross sections were adjusted in the overbanks to be perpendicular to the 2005 2-ft contours. Overbank Manning "n" values were adjusted in this section to reflect the 2005 aerial photo and 2009 field notes (Exhibit CC).

AAA. The RM 8.666 cross section was added to the MCAMLIS model based on the 2005 2-ft topography and the 1988 SEWRPC survey at 43rd Street. The sharp drop in invert was

reflected with standing water to essentially the top of the RCP at 43rd Street both in the 1988 survey and the 2009 field visit (Exhibit DD).

BBB. Original workmaps for the model cross sections and floodplain boundaries are included in Exhibit EE.

CCC. Model output for Year 2020 Land Use with Existing Channel Conditions is included in Exhibit FF.

DDD. The draft HEC-RAS model was reviewed by RJP on 4/10/09 and 8/18/09 and comments were incorporated as required (Exhibit GG). Final model is named HoneyCreek2009, dated 12/16/09.

4. Miscellaneous

A. Field visits to Honey Creek were done by LLK on 1/16/09, 2/13/09, 4/20/09, 4/23/09, and 4/24/09 to confirm geometry and Manning 'n' values along the creek corridor. Field notes and digital photos are included in Exhibit G.

B. Final floodplain mapping near the confluence with the Menomonee River (MnR) was completed using flood elevations for the MnR since these were higher than the computed HC stages. RM 6.268 elevations on the MnR were utilized.

C. Based upon the floodplain delineation 23 structures could possibly incur flood damages along Honey Creek during a 100-year event.

5. List of Exhibits

A	Final HSPF Flows
B	State Fair Park Enclosure EPA SWMM 5.0 documentation
C	2002 Proposed Grading Plan and 2007 Record Drawings - Hart Park Project
D	1996 WisDOT Plans - Pedestrian Bridge
E	Stream stationing spreadsheet and invert notes
F	2007 WisDOT Plans and notes – Two Honey Creek Parkway bridges
G	LLK Field Notes and Photos on CD 2009
H	Honey Creek Parkway bridges #3 & #4 check versus 1973 survey
I	1953 City of Milwaukee Plans – Bluemound Road extension
J	1963 C-179 Plans – abandoned RR crossing wall
K	1973 84th Street bridge plan notes
L	State Fair Park enclosure notes and original 1963-64 plans
M	1967 C-795 Plans – typical cross sections and drop structures
N	1957 Beloit Road Plans
O	2007 Oklahoma Avenue rehab plans and notes
P	1954 72nd Street Plans
Q	1960 C-635 Plans – typical cross section
R	1957 City of Milwaukee Plans – 68th Street
S	Howard Avenue / Forest Home – 1973 SEWRPC survey and 1971 C-236 plans
T	60th Street - 1973 SEWRPC survey and 1971 C-236 plans
U	Cold Spring Road - 1973 SEWRPC survey, 1971 C-236 plans, 1971 City of Greenfield plans
V	I-894 - 1971 C-236 plans and 1964 Milwaukee County Expressway Commission plans

W	2005 Biltrite plans, 1992 WisDOT as-built plans 2070-02-70
X	Layton Avenue - 1991 WisDOT C-40-72 plans
Y	1993 2-ft topography US of Layton Avenue
Z	Konkel Park Maintenance crossing – 1988 SEWRPC survey
AA	Konkel Park Pedestrian Bridge – 2001 Bonestroo plans
BB	Loomis Road – 1988 SEWRPC survey, bridge adjustment calculations
CC	1989 MMSD cross section survey notes – Honey Creek upstream of Loomis Road
DD	1988 SEWRPC survey Honey Creek at 43rd Street
EE	Cross Section, Profile Baseline, and Floodplain Workmaps
FF	HEC-RAS 4.0 final model output printout
GG	Model QC comments and response

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MEMORANDUM TO FILE

TO: Water Resources Simulation Project 331 (WRSP 331)

FROM: Zijia Li (ZL)

DATE: June 14, 2018 and February 1, 2021

SUBJECT: HONEY CREEK TO THE MENOMONEE RIVER MODEL DOCUMENTATION – 2018 AND 2021 REVISIONS

The following memorandum sets forth the procedure followed in developing the flood flows and stages for Honey Creek as part of the floodplain mapping project revision for the Milwaukee County Automated Mapping and Land Information System (MCAMLIS) project (WRSP 331). This Study builds on the model effort completed for the MCAMLIS steering committee and the Milwaukee Metropolitan Sewerage District (MMSD) in 2009 under WRSP 331. This revision includes the IH94 enclosure outlet change that was part of the Zoo Interchange project.

1. Starting Models

A. The base hydrologic and hydraulic models for the Study were the modeling completed by SEWRPC in 2009 for the MCAMLIS WRSP 331 effort. Documentation for the 2009 WRSP 331 modeling effort can be found in Worldox #201641. The 2009 WRSP 331 models built on the models completed as part of the Menomonee River Phase 1 & Phase 2 Watercourse System Management Plans in 2000. The Menomonee River Watercourse System Management Plan models were based in part on the SEWRPC models developed for CAPR No. 152.

2. Hydrology

A. Flood flows for Honey Creek were determined using the U.S. EPA Hydrologic Simulation Program – Fortran (HSPF) continuous simulation model. Simulated annual peak flows were fitted to a Log Pearson Type III distribution using U.S. Army Corps of Engineers HEC-FFA program.

B. HSPF model was updated with the latest flow-table values based on the enclosure outlet and alignment update in the hydraulic model. However, peak flow rate results remained largely the same compared to the peak flows from the 2009 WRSP 331 study. Only a few insignificant flow changes were observed, accounting for less than one percent of the total flow. Therefore, it was determined not necessary to update the peak flow rates for this addendum. Final year 2020 planned land use, existing channel condition peak flow rates remain the same as the 2009 WRSP 331 study.

WRSP 331 – Honey Creek
Planned Year 2020 Land Use, Existing Channel Conditions
Peak Flow Rates

River Mile	Location	Peak Flow (cfs)			
		10 - Year	50 - Year	100 - Year	500 - Year
0.878	DS of Wisconsin Avenue	2,440	3,380	3,470	3,660
1.935	DS of I-94	2,350	3,040	3,090	3,210
3.044	State Fair Park Enclosure DS of Greenfield Avenue	2,140	2,340	2,340	2,340
4.2813	State Fair Park Enclosure Inlet at McCarty Park	1,990	2,340	2,340	2,340
5.002	DS of 76th Street	1,600	2,450	2,850	3,860
5.227	US of Oklahoma Avenue	1,340	2,090	2,450	3,380
6.389	DS of Forest Home Avenue / Howard Avenue	1,170	1,850	2,180	3,060
7.449	DS of I-894	970	1,580	1,880	2,700
7.669	DS of Layton Avenue	495	821	988	1,460
8.020	Konkel Park pedestrian bridge	374	620	746	1,100
8.666	US end at 43rd Street	316	524	631	932

3. Hydraulics

A. In 2013, Wisconsin Department of Transportation (WisDOT) reconstructed the outlet structure of the Honey Creek enclosure under the State Fair Park located at IH94 and Glenview Avenue and realigned the downstream section of the enclosure. The 2009 WRSP 331 HEC-RAS 4.0.0 hydraulic model was updated in HEC-RAS 4.1.0 to reflect the information included in the 2013 WisDOT as-bid plans, project C-40-101 and B-40-892. 350 feet of quadruple 120-inch circular reinforced concrete pipes (C-40-101) at the outlet connected to 1,476 feet of quadruple 10-feet by 12-feet cast-in-place box culvert (B-40-892) replaced the existing triple 10-feet by 15-feet reinforced concrete box culvert at the outlet. As-bid plans can be found in Exhibit A and Exhibit B.

B. The hydraulic model update included the removal of cross-sections at RM 1.935, 1.939, 1.949, 1.9491, 2.051, 2.513, and 2.514. In addition, cross-sections at RM 1.902, 1.912, 1.9159, 1.916, 1.972, 1.9721, 2.210, and 2.2101 were added to the updated hydraulic model to match the as-bid plans.

C. Contraction and expansion values were set at 0.3 and 0.5, respectively, at cross-sections where transitions in culvert sizes occurred.

D. Manning ‘n’ values in the updated downstream concrete enclosure were set to 0.013.

E. Minor losses associated with the enclosure were added to the model including bend losses, entrance losses, and exist losses. Bend losses were computed at locations of significant bend in the enclosure. The calculations can be found in Exhibit C. The equations were taken from *Bend Losses in Rectangular Culverts* (2008) by Malone and Parr.

F. 84th St Bridge 1.79 was converted to culvert representations to address HEC-RAS computational warning messages. The left bridge opening was replaced with a box culvert and all the culvert dimensions match the bridge opening dimensions. The right bridge opening is replaced with a Conspan Arch culvert. The Conspan Arch culvert is a close approximation of the bridge opening dimensions. The Conspan culvert top arch slightly differs from the bridge opening top arch. However, since the flood elevations do not reach the top of the culvert, it was deemed appropriate for the bridge opening representation.

G. Computational method at the Hart Park Bike Path Bridge 0.032 was changed to Energy Only to address model computations not able to converge using pressure and weir calculations. Energy Only methodology is appropriate because the bridge is perched where the road approaching the bridge is at the floodplain ground level.

H. Park maintenance access road 7.953 culvert entrance loss coefficient was updated to 0.9. W. Layton Ave 7.69 and IH43 7.47 culvert entrance loss coefficients were updated to 0.4.

Final Hydraulics Model Information

I. Model output for Year 2020 Land Use with existing Channel Conditions is included in Exhibit D. Also included in Exhibit D is a CD of project files.

J. The final HEC-RAS model is named HoneyCreek2018.prj, dated 5/30/18.

K. Final floodplain boundaries for the Study are included in Exhibit E. Compared to the 2009 WRSP 331 floodplain mapping, the current updated delineation only differed between the outlet of the enclosure under IH94 and Glendale Avenue plus a number of surface ponding locations due to storm sewer surcharge described below. Milwaukee County digital contour mapping from the 2010 terrain were used for the updated floodplain delineation.

4. Miscellaneous

A. Flooding due to storm sewer surcharge of manholes from the enclosed section of Honey Creek was evaluated based on storm sewer network maps obtained from MMSD (Exhibit F). Areas of flooding are included in the floodplain maps. Calculations to determine surcharge locations and depths can be found in Worldox #201809.

B. Final floodplain mapping near the confluence with the Menomonee River (MnR) was completed using flood elevations for the MnR since these were higher than the computed HC stages. RM 6.268 elevations on the MnR were utilized.

C. Based on the revised floodplain delineation 23 structures could possibly incur flood damages along Honey Creek during a 100-year event.

5. List of Exhibits

A	2013 WisDOT C-40-101 as-bid plans
B	2013 WisDOT B-40-892 as-bid plans

C	Bend loss calculations spreadsheet
D	HEC-RAS 4.1 final model output printout and CD of files
E	Final Floodplain Maps
F	MMSD storm sewer network maps

* * *

#242636 WRSP 331 - MCAMLIS MENOMONEE RIVER - HONEY CREEK 2018 ADDENDA
330-3000
ZL/LKH/RJP

APPENDIX B
MCAMLIS EXISTING CONDITIONS FLOOD ELEVATIONS

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	8.666	10-YR	316.00	762.67
Mainstem	8.666	50-YR	524.00	764.34
Mainstem	8.666	100-YR	631.00	764.85
Mainstem	8.666	500-YR	932.00	765.56
Mainstem	8.625	10-YR	316.00	762.66
Mainstem	8.625	50-YR	524.00	764.33
Mainstem	8.625	100-YR	631.00	764.85
Mainstem	8.625	500-YR	932.00	765.55
Mainstem	8.527	10-YR	316.00	762.48
Mainstem	8.527	50-YR	524.00	764.21
Mainstem	8.527	100-YR	631.00	764.73
Mainstem	8.527	500-YR	932.00	765.39
Mainstem	8.429	10-YR	316.00	762.03
Mainstem	8.429	50-YR	524.00	763.89
Mainstem	8.429	100-YR	631.00	764.45
Mainstem	8.429	500-YR	932.00	765.03
Mainstem	8.388	10-YR	316.00	761.71
Mainstem	8.388	50-YR	524.00	763.72
Mainstem	8.388	100-YR	631.00	764.40
Mainstem	8.388	500-YR	932.00	764.98
Mainstem	8.385	10-YR	316.00	761.47
Mainstem	8.385	50-YR	524.00	763.27
Mainstem	8.385	100-YR	631.00	764.06
Mainstem	8.385	500-YR	932.00	764.45
Mainstem	8.37		Bridge	
Mainstem	8.358	10-YR	316.00	761.18
Mainstem	8.358	50-YR	524.00	762.13
Mainstem	8.358	100-YR	631.00	762.46
Mainstem	8.358	500-YR	932.00	763.09
Mainstem	8.349	10-YR	316.00	761.22
Mainstem	8.349	50-YR	524.00	762.26
Mainstem	8.349	100-YR	631.00	762.44
Mainstem	8.349	500-YR	932.00	763.19
Mainstem	8.276	10-YR	316.00	759.24
Mainstem	8.276	50-YR	524.00	760.00
Mainstem	8.276	100-YR	631.00	760.62
Mainstem	8.276	500-YR	932.00	762.02
Mainstem	8.153	10-YR	316.00	759.08
Mainstem	8.153	50-YR	524.00	759.78
Mainstem	8.153	100-YR	631.00	760.44
Mainstem	8.153	500-YR	932.00	761.87

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	8.091	10-YR	316.00	758.94
Mainstem	8.091	50-YR	524.00	759.57
Mainstem	8.091	100-YR	631.00	760.25
Mainstem	8.091	500-YR	932.00	761.70
Mainstem	8.040	10-YR	316.00	758.90
Mainstem	8.040	50-YR	524.00	759.52
Mainstem	8.040	100-YR	631.00	760.22
Mainstem	8.040	500-YR	932.00	761.69
Mainstem	8.023	10-YR	316.00	758.88
Mainstem	8.023	50-YR	524.00	759.50
Mainstem	8.023	100-YR	631.00	760.20
Mainstem	8.023	500-YR	932.00	761.68
Mainstem	8.021		Bridge	
Mainstem	8.020	10-YR	374.00	758.88
Mainstem	8.020	50-YR	620.00	759.49
Mainstem	8.020	100-YR	746.00	760.19
Mainstem	8.020	500-YR	1100.00	761.68
Mainstem	7.975	10-YR	374.00	758.79
Mainstem	7.975	50-YR	620.00	759.42
Mainstem	7.975	100-YR	746.00	760.15
Mainstem	7.975	500-YR	1100.00	761.65
Mainstem	7.957	10-YR	374.00	758.72
Mainstem	7.957	50-YR	620.00	759.40
Mainstem	7.957	100-YR	746.00	760.13
Mainstem	7.957	500-YR	1100.00	761.64
Mainstem	7.953		Culvert	
Mainstem	7.951	10-YR	374.00	758.04
Mainstem	7.951	50-YR	620.00	759.37
Mainstem	7.951	100-YR	746.00	760.10
Mainstem	7.951	500-YR	1100.00	761.64
Mainstem	7.946	10-YR	374.00	758.03
Mainstem	7.946	50-YR	620.00	759.35
Mainstem	7.946	100-YR	746.00	760.09
Mainstem	7.946	500-YR	1100.00	761.62
Mainstem	7.886	10-YR	374.00	757.88
Mainstem	7.886	50-YR	620.00	759.19
Mainstem	7.886	100-YR	746.00	759.94
Mainstem	7.886	500-YR	1100.00	761.53
Mainstem	7.792	10-YR	374.00	756.77

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	7.792	50-YR	620.00	758.17
Mainstem	7.792	100-YR	746.00	759.18
Mainstem	7.792	500-YR	1100.00	761.01
Mainstem	7.725	10-YR	374.00	753.93
Mainstem	7.725	50-YR	620.00	756.62
Mainstem	7.725	100-YR	746.00	758.32
Mainstem	7.725	500-YR	1100.00	760.47
Mainstem	7.718	10-YR	374.00	752.64
Mainstem	7.718	50-YR	620.00	756.47
Mainstem	7.718	100-YR	746.00	758.27
Mainstem	7.718	500-YR	1100.00	760.44
Mainstem	7.7113	10-YR	374.00	753.00
Mainstem	7.7113	50-YR	620.00	756.52
Mainstem	7.7113	100-YR	746.00	758.30
Mainstem	7.7113	500-YR	1100.00	760.46
Mainstem	7.711	10-YR	374.00	753.01
Mainstem	7.711	50-YR	620.00	756.52
Mainstem	7.711	100-YR	746.00	758.30
Mainstem	7.711	500-YR	1100.00	760.46
Mainstem	7.707	10-YR	374.00	752.61
Mainstem	7.707	50-YR	620.00	755.98
Mainstem	7.707	100-YR	746.00	758.03
Mainstem	7.707	500-YR	1100.00	760.29
Mainstem	7.69		Culvert	
Mainstem	7.673	10-YR	374.00	752.36
Mainstem	7.673	50-YR	620.00	754.66
Mainstem	7.673	100-YR	746.00	755.72
Mainstem	7.673	500-YR	1100.00	760.20
Mainstem	7.669	10-YR	495.00	752.46
Mainstem	7.669	50-YR	821.00	754.83
Mainstem	7.669	100-YR	988.00	755.98
Mainstem	7.669	500-YR	1460.00	760.27
Mainstem	7.627	10-YR	495.00	752.45
Mainstem	7.627	50-YR	821.00	754.86
Mainstem	7.627	100-YR	988.00	755.85
Mainstem	7.627	500-YR	1460.00	760.21
Mainstem	7.559	10-YR	495.00	752.27
Mainstem	7.559	50-YR	821.00	754.71
Mainstem	7.559	100-YR	988.00	755.71
Mainstem	7.559	500-YR	1460.00	760.16

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	7.521	10-YR	495.00	752.16
Mainstem	7.521	50-YR	821.00	754.61
Mainstem	7.521	100-YR	988.00	755.61
Mainstem	7.521	500-YR	1460.00	760.11
Mainstem	7.506	10-YR	495.00	752.08
Mainstem	7.506	50-YR	821.00	754.55
Mainstem	7.506	100-YR	988.00	755.56
Mainstem	7.506	500-YR	1460.00	760.10
Mainstem	7.498	10-YR	495.00	752.10
Mainstem	7.498	50-YR	821.00	754.55
Mainstem	7.498	100-YR	988.00	755.55
Mainstem	7.498	500-YR	1460.00	760.03
Mainstem	7.495	10-YR	495.00	752.05
Mainstem	7.495	50-YR	821.00	754.46
Mainstem	7.495	100-YR	988.00	755.44
Mainstem	7.495	500-YR	1460.00	759.90
Mainstem	7.47		Culvert	
Mainstem	7.453	10-YR	495.00	751.98
Mainstem	7.453	50-YR	821.00	754.32
Mainstem	7.453	100-YR	988.00	755.21
Mainstem	7.453	500-YR	1460.00	759.22
Mainstem	7.449	10-YR	970.00	751.95
Mainstem	7.449	50-YR	1580.00	754.29
Mainstem	7.449	100-YR	1880.00	755.17
Mainstem	7.449	500-YR	2700.00	759.20
Mainstem	7.442	10-YR	970.00	751.68
Mainstem	7.442	50-YR	1580.00	754.13
Mainstem	7.442	100-YR	1880.00	755.04
Mainstem	7.442	500-YR	2700.00	759.20
Mainstem	7.438	10-YR	970.00	751.68
Mainstem	7.438	50-YR	1580.00	754.14
Mainstem	7.438	100-YR	1880.00	755.05
Mainstem	7.438	500-YR	2700.00	759.22
Mainstem	7.430	10-YR	970.00	751.68
Mainstem	7.430	50-YR	1580.00	754.14
Mainstem	7.430	100-YR	1880.00	755.07
Mainstem	7.430	500-YR	2700.00	759.25
Mainstem	7.427	10-YR	970.00	751.69
Mainstem	7.427	50-YR	1580.00	754.15
Mainstem	7.427	100-YR	1880.00	755.08
Mainstem	7.427	500-YR	2700.00	759.25

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	7.348	10-YR	970.00	751.25
Mainstem	7.348	50-YR	1580.00	753.79
Mainstem	7.348	100-YR	1880.00	754.72
Mainstem	7.348	500-YR	2700.00	759.12
Mainstem	7.239	10-YR	970.00	750.56
Mainstem	7.239	50-YR	1580.00	753.29
Mainstem	7.239	100-YR	1880.00	754.26
Mainstem	7.239	500-YR	2700.00	758.98
Mainstem	7.162	10-YR	970.00	749.99
Mainstem	7.162	50-YR	1580.00	752.89
Mainstem	7.162	100-YR	1880.00	753.89
Mainstem	7.162	500-YR	2700.00	758.89
Mainstem	7.158	10-YR	970.00	749.90
Mainstem	7.158	50-YR	1580.00	752.80
Mainstem	7.158	100-YR	1880.00	753.81
Mainstem	7.158	500-YR	2700.00	758.86
Mainstem	7.150	10-YR	970.00	750.00
Mainstem	7.150	50-YR	1580.00	752.80
Mainstem	7.150	100-YR	1880.00	753.72
Mainstem	7.150	500-YR	2700.00	758.84
Mainstem	7.14		Bridge	
Mainstem	7.125	10-YR	970.00	749.94
Mainstem	7.125	50-YR	1580.00	751.92
Mainstem	7.125	100-YR	1880.00	753.21
Mainstem	7.125	500-YR	2700.00	757.56
Mainstem	7.117	10-YR	970.00	749.53
Mainstem	7.117	50-YR	1580.00	751.69
Mainstem	7.117	100-YR	1880.00	753.20
Mainstem	7.117	500-YR	2700.00	757.52
Mainstem	7.114	10-YR	970.00	749.56
Mainstem	7.114	50-YR	1580.00	751.73
Mainstem	7.114	100-YR	1880.00	753.23
Mainstem	7.114	500-YR	2700.00	757.53
Mainstem	7.028	10-YR	970.00	748.34
Mainstem	7.028	50-YR	1580.00	750.91
Mainstem	7.028	100-YR	1880.00	752.73
Mainstem	7.028	500-YR	2700.00	757.40
Mainstem	7.024	10-YR	970.00	748.24
Mainstem	7.024	50-YR	1580.00	750.71
Mainstem	7.024	100-YR	1880.00	752.62

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	7.024	500-YR	2700.00	757.37
Mainstem	7.017	10-YR	970.00	748.46
Mainstem	7.017	50-YR	1580.00	750.83
Mainstem	7.017	100-YR	1880.00	752.63
Mainstem	7.017	500-YR	2700.00	757.17
Mainstem	7.014	10-YR	970.00	748.44
Mainstem	7.014	50-YR	1580.00	750.75
Mainstem	7.014	100-YR	1880.00	752.53
Mainstem	7.014	500-YR	2700.00	757.00
Mainstem	7.0121	10-YR	970.00	748.32
Mainstem	7.0121	50-YR	1580.00	750.51
Mainstem	7.0121	100-YR	1880.00	752.27
Mainstem	7.0121	500-YR	2700.00	756.69
Mainstem	7.012	10-YR	970.00	748.27
Mainstem	7.012	50-YR	1580.00	750.43
Mainstem	7.012	100-YR	1880.00	751.93
Mainstem	7.012	500-YR	2700.00	755.20
Mainstem	7.010	10-YR	970.00	748.16
Mainstem	7.010	50-YR	1580.00	750.20
Mainstem	7.010	100-YR	1880.00	751.54
Mainstem	7.010	500-YR	2700.00	754.39
Mainstem	6.972	10-YR	970.00	747.94
Mainstem	6.972	50-YR	1580.00	749.85
Mainstem	6.972	100-YR	1880.00	750.85
Mainstem	6.972	500-YR	2700.00	752.98
Mainstem	6.918	10-YR	970.00	747.66
Mainstem	6.918	50-YR	1580.00	749.35
Mainstem	6.918	100-YR	1880.00	749.88
Mainstem	6.918	500-YR	2700.00	750.97
Mainstem	6.9121	10-YR	970.00	747.84
Mainstem	6.9121	50-YR	1580.00	749.67
Mainstem	6.9121	100-YR	1880.00	750.29
Mainstem	6.9121	500-YR	2700.00	751.81
Mainstem	6.912	10-YR	970.00	747.85
Mainstem	6.912	50-YR	1580.00	749.70
Mainstem	6.912	100-YR	1880.00	750.39
Mainstem	6.912	500-YR	2700.00	752.23
Mainstem	6.907	10-YR	970.00	747.92
Mainstem	6.907	50-YR	1580.00	749.84
Mainstem	6.907	100-YR	1880.00	750.56
Mainstem	6.907	500-YR	2700.00	752.51

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	6.9034	10-YR	970.00	747.83
Mainstem	6.9034	50-YR	1580.00	749.72
Mainstem	6.9034	100-YR	1880.00	750.44
Mainstem	6.9034	500-YR	2700.00	752.48
Mainstem	6.903	10-YR	970.00	747.75
Mainstem	6.903	50-YR	1580.00	749.71
Mainstem	6.903	100-YR	1880.00	750.45
Mainstem	6.903	500-YR	2700.00	752.50
Mainstem	6.896	10-YR	970.00	747.63
Mainstem	6.896	50-YR	1580.00	749.59
Mainstem	6.896	100-YR	1880.00	750.35
Mainstem	6.896	500-YR	2700.00	752.47
Mainstem	6.892	10-YR	970.00	747.66
Mainstem	6.892	50-YR	1580.00	749.62
Mainstem	6.892	100-YR	1880.00	750.37
Mainstem	6.892	500-YR	2700.00	752.48
Mainstem	6.820	10-YR	970.00	747.27
Mainstem	6.820	50-YR	1580.00	749.23
Mainstem	6.820	100-YR	1880.00	749.98
Mainstem	6.820	500-YR	2700.00	752.18
Mainstem	6.703	10-YR	970.00	746.57
Mainstem	6.703	50-YR	1580.00	748.41
Mainstem	6.703	100-YR	1880.00	749.12
Mainstem	6.703	500-YR	2700.00	751.46
Mainstem	6.609	10-YR	970.00	746.05
Mainstem	6.609	50-YR	1580.00	747.81
Mainstem	6.609	100-YR	1880.00	748.49
Mainstem	6.609	500-YR	2700.00	750.98
Mainstem	6.534	10-YR	970.00	745.56
Mainstem	6.534	50-YR	1580.00	747.25
Mainstem	6.534	100-YR	1880.00	747.91
Mainstem	6.534	500-YR	2700.00	750.62
Mainstem	6.530	10-YR	970.00	745.45
Mainstem	6.530	50-YR	1580.00	747.04
Mainstem	6.530	100-YR	1880.00	747.66
Mainstem	6.530	500-YR	2700.00	750.47
Mainstem	6.5242	10-YR	970.00	745.54
Mainstem	6.5242	50-YR	1580.00	747.10
Mainstem	6.5242	100-YR	1880.00	747.70
Mainstem	6.5242	500-YR	2700.00	750.06

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	6.524	10-YR	970.00	745.54
Mainstem	6.524	50-YR	1580.00	747.10
Mainstem	6.524	100-YR	1880.00	747.70
Mainstem	6.524	500-YR	2700.00	750.06
Mainstem	6.503	10-YR	970.00	745.52
Mainstem	6.503	50-YR	1580.00	747.07
Mainstem	6.503	100-YR	1880.00	747.66
Mainstem	6.503	500-YR	2700.00	750.03
Mainstem	6.502	10-YR	970.00	745.52
Mainstem	6.502	50-YR	1580.00	747.07
Mainstem	6.502	100-YR	1880.00	747.66
Mainstem	6.502	500-YR	2700.00	749.49
Mainstem	6.4722	10-YR	970.00	745.48
Mainstem	6.4722	50-YR	1580.00	747.00
Mainstem	6.4722	100-YR	1880.00	747.57
Mainstem	6.4722	500-YR	2700.00	749.09
Mainstem	6.472	10-YR	970.00	745.50
Mainstem	6.472	50-YR	1580.00	747.03
Mainstem	6.472	100-YR	1880.00	747.61
Mainstem	6.472	500-YR	2700.00	749.30
Mainstem	6.460	10-YR	970.00	745.24
Mainstem	6.460	50-YR	1580.00	746.93
Mainstem	6.460	100-YR	1880.00	747.59
Mainstem	6.460	500-YR	2700.00	749.41
Mainstem	6.452	10-YR	970.00	745.28
Mainstem	6.452	50-YR	1580.00	746.96
Mainstem	6.452	100-YR	1880.00	747.62
Mainstem	6.452	500-YR	2700.00	749.43
Mainstem	6.432	10-YR	970.00	745.19
Mainstem	6.432	50-YR	1580.00	746.84
Mainstem	6.432	100-YR	1880.00	747.49
Mainstem	6.432	500-YR	2700.00	749.30
Mainstem	6.423	10-YR	970.00	745.15
Mainstem	6.423	50-YR	1580.00	746.78
Mainstem	6.423	100-YR	1880.00	747.43
Mainstem	6.423	500-YR	2700.00	749.24
Mainstem	6.389	10-YR	1170.00	744.68
Mainstem	6.389	50-YR	1850.00	746.26
Mainstem	6.389	100-YR	2180.00	746.90
Mainstem	6.389	500-YR	3060.00	748.77
Mainstem	6.318	10-YR	1170.00	743.95

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	6.318	50-YR	1850.00	745.48
Mainstem	6.318	100-YR	2180.00	746.10
Mainstem	6.318	500-YR	3060.00	748.13
Mainstem	6.224	10-YR	1170.00	742.80
Mainstem	6.224	50-YR	1850.00	744.24
Mainstem	6.224	100-YR	2180.00	744.85
Mainstem	6.224	500-YR	3060.00	747.43
Mainstem	6.130	10-YR	1170.00	741.14
Mainstem	6.130	50-YR	1850.00	742.70
Mainstem	6.130	100-YR	2180.00	743.42
Mainstem	6.130	500-YR	3060.00	746.97
Mainstem	6.119	10-YR	1170.00	741.18
Mainstem	6.119	50-YR	1850.00	742.55
Mainstem	6.119	100-YR	2180.00	743.05
Mainstem	6.119	500-YR	3060.00	746.17
Mainstem	6.10		Bridge	
Mainstem	6.096	10-YR	1170.00	741.08
Mainstem	6.096	50-YR	1850.00	742.37
Mainstem	6.096	100-YR	2180.00	742.82
Mainstem	6.096	500-YR	3060.00	743.77
Mainstem	6.083	10-YR	1170.00	740.01
Mainstem	6.083	50-YR	1850.00	741.55
Mainstem	6.083	100-YR	2180.00	742.13
Mainstem	6.083	500-YR	3060.00	743.73
Mainstem	6.033	10-YR	1170.00	739.28
Mainstem	6.033	50-YR	1850.00	740.95
Mainstem	6.033	100-YR	2180.00	741.52
Mainstem	6.033	500-YR	3060.00	743.26
Mainstem	5.962	10-YR	1170.00	737.33
Mainstem	5.962	50-YR	1850.00	739.78
Mainstem	5.962	100-YR	2180.00	740.29
Mainstem	5.962	500-YR	3060.00	742.46
Mainstem	5.960	10-YR	1170.00	737.08
Mainstem	5.960	50-YR	1850.00	739.72
Mainstem	5.960	100-YR	2180.00	740.22
Mainstem	5.960	500-YR	3060.00	742.40
Mainstem	5.899	10-YR	1170.00	736.58
Mainstem	5.899	50-YR	1850.00	739.51
Mainstem	5.899	100-YR	2180.00	739.98
Mainstem	5.899	500-YR	3060.00	742.30

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	5.889	10-YR	1170.00	736.63
Mainstem	5.889	50-YR	1850.00	739.30
Mainstem	5.889	100-YR	2180.00	739.64
Mainstem	5.889	500-YR	3060.00	742.05
Mainstem	5.878		Bridge	
Mainstem	5.871	10-YR	1170.00	736.50
Mainstem	5.871	50-YR	1850.00	737.66
Mainstem	5.871	100-YR	2180.00	738.21
Mainstem	5.871	500-YR	3060.00	739.87
Mainstem	5.86866*	10-YR	1170.00	736.51
Mainstem	5.86866*	50-YR	1850.00	737.75
Mainstem	5.86866*	100-YR	2180.00	738.34
Mainstem	5.86866*	500-YR	3060.00	739.60
Mainstem	5.86633*	10-YR	1170.00	736.23
Mainstem	5.86633*	50-YR	1850.00	737.41
Mainstem	5.86633*	100-YR	2180.00	738.03
Mainstem	5.86633*	500-YR	3060.00	739.31
Mainstem	5.864	10-YR	1170.00	735.00
Mainstem	5.864	50-YR	1850.00	736.96
Mainstem	5.864	100-YR	2180.00	737.71
Mainstem	5.864	500-YR	3060.00	739.10
Mainstem	5.8636	10-YR	1170.00	732.70
Mainstem	5.8636	50-YR	1850.00	737.19
Mainstem	5.8636	100-YR	2180.00	737.90
Mainstem	5.8636	500-YR	3060.00	739.25
Mainstem	5.86173*	10-YR	1170.00	735.23
Mainstem	5.86173*	50-YR	1850.00	737.25
Mainstem	5.86173*	100-YR	2180.00	737.94
Mainstem	5.86173*	500-YR	3060.00	739.28
Mainstem	5.85986*	10-YR	1170.00	735.33
Mainstem	5.85986*	50-YR	1850.00	737.30
Mainstem	5.85986*	100-YR	2180.00	737.99
Mainstem	5.85986*	500-YR	3060.00	739.32
Mainstem	5.858	10-YR	1170.00	735.41
Mainstem	5.858	50-YR	1850.00	737.35
Mainstem	5.858	100-YR	2180.00	738.04
Mainstem	5.858	500-YR	3060.00	739.37
Mainstem	5.802	10-YR	1170.00	735.06
Mainstem	5.802	50-YR	1850.00	737.06
Mainstem	5.802	100-YR	2180.00	737.75
Mainstem	5.802	500-YR	3060.00	739.09

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	5.745	10-YR	1170.00	734.59
Mainstem	5.745	50-YR	1850.00	736.73
Mainstem	5.745	100-YR	2180.00	737.43
Mainstem	5.745	500-YR	3060.00	738.77
Mainstem	5.714	10-YR	1170.00	734.27
Mainstem	5.714	50-YR	1850.00	736.53
Mainstem	5.714	100-YR	2180.00	737.26
Mainstem	5.714	500-YR	3060.00	738.64
Mainstem	5.684	10-YR	1170.00	733.95
Mainstem	5.684	50-YR	1850.00	736.36
Mainstem	5.684	100-YR	2180.00	737.12
Mainstem	5.684	500-YR	3060.00	738.51
Mainstem	5.6144	10-YR	1170.00	732.22
Mainstem	5.6144	50-YR	1850.00	735.96
Mainstem	5.6144	100-YR	2180.00	736.81
Mainstem	5.6144	500-YR	3060.00	738.22
Mainstem	5.614	10-YR	1170.00	732.54
Mainstem	5.614	50-YR	1850.00	736.00
Mainstem	5.614	100-YR	2180.00	736.84
Mainstem	5.614	500-YR	3060.00	738.25
Mainstem	5.608	10-YR	1170.00	732.70
Mainstem	5.608	50-YR	1850.00	736.03
Mainstem	5.608	100-YR	2180.00	736.86
Mainstem	5.608	500-YR	3060.00	738.28
Mainstem	5.544	10-YR	1170.00	732.39
Mainstem	5.544	50-YR	1850.00	735.89
Mainstem	5.544	100-YR	2180.00	736.74
Mainstem	5.544	500-YR	3060.00	738.18
Mainstem	5.492	10-YR	1170.00	732.11
Mainstem	5.492	50-YR	1850.00	735.76
Mainstem	5.492	100-YR	2180.00	736.62
Mainstem	5.492	500-YR	3060.00	738.04
Mainstem	5.488	10-YR	1170.00	732.00
Mainstem	5.488	50-YR	1850.00	735.70
Mainstem	5.488	100-YR	2180.00	736.57
Mainstem	5.488	500-YR	3060.00	737.99
Mainstem	5.453	10-YR	1170.00	731.97
Mainstem	5.453	50-YR	1850.00	735.63
Mainstem	5.453	100-YR	2180.00	736.52
Mainstem	5.453	500-YR	3060.00	737.96

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	5.444	10-YR	1170.00	731.99
Mainstem	5.444	50-YR	1850.00	735.51
Mainstem	5.444	100-YR	2180.00	736.47
Mainstem	5.444	500-YR	3060.00	737.95
Mainstem	5.436		Bridge	
Mainstem	5.431	10-YR	1170.00	731.87
Mainstem	5.431	50-YR	1850.00	734.91
Mainstem	5.431	100-YR	2180.00	736.03
Mainstem	5.431	500-YR	3060.00	737.80
Mainstem	5.414	10-YR	1170.00	731.83
Mainstem	5.414	50-YR	1850.00	734.92
Mainstem	5.414	100-YR	2180.00	736.02
Mainstem	5.414	500-YR	3060.00	737.75
Mainstem	5.361	10-YR	1170.00	731.59
Mainstem	5.361	50-YR	1850.00	734.75
Mainstem	5.361	100-YR	2180.00	735.87
Mainstem	5.361	500-YR	3060.00	737.65
Mainstem	5.282	10-YR	1170.00	731.31
Mainstem	5.282	50-YR	1850.00	734.55
Mainstem	5.282	100-YR	2180.00	735.67
Mainstem	5.282	500-YR	3060.00	737.48
Mainstem	5.278	10-YR	1170.00	731.25
Mainstem	5.278	50-YR	1850.00	734.51
Mainstem	5.278	100-YR	2180.00	735.63
Mainstem	5.278	500-YR	3060.00	737.46
Mainstem	5.227	10-YR	1340.00	731.04
Mainstem	5.227	50-YR	2090.00	734.32
Mainstem	5.227	100-YR	2450.00	735.46
Mainstem	5.227	500-YR	3380.00	737.36
Mainstem	5.219	10-YR	1340.00	731.05
Mainstem	5.219	50-YR	2090.00	734.18
Mainstem	5.219	100-YR	2450.00	735.23
Mainstem	5.219	500-YR	3380.00	737.38
Mainstem	5.20		Bridge	
Mainstem	5.197	10-YR	1340.00	731.02
Mainstem	5.197	50-YR	2090.00	733.85
Mainstem	5.197	100-YR	2450.00	734.68
Mainstem	5.197	500-YR	3380.00	736.03
Mainstem	5.179	10-YR	1340.00	731.02
Mainstem	5.179	50-YR	2090.00	733.91

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	5.179	100-YR	2450.00	734.77
Mainstem	5.179	500-YR	3380.00	736.07
Mainstem	5.126	10-YR	1340.00	730.88
Mainstem	5.126	50-YR	2090.00	733.79
Mainstem	5.126	100-YR	2450.00	734.66
Mainstem	5.126	500-YR	3380.00	735.99
Mainstem	5.069	10-YR	1340.00	730.75
Mainstem	5.069	50-YR	2090.00	733.68
Mainstem	5.069	100-YR	2450.00	734.56
Mainstem	5.069	500-YR	3380.00	735.94
Mainstem	5.059	10-YR	1340.00	730.67
Mainstem	5.059	50-YR	2090.00	733.48
Mainstem	5.059	100-YR	2450.00	734.28
Mainstem	5.059	500-YR	3380.00	735.92
Mainstem	5.04		Bridge	
Mainstem	5.036	10-YR	1340.00	730.65
Mainstem	5.036	50-YR	2090.00	732.89
Mainstem	5.036	100-YR	2450.00	733.39
Mainstem	5.036	500-YR	3380.00	735.26
Mainstem	5.002	10-YR	1600.00	730.58
Mainstem	5.002	50-YR	2450.00	732.93
Mainstem	5.002	100-YR	2850.00	733.47
Mainstem	5.002	500-YR	3860.00	735.11
Mainstem	4.938	10-YR	1600.00	730.39
Mainstem	4.938	50-YR	2450.00	732.78
Mainstem	4.938	100-YR	2850.00	733.32
Mainstem	4.938	500-YR	3860.00	734.90
Mainstem	4.853	10-YR	1600.00	730.25
Mainstem	4.853	50-YR	2450.00	732.75
Mainstem	4.853	100-YR	2850.00	733.29
Mainstem	4.853	500-YR	3860.00	734.88
Mainstem	4.733	10-YR	1600.00	729.04
Mainstem	4.733	50-YR	2450.00	732.23
Mainstem	4.733	100-YR	2850.00	732.80
Mainstem	4.733	500-YR	3860.00	734.59
Mainstem	4.645	10-YR	1600.00	727.68
Mainstem	4.645	50-YR	2450.00	731.44
Mainstem	4.645	100-YR	2850.00	731.95
Mainstem	4.645	500-YR	3860.00	733.89
Mainstem	4.636	10-YR	1600.00	727.72

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	4.636	50-YR	2450.00	731.33
Mainstem	4.636	100-YR	2850.00	731.76
Mainstem	4.636	500-YR	3860.00	733.46
Mainstem	4.62		Bridge	
Mainstem	4.615	10-YR	1600.00	727.65
Mainstem	4.615	50-YR	2450.00	730.85
Mainstem	4.615	100-YR	2850.00	731.36
Mainstem	4.615	500-YR	3860.00	732.49
Mainstem	4.592	10-YR	1600.00	727.42
Mainstem	4.592	50-YR	2450.00	730.87
Mainstem	4.592	100-YR	2850.00	731.41
Mainstem	4.592	500-YR	3860.00	732.64
Mainstem	4.534	10-YR	1600.00	727.02
Mainstem	4.534	50-YR	2450.00	730.55
Mainstem	4.534	100-YR	2850.00	731.10
Mainstem	4.534	500-YR	3860.00	732.39
Mainstem	4.517	10-YR	1600.00	726.90
Mainstem	4.517	50-YR	2450.00	730.46
Mainstem	4.517	100-YR	2850.00	731.01
Mainstem	4.517	500-YR	3860.00	732.27
Mainstem	4.515		Bridge	
Mainstem	4.513	10-YR	1600.00	726.88
Mainstem	4.513	50-YR	2450.00	729.88
Mainstem	4.513	100-YR	2850.00	730.38
Mainstem	4.513	500-YR	3860.00	731.63
Mainstem	4.480	10-YR	1600.00	726.65
Mainstem	4.480	50-YR	2450.00	729.63
Mainstem	4.480	100-YR	2850.00	730.11
Mainstem	4.480	500-YR	3860.00	731.33
Mainstem	4.381	10-YR	1600.00	725.84
Mainstem	4.381	50-YR	2450.00	729.15
Mainstem	4.381	100-YR	2850.00	729.55
Mainstem	4.381	500-YR	3860.00	730.64
Mainstem	4.294	10-YR	1600.00	724.81
Mainstem	4.294	50-YR	2450.00	728.56
Mainstem	4.294	100-YR	2850.00	728.85
Mainstem	4.294	500-YR	3860.00	729.73
Mainstem	4.283	10-YR	1600.00	724.82
Mainstem	4.283	50-YR	2450.00	728.54
Mainstem	4.283	100-YR	2850.00	728.82

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	4.283	500-YR	3860.00	729.61
Mainstem	4.2814	10-YR	1600.00	724.66
Mainstem	4.2814	50-YR	2450.00	728.20
Mainstem	4.2814	100-YR	2850.00	728.34
Mainstem	4.2814	500-YR	3860.00	728.63
Mainstem	4.2813	10-YR	1990.00	724.35
Mainstem	4.2813	50-YR	2340.00	727.92
Mainstem	4.2813	100-YR	2340.00	728.02
Mainstem	4.2813	500-YR	2340.00	728.18
Mainstem	4.2769	10-YR	1990.00	724.07
Mainstem	4.2769	50-YR	2340.00	727.71
Mainstem	4.2769	100-YR	2340.00	727.81
Mainstem	4.2769	500-YR	2340.00	727.97
Mainstem	4.2767	10-YR	1990.00	723.56
Mainstem	4.2767	50-YR	2340.00	727.06
Mainstem	4.2767	100-YR	2340.00	727.15
Mainstem	4.2767	500-YR	2340.00	727.30
Mainstem	4.146	10-YR	1990.00	723.11
Mainstem	4.146	50-YR	2340.00	726.31
Mainstem	4.146	100-YR	2340.00	726.41
Mainstem	4.146	500-YR	2340.00	726.56
Mainstem	4.018	10-YR	1990.00	722.70
Mainstem	4.018	50-YR	2340.00	725.58
Mainstem	4.018	100-YR	2340.00	725.68
Mainstem	4.018	500-YR	2340.00	725.82
Mainstem	3.891	10-YR	1990.00	722.33
Mainstem	3.891	50-YR	2340.00	724.86
Mainstem	3.891	100-YR	2340.00	724.95
Mainstem	3.891	500-YR	2340.00	725.10
Mainstem	3.764	10-YR	1990.00	722.00
Mainstem	3.764	50-YR	2340.00	724.14
Mainstem	3.764	100-YR	2340.00	724.23
Mainstem	3.764	500-YR	2340.00	724.38
Mainstem	3.611	10-YR	1990.00	721.52
Mainstem	3.611	50-YR	2340.00	723.27
Mainstem	3.611	100-YR	2340.00	723.37
Mainstem	3.611	500-YR	2340.00	723.52
Mainstem	3.608	10-YR	1990.00	717.01
Mainstem	3.608	50-YR	2340.00	719.21
Mainstem	3.608	100-YR	2340.00	719.42
Mainstem	3.608	500-YR	2340.00	719.72

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	3.512	10-YR	1990.00	715.16
Mainstem	3.512	50-YR	2340.00	717.27
Mainstem	3.512	100-YR	2340.00	717.52
Mainstem	3.512	500-YR	2340.00	717.83
Mainstem	3.416	10-YR	1990.00	712.54
Mainstem	3.416	50-YR	2340.00	715.32
Mainstem	3.416	100-YR	2340.00	715.60
Mainstem	3.416	500-YR	2340.00	715.92
Mainstem	3.412	10-YR	1990.00	712.29
Mainstem	3.412	50-YR	2340.00	716.82
Mainstem	3.412	100-YR	2340.00	717.04
Mainstem	3.412	500-YR	2340.00	717.31
Mainstem	3.297	10-YR	1990.00	711.93
Mainstem	3.297	50-YR	2340.00	716.16
Mainstem	3.297	100-YR	2340.00	716.39
Mainstem	3.297	500-YR	2340.00	716.66
Mainstem	3.284	10-YR	1990.00	711.88
Mainstem	3.284	50-YR	2340.00	716.09
Mainstem	3.284	100-YR	2340.00	716.31
Mainstem	3.284	500-YR	2340.00	716.58
Mainstem	3.166	10-YR	1990.00	711.39
Mainstem	3.166	50-YR	2340.00	715.42
Mainstem	3.166	100-YR	2340.00	715.65
Mainstem	3.166	500-YR	2340.00	715.91
Mainstem	3.049	10-YR	1990.00	710.91
Mainstem	3.049	50-YR	2340.00	714.75
Mainstem	3.049	100-YR	2340.00	714.98
Mainstem	3.049	500-YR	2340.00	715.25
Mainstem	3.044	10-YR	2140.00	710.94
Mainstem	3.044	50-YR	2340.00	714.85
Mainstem	3.044	100-YR	2340.00	715.07
Mainstem	3.044	500-YR	2340.00	715.34
Mainstem	2.954	10-YR	2140.00	709.12
Mainstem	2.954	50-YR	2340.00	712.67
Mainstem	2.954	100-YR	2340.00	712.90
Mainstem	2.954	500-YR	2340.00	713.16
Mainstem	2.823	10-YR	2140.00	706.49
Mainstem	2.823	50-YR	2340.00	709.53
Mainstem	2.823	100-YR	2340.00	709.76
Mainstem	2.823	500-YR	2340.00	710.02

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	2.737	10-YR	2140.00	704.76
Mainstem	2.737	50-YR	2340.00	707.46
Mainstem	2.737	100-YR	2340.00	707.68
Mainstem	2.737	500-YR	2340.00	707.95
Mainstem	2.550	10-YR	2140.00	701.26
Mainstem	2.550	50-YR	2340.00	702.96
Mainstem	2.550	100-YR	2340.00	703.18
Mainstem	2.550	500-YR	2340.00	703.45
Mainstem	2.547	10-YR	2140.00	701.31
Mainstem	2.547	50-YR	2340.00	702.99
Mainstem	2.547	100-YR	2340.00	703.22
Mainstem	2.547	500-YR	2340.00	703.49
Mainstem	2.453	10-YR	2140.00	700.24
Mainstem	2.453	50-YR	2340.00	701.56
Mainstem	2.453	100-YR	2340.00	701.79
Mainstem	2.453	500-YR	2340.00	702.05
Mainstem	2.361	10-YR	2140.00	699.13
Mainstem	2.361	50-YR	2340.00	700.22
Mainstem	2.361	100-YR	2340.00	700.43
Mainstem	2.361	500-YR	2340.00	700.65
Mainstem	2.247	10-YR	2140.00	697.57
Mainstem	2.247	50-YR	2340.00	698.62
Mainstem	2.247	100-YR	2340.00	698.82
Mainstem	2.247	500-YR	2340.00	699.00
Mainstem	2.2101	10-YR	2140.00	696.86
Mainstem	2.2101	50-YR	2340.00	697.98
Mainstem	2.2101	100-YR	2340.00	698.20
Mainstem	2.2101	500-YR	2340.00	698.39
Mainstem	2.210	10-YR	2140.00	696.80
Mainstem	2.210	50-YR	2340.00	697.97
Mainstem	2.210	100-YR	2340.00	698.20
Mainstem	2.210	500-YR	2340.00	698.39
Mainstem	1.9721	10-YR	2140.00	696.25
Mainstem	1.9721	50-YR	2340.00	697.51
Mainstem	1.9721	100-YR	2340.00	697.60
Mainstem	1.9721	500-YR	2340.00	697.79
Mainstem	1.972	10-YR	2140.00	695.43
Mainstem	1.972	50-YR	2340.00	696.76
Mainstem	1.972	100-YR	2340.00	696.86
Mainstem	1.972	500-YR	2340.00	697.08
Mainstem	1.916	10-YR	2140.00	694.91

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	1.916	50-YR	2340.00	696.25
Mainstem	1.916	100-YR	2340.00	696.34
Mainstem	1.916	500-YR	2340.00	696.57
Mainstem	1.9159	10-YR	2140.00	695.32
Mainstem	1.9159	50-YR	2340.00	696.63
Mainstem	1.9159	100-YR	2340.00	696.72
Mainstem	1.9159	500-YR	2340.00	696.93
Mainstem	1.912	10-YR	2140.00	695.16
Mainstem	1.912	50-YR	2340.00	696.49
Mainstem	1.912	100-YR	2340.00	696.58
Mainstem	1.912	500-YR	2340.00	696.80
Mainstem	1.902	10-YR	2350.00	695.03
Mainstem	1.902	50-YR	3040.00	696.30
Mainstem	1.902	100-YR	3090.00	696.38
Mainstem	1.902	500-YR	3210.00	696.60
Mainstem	1.889	10-YR	2350.00	694.17
Mainstem	1.889	50-YR	3040.00	695.45
Mainstem	1.889	100-YR	3090.00	695.55
Mainstem	1.889	500-YR	3210.00	695.77
Mainstem	1.865	10-YR	2350.00	693.94
Mainstem	1.865	50-YR	3040.00	695.26
Mainstem	1.865	100-YR	3090.00	695.35
Mainstem	1.865	500-YR	3210.00	695.57
Mainstem	1.85942*	10-YR	2350.00	693.86
Mainstem	1.85942*	50-YR	3040.00	695.19
Mainstem	1.85942*	100-YR	3090.00	695.28
Mainstem	1.85942*	500-YR	3210.00	695.51
Mainstem	1.85385*	10-YR	2350.00	693.79
Mainstem	1.85385*	50-YR	3040.00	695.12
Mainstem	1.85385*	100-YR	3090.00	695.22
Mainstem	1.85385*	500-YR	3210.00	695.45
Mainstem	1.84828*	10-YR	2350.00	693.69
Mainstem	1.84828*	50-YR	3040.00	695.05
Mainstem	1.84828*	100-YR	3090.00	695.15
Mainstem	1.84828*	500-YR	3210.00	695.38
Mainstem	1.84271*	10-YR	2350.00	693.60
Mainstem	1.84271*	50-YR	3040.00	694.98
Mainstem	1.84271*	100-YR	3090.00	695.08
Mainstem	1.84271*	500-YR	3210.00	695.31
Mainstem	1.83714*	10-YR	2350.00	693.50
Mainstem	1.83714*	50-YR	3040.00	694.90

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	1.83714*	100-YR	3090.00	695.00
Mainstem	1.83714*	500-YR	3210.00	695.24
Mainstem	1.83157*	10-YR	2350.00	693.39
Mainstem	1.83157*	50-YR	3040.00	694.83
Mainstem	1.83157*	100-YR	3090.00	694.93
Mainstem	1.83157*	500-YR	3210.00	695.17
Mainstem	1.826	10-YR	2350.00	693.24
Mainstem	1.826	50-YR	3040.00	694.73
Mainstem	1.826	100-YR	3090.00	694.83
Mainstem	1.826	500-YR	3210.00	695.08
Mainstem	1.82225*	10-YR	2350.00	693.57
Mainstem	1.82225*	50-YR	3040.00	694.98
Mainstem	1.82225*	100-YR	3090.00	695.08
Mainstem	1.82225*	500-YR	3210.00	695.32
Mainstem	1.8185*	10-YR	2350.00	693.71
Mainstem	1.8185*	50-YR	3040.00	695.11
Mainstem	1.8185*	100-YR	3090.00	695.21
Mainstem	1.8185*	500-YR	3210.00	695.44
Mainstem	1.81475*	10-YR	2350.00	693.78
Mainstem	1.81475*	50-YR	3040.00	695.18
Mainstem	1.81475*	100-YR	3090.00	695.28
Mainstem	1.81475*	500-YR	3210.00	695.51
Mainstem	1.811	10-YR	2350.00	693.85
Mainstem	1.811	50-YR	3040.00	695.24
Mainstem	1.811	100-YR	3090.00	695.34
Mainstem	1.811	500-YR	3210.00	695.57
Mainstem	1.809	10-YR	2350.00	693.58
Mainstem	1.809	50-YR	3040.00	694.92
Mainstem	1.809	100-YR	3090.00	695.01
Mainstem	1.809	500-YR	3210.00	695.23
Mainstem	1.79		Culvert	
Mainstem	1.789	10-YR	2350.00	690.67
Mainstem	1.789	50-YR	3040.00	692.27
Mainstem	1.789	100-YR	3090.00	692.36
Mainstem	1.789	500-YR	3210.00	692.57
Mainstem	1.788	10-YR	2350.00	690.97
Mainstem	1.788	50-YR	3040.00	692.49
Mainstem	1.788	100-YR	3090.00	692.57
Mainstem	1.788	500-YR	3210.00	692.78
Mainstem	1.784	10-YR	2350.00	691.01

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	1.784	50-YR	3040.00	692.55
Mainstem	1.784	100-YR	3090.00	692.63
Mainstem	1.784	500-YR	3210.00	692.85
Mainstem	1.765	10-YR	2350.00	690.89
Mainstem	1.765	50-YR	3040.00	692.46
Mainstem	1.765	100-YR	3090.00	692.55
Mainstem	1.765	500-YR	3210.00	692.76
Mainstem	1.763	10-YR	2350.00	690.51
Mainstem	1.763	50-YR	3040.00	691.94
Mainstem	1.763	100-YR	3090.00	692.02
Mainstem	1.763	500-YR	3210.00	692.20
Mainstem	1.703	10-YR	2350.00	690.36
Mainstem	1.703	50-YR	3040.00	691.83
Mainstem	1.703	100-YR	3090.00	691.91
Mainstem	1.703	500-YR	3210.00	692.10
Mainstem	1.643	10-YR	2350.00	689.80
Mainstem	1.643	50-YR	3040.00	691.59
Mainstem	1.643	100-YR	3090.00	691.67
Mainstem	1.643	500-YR	3210.00	691.88
Mainstem	1.641	10-YR	2350.00	689.49
Mainstem	1.641	50-YR	3040.00	691.34
Mainstem	1.641	100-YR	3090.00	691.43
Mainstem	1.641	500-YR	3210.00	691.64
Mainstem	1.630	10-YR	2350.00	689.27
Mainstem	1.630	50-YR	3040.00	691.30
Mainstem	1.630	100-YR	3090.00	691.38
Mainstem	1.630	500-YR	3210.00	691.60
Mainstem	1.625	10-YR	2350.00	689.58
Mainstem	1.625	50-YR	3040.00	691.43
Mainstem	1.625	100-YR	3090.00	691.52
Mainstem	1.625	500-YR	3210.00	691.72
Mainstem	1.613	10-YR	2350.00	689.21
Mainstem	1.613	50-YR	3040.00	691.11
Mainstem	1.613	100-YR	3090.00	691.19
Mainstem	1.613	500-YR	3210.00	691.39
Mainstem	1.601	10-YR	2350.00	689.15
Mainstem	1.601	50-YR	3040.00	691.08
Mainstem	1.601	100-YR	3090.00	691.15
Mainstem	1.601	500-YR	3210.00	691.35
Mainstem	1.590	10-YR	2350.00	689.37
Mainstem	1.590	50-YR	3040.00	691.30

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	1.590	100-YR	3090.00	691.38
Mainstem	1.590	500-YR	3210.00	691.59
Mainstem	1.579	10-YR	2350.00	688.98
Mainstem	1.579	50-YR	3040.00	691.12
Mainstem	1.579	100-YR	3090.00	691.20
Mainstem	1.579	500-YR	3210.00	691.42
Mainstem	1.575	10-YR	2350.00	688.65
Mainstem	1.575	50-YR	3040.00	690.77
Mainstem	1.575	100-YR	3090.00	690.85
Mainstem	1.575	500-YR	3210.00	691.04
Mainstem	1.50	10-YR	2350.00	687.09
Mainstem	1.50	50-YR	3040.00	690.57
Mainstem	1.50	100-YR	3090.00	690.64
Mainstem	1.50	500-YR	3210.00	690.84
Mainstem	1.495	10-YR	2350.00	686.35
Mainstem	1.495	50-YR	3040.00	690.92
Mainstem	1.495	100-YR	3090.00	691.00
Mainstem	1.495	500-YR	3210.00	691.20
Mainstem	1.47675*	10-YR	2350.00	686.32
Mainstem	1.47675*	50-YR	3040.00	690.93
Mainstem	1.47675*	100-YR	3090.00	691.01
Mainstem	1.47675*	500-YR	3210.00	691.21
Mainstem	1.4585*	10-YR	2350.00	686.30
Mainstem	1.4585*	50-YR	3040.00	690.93
Mainstem	1.4585*	100-YR	3090.00	691.01
Mainstem	1.4585*	500-YR	3210.00	691.21
Mainstem	1.44025*	10-YR	2350.00	686.27
Mainstem	1.44025*	50-YR	3040.00	690.94
Mainstem	1.44025*	100-YR	3090.00	691.02
Mainstem	1.44025*	500-YR	3210.00	691.22
Mainstem	1.422	10-YR	2350.00	686.26
Mainstem	1.422	50-YR	3040.00	690.95
Mainstem	1.422	100-YR	3090.00	691.03
Mainstem	1.422	500-YR	3210.00	691.23
Mainstem	1.420	10-YR	2350.00	686.40
Mainstem	1.420	50-YR	3040.00	691.04
Mainstem	1.420	100-YR	3090.00	691.12
Mainstem	1.420	500-YR	3210.00	691.33
Mainstem	1.414	10-YR	2350.00	686.34
Mainstem	1.414	50-YR	3040.00	690.98
Mainstem	1.414	100-YR	3090.00	691.06

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	1.414	500-YR	3210.00	691.27
Mainstem	1.413	10-YR	2350.00	686.48
Mainstem	1.413	50-YR	3040.00	691.04
Mainstem	1.413	100-YR	3090.00	691.13
Mainstem	1.413	500-YR	3210.00	691.33
Mainstem	1.40475*	10-YR	2350.00	686.47
Mainstem	1.40475*	50-YR	3040.00	691.03
Mainstem	1.40475*	100-YR	3090.00	691.12
Mainstem	1.40475*	500-YR	3210.00	691.32
Mainstem	1.3965*	10-YR	2350.00	686.46
Mainstem	1.3965*	50-YR	3040.00	691.03
Mainstem	1.3965*	100-YR	3090.00	691.11
Mainstem	1.3965*	500-YR	3210.00	691.31
Mainstem	1.38825*	10-YR	2350.00	686.46
Mainstem	1.38825*	50-YR	3040.00	691.02
Mainstem	1.38825*	100-YR	3090.00	691.10
Mainstem	1.38825*	500-YR	3210.00	691.31
Mainstem	1.380	10-YR	2350.00	686.45
Mainstem	1.380	50-YR	3040.00	691.01
Mainstem	1.380	100-YR	3090.00	691.10
Mainstem	1.380	500-YR	3210.00	691.30
Mainstem	1.373	10-YR	2350.00	685.59
Mainstem	1.373	50-YR	3040.00	690.30
Mainstem	1.373	100-YR	3090.00	690.36
Mainstem	1.373	500-YR	3210.00	690.52
Mainstem	1.37		Bridge	
Mainstem	1.361	10-YR	2350.00	685.24
Mainstem	1.361	50-YR	3040.00	687.41
Mainstem	1.361	100-YR	3090.00	687.56
Mainstem	1.361	500-YR	3210.00	688.07
Mainstem	1.356	10-YR	2350.00	685.51
Mainstem	1.356	50-YR	3040.00	687.72
Mainstem	1.356	100-YR	3090.00	687.88
Mainstem	1.356	500-YR	3210.00	688.39
Mainstem	1.347	10-YR	2350.00	685.60
Mainstem	1.347	50-YR	3040.00	687.83
Mainstem	1.347	100-YR	3090.00	687.99
Mainstem	1.347	500-YR	3210.00	688.50
Mainstem	1.345	10-YR	2350.00	685.41
Mainstem	1.345	50-YR	3040.00	687.62

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	1.345	100-YR	3090.00	687.77
Mainstem	1.345	500-YR	3210.00	688.28
Mainstem	1.289	10-YR	2350.00	685.39
Mainstem	1.289	50-YR	3040.00	687.61
Mainstem	1.289	100-YR	3090.00	687.77
Mainstem	1.289	500-YR	3210.00	688.28
Mainstem	1.224	10-YR	2350.00	685.36
Mainstem	1.224	50-YR	3040.00	687.59
Mainstem	1.224	100-YR	3090.00	687.75
Mainstem	1.224	500-YR	3210.00	688.26
Mainstem	1.222	10-YR	2350.00	685.46
Mainstem	1.222	50-YR	3040.00	687.70
Mainstem	1.222	100-YR	3090.00	687.86
Mainstem	1.222	500-YR	3210.00	688.37
Mainstem	1.212	10-YR	2350.00	685.44
Mainstem	1.212	50-YR	3040.00	687.68
Mainstem	1.212	100-YR	3090.00	687.83
Mainstem	1.212	500-YR	3210.00	688.34
Mainstem	1.207	10-YR	2350.00	682.45
Mainstem	1.207	50-YR	3040.00	684.08
Mainstem	1.207	100-YR	3090.00	684.19
Mainstem	1.207	500-YR	3210.00	684.91
Mainstem	1.206	10-YR	2350.00	682.45
Mainstem	1.206	50-YR	3040.00	684.07
Mainstem	1.206	100-YR	3090.00	684.19
Mainstem	1.206	500-YR	3210.00	684.90
Mainstem	1.205	10-YR	2350.00	682.43
Mainstem	1.205	50-YR	3040.00	684.06
Mainstem	1.205	100-YR	3090.00	684.18
Mainstem	1.205	500-YR	3210.00	684.89
Mainstem	1.203	10-YR	2350.00	682.40
Mainstem	1.203	50-YR	3040.00	684.04
Mainstem	1.203	100-YR	3090.00	684.15
Mainstem	1.203	500-YR	3210.00	684.87
Mainstem	1.202	10-YR	2350.00	682.39
Mainstem	1.202	50-YR	3040.00	684.02
Mainstem	1.202	100-YR	3090.00	684.14
Mainstem	1.202	500-YR	3210.00	684.38
Mainstem	1.187	10-YR	2350.00	681.87
Mainstem	1.187	50-YR	3040.00	682.72
Mainstem	1.187	100-YR	3090.00	682.78

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	1.187	500-YR	3210.00	682.92
Mainstem	1.185	10-YR	2350.00	682.66
Mainstem	1.185	50-YR	3040.00	683.87
Mainstem	1.185	100-YR	3090.00	683.95
Mainstem	1.185	500-YR	3210.00	684.15
Mainstem	1.183	10-YR	2350.00	683.02
Mainstem	1.183	50-YR	3040.00	684.32
Mainstem	1.183	100-YR	3090.00	684.41
Mainstem	1.183	500-YR	3210.00	684.63
Mainstem	1.168	10-YR	2350.00	683.24
Mainstem	1.168	50-YR	3040.00	684.62
Mainstem	1.168	100-YR	3090.00	684.72
Mainstem	1.168	500-YR	3210.00	684.95
Mainstem	1.166	10-YR	2350.00	683.07
Mainstem	1.166	50-YR	3040.00	684.40
Mainstem	1.166	100-YR	3090.00	684.49
Mainstem	1.166	500-YR	3210.00	684.71
Mainstem	1.104	10-YR	2350.00	683.05
Mainstem	1.104	50-YR	3040.00	684.37
Mainstem	1.104	100-YR	3090.00	684.47
Mainstem	1.104	500-YR	3210.00	684.69
Mainstem	1.102	10-YR	2350.00	683.12
Mainstem	1.102	50-YR	3040.00	684.46
Mainstem	1.102	100-YR	3090.00	684.56
Mainstem	1.102	500-YR	3210.00	684.78
Mainstem	1.091	10-YR	2350.00	682.27
Mainstem	1.091	50-YR	3040.00	683.24
Mainstem	1.091	100-YR	3090.00	683.30
Mainstem	1.091	500-YR	3210.00	683.46
Mainstem	1.08		Bridge	
Mainstem	1.079	10-YR	2350.00	681.91
Mainstem	1.079	50-YR	3040.00	682.55
Mainstem	1.079	100-YR	3090.00	682.58
Mainstem	1.079	500-YR	3210.00	682.66
Mainstem	1.078	10-YR	2350.00	682.01
Mainstem	1.078	50-YR	3040.00	682.70
Mainstem	1.078	100-YR	3090.00	682.74
Mainstem	1.078	500-YR	3210.00	682.83
Mainstem	1.077	10-YR	2350.00	682.15
Mainstem	1.077	50-YR	3040.00	682.91

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	1.077	100-YR	3090.00	682.96
Mainstem	1.077	500-YR	3210.00	683.06
Mainstem	1.052	10-YR	2350.00	682.31
Mainstem	1.052	50-YR	3040.00	683.15
Mainstem	1.052	100-YR	3090.00	683.20
Mainstem	1.052	500-YR	3210.00	683.32
Mainstem	1.05	10-YR	2350.00	682.17
Mainstem	1.05	50-YR	3040.00	682.94
Mainstem	1.05	100-YR	3090.00	682.99
Mainstem	1.05	500-YR	3210.00	683.10
Mainstem	0.993	10-YR	2350.00	682.17
Mainstem	0.993	50-YR	3040.00	682.96
Mainstem	0.993	100-YR	3090.00	683.01
Mainstem	0.993	500-YR	3210.00	683.12
Mainstem	0.928	10-YR	2350.00	682.16
Mainstem	0.928	50-YR	3040.00	682.96
Mainstem	0.928	100-YR	3090.00	683.01
Mainstem	0.928	500-YR	3210.00	683.12
Mainstem	0.926	10-YR	2350.00	682.23
Mainstem	0.926	50-YR	3040.00	683.05
Mainstem	0.926	100-YR	3090.00	683.10
Mainstem	0.926	500-YR	3210.00	683.22
Mainstem	0.910	10-YR	2350.00	682.22
Mainstem	0.910	50-YR	3040.00	683.04
Mainstem	0.910	100-YR	3090.00	683.09
Mainstem	0.910	500-YR	3210.00	683.20
Mainstem	0.901	10-YR	2350.00	682.15
Mainstem	0.901	50-YR	3040.00	682.95
Mainstem	0.901	100-YR	3090.00	683.00
Mainstem	0.901	500-YR	3210.00	683.11
Mainstem	0.89		Bridge	
Mainstem	0.884	10-YR	2350.00	679.21
Mainstem	0.884	50-YR	3040.00	680.33
Mainstem	0.884	100-YR	3090.00	680.42
Mainstem	0.884	500-YR	3210.00	680.60
Mainstem	0.878	10-YR	2440.00	679.43
Mainstem	0.878	50-YR	3380.00	680.62
Mainstem	0.878	100-YR	3470.00	680.71
Mainstem	0.878	500-YR	3660.00	680.90
Mainstem	0.832	10-YR	2440.00	678.27

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	0.832	50-YR	3380.00	679.35
Mainstem	0.832	100-YR	3470.00	679.44
Mainstem	0.832	500-YR	3660.00	679.60
Mainstem	0.776	10-YR	2440.00	676.63
Mainstem	0.776	50-YR	3380.00	677.59
Mainstem	0.776	100-YR	3470.00	677.66
Mainstem	0.776	500-YR	3660.00	677.78
Mainstem	0.721	10-YR	2440.00	674.62
Mainstem	0.721	50-YR	3380.00	675.38
Mainstem	0.721	100-YR	3470.00	675.44
Mainstem	0.721	500-YR	3660.00	675.83
Mainstem	0.659	10-YR	2440.00	673.00
Mainstem	0.659	50-YR	3380.00	674.51
Mainstem	0.659	100-YR	3470.00	674.62
Mainstem	0.659	500-YR	3660.00	675.45
Mainstem	0.605	10-YR	2440.00	671.84
Mainstem	0.605	50-YR	3380.00	673.37
Mainstem	0.605	100-YR	3470.00	673.49
Mainstem	0.605	500-YR	3660.00	674.87
Mainstem	0.596	10-YR	2440.00	671.63
Mainstem	0.596	50-YR	3380.00	673.40
Mainstem	0.596	100-YR	3470.00	673.52
Mainstem	0.596	500-YR	3660.00	674.86
Mainstem	0.59		Bridge	
Mainstem	0.585	10-YR	2440.00	665.18
Mainstem	0.585	50-YR	3380.00	669.65
Mainstem	0.585	100-YR	3470.00	669.90
Mainstem	0.585	500-YR	3660.00	670.57
Mainstem	0.577	10-YR	2440.00	667.02
Mainstem	0.577	50-YR	3380.00	669.45
Mainstem	0.577	100-YR	3470.00	669.72
Mainstem	0.577	500-YR	3660.00	670.43
Mainstem	0.542	10-YR	2440.00	666.77
Mainstem	0.542	50-YR	3380.00	669.52
Mainstem	0.542	100-YR	3470.00	669.79
Mainstem	0.542	500-YR	3660.00	670.49
Mainstem	0.501	10-YR	2440.00	665.82
Mainstem	0.501	50-YR	3380.00	668.82
Mainstem	0.501	100-YR	3470.00	669.10
Mainstem	0.501	500-YR	3660.00	669.86

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	0.497	10-YR	2440.00	665.30
Mainstem	0.497	50-YR	3380.00	668.07
Mainstem	0.497	100-YR	3470.00	668.34
Mainstem	0.497	500-YR	3660.00	669.08
Mainstem	0.49		Culvert	
Mainstem	0.484	10-YR	2440.00	661.80
Mainstem	0.484	50-YR	3380.00	663.25
Mainstem	0.484	100-YR	3470.00	663.36
Mainstem	0.484	500-YR	3660.00	663.64
Mainstem	0.476	10-YR	2440.00	659.10
Mainstem	0.476	50-YR	3380.00	663.56
Mainstem	0.476	100-YR	3470.00	663.73
Mainstem	0.476	500-YR	3660.00	664.09
Mainstem	0.391	10-YR	2440.00	656.71
Mainstem	0.391	50-YR	3380.00	657.57
Mainstem	0.391	100-YR	3470.00	657.63
Mainstem	0.391	500-YR	3660.00	657.73
Mainstem	0.298	10-YR	2440.00	654.60
Mainstem	0.298	50-YR	3380.00	655.86
Mainstem	0.298	100-YR	3470.00	655.97
Mainstem	0.298	500-YR	3660.00	656.23
Mainstem	0.225	10-YR	2440.00	652.23
Mainstem	0.225	50-YR	3380.00	653.86
Mainstem	0.225	100-YR	3470.00	654.00
Mainstem	0.225	500-YR	3660.00	654.28
Mainstem	0.17	10-YR	2440.00	650.52
Mainstem	0.17	50-YR	3380.00	651.88
Mainstem	0.17	100-YR	3470.00	651.98
Mainstem	0.17	500-YR	3660.00	652.21
Mainstem	0.160	10-YR	2440.00	650.29
Mainstem	0.160	50-YR	3380.00	651.44
Mainstem	0.160	100-YR	3470.00	651.51
Mainstem	0.160	500-YR	3660.00	652.09
Mainstem	0.15		Bridge	
Mainstem	0.145	10-YR	2440.00	648.54
Mainstem	0.145	50-YR	3380.00	649.48
Mainstem	0.145	100-YR	3470.00	649.58
Mainstem	0.145	500-YR	3660.00	650.02
Mainstem	0.133	10-YR	2440.00	648.53
Mainstem	0.133	50-YR	3380.00	649.60

HEC-RAS Plan: 2021 Rev Planned River: Honey Creek Reach: Mainstem (Continued)

Reach	River Sta	Profile	Q Total	W.S. Elev
			(cfs)	(ft)
Mainstem	0.133	100-YR	3470.00	649.71
Mainstem	0.133	500-YR	3660.00	649.97
Mainstem	0.089	10-YR	2440.00	648.18
Mainstem	0.089	50-YR	3380.00	649.23
Mainstem	0.089	100-YR	3470.00	649.35
Mainstem	0.089	500-YR	3660.00	649.61
Mainstem	0.076	10-YR	2440.00	647.79
Mainstem	0.076	50-YR	3380.00	648.80
Mainstem	0.076	100-YR	3470.00	648.92
Mainstem	0.076	500-YR	3660.00	649.20
Mainstem	0.065	10-YR	2440.00	645.09
Mainstem	0.065	50-YR	3380.00	647.44
Mainstem	0.065	100-YR	3470.00	647.62
Mainstem	0.065	500-YR	3660.00	648.06
Mainstem	0.042	10-YR	2440.00	644.95
Mainstem	0.042	50-YR	3380.00	647.32
Mainstem	0.042	100-YR	3470.00	647.49
Mainstem	0.042	500-YR	3660.00	647.91
Mainstem	0.033	10-YR	2440.00	643.94
Mainstem	0.033	50-YR	3380.00	647.13
Mainstem	0.033	100-YR	3470.00	647.31
Mainstem	0.033	500-YR	3660.00	647.75
Mainstem	0.032		Bridge	
Mainstem	0.031	10-YR	2440.00	642.53
Mainstem	0.031	50-YR	3380.00	643.97
Mainstem	0.031	100-YR	3470.00	644.62
Mainstem	0.031	500-YR	3660.00	644.86
Mainstem	0.013	10-YR	2440.00	638.31
Mainstem	0.013	50-YR	3380.00	639.36
Mainstem	0.013	100-YR	3470.00	639.37
Mainstem	0.013	500-YR	3660.00	639.61

ALTERNATIVE PLANNING LEVEL COST ESTIMATE DETAILS

APPENDIX C

Table C.1
Alternative Plan No. 3 - W. Oklahoma Avenue Bridge Opening Modification and S. 76th Street Bridge Replacement

Construction	Unit	Quantity	Unit Price ($)	Total ($)
76th Street				
Bridge Construction	SF	4,640	250.00	1,160,000
			1.5 percent Aesthetics	17,400
			5 percent Demolition	58,000
			15 percent Bridge Design	174,000
			15 percent Construction Design	174,000
			25 percent Contingency	290,000
			76th St Bridge Construction Total	1,873,400
Channel Excavation	CY	2,646	5.06	13,386
Hauling Earthwork	CY	3,198	8.09	25,876
Hauling Concrete	CY	298	8.09	2,413
Concrete channel bench	SY	772	153.55	118,612
Geotextile	SY	1,126	3.73	4,204
Topsoil Placement and Grading	SY	1,126	4.11	4,627
Seeding	MSF	10	79.04	801
Dewatering - cofferdam	SF	500	35.13	17,566
Dewatering - 12" PVC	LF	316	45.94	14,516
Dewatering - pumping (8 hr/day)	DAY	5	1,452.35	7,262
			Channel Construction Sub-Total	209,262
			35 percent Contingency	73,242
			76th St Channel Construction Total	282,504
Oklahoma Avenue				
Channel Excavation	CY	3,162	5.06	15,995
Hauling Earthwork	CY	3,897	8.09	31,533
Hauling Concrete	CY	263	8.09	2,128
Concrete channel bench	SY	654	153.55	100,493
Geotextile	SY	1,419	3.73	5,299
Topsoil Placement and Grading	SY	1,419	4.11	5,833
Seeding	MSF	13	79.04	1,009
Dewatering - cofferdam	SF	500	35.13	17,566
Dewatering - 12" PVC	LF	310	45.94	14,240
Dewatering - pumping (8 hr/day)	DAY	5	1,452.35	7,262
			Channel Construction Subtotal	201,357
			35 percent Contingency	70,475
			Oklahoma Ave Channel Construction Total	271,831
			Construction Total	2,427,736
			Acquisition Total (7 Properties)	2,893,381
			Alternative Plan No. 3 Total	5,321,116

Table C.2
Alternative Plan No. 4 - W. Oklahoma Avenue Bridge and S. 76th Street Bridge Replacements

Construction	Unit	Quantity	Unit Price ($)	Total ($)
76th Street				
Bridge Construction	SF	4,640	250.00	1,160,000
			1.5 percent Aesthetics	17,400
			5 percent Demolition	58,000
			15 percent Bridge Design	174,000
			15 percent Construction Design	174,000
			25 percent Contingency	290,000
			76th St Bridge Construction Total	1,873,400
Channel Excavation	CY	2,646	5.06	13,386
Hauling Earthwork	CY	3,198	8.09	25,876
Hauling Concrete	CY	298	8.09	2,413
Concrete channel bench	SY	772	153.55	118,612
Geotextile	SY	1,126	3.73	4,204
Topsoil Placement and Grading	SY	1,126	4.11	4,627
Seeding	MSF	10	79.04	801
Dewatering - cofferdam	SF	500	35.13	17,566
Dewatering - 12" PVC	LF	316	45.94	14,516
Dewatering - pumping (8 hr/day)	DAY	5	1,452.35	7,262
			Channel Construction Sub-Total	209,262
			35 percent Contingency	73,242
			76th St Channel Construction Total	282,504
Oklahoma Avenue				
Bridge Construction	SF	4,730	250.00	1,182,500
			1.5 percent Aesthetics	17,738
			5 percent Demolition	59,125
			15 percent Bridge Design	177,375
			15 percent Construction Design	177,375
			25 percent Contingency	295,625
			Oklahoma Ave Bridge Construction Total	1,909,738
Channel Excavation	CY	3,162	5.06	15,995
Hauling Earthwork	CY	3,897	8.09	31,533
Hauling Concrete	CY	263	8.09	2,128
Concrete channel bench	SY	654	153.55	100,493
Geotextile	SY	1,419	3.73	5,299
Topsoil Placement and Grading	SY	1,419	4.11	5,833
Seeding	MSF	13	79.04	1,009
Dewatering - cofferdam	SF	500	35.13	17,566
Dewatering - 12" PVC	LF	310	45.94	14,240
Dewatering - pumping (8 hr/day)	DAY	5	1,452.35	7,262
			Channel Construction Subtotal	201,357
			35 percent Contingency	70,475
			Oklahoma Ave Channel Construction Total	271,831
			Construction Total	4,337,473
			Acquisition Total (7 Properties)	2,504,905
			Alternative Plan No. 4 Total	6,842,378

Table C.3
Alternative Plan No. 5 - Entire Concrete Channel Rehabilitation

Construction	Unit	Quantity	Unit Price ($)	Total ($)
I-43 to Morgan Ave				
Clearing & Grubbing	Acre	0.7	7,841	5,279
Excavation	CY	92,686	5	468,839
Hauling Earthwork	CY	115,295	8	932,927
Hauling Concrete	CY	6,396	8	51,756
5ft Retaining Wall	SF	72,070	50	3,629,861
Topsoil Borrow	CY	11,980	29	352,834
Topsoil Placement and Grading	SY	71,880	4	295,475
Seeding	MSF	647	79	51,133
Low Channel - Gravel Filter	CY	1,556	43	67,100
Low Channel - Streambed Stone	CY	6,222	87	540,746
Dewatering - cofferdams (16)	SF	24,000	35	843,158
Dewatering - 12" PVC	LF	500	46	22,968
Dewatering - pumping (16 reaches)	DAY	240	4,357	1,045,692
			15 percent Construction Design	8,307,768
			25 percent Contingency	2,907,719
			76th St Bridge Construction Total	11,215,487
Morgan Ave to McCarty Park Enclosure Inlet				
Clearing & Grubbing	Acre	6	7,841	50,381
Excavation	CY	197,456	5	998,802
Hauling Earthwork	CY	246,974	7	1,742,218
Hauling Concrete	CY	11,962	7	84,383
5ft Retaining Wall	SF	43,380	50	2,184,867
3ft Retaining Wall	SF	22,062	50	1,111,170
Topsoil Borrow	CY	17,608	29	518,589
Topsoil Placement and Grading	SY	105,649	4	434,284
Seeding	MSF	951	79	75,155
Low Channel - Gravel Filter	CY	1,778	43	76,686
Low Channel - Streambed Stone	CY	7,111	87	617,996
Dewatering - cofferdams (8)	SF	12,000	35	421,579
Dewatering - cofferdams (8)	SF	24,000	35	843,158
Dewatering – pumping (16 reaches)	DAY	240	4,357	1,045,692
			Channel Construction Subtotal	10,204,959
			35 percent Contingency	3,571,736
			Oklahoma Ave Channel Construction Total	13,776,694
Downstream of Enclosure				
Clearing & Grubbing	Acre	15	7,841	115,546
Excavation	CY	149,959	5	758,548
Hauling Earthwork	CY	185,919	5	1,000,356
Hauling Concrete	CY	111,12	5	59,789
3ft Retaining Wall	SF	36,714	50	1,849,129
Topsoil Borrow	CY	15,655	29	461,058
Topsoil Placement and Grading	SY	93,928	4	386,105
Seeding	MSF	845	79	66,817
Low Channel - Gravel Filter	CY	1,333	43	57,514
Low Channel - Streambed Stone	CY	5,333	87	463,497
Dewatering - cofferdams (12)	SF	27,000	35	948,553
Dewatering - pumping (12 reaches)	DAY	180	4,357	784,269
			Downstream of Enclosure Construction Sub-Total	6,951,181
			35 percent Contingency	2,432,913
			Downstream of Enclosure Construction Total	9,384,094
			Construction Total	34,376,275
			Acquisition Total (5 Properties)	2,096,017
			Alternative Plan No. 5 Total	36,472,292

Table C.4
Alternative Plan No. 6 - Partial Concrete Channel Rehabilitation

Construction	Unit	Quantity	Unit Price ($)	Total ($)
Clearing & Grubbing	Acre	6	7,841	50,381
Excavation	CY	197,456	5	998,802
Hauling Earthwork	CY	246,974	7	1,742,218
Hauling Concrete	CY	11,962	7	84,383
5ft Retaining Wall	SF	43,380	50	2,184,867
3ft Retaining Wall	SF	22,062	50	1,111,170
Topsoil Borrow	CY	17,608	29	518,589
Topsoil Placement and Grading	SY	105,649	4	434,284
Seeding	MSF	951	79	75,155
Low Channel - Gravel Filter	CY	1,778	43	76,686
Low Channel - Streambed Stone	CY	7,111	87	617,996
Dewatering - cofferdams (8)	SF	12,000	35	421,579
Dewatering - cofferdams (8)	SF	24,000	35	843,158
Dewatering - 12" PVC	LF	500	46	22,968
Dewatering - pumping (16 reaches)	DAY	240	4,357	1,045,692
			Subtotal	10,227,927
			35 percent Contingency	3,579,774
			Construction Total	13,807,701
			Acquisition Total (5 Properties)	2,096,017
			Alternative Plan No. 6 Total	15,903,718

ALTERNATIVE FLOOD ELEVATIONS COMPARISON

APPENDIX D

Table D.1
Honey Creek Alternatives 1-Percent-Annual-Probability Flood Elevations Comparison

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
0.013	639.37	639.37	0	639.37	0	639.17	-0.2	639.37	0
0.031	644.62	644.62	0	644.62	0	643.77	-0.85	644.62	0
Hart Park Bike Path Bridge									
0.033	647.31	647.31	0	647.31	0	646.72	-0.59	647.31	0
0.042	647.49	647.49	0	647.49	0	646.97	-0.52	647.49	0
0.065	647.62	647.62	0	647.62	0	647.06	-0.56	647.62	0
0.076	648.92	648.92	0	648.92	0	648.58	-0.34	648.92	0
0.089	649.35	649.35	0	649.35	0	649.02	-0.33	649.35	0
0.133	649.71	649.71	0	649.71	0	649.39	-0.32	649.71	0
0.145	649.58	649.58	0	649.58	0	649.3	-0.28	649.58	0
W. Honey Creek Parkway									
0.16	651.51	651.51	0	651.51	0	651.3	-0.21	651.51	0
0.17	651.98	651.98	0	651.98	0	651.69	-0.29	651.98	0
0.225	654	654	0	654	0	653.59	-0.41	654	0
0.298	655.97	655.97	0	655.97	0	655.65	-0.32	655.97	0
0.391	657.63	657.63	0	657.63	0	657.44	-0.19	657.63	0
0.476	663.73	663.73	0	663.73	0	663.47	-0.26	663.73	0
0.484	663.36	663.36	0	663.36	0	662.99	-0.37	663.36	0
Portland Avenue									
0.497	668.34	668.34	0	668.34	0	667.57	-0.77	668.34	0
0.501	669.1	669.1	0	669.1	0	668.43	-0.67	669.1	0
0.542	669.79	669.79	0	669.79	0	669.12	-0.67	669.79	0
0.577	669.72	669.72	0	669.72	0	669.3	-0.42	669.72	0
0.585	669.9	669.9	0	669.9	0	669.48	-0.42	669.9	0
N. Honey Creek Parkway									
0.596	673.52	673.52	0	673.52	0	673.19	-0.33	673.52	0
0.605	673.49	673.49	0	673.49	0	673.14	-0.35	673.49	0
0.659	674.62	674.62	0	674.62	0	674.3	-0.32	674.62	0
0.721	675.44	675.44	0	675.44	0	674.72	-0.72	675.44	0
0.776	677.66	677.66	0	677.66	0	674.9	-2.76	677.66	0
0.832	679.44	679.44	0	679.44	0	675.53	-3.91	679.44	0
0.878	680.71	680.71	0	680.71	0	676.1	-4.61	680.71	0
0.884	680.42	680.42	0	680.42	0	676.18	-4.24	680.42	0

Table continued on next page.

Table D.1 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
W. Wisconsin Avenue									
0.901	683	683	0	683	0	682.05	-0.95	683	0
0.91	683.09	683.09	0	683.09	0	682.26	-0.83	683.09	0
0.928	683.1	683.1	0	683.1	0	682.3	-0.8	683.01	-0.09
0.966	683.01	683.01	0	683.01	0	682.4	-0.61	--	--
0.993	683.01	683.01	0	683.01	0	682.43	-0.58	683.01	0
1.021	--	--	--	--	--	682.43	--	--	--
1.052	683.2	683.2	0	683.2	0	682.41	-0.79	683.2	0
1.078	682.74	682.74	0	682.74	0	681.97	-0.77	682.74	0
1.079	682.58	682.58	0	682.58	0	681.8	-0.78	682.58	0
N. Honey Creek Parkway									
1.091	683.3	683.3	0	683.3	0	682.49	-0.81	683.3	0
1.104	684.47	684.47	0	684.47	0	683.91	-0.56	684.47	0
1.135	--	--	--	--	--	684.08	--	--	--
1.168	684.72	684.72	0	684.72	0	684.06	-0.66	684.72	0
1.183	684.41	684.41	0	684.41	0	683.65	-0.76	684.41	0
1.185	683.95	683.95	0	683.95	0	683.45	-0.5	683.95	0
1.187	682.78	682.78	0	682.78	0	682.25	-0.53	682.78	0
W. Bluemound Road									
1.202	684.14	684.14	0	684.14	0	683.96	-0.18	684.14	0
1.203	684.15	684.15	0	684.15	0	683.97	-0.18	684.15	0
1.205	684.18	684.18	0	684.18	0	683.99	-0.19	684.18	0
1.206	684.19	684.19	0	684.19	0	684.01	-0.18	684.19	0
1.207	684.19	684.19	0	684.19	0	684.01	-0.18	684.19	0
1.212	687.83	687.83	0	687.83	0	687.47	-0.36	687.83	0
1.224	687.75	687.75	0	687.75	0	687.61	-0.14	687.75	0
1.289	687.77	687.77	0	687.77	0	687.66	-0.11	687.77	0
1.316	--	--	--	--	--	687.68	--	--	--
1.347	687.99	687.99	0	687.99	0	687.6	-0.39	687.99	0
1.361	687.56	687.56	0	687.56	0	687.21	-0.35	687.56	0
N. Honey Creek Parkway									
1.373	690.36	690.36	0	690.36	0	690.17	-0.19	690.36	0
1.38	691.1	691.1	0	691.1	0	690.89	-0.21	691.1	0
1.414	691.06	691.06	0	691.06	0	690.98	-0.08	691.06	0

Table continued on next page.

Table D.1 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
N. Honey Creek Parkway (Continued)									
1.422	691.03	691.03	0	691.03	0	690.99	-0.04	691.03	0
1.5	690.64	690.64	0	690.64	0	691.02	0.38	690.64	0
1.575	690.85	690.85	0	690.85	0	691.11	0.26	690.85	0
1.59	691.38	691.38	0	691.38	0	691.07	-0.31	691.38	0
1.601	691.15	691.15	0	691.15	0	691.03	-0.12	691.15	0
1.625	691.52	691.52	0	691.52	0	691.04	-0.48	691.52	0
1.63	691.38	691.38	0	691.38	0	691.05	-0.33	691.38	0
1.641	691.43	691.43	0	691.43	0	691.19	-0.24	691.43	0
1.684	--	--	--	--	--	691.62	--	--	--
1.703	691.91	691.91	0	691.91	0	691.67	-0.24	691.91	0
1.739	--	--	--	--	--	691.99	--	--	--
1.765	692.55	692.55	0	692.55	0	692.03	-0.52	692.55	0
1.784	692.63	692.63	0	692.63	0	692.08	-0.55	692.63	0
1.788	692.57	692.57	0	692.57	0	692.77	0.2	692.57	0
1.789	692.36	692.36	0	692.36	0	692.6	0.24	692.36	0
S. 84th Street									
1.809	695.01	695.01	0	695.01	0	694.77	-0.24	695.01	0
1.811	695.34	695.34	0	695.34	0	695.09	-0.25	695.34	0
1.826	694.83	694.83	0	694.83	0	695.04	0.21	694.83	0
1.865	695.35	695.35	0	695.35	0	695.6	0.25	695.35	0
1.889	695.55	695.55	0	695.55	0	695.71	0.16	695.55	0
1.902	696.38	696.38	0	696.38	0	695.67	-0.71	696.38	0
1.912	696.58	696.58	0	696.58	0	695.88	-0.7	696.58	0
1.9159	696.72	696.72	0	696.72	0	696.04	-0.68	696.72	0
Enclosure Outlet - I-94									
1.916	696.34	696.34	0	696.34	0	695.62	-0.72	696.34	0
1.972	696.86	696.86	0	696.86	0	696.18	-0.68	696.86	0
1.9721	697.6	697.6	0	697.6	0	697	-0.6	697.6	0
2.21	698.2	698.2	0	698.2	0	697.53	-0.67	698.2	0
2.2101	698.2	698.2	0	698.2	0	697.57	-0.63	698.2	0
2.247	698.82	698.82	0	698.82	0	698.26	-0.56	698.82	0
2.361	700.43	700.43	0	700.43	0	699.92	-0.51	700.43	0
2.453	701.79	701.79	0	701.79	0	701.25	-0.54	701.79	0

Table continued on next page.

Table D.1 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
Enclosure Outlet - I-94 (Continued)									
2.547	703.22	703.22	0	703.22	0	702.66	-0.56	703.22	0
2.55	703.18	703.18	0	703.18	0	702.62	-0.56	703.18	0
2.737	707.68	707.68	0	707.68	0	707.12	-0.56	707.68	0
2.823	709.76	709.76	0	709.76	0	709.19	-0.57	709.76	0
2.954	712.9	712.9	0	712.9	0	712.33	-0.57	712.9	0
3.044	715.07	715.07	0	715.07	0	714.51	-0.56	715.07	0
3.049	714.98	714.98	0	714.98	0	714.41	-0.57	714.98	0
3.166	715.65	715.65	0	715.65	0	715.08	-0.57	715.65	0
3.284	716.31	716.31	0	716.31	0	715.75	-0.56	716.31	0
3.297	716.39	716.39	0	716.39	0	715.83	-0.56	716.39	0
3.412	717.04	717.04	0	717.04	0	716.48	-0.56	717.04	0
3.416	715.6	715.6	0	715.6	0	714.88	-0.72	715.6	0
3.512	717.52	717.52	0	717.52	0	716.96	-0.56	717.52	0
3.608	719.42	719.42	0	719.42	0	718.96	-0.46	719.42	0
3.611	723.37	723.37	0	723.37	0	723.18	-0.19	723.37	0
3.764	724.23	724.23	0	724.23	0	724.05	-0.18	724.23	0
3.891	724.95	724.95	0	724.95	0	724.77	-0.18	724.95	0
4.018	725.68	725.68	0	725.68	0	725.49	-0.19	725.68	0
4.146	726.41	726.41	0	726.41	0	726.22	-0.19	726.41	0
4.2767	727.15	727.15	0	727.15	0	726.96	-0.19	727.15	0
4.2769	727.81	727.81	0	727.81	0	727.61	-0.2	727.81	0
Enclosure Inlet - McCarty Park									
4.2813	728.02	728.02	0	728.02	0	727.83	-0.19	728.02	0
4.2814	728.34	728.34	0	728.34	0	728.13	-0.21	728.32	-0.02
4.283	728.82	728.82	0	728.82	0	728.54	-0.28	728.75	-0.07
4.294	728.85	728.85	0	728.85	0	728.96	0.11	729.17	0.32
4.321	--	--	--	--	--	729.2	--	729.41	--
4.381	729.55	729.55	0	729.55	0	729.26	-0.29	729.46	-0.09
4.433	--	--	--	--	--	729.28	--	729.48	--
McCarty Park Pedestrian Bridge									
4.534	731.1	731.1	0	731.1	0	729.34	-1.76	729.54	-1.56
4.592	731.41	731.41	0	731.41	0	729.39	-2.02	729.59	-1.82
4.615	731.36	731.36	0	731.36	0	729.11	-2.25	729.3	-2.06

Table continued on next page.

Table D.1 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
N. Honey Creek Parkway (Continued)									
1.422	691.03	691.03	0	691.03	0	690.99	-0.04	691.03	0
1.5	690.64	690.64	0	690.64	0	691.02	0.38	690.64	0
1.575	690.85	690.85	0	690.85	0	691.11	0.26	690.85	0
1.59	691.38	691.38	0	691.38	0	691.07	-0.31	691.38	0
1.601	691.15	691.15	0	691.15	0	691.03	-0.12	691.15	0
1.625	691.52	691.52	0	691.52	0	691.04	-0.48	691.52	0
1.63	691.38	691.38	0	691.38	0	691.05	-0.33	691.38	0
1.641	691.43	691.43	0	691.43	0	691.19	-0.24	691.43	0
1.684	--	--	--	--	--	691.62	--	--	--
1.703	691.91	691.91	0	691.91	0	691.67	-0.24	691.91	0
1.739	--	--	--	--	--	691.99	--	--	--
1.765	692.55	692.55	0	692.55	0	692.03	-0.52	692.55	0
1.784	692.63	692.63	0	692.63	0	692.08	-0.55	692.63	0
1.788	692.57	692.57	0	692.57	0	692.77	0.2	692.57	0
1.789	692.36	692.36	0	692.36	0	692.6	0.24	692.36	0
S. 84th Street									
1.809	695.01	695.01	0	695.01	0	694.77	-0.24	695.01	0
1.811	695.34	695.34	0	695.34	0	695.09	-0.25	695.34	0
1.826	694.83	694.83	0	694.83	0	695.04	0.21	694.83	0
1.865	695.35	695.35	0	695.35	0	695.6	0.25	695.35	0
1.889	695.55	695.55	0	695.55	0	695.71	0.16	695.55	0
1.902	696.38	696.38	0	696.38	0	695.67	-0.71	696.38	0
1.912	696.58	696.58	0	696.58	0	695.88	-0.7	696.58	0
1.9159	696.72	696.72	0	696.72	0	696.04	-0.68	696.72	0
Enclosure Outlet - I-94									
1.916	696.34	696.34	0	696.34	0	695.62	-0.72	696.34	0
1.972	696.86	696.86	0	696.86	0	696.18	-0.68	696.86	0
1.9721	697.6	697.6	0	697.6	0	697	-0.6	697.6	0
2.21	698.2	698.2	0	698.2	0	697.53	-0.67	698.2	0
2.2101	698.2	698.2	0	698.2	0	697.57	-0.63	698.2	0
2.247	698.82	698.82	0	698.82	0	698.26	-0.56	698.82	0
2.361	700.43	700.43	0	700.43	0	699.92	-0.51	700.43	0
2.453	701.79	701.79	0	701.79	0	701.25	-0.54	701.79	0

Table continued on next page.

Table D.1 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
W. Morgan Avenue									
5.889	739.64	739.64	0	739.64	0	739.51	-0.13	739.6	-0.04
5.899	739.98	739.98	0	739.98	0	740.11	0.13	739.92	-0.06
5.962	740.29	740.29	0	740.29	0	740.47	0.18	740.22	-0.07
6.033	741.52	741.52	0	741.52	0	741.61	0.09	741.45	-0.07
6.083	742.13	742.13	0	742.13	0	742.79	0.66	742.06	-0.07
6.096	742.82	742.82	0	742.82	0	742.62	-0.2	742.77	-0.05
S. 68th Street									
6.119	743.05	743.05	0	743.05	0	742.84	-0.21	742.99	-0.06
6.13	743.42	743.42	0	743.42	0	743.7	0.28	743.33	-0.09
6.224	744.85	744.85	0	744.85	0	744.4	-0.45	744.77	-0.08
6.318	746.1	746.1	0	746.1	0	745.27	-0.83	746.02	-0.08
6.389	746.9	746.9	0	746.9	0	746.02	-0.88	746.82	-0.08
6.432	747.49	747.49	0	747.49	0	746.56	-0.93	747.4	-0.09
6.46	747.59	747.59	0	747.59	0	746.78	-0.81	747.51	-0.08
6.472	747.61	747.61	0	747.61	0	746.58	-1.03	747.53	-0.08
6.4722	747.57	747.57	0	747.57	0	746.53	-1.04	747.49	-0.08
W. Howard Avenue/W. Forest Home Avenue									
6.502	747.66	747.66	0	747.66	0	746.66	-1	747.58	-0.08
6.503	747.66	747.66	0	747.66	0	746.66	-1	747.58	-0.08
6.524	747.7	747.7	0	747.7	0	746.7	-1	747.62	-0.08
6.5242	747.7	747.7	0	747.7	0	746.7	-1	747.62	-0.08
6.534	747.91	747.91	0	747.91	0	747.29	-0.62	747.83	-0.08
6.609	748.49	748.49	0	748.49	0	747.82	-0.67	748.44	-0.05
6.703	749.12	749.12	0	749.12	0	748.38	-0.74	749.08	-0.04
6.82	749.98	749.98	0	749.98	0	748.69	-1.29	749.95	-0.03
6.892	750.37	750.37	0	750.37	0	748.84	-1.53	750.35	-0.02
6.903	750.45	750.45	0	750.45	0	748.72	-1.73	750.43	-0.02
6.9034	750.44	750.44	0	750.44	0	748.69	-1.75	750.42	-0.02
6.907	750.56	750.56	0	750.56	0	748.94	-1.62	750.54	-0.02
6.912	750.39	750.39	0	750.39	0	748.72	-1.67	750.37	-0.02
6.9121	750.29	750.29	0	750.29	0	748.68	-1.61	750.27	-0.02
6.918	749.88	749.88	0	749.88	0	748.04	-1.84	749.86	-0.02

Table continued on next page.

Table D.1 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
S. 60th Street									
6.972	750.85	750.85	0	750.85	0	749.15	-1.7	750.84	-0.01
7.01	751.54	751.54	0	751.54	0	749.77	-1.77	751.52	-0.02
7.012	751.93	751.93	0	751.93	0	750.14	-1.79	751.92	-0.01
7.0121	752.27	752.27	0	752.27	0	750.25	-2.02	752.25	-0.02
7.017	752.63	752.63	0	752.63	0	751.38	-1.25	752.61	-0.02
7.028	752.73	752.73	0	752.73	0	751.47	-1.26	752.71	-0.02
7.101	--	--	--	--	--	751.7	--	--	--
7.117	753.2	753.2	0	753.2	0	751.73	-1.47	753.19	-0.01
7.125	753.21	753.21	0	753.21	0	751.56	-1.65	753.19	-0.02
W. Cold Spring Road									
7.15	753.72	753.72	0	753.72	0	751.69	-2.03	753.71	-0.01
7.158	753.81	753.81	0	753.81	0	752.25	-1.56	753.79	-0.02
7.162	753.89	753.89	0	753.89	0	752.28	-1.61	753.88	-0.01
7.239	754.26	754.26	0	754.26	0	752.68	-1.58	754.24	-0.02
7.348	754.72	754.72	0	754.72	0	753.24	-1.48	754.71	-0.01
7.427	755.08	755.08	0	755.08	0	753.56	-1.52	755.07	-0.01
7.43	755.07	755.07	0	755.07	0	753.56	-1.51	755.06	-0.01
7.438	755.05	755.05	0	755.05	0	753.58	-1.47	755.05	0
7.442	755.04	755.04	0	755.04	0	753.57	-1.47	755.03	-0.01
7.449	755.17	755.17	0	755.17	0	753.5	-1.67	755.16	-0.01
7.453	755.21	755.21	0	755.21	0	753.56	-1.65	755.2	-0.01
I-43/I-894									
7.495	755.44	755.44	0	755.44	0	753.76	-1.68	755.45	0.01
7.498	755.55	755.55	0	755.55	0	753.92	-1.63	755.56	0.01
7.506	755.56	755.56	0	755.56	0	753.91	-1.65	755.57	0.01
7.521	755.61	755.61	0	755.61	0	754.04	-1.57	755.62	0.01
7.559	755.71	755.71	0	755.71	0	754.23	-1.48	755.72	0.01
7.627	755.85	755.85	0	755.85	0	754.5	-1.35	755.86	0.01
7.669	755.98	755.98	0	755.98	0	754.46	-1.52	755.99	0.01
7.673	755.72	755.72	0	755.72	0	754.2	-1.52	755.73	0.01
W. Layton Avenue									
7.707	758.03	758.03	0	758.03	0	756.13	-1.9	758.03	0
7.711	758.3	758.3	0	758.3	0	756.9	-1.4	758.3	0

Table continued on next page.

Table D.1 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
7.7113	758.3	758.3	0	758.3	0	756.89	-1.41	758.3	0
7.718	758.27	758.27	0	758.27	0	756.84	-1.43	758.28	0.01
7.725	758.32	758.32	0	758.32	0	756.99	-1.33	758.32	0
7.792	759.18	759.18	0	759.18	0	758.63	-0.55	759.18	0
7.886	759.94	759.94	0	759.94	0	759.67	-0.27	759.94	0
7.946	760.09	760.09	0	760.09	0	759.84	-0.25	760.09	0
7.951	760.1	760.1	0	760.1	0	759.86	-0.24	760.11	0.01
Park Maintenance Access									
7.957	760.13	760.13	0	760.13	0	759.88	-0.25	760.13	0
7.975	760.15	760.15	0	760.15	0	759.91	-0.24	760.15	0
8.02	760.19	760.19	0	760.19	0	759.96	-0.23	760.19	0
Konkel Park Pedestrian Bridge									
8.023	760.2	760.2	0	760.2	0	759.97	-0.23	760.2	0
8.04	760.22	760.22	0	760.22	0	759.99	-0.23	760.21	-0.01
8.091	760.25	760.25	0	760.25	0	760.03	-0.22	760.24	-0.01
8.153	760.44	760.44	0	760.44	0	760.25	-0.19	760.43	-0.01
8.276	760.62	760.62	0	760.62	0	760.46	-0.16	760.61	-0.01
8.349	762.44	762.44	0	762.44	0	762.44	0	762.44	0
8.358	762.46	762.46	0	762.46	0	762.45	-0.01	762.46	0
W. Loomis Road									
8.385	764.06	764.06	0	764.06	0	764.05	-0.01	764.06	0
8.388	764.4	764.4	0	764.4	0	764.39	-0.01	764.4	0
8.429	764.45	764.45	0	764.45	0	764.44	-0.01	764.45	0
8.527	764.73	764.73	0	764.73	0	764.73	0	764.73	0
8.625	764.85	764.85	0	764.85	0	764.85	0	764.85	0
8.666	764.85	764.85	0	764.85	0	764.85	0	764.85	0
S. 43rd Street									

Table D.2
Honey Creek Alternatives 0.2-Percent-Annual-Probability Flood Elevations Comparison

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
0.013	639.61	639.61	0	639.61	0	639.38	-0.23	639.61	0
0.031	644.86	644.86	0	644.86	0	643.97	-0.89	644.86	0
Hart Park Bike Path Bridge									
0.033	647.75	647.75	0	647.75	0	647.16	-0.59	647.75	0
0.042	647.91	647.91	0	647.91	0	647.35	-0.56	647.91	0
0.065	648.06	648.06	0	648.06	0	647.47	-0.59	648.06	0
0.076	649.2	649.2	0	649.2	0	648.81	-0.39	649.2	0
0.089	649.61	649.61	0	649.61	0	649.25	-0.36	649.61	0
0.133	649.97	649.97	0	649.97	0	649.62	-0.35	649.97	0
0.145	650.02	650.02	0	650.02	0	649.49	-0.53	650.02	0
W. Honey Creek Parkway									
0.16	652.09	652.09	0	652.09	0	651.45	-0.64	652.09	0
0.17	652.21	652.21	0	652.21	0	651.89	-0.32	652.21	0
0.225	654.28	654.28	0	654.28	0	653.87	-0.41	654.28	0
0.298	656.23	656.23	0	656.23	0	655.87	-0.36	656.23	0
0.391	657.73	657.73	0	657.73	0	657.57	-0.16	657.73	0
0.476	664.09	664.09	0	664.09	0	663.84	-0.25	664.09	0
0.484	663.64	663.64	0	663.64	0	663.26	-0.38	663.64	0
Portland Avenue									
0.497	669.08	669.08	0	669.08	0	668.1	-0.98	669.08	0
0.501	669.86	669.86	0	669.86	0	669	-0.86	669.86	0
0.542	670.49	670.49	0	670.49	0	669.67	-0.82	670.49	0
0.577	670.43	670.43	0	670.43	0	669.81	-0.62	670.43	0
0.585	670.57	670.57	0	670.57	0	669.98	-0.59	670.57	0
N. Honey Creek Parkway									
0.596	674.86	674.86	0	674.86	0	673.43	-1.43	674.86	0
0.605	674.87	674.87	0	674.87	0	673.4	-1.47	674.87	0
0.659	675.45	675.45	0	675.45	0	674.53	-0.92	675.45	0
0.721	675.83	675.83	0	675.83	0	674.91	-0.92	675.83	0
0.776	677.78	677.78	0	677.78	0	675.09	-2.69	677.78	0
0.832	679.6	679.6	0	679.6	0	675.72	-3.88	679.6	0
0.878	680.9	680.9	0	680.9	0	676.26	-4.64	680.9	0
0.884	680.6	680.6	0	680.6	0	676.48	-4.12	680.6	0

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Table D.2 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
W. Wisconsin Avenue									
0.901	683.11	683.11	0	683.11	0	682.23	-0.88	683.11	0
0.91	683.2	683.2	0	683.2	0	682.44	-0.76	683.2	0
0.928	683.12	683.12	0	683.12	0	682.49	-0.63	683.12	0
0.966	--	--	0	--	0	682.59	--	--	0
0.993	683.12	683.12	0	683.12	0	682.61	-0.51	683.12	0
1.021	--	--	--	--	--	682.62	--	--	--
1.052	683.32	683.32	0	683.32	0	682.6	-0.72	683.32	0
1.078	682.83	682.83	0	682.83	0	682.13	-0.7	682.83	0
1.079	682.66	682.66	0	682.66	0	681.95	-0.71	682.66	0
N. Honey Creek Parkway									
1.091	683.46	683.46	0	683.46	0	682.72	-0.74	683.46	0
1.104	684.69	684.69	0	684.69	0	684.21	-0.48	684.69	0
1.135	--	--	--	--	--	684.38	--	--	--
1.168	684.95	684.95	0	684.95	0	684.36	-0.59	684.95	0
1.183	684.63	684.63	0	684.63	0	683.92	-0.71	684.63	0
1.185	684.15	684.15	0	684.15	0	683.71	-0.44	684.15	0
1.187	682.92	682.92	0	682.92	0	682.45	-0.47	682.92	0
W. Bluemound Road									
1.202	684.38	684.38	0	684.38	0	684.35	-0.03	684.38	0
1.203	684.87	684.87	0	684.87	0	684.7	-0.17	684.87	0
1.205	684.89	684.89	0	684.89	0	684.72	-0.17	684.89	0
1.206	684.9	684.9	0	684.9	0	684.73	-0.17	684.9	0
1.207	684.91	684.91	0	684.91	0	684.73	-0.18	684.91	0
1.212	688.34	688.34	0	688.34	0	688.02	-0.32	688.34	0
1.224	688.26	688.26	0	688.26	0	688.16	-0.1	688.26	0
1.289	688.28	688.28	0	688.28	0	688.21	-0.07	688.28	0
1.316	--	--	--	--	--	--	--	--	--
1.347	688.5	688.5	0	688.5	0	688.15	-0.35	688.5	0
1.361	688.07	688.07	0	688.07	0	687.76	-0.31	688.07	0
N. Honey Creek Parkway									
1.373	690.52	690.52	0	690.52	0	690.34	-0.18	690.52	0
1.38	691.3	691.3	0	691.3	0	691.1	-0.2	691.3	0
1.414	691.27	691.27	0	691.27	0	691.2	-0.07	691.27	0
1.422	691.23	691.23	0	691.23	0	691.21	-0.02	691.23	0

Table continued on next page.

Table D.2 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
N. Honey Creek Parkway (Continued)									
1.5	690.84	690.84	0	690.84	0	691.24	0.4	690.84	0
1.575	691.04	691.04	0	691.04	0	691.32	0.28	691.04	0
1.59	691.59	691.59	0	691.59	0	691.29	-0.3	691.59	0
1.601	691.35	691.35	0	691.35	0	691.25	-0.1	691.35	0
1.625	691.72	691.72	0	691.72	0	691.25	-0.47	691.72	0
1.63	691.6	691.6	0	691.6	0	691.26	-0.34	691.6	0
1.641	691.64	691.64	0	691.64	0	691.41	-0.23	691.64	0
1.684	--	--	--	--	--	691.83	--	--	--
1.703	692.1	692.1	0	692.1	0	691.88	-0.22	692.1	0
1.739	--	--	--	--	--	692.19	--	--	--
1.765	692.76	692.76	0	692.76	0	692.22	-0.54	692.76	0
1.784	692.85	692.85	0	692.85	0	692.24	-0.61	692.85	0
1.788	692.78	692.78	0	692.78	0	692.91	0.13	692.78	0
1.789	692.57	692.57	0	692.57	0	692.74	0.17	692.57	0
S. 84th Street									
1.809	695.23	695.23	0	695.23	0	695	-0.23	695.23	0
1.811	695.57	695.57	0	695.57	0	695.33	-0.24	695.57	0
1.826	695.08	695.08	0	695.08	0	695.28	0.2	695.08	0
1.865	695.57	695.57	0	695.57	0	695.84	0.27	695.57	0
1.889	695.77	695.77	0	695.77	0	695.94	0.17	695.77	0
1.902	696.6	696.6	0	696.6	0	695.9	-0.7	696.6	0
1.912	696.8	696.8	0	696.8	0	696.13	-0.67	696.8	0
1.9159	696.93	696.93	0	696.93	0	696.28	-0.65	696.93	0
Enclosure Outlet - I-94									
1.916	696.57	696.57	0	696.57	0	695.88	-0.69	696.57	0
1.972	697.08	697.08	0	697.08	0	696.41	-0.67	697.08	0
1.9721	697.79	697.79	0	697.79	0	697.2	-0.59	697.79	0
2.21	698.39	698.39	0	698.39	0	697.7	-0.69	698.39	0
2.2101	698.39	698.39	0	698.39	0	697.72	-0.67	698.39	0
2.247	699	699	0	699	0	698.4	-0.6	699	0
2.361	700.65	700.65	0	700.65	0	700.03	-0.62	700.65	0
2.453	702.05	702.05	0	702.05	0	701.38	-0.67	702.05	0
2.547	703.49	703.49	0	703.49	0	702.81	-0.68	703.49	0

Table continued on next page.

Table D.2 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
Enclosure Outlet - I-94 (Continued)									
2.55	703.45	703.45	0	703.45	0	702.78	-0.67	703.45	0
2.737	707.95	707.95	0	707.95	0	707.28	-0.67	707.95	0
2.823	710.02	710.02	0	710.02	0	709.35	-0.67	710.02	0
2.954	713.16	713.16	0	713.16	0	712.49	-0.67	713.16	0
3.044	715.34	715.34	0	715.34	0	714.67	-0.67	715.34	0
3.049	715.25	715.25	0	715.25	0	714.57	-0.68	715.25	0
3.166	715.91	715.91	0	715.91	0	715.24	-0.67	715.91	0
3.284	716.58	716.58	0	716.58	0	715.91	-0.67	716.58	0
3.297	716.66	716.66	0	716.66	0	715.98	-0.68	716.66	0
3.412	717.31	717.31	0	717.31	0	716.64	-0.67	717.31	0
3.416	715.92	715.92	0	715.92	0	715.09	-0.83	715.92	0
3.512	717.83	717.83	0	717.83	0	717.1	-0.73	717.83	0
3.608	719.72	719.72	0	719.72	0	719.07	-0.65	719.72	0
3.611	723.52	723.52	0	723.52	0	723.22	-0.3	723.52	0
3.764	724.38	724.38	0	724.38	0	724.09	-0.29	724.38	0
3.891	725.1	725.1	0	725.1	0	724.81	-0.29	725.1	0
4.018	725.82	725.82	0	725.82	0	725.53	-0.29	725.82	0
4.146	726.56	726.56	0	726.56	0	726.26	-0.3	726.56	0
4.2767	727.3	727.3	0	727.3	0	727	-0.3	727.3	0
4.2769	727.97	727.97	0	727.97	0	727.65	-0.32	727.97	0
Enclosure Inlet - McCarty Park									
4.2814	728.63	728.63	0	728.63	0	728.34	-0.29	728.63	0
4.283	729.61	729.61	0	729.61	0	729.37	-0.24	729.61	0
4.294	729.73	729.73	0	729.73	0	730.11	0.38	730.32	0.59
4.321	--	--	--	--	--	730.48	--	730.67	--
4.381	730.64	730.64	0	730.64	0	730.55	-0.09	730.73	0.09
4.433	--	--	--	--	--	730.58	--	--	--
4.481	731.33	731.33	0	731.33	0	730.59	-0.74	730.77	-0.56
McCarty Park Pedestrian Bridge									
4.534	732.39	732.39	0	732.39	0	730.64	-1.75	730.81	-1.58
4.592	732.64	732.64	0	732.64	0	730.7	-1.94	730.87	-1.77
4.615	732.49	732.49	0	732.49	0	730.2	-2.29	730.39	-2.1

Table continued on next page.

Table D.2 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
Beloit Road									
4.636	733.46	733.46	0	733.46	0	732.16	-1.3	732.18	-1.28
4.645	733.89	733.89	0	733.89	0	733.15	-0.74	733.17	-0.72
4.733	734.59	734.59	0	734.59	0	733.3	-1.29	733.32	-1.27
4.853	734.88	734.88	0	734.88	0	733.38	-1.5	733.4	-1.48
4.938	734.9	734.9	0	734.9	0	733.44	-1.46	733.46	-1.44
5.002	735.11	735.11	0	735.11	0	733.49	-1.62	733.51	-1.6
5.036	735.26	735.24	-0.02	735.24	-0.02	733.02	-2.24	733.04	-2.22
S. 76th Street									
5.059	735.92	735.72	-0.2	735.72	-0.2	734.79	-1.13	734.81	-1.11
5.069	735.94	735.7	-0.24	735.7	-0.24	735.06	-0.88	735.08	-0.86
5.126	735.99	735.77	-0.22	735.77	-0.22	735.38	-0.61	735.41	-0.58
5.179	736.07	735.87	-0.2	735.87	-0.2	735.58	-0.49	735.6	-0.47
5.197	736.03	735.9	-0.13	735.9	-0.13	735.53	-0.5	735.54	-0.49
W. Oklahoma Avenue									
5.219	737.38	737.12	-0.26	736.97	-0.41	737.02	-0.36	737.04	-0.34
5.227	737.36	737.06	-0.3	736.91	-0.45	737.08	-0.28	737.11	-0.25
5.278	737.46	737.18	-0.28	737.04	-0.42	737.21	-0.25	737.24	-0.22
5.361	737.65	737.4	-0.25	737.29	-0.36	737.43	-0.22	737.46	-0.19
5.414	737.75	737.52	-0.23	737.41	-0.34	737.56	-0.19	737.58	-0.17
5.431	737.8	737.57	-0.23	737.46	-0.34	737.54	-0.26	737.56	-0.24
S. 72nd Street									
5.444	737.95	737.77	-0.18	737.69	-0.26	737.74	-0.21	737.75	-0.2
5.453	737.96	737.79	-0.17	737.72	-0.24	737.87	-0.09	737.89	-0.07
5.492	738.04	737.88	-0.16	737.81	-0.23	737.96	-0.08	737.98	-0.06
5.544	738.18	738.02	-0.16	737.95	-0.23	738.08	-0.1	738.1	-0.08
5.608	738.28	738.13	-0.15	738.08	-0.2	738.18	-0.1	738.2	-0.08
5.6144	738.22	738.07	-0.15	738.01	-0.21	738.18	-0.04	738.2	-0.02
5.684	738.51	738.38	-0.13	738.33	-0.18	738.52	0.01	738.54	0.03
5.714	738.64	738.52	-0.12	738.47	-0.17	738.72	0.08	738.74	0.1
5.745	738.77	738.66	-0.11	738.62	-0.15	738.87	0.1	738.88	0.11
5.802	739.09	739	-0.09	738.97	-0.12	739.29	0.2	739.3	0.21
5.858	739.37	739.29	-0.08	739.26	-0.11	739.7	0.33	739.71	0.34
5.864	739.1	739	-0.1	738.97	-0.13	739.64	0.54	739.65	0.55
5.871	739.87	739.83	-0.04	739.82	-0.05	739.27	-0.6	739.28	-0.59

Table continued on next page.

Table D.2 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
W. Morgan Avenue									
5.889	742.05	742.03	-0.02	742.02	-0.03	741.25	-0.8	741.26	-0.79
5.899	742.3	742.28	-0.02	742.27	-0.03	742.29	-0.01	742.01	-0.29
5.962	742.46	742.44	-0.02	742.43	-0.03	742.56	0.1	742.2	-0.26
6.033	743.26	743.25	-0.01	743.24	-0.02	743.4	0.14	743.13	-0.13
6.083	743.73	743.72	-0.01	743.72	-0.01	744.4	0.67	743.64	-0.09
6.096	743.77	743.76	-0.01	743.76	-0.01	744.05	0.28	743.7	-0.07
S. 68th Street									
6.119	746.17	746.16	-0.01	746.16	-0.01	746.16	-0.01	746.16	-0.01
6.13	746.97	746.97	0	746.96	-0.01	747.18	0.21	746.97	0
6.224	747.43	747.43	0	747.42	-0.01	747.48	0.05	747.43	0
6.318	748.13	748.13	0	748.13	0	747.93	-0.2	748.13	0
6.389	748.77	748.77	0	748.77	0	748.37	-0.4	748.77	0
6.432	749.3	749.3	0	749.3	0	748.76	-0.54	749.3	0
6.46	749.41	749.41	0	749.41	0	748.91	-0.5	749.41	0
6.472	749.3	749.3	0	749.3	0	748.59	-0.71	749.3	0
6.4722	749.09	749.09	0	749.09	0	748.44	-0.65	749.09	0
W. Howard Avenue/W. Forest Home Avenue									
6.502	749.49	749.48	-0.01	749.48	-0.01	748.83	-0.66	749.48	-0.01
6.503	750.03	750.03	0	750.03	0	749.2	-0.83	750.03	0
6.524	750.06	750.06	0	750.06	0	749.24	-0.82	750.06	0
6.5242	750.06	750.06	0	750.06	0	749.24	-0.82	750.06	0
6.534	750.62	750.62	0	750.62	0	750.09	-0.53	750.62	0
6.609	750.98	750.98	0	750.98	0	750.4	-0.58	750.98	0
6.703	751.46	751.46	0	751.46	0	750.83	-0.63	751.46	0
6.82	752.18	752.18	0	752.18	0	751.08	-1.1	752.18	0
6.892	752.48	752.48	0	752.48	0	751.17	-1.31	752.48	0
6.903	752.5	752.5	0	752.5	0	750.98	-1.52	752.5	0
6.9034	752.48	752.48	0	752.48	0	750.95	-1.53	752.48	0
6.907	752.51	752.5	-0.01	752.5	-0.01	751.21	-1.3	752.5	-0.01
6.912	752.23	752.23	0	752.23	0	750.87	-1.36	752.23	0
6.9121	751.81	751.81	0	751.81	0	750.61	-1.2	751.81	0
6.918	750.97	750.97	0	750.97	0	749.78	-1.19	750.97	0

Table continued on next page.

Table D.2 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
S. 60th Street									
6.972	752.98	752.98	0	752.98	0	751.76	-1.22	752.98	0
7.01	754.39	754.39	0	754.39	0	753.15	-1.24	754.39	0
7.012	755.2	755.2	0	755.2	0	753.95	-1.25	755.2	0
7.0121	756.69	756.69	0	756.69	0	755.23	-1.46	756.69	0
7.017	757.17	757.17	0	757.17	0	756.31	-0.86	757.17	0
7.028	757.4	757.4	0	757.4	0	756.38	-1.02	757.4	0
7.101	--	--	--	--	--	756.46	--	--	--
7.117	757.52	757.52	0	757.52	0	756.43	-1.09	757.52	0
7.125	757.56	757.56	0	757.56	0	756.4	-1.16	757.56	0
W. Cold Spring Road									
7.15	758.84	758.84	0	758.84	0	758.02	-0.82	758.84	0
7.158	758.86	758.86	0	758.86	0	758.18	-0.68	758.86	0
7.162	758.89	758.89	0	758.89	0	758.18	-0.71	758.89	0
7.239	758.98	758.98	0	758.98	0	758.27	-0.71	758.98	0
7.348	759.12	759.12	0	759.12	0	758.41	-0.71	759.12	0
7.427	759.25	759.25	0	759.25	0	758.52	-0.73	759.25	0
7.43	759.25	759.25	0	759.25	0	758.52	-0.73	759.25	0
7.438	759.22	759.22	0	759.22	0	758.52	-0.7	759.22	0
7.442	759.2	759.2	0	759.2	0	758.5	-0.7	759.2	0
7.449	759.2	759.2	0	759.2	0	758.43	-0.77	759.2	0
7.453	759.22	759.22	0	759.22	0	758.48	-0.74	759.22	0
I-43/I-894									
7.495	759.9	759.9	0	759.9	0	759.18	-0.72	759.95	0.05
7.498	760.03	760.03	0	760.03	0	759.33	-0.7	760.08	0.05
7.506	760.1	760.1	0	760.1	0	759.41	-0.69	760.15	0.05
7.521	760.11	760.11	0	760.11	0	759.42	-0.69	760.16	0.05
7.559	760.16	760.16	0	760.16	0	759.48	-0.68	760.21	0.05
7.627	760.21	760.21	0	760.21	0	759.55	-0.66	760.26	0.05
7.669	760.27	760.27	0	760.27	0	759.62	-0.65	760.31	0.04
7.673	760.2	760.2	0	760.2	0	759.52	-0.68	760.24	0.04
W. Layton Avenue									
7.707	760.29	760.27	-0.02	760.26	-0.03	759.77	-0.52	760.32	0.03
7.711	760.46	760.45	-0.01	760.44	-0.02	760.01	-0.45	760.49	0.03

Table continued on next page.

Table D.2 (Continued)

River Station	Existing Conditions	Alternative Plan No. 3		Alternative Plan No. 4		Alternative Plan No. 5		Alternative Plan No. 6	
	W.S. Elev (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)	W.S. Elev (ft)	Difference (ft)
W. Layton Avenue (Continued)									
7.7113	760.46	760.44	-0.02	760.44	-0.02	760	-0.46	760.49	0.03
7.718	760.44	760.43	-0.01	760.42	-0.02	759.98	-0.46	760.47	0.03
7.725	760.47	760.45	-0.02	760.45	-0.02	760.01	-0.46	760.5	0.03
7.792	761.01	761	-0.01	761	-0.01	760.69	-0.32	761.03	0.02
7.886	761.53	761.52	-0.01	761.52	-0.01	761.31	-0.22	761.54	0.01
7.946	761.62	761.62	0	761.62	0	761.43	-0.19	761.64	0.02
7.951	761.64	761.63	-0.01	761.63	-0.01	761.45	-0.19	761.65	0.01
Park Maintenance Access									
7.957	761.64	761.65	0.01	761.65	0.01	761.46	-0.18	761.66	0.02
7.975	761.65	761.65	0	761.65	0	761.47	-0.18	761.66	0.01
8.02	761.68	761.68	0	761.68	0	761.5	-0.18	761.69	0.01
Konkel Park Pedestrian Bridge									
8.023	761.68	761.68	0	761.68	0	761.51	-0.17	761.69	0.01
8.04	761.69	761.69	0	761.69	0	761.52	-0.17	761.7	0.01
8.091	761.7	761.7	0	761.7	0	761.53	-0.17	761.71	0.01
8.153	761.87	761.87	0	761.87	0	761.72	-0.15	761.88	0.01
8.276	762.02	762.02	0	762.02	0	761.88	-0.14	762.03	0.01
8.349	763.19	763.19	0	763.19	0	763.17	-0.02	763.2	0.01
8.358	763.09	763.09	0	763.09	0	763.07	-0.02	763.09	0
W. Loomis Road									
8.385	764.45	764.45	0	764.45	0	764.45	0	764.45	0
8.388	764.98	764.97	-0.01	764.97	-0.01	764.97	-0.01	764.98	0
8.429	765.03	765.03	0	765.03	0	765.03	0	765.03	0
8.527	765.39	765.39	0	765.39	0	765.39	0	765.39	0
8.625	765.55	765.55	0	765.55	0	765.55	0	765.55	0
8.666	765.56	765.56	0	765.56	0	765.56	0	765.56	0
S. 43rd Street									