

Appendix E. Flood Minimization Study Summary



I-39/90/94 Corridor Study

Technical Memorandum

Flood Minimization Study

June 2024

Rev. November 2024

Wisconsin Department of Transportation

CONTENTS

1. Introduction	1
2. Flood Minimization Study	3
3. Flood Minimization Options	3
4. Flood Minimization Option Impacts	13
5. Flood Minimization Study Coordination	16
6. Evaluation	17

TABLES

Table 3-1: Flood Minimization Options Summary	5
Table 3-2: Flood Minimization Options Summary	11
Table 4-1: Land Use Type Experiencing Increase in 100-Year Flood Elevation (1D Model)	13
Table 4-2: Land Use Type Experiencing Increase in 100-Year Flood Elevation (2D Model)	13
Table 4-3: Land Use Type Experiencing Decrease in 100-Year Flood Elevation (2D Model)	14
Table 4-4: Insurable Structures Experiencing a Change in 100-Year Flood Elevation	14
Table 5-1: Summary of Flood Minimization Coordination	17

FIGURES

Figure 1-1: FEMA Regulatory Flood Mapping for Columbia and Sauk Counties	2
Figure 2-1: Existing Caledonia Levee	3
Figure 3-1: 100-Year Water Surface Elevation, 2D Model Output – Option A vs Existing	7
Figure 3-2: 100-Year Water Surface Elevation, 2D Model Output - Option C2 vs Existing	8
Figure 3-3: 100-Year Water Surface Elevation, 2D Model Output – Option C3 vs Existing	9
Figure 3-4: 100-Year Water Surface Elevation, 2D Model Output – Option C4 vs Existing	10
Figure 3-5: 100-Year Water Surface Elevation, 1D Model Output – C2, C3 and C4 vs Existing	12

1. Introduction

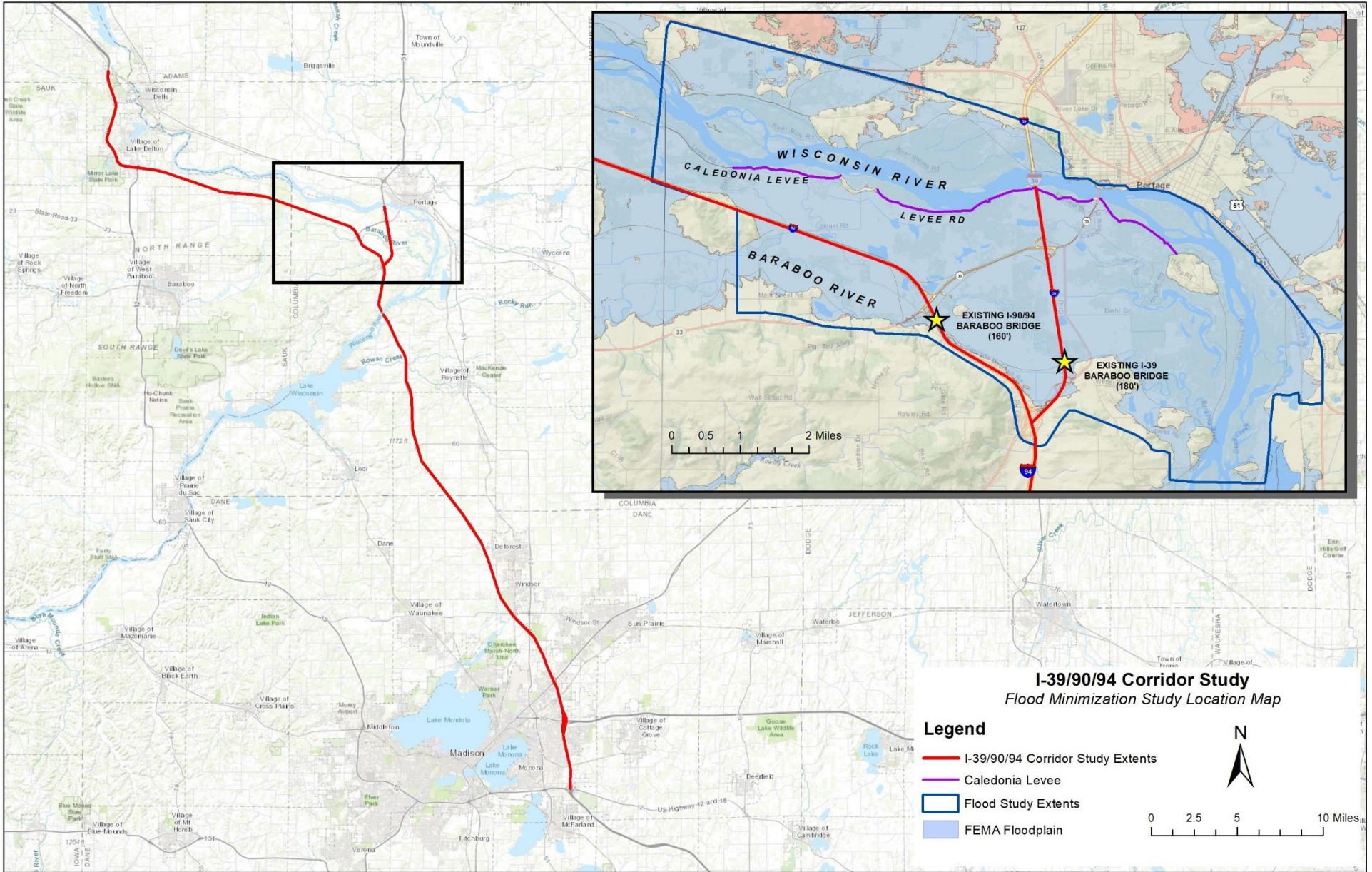
Both I-39 and I-90/94, as well as WIS 33 are within the floodplains of both the Wisconsin and Baraboo rivers, which meet about 2.5 miles east of the I-39 I-90/94 Split Interchange. Flooding of the Baraboo River has caused extensive damage and road closures. In 2008 and 2018 flooding overtopped and closed I-39 and I-90/94 in Columbia County for several days. The flooding experienced in June 2008 was caused by the Baraboo River, which experienced greater than a 500-year storm. The Wisconsin River experienced less than a 2-year event at the time. The 2018 flooding event was driven by the Wisconsin River which experienced between a 10- and 50-year storm. The Baraboo River experienced a smaller (less than 5-year) storm. For context, a 100-year flood, statistically speaking, has a 1 percent chance of occurring, but that is simply a probability. In actuality, a 100-year flood could happen twice in the same year or not happen for 200 years. Similarly, a 2-year, 10-year, and a 500-year flood have a 50, 10, and 0.2 percent of chance of occurring annually, respectively.

Hundreds of thousands of vehicles had to detour several hours out of their way due to the 2008 and 2018 events. This led WisDOT to include flood minimization as an element of the project's Purpose and Need. As the Baraboo River nears its confluence with the Wisconsin River, the two rivers share a wide floodplain. I-39, I-90/94 and WIS 33 cross this shared floodplain and are vulnerable to flooding from both rivers. While the June 2008 flooding was the result of the Baraboo River, the much larger Wisconsin River has the potential to flood substantial portions of the floodplain and overtop I-39, I-90/94 and WIS 33. Figure 1-1 shows the FEMA Special Flood Hazard Areas around the study corridor.

Wisconsin River flooding led to construction of about 14 miles of levee on the north and south side of the Wisconsin River in and upstream of Portage. Known as the Caledonia-Lewiston Levee System, the levees were built by local landowners in the late 1800's without any engineering design and were not built to a design standard. WDNR was not involved in building the levees but now has responsibility for them. A report on the levees by WDNR notes that they have survived for over 100 years, due in part to the effort of local governments and the lack of a major flood to stress the levee system.¹

¹ Levee Working Group. Preliminary Caledonia-Lewiston Levee Analysis. Undated.
<https://www.co.columbia.wi.us/columbiacounty/Portals/17/LEVEE/Levee%20Report%20-FINAL.pdf?ver=2014-11-26-120211-610>. Accessed January 11, 2024.

Technical Memo: Flood Minimization Study
Figure 1-1: FEMA Regulatory Flood Mapping for Columbia and Sauk Counties



Source: Flood Insurance Study, Columbia County, Wisconsin and Incorporated Areas, revised publication 05/16/2016. Accessed through FEMA's National Flood Hazard Layer Viewer, June 2023.

2. Flood Minimization Study

WisDOT prepared a resiliency study that identified flood minimization strategies in the Baraboo River and Wisconsin River area. A key assumption of WisDOT's flood minimization strategy is that the Caledonia levee, on the south side of the Wisconsin River, is not included in the various flood modeling analyses WisDOT conducted, see Figure 2-1. While there are no plans to remove the Caledonia levee, it is over 100 years old and, as noted above, has never been tested by a major flood. WisDOT determined it is more prudent to not include the levee in its flood models than to assume the 100+ year-old levee remains in place and functions effectively during a 100-year flood. This is the same assumption made by FEMA for the development of the regulatory 100-year floodplain as part of the National Flood Insurance Program (NFIP). Figure 1-1 shows the Flood Insurance Study (FIS) 100-year floodplain for Columbia and Sauk counties in the vicinity of this flood minimization study.

Figure 2-1: Existing Caledonia Levee



Source: WisDOT. (Looking east; Levee Road on right, Wisconsin River on left)

3. Flood Minimization Options

WisDOT evaluated the costs and benefits of several options to minimize flooding. All of the options include raising 3.5 miles of I-90/94 approximately 3 feet and about 2.9 miles of I-39 approximately 3 to 4 feet to prevent overtopping. The options vary in their approach to preventing overtopping and conveying

flood waters past I-39. At present, during the 100-year flood event, water backs up behind and eventually overtops I-39. Raising I-39 above the base flood elevation without providing additional bridges or culverts on I-39 would cause as much as 2 feet of upstream water surface rise relative to the existing 100-year flood event conditions. This would also stress the two existing bridges, Wisconsin and Baraboo River bridges, on I-39 with increased velocity and potential for additional scour. Two approaches were examined for an alternate solution. First, I-39 could be raised on a causeway with a series of long bridges to keep it above flood waters while allowing flood water to pass beneath (Option A). This allows for free passage of flood flows and no rise in the base flood elevation but opens downstream residents and businesses to more persistent flooding. The second approach is to build shorter bridges on I-39 at select locations to consolidate floodwater under and away from the freeway (Option C).² The C options would cause a small impact both upstream and downstream of I-39. However, the total impact would be less than raising the Interstate without adding additional bridge conveyance (causing as much as 2 feet of upstream water surface rise) or providing free passage of floodwater (increasing the flood risk to roughly 25 downstream residents).

WisDOT used two models to analyze flood minimization options. The 1-dimensional FEMA regulatory floodplain model (HEC-RAS v4.3) developed for the NFIP, and a 2-dimensional (2D) unsteady (or dynamic) hydrodynamic modeling (SRH2D)³ internally developed by WisDOT. The 2D model routes a dynamic hydrograph through the model domain, meaning it can observe downstream impacts. The 1D regulatory model is steady state, meaning no effect of storage or attenuation is captured. Steady state hydrology is the standard approach for FEMA floodplain inundation mapping. Any change to the 1D regulatory model floodplain elevations requires a conditional letter of map revision, including a mitigation plan for all insurable structures with a flood elevation rise greater than 0.005 feet. The 2D unsteady hydrodynamic model, which provides more detailed hydraulic outputs (water depth and velocity to the grid cell scale) is the primary tool used to evaluate flood minimization options and assess impacts to properties.

Table 3-1 summarizes the various options WisDOT analyzed to provide flood minimization in the study area. Detailed descriptions of each option that was pursued further are provided below.

² WisDOT also considered an Option B to either recertify the Caledonia levee as a flood protection facility or raise WIS 33 to function in a similar manner. This was dismissed due to concerns over long term maintenance, risk, liability and cost.

³ Bureau of Reclamation. SRH-2D (Sediment and River Hydraulics). <https://www.usbr.gov/tsc/techreferences/computer%20software/models/srh2d/index.html> . Accessed January 30, 2024.

Table 3-1: Flood Minimization Options Summary

Option	Mitigation Measure on I-90/94 ^a	Mitigation Measure on I-39 ^a		I-39 Bridges	
		North of WIS 33 Interchange	South of WIS 33 Interchange	New Bridge(s) in Floodplain (number x length)	Widen Existing Baraboo River Bridge
A	+2.6 feet for 3.5 miles	+3.7 feet for 0.7 miles	+1.6 feet for 2.3 miles	3 x 2,000 feet	-
B (dismissed-see note)	+3.8 feet for 3.5 miles	+3.7 feet for 0.7 miles	-	-	-
C1 (dismissed-see note)	+2.8 feet for 3.5 miles	+4.1 feet for 0.7 miles	+3.2 feet for 3.2 miles	4 x 360 feet	-
C2	+2.9 feet for 3.5 miles	+4.1 feet for 0.7 miles	+3.8 feet for 3.2 miles	1 x 250 feet	1 x 250 feet
C3	+2.9 feet for 3.5 miles	+4.1 feet for 0.7 miles	+3.2 feet for 3.2 miles	1 x 250 feet	1 x 250 feet
C4	+2.9 feet for 3.5 miles	+4.3 feet for 0.7 miles	+3.9 feet for 3.2 miles	-	1 x 500 feet

NOTE: Option B included either recertifying the Caledonia levee as a flood protection facility or raising WIS 33 to function in a similar manner. This was dismissed due to concerns over long term maintenance, risk, liability and cost. Option C1 considered adding four 360-foot bridge structures, in similar locations as Option A. C1 had similar downstream impacts as Option A and was more expensive than C2. It was therefore superseded by Options C2 through C4.

a. Road raise heights are average values taken across the length of the road to be improved. Individual sections may be higher or lower. All road raise heights are based on the criteria that the 100-year water surface elevation does not exceed the base shoulder point of the proposed road section.

In Option A, WisDOT would raise I-39 and build three long bridges on I-39 between Cascade Mountain Road and the Wisconsin River to minimize the risk of flood water overtopping I-39. Approximately 3 miles of I-39 would be raised between 1.6 to 3.7 feet between the I-39 I-90/94 Split Interchange to the south and the north project limit at Levee Road. By building roughly 6,000 feet of bridge the overtopping of I-39 could be avoided during a 100-year flood, with no net rise in upstream flood elevation per the 1D regulatory floodplain model. Results of the 2D hydrodynamic model indicate a decrease in water elevation during the 100-year flood between I-90/94 and I-39, including the USFWS Baraboo River Waterfowl Production Area, Figure 3-1. Results of the 2D model also indicate increased flood elevations immediately downstream (east) of I-39. Additional investigation of the 2- and 10-year flood events also indicate increased flood elevations downstream of I-39. There are 23 residences and 7 businesses included in the impact area (Table 4-4). The bridges are also very expensive, roughly \$110 million dollars (Table 3-2).

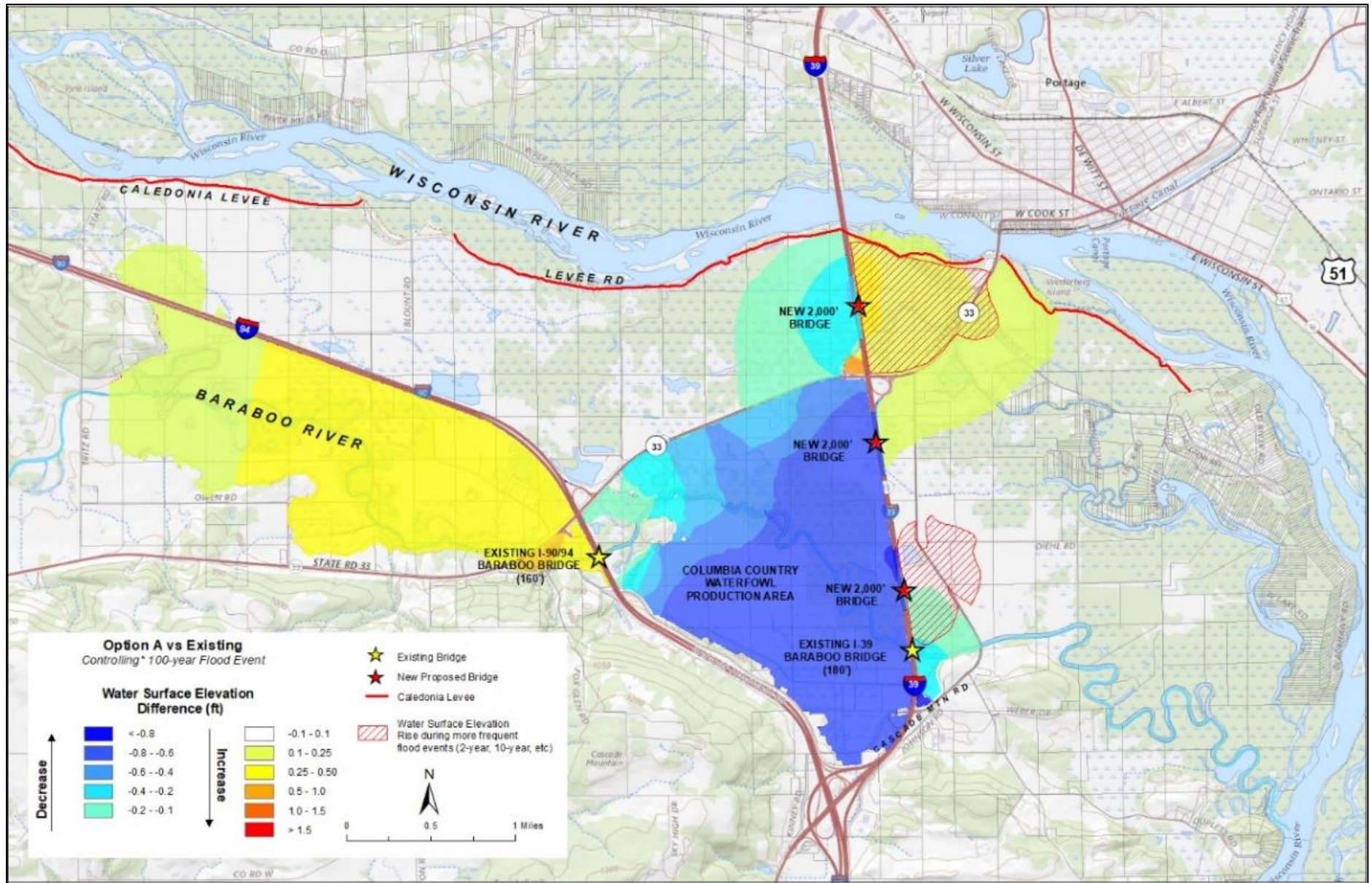
In Option C, WisDOT would build shorter and fewer new bridges on I-39 and raise I-39 such that some water surface rise upstream (west) is expected. Option C raises I-39 about 4 feet between the I-39 I-90/94 Split Interchange to the south and the north project limit at Levee Road, a length of approximately 2.9 miles. About 3.5 miles of I-90/94 would be raised 3 feet around the WIS 33 Interchange. The goal of

Option C is to balance upstream impacts with the risks to downstream properties, creating a solution that minimizes the overall flood impact of the Build alternatives. All C options would also reduce the risk of floodwater overtopping I-39 and I-90/94. The majority of affected property upstream of I-39 is owned by WDNR or USFWS and is used as a wildlife refuge. The remainder is privately owned farmland, undeveloped land and a few residences and businesses. As noted in Table 3-1, WisDOT dismissed option C1 and further developed Options C2, C3 and C4, which are discussed below.

Option C2 would lengthen the current I-39 Baraboo River bridge to 250 feet and build a second 250-foot bridge roughly 2,000 feet north of the current Baraboo River bridge. Option C3 is similar, however the new bridge would be on I-39 north of the WIS 33 interchange. Option C4 would lengthen the current I-39 Baraboo River crossing to 500 feet without adding any additional bridges. For Options C2-4 the existing Baraboo River bridges on both I-39 and I-90/94 would be raised proportionally to the surrounding road profile in order to accommodate appropriate freeboard and deck thickness.

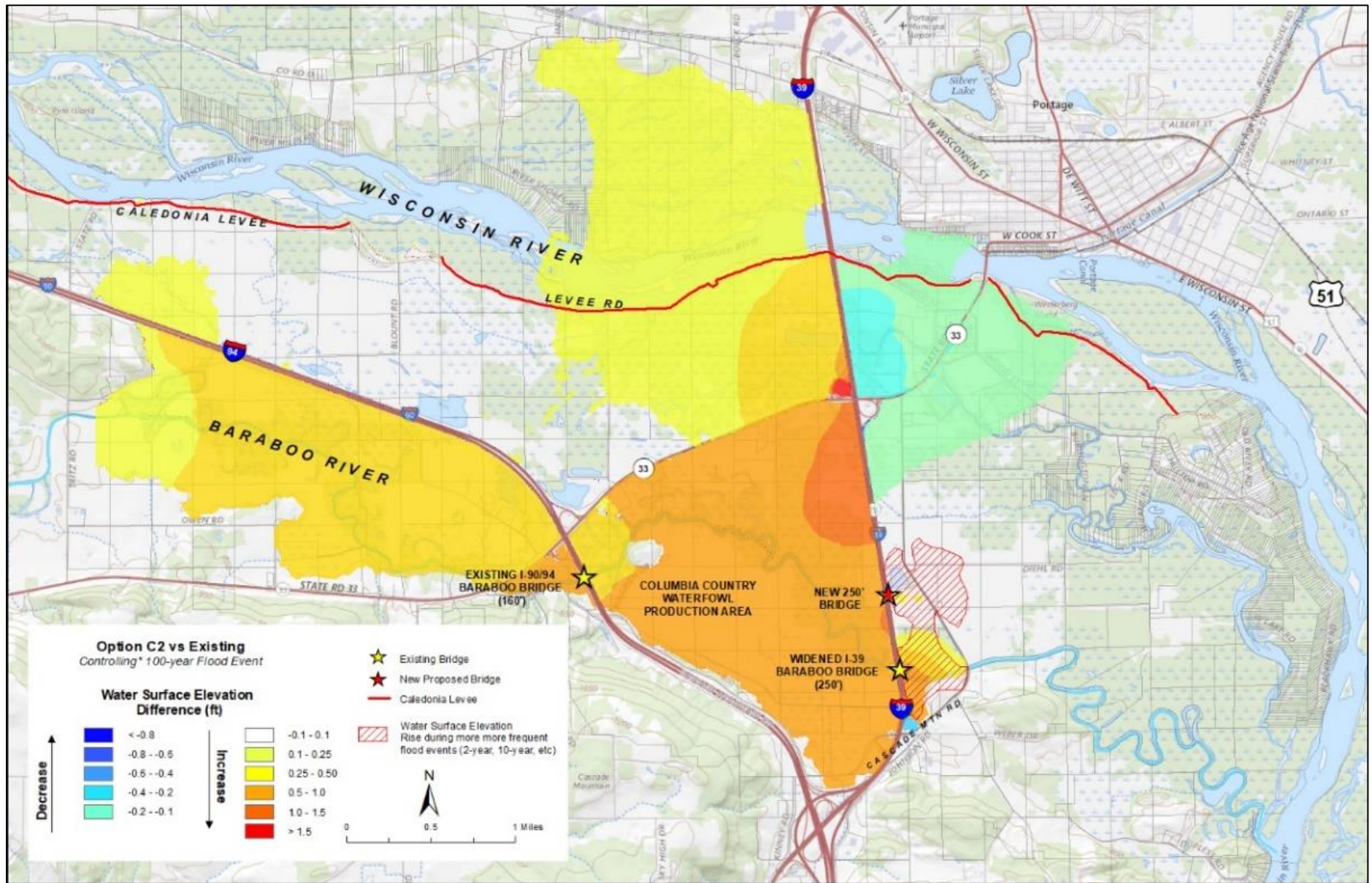
Lengthening the Baraboo River bridge has multiple benefits, the current 174-foot bridge was constructed in 1962 and spans only the active Baraboo River channel. A longer bridge spanning part of the floodplain would allow for some of the natural, beneficial channel processes to remain and would reduce the risk of scour at the pier foundations and abutments. The geomorphic setting of the lower Baraboo River is a low gradient, single threaded meandering river. As such, the system is laterally active as sediment deposits on the inside of bends and erodes the outside bend. When the channel banks are fixed by the I-39 embankment and the natural migration process arrested, the river responds by scouring the channel bed, as has been observed in routine bridge inspections. Debris racking up against the piers, abutments and bridge deck is also a significant concern to WisDOT and FHWA. Debris racking limits the capacity of the bridge opening to convey floodwater and drives scouring at the bridge, which causes structural damage. A longer bridge that allows for some of these natural processes to occur is in the best interest of the health of the river system and the long-term structural integrity of the bridge. There are currently two piers in the channel. A longer bridge structure that doesn't have piers in the active channel would allow for floating debris to pass under the bridge and reduce accumulation. The consequences of these options would vary depending on the nature and magnitude of flooding. Figure 3-2, Figure 3-3 and Figure 3-4 show the 100-year flood water surface rise of Options C2, C3 and C4 compared to current 100-year flood levels, based on 2D model outputs.

Figure 3-1: 100-Year Water Surface Elevation, 2D Model Output – Option A vs Existing



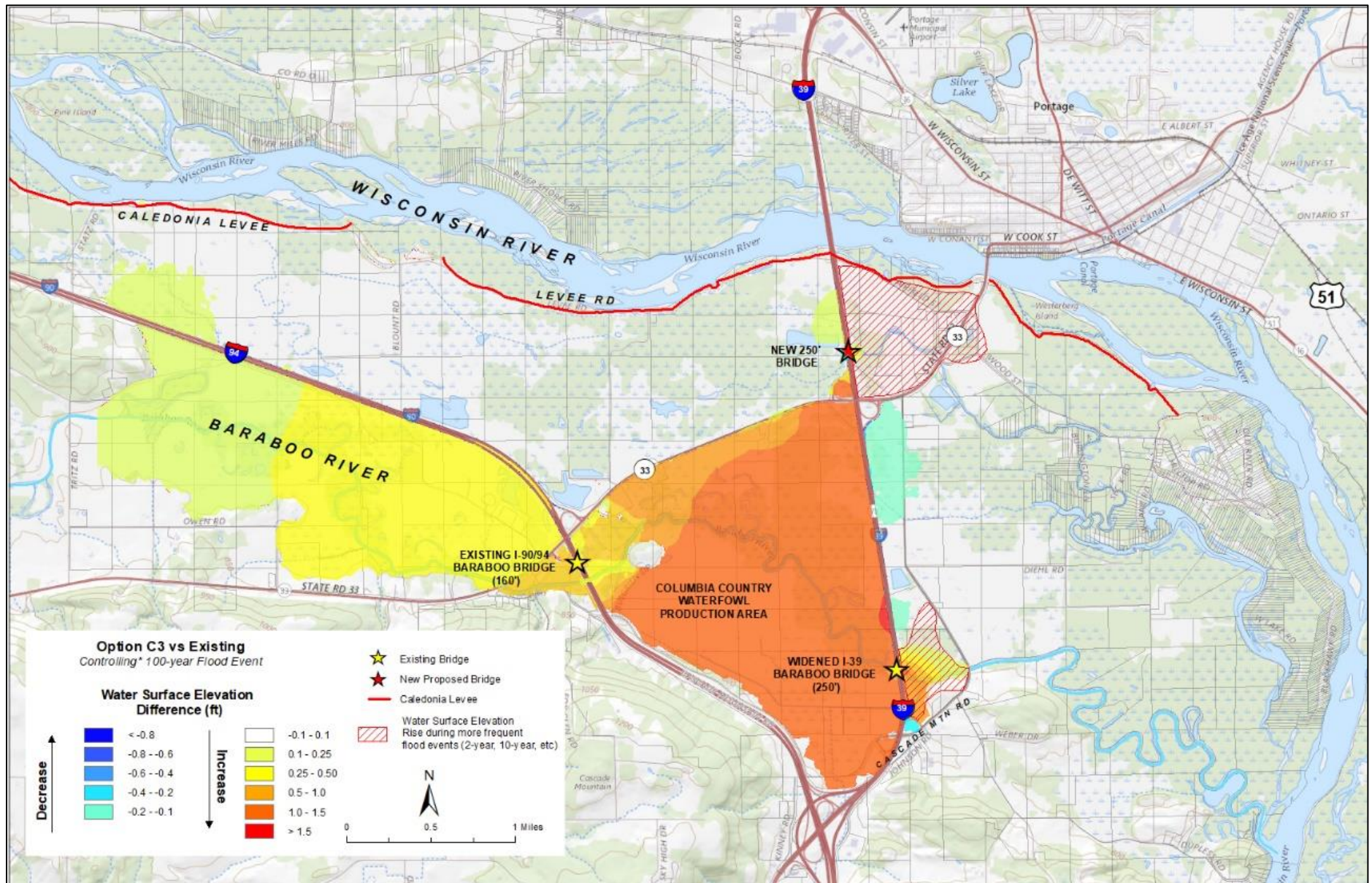
Source: WisDOT

Figure 3-2: 100-Year Water Surface Elevation, 2D Model Output - Option C2 vs Existing



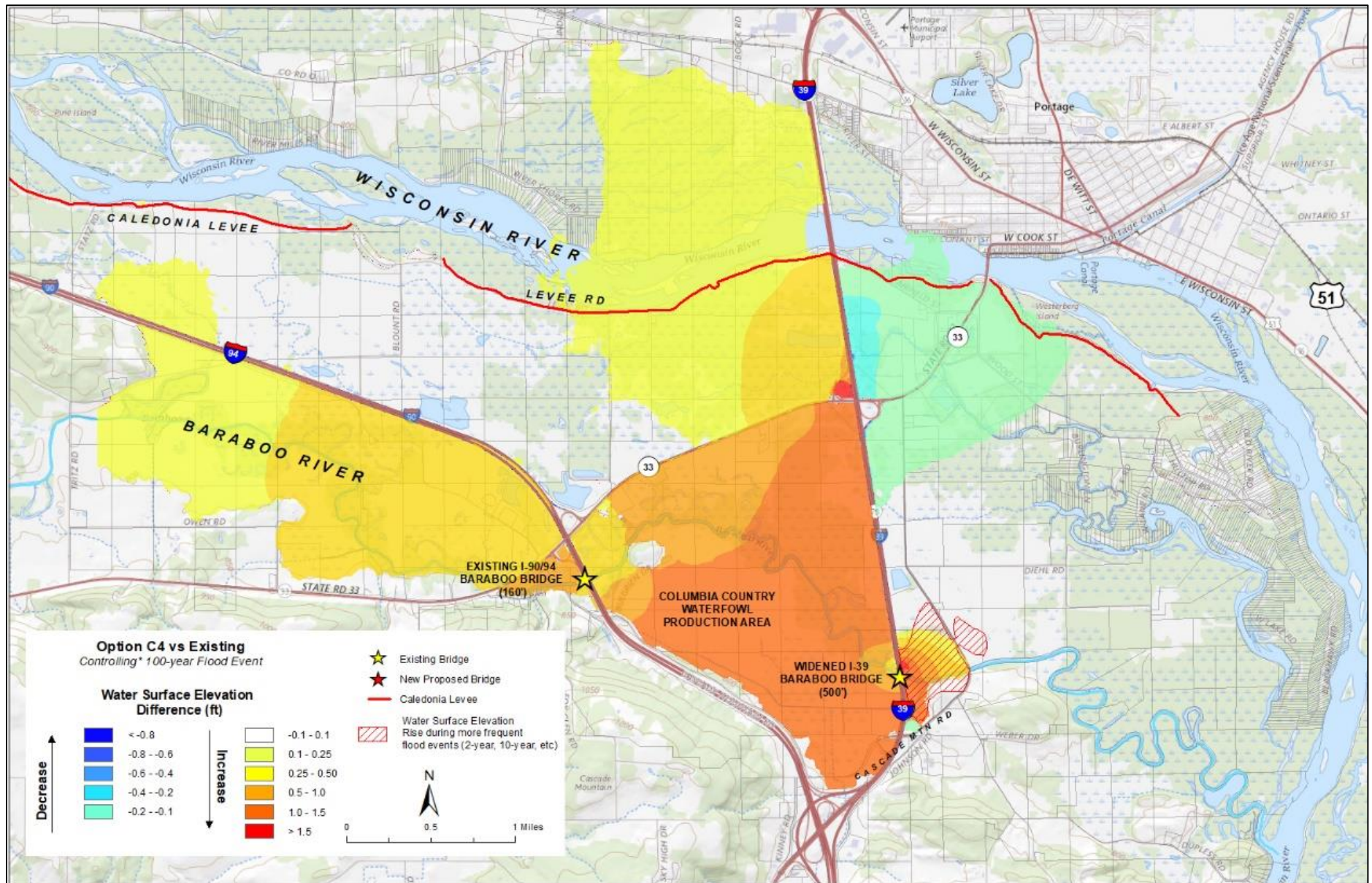
Source: WisDOT

Figure 3-3: 100-Year Water Surface Elevation, 2D Model Output – Option C3 vs Existing



Source: WisDOT

Figure 3-4: 100-Year Water Surface Elevation, 2D Model Output – Option C4 vs Existing



Source: WisDOT

Option C2 would raise the flood elevation to areas west of I-39 that are largely within the Baraboo River Waterfowl Production Area and the Pine Island State Wildlife Area. While coordination is on-going, impacts from relatively small surface water elevation increases are not expected to negatively affect either property. Flood elevation increases would be anywhere from a few inches up to 1 foot during a 100-year flood. Impacts also reach to the north of the Wisconsin River and south of I-90/94. Additionally, some properties would experience flooding at lower frequency flow events, which they do not currently experience.

Under Option C3, the impacts upstream of I-39 are less substantial, with a maximum upstream rise of up to 1 foot and no water surface increase to the north of the Wisconsin River. However, the northern proposed bridge would increase flood elevations downstream of I-39 along WIS 33. Additionally, those properties would experience flooding at lower frequency flow events, which they do not currently experience.

Under Option C4, the flood minimization measures would be limited to lengthening the bridge at the Baraboo River crossing. The extent of the increases and decreases in surface water elevation would be very similar to Option C2. The 100-year flood increase would be up to 1.5 feet, occurring mostly on WDNR- and USFWS-owned land upstream of I-39 and creates little downstream flood elevation increase. The increase that is created downstream of I-39 is limited to the Baraboo River floodplain and avoids private residences. This is true for both the 100-year event and more frequent flood events. WisDOT recommends implementing Option C4 as part of the build alternatives for the I-39/90/94 Corridor Study. Option C4 and C3 have nearly identical benefit cost analysis (BCA) ratios, 2.27 and 2.28, respectively. Option C3 increases the flood elevation to at least 24 properties east of I-39 during more frequent storms, such as the 10- and 25-year events on the Wisconsin River, this is not reflected in the BCA. Additionally, Option C4 reduces the flood elevation at 24 properties compared to C3, another benefit not reflected in the BCA. A 500-foot bridge span also allows for more of the geomorphic and ecological benefits previously described by reconnecting a portion of the floodplain to the main channel through the bridge structure. Table 3-2 summarizes the flood minimization options WisDOT considered.

Table 3-2: Flood Minimization Options Summary

Option	Mitigation Measure on I-39	Regulatory Water Surface Elevation Rise (1D model)	Downstream Water Surface Elevation Rise (2D model)	Preliminary Cost Estimate (millions) ^a	Benefit Cost Analysis
A	Multiple large bridges	No	Yes, primarily residences on County Rd U and on WIS 33 east of I-39.	110.5	0.58
C2	Widen Baraboo River bridge and one floodplain bridge between Baraboo River and WIS 33 interchange	Yes	Yes, primarily residences on County U	31.0	2.19
C3	Widen Baraboo River bridge and one floodplain bridge north of WIS 33 interchange	Yes	Yes, primarily residences on WIS 33 and east of I-39	28.8	2.28

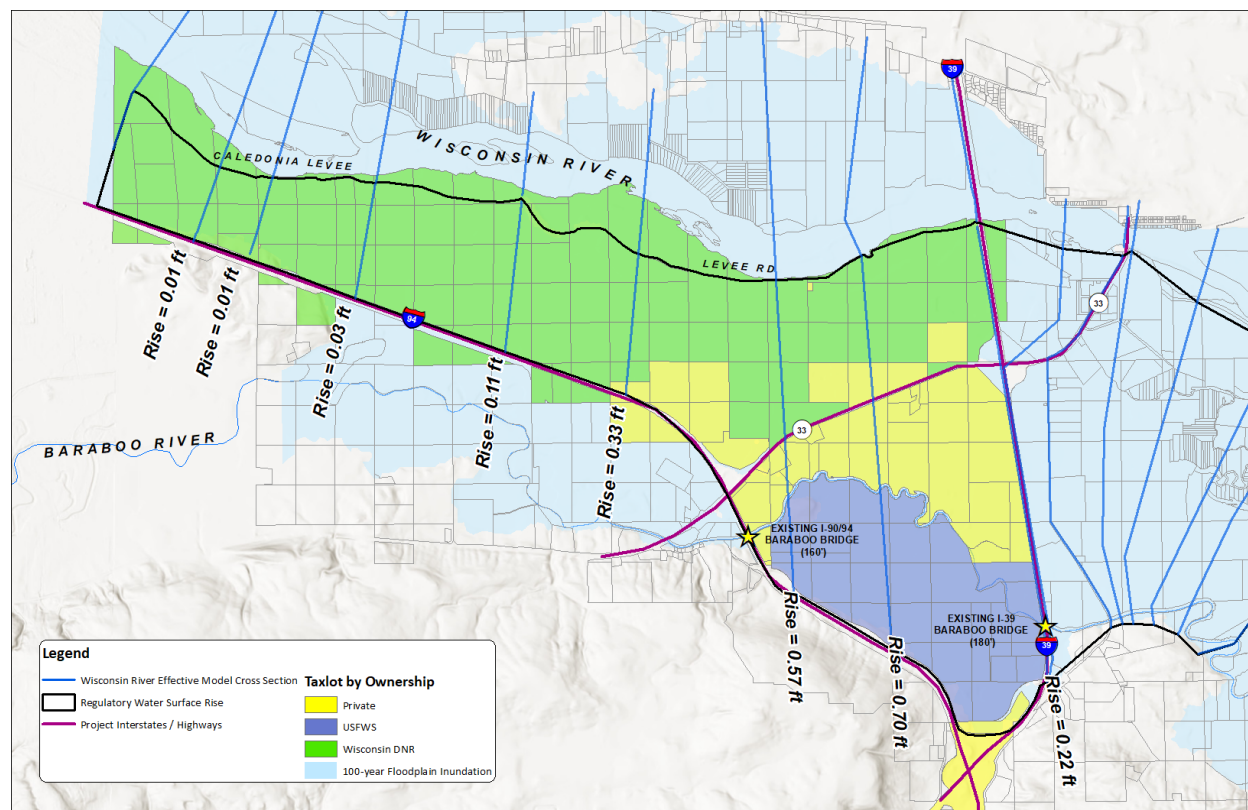
Option	Mitigation Measure on I-39	Regulatory Water Surface Elevation Rise (1D model)	Downstream Water Surface Elevation Rise (2D model)	Preliminary Cost Estimate (millions) ^a	Benefit Cost Analysis
C4 (see note)	Widen Baraboo River bridge	Yes	Yes, localized to historic Baraboo River floodplain. No properties at risk east of I-39	29.0	2.27

NOTE: Highlighted row is the recommended option to implement with Build alternatives. A Benefit Cost Analysis determines the future risk reduction benefits of a project and compares those benefits to its costs. A project is considered cost-effective when the ratio is 1.0 or greater.

a. Preliminary cost estimate includes cost of earthwork and bridge replacements. It also includes \$2.9 million in property acquisition costs for each of the C options.

The 1-dimensional (1D) model results are fundamentally different from the 2D model outputs presented above. The 1D outputs occur at channel averaged locations across the model domain, shown as blue lines in Figure 3-5. The cross-sectional averaging means there is no differentiation in the location of the bridge structure, only the total flow area available to convey water to the next downstream cross section. As a result, Options C2, C3 and C4 have the same area of impact from the 1D model perspective, shown as the black outline area in Figure 3-5 and the rise value called out below the cross section.

Figure 3-5: 100-Year Water Surface Elevation, 1D Model Output – C2, C3 and C4 vs Existing



Source: WisDOT

4. Flood Minimization Option Impacts

Based on the 2D hydraulic model, the primary impact of the flood minimization options WisDOT considered is that flood elevations would change by a few inches in some locations to over 1.0 feet in one location. This would occur east and west of I-39 between the I-39 and I-90/94 Split interchange and the Wisconsin River, about 3 miles north of the split interchange. The 1D regulatory floodplain model impacts range from 0.01 to 0.70 feet. The impacts presented here are worst case. As noted previously, WisDOT's models assume the Caledonia Levee is not in place. Also, some areas would see increased flood elevations in a 100-year flood compared to today, but those same areas would see a lower flood elevation in a 10-year flood or a 2-year flood. Those floods, statistically, are more likely to occur than a 100-year flood.

Changing the flood elevation would not affect any properties or resources until there is a flood. In most locations the flood elevation change would only occur during a 100-year flood. The duration of impact is likely to persist only for a portion of the total flood duration, days to weeks depending on the nature of the flood event. Table 4-1 summarizes the different type of land that would see an increase in the 100-year flood elevation in the 1D model.

Table 4-2 and Table 4-3 summarize the different type of land that would see an increase or decrease in the 100-year flood elevation in the 2D Model, respectively. All the impacted area in the 1D (Table 4-1) or 2D model scenarios (Table 4-2 and Table 4-3) area are already in the Wisconsin River and Baraboo River floodplain. The additional area inundated as a result of the project is less than 1% of the pre-project inundated area.

Table 4-1: Land Use Type Experiencing Increase in 100-Year Flood Elevation (1D Model)

Option	Other Land Uses (acres)	Ag. Land (acres)	WDNR Pine Island State Wildlife Area (acres)	USFWS Baraboo Waterfowl Production Area (acres)
A	0	0	0	0
C2, C3, C4	966	230	2,666	866

Table 4-2: Land Use Type Experiencing Increase in 100-Year Flood Elevation (2D Model)

Option	Other Land Uses (acres)	Agricultural Land (acres)	WDNR Pine Island State Wildlife Area (acres)	USFWS Baraboo Waterfowl Production Area (acres)
A	1,570	370	475	0
C2	4,210	435	1260	820
C3	1,450	435	550	820
C4	4,210	435	1200	820

Table 4-3: Land Use Type Experiencing Decrease in 100-Year Flood Elevation (2D Model)

Option	Other Land Uses (acres)	Agricultural Land (acres)	WDNR Pine Island State Wildlife Area (acres)	USFWS Baraboo Waterfowl Production Area (acres)
A	745	190	320	800
C2	640	130	0	0
C3	120	0	0	0
C4	640	130	0	0

Land Use. The area affected by the changes in 100-year flood elevations includes WDNR and USFWS wildlife refuge land as well as private agricultural, business and residential land uses. Changes in the flood elevation would not directly change any land use.

Residences and Businesses. All insurable structures, including residential and business structures, that are impacted under the 1D regulatory model would need to either be relocated or floodproofed, for example raising structures. Up to one residence and two businesses in the 1D regulatory model would experience a higher flood elevation during a 100-year flood under each option.

Table 4-4 summarizes insurable structures, including residences and businesses, that would experience an increase or decrease in the 100-year flood elevation under both the 1D and 2D models. Insurable structures that experience an increase in flood elevation under the 2D non-regulatory model would not need to be relocated unless they also experience an increase with the 1D regulatory model.

Determination of insurable structures impacted in each alternative was determined using aerial photos to identify all structures within FEMA's regulatory floodplain boundary, in the case of the 1D regulatory model. Structures impacted in the 2D non-regulatory model were determined based on the 100-year flood inundation extent produced by that model. All insurable structures in the mapped regulatory floodplain which experience an increase in base flood elevation are already within the 100-year floodplain and will require flood mitigation either through acquisition, floodproofing or purchase of flood easements.

Table 4-4: Insurable Structures Experiencing a Change in 100-Year Flood Elevation

Option	Insurable Structures with Increased Flood Elevation Regulatory (1D Model)	Insurable Structures with Increased Flood Elevation Non-Regulatory (2D Model)	Insurable Structures with Reduced Flood Elevation Regulatory (1D model)	Insurable Structures with Reduced Flood Elevation Non-Regulatory (2D model)
A	0	23 Residences 7 Businesses (incl. 2 vacant)	0	1 Residence 1 Business (vacant)

Option	Insurable Structures with Increased Flood Elevation Regulatory (1D Model)	Insurable Structures with Increased Flood Elevation Non-Regulatory (2D Model)	Insurable Structures with Reduced Flood Elevation Regulatory (1D model)	Insurable Structures with Reduced Flood Elevation Non-Regulatory (2D model)
C2	1 Residence 2 Businesses (incl. 1 vacant) 1 USFWS Maintenance/Storage Building 3 Buildings on WDNR Property 1 AT&T structure 1 cell tower/building	12 Residences 6 Businesses (incl. 2 vacant) 1 USFWS Maintenance/Storage Building 1 Building on WDNR Property 1 AT&T structure	0	26 Residences 3 Businesses
C3	1 Residence 2 Businesses (incl. 1 vacant) 1 USFWS Maintenance/Storage Building 3 Buildings on WDNR Property 1 AT&T structure 1 cell tower/building	6 Residences 6 Businesses (incl. 3 vacant) 1 USFWS Maintenance/Storage Building 1 AT&T structure	0	2 Residences
C4	1 Residence 2 Businesses (incl. 1 vacant) 2 USFWS Maintenance/Storage Buildings 3 Buildings on WDNR Property 1 AT&T structure 1 cell tower/building	9 Residences 6 Businesses (incl. 3 vacant) 1 USFWS Maintenance/Storage Building 1 Building on WDNR Property 1 AT&T structure	0	26 Residences 3 Businesses

Community Facilities. In the area near USFWS’s field office on Crystal Mountain Road, just north of I-90/94, Options C2, C3 and C4 would raise the 100-year flood limit boundary slightly. It would encroach onto one of USFWS’s two maintenance and storage garages and some parking. One to three buildings on WDNR property would also be impacted. No other community facilities would be affected by changes in 100-year flood elevation.

Agriculture. As noted in Table 4-2, several hundred acres of farmland would see an increase in the 100-year flood elevation based on the 2D model. Up to 130 acres would see a decrease in the flood elevation during floods based on the 2D models. The agricultural land is already prone to flooding because it is in

the floodplain. During normal conditions the flood minimization options would not affect farmland but during flood events the land may take longer to drain than it would today. This could affect planting or increase the crops lost to a flood.

Environmental Justice. Property owner interviews indicated no evidence of environmental justice populations living in the area affected by changing 100-year flood elevations.

Visual. The modest changes in flood elevation would not change views to/from the freeway.

Wetlands. Much of the floodplain adjacent to the Baraboo and Wisconsin Rivers are wetlands. Wetlands are inundated at least part of the time. Under normal conditions the flood minimization options would not affect wetlands. Floodwaters may increase in elevation by a few inches during flood events. This could change the types of plants that grow in the wetland or even change the wetland boundary, but not enough to change the wetland functionality. These wetlands are prone to flooding today and the project will not increase the frequency of flooding. It is not possible to predict to what extent wetland boundaries would change. No wetland would be filled by any of the flood minimization alternatives, although other aspects of the I-39/90/94 project would impact wetlands.

Threatened and Endangered Species. A state-listed plant species and the federally listed Eastern Massasauga rattlesnake are known to occur in this area. Flooding is a natural occurrence and the changes in flood elevation would not change the preferred habitat of these or other species. The flood minimization alternatives would not adversely affect any state-listed plant species because the majority of the state-listed plant species found within the flood study area are species frequently found in floodplains or in habitats that exhibit a prolonged seasonally high water and/or standing surface water. It is unlikely that an increase in flood levels within the study area would negatively impact established populations of state-listed plant species that currently exist within the floodplain in the study area.

Cultural Resources. A National Register-eligible archaeological site is in the area that would be affected. This site is in a floodplain and undoubtedly has been flooded before. The site would flood again regardless of which flood minimization options is selected. Therefore, none of WisDOT's flood minimization options would affect the site.

Recreation. Pine Island State Wildlife Area and Baraboo River Waterfowl Production Area are in areas affected by flood elevation changes. The primary purpose of both areas is to provide wildlife habitat, but they do provide passive recreation opportunities. Under any of the flood minimization options, those opportunities would remain. During flood events some areas would not be available, but this is already the case during current floods. There would be a modest reduction in the area available for hunting and hiking during floods.

5. Flood Minimization Study Coordination

As part of its detailed flood study, WisDOT met with WDNR, Columbia County (the local floodplain zoning administrator), and owners impacted by the recommended option. Table 5-1 summarizes outreach activities. WDNR is the agency responsible for the floodplain management program mandated by state statutes. WDNR also partners with FEMA, through the Cooperating Technical Partners program, on the implementation of the NFIP Program. WisDOT will continue coordination with WDNR through the design process as updated flood maps are developed and finalized. WisDOT will request a formal Conditional Letter of Map Revision from FEMA. After construction, WisDOT will submit plans of the Interstate and interchanges, as built, along with the final flood map and request a Letter of Map Revision from FEMA. WisDOT will continue coordination with property owners affected by potential flood elevation changes and finalize measures to mitigate property impacts, as needed.

Table 5-1: Summary of Flood Minimization Coordination

Agency or Stakeholder	Date
WDNR	June 29, 2023 January 24, 2024
Columbia County	June 29, 2023
Town of Caledonia	January 10, 2024
USFWS	December 6, 2023
FEMA ^a	January 24, 2024
Private Property Owners	January 29, 2024

a. Wisconsin State National Flood Insurance Program (NFIP) coordinator participated in this meeting

6. Evaluation

Consistent with 23 CFR 650 Subpart A, WisDOT will minimize risks associated with unavoidable floodplain impacts to the greatest extent practicable. A final decision according to 23 CFR 650.113 will be made in the Final EIS and Record of Decision.

Both I-39 and I-90/94 cross through the Wisconsin River and Baraboo River 100-year floodplain where previous flood events required closing the Interstate. WisDOT considered alternatives to significant floodplain encroachment associated with the preferred alternative, as well as the build alternatives recommended for further study. Early in the study, WisDOT evaluated and dismissed a new alignment alternative that would avoid floodplain impacts in the study corridor. A new alignment alternative would not meet the study corridor purpose and need, and it would have comparatively higher impacts associated with new alignment right of way and related natural resources impacts.

WisDOT considered flood minimization options on existing I-39/90/94 to improve resiliency and reduce flood risks on the Interstate. While the flood minimization options considered in this study improved resiliency to flooding on the Interstate, most options result in a significant encroachment to a floodplain.

WisDOT considered minimization options that ranged from no increase in the regulatory 100-year flood elevation to varying levels of increase, depending on the number of and location of additional bridges, see Table 3-2. Option A avoids a significant floodplain encroachment; however, this option had the lowest cost benefit and raises the 100-year flood elevation at a substantial number of properties downstream of I-39. Options C2 and C3 are less costly compared to Option A but raise the regulatory flood elevation and increase the flood elevation at properties downstream of I-39. Options C2 and C3 also result in some properties experiencing flooding in lower frequency flow events, which they do not currently experience. Option C4 also raises the regulatory flood elevation, similar to Options C2 and C3, but creates little downstream flood elevation increase, see Section 3. The wider Baraboo River crossing under Option C4 would allow adequate room to pass the base flood discharge without damaging the roadway, bridges, or disruption of traffic. There are no build alternatives that would avoid encroachment into the floodplain. WisDOT recommends implementing Option C4 as part of the build alternative.

Incorporating Option C4 into the build alternative includes measures to minimize impacts by maintaining I-39 in its current 4-lane configuration, widening I-90/94 mainline to the inside and steepening side slopes where practicable. As part of the build alternative, Option C4 would raise the Interstate above of the 100-year flood elevation to avoid and minimize interrupting public or emergency vehicle access and

damage to the roadway or structures during flood events. Option C4 increases base flood elevations by more than 0.01 foot primarily on WDNR and USFWS wildlife refuge property. Impacts are also anticipated on private properties and WisDOT will mitigate unavoidable impacts to insurable structures in the regulatory floodplain. Option C4 would not cause a substantial potential for interruption or termination of a transportation facility needed for emergency vehicles. Option C4 would be consistent with local floodplain management goals and objectives, which include maintaining the natural and beneficial floodplain values on local public lands and avoiding support of incompatible floodplain development. The build alternatives do not support development in floodplains, as much of the property in the area is maintained for long-term natural resource preservation and Columbia County has floodplain management regulations in place to prevent inappropriate development.

WisDOT has also coordinated with WDNR to present the flood minimization options and recommendations. Increases in regulatory floodplain elevations are permissible when coordinated with WDNR following procedures defined in the February 11, 1988 Cooperative Agreement Implementation Memo of the DOT/DNR Cooperative Agreement.⁴

⁴ Wisconsin Department of Transportation and Wisconsin Department of Natural Resources. *Implementation of DOT/DNR Cooperative Agreement, Section VII Waterway Crossings and Other Floodplain Encroachments. February 11, 1988.*