US Army Corps
of Engineers®
St. Paul District

Design Documentation Report

Fargo Moorhead Metropolitan Area
Flood Risk Management Project

Reach 5 Diversion Channel and Lower Rush River Drop Structure

Engineering and Design Phase

P2# 370365

Doc Version: Post FTR Submittal

24 February 2015

This page is intentionally left blank

Design Documentation Report

Table of Contents

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

ATTACHMENTS

Design Documentation Report

1 INTRODUCTION

1.1 Project Location

The cities of Fargo, North Dakota and Moorhead, Minnesota are located near the confluence of the Red River of the North and the Sheyenne River. The Fargo-Moorhead Metropolitan Area is located within an area from approximately 12 miles west to 5 miles east of the Red River of the North and from 20 miles north to 20 miles south of Interstate Highway 94. The metropolitan area is approximately 600 square miles, encompassing several smaller communities and has a population of approximately 200,000 people.

1.2 Project Description

Because of the relatively flat terrain, the majority of the Fargo-Moorhead Metro area is located in the regulatory floodplain. The Red River of the North has exceeded the National Weather Service flood stage of 18 feet in 50 of the past 112 years (1902 though 2013), and recently every year from 1993 through 2011 and in 2013. During flood events, the Fargo-Moorhead Metro area relies on a number of emergency measures, including a series of emergency levees, to provide flood protection. Some permanent levees also exist within the metro area.

1.3 Project Purpose

The purpose of the project is to reduce flood risk for the Fargo-Moorhead Metro Area.

Flooding in Fargo-Moorhead typically occurs in late March and early April. The flood of record at Fargo-Moorhead was the 2009 spring flood with a stage of 40.8 feet on the Fargo gage. With an estimated peak flow of 29,200 cubic feet per second (CFS), the 2009 flood was approximately a 2-percent annual chance (50-year) event. Equivalent expected annual flood damages in the Fargo-Moorhead metropolitan area are estimated to be over $194.8 million in the future without project condition. Although emergency measures have been very successful, they may also contribute to an unwarranted sense of security that does not reflect the true flood risk in the area.

1.4 Project Authorization

The Fargo-Moorhead Metropolitan Area is part of the Red River of the North Basin. The Red River Reconnaissance Study was authorized by a September 30, 1974, Resolution of the Senate Committee on Public Works:

> *RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review reports on the Red River of the North Drainage Basin, Minnesota, South Dakota and North Dakota, submitted in House Document Numbered 185, 81st Congress, 1st Session, and prior reports,*

with a view to determining if the recommendations contained therein should be modified at this time, with particular reference to flood control, water supply, waste water management and allied purposes.

The Fargo-Moorhead metropolitan area was included in the Red River Basin Reconnaissance Study approved on September 19, 2002, but the level of detail in that report was insufficient to recommend a feasibility study specifically for measures in Fargo, North Dakota, and Moorhead, Minnesota. A supplemental Reconnaissance Study for Fargo-Moorhead was approved by the Mississippi Valley Division on April 08, 2008.

Based on the recommendations contained in the Reconnaissance Report, the city of Fargo, the city of Moorhead and the federal government entered into a Feasibility Cost Share Agreement on September 22, 2008. The study was cost shared 50/50 between the two non-federal sponsors and the Federal Government. The Corps of Engineers issued a notice of intent to prepare an environmental impact statement in the Federal Register on May 5, 2009. The Draft Feasibility Report and Environmental Impact Statement (DEIS) was published in the Federal Register for a 45 day public review period on June 11, 2010. The review period closed on August 9, 2010 after being extended by 14 days. In response to comments and to more fully study upstream and downstream impacts, the Corps made the decision to prepare a Supplemental DEIS. The notice of intent to prepare a Supplemental DEIS was published in the Federal Register on December 27, 2010. The Final Feasibility Report and Environmental Impact Statement were published in July 2011.

The Federal Water Project Recreation Act of 1965 (Public Law 89-72), as amended, requires an agency to fully consider recreational features that may be associated with Federal flood risk management projects.

1.5 Reference Documents

Final Feasibility Study and Environmental Impact Statement, Fargo-Moorhead Metropolitan Area Flood Risk Management, January 5, 2012
Value Based Design Charrette, Fargo-Moorhead Metropolitan Area Flood Risk Management Project, Outlet & Diversion Reach 1, Cass County, ND, November 2011
Value Engineering Study, Fargo-Moorhead Metropolitan Area Flood Risk Management Project, Outlet & Diversion Reach 1, Cass County, ND, October 2011
Scope of Work – Reach 5, Fargo-Moorhead Metropolitan Area Flood Risk Management Project, July 2012
Project Component Summaries, Fargo-Moorhead Metropolitan Area, January 2012
Reach Management Plan for Reach 5, Fargo-Moorhead Metropolitan Area Flood Risk Management Project, August 2012
Project Design Guidelines for the overall FMM Project and Reach-Specific Design Guidelines, February 2012

2 PROJECT FEATURES

2.1 Overview of the Overall Fargo-Moorhead Metropolitan (FMM) Project

The Fargo-Moorhead Metropolitan Flood Risk Management project consists of a diversion channel with low flow channel, a connecting channel that diverts water from the Red and Wild Rice Rivers to the diversion channel, an upstream staging area, associated structures, non-structural features, recreation features and environmental mitigation. Approximately 20,000 cfs is diverted into the diversion channel from the upstream staging area during the 1% and 0.2% chance flood events. Additional inflows from the Sheyenne River, Drain 21C, Drain 14, Maple River, Rush River, Lower Rush River and other smaller drains may result in significantly higher discharges at the downstream end of the diversion channel.

The connecting channel starts on the Red River approximately three miles south of the confluence of the Red and Wild Rice Rivers and extends west, crossing the Wild Rice River, to the diversion inlet structure that is located just south of Horace. The diversion channel extends from its inlet, around the cities of Horace, Fargo, West Fargo and Harwood. It ultimately will re-enter the Red River north of the confluence of the Red and Sheyenne Rivers near the city of Georgetown, MN. The 36 mile path of the connecting channel and diversion channel will cross the Wild Rice, Sheyenne, Maple, Lower Rush and Rush rivers.

Two hydraulic structures will control the flows passing out of the staging area into the flood risk management area during larger flood events; one on the Red River and the other on the Wild Rice River. Flow into the diversion from the staging area will be controlled by a gated diversion inlet structure located at Cass County Highway 17 south of Horace, ND. The outlet structure is located where the diversion returns to the Red River of the North and will be a rock spillway with a low flow channel capable of accommodating fish passage.

The main line of flood risk reduction at the south end of the project is a tieback embankment that extends about 12 miles west to east from the diversion inlet to high ground in Minnesota and ties into the Wild Rice River and Red River control structures along its path.

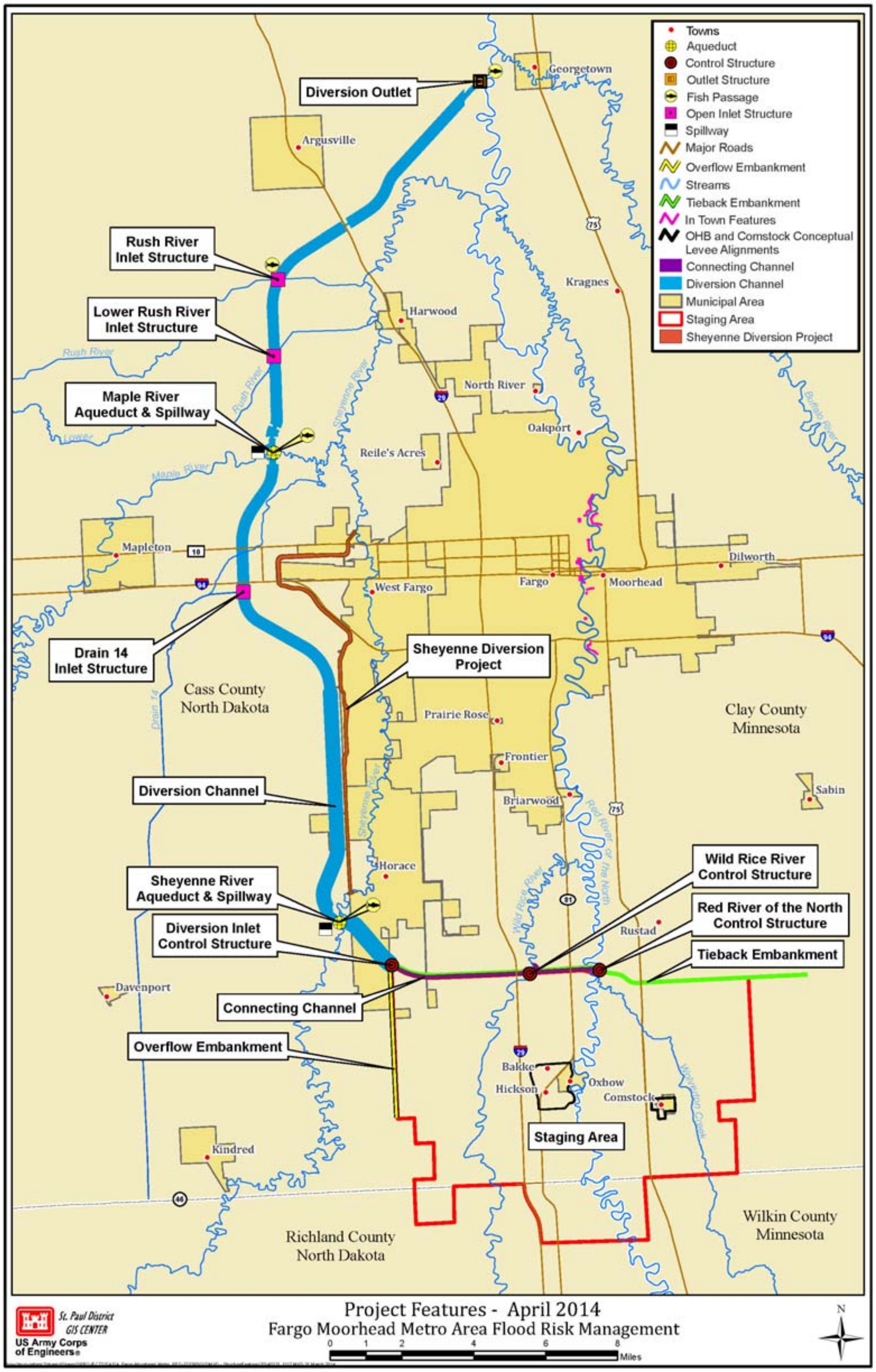
In order to eliminate downstream impacts, an additional 150,000 acre-feet of water will be staged immediately upstream of the tieback embankment. An overflow embankment approximately 4 miles in length along Cass County Road 17 (CR17) will be included to keep staged water from crossing overland into the Sheyenne River basin up through the 0.2% chance event. For events larger than the 0.2% event some of the staged water could flow to the Sheyenne River basin. **Figure 1** shows the major features of the project.

At the Sheyenne and Maple rivers, aqueduct structures will allow base flows to follow the natural river channels to maintain habitat in the natural channels. Flows in excess of the channel forming discharge will be diverted into the diversion channel via a spillway. The Lower Rush River and Rush River inlet structures into the diversion will be drop structures that will direct the entire flow of those rivers into the diversion channel.

A wide variety of mitigation features are required to offset the impacts associated with construction and operation of the project. Measures required for aquatic habitat and connectivity mitigation include stream restoration, riparian corridor restoration, a meandering low-flow channel in the diversion and providing fish passage. Fish passage will be provided at the diversion outlet, Rush River inlet, Maple River aqueduct, Sheyenne River aqueduct, and several existing dams. Floodplain forest mitigation will be provided by re-establishing floodplain forest on 262 acres of floodplain agricultural land or pastured land. Wetland mitigation will be provided in the diversion channel by planting the bottom and fringe of the side slopes with native wetland species. The meandering low-flow channel will facilitate the development of wetland habitat in the diversion channel.

In accordance with the cultural resources programmatic agreement, construction in select reaches of the project will need to be monitored by a qualified professional archeologist. Areas requiring construction excavation monitoring include river floodplains, terraces and oxbows, which are locations with high potential to contain buried archaeological sites.

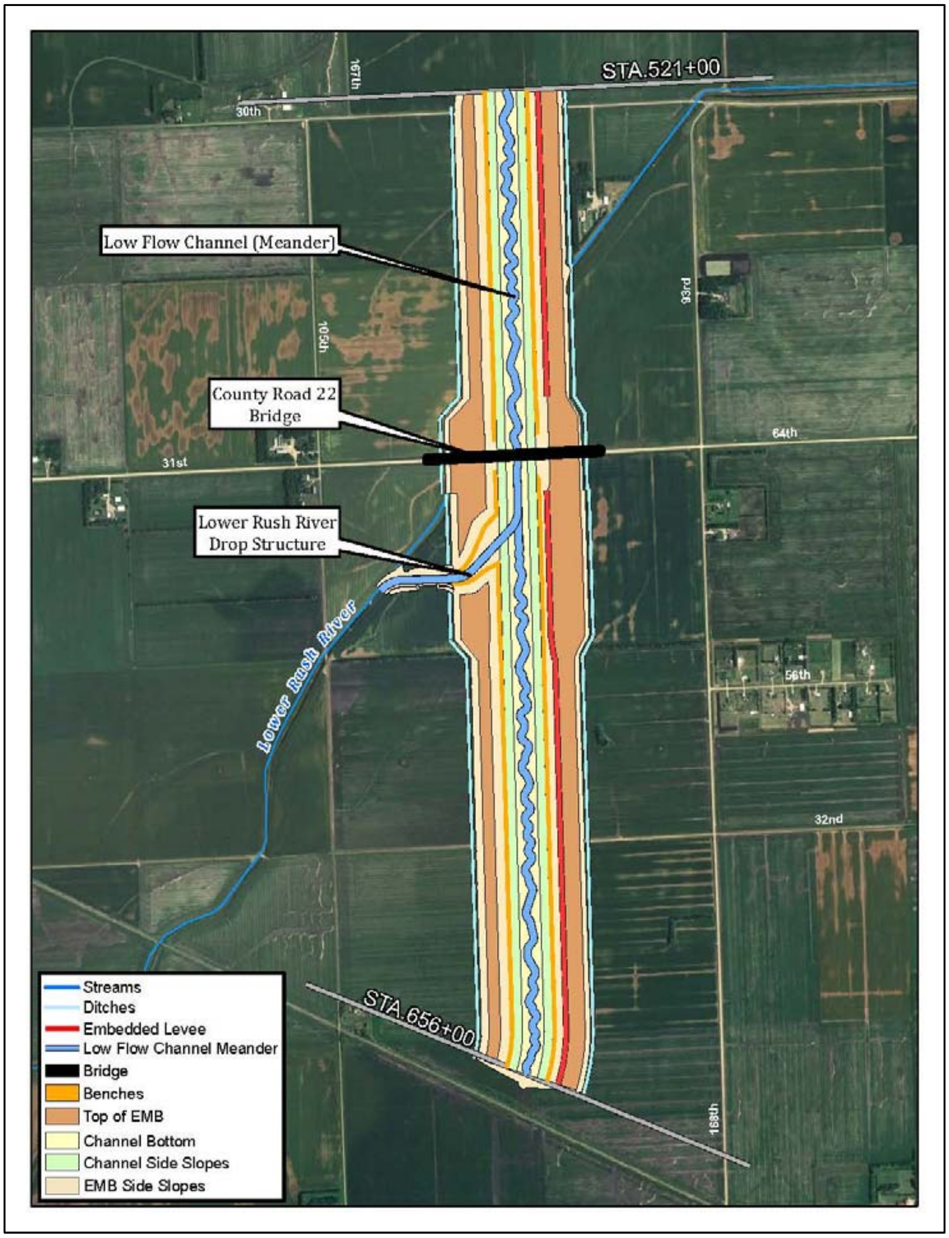
Figure 1: Diversion Alignment and Features



2.2 Description of Reach 5 and Lower Rush River Structure

As depicted in Figure 2, Reach 5 include the diversion channel beginning at the upstream end of Reach 4 (Sta. 521+00) and proceeding upstream to station 656+00, which is just north (downstream), of the County Road 20 and Burlington Northern Railroad bridges (Reach 6). The County Road 22 Bridge and the Lower Rush River Structure are included in Reach 5, although the bridge will be designed by the project sponsor. The major project components in Reach 5 include approximately 12,500 feet of diversion channel flanked on each side by excavated material berms (this excludes 1,000 feet of channel associated with the County Road 22 bridge.). An embedded levee is located within the right bank EMB. Within the main channel there will be sinuous low flow channel and wetland mitigation.

Figure 2: Location Map – Reach 5



2.2.1 Lower Rush River Inlet Structure

An inlet structure at the confluence of the Lower Rush River and the diversion channel will accommodate the head loss from the Lower Rush River to the main diversion using a series of rock armored drops. This multi-drop ramp consists of a gradual drop of 1V:20H from the invert of the Lower Rush River to the low-flow channel, and will contain a series of boulder steps to create a pool-riffle system. The boulder steps will consist of lines of 5 ft median diameter boulders placed in rows perpendicular to the direction of flow to provide the required energy dissipation and erosion protection necessary for the inlet structure. An overflow weir will be located in the Lower Rush River immediately upstream of the rock ramp to prevent impact to local drainage at the 0.2% chance annual exceedance event. Two sets of rock structures will be placed upstream of the ramp to reduce velocities and maintain the existing 1% chance annual exceedance event water surface elevation in the Lower Rush River channel upstream of the inlet structure.

2.2.2 Diversion Channel and Low Flow Channel

The diversion channel is 300 feet wide at the bottom with 1V:7H side slopes up to existing ground. The bottom of the channel slopes at 2% toward the low flow channel. A meandering low flow channel is included within the main channel; see Hydrology and Hydraulics Appendix for details.

2.2.3 Excavated Material Berms and Levees

The excavated material will be placed in berms located along the left and right banks of the diversion channel. The berms will extend from station 521+00 to station 656+00, and will be set back from the top of the excavated channel. A portion of the right bank berm will have an embedded levee. The embedded levee will have more stringent construction control requirements.

2.2.4 Transportation System Modifications

The alignment of the channel will result in modifications to the local transportation system, including a new County Road 22 bridge at approximately channel station 571+00 to allow traffic to cross the new channel. Local transportation system modification also include an intersection of 76th Avenue and the channel, with no bridge construction. The bridge and road realignment will be designed and constructed by the non-federal sponsor. The EMBs adjacent to the channel will be tied into the bridge approaches. The transportation system modifications will result in changes to the local drainage system. The roadway ditch flows are expected to be routed to the drainage ditches designed within Reach 5.

2.2.5 Environmental Considerations

Environmental considerations which will be incorporated into the design of Reach 5 include the meandering low flow channel and a planting plan that includes planting of native wetland species in the channel bottom and fringe of the side slopes. In addition, monitoring for cultural resources by a qualified professional archeologist will be required during construction of select project areas with high potential for buried archeological sites. Construction monitoring is not necessary for Reach 5.

3 PERTINENT TECHNICAL AND DESIGN DATA

3.1 Design Flood

The diversion is designed for the 1% annual chance exceedance flood (1% flood), but the amount of excavation required to achieve the goals for the 1% flood design allows the diversion to function for much larger flood events. Flood events larger than the 1% flood are being investigated during the design effort to evaluate structure and levee resiliency. Design flows in the diversion were determined from the unsteady HEC-RAS modeling effort, which routes the Red River of the North balanced hydrographs and coincident tributary hydrographs described in Appendix A of the Final Feasibility Report and Environmental Impact Statement for the Fargo-Moorhead Metropolitan Area Flood Risk Management Project, dated July 2011.

3.2 Design Flows

Early in the design process a cursory review of flow results along the diversion resulted in using 30,000 cfs for the 1% event flow and 35,000 cfs for the 0.2% event flow for the entire reach between the Maple River aqueduct and the diversion outlet. As the design effort progressed, a detailed assessment of the flow profile along the diversion was conducted that resulted in the more detailed design flow table presented as Table 1.

The following table lists the flows for key features of the project.

Table 1: Channel Flows

DESCRIPTION	1% FLOW (cfs)	0.2% FLOW (cfs)	EST. MAX. FLOOD FIGHT FLOW (cfs)
Diversion Inlet to Sheyenne River Aqueduct	20,000	20,000	26,000
Sheyenne River Aqueduct to Cass CR 14	20,500	22,000	38,000
Cass CR 14 to Ditch 21C	20,500	22,000	40,000
Ditch 21C to Ditch Upstream of I-94	21,000	22,500	41,000
Ditch Upstream of I-94 to Drain 14	21,500	23,500	41,000
Drain 14 to Maple River Aqueduct	25,000	28,000	41,000
Maple River Aqueduct to Lower Rush River	29,000	34,000	41,000
Lower Rush River to Rush River	30,000	36,000	45,000
Rush River to Diversion Outlet	32,000	38,000	45,000

3.3 Controlling Elevations

The following table lists the finish elevations of key features of the project. All elevations shown refer to NAVD88.

Table 2: Controlling Elevations

DESCRIPTION	ELEVATION (NAVD88)
Low Flow Channel Invert at Downstream End of Reach 5 – Sta 521+00	865.13
Low Flow Channel Invert at Upstream End of Reach 5 – Sta 656+00	867.43
Lower Rush River Inlet Invert Upstream End Sta – 9+10	885.20
Lower Rush River Inlet Invert Downstream End Sta – 5+30	866.20
Lower Rush River Overflow Weir Crest	893.35

3.4 Previously Obtained Data

3.4.1 Existing Condition Data

Existing topographic data utilized for the design and drawings is from Aerial Light Detection and Ranging (LIDAR) and ground survey campaigns performed in May 2011 by Merrick and Company through contract with the local sponsors. Detailed ground and hydrographic survey campaigns were performed between October 2011 and March 2012 by the St. Paul District Corps of Engineers survey crew and Anderson Engineering of MN in order to enhance the accuracy of the surface models. The coordinate system and projection of the existing condition data is NAD83 (2007), North Dakota State Plane Coordinate System, South Zone (U.S. Survey Feet). The elevation datum of the existing condition data is NAVD88 (U.S. Survey Feet). The existing condition data can be accessed through ProjectWise.

3.4.2 Cadastral Data

During the acquisition of rights-of-entry (ROE) for the project, the St. Paul District Corps of Engineers, non-federal sponsors, and Moore Engineering created a cadastral dataset for the project. The cadastral dataset is a geodatabase with parcel geometries and attributes, which will be used as the reference source for all property information. This dataset is incorporated into the base map for informational purposes only. The parcel geometries of the dataset have not been surveyed and should not be relied upon as such.

Detailed property surveys will be conducted by the non-federal sponsors during the final stages of the project.

3.4.3 Utility Information

Utility information, including surveyed locations was obtained from Moore Engineering between December 2011 and January 2012 under contract with the non-federal sponsors. The utilities that are known to exist within Reach 5 are summarized in Appendix E: Civil-Site.

4 OUTSTANDING ISSUES / CONTINUING DESIGN TASKS

The design of Reach 5 is nearing completion and most of the technical issues have been resolved. The Project Delivery Team (PDT) is continuing to work through the following issues.

4.1 Incorporation of Utility Relocation Designs

Based on the Task Order No. 10 Memo from Houston-Moore Group dated 7/27/2012, all of the utility companies impacted by Reach 5 construction efforts have proposed to relocate and/or abandon their own facilities. Neither the USACE's nor the Diversion Authority's contractors will be required to relocate or abandon existing utilities, however, the abandoned underground lines will need to be removed from the Project footprint by the USACE's contractor during construction of the channel.

4.2 Bridge Construction Coordination

Additional coordination is needed with the bridge design team and other Districts regarding construction sequencing of bridges, main channel reaches and inlet\drop structures. Sequencing could affect grading and transitioning at the limits of reaches.

5 HYDROLOGY AND HYDRAULICS

5.1 Introduction

The following paragraphs provide a summary of the Hydraulic Design considerations for Reach 5 of the Fargo-Moorhead Metro Project. Detailed information related to the Hydrology and Hydraulic design of the FMM Project can be found in the Hydrology and Hydraulics Appendix. The design effort involves the review of the local drainage plan developed by the local sponsors AE, Houston-Moore Group, for the areas adjacent to the diversion canal within Reach 5. The needs of other disciplines, (e.g. environmental and geotechnical) have been considered during the design process.

5.2 Technical Guidelines and References

The US Army Corps of Engineers is governed by engineering regulations (ER's), engineering manuals (EM's), engineering technical letters (ETL's) and engineering circulars (EC's). These Corps publications are available on line at the following web site: http://www.publications.usace.army.mil

The project design will comply with all civil works engineering regulations, circulars, technical letters and manuals (Corps publications). Industry standards shall apply when Corps guidelines are not applicable. The applicable guidelines and standards that will be used for hydrologic and hydraulic design can be found in the "Project Design Guidelines."

5.2.1 Diversion Channel

The diversion channel is designed so that the 1% flood profile is generally below existing ground from the diversion inlet downstream to the Lower Rush River. This was done to minimize impacts on local drainage outside the diversion channel. However, it is not practical to keep the 1% profile below existing ground at the downstream end of the diversion due to backwater effects from the Red River. Conveyance must be maintained in the diversion channel. The Feasibility design of a 250 feet wide, flat bottom diversion at a 0.8 feet/mile channel slope has been changed to a 300 foot wide, 2% bottom sloping diversion at a 0.9 feet/mile channel slope. The combination of increasing the bottom width while raising the toes of the channel for drainage generally balances the excavation material calculated in the Feasibility Phase. Increasing width and cross-sloping the bottom of the diversion was needed to both provide adequate drainage toward the low-flow channel and to provide an adequate meander belt width to achieve the minimum required sinuosity for the low-flow channel. Increasing the channel slope from 0.8 feet/mile to 0.9 feet/mile by rotating it around the approximate halfway point, at the Maple River Aqueduct, balances the excavated material quantity to approximately the quantity determined in Feasibility. It was desired to steepen the diversion slope rather than flatten the low-flow slope when the size and sinuosity of the low-flow channel was determined.

It is important to note that this configuration of the diversion channel, when the Excavated Material Berms (EMBs) are included, allows for a capacity much greater than the design event. Each individual component (cross-slope, channel slope, side slope, bottom width, low-flow width, etc.) has not been perfectly optimized to bring the size of the diversion down to the minimum capacity. An optimization phase in the design process may be warranted, but it is important to consider that this additional capacity allows for robustness of the project for events greater than the design event and allows the profile of the design event to remain below existing ground surface for a larger distance. Passing more of the flow below the existing ground surface would reduce the length and height of the levees within the EMBs.

5.2.2 Sinuous Low Flow Channel

Based on the most recent hydrology and hydraulics for the project, the low-flow channel for all of Reach 5 is currently sized at six feet deep with a 90 foot top width and 1V:4H side slopes, producing a 46 foot bottom width. This 90 foot top width will be designed to meander across a 200 foot wide meander belt with a variable meander wavelength for an overall sinuosity of approximately 1.09. With a main channel slope of 0.9 feet/mile, the sinuosity results in the low-flow channel having a slope of approximately 0.8 feet/mile. This is approximately the average slope of the nearby Maple River. This mild slope and slight sinuosity should allow for environmental variability and closer conditions to a natural river channel.

In the hydraulic modeling, a Manning's n-value of 0.030 was used for the full width of the diversion, including the low-flow channel. This value is slightly more conservative than the n-values calculated based on performance of existing diversions in the area (n = 0.028 approximately). The more conservative 0.030 value was used to account for dense vegetation across the entire diversion and the uncertainty of the performance of the sinuous low-flow channel.

5.2.3 Local Drainage Features

The orientation of the diversion inevitably causes the channel to intersect numerous ditches and drains. Agricultural ditches and legal drains that currently drain to Red River Basin streams and rivers will need to be re-routed and terminated in the diversion channel as the diversion alignment intersects their current paths. In Reach 5 the affected local drainage includes the Section 11 of Raymond Township Drain. Preliminary design efforts assumed this drain would require a culvert and impact stilling basin to convey drainage to the low-flow channel. However, alignment changes at the Lower Rush River inlet structure will allow this local drainage to be routed north to the Lower Rush River, eliminating the need for a local drainage structure in Reach 5. A complete summary of the local drainage in the vicinity of Reach 5 can be found in AWD-0005, Local Drainage Report, Appendix M.

5.2.4 Lower Rush River Inlet/Drop Structure

The Lower Rush River Inlet/Drop Structure will accommodate the head loss between the Lower Rush River and the low flow channel of the diversion channel using a series of rock armored drops. This multi-drop ramp consists of a gradual drop of 1V:20H from the invert of the Lower Rush River to the invert of the low-flow channel, and will contain a series of boulder steps to create a pool-riffle system. The boulder steps will consist of lines of 5 foot median diameter boulders placed in rows perpendicular to the direction of flow to provide the required energy dissipation and erosion protection necessary for the inlet structure. These large boulders will be partially embedded in the ground and placed on a sub-layer of base material. The rows will be spaced 30 feet apart so that each pool will drop approximately one foot as the pools descend down the overall 1V:20H slope. An overflow weir will be located in the Lower Rush River immediately upstream of the rock ramp to prevent impacts to local drainage at the 0.2% chance annual exceedance event. Two sets of rock structures will be placed upstream of the ramp to reduce velocities and maintain the existing 1% chance annual exceedance event water surface elevation in the Lower Rush River channel upstream of the inlet structure. Further information on the Lower Rush River can be found in Appendix C1.

6 GEOTECHNICAL ENGINEERING

6.1 General

The geotechnical engineering and geology work completed for the Reach 5 submittal was associated with the stability, settlement, and rebound along the diversion channel and at the Lower Rush River Drop Structure. Detailed information related to the geotechnical design criteria, design cases, and other information related to geotechnical design for the diversion channel can be found in “Appendix D1: Geotechnical Engineering and Geology, Reach 5, Volumes 1 & 3”. Detailed information related to the geotechnical design criteria, design cases, and other information related to geotechnical design for the Lower Rush River Drop Structure and associated portion of the diversion channel can be found in “Appendix D2: Geotechnical Engineering and Geology, Volume 2: Reach 5 Lower Rush River Inlet/Drop Structure”.

6.2 Technical Guidelines and References

A list of technical guidelines associated with the geotechnical design can be found in the "Project Design Guidelines."

6.3 Geotechnical Design Features/Analysis

A brief summary of the features and analyses completed is provided below.

6.3.1 Diversion Channel

The slopes of the diversion channel were analyzed to evaluate the stability of the hydraulic cross section provided. At this time, the diversion channel side slopes of 1V:7H have been found to be stable in Reach 5. As the design progresses, if additional information is obtained and the information suggests that the assumptions are incorrect, the modeling will be updated. It is not anticipated that these changes will result in drastic changes to the diversion channel geometry.

6.3.2 Excavated Material Berms and Levees

The excavated material berms (EMBs) are offset 50 feet from the top of the diversion channel and have approximate initial heights ranging from 15 to 21 feet, with variation depending on local soil conditions and other non-geotechnical criteria that may limit the EMB Maximum height. The EMBs have been taken into consideration when analyzing the stability of the diversion channel slopes. Grading guidelines and maximum grading extents have been developed to ensure that the layout of the EMB meets geotechnical design criteria. It should be noted that the viewshed requirements only allow a maximum EMB height of 21 feet yet the geotechnical analysis indicates EMB heights higher than this.

6.3.3 Lower Rush River Drop Structure

The Lower Rush River will empty into the FMM Diversion Channel near Station 580+00 via a rock ramp which employs boulder steps and a 5% slope to achieve the majority of the elevation change. 1V:8H ramp side slopes are required to meet stability criteria.

The Lower Rush River ramp diverges from the Lower Rush River at a 0.087% slope. The boulder steps begin at Sta 9+10 and the ramp descends at a 5% slope. The last boulder step is located at Sta 5+30, after which the ramp maintains a descending 0.017% slope to match that of the diversion channel until their confluence.

Throughout the outlet the base of the excavation will be covered with a layer of rock and bedding material in order to prevent erosion. Throughout the 5% sloped rock structures and extending down the ramp an additional approximately 285 feet, a five foot riprap thickness is required due to increased velocities. Prior to the rock ramp structures and at the outlet of the ramp into the diversion channel, a two foot rip rap thickness is required. Further details on the geotechnical design of the Lower Rush River Inlet/Drop Structure can be found Appendix D2.

6.3.4 Settlement and Rebound

The excavation of the diversion channel will lead to rebound of the invert. Construction of the EMBs will lead to settlement. The estimated settlement of the EMBs will be 1.3 to 1.6 feet. It is recommended that the embedded levee be overbuilt by 1.5 feet. The estimated rebound at the center of the excavation is approximately 1.2 feet. It is anticipated that some of the rebound will occur during construction. Overexcavation of the diversion channel is not recommended based on geotechnical and hydraulic evaluations.

6.3.5 Local Drainage Inlets

No local drainage inlet structures are currently contemplated in Reach 5. The EMBs may be lowered in some specific areas to allow local drainage access to the diversion channel.

6.3.6 Constructability

Based on the results of borings and a topsoil survey along the Reach 5 alignment, topsoil thickness is estimated to be approximately 1 to 2.2 feet thick. Local variations could be encountered along the alignment, especially adjacent to existing drainage features.

Different techniques may be required to excavate the diversion channel. It is likely that scrapers can be used to excavate the upper soils (Alluvium and Sherack formations). As the excavation increases with depth, the soils will become wetter and weaker. These weaker soils will have a reduced capacity to support construction equipment and therefore it is likely an excavator will be used and material hauled away using off-road trucks.

Due to the impervious nature of the soils, dewatering of the site prior to excavation is not required as flow into the excavation will be minimal. A slope will need to be maintained in the excavation to allow precipitation and any seepage to drain to a low area. Depending on amount of precipitation and seepage, this low area may need to be pumped out.

6.4 Phase 1 Environmental Site Assessment

A Phase I Environmental Site Assessment (ESA) was completed on a previous North Dakota Diversion alignment during the feasibility study in 2010. A supplemental ESA was completed along the current alignment in 2012. The ESAs identified minor recognized environmental conditions (RECs) which are common to small agriculture and rural residential throughout the entire project. There were no RECs identified in Reach 5. No major issues are anticipated along the current alignment in the area of the Reach 5.

7 CIVIL-SITE ENGINEERING

7.1 General

Civil design for this project will include demolition, levee and excavated material berm layout, access road layout, utility relocations, Lower Rush outlet structure general grading, and storm water pollution prevention. This section summarizes the proposed layout, method of analyses, and support for preparation of the plans, specifications, and cost estimate.

7.2 Technical Guidelines and References

A list of technical guidelines associated with the civil-site design can be found in the "Project Design Guidelines."

7.3 Programs and Standards for Design and Drawings

The computer-aided drafting and design (CADD) program used for the drawings utilized MicroStation V8i (Version 8.11, October 2008) and topographic data with InRoads generated Digital Terrain Model (DTM) files, profiles, and cross sections. All drawings adhere to national, Mississippi Valley Division, and St. Paul District CAD standards as referenced in the current Design Guidelines.

7.3.1 Geometric Design – Channel and Excavated Material Berms

The alignment and configuration of the channel and EMBs are based on Hydraulic and Geotechnical considerations. Final layout of the EMB's will take into account balance of cut and fill, local drainage, real estate acquisition, and other considerations.

7.3.2 Vegetation Free Zone

The Vegetation Free Zone (VFZ) will comply with the requirements in ETL 1110-2-571, as well as the criteria set forth in project specific guidance documents such as the Memo For Record (MFR) FMM Vegetation Free Zone, and Dam vs Levee Criteria. The VFZ will be a minimum of 15 feet from the toes of the stand-alone levees and partially embedded levees. For the right bank embedded levees there will be a vegetation management zone (VMZ) that extends 15 feet from the landside crown of the levees embedded within the EMBs and across the width of the diversion channel and 15 feet beyond the maintenance road on the left bank EMB.

7.3.3 Utility Relocations

Utility relocations will comply with the MVP MFR for Utility Relocation Requirements and local/state requirements. The utilities that are known to exist within Reach 5 are summarized in Appendix E: Civil-Site.

7.4 Engineering Drawings for Civil Features and Site Work

Drawings produced for this document utilized the following information:

• LIDAR Topographic Survey Data

• Corps of Engineers Field Survey Data (topographic and hydrographic)

• MicroStation V8i model and sheet seed files

• Design files including cross-sections, alignment, and DTM files

Civil engineering drawings and plans prepared concurrent with this report are included as attachments.

8 STRUCTURAL ENGINEERING

8.1 General

There are no structural features within Reach 5.

9 MECHANICAL ENGINEERING

9.1 General

There are no mechanical features within Reach 5.

10 ELECTRICAL ENGINEERING

10.1 General

There are no electrical features within Reach 5.

11 LANDSCAPE AND RECREATION

11.1 General

The Local Sponsor is responsible for the design and construction of any proposed recreational features of the Fargo-Moorhead Flood Risk Management Project. A draft report, Fargo-Moorhead (FM) Area Diversion, Recreation and Use Master Plan which details the current plan for rec features has been developed for the local sponsor. Included in the Master Plan is the concept of an undulating landscape on the right bank EMB that will provide varying landscape and separation between equestrian and pedestrian trails. The COE and the Sponsor have agreed that the most cost effective way to construct these undulations would be to include them in the Diversion Reach Plans and Specifications. The undulations will be designed by the Sponsor and incorporated into the Reach 5 plans by the COE design team (see further discussion in “Proposed Recreation Features” section. In addition, Reach 5 includes a turf establishment plan that was developed in compliance with mitigation and NPDES requirements (see further discussion in “Landscape” section). All additional recreation features, such as trails and permanent landscape plantings, will be designed by the Sponsor and constructed at a later date under a separate contract

11.2 Proposed Recreation Features

It was the Sponsors’ responsibility to determine the end use of each EMB. The concept proposed in the draft Master Plan was to incorporate recreation features, including trails, plantings, and an undulating landscape, into the EMB on the right bank of the channel. The left bank EMB concept was to grade and place topsoil so that the EMB may be used for agricultural purposes. However, after the Master Plan was submitted, the PDT developed more detailed design for Reach 5 and the associated EMBs. The top width of the EMBs is now in the range of 200 to 250 feet. The draft Master Plan was based on a 400 foot width as defined in the Feasibility Report for the project.

Because of the width reduction, the end use of the left bank EMB was revisited. The current concept proposed by the Local Sponsor is to abandon the concept of agricultural use on the left bank EMB. The Sponsor has requested that the footprint of the left bank EMB be minimized by slightly increasing the EMB height away from the channel. However, based on a view shed analysis agreement with ND SHPO, the top of the EMBS and undulations should be 21 feet or less above existing ground elevation. This footprint reduction will help preserve existing agricultural land outside the EMB footprint for continued use. For the left bank EMB the Sponsor provided grading, slope, and topsoil depth information and the COE incorporated this into the design plans. Vegetation, such as wind breaks, has been discussed but has not been finalized by the Sponsor. Topsoil depths on the land side of the maintenance road are 1 feet to accommodate future plantings, or perhaps minimal agricultural use.

For the right bank EMB, the undulating landscape requires a detailed grading design that will ultimately accommodate future multi-use and equestrian trails. As previously discussed, the Sponsor is responsible for the design of the undulations. The COE provided the “base EMB” design to the Sponsor, with the top graded at 2% to shed drainage away from the channel. COE also provided design guidance including geotechnical grading requirements and Guidance Memo-001 “Construction Heights of EMBs” to the Sponsor. The Sponsor designed the undulations a certain height above and below the “Base EMB” top, based on COE guidance, and delivered a design surface (DTM) to the COE for incorporation into the COE construction documents (COE reviewed this submittal and determined that it is acceptable prior to incorporation). The COE developed the plan views, details and cross sections for the undulating landscape that are included in the Reach 5 plan set.

11.3 Landscape

Any planting plan will be coordinated with the environmental mitigation planned for the project. Planting plans proposed in the FM-M Area Diversion Recreation and Use Master Plan will follow USACE design guidance.

Seeding for the initial construction contract will consist of temporary seed mixes. There will be two basic zones for the temporary seed mixes, one wet zone for riparian species and one dry zone for upland grasses and forbs. These temporary mixes will include a few native species and a cover crop of oats for seeding in the spring and early summer or winter wheat if seeding in the fall. The construction contractor will be responsible for establishment and maintenance of the cover crop for a period of up to one year. The construction contractor will also be responsible for erosion control and corrections during the period of cover crop establishment and growth as well as the NPDES construction Storm Water permit during that time. The permanent planting plan as well as the establishment and maintenance of native plant species will be accomplished by a joint effort between the Local Sponsors and the COE, utilizing either a Local Sponsors’ let contract(s) and/or the Local Sponsors’ own work force. After the initial construction contract is complete, (potentially up to one year after the cover crop has been planted) the site will be seeded with the permanent native plant species. Once planted, the native grasses will take approximately three years to become established under good growing conditions.

Guidance for seed mixes and planting zones will be in accordance with MFR-003, Vegetation within the Fargo-Moorhead Metro Diversion; MFR-003 attachment, Guidelines for Reach 1 Planting Plan of the Fargo Moorhead Diversion Channel; and MFR-017, Turf Establishment with Native Species via Construction Contract and the Sponsors Involvement within the Fargo-Moorhead Metro Diversion.

12 ENVIRONMENTAL CONSIDERATIONS

12.1 Introduction

The environmental consideration for this reach includes providing planting guidance to facilitate wetlands in the bottom of the diversion channel, and to ensure the low flow channel is designed to meander. These efforts are discussed in the Feasibility Report and Environmental Impact Statement (EIS).

12.2 Fish Passage – Not applicable

During feasibility there was an environmental need for fish passage from the Lower Rush River to the diversion channel identified. After field observations from 2011 and 2012 it was determined that there is not a substantial environmental need for fish passage, and the outlet design should be based on engineering and cost considerations.

12.3 Planting Guidelines

Vegetation establishment guidelines for the diversion channel have been developed with the goal of a planting plan that will limit the potential for the establishment of undesirable species (such as cattails, willow, etc.), compatible with conveyance criteria (resulting in a Manning's roughness n value of .03 or less), and resilient to maintenance activities. In consultation with a variety of experts, planting guidelines and initial seed mixes for various zones of the channel cross section have been identified that will ensure we meet overall objectives.

12.4 Cultural Resources

The overlapping portion of the former and current Reach 5 diversion channel alignments was surveyed for cultural resources in June and October 2011 (Tucker et al. 2012), with the remainder of the current Reach 5 alignment surveyed in May 2012 (Meier et al. 2013). The Lower Rush River inlet area of Reach 5 was surveyed for cultural resources in October 2011 (Tucker et al. 2012) and October 2012 (Meier et al. 2013). Parcels along 105th Avenue SE and parts of the temporary Lower Rush River bypass channel and adjacent temporary work areas, as well as three excavated material pile (EMP) and construction staging areas, were surveyed for cultural resources in November 2013 (Meier 2013). Four archeological sites, one bridge, and one built-environment linear resource were recorded in the Reach 5 area.

Prehistoric isolated find spot sites 32CSX348 and 32CSX385 are each single projectile points found in the SE¼ and NW¼ of Section 2, Township 140 North, Range 50 West. Site 32CS5189 is a historic cultural material scatter also located in Section 2, Township 140 North, Range 50 West. Historic isolated find spot site 32CSX397 and single-span concrete bridge 32CS5216, both along 105th Avenue SE, are in Sections 10 and 11, Township 140 North, Range 50 West. All five sites were recommended as not eligible to the National Register of Historic Places (Tucker et al., 2012; Meier et al. 2013; Meier 2013). Coordination with the North Dakota SHPO to confirm their non-eligibility is ongoing.

Finally, the channelized portion of the Lower Rush River in Sections 2 and 11, Township 140 North, Range 50 West, was recorded as Feature 3 (Harwood Drain No. 2) of linear resource 32CS5113, historic flood control ditch channels(Tucker et al. 2012). This linear built-environment feature has been determined not eligible to the National Register (letter from North Dakota SHPO dated May 20, 2014).

12.5 NEPA Compliance

The proposed plan for the diversion channel was discussed in the 2011 Fargo-Moorhead Metropolitan Area Flood Risk Management Final Feasibility Report and Environmental Impact Statement. Changes to the original layout for the Lower Rush River inlet consisted of a modified inlet structure and an optimization of the diversion alignment. A Supplemental Environmental Assessment, Design Modifications to the Fargo Moorhead Metropolitan Flood Risk Management Project, dated September 2013 was prepared to address changes in impacts caused by alignment changes, construction of levees in-town to provide the opportunity to allow more flow through town, and the construction of a levee around the communities of Hickson, Bakke, and Oxbow. The Finding of No Significant Impact (FONSI) was signed on 19 September 2013.

12.6 References

Meier, M., G.C. Tucker Jr., B. Shaw, M. Dolin, K. Bedingfield, J. McNutt, S. Buskey, C. Kirvan, L. Dissette, and J. Rigley. 2013. The Fargo-Moorhead Flood Risk Management Project, Cass County, North Dakota and Clay County, Minnesota: Results of Phase I Cultural Resources Investigations, 2012. URS, Denver, Colorado.

Meier, M. December 2013. Fargo-Moorhead Metro Flood Risk Management Project: Phase I Cultural Resources Investigations, Progress Report for 2013 Archaeological Fieldwork. URS, Denver, Colorado.

Tucker, G.C., Jr., M. Meier, B. Shaw, M. Dolin, J.M. Gallagher, J. Fariello, K. Bedingfield, J. McNutt, K. Zielinski, and J. Rigley. 2012. The Fargo-Moorhead Flood Risk Management Project, Cass County, North Dakota and Clay County, Minnesota: Results of Phase I Cultural Resources Investigations, 2010-2011. URS, Denver, Colorado.

13 PROJECT DELIVERY TEAM

The Project Delivery Team (PDT) is an inclusive term that is meant to include all parties involved in the design, review, and approval of the products produced by a definable work effort; this includes USACE personnel, non-federal sponsor personnel, and in some instances key stakeholders. The members assigned have extensive professional and technical experience in their assigned areas of responsibility.

13.1 Project Delivery Team

Table 3: Project Delivery Team

Project Delivery Team				
NAME	**DISTRICT / ORG**	**DISCIPLINE/ROLE**	**PHONE**	**EMAIL**
Terry Williams	CEMVP-PM-B	PM-FMM	651 290-5517	terryl.l.williams@usace.army.mil
Brett Coleman	CEMVP-PM-B	PM-FMM	651 290-5452	brett.r.coleman@usace.army.mil
Dennis Gilmore	CEMVS-PM-N	PM	314 331-8108	dennis.w.gilmore@usace.army.mil
Mark Roenfeldt	CE-MVS-GT	Technical Lead	314 331-8440	mark.a.roenfeldt@usace.army.mil
Donald Duncan	CEMVS-EC-HH	Hydraulics	314 331-8809	donald.l.duncan@usace.army.mil
Richard Femrite	CEMVP-EC-D	Costs	651 290-5550	richard.h.femrite@usace.army.mil
Paige Scott	CEMVS-EC-DCS	Costs	314 331-8275	paige.a.scott@usace.army.mil
Karl Berg	CEMVP-EC-D	Civil Site Layout	651 290-5215	karl.r.berg@usace.army.mil
Mike Hanks	CEMVS-EC-D	Civil Site Layout	314 331-8252	michael.v.hanks@usace.army.mil
Kurt Heckendorf	CEMVP-EC-G	Geotechnical	651 290-5411	kurt.a.heckendorf@usace.army.mil
Rachel Lopez	CEMVS-EC-GE	Geotechnical	314 331-8425	rachel.l.lopez@usace.army.mil
Jose Lopez	CEMVS-EC-GH	Geotechnical	314 331-8448	jose.r.lopez@usace.army.mil
Eduardo Torrens	CEMVP-EC-D	Survey	651 290-5596	eduardo.torrens@usace.army.mil

Project Delivery Team				
Jon Sobiech	CEMVP-PD-P	Environmental	651-290-5428	jonathan.j.sobiech@usace.army.mil
Ken Cook	CEMVP-PD-C	Environmental	314-331-8498	kenneth.m.cook@usace.army.mil
Kara Mitvalsky	CEMVR-EC-DN	Fish Passage	309-794-5623	kara.n.mitvalsky@usace.army.mil
Lance Awsumb	CEMVP-PD-E	Economics	651-290-5379	lance.g.awsumb@usace.army.mil
Ginny Gnabasik	CEMVP-PD-P	Cultural	651-290-5262	virginia.r.gnabasik@usace.army.mil
Byron Williams	CEMVP-PD	GIS	651-290-5727	byron.g.williams@usace.army.mil
Katie Young	CEMVP-PD-F	Planning	651-290-5259	katie.young@usace.army.mil
Rod Peterson	CEMVP-RE	Real Estate	651-290-5397	rodney.r.peterson@usace.army.mil
Dawn Linder	CEMVP-CT-C	Contracts	651-290-5407	dawn.m.linder@usace.army.mil

13.2 Technical Leads and Functional POCs

Table 4: Technical Leads and Functional POCs

Technical Leads and Functional POCs				
NAME	**DISTRICT / ORG**	**DISCIPLINE/ROLE**	**PHONE**	**EMAIL**
Renee McGarvey	CEMVP-EC-D	Technical Lead Engineer	651-290-5640	renee.c.mcgarvey@usace.army.mil
Rick Femrite	CEMVP- EC-D	Technical Lead Engineer	651-290-5550	richard.h.femrite@usace.army.mil
Aaron Buesing	CEMVP-EC-H	H&H Lead Engineer	651-290-5627	aaron.w.buesing@usace.army.mil
Lisa Buchli	CEMVP-EC-H	Channels and Hydraulic Structures	651-290-5416	lisa.a.buchli@usace.army.mil
Kurt Heckendorf	CEMVP- EC-D	Geotechnical	651-290-5411	kurt.a.heckendorf@usace.army.mil
Grant Riddick	CEMVP- EC-D	Geology	651-290-5599	grant.a.riddick@usace.army.mil
Kent Hokens	CEMVP- EC-D	Structural	651-290-5584	kent.d.hokens@usace.army.mil
Eduardo Torrens	CEMVP- EC-D	Geospatial and Surveys	651-290-5596	eduardo.torrens@usace.army.mil
Christine Moss	CEMVP- EC-D	Civil-Site, NPDES/SWPPP	651-290-5025	christine.r.moss@usace.army.mil
Greg Fischer	CEMVP- EC-D	Utilities and Relocations	651-290-5464	russell.g.fischer@usace.army.mil
Renee McGarvey	CEMVP- EC-D	Landscape and Recreation	651-290-5640	renee.c.mcgarvey@usace.army.mil
Jeff Hansen	CEMVP- EC-D	Specifications and Cost Engineering	651-290-5649	jeffrey.l.hansen@usace.army.mil
Chris Afdahl	CEMVP- EC-D	CAD and Drawing Standards	651-290-5712	chris.a.afdahl@usace.army.mil
Jon Sobiech	CEMVP- PD-E	Environmental	651-290-5428	jonathan.j.sobiech@usace.army.mil
Ginny Gnabasik	CEMVP- PD-E	Cultural Resources	651-290-5262	virginia.r.gnabasik@usace.army.mil
Rod Peterson	CEMVP- RE	Real Estate	651-290-5397	rodney.r.peterson@usace.army.mil

13.3 District Quality Control (DQC) Team

Table 5: DQC Team

DQC Team				
NAME	**DISTRICT / ORG**	**DISCIPLINE/ROLE**	**PHONE**	**EMAIL**
Lisa Buchli	CEMVP-EC-H	Hydraulics - Hydraulic Structures	651-290-5416	lisa.a.buchli@usace.army.mil
Greg Wachman	CEMVP- EC-D	Geotechnical	651-290-5192	gregory.s.wachman@usace.army.mil
Kevin Nelson	CEMVP- EC-D	Geology	651-290-5844	kevin.s.nelson@usace.army.mil
Eduardo Torrens	CEMVP- EC-D	Geospatial and Surveys	651-290-5596	eduardo.torrens@usace.army.mil
Christine Moss	CEMVP- EC-D	Landscape and Recreation	651-290-5025	christine.r.moss@usace.army.mil
Greg Fischer	CEMVP- EC-D	Utilities and Relocations	651-290-5464	russell.g.fischer@usace.army.mil
Renee McGarvey	CEMVP- EC-D	Civil-Site, NPDES/SWPPP	651-290-5640	renee.c.mcgarvey@usace.army.mil
Jeff Hansen	CEMVP- EC-D	Specifications and Cost Engineering	651-290-5649	jeffrey.l.hansen@usace.army.mil
Chris Afdahl	CEMVP- EC-D	CAD and Drawing Standards	651-290-5712	christine.a.afdahl@usace.army.mil
Elliott Stefanik	CEMVP- PD-E	Environmental	651-290-5260	elliott.l.stefanik@usace.army.mil
Ginny Gnabasik	CEMVP- PD-E	Cultural Resources	651-290-5262	virginia.r.gnabasik@usace.army.mil
Rod Peterson	CEMVP- RE	Real Estate	651-290-5397	rodney.peterson@usace.army.mil
Bryan Dirks	CEMVS-EC-D	Civil Engineer	314-331-8282	bryan.j.dirks@usace.army.mil
Nathan Rose	CEMVS-EG-GT	Geotechnical	314-331-8432	nathan.S.Rose@usace.army.mil
John Boeckmann	CEMVS-EC-HH	Hydraulics	314-331-8801	john.Boeckmann@usace.army.mil

13.4 Agency Technical Review (ATR) Team

Table 6: ATR Team

ATR Team				
NAME	**DISTRICT / ORG**	**DISCIPLINE/ROLE**	**PHONE**	**EMAIL**
Mark Nelson	CENWO-PM-AA	ATR Leader /Planning	402-995-2703	mark.e.nelson@usace.army.mil
Mike Jerina	CENWO-ED-DJ	Civil	402-995-2202	mike.jerina@usace.army.mil
Kathleen Englert	CENWO-CD-C-CM	Construction	402-995-2038	kathleen.j.englert@usace.army.mil
Ron Beyer	CENWO-ED-HE	Hydrology	402-221-4475	ronald.s.beyer@usace.army.mil
Roger Kay	CENWO-ED-HD	Hydraulics	402-995-2342	roger. l.kay@usace.army.mil
Dan Pridal	CENWO-ED-HF	Channel Stability	402-995-2336	daniel.b.pridal@usace.army.mil
Steve Butler	CENWO-ED-GB	Geotechnical	402-995-2244	steve.m.butler@usace.army.mil
Aaron Quinn	CENWO-PM-AC	Environmental	402-995-2669	aaron.t.quinn@usace.army.mil
Rick Noel	CENWO-RE-C	Real Estate	402-995-2832	rick.l.noel@usace.army.mil

13.5 Sponsor Representatives

Table 7: Sponsor Representatives

Sponsor Representatives				
NAME	**ORGANIZATION**	**DISCIPLINE/ROLE**	**PHONE**	**EMAIL**
Mark Bittner	City of Fargo	City Engineer	701-241-1572	mbittner@cityoffargo.com
April Walker	City of Fargo	Engineer	701 241-1554	awalker@cityoffargo.com
Bob Zimmerman	City of Moorhead	City Engineer	218-299-5390	bob.zimmerman@ci.moorhead.mn.us
Keith Berndt	Cass County	County Engineer		berndtk@casscountynd.gov
Tom Waters, P.E.	CH2MHill	Program Manager	571-296-5245	tom.waters@ch2mh.com
John Glatzmaier, P.E.	CH2MHill	Project Manager	651-253-5910	john.glatzmaier@ch2m.com
Rick Carson	CH2MHill / KGS Group	H&H and Geology	204-478-3237	rcarson@kgsgroup.com
Leon Schieber	CH2MHill / Black & Veatch	Structures	913-515-8657	schieberla@bv.com

13.6 State Agency Representatives

Table 8: State Agency Representatives

State Agency Representatives				
NAME	**ORGANIZATION**	**DISCIPLINE/ROLE**	**PHONE**	**EMAIL**
Luther Aadland	Minnesota DNR			luther.aadland@state.mn.us
David Friedl	Minnesota DNR			david.friedl@state.mn.us
Tom Groshens	Minnesota DNR			tom.groshens@state.mn.us
Bruce Kreft	North Dakota GFP			bkreft@nd.gov

14 REVIEW DOCUMENTATION

14.1 District Quality Control (DQC) Review

The 65% DQC, DTR DQC, and the FTR DQC reviews were completed and formal comments were entered into ProjNet (Dr. Checks). Informal comments on minor items were provided directly to the designers. Documentation of the DQC Review can be found in Appendix L: Quality Control Documentation.

14.2 Agency Technical Review (ATR)

The 65% ATR, DTR ATR and FTR ATR reviews were completed and formal comments were entered into ProjNet (Dr. Checks). Informal comments on minor items were provided directly to the designers. Documentation of the DQC Review can be found in Appendix L: Quality Control Documentation.

.

Table 9: List of Common Acronyms

AAA	Army Audit Agency (AAA)
AAR	After Action Review (AAR)
ACI	American Concrete Institute (ACI)
AE	Architect/Engineer (AE) firms
AEP	Alternatives Evaluation Report (AEP)
AO	Area of Operations (AO)
AOR	Area of Responsibility (AOR)
APIR	Abbreviated Project Information Report APIR)
AR	Army Regulation (AR)
ASA	Assistant Secretary of the Army
ASA(CW)	Assistant Secretary of the Army for Civil Works (ASA(CW))
ATR	Agency Technical Review (ATR)
ATTN	Attention (ATTN)
ASPRS	American Society of Photogrammetry and Remote Sensing (ASPRS)
ASTM	American Society for Testing and Materials (ASTM)
AWS	American Welding Society (AWS)
BCOE	Biddability, Constructability, Operability, and Environmental (BCOE) review
BCR	Benefit to Cost Ratio (BCR)
BM	Benchmarks (BMs)
BMP	Best Management Practices (BMP)
CAA	Clean Air Act (CAA)
CAD	Computer-Aided Design (CAD)
CAP	Continuing Authorities Program (CAP)
CBO	Congressional Budget Office (CBO)
CCR	Change Control Request (CCR)
CDM	Current Design Maximum (Water Level)
CDR	Commander (CDR)
CEFMS	Corps of Engineers Financial Management System (CEFMS)
CFS	Cubic Feet per Second (CFS)
CG	Commanding General (CG)
CIR	Compensability Interest Review
CMP	Corrugated Metal Pipe (CMP)
CO	Contracting Officer (CO)

COA	Course Of Action (COA)
COE	Corps of Engineers (COE);Chief of Engineers (COE)
CONUS	Continental United States (CONUS)
COR	Contracting Officer Representative (COR)
CORS	Continuously Operating Reference Stations (CORS)
CPRA	Coastal Protection Restoration Authority (CPRA)
CPT	Cone Penetration Test (CPT); Captain (CPT)
CRREL	Cold Regions Research and Engineering Laboratory (CRREL)
CS	Construction Schedule (CS)
CSI	Construction Specifications Institute
CT	Contracting Office
CW	Civil Works (CW)
CWA	Clean Water Act (CWA)
CWE	Current Working Estimate (CWE)
CWRB	Civil Works Review Board (CWRB)
DA	Design Agreement (DA); Department of the Army (DA)
DDR	Design Documentation Report (DDR)
DE	District Engineer (DE)
DEIS	Draft Environmental Impact Statement (DEIS)
DEM	Digital Elevation Model (DEM)
DNR	Department of Natural Resources (DNR)
DOD	Department of Defense (DOD)
DOI	Department of the Interior (DOI)
DOT	Department Of Transportation (DOT)
DQC	District Quality Control (DQC)
DRCheckS	Design Review and Checking System (DRCheckS)
DS	Direct Shear Test (DS)
DTM	Digital Terrain Model (DTM)
DTR	Draft Technical Review (DTR)
E&D	Engineering and Design (E&D)
EA	Environmental Assessment (EA)
EC	Engineering Circular (EC); Engineering and Construction Division (EC)
EDC	Engineering During Construction (EDC)
EEO	Equal Employment Opportunity (EEO)

EIS	Environmental Impact Statement (EIS)
EM	Engineering Manual (EM)
EMB	Excavated Material Berm (EMB)
EO	Executive Order (EO)
EOC	Emergency Operations Center (EOC)
EPA	Environmental Protection Agency (EPA)
ER	Engineering Regulation (ER)
ERDC	Engineer Research and Development Center (ERDC)
ESA	Environmental Site Assessment (ESA)
ETL	Engineering Technical Letter (ETL)
FCA	Flood Control Act (FCA)
FCSA	Federal Cost Share Agreement (FCSA)
FEIS	Final Environmental Impact Statement (FEIS)
FEMA	Federal Emergency Management Agency (FEMA)
FERC	Federal Energy Regulatory Commission (FERC)
FGDC	Federal Geographic Data Committee (FGDC)
FMM	Fargo Moorhead Metro (FMM)
FMV	Fair Market Value (FMV)
FOIA	Freedom of Information Act (FOIA)
FONSI	Finding of No Significant Impact (FONSI)
FTR	Final Technical Review (FTR)
FY	Fiscal Year (FY) – Federal FY begins October 1st annually
FYI	For Your Information (FYI)
GAO	General Accounting Office (GAO)
GIS	Geographic Information System (GIS)
GPS	Global Positioning System (GPS)
GSA	General Services Administration (GSA)
H&H	Hydrology and Hydraulics (H&H)
HTRW	Hazardous, Toxic, and Radioactive Waste (HTRW)
IAW	In Accordance With (IAW)
IEPR	Independent External Peer Review (IEPR)
IGE	Independent Government Estimate (IGE)
IJC	International Joint Commission (IJC)
LPCP	Local Project Control Points (LPCP)

M&IE	Miscellaneous and Incidental Expenses (M&IE)
MFR	Memorandum For Record (MFR)
MOA	Memorandum of Agreement (MOA)
MOB	Mobilization (MOB)
MOU	Memorandum of Understanding (MOU)
MVD	Mississippi Valley Division (MVD) – located in Vicksburg, MS
MVK	Vicksburg District (MVK)
MVM	Memphis District (MVM)
MVN	New Orleans District (MVN)
MVP	St. Paul District (MVP)
MVR	Rock Island District (MVR)
MVS	St. Louis District (MVS)
NAD83	North American Datum of 1983 (NAD83) – Horizontal Control Datum
NAVD 88	North American Vertical Datum of 1988 (NAVD 88)
NEPA	National Environmental Policy Act, 1969 (NEPA)
NGS	National Geodetic Survey (NGS)
NMAS	National Map Accuracy Standard (NMAS)
NPDES	National Pollutant Discharge Elimination System (NPDES)
NRCS	Natural Resource Conservation Service (NRCS)
NSRS	National Spatial Reference System (NSRS)
NSSDA	National Standard for Spatial Data Accuracy (NSSDA)
NWS	National Weather Service (NWS)
O&M	Operation and Maintenance (O&M)
OC	Office of Council (OC)
OCONUS	Outside Continental United States (OCONUS)
OMB	Office of Management and Budget (OMB)
OPM	Office of Personnel Management (OPM)
P&S	Plans and Specifications (P&S)
PAO	Public Affairs Office (PAO)
PDS	Permanent Duty Station (PDS)
PDT	Project Delivery Team (PDT)
PER	Preliminary Engineering Report (PER)
PIR	Project Information Report (PIR)
PM	Project Manager

PMP	Project Management Plan (PMP)
PM-R2	Reach Project Manager (PM-R2) – Reach 2
POC	Point of Contact (POC)
PPCP	Primary Project Control Points (PPCP)
PPM	Programs, Planning and Project Management Division (PPM)
PW	ProjectWise (PW)
QA	Quality Assurance (QA)
QC	Quality Control (QC)
QAP	Quality Assurance Plan (QAP)
QCP	Quality Control Plan (QCP)
QMP	Quality Management Plan (QMP)
R-Bar	pore-water pressure measurements (R-Bar)
RCP	Reinforced Concrete Pipe (RCP)
RDDR	Reach Design Documentation Report (RDDR)
RE	Real Estate (RE)
RF	Revolving Funds (RF)
RGG	Regional Geotechnical and Geology team (RGG)
RM	Resource Management
RMC	Risk Management Center (RMC)
RMP	Reach Management Plan (RMP)
ROE	Right of Entry (ROE)
ROW	Right of Way (ROW)
RP	Review Plan (RP)
RRN	Red River of the North (RRN)
SAACONS	Standard Army Automated Contracting System (SAACONS)
SBA	Small Business Administration (SMA)
SDEIS	Supplemental Draft Environmental Impact Statement (SDEIS)
SDSFIE	Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE)
SEP	Special Emphasis Program (SEP)
SITREP	Situation Report (SITREP)
SOP	Standard Operating Procedures (SOP)
SOW	Scope of Work (SOW)
SPCS	State Plane Coordinate System (SPCS)
SWPPP	Storm Water Pollution Prevention Plans (SWPPP)

TDY	Temporary Duty (TDY)
TM	Technical Manager (TM); Technical Manual (TM)
UFGS	Unified Facilities Guide Specifications (UFGS)
UMR	Upper Mississippi River (UMR)
USACE	US Army Corps of Engineers (USACE)
USC	United States Code (USC)
USCG	United States Coast Guard (USCG)
USDA	United States Department of Agriculture (USDA)
USFWS	United States Fish and Wildlife Service (USFWS)
USGS	United States Geological Survey (USGS)
VBDC	Value Based Design Charrette (VBDC)
VFZ	Vegetation Free Zone (VFZ)
VMZ	Vegetation Management Zone (VMZ)
VTC	Video Teleconference (VTC)
WBS	Work Breakdown Structure (WBS)
WRDA	Water Resources Development Act (WRDA)