US Army Corps of Engineers®
St. Paul District

Fargo-Moorhead Flood Risk Management Project

Supplemental Environmental Assessment

Appendix B

Adaptive Management and Mitigation Plan

July 2018

INTRODUCTION

The Fargo-Moorhead Metropolitan Area Flood Risk Management Project (Project) was authorized by Section 7002 of the Water Resources Reform and Development Act of 2014 (WRRDA). The purpose of the Project is to reduce flood risk, flood damages and flood protection costs related to flooding in the Fargo-Moorhead metropolitan area. The project is led by the St. Paul District, Army Corps of Engineers (USACE), and the non-federal sponsors Fargo, North Dakota; Moorhead, Minnesota; and the Metro Flood Diversion Authority (collectively Sponsors).

The Project is located in the Fargo-Moorhead Metropolitan Area (Figure 1). The Project consists of a diversion channel system including, but not limited to: excavated channels; control structures; aqueducts; tie-back embankments; an upstream staging area; levees; and environmental mitigation projects located inside and outside the project area.

The Project originated as a recommendation from the Final Feasibility Report and Environmental Impact Statement (FEIS), Fargo-Moorhead Metropolitan Area Flood Risk Management, July 2011. As outlined within the FEIS the Project would have various environmental effects. Some of the identified effects were significant enough to warrant mitigation. These impacts and mitigation needs were updated through the 2013 Supplemental Environmental Assessment (2013 SEA) and the 2018 Supplemental Environmental Assessment (2018 SEA). Based on the current NEPA analysis, impacts requiring mitigation would include impacts to aquatic habitat, riparian forest and wetland resources. For these impacts, mitigation will be implemented to offset these adverse effects to the greatest extent practicable. Conversely, other resource types or functions were not deemed to have significant impacts, but could warrant monitoring to ensure impacts stay within those outlined within this NEPA analysis. Within this 2018 SEA, this included concerns with effects to river geomorphology, biological connectivity and fish stranding.

The purpose of this Adaptive Management and Mitigation Plan (AMMP) is to provide a framework for implementing this adaptive approach.

Section 1 provides an overview of the adaptive process, including the collaboration process with State and federal natural resource agencies.

Section 2 provides a habitat-based assessment of impacts and mitigation needs for aquatic habitat, forest and wetland resources.

Section 3 provides an overview of project mitigation, including a summary table of mitigation needs, mitigation accomplished to date, and remaining mitigation needed. Specific mitigation sites have not been finalized for all impact needs, and the amounts of mitigation could shift based on final design of the project, as well as pre-project monitoring. The Corps continues to coordinate with local agencies to refine mitigation plans. The Corps has identified several

mitigation projects, and will continue to refine specific mitigation plans during detailed project design.

Section 4 outlines specific monitoring activities that will be done pre- and post-construction, including cost estimates for these activities.

Section 5 outlines performance standards/metrics that will be used to measure the success of mitigation. It also overviews a contingency process where corrective actions could be pursued should impacts prove greater than anticipated; and/or if mitigation proves to be less effective at offsetting impacts.

Collectively, this AMMP will drive the implementation of mitigation, and the data collection and review process to ensure impacts have been addressed. Monitoring results will be compared in the future to verify whether the impacts of the Project have been offset by mitigation actions. It should be noted that many of these details are currently being refined, and will be finalized prior to construction. In addition, this AMMP will remain flexible to adapt to the needs of the Project over time. As such, this document is open to change throughout the life of the Project.

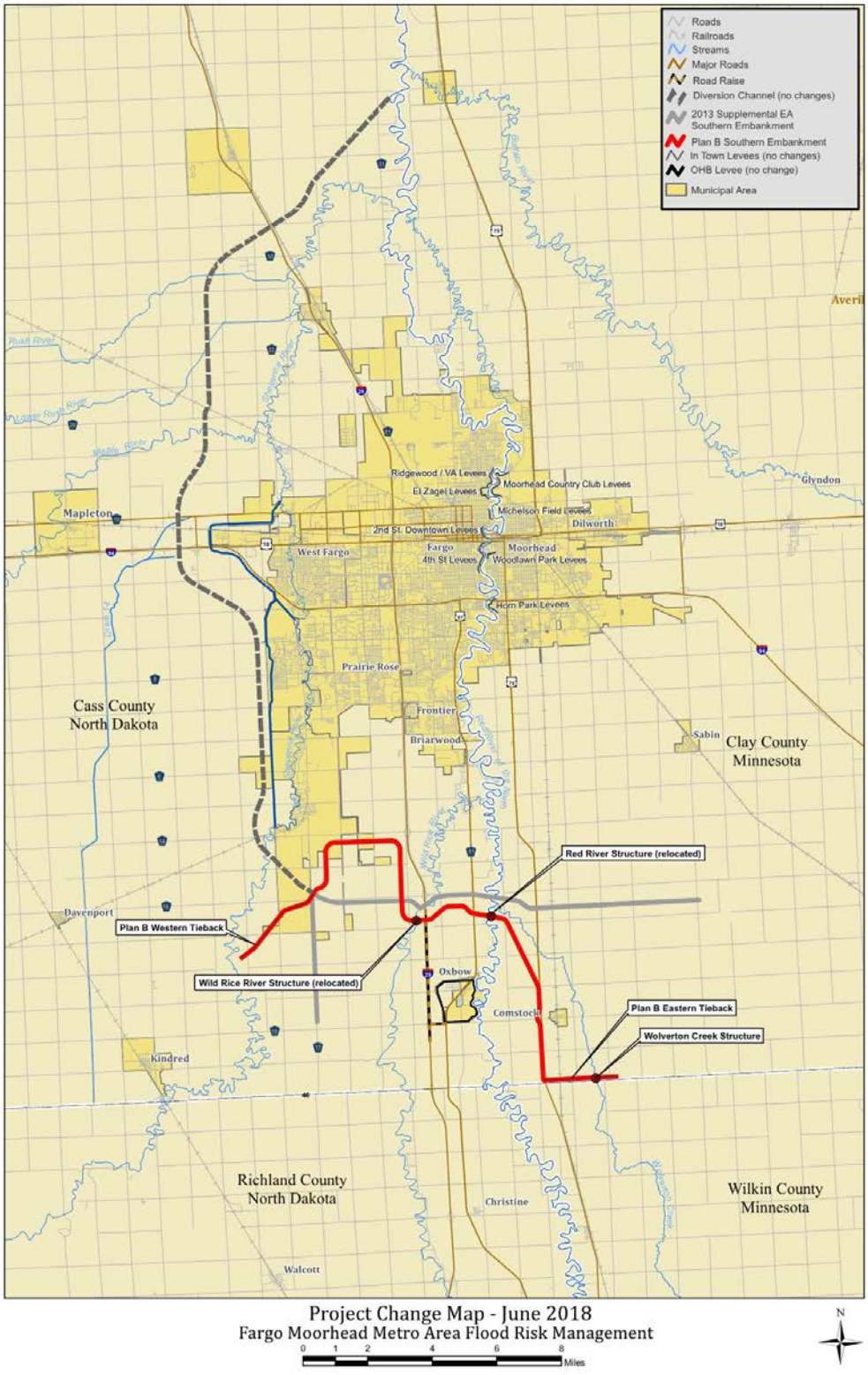

Figure 1. Map of project changes.

SECTION 1. OVERVIEW OF ADAPTIVE MANAGEMENT

1.1 Adaptive Management Approach:

Adaptive management (AM) is a "learning by doing" management approach which promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood (National Academy of Sciences 2004). It is used to address the uncertainties often associated with complex, large scale projects. In AM, a structured process is used so that the "learning by doing" is not simply a "trial and error" process (Walters, 1986).

The basic elements of an AM process are: (1) Assess; (2) Design; (3) Implement; (4) Monitor; (5) Evaluate; and (6) Adjust. In practice, AM is implemented in a non-linear sequence, in an iterative way, starting at various points in the process and repeating steps based on improved knowledge.

Application of AM should occur in two phases. A setup phase would involve the development of key components and an iterative phase would link these components in a sequential decision process. Elements of the set-up phase include: stakeholder involvement, defining management or mitigation objectives, identifying potential management or mitigation actions, identifying or building predictive modeling or assessment tools, specifying performance measures and/or risk endpoints, and creating monitoring plans. In addition, values for the monitored measures that would trigger AM should be determined in this phase. The iterative phase uses these elements in an ongoing cycle of learning about system structure and function, and managing based on what is learned. The elements of the iterative phase include decision making, follow-up monitoring, and assessment.

1.2 Adaptive Management Team

An Adaptive Management Team (AMT) will provide essential support to the Project in meeting its goals and objectives through the application of a systemic approach to evaluating Project impacts and mitigation effectiveness through monitoring activities. The AMT consists of a multi-agency (State and federal) staff from the appropriate disciplines, including engineering, planning, environmental science and resource management. The non-Federal sponsors will participate directly on the AMT and serve with the Corps as the AMT leader. The members of the AMT will include:

- Corps,
- Non-federal sponsors,
- U.S. Fish and Wildlife Service (FWS),
- Natural Resources Conservation Service (NRCS),
- North Dakota Game and Fish (NDGF),

- North Dakota Department of Health (NDDoH),
- North Dakota State Water Commission (NDSWC),
- Minnesota Department of Natural Resources (MnDNR),
- Minnesota Pollution Control Agency (MnPCA),
- U.S. Geological Survey (USGS), and
- U.S. Forest Service (USFS).

The AMT is an advisory group with final decisions for mitigation and monitoring falling to the Corps and the non-Federal sponsor. However, the Corps and sponsors take the adaptive approach seriously and will value and fully consider the input from all members of the AMT, recognizing within the AMT there may not be full consensus on all issues.

Membership and participation on the AMT is voluntary. However, the Corps and sponsors will make every effort to be all inclusive with those agencies and representatives that wish to participate. The AMT helps to formalize the continued interagency coordination that has occurred throughout the planning and implementation process dating back at least to 2009 during early stages of the Project. The AMT will continue to meet into the future to discuss the mitigation plans, pre- and post-project monitoring, evaluation of mitigation and other aspects of the adaptive management plan.

Note that technical sub-teams also have met, and will continue to do so in the future to provide resource-specific expertise for aquatic habitat and fish passage/connectivity concerns; as well as geomorphology. These two resource areas required enough specific focus to warrant sub-teams. Many of the same people that participate on the AMT have also met for the two sub-teams.

1.3 Establish Goals, Objectives and Performance Standards Metrics

Clearly focused and quantitative goals and objectives are essential to AM. They should be logically linked to mitigation actions, action agencies, indicators/metrics, monitoring activities, and ecosystem values. Goals and objectives will be specifically identified during detailed mitigation planning. These goals and objectives will be critical elements of the Project, with implementation concurrent with overall Project construction.

Performance metrics will be used during two AM processes: plan evaluation (evaluation performance measures and metrics like those described above to predict Project impacts) and assessment of actual plan performance (assessment performance measures following Project implementation). In many cases, these processes would be the same, allowing predictions to be compared to actual responses.

Performance standards/metrics are further discussed in Section 5. This includes metrics for quantifying impacts following Project construction, and how mitigation effectiveness will be

measured. These standards/metrics will be fully developed based on input from the AMT during future planning for monitoring and evaluation. At a minimum, the goal of mitigation will be to replace the habitat lost through Project impacts. Performance standards/metrics will allow for this evaluation of mitigation effectiveness.

1.4 Develop and Implement Monitoring Plans

The Council on Environmental Quality (CEQ) NEPA Task Force (CEQ 2003) suggests that the effectiveness of adaptive management hinges upon an effective monitoring program to establish objectives, thresholds, and baseline conditions. This will be achieved through a stepwise process that includes both pre-construction and post-construction studies of biota and physical habitat. These studies are scheduled for both impact and mitigation sites, allowing impacts to be verified, and for mitigation effectiveness to be evaluated.

Monitoring programs are a key component of AM. Monitoring provides feedback between decision making and system response relative to management goals and objectives. An essential element of AM is the development and execution of a scientifically rigorous monitoring and assessment program to analyze and understand system response to Project implementation. It is recognized that Project level monitoring would be limited by cost and duration based on current regulations and that Project level AM plans would need to be designed to reflect this constraint. However, post-project monitoring would be a part of Project implementation, with monitoring required from the non-federal sponsors as a part of Project operation and maintenance.

Following the adaptive framework of this document, impacts would be monitored over time and performance of measures would be assessed to determine whether additional avoidance, minimization, or mitigation measures are needed. Future monitoring will provide information on the accuracy of the conclusions reached on the extent of impacts from the Project features and evaluate the effectiveness of mitigation. Monitoring activities, including review of results, will be performed collaboratively with the AMT.

Pre- and post-project monitoring is discussed in greater detail below in Section 4. Specific proposed sampling methodologies are being designed to address the performance standards/metrics outlined in Section 5.

SECTION 2. PROJECT IMPACTS AND MITIGATION NEEDS

The following discussions outlines the quantification of Project impacts deemed significant enough to warrant mitigation, as well as the corresponding mitigation needs.

The previous NEPA documentation for the Project evaluated potential impacts to a wide range of resource types. Please reference the FEIS and 2013 SEA for discussion of how impacts were quantified, and how the determination was made whether or not impacts were deemed significant enough to warrant mitigation. In short, Project designs were compared with aerial photographs, available data, and in-field observations to estimate the amount, quality and value of potential habitat impacted by all Project features. The Corps reviewed this information, collaborated with agency partners, and made a final determination on whether or not these losses warranted mitigation. Habitat types previously needing mitigation included aquatic riverine habitat; fish passage and connectivity; wetlands and floodplain forest.

Since completion of the FEIS and 2013 SEA, impacts and mitigation needs were updated for several key reasons. First, Project designs and operations have been updated from those previously assessed. In addition, collection of additional field data has allowed for a better understanding of both habitat quantity and quality. Finally, the FEIS provided conservative assumptions to ensure that mitigation needs and related funding would be adequate to complete the Project. Some of these conservative assumptions should be revisited to ensure an appropriate level of mitigation. For example, it was assumed that aquatic habitat within the Project footprint would be completely lost. In reality, some aquatic habitat would exist within newly excavated channels leading into and out of Project structures. This aquatic habitat should be factored into mitigation planning, and will need to be evaluated throughout the life of the Project to confirm the amount of habitat they provide.

Corps regulations require that any potential mitigation planning factor habitat quality into impact determinations. The FEIS estimated habitat quality based on best available information at that time. For example, as described in the FEIS, the quality of floodplain forest impacted was quantified by using a series of USFWS Habitat Evaluation Procedures (HEP) habitat models. These models were used to compute an average habitat quality score between 0 and 1.0. From the qualitative and quantitative determinations, the standard unit of measure, the Habitat Unit (HU), is calculated using the formula: HSI score x Acres impacted = HUs.

Another aspect to assessing lost habitat and mitigation need is how conditions could change over time. Changes in the amount of habitat (and habitat units) could occur as habitat changes and are influenced over time by river and watershed conditions. Improved watershed conditions could improve stream health in the future, thus habitat loss could be greater over time. Conversely, continued degradation could further reduce the amount of habitat that is lost through these footprint impacts. Mitigation value could also change over time. For example, floodplain forest mitigation must consider that it takes a considerable amount of time for floodplain forest to grow and mature to full functionality. To characterize habitat changes over

time, Habitat Units are calculated for target years and averaged over the life of the Project (50 years) to determine what is known as the Average Annual Habitat Units (AAHUs).

Given the uncertainty with whether habitat conditions might generally improve or degrade in the future, or to what magnitude such changes would occur, it was assumed that conditions would remain constant over time when assessing impacts. It is recognized that habitat conditions likely will not remain constant. However, this approach hopefully minimizes the potential to either underestimate or overestimate potential Project impacts to aquatic habitat. For assessing mitigation benefits, consideration was given as to how long it may take habitat restoration projects to reach full effect.

The above approach was used to estimate habitat quality and mitigation needs for aquatic habitat; floodplain forest; and wetlands resources. The following represents the Project impact and mitigation needs updated through the current (2018) SEA.

Aquatic Habitat

Impacts will be verified through collection of pre- and post-project fish and invertebrate data. This data could be compared in several ways. At a minimum, an IBI score will be generated from Project data, with scores compared before and after construction to verify resulting impacts. IBI scores also would be generated for mitigation sites to help quantify the amount of mitigation created compared to the habitat lost through construction.

An Index of Biotic Integrity (IBI) scoring system had previously been generated in the Red River basin back in the 1990s to describe general biotic conditions (EPA 1998). This was used in the FEIS to estimate habitat quality, impacts and mitigation needs. However, revised IBIs will be utilized within this AMP. North Dakota has developed both a fish and macroinvertebrate IBI for Red River basin tributaries (NDDoH 2011a; 2011b). These two IBIs will be utilized to calculate IBI scores for all rivers except the Red River. At this time, the Red River will only utilize a specific fish IBI to calculate habitat quality for sites on this river. The reason is due to limitations with 2017 invertebrate sample collection and the resulting questionable invertebrate data for the Red River. However, this assumption can be revisited with the AMMP. For data collected to date, the North Dakota Department of Health has provided the IBI scoring results to the Corps.

Impacts to aquatic habitat will be quantified by calculating a “Habitat Unit” as Impact Area multiplied by Habitat Quality, as identified from the above IBI scores. The IBIs calculate habitat condition on a scale of 0 to 100. This value will be converted to a score between 0 and 1.0, and multiplied by the impact area to calculate an amount of habitat lost via impact, or an amount of habitat gained via mitigation. This approach will also take into account the Habitat Units that are present within any newly constructed river channels to facilitate routing flow through

Project features (e.g., water control structures, aqueducts, etc.). The net habitat amount resulting from impacts and mitigation should be zero.

Aquatic habitat lost through the latest Project designs, and associated proposed mitigation needs, are presented in Tables 1 through 3. Habitat quality was assessed via the use of recently collected biotic data, processed through available IBI tools. The IBI output provided a quality factor to apply against the quantity of impact to produce the Habitat Unit of measure. For habitat losses (Table 1), it was assumed that habitat quality (as measured by the IBI value) would remain constant over time. For habitat gains through newly created channels (Table 2), the current IBI quality scores were applied to the new acreages to generate the expected habitat units of new habitat. It was assumed that this new habitat would be functional after construction and implementation. Mitigation need (Table 3) is identified as the difference between the habitat units of aquatic habitat lost by impact, and the habitat gained through newly constructed channels. However, please note the habitat value for these newly created channels remains under discussion with the AMT. It's possible that both the value of habitat provided by these channels (Table 2) and the resulting mitigation needs (Table 3) could change.

Table 1. Aquatic habitat footprint impact areas and corresponding habitat units for aquatic impacts by Project feature, updated for the revised plan presented in the SEA.

Impact	Footprint Area (ac)	IBI Score*	Habitat Units Lost
Red River Control Structure	13	0.52	6.8
Wild Rice River Control Structure	8	0.44	3.5
Sheyenne River Aqueduct	8.4	0.54	4.5
Maple River Aqueduct	10.7	0.57	6.1
Wolverton Creek Structure	1	0.62	0.6
Total	41.1		21.5

*IBI scores are an average of fish and invert IBI scores for 2012 and 2017 at the footprint sampling site. Red River control structure uses fish only given some of the challenges with sampling invertebrates on the Red River. Fish IBI scores are also higher than Invertebrate IBI for the Red River, providing a more conservative estimate.

Table 2. Newly constructed channel aquatic habitat by Project features, updated for the revised plan presented in the SEA.

Impact	Footprint Area (ac)	IBI Score*	Habitat Units Gained
Red River Control Structure	6	0.52	3.1
Wild Rice River Control Structure	4	0.44	1.8
Sheyenne River Aqueduct	6	0.54	3.2
Maple River Aqueduct	7	0.57	4.0
Wolverton Creek Structure	--	--	--
Total	23		12.1

*IBI scores are an average of fish and invertebrate IBI scores for 2012 and 2017 at the footprint sampling site. Red River control structure uses fish only given some of the challenges with sampling invertebrate on the Red River. Fish IBI scores are also higher than Invertebrate IBI for the Red River, providing a more conservative estimate.

Table 3 Estimated aquatic habitat mitigation need based on updated footprint habitat lost minus new habitat created from Project features.

River Impact	Habitat Lost	Habitat Gained	Mitigation Need
Red River Control Structure	6.8	3.1	3.7
Wild Rice River Control Structure	3.5	1.8	1.7
Sheyenne River Aqueduct	4.5	3.2	1.3
Maple River Aqueduct	6.1	4.0	2.1
Wolverton Creek Tie-back Levee	0.6	0.0	0.6
Total	21.5	12.1	9.4

Floodplain Forest

Some forested areas would need to be cleared for construction of the Project. Forest areas impacted by construction of Project features total 124 acres for the Plan B alignment. The FEIS outlined a habitat evaluation process for existing floodplain forest in the Project area, and identified a suitability factor of 0.51. This suitability factor is likely the same today (2018), as no major changes have occurred that would result in appreciable changes of that suitability factor. Thus, 0.51 is applied to the acres impacted to identify the habitat units for lost forest habitat and the targeted amount for mitigation.

Table 4. Estimated floodplain forest mitigation need based on updated footprint habitat lost.

Impact	Footprint Area (ac)	Habitat Quality Score	Habitat Units Lost/Mitigation Need
Floodplain Forest Losses	124	0.51	63.2

In terms of habitat conditions over the next 50 years, woodland extent, structure and composition is assumed to remain fairly similar to existing condition. While habitat value for individual species may change over time as natural setback/succession processes occur on these established tracts, the overall habitat value for the riparian woodland community would remain essentially the same and be rated as fair with an HSI of .51.

Wetlands

Wetland areas would need to be filled or modified for construction of the Project. This includes areas for the diversion channel, southern embankment, and Oxbow-Hickson-Bakke ring levee. The wetland impacts for the diversion channel and Oxbow-Hickson-Bakke are being addressed by parallel Section 404 permitting efforts (referenced below). Wetland impacts for the southern embankment are provided in Table 5. The analysis included a Minnesota Routine Assessment Method (MNRAM) wetland functionality assessment. Mitigation would target no net loss of wetland impacts.

Table 5. Estimated wetland impact and mitigation need based on updated footprint habitat lost. Wetland impacts from the diversion channel and Oxbow-Hickson-Bakke ring levee are being addressed through specific Section 404 permits identified below, and all mitigation and monitoring for those wetland impacts are addressed via the referenced permits.

Wetland Type	**Southern Embankment Wetland Impacts (acres)**
Open Water	0
Farmed Seasonally Flooded Basin	156
Shallow Marsh	17
Shrub-Carr	0
Wet Meadow	71
Total Acres	**244**

Geomorphology

Potential effects to waterways, bank stability, erosion and sedimentation within and outside the existing channel and floodplain (including newly inundated areas) has been discussed at length in the FEIS (geomorphic impacts discussion including Section 5.2) and subsequent NEPA documents. These impacts and related monitoring are also described in the Final State Environmental Impact Statement (MN EIS), Section 3.3 and Appendix B. As outlined in the FEIS and the MN EIS, no significant adverse impacts are anticipated. The Project would not likely have a significant effect on stream stability and geomorphology throughout the potentially impacted/affected environment. Multiple features were incorporated to reduce the frequency the Project would operate in the future. This was done specifically to minimize potential adverse effects to multiple resource types, including geomorphology. With reduced Project operations, no significant adverse effects are anticipated, and no mitigation is proposed. However, geomorphic conditions will be monitored as a part of the AMMP (outlined below). The approach for monitoring has been discussed at length with the natural resource agency team, including geomorphology experts from the MDNR. The monitoring plan for geomorphology has been developed, and will be revised over time, as needed, to capture any new concerns. Pre-Project geomorphology monitoring is on schedule to be conducted summer/fall 2018. The scope of work for the pre-Project geomorphology monitoring was developed through a collaborative effort with participating agencies.

Invasive Species Management

Concern has been raised by agency representatives about invasive species. A formal invasive species management plan will not be prepared for this Project. The Project is not anticipated to contribute to the spread of invasive species. Invasive species concerns may be addressed

individually within mitigation areas for wetlands or floodplain forest to ensure mitigation success. Plans and specifications for all construction actions also will require that construction equipment is free of Aquatic Invasive Species (AIS) and does not contribute to the spread of invasive species. The Red River of the North is listed as an infested water by MDNR for zebra mussels. The Project proponents will work with MDNR to identify measures that can be taken to reduce the probability of invasive species impacts.

SECTION 3. PROJECT MITIGATION

Significant impacts warranting mitigation were quantified above for Aquatic river habitat; Forests; and Wetlands. The following discussions outlines the mitigation approach to meet the mitigation needs identified in Section 2. Mitigation shall be in accordance with federal requirements; mitigation undertaken beyond the federal requirement will be the responsibility of the sponsors.

A summary table (Table 6) is attached to the end of this section and provides a summary of mitigation needs, mitigation accomplished to date, and mitigation needs remaining. This table will be updated over time and will demonstrate where the Corps and the non-federal sponsors are in relation to meeting their mitigation commitments. The Corps and the sponsors are committed to implementing mitigation by the time that Project impacts occur.

3.1 Aquatic Habitat

Aquatic habitat losses are outlined above in Tables 1-3. The Project results in approximately 9.4 habitat units of aquatic riverine habitat losses that would need mitigation.

Extensive work and collaboration has been done to identify potential river restoration projects to serve as mitigation for Project impacts. This has included meetings and site visits with natural resource agencies, county representatives, watershed coordinators and other stakeholders. This has included meetings with representatives from Cass, Sargent, Ransom and Barnes counties in North Dakota. Opportunities are available, but limited. No mitigation projects have been implemented so far for aquatic habitat. Unfortunately, land owner interest to participate has been low, limiting the potential to move forward on any individual project. To date, the best candidate projects for aquatic habitat mitigation include the following:

Restoration of the Bois de Sioux River. This river is the headwaters of the watershed, forming the Red River when it joins the Otter Tail River at Wahpeton, ND and Breckenridge, MN. Sections of this river that forms the border between North Dakota and Minnesota have been channelized for flood control purposes. The project under consideration includes reconnecting the isolated oxbows, with additional channel work, grading and other features to recreate more natural river habitat. There are limitations with restoration in the area, including that it is a smaller river with potentially lower existing habitat quality. However, depending on the level of work performed it is possible that most if not all of the lost aquatic habitat could be offset by mitigation in this area. Unfortunately, preliminary discussions with landowners had a very low level of interest to support construction.

Restoration of the Lower Otter Tail River. Similar to the Bois de Sioux, the Lower Otter Tail River forms the headwaters of the Red River. Sections of this river, which flows entirely within Minnesota, have been channelized for flood control purposes below Orwell Dam, near Fergus Falls, MN. The project under consideration includes reconnecting the isolated oxbows, with

additional channel work, grading and other features to recreate more natural river habitat. There is a large area to work with, including several meander bends that have been disconnected. There is high potential that all of the lost aquatic habitat losses could be offset by mitigation in this area. However, preliminary discussions with local constituents also suggested a very low level of interest.

Restoration of the Sheyenne River. A meander bend of the Sheyenne River within the Project area has experienced a meander bend cut-off. This cut-off is located between Horace and West Fargo, North Dakota, immediately to the east of Sheyenne Street/Highway 17. The project under consideration includes reconnecting the isolated oxbow, potentially with additional channel work, grading and other features to recreate more natural river habitat. The area is relatively small and a project would need to work within potential constraints of the adjacent highway and residencies. Landowner interest needs to be confirmed. While the amount of mitigation that could be credited here is small, it does provide an opportunity for at least some direct aquatic habitat mitigation on an impacted water body within North Dakota.

As has been discussed with the AMT, the Corps is recommending a step-wise approach to implement mitigation. The Corps will attempt to implement one of the above projects to cover mitigation for lost aquatic habitat. The first site that will be revisited with landowners (and thus the highest priority site) will be the Bois de Sioux. While this is a smaller tributary with lower summer discharge and limited habitat quality, it is a shared water body between the two states. Given that the majority of lost aquatic habitat occurs within the State of North Dakota, it is important to meet a significant portion of aquatic mitigation needs, if at all possible, within North Dakota.

If a restoration project cannot be implemented on the Bois de Sioux, or if a small project is implemented and there are remaining mitigation needs for lost aquatic habitat, then the Lower Otter Tail River will be revisited for remaining mitigation needs. In the event the Lower Otter Tail is revisited, then the project on the Sheyenne would also be revisited to potentially implement at least some mitigation within North Dakota.

If some or all of the mitigation needs for lost aquatic habitat cannot be met with restoration on one or a combination of the Bois de Sioux, Lower Otter Tail, and Sheyenne rivers then the Corps will consider implementing fish passage to offset footprint impacts. Use of connectivity for mitigation of lost habitat is challenging in that it is difficult to quantify exactly “how much” connectivity must be restored to off-set a certain loss of habitat. That said, there are clear ecological benefits of improving connectivity, and in the absence of other logical projects, connectivity improvements represent a way to move mitigation forward in a timely fashion. Discussion within the AMT, including resource agency personnel from both North Dakota and Minnesota, suggested that the two States would support use of connectivity mitigation if more suitable projects are unavailable. To that end, potential connectivity projects include the following:

Drayton Dam Fish Passage. Drayton Dam is a low-head dam on the lower Red River at Drayton, North Dakota. It is the last fish barrier on the mainstem Red River within the United States. Several other low head dams on the Red have been retrofitted with rock rapids fishways to facilitate fish movement. Drayton is the last location without fish passage. It is also the most downstream dam within the U.S., representing a barrier to the watershed. Potential fish passage projects have been considered at Drayton for a long time, including recently as mitigation for connectivity impacts for the Project. However, with the modifications made to the project under Plan B, connectivity impacts from the Project would no longer be significant enough for the Corps to recommend mitigation and the Drayton Dam project. However fish passage at this location would still be extremely valuable as the dam is a significant barrier to fish (e.g., approximately 50-70% of the time during key migration months). Such a project would provide very strong ecological benefits to fish under a broad range of flow conditions. This project would be the highest priority project considered for connectivity mitigation applied for lost aquatic habitat.

Red River Fish Passage Retrofit. Several dams on the Red River have been retrofitted with rock rapids fishways. Older designs used a general slope of 5% across several boulder weirs. This design was used on the three Red River dams retrofitted in Fargo, and one dam in Grand Forks. While this design passes fish, the efficiency is unknown. Current designs for similar projects use a flatter 3% slope. One possible project would be to modify these existing rock rapids fishways to use the flatter 3% slope. This type of project would provide valuable benefits, but more limited benefits compared to Drayton Dam.

Sheyenne River Fish Passage. The existing West Fargo Diversion project includes multiple control structures and diversion channels on the lower Sheyenne River that disconnect the Sheyenne from the Red River. A possible project would be to modify these structures to improve connectivity. Preliminary investigations suggest that complete connectivity may not be possible without impacting the existing flood diversion project. However, some level of connectivity could be restored, and further evaluation would consider whether this could be increased further. This type of project would provide valuable benefits, but again, more limited benefits compared to Drayton Dam.

Other Fish Passage Projects. There are many dams in the basin that could be removed or retrofitted to improve fish passage. Other locations could be considered for connectivity mitigation after consideration is given to the above.

3.2 Forests

Floodplain forest impacts are outlined above in Table 4. The Project results in a need for approximately 63.2 habitat units of mitigation. The assumed general floodplain forest habitat value (HSI) is 0.51. It is also assumed that it could take a full 50 years for a created forest to reach its full functioning level. Over a 50 year planning horizon (the standard for the Corps

planning activities), assuming a starting HSI of 0, and an ending HSI of 0.51, this amounts to an average HSI value of 0.25. Thus, about 253 acres of floodplain forest habitat would be needed to generate the 63.2 Habitat Units of mitigation needed to offset Project impacts.

Work and collaboration to date has resulted in 13 acres (3.3 habitat units) of forest mitigation already implemented (Table 6). It is estimated an additional 240 acres (60 habitat units) will be needed for mitigation. While the locations for this are uncertain, there are many opportunities for implementing floodplain forest mitigation. For example, several areas have been analyzed in recent years, and up to four sites have been identified as meeting the needs for forest mitigation. These sites will be added to Table 6 as there design becomes more certain. Further, a substantial amount of land will be needed for the Project, including large areas for upstream staging. As these areas are acquired, the Corps and the sponsors will identify opportunities to complete the needed amount of forest mitigation.

In addition to the activities outlined above, forestry mitigation will include, based on agency input, the following actions:

- As outlined in the paragraph above, mitigation will be implemented based on the habitat analysis performed in the original FEIS. Based on this habitat analysis, a 2:1 mitigation ratio would be applied for floodplain forest impacts.

- Floodplain lands would be acquired that are currently in agriculture or pasture, and forest would be re-established on those tracts. This would include restoring native floodplain forest and herbaceous vegetation. These areas would also provide wildlife habitat. Monitoring will be performed, as outlined in the next section, to verify floodplain forest response is as needed.

- The Corps would develop site restoration plans, including tree planting areas, and clearing, treatment and management schedule for forest mitigation sites. A combination of direct seeding and seedling trees would be used as needed. Site(s) would be managed for effective growing. Site(s) would be protected and managed into perpetuity by an agreement for management as a wildlife management area by the MNDNR or North Dakota Game and Fish Department (NDGF).

3.3 Wetlands

Wetland impacts are outlined above in Table 5. Wetland losses due to the diversion channel will be mitigated via wetland replacement that will occur at the base of the constructed diversion channel. These mitigation requirements have been outlined in Army Permit No. NWO-2013-1723-BIS issued to the Project sponsors on December 14, 2016. Wetland mitigation for the diversion channel will be addressed through this permit and will not be a detailed for this AMMP.

Wetland losses due to the Oxbow-Hickson-Bakke ring levee are addressed in Army Permit No. NW0-2014-0236-BIS. Wetland mitigation for the Oxbow-Hickson-Bakke ring levee will be addressed through this permit and will not be a detailed for this AMMP.

Wetland losses due to the Southern Embankment, which total approximately 244, acres would still need to be mitigated. This includes 156 acres of farmed seasonally flooded areas; 17 acres of shallow marsh; and 71 acres of wet meadow.

Work and collaboration to date has resulted in about 17 acres (17 habitat units) of wetlands mitigation implemented through the Ducks Unlimited In-Lieu Fee Program (Table 6). It is estimated an additional 241.5 acres (241.5 habitat units) will be needed for mitigation. While the locations for this are uncertain, there are many opportunities for implementing wetland mitigation. A substantial amount of land will be needed for the Project, including large areas for upstream staging. As these areas are acquired, the Corps and the sponsors will identify opportunities to complete the needed amount of wetland mitigation.

In addition to the mitigation activities outlined above, wetland mitigation will include, based on agency input, the following actions:

- Wetland replacement for wetland impacts from the diversion channel including side slopes and other areas, at a 1.19 to 1 ratio and would be mitigated through revegetation/wetland creation at the bottom of the diversion channel and management of upland inside slopes.

- Mitigation will be consistent with the Wetland Conservation Act (WCA) for wetlands in Minnesota.

Agency representatives have also noted the following with regard to wildlife habitat losses and potential mitigation needs:

- Wildlife habitat replacement would be incidental to wetland replacement.

3.4 Aquatic Connectivity

Previous Project plans and resulting analyses identified potential impacts to biological connectivity and proposed mitigation actions to offset these impacts (2011 FEIS; 2013 SEA). With the Plan B discussed in the 2018 SEA, the impact determination and resulting mitigation needs have changed. While the Project would briefly limit biological connectivity, the level of adverse effect associated with this brief and infrequent disruption is expected to be less than that which would require mitigation. As such, mitigation is no longer proposed for connectivity impacts under Plan B.

Coordination with agency members during preparation of the SEA identified concerns associated with the aqueducts and resulting effects on biota. These relate to connectivity, and project features will include the following considerations to reduce potential risk for impacts to connectivity:

- Current engineering plans include heating components to reduce the potential for freezing or ice buildup.

Coordination with agency members during preparation of the SEA also identified concerns associated with connectivity in the lower diversion channel and the Rush and Lower Rush Rivers that will be permanently re-routed into the diversion. The Project will include the following considerations to address connectivity, reduce risk for fish stranding, and other possible adverse effects:

- A low flow channel would be constructed in a sinuous nature from the Maple River downstream to the outlet of the diversion channel into the Red River to mimic a more natural stream channel.

- Construction Avoidance Periods: Proper timing of Project construction will be considered in order to minimize or avoid further potential impacts to the fish community.

- Plan B allows for 37-ft through town before project operation. This decreases project operation frequency from a 10-percent chance (10-year) event to a 5-percent chance (20-year) event.

- Stream restoration would be completed that includes stream remeandering, bank grading, riffles/grade control, riparian buffer strips and other actions. If stream restoration projects in the Red River basin are not feasible for project mitigation, the Corps will consider alternative types of mitigation, such as dam removal or rock rapids fish passage to improve connectivity.

- As described in the 2013 SEA, gates were added to the diversion inlet structure allow for more control over receding waters within diversion channel. The rate of fall in the staging area will be limited to ensure it is in line with the natural rate of stage fall.

3.5 Additional Considerations to Minimize Impacts and Mitigation Needs

Coordination with agency members during preparation of the SEA identified additional concerns for the Project. The following recommendations will be performed to minimize adverse effects related to the Project, or its construction:

- To the extent practicable, vegetation clearing activities would be done so as to avoid affecting nesting individuals.

- To the extent practicable, tree clearing on forested land would occur during the winter months in order to not impact listed bird species during their nesting and rearing periods.

- An invasive species management plan, including pre-construction monitoring data previously collected by the Corps and post-construction monitoring of biota and physical habitat for both construction sites and mitigation sites, would be prepared. The plan would outline the inspection procedures and occurrences to ensure compliance. Best Management Practices (BMPs) would be followed to prevent the introduction and spread of aquatic or terrestrial invasive species during Project construction and monitoring.

- Wetland mitigation sites would be managed for invasive species. Invasive and/or non-native plant species would be controlled for three full growing seasons at floodplain forest mitigation sites. Control would consist of mowing, burning, disking, mulching, biocontrol and/or herbicide treatments as needed. By the third growing season, any planted areas one-half acre in size or larger that have greater than 50 percent areal cover of invasive and/or non-native species would be treated (e.g., herbicide) and/or cleared (e.g., disked) and then replanted with appropriate non-invasive plants.

- When construction activities are complete, disturbed areas would be seeded with native plant species or other plant species per Project plans and specifications. After native species have been planted, the seeded areas would be monitored per the Project plans and specifications.

- The non-Federal sponsors would be responsible for noxious weed control on the whole Project perpetually as part of the Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R).

Previous project documentation also had discussed other resource types and potential mitigation needs. These are addressed as follows:

Water Supply Impacts and Mitigation. The FEIS did not identify any significant adverse impacts to water supply. The Project would improve water supply through reduced risk of

contamination or loss of water supply during floods. Water use is described in Section 13 of the Environmental Assessment Worksheet (MN). Impacts and mitigation for rural water supply utilities are described in the MN EIS, Section 3.13.3.3. Impacts and mitigation for water wells are described in the MN EIS, Section 3.16.2.3.6.

Groundwater or Sub-Surface Water Impacts and Mitigation. The FEIS identified a low likelihood of potential impacts to aquifers (Section 5.2.1.6.1). Groundwater is discussed in Section 12 of the Environmental Assessment Worksheet (MN) dated April 12, 2013, which states "The Project is not expected to have adverse impacts to the cumulative condition of aquifers or shallow groundwater in the region." There is no mitigation proposed for aquifers. Groundwater monitoring is discussed in the MN EIS, Appendix B, page 7.

Navigation Impacts and Mitigation. Navigation on the Red River and tributaries is primarily recreation-related. No impacts to recreational opportunities were identified in the FEIS (Section 5.2.3.1.3) or subsequent NEPA documents. This would include recreational boating. The Project would only operate under moderate to high flood conditions when such activities would already be limited if not impossible and dangerous. No mitigation is proposed for navigation. There is a Recreational Plan described in Appendix M of the FEIS. Watercraft use is discussed in Section 15 of the Environmental Assessment Worksheet (MN).

Drainage Impacts and Mitigation. Drainage features of the Project are described in the MN EIS, throughout Chapter 2 and specifically in Section 2.1.1.9. The Project will affect water surface elevations in the upstream inundated area while it is in operation, including drainage ditches that convey flow to the Red River and Wild Rice River in the vicinity of the upstream mitigation area. When the Project control structures are not in operation, there will be no effect on drainage systems upstream. Potential geomorphic changes that could possibly affect drainage over many years are discussed in the MN EIS, Section 3.3 STREAM STABILITY. Specific drainage issues raised in public comments are discussed and responded to with possible mitigation options in Appendix L, including comment #72cc on page 97, comment #112h on page 100, comments summarized on page 104, comment #72t on page 134, and comment #128f on page 138.

Impacts to the Rush and Lower Rush Rivers. Impacts to the Rush and Lower Rush Rivers due to the Project are not deemed to be significant and do not warrant mitigation. These two streams/rivers are channelized and essentially function as a ditch conveying flow. They do function as habitat under some conditions, but they are significantly degraded. They also are intermittent, especially during late summer. Moreover, the Project will re-route flow into the bottom of the diversion channel which is intended to provide some level of sinuosity and habitat value. This habitat value would be similar to, and perhaps slightly greater than, what occurs under existing conditions, as coordinated with the natural resource agencies.

Cold weather impacts at the aqueducts. Biotic monitoring for the Project has been discussed collaboratively with the state and federal agencies. Monitoring during the winter months was

not suggested by this team as biota are typically inactive during this time. During initial design of the Maple River Aqueduct, expertise was sought from the Corps' Cold Regions Research and Engineering Laboratory (CRREL). Concepts for heating the aqueduct were developed by this group and heating the aqueducts has been incorporated into the aqueduct design requirements. A flow gauge or some other method of monitoring could be implemented to ensure flow is continuous.

Mitigation Master Tracking Table (Table 6)

Impact Tables

Aquatic Riverine Habitat Impact	Habitat Lost	Habitat Gained (created channels)	Mitigation Need
Red River Control Structure	6.8	3.1	3.7
Wild Rice River Control Structure	3.5	1.8	1.7
Sheyenne River Aqueduct	4.5	3.2	1.3
Maple River Aqueduct	6.1	4	2.1
Wolverton Creek Structure	0.6	0	0.6
Total Aquatic Mitigation Need:	**21.5**	**12.1**	**9.4**

Impact	Footprint Area (ac)	Habitat Quality Score	Habitat Units Lost (mitigation need)
Total Floodplain Forest Losses:	**124**	**0.51**	**63.2**

Wetland Type	**Southern Embankment Wetland Impacts (acres)**
Open Water	0
Farmed Seasonally Flooded Basin	156
Shallow Marsh	17
Shrub-Carr	0
Wet Meadow	71
Total Acres	**244**

*Wetland impacts from the Diversion Channel will be mitigated through wetlands created in the bottom of the Diversion Channel.

Mitigation Tables

Aquatic Mitigation Projects

Site/Project Name	Site Location	Completion	Acres	Habitat Units	Description
Total Aquatic Habitat Mitigation:					

*Only completed mitigation projects are included in the total mitigation summary.

Floodplain Forest Mitigation Projects

Site/Project Name	Site Location	Completion Date	Acres	Habitat Units Received	Description
Red River site	Oxbow, ND	2017	13	3.3	Restoration of ag row crop area with modifications to hydrology.
OHB Levee Vegetation	Oxbow, ND	In planning	6	1.5	Restoring wetland features for an old Red River oxbow. Includes:
Total Forest Mitigation:				**3.3**	

*Only completed mitigation projects are included in the total mitigation summary.

Wetland Mitigation Projects

Site/Project Name	Site location	Completion Date	Acres	Habitat Units Received	Description
OHB Levee Vegetation	Oxbow, ND	In planning	12	12	Restoring wetland features for an old Red River oxbow. Includes: 7.33 acres of Wet Meadow; 5.08 acres of Shallow Marsh
Forest River	Briarwood, ND	In Planning	6	6	Restoring abandoned property adjacent to RR
Total Wetland Mitigation:			18	**18**	

*Only completed mitigation projects are included in the total mitigation summary.

Section 4. Monitoring

The purpose of this section is to lay out the plan for pre- and post-construction monitoring. Monitoring will be done in concert with the overall adaptive management approach outlined above.

The purpose of monitoring is to better characterize pre-project conditions for key resources, characterize these resources following Project implementation, verify resulting Project impacts, and verify whether mitigation is offsetting these Project impacts. An overview of methodologies is provided, along with a summary of costs. Pre-construction monitoring efforts will be led by the Corps and the Sponsors. Following construction, monitoring and adaptive management would be the responsibility of the Sponsors as a requirement of Project Operation and Maintenance. All monitoring will be done collaboratively with the AMT.

The monitoring approaches outlined below will need to remain flexible to adapt to the needs of the Project. As such, this AMMP, including the monitoring strategies is open to change. Modifications to the monitoring approach could be needed due to altered conditions either pre- or post-project; alternative technologies or techniques that become available for monitoring; and refinement of specific Project features or mitigation actions.

MONITORING ACTIVITIES

Monitoring activities will be focused on key resources of concern. These include:

- Aquatic Habitat (Fish, Invertebrate and Physical Aquatic Habitat)
- Floodplain Forest
- Wetlands
- Geomorphic and Water Quality
- Aquatic Connectivity and Fish Passage
- Fish Stranding

Monitoring for aquatic habitat, floodplain forest and wetlands is associated with impacts warranting mitigation. Monitoring for geomorphology and aquatic connectivity is for impacts that were not deemed to be significant, and will be further assessed following Project construction and operation.

Each monitoring plan includes a recommended schedule(s) based on the information available at the time the team drafted the plan and should be considered preliminary and open to revision based on data and resources available at subsequent planning steps. In addition, many of the monitoring schedules may overlap with each other. Where this occurs, it is highly recommended that the AMT attempt to coordinate field surveys concurrently so that data can be compared and utilized efficiently.

Monitoring activities generally include:

- Pre-Construction monitoring to establish a baseline prior to implementation of the Project.
- Post-Construction monitoring of the impacts that occur, compared to those that were predicted, and evaluate the effectiveness of the mitigation features.

Pre-construction monitoring includes studies that have already been completed, studies underway, and future planned and funded studies performed prior to impacts occurring from the construction process. Pre-construction monitoring may occur during the construction process, provided the resource being evaluated is not being affected by the construction activities. Post-construction is defined as the time period following construction completion of all the Project features. This includes monitoring that may occur following Project operation.

4.1 Aquatic Habitat Monitoring:

Biotic assessments will help answer the following specific questions:

- What is the quality of aquatic habitat directly lost, or potentially altered, through Project features?
- How effective has mitigation been at offsetting impacts to aquatic habitat and biotic integrity?

Biotic assessments will include a series of field investigations:

- Fisheries Assessment
- Macroinvertebrate Assessment
- Physical Habitat Assessment
- Mussel surveys

Biotic assessments outlined here will identify general biotic conditions of the Project area. While there could be some seasonal variability in fish and macroinvertebrate use of select areas, the assessments outlined below are targeted at assessing the general biotic condition and integrity of the Project area.

The general study approach for biotic assessments in impact areas will be a “Before-After-Test-Control” design, allowing multiple forms of comparison. First, sampling prior to and following construction will allow a “Before-After” comparison. Similarly, sampling areas potentially impacted by the Project, as well as adjacent control sites, will allow a “Test-Control” comparison to further verify potential changes due to the Project.

The study locations for biotic assessments will include those identified in Figure 2. These locations may shift based on further Project design or site conditions. Sites will include areas directly within the Project footprint, areas either downstream or upstream of Project structures where hydraulics could change, and nearby control sites. Note that the Lower Rush River was originally sampled for fish in 2011/12, but was dropped from fish sampling during 2017 (Sites

19 and 20, absent from Figure 2). The Lower Rush is highly ephemeral, and though it does have fish during periods when it is flowing, these are generally limited to a few weeks during the spring or other wet periods. Also note that Wolverton Creek is not currently included in Figure 2. This creek was previously sampled in 2011/12, but was dropped from sampling in 2017 when Project designs appeared to avoid impacts to the Creek. With Plan B, box culverts would be placed across Wolverton Creek. Future sampling may be added back in to Wolverton Creek to address impact and mitigation concerns.

Also note that Figure 1 does not include potential aquatic mitigation sites. These will be needed once aquatic mitigation sites are finalized.

Post-construction surveys will include assessing biotic conditions within newly created stream channels that route flow through Project structures. In the case of the Rush and Lower Rush rivers, these stream channels will be re-routed as a single channel in the bottom of the diversion channel. This new channel will be assessed at one or two locations post-construction. This approach will help determine habitat quality and biotic integrity within these new stream channels.

Additional surveys also will be performed in potential mitigation sites. However, since mitigation plans are still being refined, these survey locations have yet to be finalized. Stream restoration will be a primary mitigation method for aquatic impacts, with fish passage also providing mitigation. Monitoring will be needed to verify effectiveness of the mitigation. Mitigation sites will include pre- and post-project sampling. They also may include additional control sites. This plan will be updated as mitigation sites are finalized.

For each sampling site, the following activities will be performed.

1) Site Reconnaissance Investigation
2) Fisheries Assessment
3) Macroinvertebrate Assessment
4) Physical Habitat Assessment

The methodologies to perform the above sampling will largely be adapted from methodologies developed by NDDoH. Both states are developing respective fish and invertebrate IBI scoring systems for the Red River Basin, and these will generally be used to assess rivers in the respective states. Given that the majority of assessments will be performed in North Dakota, the DoH methodology will serve as the source method.

First, site reconnaissance will be performed to establish survey sites and identify appropriate sampling methods for fish, invertebrates and physical habitat based on survey site characteristics. Site reconnaissance likely would be performed during May or June.

Fisheries assessments would then be performed following the fisheries sampling methodology utilized in the 2017 Corps task order for biotic monitoring (available upon request).

Methodology for fish sampling is defined by whether the river is characterized as “wadeable” or “nonwadeable.” Site conditions will dictate which sampling methodology is used. Methodology may need to be modified to accommodate rivers in the Project area, especially the Wild Rice, Sheyenne and Maple rivers which are borderline between being either wadeable or non-wadeable depending on flow conditions. Fisheries sampling for all sites will occur during the low-flow summer period (i.e., July thru September).

Macroinvertebrate surveys would then be performed by methodology also developed NDDoH (methodology also follows the 2017 Corps task order for biotic monitoring; available upon request)) for streams that can be characterized as “wadeable” streams. For streams that are considered “nonwadeable” the methodology will be modified, if possible, to facilitate sampling. This could include sampling macroinvertebrates in near-shore areas that could be accessible by wading. Macroinvertebrate sampling from a boat also will be considered. If acceptable sampling conditions are not available, then macroinvertebrate sampling may be dropped from those survey sites. To the extent possible, invertebrate sampling will occur after fisheries sampling during the low-flow late summer period (i.e., September).

Lastly, a qualitative habitat assessment will be performed to characterize in-stream habitat conditions. The methodology for this is provided at Attachment C. Habitat assessments will be completed during the July through September period.

The monitoring results will be compiled, analyzed, interpreted and described in reports. The monitoring reports will be provided to the partnering agencies either electronically, or in hard copy format, approximately 6 months following completion of field activities (likely in September).

Where needed, all of the above methodologies may be modified to adjust to site conditions. As outlined, river depths may warrant switching between protocol for wadeable and non-wadeable streams. River conditions also could require modifications to sampling equipment or methods. Survey station lengths may be modified, particularly in footprint areas where additional sampling may be done to cover an entire footprint area. Any modifications will be coordinated with the AMT and reflected within the more detailed Scope of Work that will be developed for executing sampling.

Biotic surveys for fish, macroinvertebrates and physical habitat have been performed in project areas (Figure 2) twice prior to construction: 2011/12; and 2017 (Tables 7 and 8). A third round of pre-project sampling will be considered based on results observed during the first two sampling efforts. There will be two post-construction biotic monitoring surveys performed over the first 5 to 10 years following Project completion. Surveys would be performed in the same locations as those for the pre-construction surveys to identify any changes to habitat quality. The need for additional surveys will be considered by the AMT following review of the first two post-construction sampling events.

Mitigation sites, once identified, also will have a minimum of two rounds of pre-project monitoring; and two events of post-project monitoring. Additional sampling events may be performed on mitigation sites, pending review of sampling results by the AMT.

Preliminary mussel surveys were performed in 2011, with results discussed in USACE 2012. As of 2018, the additional need, locations, methodology and number of mussel survey sites are still under consideration. Mussel surveys can be labor intensive, with mussel distribution often spotty or sparse, especially in poor habitat areas. The methods outlined above for macroinvertebrates will assess general biotic condition of the Project area. However, to address remaining specific concerns for mussels, mussel surveys may be considered in footprint impact areas, and potentially other sites. Review of recent mussel survey data may help direct and streamline mussel sampling. Sampling methodology and survey sites will be coordinated with the AMT.

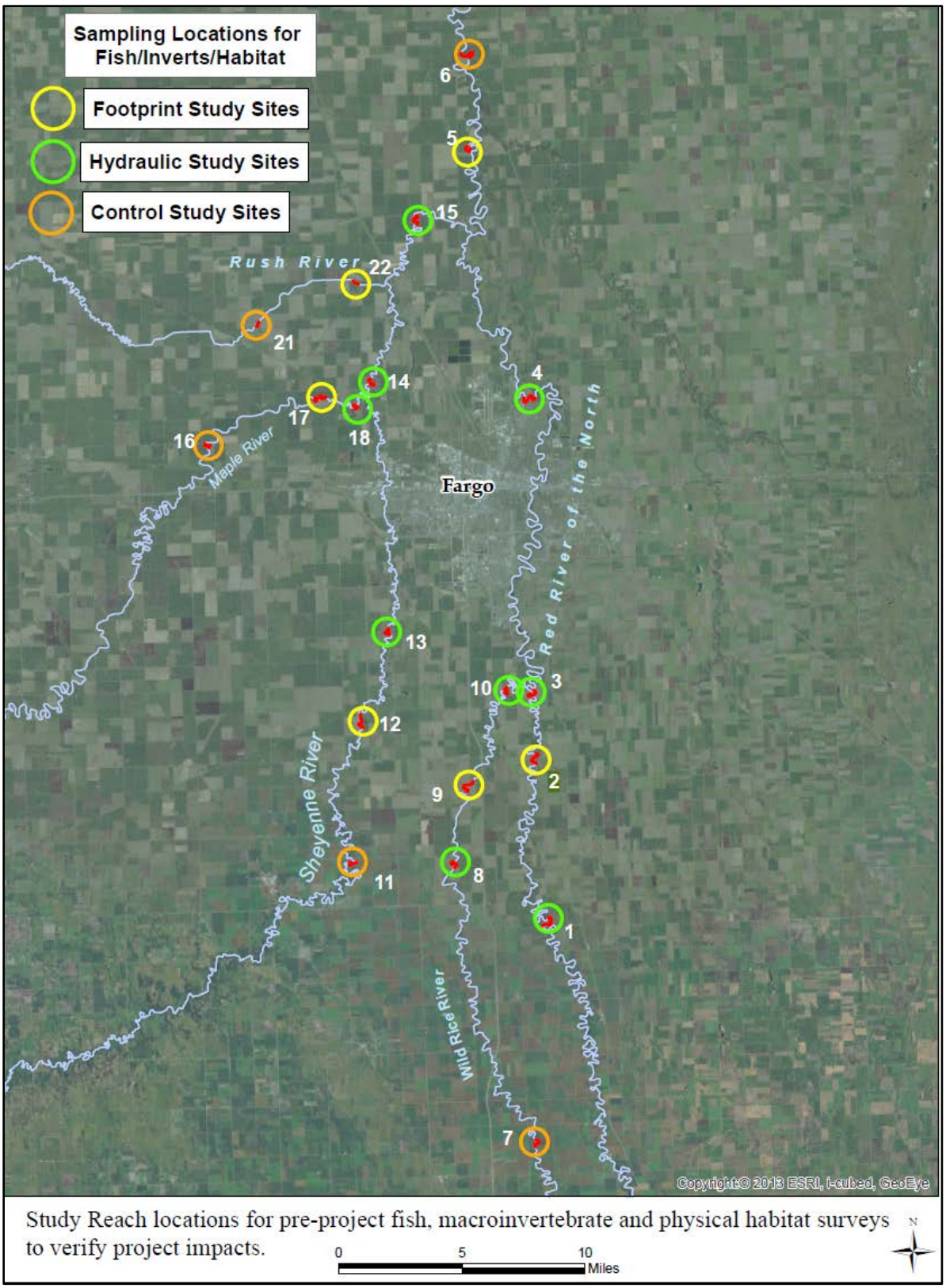

Figure 2. Study Reach locations for pre-project fish, macroinvertebrate and physical habitat surveys to verify project impacts.

Table 7. Calculated IBI scores for fish sampling conducted in 2011/12 and 2017. IBI calculations provided by North Dakota Department of Health from data collected for the Project.

Site	River	Location	2011/12	2017	Site Avg
1	Red River of the North	Upstream Location	60	55	58
2	Red River of the North	Footprint Site	52	53	52
3	Red River of the North	Protected Area	56	43	49
4	Red River of the North	Protected Area	65	46	55
5	Red River of the North	Footprint Site	46	34	40
6	Red River of the North	Downstream Location	51	44	48
7	Wild Rice River	Upstream Location	61	43	52
8	Wild Rice River	Upstream Location	44	59	51
9	Wild Rice River	Footprint Site	43	45	44
10	Wild Rice River	Protected Area	51	46	48
11	Sheyenne River	Upstream Location	60	36	48
12	Sheyenne River	Footprint Site	67	37	52
13	Sheyenne River	Protected Area	63	39	51
14	Sheyenne River	Protected Area	65	43	54
15	Sheyenne River	Protected Area	60	35	47
16	Maple River	Upstream Location	44	61	52
17	Maple River	Footprint Site	49	65	57
18	Maple River	Protected Area	46	52	49
21	Rush River	Upstream Location	65	32	48
22	Rush River	Downstream Location	48	45	46

Table 8. Calculated IBI scores for invertebrate sampling conducted in 2011/12 and 2017. IBI calculations provided by North Dakota Department of Health from data collected for the Project.

Site	River	Location	2011/12	2017	Site Avg
1	Red River of the North	Upstream Location	45	52	49
2	Red River of the North	Footprint Site	48	28	38
3	Red River of the North	Protected Area	41	56	49
4	Red River of the North	Protected Area	58	23	40
5	Red River of the North	Footprint Site	39	46	43
6	Red River of the North	Downstream Location	36	23	29
7	Wild Rice River	Upstream Location	62	61	62
8	Wild Rice River	Upstream Location	47	37	42
9	Wild Rice River	Footprint Site	57	30	44
10	Wild Rice River	Protected Area	35	51	43
11	Sheyenne River	Upstream Location	71	42	57
12	Sheyenne River	Footprint Site	56	55	56
13	Sheyenne River	Protected Area	78	42	60
14	Sheyenne River	Protected Area	73	30	51
15	Sheyenne River	Protected Area	53	32	42
16	Maple River	Upstream Location	61	45	53
17	Maple River	Footprint Site	62	52	57

Site	River	Location	2011/12	2017	Site Avg
18	Maple River	Protected Area	57	41	49
21	Rush River	Upstream Location	68	46	57
22	Rush River	Downstream Location	57	62	59

4.2 Floodplain Forest Habitat:

The majority of baseline data needed to quantify existing habitat value of floodplain forest impact areas has been collected (please see Appendix F of 2011 FEIS). No additional floodplain forest surveys are planned prior to construction. Following construction, monitoring will be performed to determine the condition of these habitat types and the overall effectiveness of their mitigation; see Section 5 for detailed performance standards/metrics.

Vegetation will be monitored annually for the first 5 years following planting using stratified random sampling. At each randomly generated point within the areas planted, plots of 0.01 acre will be surveyed according to Corps standard forest inventory procedures. An average of at least one plot per acre will be surveyed. Tree survival and composition will be monitored every 10 years and following major flooding. Plot monitoring will assess the following specific criteria (also repeated in Section 5)

1. Restore native floodplain forest and herbaceous vegetation. The floodplain forest should include green ash, cottonwood, black willow, hackberry, silver maple, quaking aspen, American elm, American basswood, and bur oak.
2. Restore stand density with an average of 300 trees per acre over 80 percent of the mitigation site(s) with diameter at breast height (DBH) of 2 inches within 10 years. This tree density is typical for the Red River Basin floodplain forest in the Project vicinity.
3. Restore floodplain forest community with a target species composition of at least 10 percent by number of individual trees to be bur oak and hackberry, with the rest a mix of green ash, cottonwood, black willow, boxelder, American elm, silver maple and American basswood.
4. Allow some regeneration of native herbaceous plants, shrubs, and trees from locally produced propagules on 20 percent of the mitigation land area, to create diversity in forest and herbaceous vegetation in the mitigation area.
5. Protect and manage the site(s) in perpetuity by an agreement for management as a wildlife management area by the Minnesota Department of Natural Resources or North Dakota Game and Fish Department.

The monitoring results will be compiled, interpreted and described in letter reports. The monitoring reports will be provided to the partnering agencies and the public upon request. The AMT will decide if additional forest monitoring is needed at the conclusion of the 5 year period for floodplain forest.

The monitoring approach identified above is targeted for establishing new forests. As the forests sites age, monitoring beyond the first 5 years, if recommended by the AMT, may be adjusted to evaluate mature forests. At that point, forestry monitoring may be performed using St. Paul District's Forest Inventory Phase II Protocol (available upon request), adapted as needed for monitoring in the project area.

In addition to the monitoring activities outlined above, forest monitoring will include, based on agency input, the following actions:

- Monitoring Plan: Sites would be monitored for tree survival annually for five years, then tree survival and composition at ten years. Tree survival and composition would be monitored every five years thereafter and following major wind storms.

- Adaptive management would be used to monitor the mitigation sites. Monitoring would include measurement of specific performance standards (outlined above and in Section 5) and the implementation of corrective action measures if the standards were not being met.

- For those impacted forest areas that are also wetlands, the MNRAM wetland assessment method or other agreed upon methods would be used to assess the adequacy with which the mitigations replaced lost wetland function.

4.3 Wetland Habitats:

A wetland delineation has been conducted along the alignments for the diversion channel and Plan B southern embankment, and included a MNRAM functionality assessment. This information was used to verify the mitigation approach for these wetlands. Surveys of the diversion channel will be performed to verify that wetland type and function present are offsetting wetland areas lost through construction.

Wetland monitoring will include a wetland delineation of the site applying the *Corps of Engineers Wetlands Delineation Manual*, *Regional Supplement to the Corps of Engineers Wetland Delineation Manual: Great Plains Region (current version)*. Please reference that manual for specific methodology. This delineation will be prepared by a wetland professional.

Annual mitigation monitoring will be performed for five years after completion of a given mitigation site. Annual mitigation reports will be submitted to the AMT on the status of the mitigation. The reports will be submitted by December 31 following each of the first five growing seasons. The reports will, at a minimum, include the following information:

1. All plant species along with their percent cover, identified by meandering through each vegetative community, including upland buffers, and list commonly encountered – or dominant and co-dominant species observed. In addition, the presence, location and

percent cover of invasive, noxious and/or non-native species in any of plant communities will be noted.

2. Vegetation cover maps at an appropriate scale will be submitted for each reported growing season.
3. Photographs showing all representative areas of the mitigation site taken at least once each reported growing season during the period of July 1 to September 30. Photographs will be taken from a height of approximately five to six feet from at least one location per acre. Photos will be taken from the same reference point and direction of view each reporting year. Location of the photographs should be mapped on a GPS unit
4. Surface water and groundwater elevations in representative areas (e.g., at least one sample point in each plant community) recorded at least once each week for the first 10 weeks of each growing season, thereafter taken monthly for the remainder of each growing season. The location of each monitoring site will be shown on a plan view of the site.
5. If non-compliance activities are occurring on the site, the activity will be noted, photographed and mapped on a GPS unit. Best professional judgment would be used to determine if the activity is not compliance with easement or mitigation site plan.

Over two-thirds of the wetlands that are impacted are seasonally flooded wetlands or farmed wetlands; these wetlands have very poor function. It is not environmentally preferable to compensate for impacts to degraded wetlands by deliberately providing degraded compensatory mitigation projects. A compensation project should result in high quality wetlands that provide optimum functions within its landscape context, taking into account unavoidable constraints. Even though the wetlands impacted by the Project are generally highly degraded they should be mitigated for by restoring equal acres of wetland or by restoring functions that are lacking in the Red River Basin watershed. Wetland mitigation will be evaluated with a functional assessment tool (MNRAM) to factor in wetland quality and functional value and ensure that mitigation is adequate.

In addition to the monitoring activities outlined above, wetland monitoring will include, based on agency input, the following actions:

- Adaptive management would be used to monitor any project-specific mitigation sites. Monitoring would include measurement of specific performance standards (described in Section 5) and the implementation of corrective action measures if the standards were not being met.

- The MNRAM wetland assessment method or other agreed upon methods would be used to assess the adequacy with which the mitigations replaced lost wetland function.

4.4 Geomorphology Monitoring:

The Red River and tributaries are dynamic river systems that naturally show movement of their mobile boundaries. A first step for evaluating the system and rates of change is to use existing data to start describing typical types of change and what types and scales of impacts will trigger a need for a response action. The monitoring plan included with this AMMP also identifies and recommends survey sites and protocols that would help to establish baseline conditions. Geomorphic monitoring would be performed following the sampling methodology utilized in the 2018 Corps task order for geomorphology monitoring of the Project (available upon request). Sites that already show changes in response to existing processes will need to be monitored as well as sites that are expected to show change in response to the Project construction and operation. Test sites, i.e., control sites, outside of the Project impact area will also be monitored to help establish rates of change and natural variability in response to drivers other than the Project. Collecting reference and pre-construction data will help establish reference ranges of change rather than singular thresholds for delineating changes outside of the range of norms. Reference ranges of change or acceptable levels of change will be established for individual reaches or Stations as appropriate. This will ensure that ranges established consider local site conditions.

The specific criteria for defining impacts and response action levels will need to be further refined. The Geomorphology Monitoring Team (GMT) has started developing a list that includes:

Quantity/Nature of Change

- The fraction of total study area experiencing a given impact
- Human induced changes
- Status of boundary conditions
- Identified acceptable ranges of change for variables

Hydrology & Hydraulics

- Driven by changes in land use, precipitation, others
- Others

Water Quality/Biogeochemistry

- Total Maximum Daily Loads (TMDL's)

Geomorphology

- Natural meander migration
- Planform changes i.e.:
  - radius of curvature
  - sinuosity
- Changes in Channel Migration and Rates
- Incidence of slope failures: Existing, New, and Re-activated
- Characteristics of bank and over bank areas/Riparian and other

Biota

- Vegetative characteristics
  - Bank
  - Overbank
  - Riparian
- Ecosystem community characteristics
- Others

As stated above, vital data will need to continue to be collected and analyzed that will be used to help develop the significance criteria. This data would include key stability indices/ parameters of change such as:

- Cross sectional area
- Bed slope
- Width to Depth Ratio
- Thalweg elevation trends to indicate aggradation or degradation/incising
- Bank Height and slope

Drivers that will be considered include but may not be limited to, are:

- Precipitation changes in duration, frequency, and volumes.
- Project operation variables
- Vegetation changes—Riparian Corridor, Trees, Power lines
- Overbank deposition
- Sediment
- Woody Debris
  - Rotation into center of channel affects flows and can direct flow into banks.
  - Can also serve as bank protection
- Natural Levee Deposition
- Hydraulic Drivers – Flow changes due to
  - Land use changes
  - Drainage

The significance of the changes will depend on the context of the change including: location, rates, and secondary impacts of the change on: channel stability, ecosystem functions and values, flood and infrastructure protection and others.

The GMT recognizes that there are several classes of criteria that can be used to set thresholds for defining impacts to the system. Those classes of criteria may be for example; impacts on structures, impacts on riparian habitat, impacts on meander migration rates, etc. and have different thresholds for triggering responses and need to be recognized and discussed explicitly in future.

Further discussion on criteria will need to occur prior to finalization. These discussions will continue through multiple sampling intervals as data both pre- and post-construction data

collection help to inform what impacts are natural, as a result of some other action, or as a result of the Project.

Geomorphology monitoring will be performed three times for pre-project conditions. At this time, the plan is to include up to four post-project monitoring events. Post-project monitoring will include two sampling events within 5 to 10 years after project construction. Ideally, an additional two monitoring events would be completed after the project operates. However, given the uncertainty when that will occur, the timing of these last two sampling events will be re-evaluated by the AMT within 5 to 10 years of project completion.

In addition to the activities outlined above, geomorphology monitoring will include, based on agency input, the following actions:

- Monitoring and adaptive management to track before and after Project changes and adjust management of the Project through Geomorphology Assessments.

- **Geomorphology Assessment** – Monitoring - Includes: Pre- and post-construction geomorphic surveys, including two surveys prior to, and two surveys following construction. This is in addition to the previously collected pre-design data set. Another pre-project sampling event may occur during construction if a large event occurs. A pre-design survey was completed in 2010 and 2011 (Geomorphology Report of Fargo, North Dakota and Moorhead Minnesota Flood risk Management Project, West 2012). The Geomorphology Monitoring Team (GMT) adapted the survey plan used in 2010-2011 with additional and revised cross section survey locations, longitudinal profiles, and overbank deposition assessments for a more complete pre-construction geomorphology monitoring survey plan that is being implemented summer of 2018. Post-construction geomophic surveying would occur at five year intervals for three cycles following completion of Project construction. Additional surveys may occur if deemed necessary through the adaptive management process.

- **Geomorphic Assessment Tasks**: Analysis of hydrology, bank stability, sediment transport, and morphological classification. Following three sampling events, both pre- and post-construction, the Geomorphology Monitoring Team (GMT) would assess findings and determine whether changes to the sampling locations, types of data and/or sampling frequency are necessary. If Project is operated, sampling would occur as soon as possible following Project operation.

- Final control structure designs will account for energy dissipation. Once design is finalized, shear stresses and velocities flowing out of the control structures will be verified to be lower than the threshold values for stiff clay.

- **Adaptive management approach**: Following Project operation, if bank failures or increasing bank instability is observed under the typical receding limb rate, the

drawdown should be decreased systematically until a solution is reached by the AMT. The AMT would consider potential impacts that would result from decreasing the drawdown (e.g., agricultural impacts) in their approach.

- **Cross Section and Geomorphic Assessments Qualifications**: The RIVERMORPH data management software package (Software and Worksheets http://www.wildlandhydrology.com/html/RiverStability.html) associated with the Rosgen Stream assessments is a DNR-preferred storage format and shall be part of the data management and analysis package supported by the monitoring plan implementation. Other data management software packages like, but not limited to, DSS (Data Support System) used widely by the Corps and other agencies will be considered for specific uses. Standards for qualification in cross section and geomorphic sampling and analysis is for the raw data for the geomorphic assessment be collected by practitioners with 10 years of experience in riverine geomorphic measurements and analysis. The standard Level III assessment is not entirely applicable to the Red River, but some of the data collected will be useful for tracking changes over time. There are additional peer reviewed references to consider in addition to the Rosgen method for a comprehensive analysis of the system.

- **Hydrology and Hydraulic Monitoring**: USGS gages will used for hydrology and hydraulic monitoring in the study area. The addition of three new gages is proposed at the three control structures: the diversion inlet structure, the Red River structure, and Wild Rice River structure.

- **Bathymetry**: This data will be collected every 10-20 years in absence of large geomorphic change events.

- **Sediment Samples**: Both instream and bed and bank sediment samples will be taken to determine sediment load and particles. Pre- and post-construction surveys will follow the same schedule as cross sections in new GMS locations or where significant changes are apparent with respect to the historical data.

- **Bed Scour**: Monitoring for bed scour at the control structures will be completed once the design and operating plan is finalized for these structures.

- **Communication with Local Agencies**: Annual or more frequent communication will occur with representatives from local agencies regarding channel morphology.

- **Field Reconnaissance**: A reconnaissance of the detailed study reaches and the diversion channel will be conducted upon completion of the Project (to establish baseline as a conditions) and every five years thereafter for the first ten years. If no significant changes are noted, reduce to every ten years. Prior to every ten-year interval, the GMT will meet to determine whether the reconnaissance is needed, based on the occurrence

of floods in the previous 10 years. If no flooding has occurred, it is possible the reconnaissance won't be needed.

- **LiDAR**: LiDAR is flown every 3 years and will be used to complement cross section data on the reaches in areas that are not surveyed, with a focus on the Red River corridor. If the interval of LiDAR flights is changed in the future, the Corps recommends it be flown the years that geomorphology monitoring surveys are done in order to improve comparisons.

- **Water Quality**: Water quality will be sampled to assess river response to the Project. Sampling frequency would be dependent on data being gathered (some continuous and some parameters would follow sediment sampling frequency).

- **Aerial Photography**: Aerial photography would be used to capture trends in the land surface, including use and observations of impacts from the Project and other causes. Aerial photographs would be taken in conjunction with the LiDAR sampling and immediately following Project operation. The sampling frequency can be revisited with each geomorphic assessment and adapted to address or monitor specific concerns.

4.5 Aquatic Connectivity and Fish Passage:

Previous Project plans and resulting analyses identified potential impacts to biological connectivity and various mitigation actions (2011 FEIS; 2013 SEA). Monitoring was previously outlined to evaluate these impacts and resulting mitigation success following Project implementation.

With the revised Project presented within the 2018 SEA, the impact determination and resulting mitigation needs have changed. While the proposed Project will briefly limit biological connectivity, the level of adverse effect associated with this brief and infrequent disruption is expected to be less than that which would require mitigation.

Monitoring will be done to verify conditions associated with the following:

1) Are fish likely able to pass through the Red River and Wild Rice River control structures up until the point of Project operation?
2) Are fish able to migrate through the Sheyenne and Maple river aqueducts?

Monitoring to assess potential impacts to fish migration would be done once Project features are in place. Evaluation of the aqueducts could occur immediately; while evaluation of the control structures would be dependent on flow conditions approaching that which would put the Project into operation. No pre-project monitoring is currently planned to assess fish movements.

During coordination in winter 2010-2011, natural resource agencies expressed a preference to perform a comprehensive pre-project fisheries monitoring to assess fish migration. This would include detailed assessments to document the timing and duration of migration for most Red River species and movement of fish back and forth between the Red River and Project area tributaries. However, while this could be helpful information, a comprehensive pre-project migrational assessment is currently not planned for the following reasons. First, existing data is available to suggest the timing and duration of migration for several species in the Red River basin. Second, this report assumes fish have the ability to migrate freely through the upper Red River at any time under pre-project conditions. Third, collection of detailed information on fish migrations would be expensive compared to other baseline monitoring. Fourth, data such as fish telemetry data is highly variable, and may not provide a substantial improvement over existing knowledge. For these reasons, the Corps concluded that pre-project monitoring for fish migrations would not be completed. This conclusion could be revisited if more cost-effective means are identified to collect such information.

Monitoring of conditions at both the aqueducts and the control structures would likely occur in phases. First, hydraulic observations would be made at both the aqueducts and the control structures. For the aqueducts, this could occur at a range of flow conditions, up to and beyond the point where the aqueducts are spilling water into the diversion channel. For the control structures, hydraulic observations would be considered for flows at approximately a 20%, 10% and 5% chance discharge. Observations at both the aqueducts and control structures would help biologist understand not only velocities, but flow patterns and other factors that influence the ability for fish to cross identified features.

Based on hydraulic observations, the AMT may recommend a second phase of biological monitoring to evaluate if fish can cross the aqueducts and control structures under certain conditions. The exact methodology and number of sampling events still need to be identified. However, monitoring could include activities such as netting, radio telemetry and/or hydroaccoustic monitoring.

Netting could be done immediately above a control structures or aqueduct, and would provide insight into which species are able to migrate through these features. Netting is a fairly easy and inexpensive method to evaluate whether fish are able to pass through Project structures. However, netting may be difficult under high flow conditions.

Radio telemetry could be used to assess how many fish approach the structures, and what portions of those fish are able to migrate through these structures. This information would be extremely beneficial for assessing fish movement through Project structures. The drawback is that radio telemetry studies can be considerably more expensive, particularly for the equipment that is involved. It also requires the collection of fish and attachment or surgical implantation, which is labor intensive. Radio telemetry is biased toward larger bodied fish that can better handle the radio transmitter. There are also limitations in how long radio

transmitters may last, which is problematic given that we do not know when there will be flooding events significant enough to activate the Project.

Hydroaccoustic monitoring can detect the presence of fish much like a camera, but work effectively in turbid waters. Hydroaccoustic monitoring (e.g., imaging sonars such as the DIDSON) can monitor presence of fish below a potential impediment, and could monitor fish migration through structures. This technology has limitations in how effectively it may work under conditions with heavy debris flow, turbulence and entrained error. It also generally does not differentiate species of fish, only fish size.

It should be noted that the technology available for radio telemetry, sonar and hydroaccoustic monitoring is evolving rapidly. The tools available for assessing fish migration may be different (and improved) by the time the Project is ready for operation. The exact methodology to evaluate fish migration has not been developed as Project construction may not be completed for several years. The AMT will further develop this specific methodology in the years ahead.

Coordination with agency members during preparation of the 2018 SEA identified concerns associated with the aqueducts and resulting effects on biota. These relate to connectivity, and monitoring will include the following considerations:

- The mitigation and adaptive management proposed that includes monitoring fish, macroinvertebrates, and physical habitat would apply.

In addition to the activities outlined above, fish passage and connectivity monitoring will include, based on agency input, the following actions:

- Fisheries, physical habitat, and macroinvertebrate assessments would be completed pre- and post-Project operation to establish baseline and Project conditions. At least two fish monitoring events would be conducted prior to construction of the Project and the survey locations would include areas near the footprint of the Project structures (i.e., control structures, aqueducts, rock-ramps, etc.), as well as sites above or below the features. As of 2018, two pre-construction fish surveys have already been completed and a third is being considered. At least two fish monitoring events would be conducted post-construction.

- Adaptive management would be used by the AMMPT to determine if additional mitigation is necessary based on assessment results.

- The aquatic habitat within constructed channels would be measured (quantity and quality) and compared against pre-construction conditions to assess if additional aquatic habitat mitigation is necessary.

- Visual Assessment to evaluate fish stranding after Project operation would be completed by the non-Federal sponsors (discussed in section 4.6)

4.6 Fish Stranding:

Monitoring will be done to assess the effects of Project features on fish stranding. Monitoring will include cursory visual assessments, following Project operations, to observe potential for stranded fish. Observations will focus on likely problem areas, to include low areas in topography near the river channel upstream of the Red River and Wild Rice River control structures. Observations also will be made in the diversion channel. Observations will include notes on numbers, species and size of fish observed. This effort should be done collaboratively with resource agency partners. Observations would then be discussed within the AMT. At a minimum, these observations should be made following the first two events where the Project operates. If substantial numbers of stranded fish are observed, a more rigorous assessment of fish stranding could be developed and employed to better quantify the number of fish stranded. A decision can be made at that time, based on recommendations by the AMT, whether corrective actions should be taken.

4.7 Additional monitoring needs:

Coordination with agency members during preparation of the 2018 SEA identified additional monitoring concerns for the Project. These include needs for species or biota of special concern, and invasive species. Monitoring will include the following activities:

- Bald eagles nests would be monitored every spring through the completion of all construction. The project area would continue to be monitored during the upcoming years to ensure that no new nests would be impacted by Project construction.

- Similar to eagle surveys, there would be raptor nest surveys completed in the spring of the year preceding construction within or near any affected wooded areas.

- Additional mussel surveys are being considered for Project footprint areas to verify whether impacts to mussel resources would be substantial. This would include determining presence of the black sandshell, mapleleaf and Wabash pigtoe mussels.

- To the extent practicable, vegetation clearing activities would be done so as to avoid affecting nesting individuals.

- To the extent practicable, tree clearing on forested land would occur during the winter months in order to not impact listed bird species during their nesting and rearing periods.

- Plan B allows for 37-ft through town before project operation. This decreases project operation frequency from a 10-percent chance (10-year) event to a 5-percent chance (20-year) event. Because of this reduction in project operation frequency, the Corps no longer considers operation of the Red River control structure a significant connectivity impact. Specific monitoring of connectivity impacts to lake sturgeon associated with project operation is not recommended.

- A monitoring plan would be prepared that would include procedures on survey for identifying invasive species, treatment plans, and follow-up surveys to confirm that treatments are effective.

- Monitoring would be completed on an annual basis in accordance with the OMRR&R and adaptive management plan.

4.8 Monitoring Schedule and Costs

Table 9 provides a summary of what monitoring has been completed; and a tentative plan for additional monitoring prior to or during Project construction. Because of uncertainties with funding, field conditions, and the results of earlier surveys, the need and timing of additional survey work could shift. Note that two of three events of aquatic biotic/habitat surveys have been completed for impact areas; and two of three or four geomorphic survey events will have been completed by the end of 2018. The schedule for surveys of aquatic habitat mitigation sites will be developed once mitigation plans are finalized.

Table 9. Estimated scheduled for pre-construction Project monitoring. The number and timing of events for aquatic habitat mitigation sites will be set once the mitigation plans are finalized.

Monitoring Event	Year	Status
Geomorphology Pre-construction, first round	2011	Completed
Geomorphology Pre-construction, second round	2018	Underway
Geomorphology, third round	2020	Tentatively Scheduled
Aquatic Biotic/Habitat, first round	2011 & 2012	Completed
Aquatic Biotic/Habitat, second round	2017	Completed
Aquatic Biotic/Habitat, third round	2020	Tentatively Scheduled
Aquatic Habitat Mitigation	TBD	TBD
Floodplain Forest, Pre-Construction	2010	Completed
Wetlands, Pre-Construction	2010-2018	To be updated with final designs
Eagle/Raptor Monitoring	Annual	On-going

The schedule for post construction surveys will be set once the Project is largely constructed.

Table 10 provides an estimate for pre- and post-construction monitoring costs. Specific line-item costs have not been included for observations for fish stranding or floodplain forest

success as these activities would be likely be a relatively small efforts accomplished by the non-Federal sponsor. Invasive species monitoring will be included as a component of both forestry and wetlands monitoring. The estimate below will be revised as Project costs are updated to reflect current dollars as well as any necessary changes. Note that monitoring estimates for mitigation sites could increase or decrease depending on the number, location and type of mitigation and monitoring sites ultimately selected.

Table 10. Estimated monitoring costs for the AMMP.

Project Phase	Studies	Cost
Pre-Project	Geomorphic Assessment (up to 2 events remaining after 2018)	$1,000,000 (per event)
Pre-Project	Aquatic Biotic/Habitat (1 event remaining)	$750,000 (per event)
Pre-Project	Aquatic Biotic/Habitat – Mitigation Sites (2-3 events)	200,000 (per event)
Post-Project	Geomorphic Assessment (3 events and re-evaluation)	$1,000,000 (per event)
Post-Project	Aquatic Biotic/Habitat (including mitigation sites; up to 3 events)	$1,000,000 (per event)
Post-Project	Connectivity Hydraulics Monitoring (3 flow levels)	$250,000 (per event)
Post-Project	Diversion Channel Wetlands Monitoring (5-10 years)	$200,000 (annually)

Section 5. Performance Standards/Metrics

Corps regulations require that projects develop and use criteria for determining ecological success of mitigation, and to ensure Project impacts are offset. The metrics used to measure impacts and mitigation effectiveness are described below. Even with the use of metrics, it is recognized that conclusions on Project impacts and mitigation success will need to include detailed review of data and collaboration amongst the AMT. Even then, opinions may differ on the questions at hand. However, the discussion below provides guidance on the metrics that will be used to verify Project impacts and mitigation effectiveness. These metrics will provide the primary measure of whether or not mitigation has proven effective.

5.1 Performance Standards and Metrics

Aquatic Habitat

Performance Standards:
Restore aquatic riverine habitat with an area and quantity needed to offset the loss of such habitat through footprint impacts. Using IBI scores as a quality indicator, calculate habitat lost/gained by the equation: IBI score X footprint area = Habitat Unit. The metric for measuring success will be the habitat unit calculated using IBI scores as the quality factor.

Floodplain Forest

Restore floodplain forest habitat with an area and quantity needed to offset the loss of such habitat through footprint impacts. The following performance standards will be used to measure when forest mitigation has reached full effectiveness. The metric will be the habitat unit, adjusted for quality over time against when the standards below are met.

Performance Standards:

1. Restore native floodplain forest and herbaceous vegetation. The floodplain forest should include green ash, cottonwood, black willow, hackberry, silver maple, quaking aspen, American elm, American basswood, and bur oak.
2. Restore stand density with an average of 300 trees per acre over 80 percent of the mitigation site(s) with diameter at breast height (DBH) of 2 inches within 10 years. This tree density is typical for the Red River Basin floodplain forest in the Project vicinity.
3. Restore floodplain forest community with a target species composition of at least 10 percent by number of individual trees to be bur oak and hackberry, with the rest a mix of green ash, cottonwood, black willow, boxelder, American elm, silver maple and American basswood.
4. Allow some regeneration of native herbaceous plants, shrubs, and trees from locally produced propagules on 20 percent of the mitigation land area, to create diversity in forest and herbaceous vegetation in the mitigation area.

5. Protect and manage the site(s) in perpetuity by an agreement for management as a wildlife management area by the Minnesota Department of Natural Resources or North Dakota Game and Fish department.

Trees will be replanted as needed to meet the target vegetation cover (see Performance Standards in Section 5). Invasive and/or non-native plant species will be controlled for 3 full growing seasons. Control will consist of mowing, burning, disking, mulching, biocontrol and/or herbicide treatments as needed. By the third growing season, any planted areas one-quarter acre in size or larger that have greater than 50 percent areal cover of invasive and/or non-native species will be treated (e.g., herbicide) and/or cleared (e.g., disked) and then replanted with trees.

Wetlands

Restore wetland habitat with an area and functional value to offset the loss of such habitat through footprint impacts. The following performance standards will be used to measure when wetland mitigation has reached the appropriate functional value. The metric will be the acre meeting functional value as measured by MNRAM.

Performance Standards:

Seasonally Flooded Basin Wetland Compensatory Mitigation Performance Standards

1. Seasonally flooded basin plant community types shall achieve a species composition that includes ten or more species of native/non-invasive grasses, sedges, ferns, rushes and/or forbs by the end of the fifth full growing season. Alternatively, a MnRAM vegetative diversity and integrity rating of “high quality” at the end of the fifth full growing season will also satisfy this performance standard.

2. More than 50 percent of vegetative areal cover within the wetland communities of the mitigation site shall be composed of FAC, FACW or OBL species.

3. Control of invasive and/or non-native plant species shall be carried out for five full growing seasons. Control shall consist of mowing, burning, disking, mulching, biocontrol and/or herbicide treatments. By the third growing season, any areas one-quarter acre in size or larger that have greater than 50 percent areal cover of invasive and/or non-native species shall be treated (e.g., herbicide) and/or cleared (e.g., disked) and then reseeded. Follow-up control of invasive and/or non-native species shall be implemented as stated above.

4. Hydrology shall consist of inundation by a few inches to 24 inches of water for a minimum of 14 consecutive days during the growing season under normal to wetter than normal hydrological conditions (the 70 percent of years based on the most recent 30-year record of

precipitation). Inundation shall be typically absent following the first 6 weeks of the growing season and the water table typically drops below 12 inches from the soil surface for the majority of the growing season in most years (>50 percent). Minor deviations from this hydrology standard shall be allowed provided monitoring data demonstrates that the site has wetland hydrology and the Corps concurs that the vegetative performance standards for a seasonally flooded basin have been achieved.

Shallow Marsh Wetland Compensatory Mitigation Performance Standards

1. Shallow marsh plant community types shall be dominated by three or more native aquatic species, with at least four native species occurring within areas demarcated as shallow marsh by the end of the 5th full growing season. Alternatively, a MnRAM vegetative diversity and integrity rating of "high quality" at the end of the fifth full growing season will also satisfy this performance standard.

2. More than 50 percent of vegetative areal cover within the wetland communities of the mitigation site shall be composed of FAC, FACW or OBL species.

3. Control of invasive and/or non-native plant species shall be carried out for five full growing seasons. Control shall consist of mowing, burning, disking, mulching, biocontrol and/or herbicide treatments. By the third growing season, any areas one-quarter acre in size or larger that have greater than 50 percent areal cover of invasive and/or non-native species shall be treated (e.g., herbicide) and/or cleared (e.g., disked) and then reseeded. Follow-up control of invasive and/or non-native species shall be implemented as stated above.

4. Hydrology shall consist of a water table <6 inches below the soil surface, to inundation up to 6 inches in depth, for a minimum of 56 consecutive days, or two periods of 28 or more consecutive days, or four periods of 14 or more consecutive days, during growing seasons under normal to wetter than normal hydrological conditions (the 70 percent of years based on the most recent 30-year record of precipitation). During the growing season, inundation up to 18 inches in depth is permissible during wetter than normal years or in response to precipitation events provided that the duration does not exceed 28 consecutive days (i.e., water depth drops from 18 inches to 6 inches within 28 days).

Wet Meadow Wetland Compensatory Mitigation Performance Standards

1. Wet meadow plant community types shall achieve a species composition that includes ten or more species of native/non-invasive grasses, sedges, ferns, rushes and/or forbs by the end of the fifth full growing season. Alternatively, a MnRAM vegetative diversity and integrity rating of "high quality" at the end of the fifth full growing season will also satisfy this performance standard.

2. More than 50 percent of vegetative areal cover within the wetland communities of the mitigation site shall be composed of FAC, FACW or OBL species.

3. Control of invasive and/or non-native plant species shall be carried out for five full growing seasons. Control shall consist of mowing, burning, disking, mulching, biocontrol and/or herbicide treatments. By the third growing season, any areas one-quarter acre in size or larger that have greater than 50 percent areal cover of invasive and/or non-native species shall be treated (e.g., herbicide) and/or cleared (e.g., disked) and then reseeded. Follow-up control of invasive and/or non-native species shall be implemented as stated above.

4. Hydrology shall consist of a water table 12 inches or less below the soil surface for a minimum of 28 consecutive days, or two periods of 14 or more consecutive days, during growing seasons under normal to wetter than normal hydrological conditions (the 70 percent of years based on the most recent 30- year record of precipitation). Depth of inundation during the growing season shall typically be 6 inches or less with duration of less than 14 consecutive days (Exceptions can be made for wetter than normal years or sites with hummocky microtopography where hollows between hummocks can have standing water depths up to 6 inches for extended periods of time). Minor deviations from this hydrology standard shall be allowed provided monitoring data demonstrates that the site has wetland hydrology and the Corps concurs that the vegetative performance standards for a wet meadow have been achieved.

Geomorphology

The performance standards and metrics for evaluating geomorphological change are still under development by the AMT. Impacts will be assessed through collection of pre- and post-project geomorphic data. Factors such as channel stability, channel location and cross-sectional area, slope and other factors will be compared for potential change. Prior to construction, experts in geomorphology will be consulted to verify what level of change with these variables constitutes a significant geomorphic impact. This information will be coordinated with the AMT, and this plan will be updated as appropriate.

Connectivity

Impacts to connectivity will be assessed, although verifying the level of effect may be more subjective. The AMT will collaboratively work to assess the effectiveness of Project structures in facilitating fish movement.

5.2 Contingency Plans

Post-project monitoring will include an evaluation of mitigation effectiveness. Should mitigation prove ineffective, or should impacts prove more significant than previously anticipated, then additional mitigation may be warranted. Contingency mitigation would likely involve additional

habitat creation or restoration features in a great enough quantity to satisfy the mitigation deficiency.

The AMT must first identify which resources still have remaining impacts needing mitigation. This remaining impact should be quantified. Potential mitigation can then be identified to offset this remaining impact.

Funding mechanisms for implementing additional mitigation must then be identified. In this case, federal project funding would be provided through construction and until the Project is turned over to the non-Federal sponsors. Thus, funding would be provided for construction of planned mitigation projects, and potentially some of the initial post-project monitoring. It cannot be guaranteed that federal funds would be available, specific to this Project, for contingency mitigation.

The non-Federal sponsors will be responsible for contingency mitigation. They will collaborate with the AMT and other appropriate local, state and federal agency representatives to identify the appropriate mitigation needs and funding source. This could include the use of local or State funds to address remaining mitigation needs. The non-Federal sponsors could coordinate with the Corps for possible funding under the Corps' Continuing Authorities Program (CAP). The non-Federal sponsors also could coordinate with their congressional leaders for authorization and appropriation of additional funds to address contingency mitigation.

5.3 Data Storage

The AMMP will generate a lot of data, information and reports over time. The data and subsequent reports should be accessible and shared for redundancy and analysis purposes as well as stored as part of the monitoring record and for future data needs. The Corps and the sponsors will work with the AMT to develop a repository for this information. This will likely be a web-based system, providing access to summary reports and potentially raw data. All AMMP work products will be shared with the AMT when requested.

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