



**US Army Corps  
of Engineers®**  
St. Paul District

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## **Appendix E: Civil-Site**

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Fargo Moorhead Metropolitan Area  
Flood Risk Management Project  
**Reach 5, Volumes 1 and 3: Stations 521+00  
to 566+00 and 596+00 to 656+00**

Engineering and Design Phase

P2# 370365

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# Appendix E: Civil-Site

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# Appendix E: Civil-Site

## E.1 GENERAL

Civil design for this project will include demolition, levee and excavated material berm (EMB) layout, access road layout, utility relocations, grading and rock placement at the Lower Rush River drop 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.

## E.2 DEMOLITION

Demolition by the diversion contractor will include clearing and grubbing of mature trees. The non-federal local sponsor is responsible for providing all lands and removing/capping existing utility structures prior to construction of the diversion channel. All holes resulting from the removals in the non-federal sponsor's demolition contracts will be temporarily filled to prevent any safety hazard.

Existing roads located within the proposed diversion, levees, and EMB areas will also require demolition. 30<sup>th</sup> ST SE/76<sup>th</sup> AVE N located at approximately Station 523+50 and 32<sup>nd</sup> ST SE located at approximately Station 624+00 will require demolition. See Section E.7 for demolition of utilities. The Phase 1 Environmental Investigation (Phase 1 ESA) will address the removal and disposal of materials. The non-federal local sponsor is responsible for providing all lands.

## E.3 DIVERSION CHANNEL LAYOUT

The control for the Reach 5 centerline of the diversion channel was set to flow parallel to existing property lines between Stations 521+00 and 656+00. Reach 5 Plans include three volumes. Volume 1 control alignment extends between Stations 521+00 and 566+00, Volume 2 extends between Stations 576+00 and 596+00 and includes the Lower Rush River Structure, and Volume 3 extends between Stations 596+00 and 656+00. Within Reach 5 is the County Road 22 bridge (Stations 566+00 to 576+00) which will be designed by the local sponsor. The proposed 590 foot bridge located at approximately Station 571+50 will be designed to allow traffic to pass over the channel via CR 22. In addition to the bridge and associated road realignments, this Bridge Reach also includes 1000' of diversion channel and EMB's to be designed by the local sponsor.

The overall length of Reach 5, excluding the bridge reach limits, is approximately 12,500 ft with 4500' in Volume 1, 2000' in Volume 2, and 6000' in Volume 3. Station 521+00 ties into reach 4 approximately 250 ft. north of 76th Ave. Station 656+00 ties into Reach 6 approximately 500 ft. downstream from the BNSF rail line.

The Lower Rush River reach (Volume 2) is bounded on the downstream end by the CR 22 bridge reach

and on the upstream end by the Volume 3 reach. The Lower Rush River drop structure intercepts the main diversion channel at Station 578+34.31.

### **E.3.1 Low Flow Channel and Sinuosity**

The low flow channel within the main diversion channel for Reach 5 including the Lower Rush River has a 46' wide bottom with a 2% cross slope and 1V:4H side slopes. The low flow channel side slopes extend and tie into the main diversion channel bottom which has a cross slope of 2%. The top of the low flow channel is approximately 90' wide. The low flow channel meanders within a 200' wide meander belt width. Based on the width of the meander belt width and this constraint, the sinuosity within the low flow channel is somewhat restricted. The sinuosity of the downstream portion (Station 521+00 to Station 566+00) of the Reach 5 Diversion Channel is approximately 1.12. The upstream sinuosity for the Reach 5 Diversion Channel is also approximately 1.12. In the Lower Rush River reach, there will be a straight portion of low flow channel between Stations 576+00 to 583+37.66 where the drop structure discharges into the main diversion channel. The overall average sinuosity for the Lower Rush River reach is 1.07. Excluding the straight portion of low flow channel necessary at the drop structure confluence, the average sinuosity for the Lower Rush River is 1.11.

## **E.4 LEVEES/EXCAVATED MATERIAL BERMS (EMB)**

For the Reach 5 Diversion Channel (not including the Lower Rush Drop Structure) the Excavated Material Berms (EMBs) are located on both sides of the diversion channel along the entire reach length. Between Stations 521+00 and 530+00, the EMB can be constructed to a maximum elevation of 911' at the top edge of the EMB closest to the diversion channel. Between Stations 530+00 and 566+00, the EMB can be constructed to a maximum elevation of 909' at the top edge of the EMB closest to the diversion channel. Between Stations 596+00 and 614+00, the EMB can be constructed to a maximum elevation of 912' at the top edge of the EMB closest to the diversion channel. Between Stations 614+00 and 648+00, the EMB can be constructed to a maximum elevation of 914' at the top edge of the EMB closest to the diversion channel. Between Stations 648+00 and 656+00, the EMB can be constructed to a maximum elevation of 915' at the top edge of the EMB closest to the diversion channel. In addition, view shed analysis prohibits any portion of the EMB from exceeding a height of 21' above the ground surface elevation. No benches are required on any portions of the reach. The EMB will rise at 2% from the inside edge to a crest point, then down at a 2% to the backside edge of the EMB. The EMBs will tie into Reach 4, the CR 22 Bridge EMBs, the Lower Rush Drop structure EMBs and continue along the length of the diversion up to the end of the Reach 5 project to Station 656+00 and tie into the Reach 6 EMBs. The alignment and configuration of the channel and excavated material berms are based on Hydraulic, Geotechnical, and Cultural considerations.

With the continuation of design, coordination with, and support of the local sponsor, final layout of the EMBs will take into account the desired end use as determined by the local sponsor. The final layout will involve balancing excavation/fill while generally placing 50% of the volume on each side of the channel except in the area of the drop structure. Other factors effecting EMB layout include coordination of the

design section with adjacent reaches, the new CR 22 bridge, the Lower Rush River drop structure, and real estate acquisition.

#### **E.4.1 Shrink/Swell/Overexcavation/Rebound**

Guidance Memo (GM)-002 Excavated Material Berm Design with Swell Factor Variations, provides guidance for design considerations of the EMBs for shrink and swell variations of the excavated material. The EMB has been designed to accommodate a 15% swell factor in the excavation material. The right bank EMB must be constructed to the neatlines shown in the drawings, and within allowable tolerances. The left bank EMB may be constructed between the neatline shown and the minimum berm limits shown on the plans.

#### **E.4.2 Excavated Material Piles**

Excavated material piles are being designed for the placement of excess material if the swell factor exceeds 15%. Excavated material piles have been designed and are directly adjacent to the local drainage ditch on both the right bank and left bank. Excavated material piles are located on the left bank south of 30<sup>th</sup> Street SE and on the right bank south of 32<sup>nd</sup> Street SE. The piles were designed with a 1V:6H side slope and a maximum height not to exceed the maximum height of the EMB directly adjacent to the pile. The top slope of the pile will slope at a minimum of 1% to provide positive drainage.

#### **E.4.3 Viewshed**

Guidance Memo (GM-001) Construction Heights of EMBs provides guidance for design considerations related to the construction height of EMBs. Cultural considerations included a viewshed analysis to determine visual impacts to the project. The analysis determined EMBs over 20 feet in maximum height will be visually intrusive, therefore the maximum construction height of the EMB is 21 ft. and accounts for an expected settlement of 12" for a final height of 20 ft.

#### **E.4.4 Recreation/Undulations**

The minimum EMB width recommended by the local sponsor to accommodate the undulations for the right bank EMB is 250'. Below this minimum would be difficult to balance earthwork with the undulation grading and could impact the user experience with the future recreational features. The right bank EMB considered this minimum width and where practical, this 250' guidance was followed.

The Local Sponsor requested that the existing shelter belt between STA 529+00 and STA 545+00 be protected. Therefore, the right side EMB was shifted and transitions were provided to avoid negative impacts to this area.

### **E.5 LOCAL DRAINAGE STRUCTURES**

Local drainage was designed by the local sponsor for incorporation into the Reach 5 construction documents. The local drainage design includes drainage ditches that run parallel along the right and left



bank EMB's. The local ditches convey local runoff from adjacent properties, as well as the EMB's, to larger County Drains or rivers. A minimum 20' wide buffer will be provided between the toe of the EMB and the local drainage ditch. The Lower Rush River flows east towards the Sheyenne River and would intercept the project footprint at approximately Station 560+00. The right local drainage ditch shall intersect and drain into the Lower Rush River at approximate Station 546+00. For the downstream portion of Reach 5, the left local drainage ditch will transition into the left drainage ditch of the CR 22 bridge reach. For the upstream portion of Reach 5, the left local drainage ditch will transition into the left drainage ditch of Lower Rush Drop Structure.

For the Lower Rush Drop Structure, the local ditch behind the right bank EMB will drain to the portion of the Lower Rush River remaining east of the diversion channel that discharges into the Sheyenne River. The local ditch behind the left bank EMB will drain to the realigned Lower Rush River and drop structure where it will be discharged into the main diversion channel. Culverts will be installed through the spoil piles upstream of the drop structure to pass the ditch flows into the realigned Lower Rush River.

Additional information on the Non-Federal Sponsor Local Drainage Plan can be found in Appendix M, Attachment M-7.

Culverts for the Local Drainage Ditch will be either corrugated steel pipe (CSP) or arch corrugated steel pipe (CSPA). CSPA provides greater capacity at shallow depths. Some of the local drainage channels will have relatively shallow normal water depths as indicated in the Local Drainage Report and therefore, CSPA is recommended.

Draft technical memorandum prepared by Houston Moore dated 12/18/2012, AWD-0005, Local Drainage Plan, provided sizing of the culverts in Table 2 for the local drainage ditches.

As part of the CR 22 bridge construction contract, a temporary bypass channel will be excavated by the local sponsor in order to reroute all Lower Rush River flows around the project site to the east. After the Lower Rush River drop structure is completed and the Lower Rush River is realigned into the main diversion channel, the temporary bypass channel will be backfilled in its entirety and the box culverts under CR 22 will be abandoned in place.

The flow within both the right and left local drainage ditches near STA 523+00 has a high point grade break with flow draining north towards an existing drainage tributary within Reach 4 and south towards the Lower Rush River. This high point is located at the existing 30<sup>th</sup> Street SE and 76<sup>th</sup> Avenue N road where access ramps up to the left and right EMBs are provided therefore, culverts are not necessary for the local drainage ditches at this location.

### **E.5.1 Field Drainage and Drainage Ditch Inlets**

Reach 5 includes drainage ditches along the outside of the EMB's that convey runoff from the EMB's and adjacent properties to larger County Drains or rivers. These ditches were designed by the local sponsor design team and incorporated into the Reach 5 plans by the PDT. The ditches intersect large drains (County Drains), small drains (Road Ditches), and open swales on adjacent agricultural fields. The intersection points, referred to as drainage ditch inlets, were designed to provide adequate drainage and minimize erosion.

The Local Sponsor's drainage ditch design includes side berms to contain the local runoff from a 10-percent chance rainfall event and not allow it to back into the adjacent field. Side berms were necessary in Reach 5 to contain the 10 year event. The embankment elevation is based on the 10-percent chance channel water surface elevation plus two feet.

Side berms were necessary on the left local drainage ditch between STA LD 0+09.23 and STA LD 19+66.37 within Volume 1. No side berms were necessary for Volume 3. Side berms were necessary on the right local drainage ditch between STA RD 0+00 and STA RD 1+41.90 within Volume 1 near 76<sup>th</sup> Ave N/30<sup>th</sup> St SE. No side berms were necessary in Volume 3.

Design of inlets is in accordance with GM-003, Local Drainage Features Outside of the Diversion Channel with the exception of the minimum 3 feet between the toe of the berm and the invert of the parallel drainage ditch. In Reach 5, Volumes 1 and 3, the elevation difference between the field drains and the parallel drainage ditches is approximately .70 – 2 ft and could not meet the 3 foot minimum. After discussing this with the Local Sponsor, the PDT modified the minimum elevation difference to 1 foot for this Reach.

The design team analyzed base topography and aerial photography to identify each location where the drainage ditch intersected an adjacent drainage feature. Each intersection point is identified in the drawings, along with the type of inlet Based on GM-003.

## **E.6 ACCESS ROADS AND PARKING AREAS**

The design of permanent access roads for operation and maintenance of the diversion channel, drop structure and EMB's will be developed through coordination with the local sponsor and in accordance with USACE MVP MFR-001-Fargo-Moorhead Metro Flood Risk Management (FMMFRM) Project-Levees and Excavated Material Berms along the Diversion Channel. Primary Access to the Reach 5 Diversion Channel will be from both cut off/abandoned 30<sup>th</sup> ST SE (Downstream Portion of Reach 5), and the CR 22 bridge. 30<sup>th</sup> ST SE shall be cut off and abandoned during Diversion Channel construction efforts. Permanent access roads shall be designed and constructed on the land side of the EMBs where the existing roadway dead ends.

The CR 22 bridge reach is located between diversion channel Station 566+00 and Station 576+00. A new bridge at approximate diversion channel Station 571+00 will be constructed to allow CR 22 traffic to cross the new diversion channel. The proposed CR 22 bridge will be designed and constructed by others. Primary access to the Lower Rush Drop Structure site will be by CR 22.

Permanent access ramps for operation and maintenance of the EMBs are proposed at 76<sup>th</sup> Avenue North and 32<sup>nd</sup> St SE for the left bank EMB and at 30<sup>th</sup> St SE for the right bank EMB.

The design of permanent access roads for operation and maintenance of the diversion and EMBs include culverts where the roads cross over local drainage ditches.

### **E.6.1 Geometric Design Criteria – Access Road**

The geometric design criteria and guidance used for the design of the access and maintenance roads is summarized below:

- 20' wide with 8" thick ND Class 13 gravel surface
- Grade of ramp should be no steeper than 1:10.
- Design Speed of vertical curves 15 mph minimum
- Design Length of vertical curves 100 ft minimum
- Side slopes should not be less than 1:3 to allow grass cutting equipment to operate.
- Turnouts should be provided at intervals of approximately 2,500 feet, provided there are no ramps within that reach.
- Turnarounds shall be provided at dead ends. Cul-de-sacs are designed with 50' radius for turnaround and emergency vehicles near the outlet.

EM 1110-2-1913 defines some design considerations for permanent project access ramps as well as maintenance roads.

6" gravel over geotextile fabric is a typical section for Cass County roads in this area. The maintenance and access roads are designed with 8" gravel over geotextile fabric due to the uncertainty in the compaction that will be achieved in the excavated material berms (EMBs).

## **E.7 UTILITY INFORMATION**

Utility information, including surveyed locations was obtained from Moore Engineering under contract with the local sponsor.

### **E.7.1 Existing Utilities**

Utilities identified within the limits of Reach 5 include overhead electrical power lines; buried telephone lines (to include fiber optic); and buried water mains. A total of nine encroachments were identified through review of utility mapping and field locates. Field locates were conducted in December of 2011 and January of 2012.

Six encroachments are from overhead electric lines; one encroachment is from a buried fiber optic communication cable, one encroachment is from a buried unspecified communication cable, and one encroachment is from a water main crossing. No utilities were identified within the Lower Rush River reach.

The following table lists utilities known to cross the diversion channel within Reach 5 including utilities along CR 22:

**Table E-1: Utility Encroachments Reach 5**

UTILITY	LOCATION	DESCRIPTION
<b>ELECTRIC</b>		
Cass County Electric	Overhead Electric Line Crosses Reach 5 at Control Line Sta. 524+10	Line runs East – West along the south side of 76 <sup>th</sup> Ave. N (30 <sup>th</sup> Street SE), intersects with power line running northwest-southeast approximately 1000' west of 168 <sup>th</sup> Ave. SE.
Cass County Electric	Underground Electric Line Crosses Reach 5 Control Line at Sta. 570+00	Line runs East – West along the north side of CTY RD 22 (31 <sup>st</sup> Street).
Minnkota Electric	Overhead Transmission lines cross Reach 5 at Control Line Sta. 612+00 and 613+75.	Lines are large parallel transmission lines running East – West across project.
<b>COMMUNICATION</b>		
Midcontinent Fiber Optic	Underground fiber optic line crosses Reach 5 at Control Line Sta. 570+50.	Line runs East – West along the north side of CTY RD 22 (31 <sup>st</sup> Street).
Century Link Telephone	Underground unspecified telephone line crosses Reach 5 at Control line Sta. 571+60	Line runs East – West along the south side of CTY RD 22 (31 <sup>st</sup> Street).
<b>WATER</b>		
Cass Rural Water Users, Inc.	Underground water line crosses Reach 5 at Control Line Station 570+24	1 ½" water line runs East – West along the north side of CTY RD 22 (31 <sup>st</sup> Street).

The local sponsor is coordinating the utility relocations, and the role that the Reach 5 design team will have is yet to be determined. Expected Reach 5 involvement is as follows:

- Incorporate existing utility locations into the design files.

- Coordinate with MVP and local sponsor to determine if lines will be relocated by others prior to the project or by the Reach 5 contractor. It is anticipated that the electric and telecommunication lines will be relocated by others prior to the project.
- Reach 5 design team will be responsible for designing relocations determined to be part of the project. The MVP MFR for Utility Relocations contains guidelines for utility relocation design.
- Reach 5 design team will coordinate with MVP and local sponsor to obtain as-built information for any relocation to be done by others that is still located within the project limits. The as-built locations should be incorporated into the Reach 5 plans.
- Coordinate with MVP and local sponsor to determine if abandoned lines will be removed by others prior to the project or by the Reach 5 contractor. Reach 5 design team is responsible for designing the demolition and removal of abandoned lines determined to be part of the project.

## **E.7.2 Utility Relocations**

Any utility relocation that become necessary during the course of design or construction will comply with the MVP MFR-001 Utility Relocation Requirements for Utility Relocation Requirements and local/state requirements.

### **E.7.2.1 Overhead Electric**

Overhead electrical lines will be relocated by the utility owner prior to project construction. Demolition of existing lines will be the responsibility of the utility owner Cass County Electric.

### **E.7.2.2 Buried Communication Lines**

Buried Communication lines will be relocated by the utility owner prior to project construction. Existing lines will be abandoned in place by the Utility Company and removed by the Reach 5 Contractor during construction of the diversion channel. The removals will be included in the Reach 5 plans.

### **E.7.2.3 Water Mains**

Existing water mains will be relocated by the utility owner prior to project construction. The Reach 5 contractor's demolition activities may include demolition of existing water mains/lines abandoned in place.

## **E.8 VEGETATION MANAGEMENT ZONE (VMZ)**

The Vegetation Free Zone (VFZ) and Vegetation Management Zone (VMZ) will comply with the requirements of the Memorandum for Record (MVP MFR-Fargo-Moorhead Metro Flood Risk Management (FMMFRM) Project-Levees and Excavated Material Berms along the Diversion Channel).

The requirements for VFZ are outlined in the USACE Technical Letter ETL 1110-2-583 which the MFR has been developed in accordance with. The VFZ will be a minimum of 15' from the toe of stand-alone levees and partially embedded levees. The VMZ will extend 15' from the landside crown of the levees embedded within EMB's. The VFZ/VMZ lines will not be shown in the Reach 5 contract documents, but will be defined in the O&M documents provided to the local sponsor at project completion.

## **E.9 REAL ESTATE/WORK LIMITS**

### **E.9.1.1 Easements**

Permanent easement is being set at 50' from the toe of the outermost project feature. Temporary easement is being set at 200' from the 50' permanent easement line. Temporary easement will be used for a variety of construction purposes, including temporary storage of stripped topsoil. Additional easements will likely be required for access roads when that design is complete. Additional temporary easement will be shown once contractor storage and staging areas are defined by the local sponsor and incorporated into the Reach 5 design.

### **E.9.1.2 Construction Staging Areas**

There is a 7.67 acre staging area for Reach 5 Volume 1 located immediately South of 76<sup>th</sup> AVE on the West Side of the Diversion Channel and a 9.25 acre staging area for Reach 5 Volume 3 located immediately South of an existing farm road at Station 624+00 along the East Side of the Diversion Channel. Both areas shall serve as construction staging areas and as locations for placing excavated material for instances where excavated material quantities exceed the EME design (Swell exceeds 15% swell factor). It shall also serve as a location placing excavated material during future channel maintenance operations.

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## E.10 TECHNICAL GUIDELINES AND REFERENCES

<p><b><i>A Policy on Geometric Design of Highways and Streets</i></b>, Sixth Edition; American Association of State Highway and Transportation Officials (AASHTO); 2011.</p>
<p><b><i>Guidelines for Geometric Design of Very Low-Volume Local Roads</i></b>, American Association of State Highway and Transportation Officials (AASHTO); 2001</p>
<p>USACE EM 1110-2-1913, Design and Construction of Levees</p>
<p>USACE EM 1110-2-2902, Conduits, Culverts and Pipes</p>
<p>USACE ETL 1110-2-583, Guidelines for Landscape Planting and Vegetation Management at Levees, Floodwalls, Embankment Dams, and Appurtenant Structures</p>
<p>USACE MVP MFR-001-Fargo-Moorhead Metro Flood Risk Management (FMMFRM) Project- Levees and Excavated material Berms along the Diversion Channel</p>
<p>USACE MVP MFR-010-Utility Relocation Requirements; Fargo-Moorhead Metropolitan Area Flood Risk Management Project</p>