Draft Feasibility Report and Environmental Impact Statement

Fargo-Moorhead Metropolitan Area Flood Risk Management

May 2010

US Army Corps of Engineers®

Prepared by:
U.S. Army Corps of Engineers
St. Paul District
190 Fifth Street East, Suite 401
St. Paul, Minnesota 55101-1638

Page intentionally left blank

Table of Contents

Items designated with a * are sections related to the Environmental Impact Statement

List of Figures

List of Tables

List of Pictures

List of Attachments

List of Appendices

Page intentionally left blank

Draft Feasibility Report and Environmental Impact Statement
Fargo-Moorhead Metropolitan Area Flood Risk Management

EXECUTIVE SUMMARY

STUDY AUTHORITY

The St. Paul District, Corps of Engineers, and the sponsor cities of Fargo, North Dakota and Moorhead, Minnesota began the Fargo-Moorhead Metro Feasibility Study in September 2008. The study was authorized by a September 30, 1974, Resolution of the Senate Committee to Public Works. Prior to 2008 the Corps conducted numerous studies and projects in the study area. The Fargo-Moorhead metropolitan area was included in the Red River Reconnaissance Study approved in 2002; that study was not to a sufficient level of detail to recommend a feasibility study specifically for measures in Fargo and Moorhead. A supplemental reconnaissance report recommended this feasibility study and was approved by the Mississippi Valley Division on April 8, 2008.

Based on the reconnaissance study findings, 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 cost share was 50/50 between the Federal Government and the two non-federal sponsors. The Corps of Engineers issued a notice of intent to prepare an environmental impact statement in the Federal Register on May 5, 2009.

PURPOSE AND SCOPE

The scope of the feasibility study was to better understand flood issues, establish flood risk management measures that could be implemented, document findings and, if appropriate, recommend implementation of a Federal project in the Fargo-Moorhead Metropolitan Area. The planning objectives were specified as follows:

- Reduce flood risk and flood damages in the Fargo-Moorhead metropolitan area.
- Restore or improve degraded riverine and riparian habitat in and along the Red River of the North, Wild Rice River (North Dakota), Sheyenne River (North Dakota), and Buffalo River (Minnesota) in conjunction with other flood risk management features.
- Provide additional wetland habitat in conjunction with other flood risk management features.
- Provide recreational opportunities in conjunction with other flood risk management features.

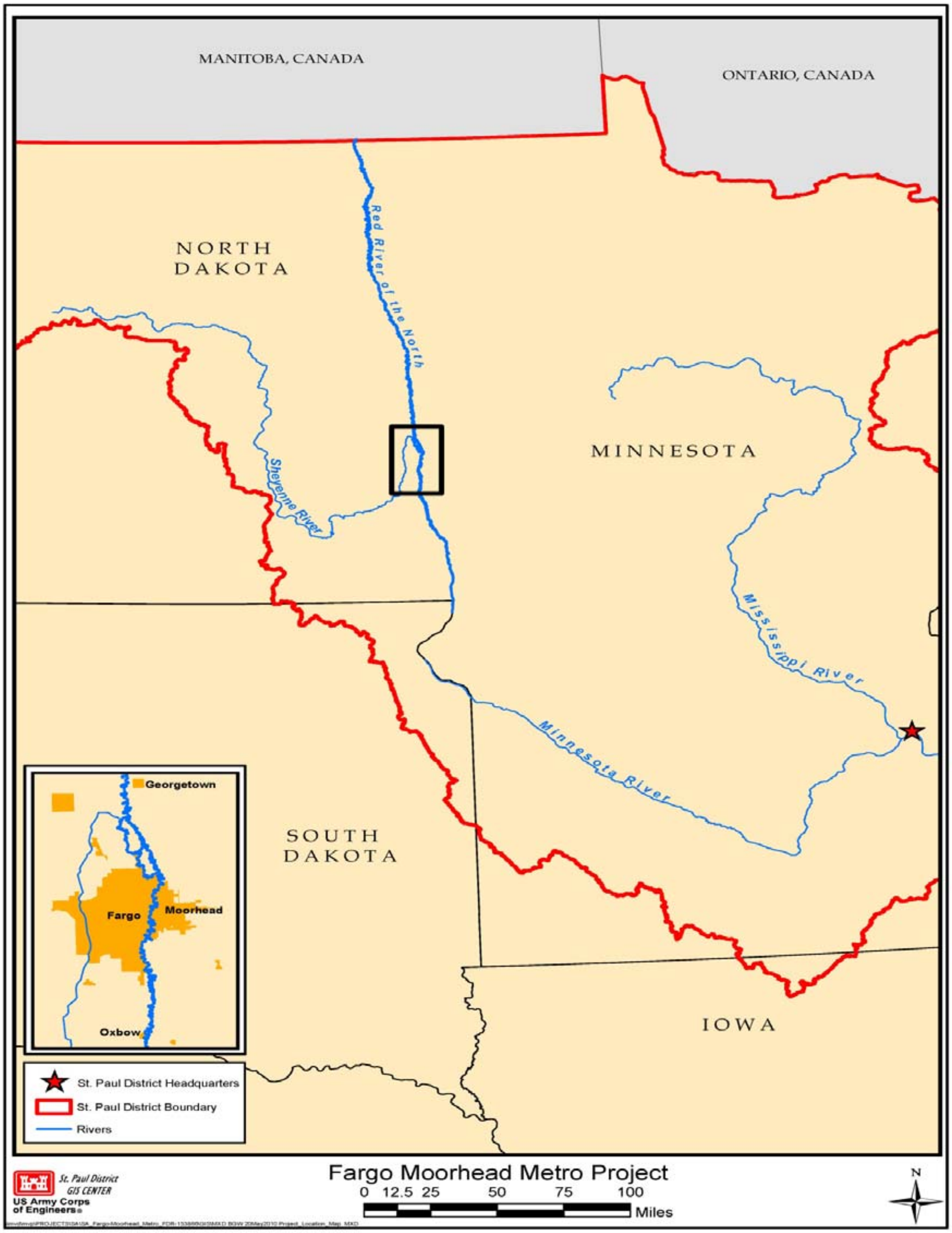
The study product is a decision document in the form of an integrated feasibility report and National Environmental Policy Act (NEPA) document in accordance with the Corps' Planning Guidance Notebook, Engineer Regulation (ER) 1105-2-100. The feasibility study investigated measures to reduce flood risk and analyzed the potential for federal participation in implementing a flood risk management project in the Fargo-Moorhead Metropolitan Area. This report, in accordance with the authorizing legislation, will allow for tiering supplemental NEPA documentation as permitted by Council on Environmental Quality (CEQ) Regulation 40 C.F.R. 1508.28.

The feasibility study team collected pertinent engineering, economic, social and environmental information needed to accomplish the study objectives. Interagency, public and potentially affected landowners were identified, and potential issues and opportunities were defined. An array of possible flood risk reduction plans were considered and screened to define the costs, benefits, and impacts to the study area.

LOCATION OF STUDY AREA

The Fargo-Moorhead metropolitan area is located in the Red River of the North Basin. Fargo, North Dakota and Moorhead, Minnesota are situated on the west and east banks, respectively, of the Red River of the North. Figure 1 shows the location of the study area.

Figure 1 - Fargo-Moorhead study area location



The study area is approximately 600 square miles surrounding the cities of Fargo and Moorhead and encompassing several smaller communities within ten miles of the Red River from Hickson, North Dakota to Georgetown, Minnesota. The Wild Rice, Sheyenne, Maple, Rush and Lower Rush Rivers in North Dakota and the Buffalo River in Minnesota also cross the study area. The Red River originates at the confluence of the Otter Tail and Bois de Sioux Rivers south of Fargo-Moorhead. The river is approximately 453 river miles long and flows north where it empties into Lake Winnipeg in Manitoba, Canada.

The Fargo-Moorhead metropolitan area has a population of approximately 200,000. Fargo-Moorhead is a gateway to the west and a hub of educational and health- related industries. The metropolitan area is the largest urban area in North Dakota and a principal regional economic and social center.

FLOOD HISTORY

Because of its relatively low elevation and flat topography, the majority of the study 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 47 of the past 108 years, and every year from 1993 through 2010. Flooding in Fargo-Moorhead typically occurs in late March and early April. Average annual flood damages in the Fargo-Moorhead metropolitan area are estimated to be over $195.9 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.

ALTERNATIVES CONSIDERED

The study analyzed a number of possible types of measures and alternative plans that could reduce the flood risk in the Fargo-Moorhead metropolitan area. These measures and plans included:

- No Action - Continue emergency measures
- Non-structural measures
- Flood barriers (including levees)
- Increase conveyance (including diversion channels)
- Flood storage

The alternatives went through an initial screening that used the following criteria: Effectiveness, Environmental Effects, Social Effects, Acceptability, Implementability, Cost, Risk, Separable Mitigation, and Cost Effectiveness. The initial screening analysis was published in the Alternatives Screening Document dated December 2009. The analysis resulted in two diversion concepts being carried forward: a diversion in Minnesota and a diversion in North Dakota.

The plans that were analyzed in detail were the:

- No Action – synonymous with "Without Project Condition"
- MN20k: Minnesota Short Diversion, 20,000 cubic feet per second (cfs) capacity
- MN25k: Minnesota Short Diversion, 25,000 cfs capacity
- MN30k: Minnesota Short Diversion, 30,000 cfs capacity
- MN35k: Minnesota Short Diversion, 35,000 cfs capacity
- MN40k: Minnesota Short Diversion, 40,000 cfs capacity
- MN45k: Minnesota Short Diversion, 45,000 cfs capacity
- ND30k: North Dakota East Diversion, 30,000 cfs capacity
- ND35k: North Dakota East Diversion, 35,000 cfs capacity
- The preceding plans with the addition of non-structural measures

The design, alignments, and features were refined, and cost estimates for each plan were completed. The expected future without project conditions were assessed and compared to the expected future conditions with each project in place. The hydraulic and associated economic effects of each plan were quantified so that the plans could be compared.

STUDY CONCLUSIONS

Table 1 and Table 2 summarize the final study results.

Table 1 - Phase 3 cost-effectiveness analysis results

Screened Alternatives Ranked by Net Benefits with Cost and Schedule Risk Assessment					
Alternative	Cost [1]	Avg Annual Net Benefits [1]	Avg Annual Benefits [1]	Residual Damages [1]	B/C Ratio
MN Short Diversion 20K	$1,032	$87.0	$140.0	$55.9	2.64
MN Short Diversion 25K	$1,121	$98.8	$156.4	$39.5	2.71
MN Short Diversion 30K	$1,194	$101.7	$163.1	$32.8	2.66
MN Short Diversion 35K	$1,286	$104.9	$171.0	$24.9	2.59
MN Short Diversion 40K [2]	$1,367	$105.6	$175.9	$20.0	2.50
MN Short Diversion 45K [2]	$1,450	$104.9	$179.5	$16.4	2.41
ND East Diversion 35K	$1,462	$95.4	$171.1	$24.8	2.26
1. In millions of dollars with interest during construction and discounting included					
2. Estimate based on linear extrapolation					
Expected average annual damages without a project are $195.9 million.					

Table 2 - Phase 3 estimated flood stages assuming various diversion capacities

	Stage at Fargo Gage (ft)	
	1% Chance (100- year)	0.2% Chance (500- year)
Existing Condition (Stage)	42.4	46.7
Existing Condition (CFS)	34,700	61,700
Work Group Goal	30	36
20K Diversion Channels	36.9	43.7
25K Diversion Channels	34.8	42.4
30K Diversion Channels	33.6	41.9
35K ND Diversion Channel	30.6	40.0
35K MN Diversion Channel	31.9	39.6
40K Diversion Channels	31.9	37.6
45K Diversion Channels	31.9	35.3

The study identified three plans of significance to decision makers:

- The National Economic Development plan (NED)
- The Locally Preferred Plan (LPP)
- The Federally Comparable Plan (FCP)

The NED plan was the MN40k diversion. The NED plan provides the greatest net economic benefit consistent with protecting the Nation's environment.

The LPP was the ND35k diversion. The LPP is the tentatively selected plan. The LPP is the plan that, in the opinion of the non-federal sponsors, best meets the needs of the local community. The Cities of Fargo and Moorhead, Cass County, North Dakota and Clay County Minnesota jointly requested that the ND35k plan be pursued as the LPP on March 29, 2010. The request to designate the LPP as the tentatively selected plan was approved by the Assistant Secretary of the Army for Civil Works on April 28, 2010.

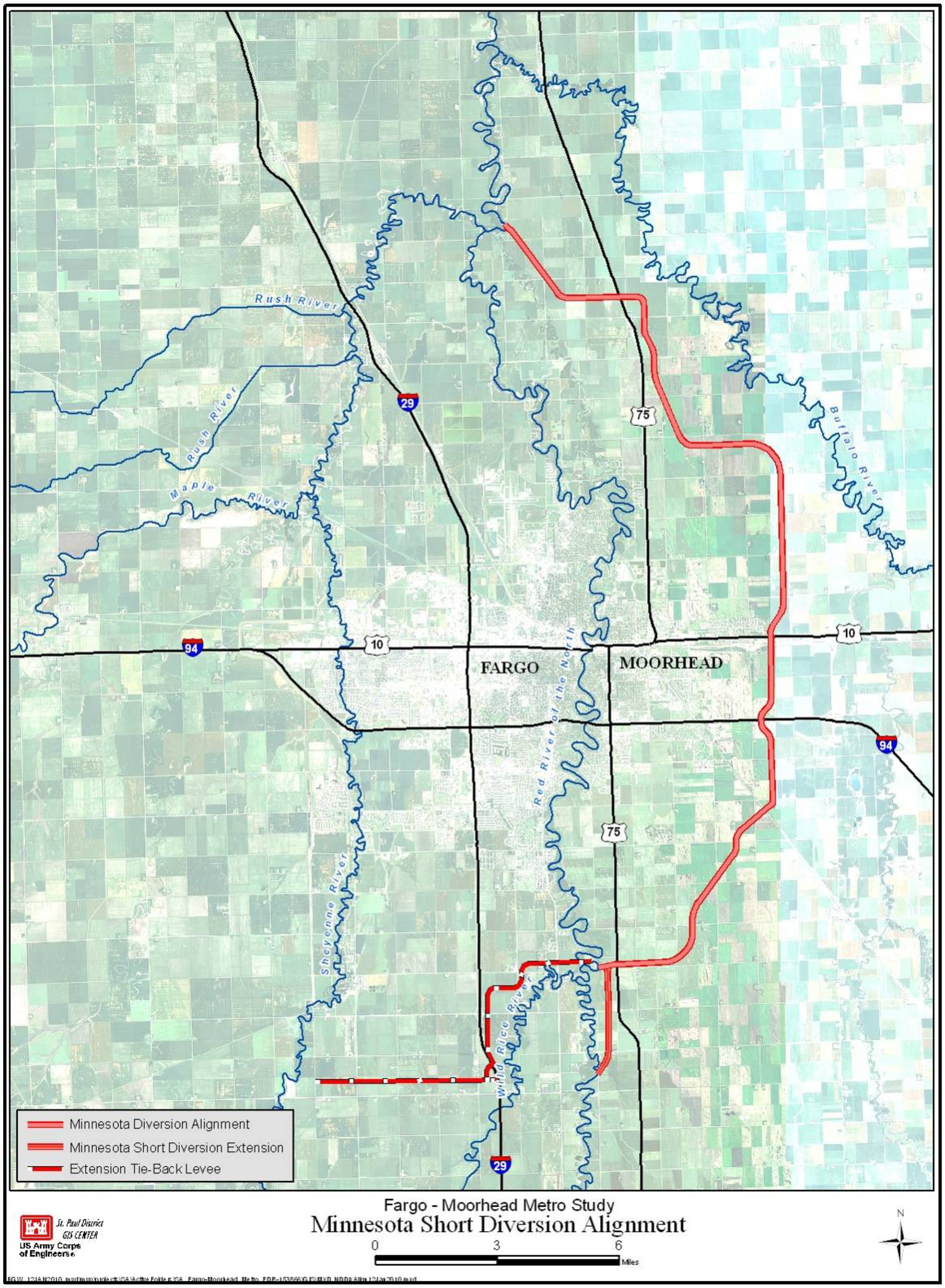
The FCP was the MN35k diversion. The FCP is a plan that provides comparable total annual economic benefits to the LPP and is smaller and less expensive than the NED plan. Normally the NED plan establishes the basis for federal cost sharing of a LPP, but in this case the LPP provides fewer total annual economic benefits than the NED plan does. Therefore, the FCP will be used as the basis for federal cost sharing instead of the NED plan.

DESCRIPTION OF THE FEDERALLY COMPARABLE PLAN (FCP)

The MN35k diversion channel, which is the FCP, would be a 25 mile long diversion channel with a base width of 360 feet and maximum depth of 30 feet. The plan would include 20 highway bridges, four railroad bridges, and a Red River control structure. The FCP would start just north of the confluence of the Red and Wild Rice Rivers and extend north and east around the cities of Moorhead and Dilworth and re-enter the Red River near the confluence of the Red and Sheyenne Rivers. The diversion channel and spoil banks would have a construction footprint of approximately 6,415 acres.

The Red River control structure located at the south end of the diversion channel would reduce water surface elevations downstream of the structure by limiting the flow of water in the natural channel. Flows in excess of the natural channel capacity would be diverted into the constructed diversion channel and passed around the urban area. In addition to the main diversion channel, the FCP would include two smaller channels upstream of the Red River control structure to prevent stage increases upstream of the project along the Red and Wild Rice Rivers. The plan would have a tie-back levee at the southern limits of the project. The tie-back levee would connect the Red River control structure to high ground and prevent flood water from flowing overland to the north and west into the protected area. Figure 2 shows the alignment of the FCP.

Figure 2 – Federally Comparable Plan (FCP) Diversion Alignment.

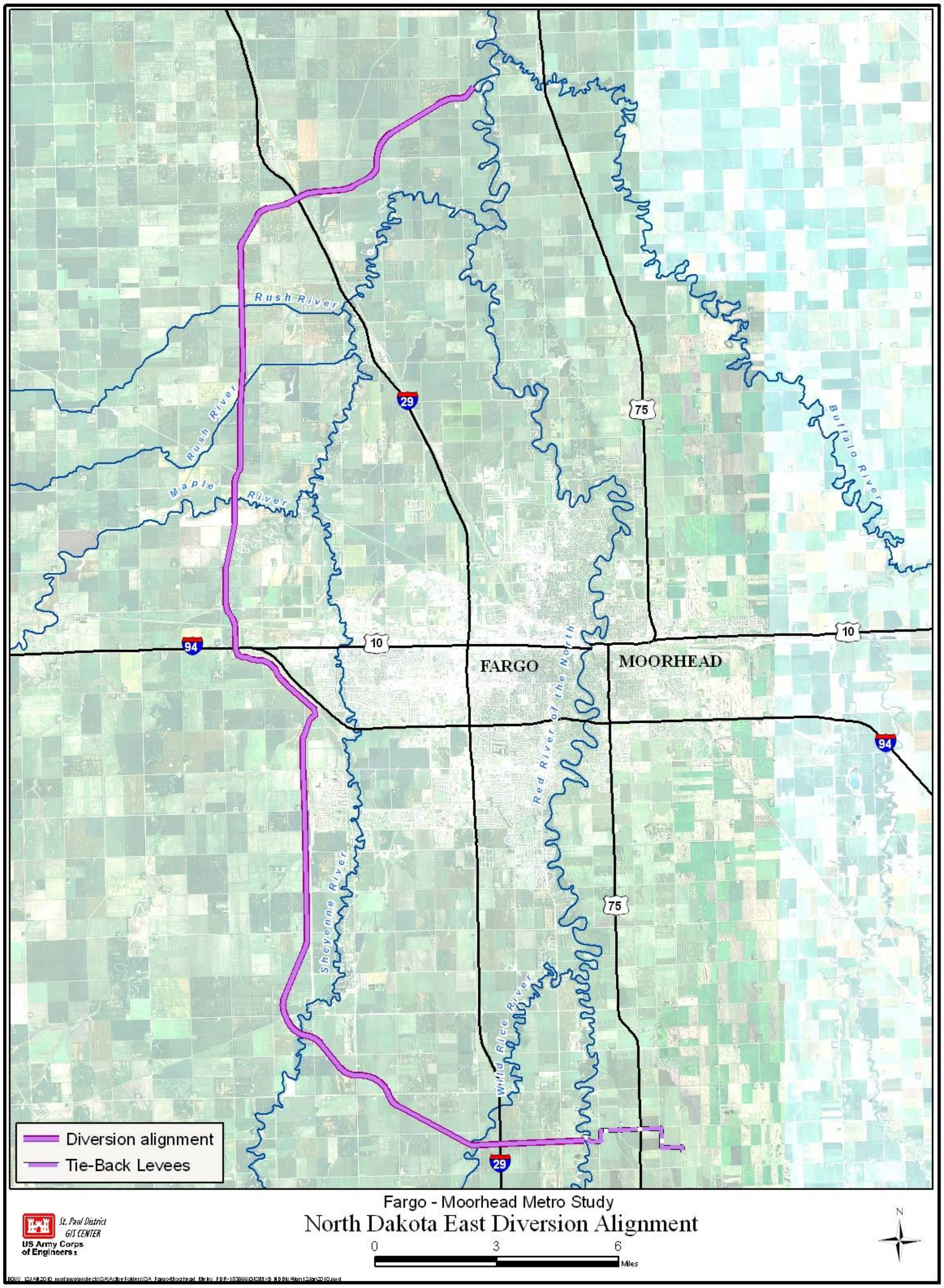


DESCRIPTION OF THE TENTATIVELY SELECTED AND LOCALLY PREFERRED PLAN (LPP)

The ND35k diversion channel is the tentatively selected and locally preferred plan (LPP). The LPP would be a 36 mile long diversion channel that would start approximately four miles south of the confluence of the Red and Wild Rice Rivers and would re-enter the Red River north of the confluence of the Red and Sheyenne Rivers. The LPP would incorporate the existing Horace to West Fargo Sheyenne River diversion channel. The channel bottom width varies on the channel from 100 to 300 feet and has a maximum depth of 29 feet. The plan includes 18 highway bridges, four railroad bridges, and would have a construction footprint of approximately 6,560 acres.

The ND35k diversion would begin approximately four miles south of the confluence of the Red and Wild Rice Rivers. A connecting channel between the Red and Wild Rice Rivers would convey flow from the Red River to the diversion channel inlet on the west side of the Wild Rice River. A combination of control structures on the Red and Wild Rice Rivers at the south end of the project, along with weirs at the west end of the connecting channel and at the entrance to the diversion channel near the Wild Rice River, control the flow split between the Red and Wild Rice River channels and the diversion channel. The diversion would also cross the Sheyenne, Maple, Lower Rush, and Rush rivers. At the Sheyenne and Maple rivers, structures would be necessary to allow base flows to follow the natural river channel. Flows in excess of a 50-percent chance event would be diverted into the diversion channel. The Lower Rush and Rush rivers would have drop structures that would drop the entire flow of those rivers into the diversion channel. Figure 3 shows the alignment of the LPP.

Figure 3 – LPP Diversion Alignment



The total estimated first cost (without interest during construction) of the LPP based on October 2009 price levels is $1,272,108,000, with the Federal and non-federal shares of total first cost estimated at $710,666,000 and $561,442,000, respectively. The flood risk management features have an estimated total first cost of $1,237,354,000 with the Federal and non-federal shares estimated at $693,289,000 and $544,065,000, respectively. The recreation features have an estimated total first cost of $34,753,000, with the Federal and non-federal shares estimated at $17,376,000 and $17,376,000 respectively. The annual operation and maintenance costs are $3,365,000. The tentatively selected plan has an overall benefit-cost ratio of 2.27 and would provide a level of risk reduction in excess of the 1-percent chance event for the majority of the region. Table 3 shows the breakout of the project first costs, interest during construction, and the project benefit cost ratio. Table 4 shows the breakout of project costs split between the non-federal sponsors and the Federal Government, along with the estimated cash contribution that is required.

Table 3 - Estimated Project Costs for the LPP (ND35K) (including interest during construction)

Estimate of Project First Costs ND 35K				
Account	**Item**	**Flood Risk Management**	**Recreation**	**Total**
01	Lands & Damages	60,593		60,593
02	Relocations	82,251		82,251
06	Fish and Wildlife Facilities	82,960		82,960
08	Roads, Railroads and Bridges	54,971		54,971
09	Channels & Canals	741,990		741,990
11	Levees and Floodwalls	2,386		2,386
14	Recreation Facilities		28,486	28,486
Subtotal		$ 1,025,151	$ 28,486	$ 1,053,637
30	Planning, Engineering and Design	144,684	4,273	148,957
31	Construction Management	67,520	1,994	69,514
Subtotal		$ 212,204	$ 6,267	$ 218,471
	Interest During Construction	224,549	760	225,309
	Total Investment Costs	**$ 1,461,904**	**$ 35,513**	**$ 1,497,417**
Estimate of Annual Costs				
	Annualized Project Costs	72,477	1,761	74,238
	Annual OMRR&R Cost	3,318	47	3,365
	Total Annual Costs	**$ 75,795**	**$ 1,808**	**$ 77,603**
Average Annual Benefits				
	Flood Damage Reduction	160,197	0	160,197
	Flood Proofing Cost Savings	9,993	0	9,993
	Flood Insurance Administrative Costs	958	0	958
	Non Structural Flood Risk Benefit	-		-
	Recreation	-	5,130	5,130
	Total Annual Benefits	**$ 171,148**	**$ 5,130**	**$ 176,278**
	Net Annual Benefits	$ 95,353	$ 3,322	$ 98,675
	Benefit to Cost Ratio	2.26	2.84	2.27
All costs and benefits in thousands ($1,000)				

Table 4 – Allocation of funds table (first costs).

ND 35,000 cfs			
Item	Federal ($)	Non-Federal ($)	Total ($)
Flood Risk Management			
Lands and Damages		60,593	60,593
Relocations	54,971	82,251	137,222
Fish and Wildlife Facilities	82,960		82,960
Channels and Canals	741,990	0	741,990
Levees and Floodwalls	2,386	0	2,386
Planning, Engineering, & Design	132,346	12,338	144,684
Construction Management	61,761	5,758	67,519
Cash Contribution	-383,126	383,126	0
Total FRM	693,289	544,065	1,237,354
Recreation			
Lands and Damages	0	0	0
Relocations	0	0	0
Recreation Facilities	28,486	0	28,486
Planning, Engineering, & Design	4,273	0	4,273
Construction Management	1,994	0	1,994
Cash Contribution	-17,376	17,376	0
Total Recreation	17,376	17,376	34,753
Total Project	710,665	561,441	1,272,107
All costs in thousands ($1,000)			

EFFECTS OF THE PROJECT

Implementing either the FCP or LPP would result in a substantial beneficial effect on the local economy by significantly reducing flood damages and flood risk, improving public safety and peace of mind. Both plans would remove much of the Fargo-Moorhead area from the regulatory floodplain. The LPP would benefit a larger geographic area and more people than the FCP would. Either diversion would significantly reduce flood damage and flood risk, but neither of the plans would completely eliminate the flood risk.

A diversion channel in either Minnesota (FCP) or North Dakota (LPP) would change the flow and timing of water during flood events, significantly reducing the quantity of water flowing in the natural Red River channel through Fargo-Moorhead. As a result of the modifications to the flow and timing, there would be downstream impacts. The potential downstream impacts resulting from operation of the MN35k and ND35k plans will be evaluated further, including an analysis of the 10-, 2-, and 1-percent chance events. Earlier analyses indicated that the increases in the level and duration of downstream flooding would have no appreciable effects on natural resources and would not be considered environmentally significant, but the resulting adverse effects on social resources may be considered significant.

There are 4,626 acres of wetlands in the project area, which is less than 0.05% of the area within the project boundary. The Minnesota diversion alignment would directly impact approximately 17 acres of wetlands and could indirectly impact up to 85 acres of wetlands. The North Dakota diversion alignment would directly impact approximately 33 acres and could indirectly impact up to 193 acres of wetlands. Either alternative would include appropriate measures to minimize or mitigate potential losses to wetland areas.

Groundwater resources in the project area include the Buffalo Aquifer and the West Fargo Aquifer. The Buffalo aquifer, located five to seven miles east of Moorhead and a mile east of the Minnesota alignment, is not expected to experience measureable effects from the diversion channel. The West Fargo aquifer appears to be deep enough to avoid adverse impacts from the North Dakota alignment. Neither the FCP or the LPP is expected to have adverse impacts to significant groundwater resources in the project area.

The FCP and LPP use similar structures to facilitate the routing of floodwater from the Red River into a diversion channel, and both plans would reduce Red River flood stages. This could affect sediment transport, accretion, and erosion, which are critical forces in shaping and maintaining aquatic habitat. Sediment would be conveyed through both the Red River control structure and down the diversion channel. Given this, the likelihood for drastic changes in sediment scour and deposition downstream of the confluence of the diversion channel appears small.

Connectivity and habitat for fisheries is a concern throughout the river basin and for either the FCP or the LPP. Habitat connectivity is important in terms of fulfilling seasonal and life stage-specific habitat needs for river fish. With either alignment, fish could use the diversion channel during flood periods, although conditions in most of the diversion channel would not provide any meaningful fisheries habitat, and this would happen relatively infrequently. The LPP diversion channel downstream of the Lower Rush River would be designed to provide fish habitat. Fish that are drawn up the diversion channel would still be able to pass back into the Red River at the head of the diversion channel. While it is possible that fish could be lost in isolated pools within the diversion channel, it is not believed that this would be a significant issue during project operation. No significant impacts would be anticipated from fish stranding under any diversion alternative.

The Minnesota alignment does not cross any tributaries or other surface waters with fisheries resources. The North Dakota alignment would cross five tributaries: Wild Rice River, Sheyenne River, Maple River, Lower Rush River and Rush River.

The FCP and LPP would remove approximately 5,700 and 5,400 acres of prime and unique farmland from operation, respectively. The plans would result in acquisition of farm land in Clay County, MN or Cass County, ND. Both plans would result in a cumulative loss of farmland and business income, but mitigation measures would be taken to ensure minimum impacts to farm land and property owners.

Both the Minnesota and North Dakota alignments would require relocation of dwellings and cause direct impacts to affected landowners. There are an estimated six residential or farmstead relocations for the North Dakota alignment and five residential or farmstead relocations for the Minnesota alignment. Owners would be fairly compensated for their property and relocation.

Recreational features are included in the tentatively selected plan. Recreation features would include but not be limited to multipurpose trails, interpretive signage, benches, and trail heads with parking facilities. The recreation plan could result in a healthier, more vibrant community. The plantings associated with the recreation would make the recreational experience more aesthetically pleasing and would enhance the overall experience. Recreational features could add social and economic benefits to the metropolitan region.

RECOMMENDATIONS

The St. Paul District Engineer, after considering the environmental, social, and economic effects, the engineering feasibility, and comments received from the other resource agencies, the non-federal sponsors, and the public, has determined that the tentatively selected plan presented in this report is in the overall public interest and is technically sound, environmentally acceptable, and economically feasible. The St. Paul District Engineer recommends that the North Dakota East 35,000 cfs diversion channel and associated features described in this report be authorized for implementation as a federal project. This plan is being recommended with such modifications thereof as in the discretion of the Commander, HQUSACE, may be advisable.

1.0 STUDY INFORMATION

1.1 STUDY AUTHORITY

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 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 local sponsors and the federal government. Funds to initiate the feasibility study were provided in the Consolidated Appropriations Act, 2008, approved December 26, 2007 (Public Law 110-161). The Corps of Engineers issued a Notice of Intent to prepare an environmental impact statement (EIS) in the Federal Register on May 5, 2009.

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.

1.2 PURPOSE AND SCOPE

The purpose of this feasibility study was to identify measures to reduce flood risk in the entire Fargo-Moorhead Metropolitan Area. This report documents the plan formulation studies conducted by the St. Paul District of the U.S. Army Corps of Engineers in close cooperation with the non-federal sponsors.

The study objectives were as follows:

1) To understand the flood problems in the greater Fargo-Moorhead Metropolitan area and develop a regional system to reduce flood risk.

2) To determine the federal government's role in implementing flood risk management measures in Fargo-Moorhead.
3) To document study findings in a Feasibility Report and Appropriate National Environmental Policy Act (NEPA) document (either an Environmental Assessment or an Environmental Impact Statement).
4) If appropriate, recommend implementation of a federal project to U.S. Congress.

The study team collected and evaluated pertinent engineering, economic, social, and environmental information needed to accomplish the study objectives. An array of possible flood risk management plans were considered and screened to define the costs, benefits, and impacts to the project area.

The study product is a decision document in the form of an integrated feasibility report and NEPA document in accordance with the Corps' Planning Guidance Notebook, Engineer Regulation (ER) 1105-2-100. The feasibility study investigated measures to reduce flood risk and analyzed the potential for federal participation in implementing a flood risk management project in the Fargo-Moorhead Metropolitan Area. This report, in accordance with the authorizing legislation, will allow for tiering supplemental NEPA documentation as permitted by Council on Environmental Quality (CEQ) Regulation 40 C.F.R. 1508.28.

1.3 LOCATION OF THE STUDY AREA

The study location is shown on Figure 4. The study area is the Fargo-Moorhead metropolitan area and communities in the vicinity, shown on Figure 2.

The study area is located in the At Large Congressional District of North Dakota (Congressman Earl Pomeroy – D) and Minnesota's Seventh Congressional District (Congressman Collin Peterson – D).

Fargo-Moorhead is located on the Red River of the North, but the Wild Rice, Sheyenne, Maple and Rush Rivers in North Dakota and the Buffalo River in Minnesota also cross the study area. Fargo and Moorhead are on the west and east banks, respectively, of the Red River of the North which flows north approximately 453 river miles to the mouth of the river at Lake Winnipeg in Manitoba, Canada. The drainage area of the Red River of the North above the U.S. Geological Survey gauging station at Fargo is approximately 6,800 square miles, of which about 2,175 square miles do not contribute to runoff.

Figure 5 shows the study area and the topography on a color-shaded plot. Dark blue represents the lowest elevations and dark brown represents the highest elevations. This plot illustrates that the land, while generally very flat, slopes down from South to North.

Figure 4 - Fargo-Moorhead Location

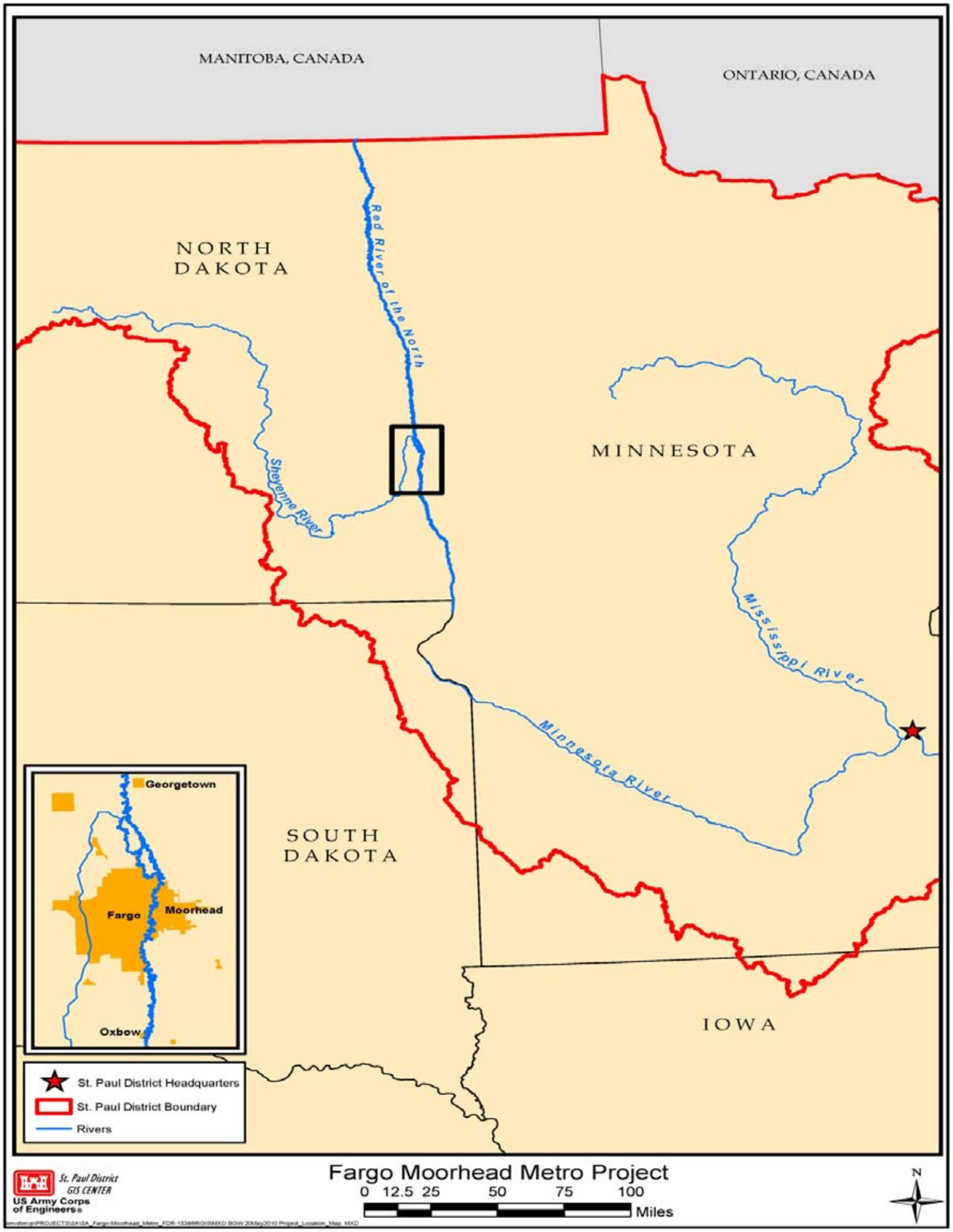
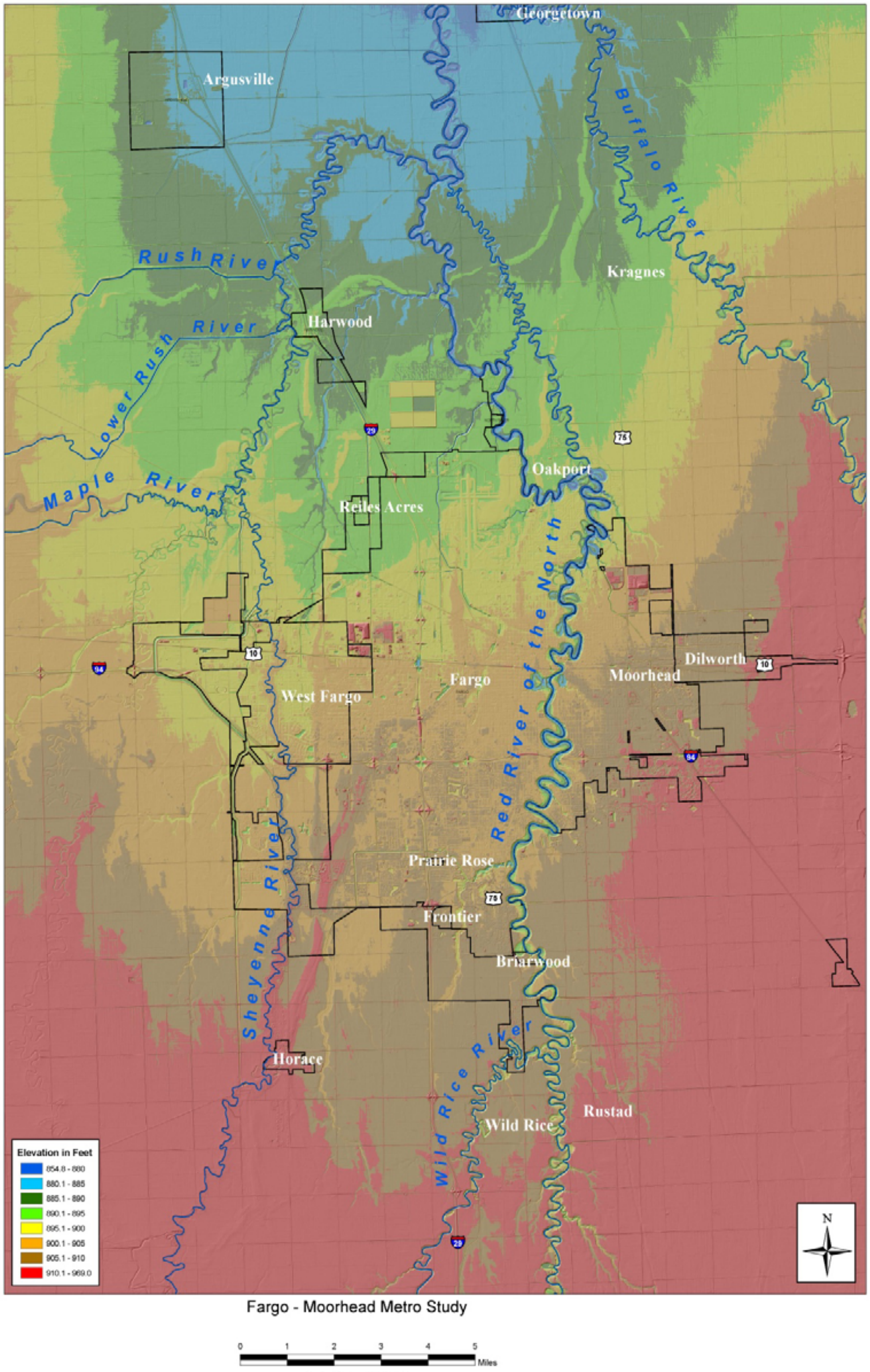


Figure 5 – Project Area topography



1.4 HISTORY OF THE INVESTIGATION

The Fargo-Moorhead metropolitan area has a relatively high risk of flooding. The highest river stages usually occur as a result of spring snowmelt, but summer rainfall events have also caused significant flood damages. The Red River of the North has exceeded the National Weather Service flood stage of 18 feet in 47 of the past 108 years, and every year from 1993 through 2010. The study area is between the Wild Rice River, the Sheyenne River, and the Red River of the North; interbasin flows complicate the hydrology of the region and contribute to extensive flooding. Average annual flood damages in the Fargo-Moorhead metropolitan area are currently estimated at over $187 million.

In June, 2006, the City of Fargo requested that the Corps study a floodwall concept along 2nd Street near City Hall under the Section 205 continuing authority. Discussion with the cities of Fargo and Moorhead led to an expansion of the scope of study to include the entire metropolitan area. Funds to conduct a Reconnaissance study were received in April 2007, and the Reconnaissance study was completed in April 2008. The Corps and the cities of Fargo and Moorhead began the Fargo-Moorhead Metro feasibility study in September 2008. The flood of 2009 heightened awareness of the flood risk in the study area and significantly increased public and political interest in study activities.

Fargo, Moorhead, and the other communities in the study area have become accustomed to dealing with flooding. Sufficient time is usually available to prepare for flood fighting, because winter snowfall can be monitored to predict unusual spring runoff. The communities have well documented standard operating procedures for flood fights. Fargo and Moorhead avoided major flood damages in the historic floods of 1997 and 2009 by either raising existing levees or building temporary barriers. After the 1997 flood, both communities implemented mitigation measures, including acquisition of nearly 100 floodplain homes, raising and stabilizing existing levees, installing permanent pump stations, and improving storm sewer lift stations and the sanitary sewer system. These actions paved the way for a successful flood fight during the record-setting 2009 flood event. The communities have continued to buy flood-prone homes and improve flood-related infrastructure in the wake of the 2009 flood. 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.

1.5 PRIOR REPORTS AND EXISTING PROJECTS

1.5.1 <u>Reports</u>

Since the 1940s, the Corps of Engineers and others have prepared numerous reports on the Red River of the North basin. The following reports contain the most relevant information for the current effort:

1.5.1.1 House Document 185, 81st Congress, 1st Session, dated May 24, 1948. This report proposed a comprehensive plan for the Red River of the North basin. The plan included channel improvements, levees and floodwalls in Fargo and Moorhead. Other components of the plan included the Orwell Reservoir on the Ottertail River in Minnesota; channel improvements on the lower Sheyenne, Maple and Rush Rivers in North Dakota; channel improvements on the Mustinka, Ottertail, Wild Rice, Marsh and Sand Hill Rivers in Minnesota; channel improvements along the Bois de Sioux and upper Red Rivers near Wahpeton, North Dakota/Breckenridge, Minnesota; and local flood protection works on the Red River in Grand Forks, North Dakota/East Grand Forks, Minnesota. The study found that channel improvements along the lower 31.6 miles of the Wild Rice River in North Dakota were economically justified, but the majority of affected local interests did not support the project, so it was not recommended. The report specifically recommended no further investigations in the Buffalo River basin and several other basins in Minnesota.

1.5.1.2 Section 205, Flood Control Reconnaissance Report, Red River of the North at Fargo, North Dakota, Corps of Engineers, May 1967. This study evaluated the potential to build a portion of the levee in Fargo that had been approved as part of the 1948 comprehensive plan but was later omitted from the constructed project. The study concluded that the proposed project was not economically feasible and did not warrant further Federal involvement at that time.

1.5.1.3 Fargo-Moorhead Urban Study, Corps of Engineers, May 1985. This study was a cooperative Federal, State and local planning effort aimed at developing viable solutions to water and related land resource problems, needs and concerns for 1980 to 2030. The study area encompassed 13 townships in Cass County, North Dakota, and Clay County, Minnesota. The study addressed water supply, water conservation, flood risk management, energy conservation and water resources data management. The study evaluated the potential to construct levees, floodwalls and channel modifications in Fargo and Moorhead. The report concluded that extremely long levees or floodwalls would be required to ring the urban areas to provide adequate protection from larger floods, and the costs would greatly exceed the damages prevented. Therefore, Federal participation in Fargo and Moorhead flood risk management projects was not recommended. However, the report did support further studies for flood control in Harwood and Rivertree Park, North Dakota.

1.5.1.4 “Living with the Red,” International Joint Commission, November 2000. In June 1997, following record-setting flooding on the Red River of the North, the governments of Canada and the United States asked the International Joint Commission (IJC) to examine and report on the causes and effects of damaging floods in the Red River basin, and to make recommendations on means to reduce, mitigate and prevent harm from future flooding.” The IJC established the International Red River Basin Task Force to undertake the necessary studies. The task force produced its report in April 2000. The IJC’s report, entitled “Living with the Red,” was completed in November 2000. These reports included discussion of the flooding in the Fargo-Moorhead area. The report cited hydraulic and hydrologic analyses conducted after the 1997 flood that indicated flood risks in the Fargo-Moorhead area were likely greater than previously thought. The report supported a basin-wide flood mitigation approach including reduction in flows, strengthening of existing protection structures, and use of other techniques. The report recommended that Federal, State and local governments should “expedite the study of flood risk potential and implement plans for flood protection measures for the Fargo-Moorhead area.”

1.5.1.5 Reconnaissance Study, Red River Basin, Minnesota, North Dakota, South Dakota, Corps of Engineers, September 2001. This study, supported by supplemental information, was approved in October 2002. The study recommended three initial feasibility studies to be followed by additional studies throughout the basin. Only the initial three studies were approved in 2002. The additional proposed studies would be considered for approval on the basis of additional 905(b) analyses. The Fargo-Moorhead and Upstream feasibility study, currently underway, was one of the initial studies recommended and approved in the reconnaissance study.

1.5.1.6 Final Environmental Impact Statement (FEIS) for the Red River Valley Water Supply Project, U.S. Department of the Interior, Bureau of Reclamation, December 21, 2007. The purpose of the proposed project is to meet the comprehensive water quality and quantity needs of the Red River Valley through the year 2050. The needs were identified as municipal, rural and industrial water; water quality; aquatic environment; recreation; and water conservation measures. The preferred alternative would import water to the Red River basin from the Missouri River via the Garrison Diversion and the Sheyenne River.

1.5.1.7 Fargo-Moorhead Downtown Framework Plan Update, Fargo-Moorhead Council of Governments, City of Fargo, and City of Moorhead, June 2007. This report builds upon earlier planning efforts in both Fargo and Moorhead. Many of the concepts presented depend on implementation of effective flood risk management strategies.

1.5.2 <u>Current Studies</u>
The following studies are being conducted:

1.5.2.1 Fargo-Moorhead and Upstream Feasibility Study, Corps of Engineers. The study began in August 2004. The study area is the entire headwaters of the Red River of the North upstream (south) of the Fargo-Moorhead metropolitan area. The major tributaries are the Mustinka, Bois de Sioux, and Ottertail Rivers in Minnesota and the Wild Rice River in North Dakota. The study is evaluating alternatives that would restore wetland habitat and reduce flood damages. The major underlying assumption is that a system of surface water storage sites upstream of Fargo-Moorhead would reduce flood stages and flood damages downstream. It is also assumed that water storage could be accomplished in ways that would restore aquatic ecosystems and increase habitat for wildlife. Phase 1 analyses, completed in June 2005, showed that distributed flood storage could provide significant economic benefits, but additional study of environmental benefits is needed to justify a Federal project. The North Dakota State Water Commission and the City of Moorhead are jointly sponsoring the study. Additional cost-share partners include the Southeast Cass Water Resource District; Richland County Water Resource District; Red River Joint Water Resource District; city of Fargo; Buffalo-Red River Watershed District; Bois de Sioux Watershed District; Minnesota Department of Natural Resources; Minnesota Board of Water and Soil Resources; Minnesota Pollution Control Agency; South Dakota Department of Game, Fish, and Parks; and Red River Basin Commission.

1.5.2.2 Fargo Southside Flood Control Project, City of Fargo, North Dakota. After the 1997 flood, the city of Fargo and the Southeast Cass County Water Resource District conducted planning for a flood risk management project to protect developments in the area south of Fargo and north and west of the Wild Rice River up to 4 miles south of its confluence with the Red River. Several alternatives were explored, including combinations of levees, diversion channels, channel modifications, and flood storage. The Southside study was discontinued when it was overcome by the Fargo-Moorhead Metro feasibility study (the subject of this report). The Southside study will resume only if no federal project is recommended to address flooding in the area south of Fargo.

1.5.2.3 Oakport Township, Minnesota. The Buffalo-Red River Watershed District is working on a flood risk management project for Oakport Township. The project is designed to protect areas of town to a level equal to the 2009 flood plus 3 feet. The project includes ring levees on either side of Oakport Coulee and buying several homes that cannot be protected by the levee system. A Corps of Engineers study performed under the Section 205 Continuing Authority was terminated in December 2002 after it was determined that national economic benefits were insufficient to support further Federal efforts.

1.5.2.4 Flood Insurance Study Update, Federal Emergency Management Agency (FEMA). FEMA is updating the flood insurance maps for the Fargo-Moorhead area. As a result of recent flood events and revised hydrologic and hydraulic modeling, FEMA is likely to increase the 1-percent-chance flood elevation on the order of 1 foot above the current administratively determined elevation.

1.5.3 <u>Existing Water Resource Projects</u>

1.5.3.1 The Lake Traverse project, including White Rock Dam and Reservation Dam, provides flood storage at the headwaters of the Bois de Sioux and Red River of the North. The project was authorized by the 1936 Flood Control Act, and construction was completed in 1948. The project is operated by the Corps of Engineers, St. Paul District.

1.5.3.2 Baldhill Dam and Lake Ashtabula provide water storage for flood control and water supply on the Sheyenne River. The project was authorized by the 1944 Flood Control Act, and construction was originally completed in 1951. The dam was modified in 2004 to raise the flood control pool by 5 feet. (The pool raise was part of the Sheyenne River project.)

1.5.3.3 The Orwell Dam provides water storage for flood control and water supply on the Ottertail River. The dam was included in the Corps' 1947 comprehensive plan for the Red River basin and authorized by the Flood Control Acts of 1948 and 1950. Construction of the dam was completed in 1953; it provides 8,600 acre-feet of storage.

1.5.3.4 Fargo levees: The Corps participated in a permanent flood control project completed in Fargo in 1963. The project was recommended in the Corps' 1948 comprehensive plan for the Red River basin and authorized by the Flood Control Acts of 1948 and 1950. The project included four channel cutoffs, the Midtown Dam, and a 3,500-foot levee east of Fourth Street South between First Avenue South and Tenth Avenue South. The top of levee is at approximately a 40.0-foot stage. The city later extended the levee south to Thirteenth Avenue.

Fargo has several other publicly and privately owned sections of levee and floodwall throughout the city. The current line of protection has top elevations that vary from a stage of 30 feet to 42 feet, but most reaches are at or below 37 feet. (Note: the proposed new FEMA 1-percent-chance flood stage is expected to be approximately 39.3 feet.)

1.5.3.5 Moorhead levees: There are no federally constructed levees in Moorhead. The Corps proposed a 1,800-foot-long levee in the 1948 comprehensive plan for the Red River basin. It was authorized by the Flood Control Acts of 1948 and 1950, but the city declined to participate in the project. The city has built four small levees and several lift stations and control structures on storm water lines that can be closed or operated during high-water events. The city has also installed valves on the sanitary sewer lines at several individual flood-prone residences to prevent floodwater from inundating the system. The city also builds emergency levees when necessary.

1.5.3.6 Rush River Channel Improvement: The Corps participated in the channel improvement project completed in 1956. The improvement was authorized by the Flood Control Acts of 1948 and 1950. The project extends along the Rush River from a point near Amenia, North Dakota to the mouth at the Sheyenne River . The improvements consist of channel clearing, enlargement, and straightening. Appurtenant construction in connection with the project includes stone riprap at bridges, a drop structure, stone protection at three culvert outlets, and ditching. The project provides flood risk management for the flood plain lying adjacent to the channel improvement by confining all floods, up to those having an occurrence frequency of about once in 10 years.

1.5.3.7 Lower Rush River Channel Improvement: The improvements were authorized under provisions of Section 205 of the 1948 Flood Control Act, as amended. The project, constructed to provide agricultural flood risk management, was completed in November 1973. The improvements consist of channel enlargement and straightening along the Lower Branch of the Rush River. The work extended from mile 17.3 to the confluence with the Sheyenne River.

1.5.3.8 Argusville, ND Levee: The project was authorized under Section 205 of the 1948 Flood Control Act, as amended. Construction was completed in 1990. The flood risk management consists of about 1.9 miles of earth levees, with an average height of 8 feet, that encircles the city of Argusville. This includes sandbag closures at two railroad and four road crossings, and raised roadways at three locations. Levees on the north and east sides of the city have a design top elevation of 891.1 feet including 3 feet of freeboard above design flood level. Levees on the south and west sides of the city have a design top elevation of 888.6 feet. The project is designed to provide the city with protection against the estimated 1 percent chance flood event.

1.5.3.9 Halstad, MN Levee: The project was authorized under the provisions of Section 205 of the Flood Control Act approved 30 June 1948, as amended. The flood barrier consists of 2.41 miles of earth levee, eight emergency closures, and road raises on Trunk Highways 75 and 200. Interior flood control facilities consist of 4 ponding areas with gravity outlets and sluice gates, 464 feet of twin 66-in interceptor pipes, and 350 feet of interceptor ditch. Additionally, there are small ditches and drainage swales alongside the toe of the levees. Once the closures are in place the city is provided flood risk management against a 250-year flood event on the Red River of the North.

1.5.3.10 The Sheyenne River project was authorized by the 1986 Water Resources Development Act. The project originally included four components: a 5-foot raise of the Baldhill Dam flood control pool; a dam to provide approximately 35,000 acre-feet of storage on the Maple River; a 7.5-mile flood diversion channel from Horace to West Fargo, North Dakota; and a 6.7-mile flood diversion channel at West Fargo. The Southeast Cass Water Resource District and the St. Paul District, Corps of Engineers, signed cost share agreements for the West Fargo Diversion project in 1988 and the Horace to West Fargo Diversion in 1990. The projects were essentially completed in 1993 and 1994. A pump station was added to the West Fargo project in 2003 and emergency generators were provided in 2007. The Maple River dam was deauthorized in 2002 for federal participation, and the Southeast Cass Water Resource District completed the project without federal assistance in 2007. These projects reduce flood risk for the cities of Horace and West Fargo and the west side of Fargo from Sheyenne River flooding. From Horace to West Fargo, the system is designed for a 1-percent chance event plus 2 feet. At West Fargo, the channel and left bank levee contain the 1-percent chance event plus 2 feet, and the right bank levee is higher, providing the city with protection from the Standard Project Flood plus 3 feet. The standard project flood is defined as the volume of streamflow expected to result from the most severe combination of meteorological and hydrologic conditions which are reasonably characteristic of the geographic region involved, excluding extremely rare combinations. Although these features reduce the risk associated with Sheyenne River flooding, these cities are still potentially affected by floods on the Wild Rice and Red Rivers that are larger than approximately a 0.5-percent chance event.

1.5.3.11 A Section 208 (1954 Flood Control Act) clearing and snagging project was completed in Fargo-Moorhead in 1991. The project cleared and snagged trees affected by Dutch elm disease that would otherwise have caused stage increases in the Red River. Dead and dying trees were removed along a 9.7-mile reach of the Red River of the North.

1.5.3.12 Three Section 14 (1946 Flood Control Act) emergency streambank protection projects were completed in Fargo between 2001 and 2003. Erosion from the Red River of the North occurred at three separate project locations. At Reach A, erosion along 4,100 feet of riverbank threatened a levee near 37th Avenue. At Reach B, erosion along a 950-foot reach threatened Kandi Lane and North Broadway and utilities located beneath them. At Reach C, erosion along a 1,900-foot reach threatened Elm Street between 13th and 17th Avenues North and the utilities located beneath it. The erosion progressed to within 50 feet of the roadway. The projects involved shaping the banks and placing rockfill or granular fill and riprap along the eroded areas.

1.5.3.13 Two Section 206 (1996 Water Resource Development Act) aquatic ecosystem restoration projects were implemented to improve fish passage over two dams on the Red River within the metropolitan area. Rock slope fishways were constructed at the 12th Avenue North Dam and the 32nd Avenue South Dam in 2002 and 2004, respectively. A similar fishway was constructed at the Midtown Dam in 1998 without Corps construction assistance.

1.5.3.14 A Section 205 (1948 Flood Control Act) project known as the Fargo-Ridgewood project is located on the north side of Fargo in the Ridgewood area, along the west bank of the Red River of the North. The project consists of levees, floodwalls, pump stations and associated interior drainage structures along a line of protection 4,200 linear feet long. The project would provide flood risk management to the Ridgewood neighborhood and a Department of Veterans Affairs (VA) hospital. The project will reduce risk to the Department of Veterans Affairs (VA) hospital and that portion of Fargo between 15th Avenue North and 22nd Avenue North. High ground at the ends of the project is at elevation 899.5 feet msl. However the top elevation of the levees is at elevation 902.6 feet msl. The construction of the VA floodwall is complete, and the remaining levee/floodwall construction is scheduled to be completed by September 2010. The project successfully provided a line of protection during the March 2010 flood event.

1.5.3.15 Non-federal emergency levees:
Georgetown, MN: The existing levee in Georgetown protects to roughly the 1 percent chance event. The 1 percent chance base flood elevation varies from 883.2 to 883.4 (NAVD 1988) near Georgetown. The levee was raised by the Corps during the 2009 flood. The Corps hired a contractor to restore the dike so that now west of Highway 75 the levee varies from 883.3 to 884.2 (NAVD1988). East of Highway 75, the levee was restored to 884.4. Highwater marks taken after the 1997 flood were used to set the elevation for the levee. There is no written operation plan for this levee. The 23 culverts through the levee are equipped with flapgates and close automatically. The locals place sandbags over these gates to ensure their closure and minimize leakage during large flood events.

Perley, MN: The current system consists of emergency flood levees built in 1970 after extensive damage occurred during the 1969 spring flood. Improvements were made in 1975 and 1997. The levee consists of two reaches and 2 closures. Reach 1 constructed to elevation 877.5 ft (NGVD 29), Reach 2 constructed to elevation 878.4 feet (NGVD 29). The design is to a level of 2 feet above 1997 flood. Currently the city is working on raising the levee to 3 feet above the 2009 flood.

Hendrum, MN: Two separate reaches were constructed in anticipation of flooding from the Red River in July 1975 and was most recently modified in 1998. The levee consists of 3 reaches and requires 4 closures. The minimum levee elevations for reaches 1, 2, 3, are 873.7, 873.1, 873.1 feet respectively (NGVD 29). The estimated 1 percent chance flood elevation at this location is between 872 and 873 feet. The current design is to a level of 2 feet above 1997 flood. Currently the city is working on raising the levee to 3 feet above the 2009 flood.

Kragnes, MN: After the Spring 2009 flood, most of the project embankments that could be raised were. The elevation of the raised embankments is 893.5 (NAVD1988). However, Highway 75 provides protection to roughly elevation 892.5 (NAVD1988). The roads in the area - County State Aid Highway (CSAH) 26, County Road 96, and Highway 75 - provide most of the embankments that protect Kragnes. The pipes through these roads have been installed with screwgates to prevent water from flowing into the triangular area formed by these three roads. In general, to provide protection in excess of 892.5 (NAVD1988) requires building embankments along the roads. County Road 96 provides protection that is slightly higher and CSAH 26 is a few feet higher. The Highway 75 overtopping elevation had to be raised by building a clay embankment along a stretch of the east shoulder the spring of 2009 to prevent the floodwaters from overtopping the highway to the west. Water breaks out of the Buffalo River and floods northwesterly toward Kragnes. 2009 is the first flood that would have overtopped Highway 75 between CSAH 26 and CSAH 5.

Shelly, MN: The city levee system consists of two reaches. Reach 1 is a 2000 feet levee constructed to an elevation 868.8 (NGVD 29). It protects the property north of Highway 3 that runs through town. Reach 2, which is 545 feet long, protects the portion of the city located south of Highway 3. Reach 2 is constructed to an elevation of 867.0 feet (NGVD 29). The last modification to this system was made in 1999 and the design is to a level of 2 feet above 1997 flood. However, the levee does not encircle the town and fill needs to be placed to complete the protection. City is currently contemplating raising the level of protection to 3 feet above 2009 flood.

Harwood, ND: The city's levee system consists of two main reaches and several smaller reaches along Interstate 29, including one sandbag closure and a breach controlled section. The system provides protection up to a flood elevation of 892.8 (NAVD88). When flood elevation reaches 891.0 (NAVD88) and is projected to reach above the elevation of 892.8, additional work is done within the I-29 right of way. The highest record peak flood elevation on the Sheyenne River at Harwood, ND reached an elevation of 892.02 (NAVD88) in April of 1997.

1.6 PLANNING PROCESS AND REPORT ORGANIZATION

The planning process consists of six major steps which are generally taken in order and are an iterative process. The steps are: (1) Specification of water and related land resources problems and opportunities; (2) Inventory, forecast and analysis of water and related land resources conditions within the study area; (3) Formulation of alternative plans; (4) Evaluation of the effects of the alternative plans; (5) Comparison of the alternative plans; and (6) Selection of the recommended plan based upon the comparison of the alternative plans.

The chapter headings and order in this report generally follow the outline of an Environmental Impact Statement. Chapters of the report relate to the six steps of the planning process as follows:

- The second chapter of this report, Need for and Objectives of Action, covers the first step in the planning process (Specification of water and related land resources problems and opportunities).

- The third chapter of this report, Alternatives, is the heart of the report and is therefore placed before the more detailed discussions of resources and impacts. It covers the third step in the planning process (Formulation of alternatives), the fifth step in the planning process (Comparison of alternative plans), and the sixth step of the planning process (Selection of the recommended plan based upon the comparison of the alternative plans).

- The fourth chapter of this report, Affected Environment, covers the second step of the planning process (Inventory, forecast and analysis of water and related land resources in the study area).

- And, the fifth chapter of this report, Environmental Consequences, covers the fourth step of the planning process (Evaluation of the effects of the alternative plans).

2.0 NEED FOR AND OBJECTIVES OF ACTION *

This chapter presents the results of the first step of the planning process, the specification of water and related land resources problems and opportunities in the study area. The chapter concludes with the establishment of planning objectives and planning constraints, which is the basis for the formulation of alternative plans.

2.1 NATIONAL OBJECTIVES

The national or federal objective of water and related land resources planning is to contribute to national economic development consistent with protecting the nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements. Contributions to national economic development (NED) are increases in the net value of the national output of goods and services, expressed in monetary units. Contributions to NED are the direct net benefits that accrue in the planning area and the rest of the nation.

The Corps has added a second national objective for Ecosystem Restoration in response to legislation and administration policy. This objective is to contribute to the nation's ecosystems through ecosystem restoration, with contributions measured by changes in the amounts and values of habitat.

2.2 PUBLIC CONCERNS

A number of public concerns have been identified during the course of the study. Initial concerns were expressed in the Sponsors' study request. Additional input was received through coordination with the sponsors, coordination with other agencies, public review of draft and interim products, and through public meetings. A discussion of public involvement is included in Chapter 6, Public Involvement, Review and Consultation. The public concerns that are related to the establishment of planning objectives and planning constraints are as follows:

- Flooding and impacts to rural and urban infrastructure
- Potential for flood risk management measures employed in one place to increase flood stages or impact water quality elsewhere
- Desire for additional flood storage in the watershed
- Desire for wetland and grassland restoration in the watershed
- Desire for increased recreational opportunities in the study area
- Need to protect limited groundwater resources
- Need to protect riverine habitat and connectivity

2.3 HISTORY AND FUTURE WITHOUT PROJECT CONDITIONS

2.3.1 Flood History

The Fargo-Moorhead metropolitan area has a relatively high risk of flooding; average annual flood damages in the metropolitan area are estimated at more than $195.9 million (see Appendix

C, Economics). The highest river stages usually occur as a result of spring snowmelt. Summer rainfall events have also caused significant flood damages, although this flooding is usually related to the capacity of the storm sewer system rather than high river stages.

The Red River of the North has exceeded the National Weather Service flood stage of 18 feet in 47 of the past 108 years, and every year from 1993 through 2010. The study area includes the Buffalo River, Wild Rice River (ND), the Sheyenne River, and the Red River of the North; interbasin flows complicate the hydrology of the region and contribute to extensive flooding. The record-setting Red River of the North flood stage in 2009 at Fargo was 40.82 feet on the Fargo gage.

Official estimates vary for the 1-percent chance event flow and stage. The current base flood elevation (1-percent chance event) established by the Federal Emergency Management Agency (FEMA) corresponds to a stage of 38.3 feet on the Fargo gage. FEMA is proposing a revised 1-percent chance event flow of 29,300 cubic feet per second (cfs) and stage of 39.3 feet based on flood insurance studies completed after the 1997 flood event. The hydrologic record of the Red River of the North shows a trend of increasing magnitude and frequency of flooding in recent decades. Figure 6 shows the annual peak flow for the period of record. Figure 7 shows annual peak stages for the period of record.

Figure 6 – Annual peak flow on the Fargo gage

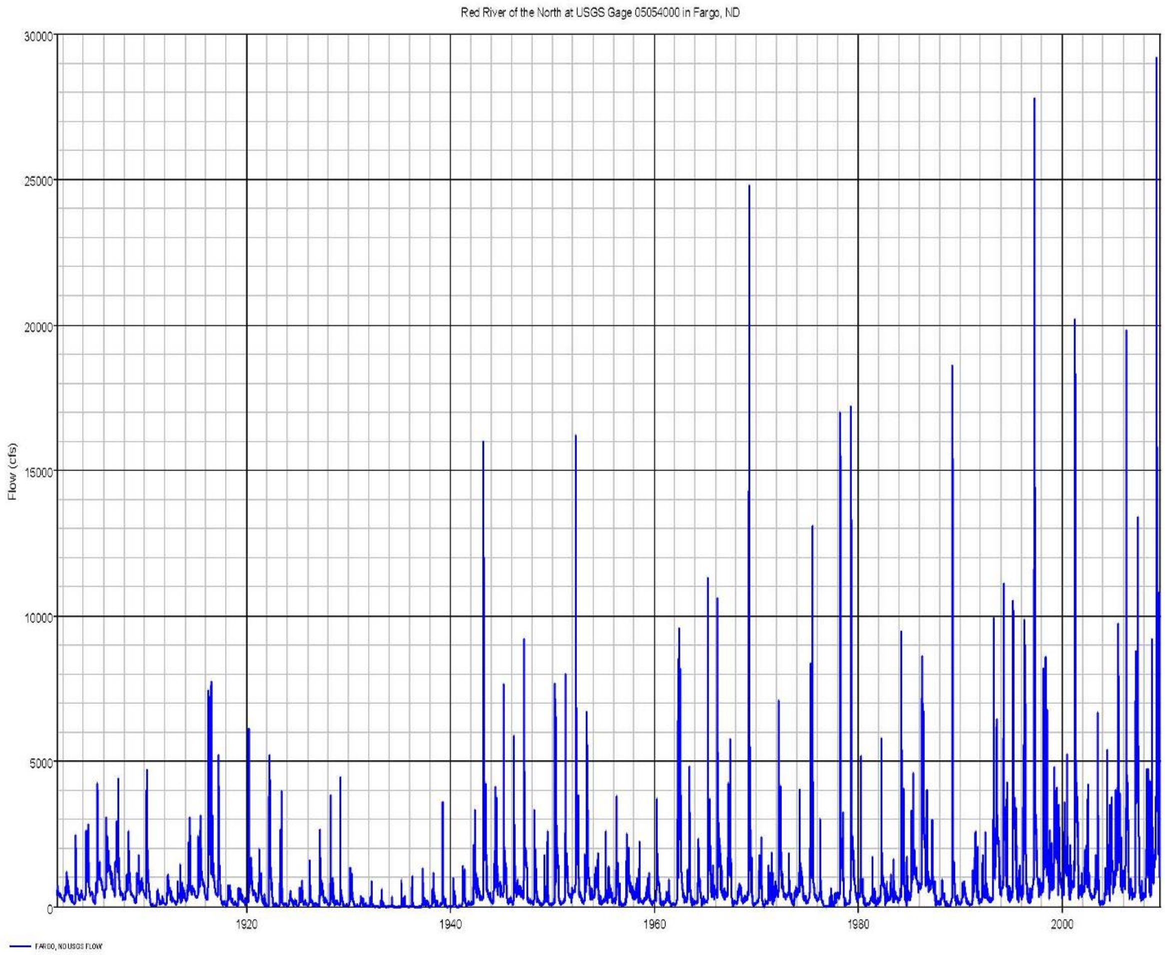
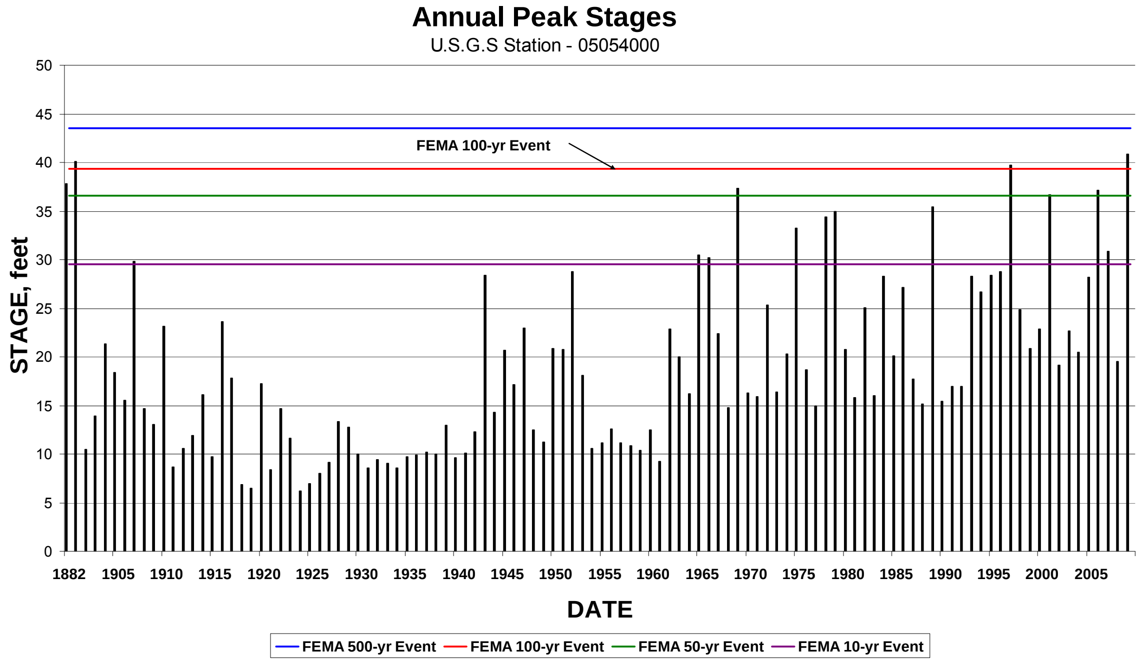


Figure 7 – Annual peak stages on the Fargo gage (Gage 0 = elev. 862.74 NAVD 1988)



A panel of experts in hydrology and climate change was convened to elicit opinions on how to appropriately reflect this trend in the current analysis (see Appendix A, Hydrology). The panel concluded that the hydrologic record showed a "dry" period in the early decades and a "wet" period in later years continuing to the present. The panel recommended developing revised flow frequency curves separately for the dry and wet periods and then combining the curves using probabilistic assumptions about future conditions. On the basis of the panel's recommendations, revised flow frequency curves were developed which show the 1-percent chance event flow to be approximately 34,700 cfs at present; 32,900 cfs in 2035; and 31,300 cfs in 2060. The hydraulic modeling developed for this feasibility study and calibrated to the 2009 flood event indicated that a flow of 34,700 cfs at the Fargo gage would produce a stage of 42.4 feet (See Appendix B, Hydraulic Engineering). The analyses described in Section 3.4 of this report were based upon the Expert Opinion Elicitation (EOE) panel's hydrologic recommendations, which result in significantly higher stages for the 1-percent chance event than what FEMA is proposing to use for the National Flood Insurance Program.

Figure 8 through Figure 11 show the proposed FEMA 10, 50, 100 and 500-year existing flooded areas truncated to the area inside the proposed diversion alignments. Note: these figures illustrate the areas potentially benefited by the project, but they do not show the entire floodplain in the study area. This was done to show what benefits the project would provide to the Fargo-Moorhead Metropolitan area.

Figure 8 – Existing 10-Year floodplain (10-percent chance)

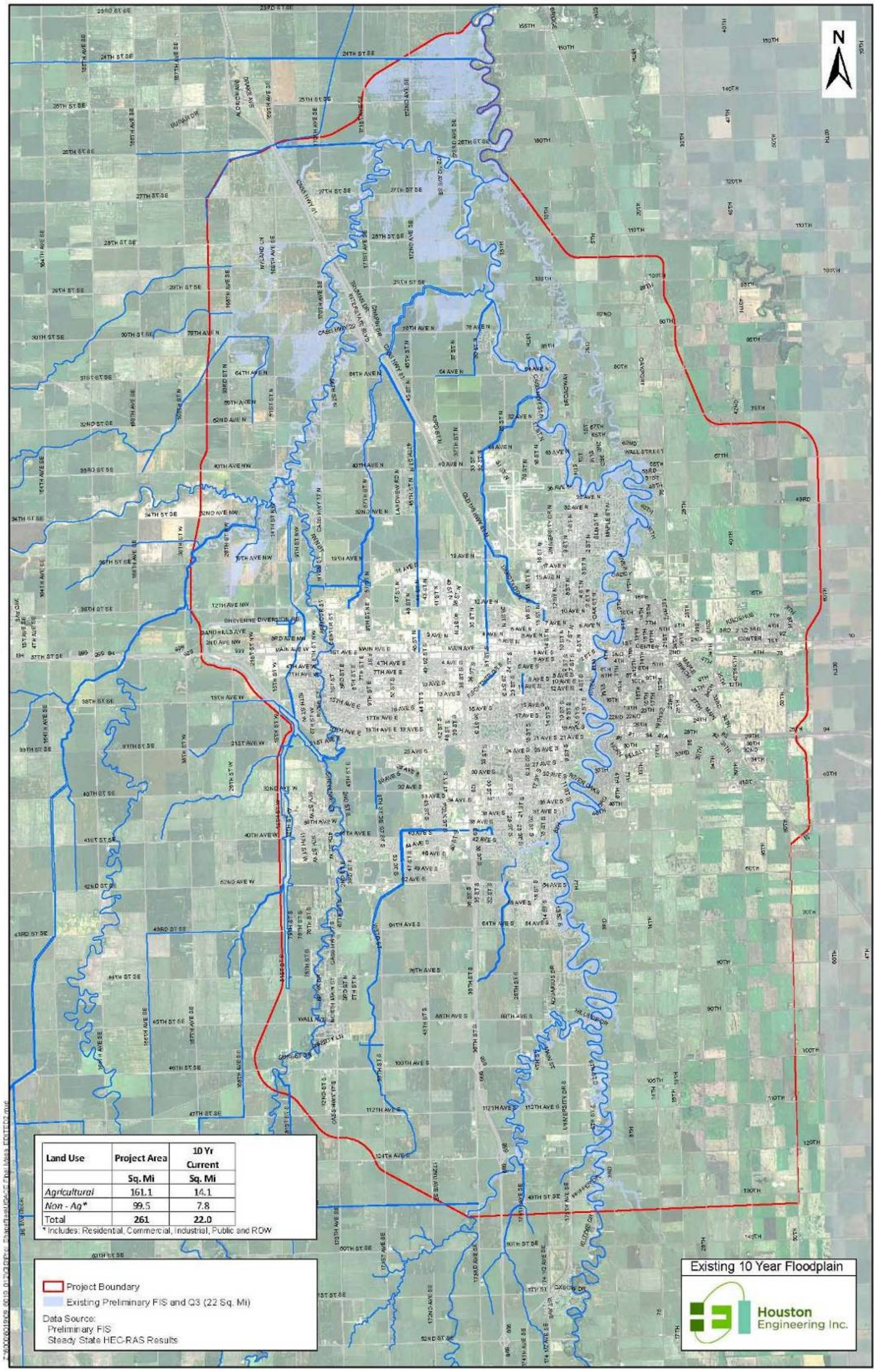


Figure 9 – Existing 50-year floodplain (2-percent chance)

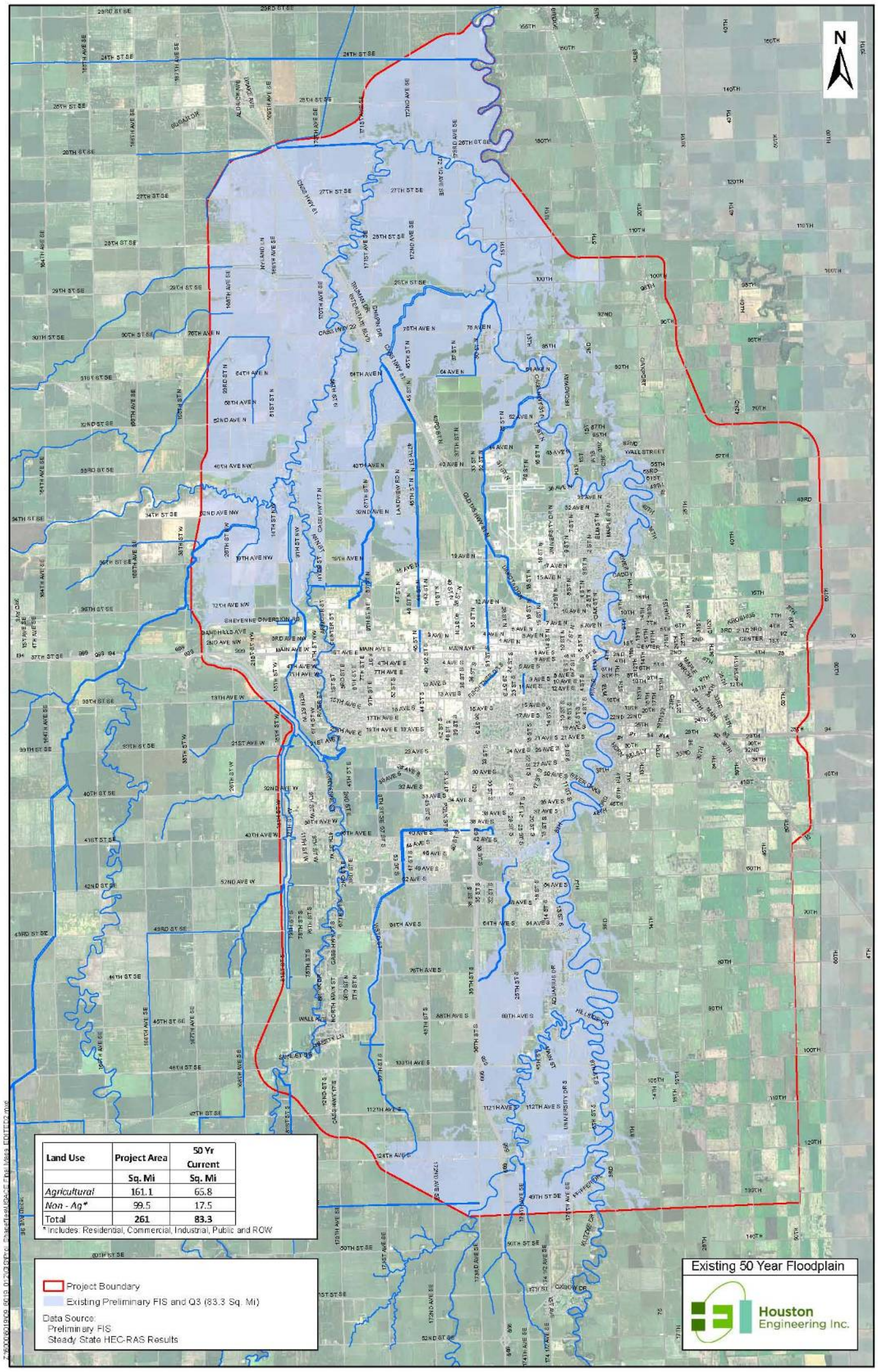
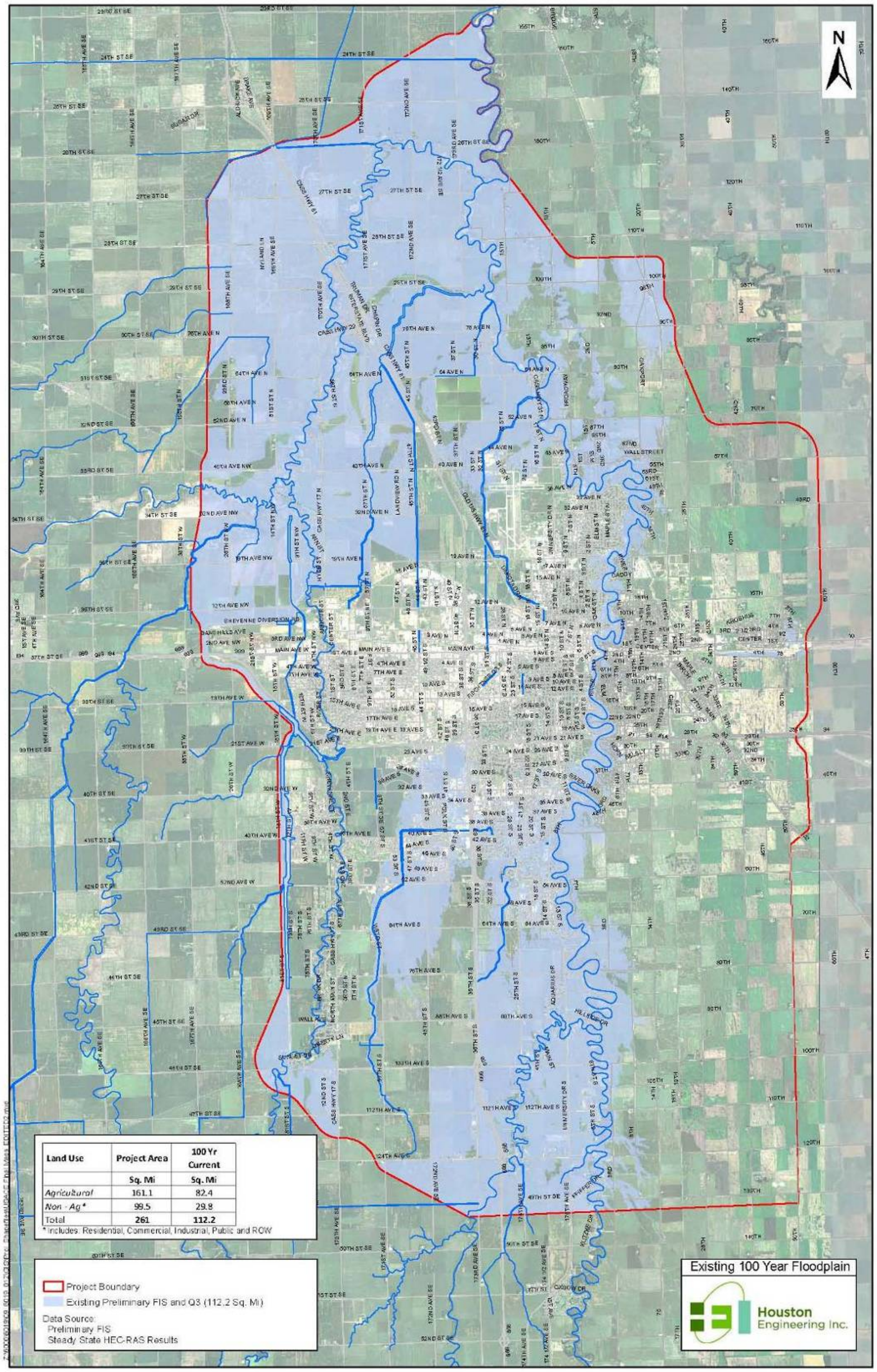


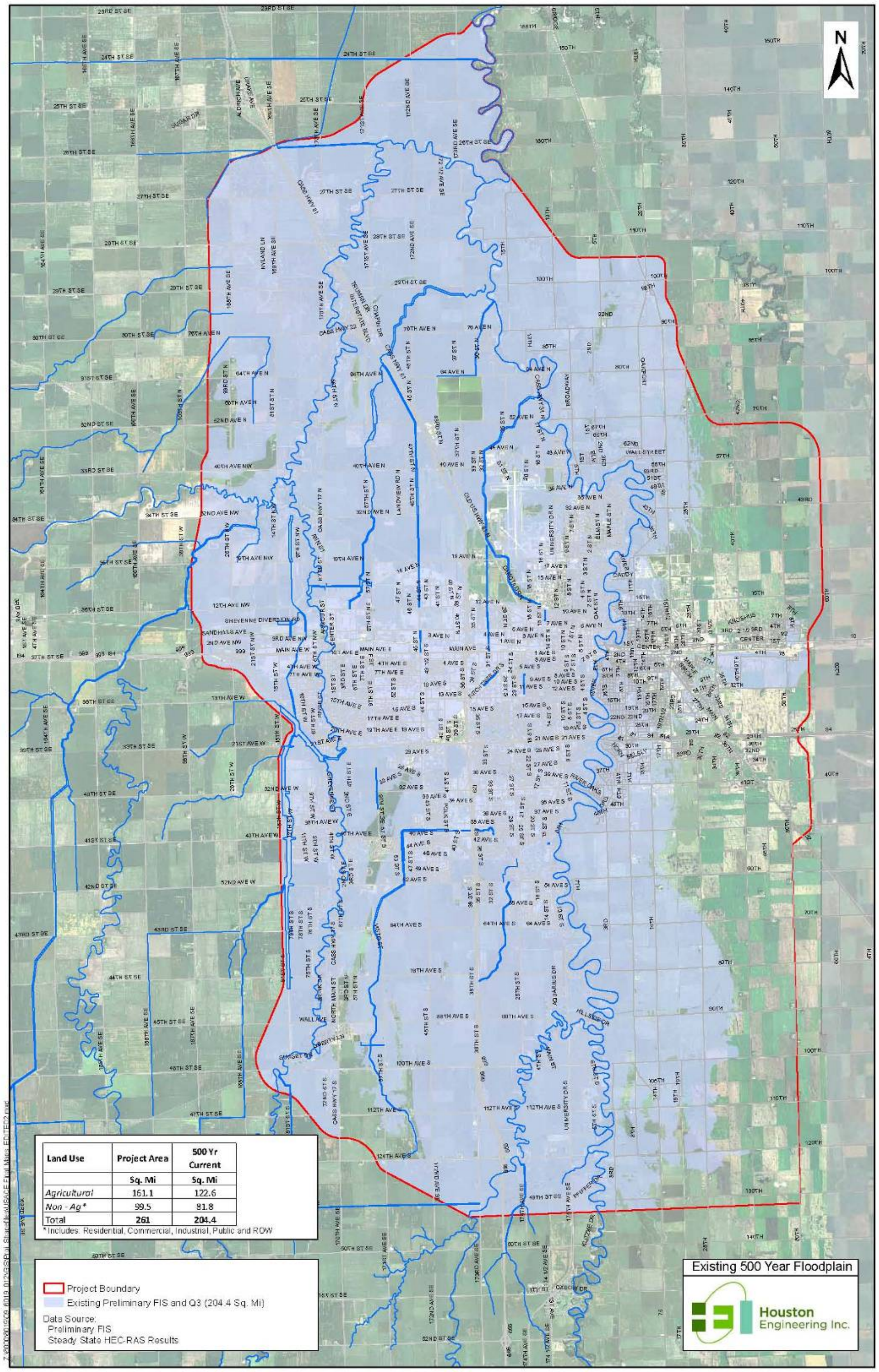
Figure 10 – Existing 100-year floodplain (1-percent chance)



Land Use	Project Area	100 Yr Current
	Sq. Mi	Sq. Mi
Agricultural	161.1	82.4
*Non - Ag**	99.5	29.8
Total	**261**	**112.2**

*Includes: Residential, Commercial, Industrial, Public and ROW

Figure 11 - Existing 500-year floodplain (0.2-percent chance)



Land Use	Project Area	500 Yr Current
	Sq. Mi	Sq. Mi
Agricultural	161.1	122.6
*Non - Ag**	99.5	81.8
Total	**261**	**204.4**

*Includes: Residential, Commercial, Industrial, Public and ROW

2.3.2 Existing infrastructure

Existing projects in the study area are described earlier in this report in Section 1.5 Prior Reports and Existing Projects. The information below supplements the earlier discussion. Information related to existing levees including photos and locations can be found in Appendix H.

Flood impacts in Fargo begin at a stage of about 18 feet, when Elm Street is closed to traffic. The City of Fargo's existing levees have top elevations that vary from a stage of 30 feet to 42 feet, but most reaches are at or below 37 feet. The Second Street area near Fargo City Hall begins to flood at a stage of approximately 30 feet, and emergency levees have been built there 12 times since 1969. Many places along the line of protection rely on private sandbag levees which begin to be needed at a stage of about 33 feet, which has an exceedence frequency between 10-percent and 20-percent. Newer developments in the southern part of the study area have been elevated above the base flood elevation, but the city infrastructure (roads, sewers, etc.) is still at risk.

Rural areas and developed subdivisions in Cass County, North Dakota are susceptible to flooding from the Sheyenne, Maple, Rush, Lower Rush, Wild Rice and Red Rivers. During the 2009 flood, many homes north and west of Fargo were surrounded by flood waters. Although most structures in this area were elevated above the flood level and escaped major damage, residents were not able to access their homes for up to six weeks except by boat. The rural road network was significantly damaged by overland flows that washed out portions of roads. There were approximately 200 damage sites on the Cass County highway system and 1000 damage sites on the township road system in Cass County. Cities and subdivisions south of Fargo, including the cities of Briarwood, Chrisan, Forest River, Heritage Hills, Hickson and Oxbow were also at risk of flooding from the Wild Rice and Red Rivers. Private sandbag levees and emergency clay levees constructed by the Corps of Engineers protected many areas, but the areas closest to the rivers were hard hit. Significant damage occurred to five of 27 homes in Briarwood, 60 homes in the Chrisan and Heritage Hills area, seven of fourteen homes in Butch-R-Block subdivision, and fifteen of 140 homes in Oxbow.

The West Fargo and Horace to West Fargo diversions of the Sheyenne River Flood Control Project, completed in 1994, prevented breakout flows from the Sheyenne River from flooding Fargo and West Fargo in 1997, 2009 and 2010. While these existing diversions provide significant benefit from Sheyenne River flooding, Horace and West Fargo are vulnerable to flooding from the Red River during events larger than the 1-percent chance (100-year) event.

The City of Moorhead sits on relatively higher ground compared to Fargo. At a stage of 31 feet, Moorhead's First Avenue North is closed. Homes begin to be threatened at stages of 32 to 35 feet. Most of Moorhead's developed areas are above the proposed FEMA 1-percent chance flood stage, but the 0.2-percent chance event floodplain south of Interstate 94 (I-94) extends east almost to 20th Street South. North of I-94 the 0.2-percent chance event floodplain generally extends east of 14th Street. During flood events larger than a 1-percent chance, it is anticipated that I-94 would be inundated, eliminating a major thoroughfare and possible evacuation route. Moorhead has no permanent federal flood risk management project. Most of the land along the river is residential development, and private sandbag levees or other private measures provide most of the line of protection. Flooding through the sanitary sewer system is a significant concern in Moorhead, because several residences have walkout basements adjacent to the river. If these basements are flooded, water can enter the sanitary sewer and affect homes far from the surficial floodplain. Flooding from the Buffalo River to the east of Moorhead is not a significant concern in the city. Drainage projects in this area have been improved to address any historic flooding issues.

Oakport Township (population 1,689) is located north of Moorhead. Oakport sustained $3.7 million in damages in the 1997 flood. High water from the Red River of the North and Oakport Coulee damaged 150 homes and isolated 200 others. Oakport was severely affected during the 2009 flood as well. The Buffalo-Red River Watershed District is currently constructing a permanent levee system with a top elevation three feet above the 2009 event, which is expected to be certifiable to the 1-percent chance level. Portions of Oakport Township will be annexed by the City of Moorhead in 2015.

Since the 1997 flood, Fargo and Moorhead have implemented mitigation measures, including acquisition of floodplain homes, building levees and floodwalls, raising and stabilizing existing levees, installing permanent pump stations, and improving storm sewer lift stations and the sanitary sewer system. Moorhead has a list of several low elevation properties adjacent to the river that it would like to buy to install higher levels of flood risk management; to date, 65 properties have been purchased. Moorhead has a draft plan for a voluntary program for assistance to build private levees/floodwalls, but reaction to the proposed program has been mixed, and the city has not yet officially adopted it. Fargo maintains a prioritized list of potential buyouts and actively seeks to purchase and remove floodplain homes. Fargo has purchased 125 homes from willing sellers since 1997. Fargo also adopted a flood risk management incentive program in 2006 and amended it in 2009. The program provides for a cost share of up to 75-percent by the city in improvements made by the individual homeowners to improve their level of flood risk management. The homeowner must enter into an elevation agreement to be eligible.

The Department of Veterans Affairs and the City of Fargo worked with the Corps of Engineers to construct a floodwall and levee system in the Ridgewood neighborhood of Fargo, which is discussed in Section 1.5.3.14 of this report.

2.3.3 Flood fighting activities

The Fargo-Moorhead area has become accustomed to dealing with flooding. Time is usually available to prepare for flood fighting, because winter snowfall can be monitored to predict unusual spring runoff. But the time required to build emergency works depends on the anticipated flood crest elevation, with higher crests requiring significantly more construction time and effort. Fargo and Moorhead have well-documented standard operating procedures for flood fights. Both communities avoided major flood damages in the historic floods of 1997 and

2009 through the use of extreme emergency measures. These emergency measures included such actions as temporarily raising existing levees, constructing temporary levees and floodwalls in various areas, and sandbagging.

The residents of Fargo-Moorhead have been successful at preventing significant damages during past flood events by constructing emergency levees along large portions of the Red River. Constructing the emergency levees takes significant financial and human resources, causes business and traffic disruptions, and is taxing to the social fabric of the communities. Although the emergency levees have been successful in the past, there is a high risk of a catastrophic failure which would result in significant damages and loss of life to the area.

Significant costs are incurred during emergency flood fighting efforts. During large flood events, the cities build as many as 80 miles of emergency levees through town in an effort to retain flood waters. Businesses, residents, federal agencies, local and state governments, as well as humanitarian organizations such as the Red Cross and Salvation Army all contribute to the flood fight, rescue and clean-up efforts. These costs are estimated to be $2,883,000 on an average annual basis.

During the 2009 flood, more than 80 miles of temporary measures were built in less than two weeks, including the placement of more than three million sandbags by thousands of volunteers. Picture 1 through Picture 6 show the conditions and flood fighting activities that took place during the 2009 flood event.

Picture 1 – Thousands of residents from the region assisted with building miles of sandbag levees in 2009.

Picture 2 – Various temporary measures were used as barriers in difficult winter conditions in 2009.

Picture 3 – Citizens set up steel frames to hold back the water in 2009.

Picture 4 – Roads were closed throughout the region making travel difficult in 2009.


Picture 5 – Agricultural lands, sport facilities, and public areas were dug up for levee material in 2009.

Picture 6 – Sand filled barriers were backed with clay and used as a second line of defense after the sandbags in 2009.

Floods in the Fargo-Moorhead area typically occur in late March and early April. During this time, temperatures vary from sub-zero (°F) to well above freezing. In March the average monthly temperature is 27.2 °F, with an average daily high of 35.3 °F and an average daily low of 19.0 °F. In April the average monthly temperature is 43.5 °F, with an average daily high of 54.5 °F and an average daily low of 32.4 °F. The ground is still frozen, with average frost penetration estimated at about 4.5 feet in early April. The extreme range of temperatures results in varying precipitation conditions ranging from blizzards with heavy snowfall to soaking rains.

These conditions impede flood fighting by hampering earth-moving and levee construction. Emergency levees must often be constructed on frozen ground with frozen materials. Many portions of the line of protection are located in private yards with little or no access for construction equipment. Borrow sites for clay material become inaccessible when the soil is saturated by melting snow or rain. The logistics required for successful emergency actions under these conditions cannot be overestimated.

The extremely variable weather conditions also complicate efforts of the National Weather Service to predict the flood crest. Accurate crest predictions are needed to establish the elevation of emergency levees, but it is difficult to anticipate rates of snowmelt and effects of additional precipitation when temperatures hover around the freezing point. There is considerable uncertainty surrounding every crest prediction. Both the 1997 and 2009 flood events were affected by sudden cold snaps that served to temporarily halt melting and likely contributed to lower peak stages than would have occurred if slightly warmer temperatures had prevailed.

Because emergency measures have been very successful in the past, they may also contribute to an unwarranted sense of security that does not reflect the true flood risk in the area. History has shown that the people in the study area will stay to fight a flood rather than evacuating to safer locations. A loss of life analysis conducted for this feasibility study estimated that as many as 200 people could perish if emergency levees failed suddenly during a 1-percent chance event (See Appendix O, Plan Formulation). Flood water would be extremely cold, just above freezing, and anyone caught in the water would suffer hypothermia in a short time.

Due to all of the factors mentioned above, the probability of having consistently successful emergency efforts in the future must be considered extremely low, especially for events larger than the 1-percent chance event. However, it is acknowledged that the probability of success with an emergency flood fight is not zero. To account for this, a sensitivity analysis was completed on the selected plan to determine how successful flood fights could impact the project benefits. (See Appendix C, Economics.)

Although the economic analyses conducted for this study assumed no credit for emergency actions, credit was given to existing permanent levees in accordance with applicable Corps of Engineers guidance. (See Appendix H, Credit to Existing Levees.)

2.3.4 Future Without Project condition (No Action alternative)

Without a comprehensive flood risk management project in the area, the metropolitan region will continue to be subject to flooding and will rely on emergency responses to ensure the safety of the community. These emergency efforts will eventually be overwhelmed, and the area could experience a disaster similar to the 1997 flood in Grand Forks and East Grand Forks. A disaster of that magnitude would cause significant damage and would impact the entire region. It is expected that the average annual damages of more than $195.9 million will continue and increase as a result of additional development between the 1-percent chance and 0.2-percent chance flood elevations.

The Oakport, MN levee project is the only major levee project that will be completed in the metropolitan area in the near future. The City of Fargo had developed plans for a Southside levee project; those plans have been put on hold indefinitely, pending the outcome of this feasibility study. It is possible that without a federal project the Southside levee plan could be pursued in the future, but it would face many challenges before being realized. It is assumed that the Southside project is not in place for the future without-project condition. This is consistent with guidance in IWR 88-R-2, National Economic Development Procedures Manual - Urban Flood Damage, Volume 1, Page VI-3, paragraph 6 which states: "If local action is planned to occur only as the result of no federal action, the project should not be assumed as part of the "without" condition. Local interests should not be penalized for their own incentive."

It is anticipated that the metropolitan communities will continue to use best practices and make minor modifications to enhance their overall flood risk management whenever possible. This includes construction of short sections of levees and floodwalls that do not tie into high ground but would be augmented with emergency measures. Communities downstream on the Minnesota side, including Georgetown, Perley and Hendrum, are planning to construct levees to bolster their flood defenses if funding for the projects can be obtained.

Efforts to reduce flood stages by storing water upstream are also being evaluated by the local communities and the Corps. Phase 1 of the Corps' Fargo-Moorhead and Upstream feasibility study determined that stage reductions up to about 1.6 feet could be obtained using storage during a 1-percent chance event, but the economic benefits would not likely support federal participation solely for flood risk management. The study is now considering the potential for ecosystem restoration and looking for synergistic solutions to both flooding and historic loss of native aquatic habitat. It is anticipated that some impoundments will be constructed by non-federal entities in the upstream watershed, however, reductions to flood stages in the Fargo-Moorhead area would be relatively small. For purposes of this feasibility study and evaluating the economics of alternatives, we cannot assume that upstream flood retention will be built in the future to a sufficient extent to significantly reduce the flood risk in the study area.

2.3.5 Environmental conditions

Existing and expected future environmental conditions are discussed in detail in Chapter 4, Affected Environment. The Red River basin lies within the Prairie Pothole Region, which has been dramatically affected by drainage and tillage predominantly related to this region's urban development and agriculture-based economy. According to the 1997 Minnesota Wetlands Conservation Plan, over 95 percent of the native wetlands in the Minnesota portion of the Fargo-Moorhead and upstream subbasin have been lost. The North Dakota portion of the study area has also experienced a similar amount of lost wetlands. The resulting habitat loss has caused a dramatic decline in wetland-dependent wildlife populations. Because the Red River basin lies within a major waterfowl and shorebird migration route, the loss of permanent and seasonal wetlands has had a measurable adverse impact on migratory success.

There are numerous wetland restoration programs within the Red River Basin, but implementation has often been hindered by cost and/or land availability. The objectives of the wetland restoration programs include providing flood storage, improving water quality, and increasing wildlife and recreation opportunities.

Due to increasing pressure to either urbanize or improve drainage on cropland, it is anticipated that wetland acreage will either remain the same or decrease within the study area under the without project condition.

Upland habitat in the study area is mainly cropland, with a mixture of hayed pasture, hobby farms and suburban dwellings. Wooded areas include mostly a mixture of bottomland hardwood tree species and low vegetation. The narrow riparian zone is in a relatively natural condition. The remaining wooded riparian areas are an important wildlife and aesthetic resource. The riparian woodlands are essentially the only wooded habitat remaining in this predominantly agricultural area. Tree species identified in these areas include bur oak, American linden, eastern cottonwood, American elm, boxelder, green ash, silver maple, buckthorn, and hackberry. Woodland was never very common in the prairie environment, but it is extremely important as nesting, breeding, and overwintering habitat for a number of birds, mammals, and reptiles.

2.4 PROBLEMS AND OPPORTUNITIES

The evaluation of public concerns reflects a range of needs and desires perceived by the public. This section describes these needs in the context of problems and opportunities that can be addressed through water and related land resource management. The problems and opportunities are based upon the flood history and future without project conditions.

2.4.1 Problems

The primary problem identified in the study area is a high risk of flood damage to urban infrastructure from the Red River of the North, the Wild Rice River (ND), the Buffalo River, and the Sheyenne River and its tributaries, the Maple River, Lower Rush River and Rush River. Flooding also causes damage to rural infrastructure and agricultural land and disrupts transportation and access to properties within the study area. The study area has estimated average annual flood damages of more than $195.9 million.

2.4.2 Opportunities

There are opportunities to increase and improve wildlife habitat in conjunction with the measures used to reduce flood risk. Wildlife habitat in the study area has been significantly altered by various human activities associated with conversion of native prairie for agricultural uses and urban development.

Flood risk management measures that involve land use changes could provide opportunities to increase recreation in conjunction with reducing flood risk.

2.5 PURPOSE AND NEED

The purpose of the proposed action is to reduce flood risk, flood damages and flood protection costs related to the flooding in the Fargo-Moorhead Metropolitan Area.

2.6 PLANNING OBJECTIVES

The national objectives are general statements that are not specific enough for direct use in plan formulation; maximizing national economic development (NED) and restoring ecosystem functions are the overarching goals for this study. The water and related land resource problems and opportunities identified in this study are stated as specific planning objectives to provide focus for the formulation of alternatives. These planning objectives reflect the problems and opportunities in the study area and represent desired positive changes from the future without-project conditions. The planning objectives are specified as follows:

- Reduce flood risk and flood damages in the Fargo-Moorhead metropolitan area.
- Restore or improve degraded riverine and riparian habitat in and along the Red River of the North, Wild Rice River (North Dakota), Sheyenne River (North Dakota), and Buffalo River (Minnesota) in conjunction with other flood risk management features.
- Provide additional wetland habitat in conjunction with other flood risk management features.
- Provide recreational opportunities in conjunction with other flood risk management features.

2.7 PLANNING CONSTRAINTS

Unlike planning objectives that represent desired positive changes, planning constraints represent restrictions that should not be violated. The planning constraints identified in this study are as follows:

- Avoid increasing peak Red River flood stages, either upstream or downstream
- Comply with the Boundary Waters Treaty of 1909 and other pertinent international agreements.
- Avoid negatively impacting the Buffalo Aquifer in Minnesota.
- Minimize loss of floodplain in accordance with Executive Order 11988, Floodplain management

2.8 NATIONAL ECONOMIC DEVELOPMENT (NED) PLAN

Federal policy requires that the feasibility study must identify the plan that reasonably maximizes net national economic development (NED) benefits consistent with protecting the environment. That plan, the "NED plan," must be recommended for implementation unless there are overriding reasons for recommending another plan, based on other Federal, State, local and international concerns. A different plan may be recommended as a "locally preferred plan" if it has positive net economic benefits and is approved by the Assistant Secretary of the Army for Civil Works (ASA(CW)).

3.0 ALTERNATIVES*

This chapter describes the development of alternative plans that address the planning objectives, the comparison of those plans and the *tentative* selection of a plan. It also describes the *tentatively* selected plan and its implementation requirements.

3.1 PLAN FORMULATION RATIONALE

A wide variety of management measures were developed that would address one or more of the planning objectives. These measures were evaluated and then screened. Alternative plans were then developed which comprised one or more of the management measures.

3.2 MANAGEMENT MEASURES AND PRELIMINARY PLANS

<u>3.2.1 No Action</u>

The Corps is required to consider the option of "No Action" as one of the alternatives in order to comply with the requirements of the National Environmental Policy Act (NEPA). With the No Action alternative, which is synonymous with the "Without Project Condition," it is assumed that no project would be implemented by the federal government to achieve the planning objectives. The No Action alternative forms the basis against which all other alternative plans are measured. The No Action alternative was described in detail in Chapter 2. Critical assumptions in defining the no action alternative include:

- Emergency flood fighting activities would continue to occur
- Emergency flood fighting measures have low reliability
- Urban areas will expand into the floodplain
- Development in the floodplain will comply with floodplain regulations; floodplain development will be elevated above the FEMA 1-percent chance event in accordance with local standards

<u>3.2.2 Measures to address identified planning objectives</u>

A management measure is a feature or activity at a site which addresses one or more of the planning objectives. Several alternative measures were identified for consideration in evaluating future possible actions in the Fargo-Moorhead Metropolitan Area. Input provided during the reconnaissance and feasibility phases directly from sponsors and stakeholders, at public meetings and written public comments, provided a wide array of potential measures. Each measure was assessed and a determination made regarding whether it should be retained in the formulation of alternative plans.

3.2.2.1 Non-structural measures reduce flood risk by modifying the characteristics of the buildings and structures that are subject to floods or modifying the behavior of people living in or near floodplains. In general, non-structural alternatives do not modify the characteristics of floods nor do they induce development in a floodplain that is inconsistent with reducing flood risk. Some non-structural measures that can be formulated into non-structural alternatives include removing buildings from floodplains by relocation or acquisition; flood proofing buildings; placing small levees, berms or walls around buildings; implementing flood warning and preparedness activities; and implementing floodplain regulation. The National Flood Insurance Program (NFIP) is considered among non-structural alternatives since it contains programs to provide minimum standards for floodplain regulation, to provide flood insurance, and to provide flood hazard mitigation. Many non-structural measures are already in place throughout the study area, primarily in newer development built in accordance with floodplain regulations. The Corps must develop and present at least one plan that is primarily non-structural in nature. Non-structural measures will also be considered for integration with structural measures to maximize effectiveness of all alternatives.

3.2.2.2 Structural measures reduce flood risk by modifying the characteristics of the flood; they are often employed to reduce peak flows (flood storage), direct floodwaters away from damageable property (flood barriers), or facilitate the flow of water through or around an area (channel modifications or diversions). Several structural measures have already been implemented to provide benefits to the study area, as described earlier in this report.

3.2.2.3 The measures that were considered in this study are listed below. Detailed descriptions of the measures are included in Appendix O, Plan Formulation.

- No Action: Continue emergency measures

- Non-structural measures
  - Buy and relocate flood-prone structures
  - Flood proofing
  - Elevate structures
  - Flood warning systems
  - Flood insurance
  - Wetlands
  - Grasslands
  - Pay landowners for water retention

- Flood barriers
  - Levees
  - Floodwalls
  - Invisible floodwalls
  - Gate closures
  - Pump stations

- Increase conveyance
  - Diversion channels around the study area
    - In Minnesota
    - In North Dakota
  - Increase conveyance in Oakport Coulee
  - Cutoff channels (to short-cut existing meanders)
  - Flattening the slopes on river bank

    - Replacing bridges
    - Underground tunnels
    - Interstate 29 viaduct
    - Dredge river deeper and wider

- Flood storage
    - Large dams upstream
    - Distributed storage
    - Controlled field runoff
    - Storage ponds, also used for water conservation

3.3 FEASIBILITY PHASE 1

3.3.1 General

This feasibility study was conducted in an iterative fashion. A wide array of potential measures was identified during the reconnaissance phase and expanded during the feasibility study. As the study progressed, additional data was produced that allowed the narrowing of alternatives. The planning steps of formulating, evaluating and comparing alternative plans were accomplished iteratively as information about the alternatives was developed.

3.3.2 Phase 1

Feasibility Phase 1 took place from September 2008 through May 2009. In Phase 1 the study team gathered information to assess existing conditions in the study area and worked to understand the potential for economic justification of a large regional flood risk management project. Hydraulic models were built to determine expected water surface elevations for a full range of possible flood events. A structure inventory was conducted focusing on both residential and commercial structures within the study area. This information was used to calculate expected annual flood damages without federal action. Conceptual designs and cost estimates were prepared for two structural alternatives: a diversion alternative without a control structure and a levee/floodwall alternative. In March 2009 the study area experienced its flood of record, which produced a maximum stage of 40.8 feet on the Fargo gage. The results of the preliminary work were released in May 2009. The preliminary analyses indicated that a levee plan could be economically justified. The preliminary diversion plan was shown to be very effective at reducing flood stages, but it was not cost-effective. Additional study would be needed to refine these concepts. On the basis of this preliminary information, and in the wake of the record-setting flood of 2009, the study team decided to continue planning efforts.

3.4 FEASIBILITY PHASE 2, SCREENING #1

3.4.1 General

Feasibility Phase 2, Screening #1 took place from May 2009 through November 2009. The study team performed cursory technical analysis of all proposed measures and developed screening criteria to focus evaluation and design efforts on the most implementable alternatives. Preliminary results were presented at public meetings in October 2009. Screening #1 analyses were based on Phase 1 traditional hydrology (without the 2009 flood event) and steady-state hydraulic modeling calibrated to the 2006 flood event. Phase 2 activities included updating both the hydrologic record and hydraulic modeling to reflect the 2009 event, but the updated information was not available for use during the first screening.

3.4.2 Screening criteria

Corps planning guidance requires that plans be evaluated against four criteria listed in the United States Water Resources Council's Economic and Environmental Principles and Guidelines for Water and Related Land Resources Implementation Studies (P&G): completeness, effectiveness, efficiency and acceptability. Other criteria deemed significant by participating stakeholders are also used to evaluate alternatives. The screening criteria represent the most critical factors to be considered in selecting plans for further evaluation. The following criteria were used to assess the overall characteristics of each alternative measure to identify those most likely to meet the project purpose and objectives.

Effectiveness: Whether the measure or alternative would be effective in maintaining an acceptable level of flood risk management for the Fargo-Moorhead Metropolitan Area. This is one of the P&G criteria. The team assessed conceptual measures for their potential to contribute substantially to the overall effectiveness of any alternative.

Environmental Effects: Direct and indirect effects of natural resources and cultural resources. Direct effects are those effects associated with the construction. Indirect effects are those effects that occur as a result of changed environmental conditions resulting from the construction or operation of the project. This criterion related to the planning objectives to restore or improve riverine, riparian and wetland habitat, and a desire to minimize environmental impacts and produce an environmentally sustainable project. It is also a component of overall effectiveness.

Social Effects: Direct and indirect effects on socio-economic resources such as transportation, regional growth, public safety, employment, recreation, public facilities, and public services. This criterion is a component of overall effectiveness.

Acceptability: Controversy and potential effects on community cohesion and compliance with policy are indicators of acceptability. This criterion is one of the P&G criteria.

Implementability: This criterion considered the existence of significant outstanding technical, social, legal or institutional issues that could affect the ability to implement the alternative. This is related to the P&G criterion for acceptability.

Cost: The first cost of the project, costs of local operations and maintenance, and long-term residual costs. Cost is related to two P&G criteria: efficiency and acceptability. Cost alone was not used to eliminate any alternatives, but was considered in relation to the other criteria.

Risk: The uncertainties, vulnerabilities, and potential consequences of the alternative. Risk is related to the P&G criteria of effectiveness and acceptability.

Separable Mitigation: This criterion considered the potential need for mitigation resulting from the project's implementation to address environmental, hydraulic or other impacts. Is mitigation possible, what does it cost, and how does it impact the project cost? This criterion is related to all four of the P&G criteria.

Cost Effectiveness: This criterion was a comparison of expected economic benefits and estimated costs for each alternative and between alternatives. This is a primary consideration in determining whether there is a federal interest in the project and to what extent federal participation can be justified. This is a component of the P&G criteria of efficiency.

3.4.3 Screening #1 Process

Using the preliminary technical information, the team applied professional judgment in order to assess the measures against the screening criteria. Those measures that appeared to be most viable were refined and further developed so that accurate costs and economic benefits could be determined. Several different scales of non-structural measures, flood barriers and diversion channels were evaluated during this phase of study. The initial diversion channel concept referred to in Section 3.3.2 was improved upon to make it a more economically justifiable solution as described in Section 3.4.7.3.1. Using all of the information developed, the team compared the alternatives to each other to screen out inferior plans and identify the optimal plans. Initial screening results were presented at public meetings in October 2009. Subsequent discussions with the non-federal sponsors narrowed the alternatives to various capacities and locations of diversion channels.

3.4.4 Screening #1 Results

The initial screening process and results are fully described in Appendix O, Plan Formulation. A summary of the screening conclusions is provided in sections 3.4.5 through 3.4.7 of this report. The initial design and economic analyses of the levee and diversion channel alternatives were based on Phase 1 hydrology (without the 2009 flood event) and steady-state hydraulic modeling calibrated to the 2006 flood event. During this screening, 11 separate plans were analyzed based on five alignments and various sizes: Minnesota Long Diversion (25,000, 35,000, and 45,000 cfs), Minnesota Short Diversion (25,000, 35,000 and 45,000 cfs), North Dakota East Diversion (35,000 cfs), North Dakota West Diversion (35,000 and 45,000 cfs), and in-town levees (2-percent and 1-percent chance level of protection).

Table 5 presents the results of the initial cost-effectiveness analyses of the levee and diversion alternatives. Table 6 presents the expected flood stages with various capacities of diversion channel. Figure 12 shows the alignments of the diversions and levees considered in the initial screening.

Table 5 – Phase 2, Screening #1 cost-effectiveness analysis results

Fargo-Moorhead Metro Feasibility Study
Initial Screening Results, October 2009
Screened Alternatives Ranked by Net Benefits

Alternative	First Cost *	Avg Annual Net Benefits *	Residual Damages *	B/C Ratio
MN Short Diversion 25K	962	11.0	14.3	1.22
MN Short Diversion 35K	1,092	9.4	9.3	1.17
Levee 1% chance (100-year)	902	7.7	20.9	1.17
MN Long Diversion 25K	1,055	5.6	15.0	1.10
MN Short Diversion 45K	1,264	2.5	7.4	1.04
MN Long Diversion 35K	1,260	0.3	9.8	1.00
ND East Diversion 35K	1,337	-3.1	9.2	0.95
ND West Diversion 35K	1,363	-4.4	9.2	0.94
Levee 2% chance (50-year)	840	-5.3	37.1	0.88
ND West Diversion 45K	1,439	-6.7	7.6	0.91
MN Long Diversion 45K	1,459	-8.3	8.2	0.89

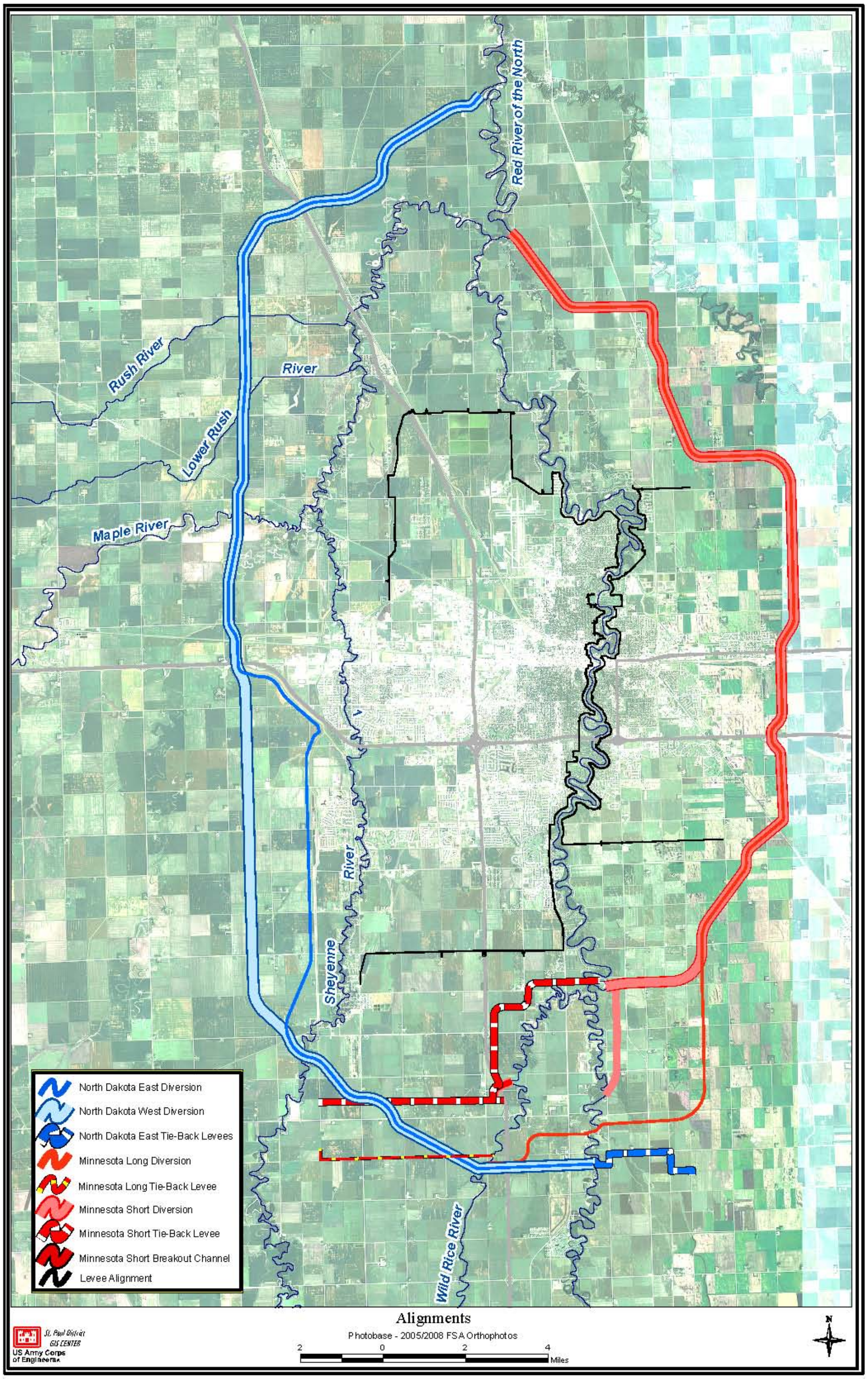
* In millions of dollars

Note: Expected average annual damages without a project are $73.7 million.

Table 6 –Phase 2, Screening #1 estimated flood stages assuming various diversion capacities

	STAGE at the FARGO GAGE		
	2% Chance	**1% Chance**	**0.2% Chance**
	(50-year)	(100-year)	(500-year)
Existing Condition	37.8	39.5	43.9
25k Diversion	29.1	30.4	39.2
35k Diversion	28.8	29.2	35.9
45k Diversion	27.1	27.2	30.4

Figure 12 – Phase 2, Screening #1 alternatives alignments



3.4.5 Preliminary Plans Eliminated from Further Consideration
The following alternatives were not recommended for further evaluation as stand-alone alternatives for this project:

- Flood Barriers
- Tunneling
- Interstate 29 Viaduct
- Dredging and Widening the River
- Increase conveyance in Oakport Coulee

Appendix O, Plan Formulation, contains a complete discussion of the screening process and the consideration given to each preliminary measure. The following paragraphs summarize the screening effort.

3.4.5.1 Flood barriers (including levees) were eliminated because they were both less effective and less cost effective than diversion plans in providing a high level of risk reduction. The top elevation of flood barrier alternatives is limited to the highest natural ground available to begin and end the levee; within the study area, flood barriers could not be certified to contain floods larger than about a 30,000 cfs event. Such a plan would leave unacceptably high residual risk. The flood barrier plans that were evaluated would also have caused large short term social impacts, due to the need to remove over 1,000 structures in the urban floodplain. The flood barrier plans were eliminated with knowledge of a number of uncertainties which would likely increase the overall cost which include: possible upstream impacts, the use of floodwalls versus earthen levees, geotechnical concerns, uncertainties with local pump stations, impacts to historical properties, and possible mitigation

3.4.5.2. Tunneling was eliminated from consideration due to low cost effectiveness. Tunneling would be used to divert flows under the communities; this would function similar to a diversion channel, but underground. It was estimated that at least three 30-foot diameter tunnels approximately 25 miles long would be needed to provide approximately 25,000 cubic feet per second capacity. The cost of such a plan was estimated to be $3.75 billion, which is significantly higher than the cost of a comparably sized diversion channel.

3.4.5.3 Reconstructing the Interstate 29 (I-29) corridor to serve as an open viaduct during floods was considered. The system would function as an interstate highway during non-flood times. It would essentially be a diversion channel with an interstate highway either on the bottom or elevated. Demolition and reconstruction of the existing Interstate highway structures and pavement would cost at least $400 million. Excavation costs would be similar to diversion channels. Real estate would be required to dispose of the excavated material. Total cost of this alternative would likely be $1.4 billion to $4.0 billion. Operation and maintenance costs of the corridor and the roadway would be high. Concerns with this alternative included ice jams, access to evacuation routes during flood events, and long term maintenance of the structures. Local drainage and snow melt year-round and backwater into the channel during minor flood events would inundate the highway if it was located at the bottom of the channel. This alternative was dropped from consideration due to low cost-effectiveness, operation and maintenance concerns and impacts to transportation.

3.4.5.4 Digging the Red River channel deeper and wider to allow for more flow to pass through the Fargo-Moorhead Metropolitan Area was considered, including Oakport Coulee. This alternative could also be looked at underneath existing bridges to prevent the damming effect the bridges can create. This alternative would have very limited hydraulic effectiveness and would likely have negative effects on the stability of the riverbanks throughout the length of the project. Dredging and widening the channel would have a variety of potential adverse environmental effects. Increased sedimentation, displacement of mussels, erosion issues, riparian forest habitat loss, aquatic habitat, and wildlife mortality issues would need to be addressed. This alternative would also have a large potential impact on archeological resources, which are typically located on riverbanks and would be disturbed by this alternative. Because of the extreme environmental impacts, this alternative would violate many local and national policies and would not be acceptable. The alternative was dropped due to its relative ineffectiveness and overall unacceptability.

<u>3.4.6 Preliminary plans dropped as stand-alone plans but retained for possible inclusion</u>

The following measures were retained for possible inclusion as features of the alternative plans where they could be incrementally economically justified:

- Non-Structural Measures
- Flood Storage
- Wetland and Grassland Restoration
- Bridge Replacement or Modification
- Cut-Off Channels

3.4.6.1 Non-structural measures were eliminated as stand-alone plans because they were not found to be cost effective. Additionally non-structural measures would provide protection from property damage but evacuation would be required due to local infrastructure being impacted. This would cause large disruptions to transportation and businesses, and these impacts could last more than a month. Three levels of comprehensive stand-alone non-structural plans were investigated for the study area: 1-percent chance, 0.5-percent chance and 0.2-percent chance. None of the plans were cost-effective, with total costs of $1.6 billion, $3.3 billion and $4.7 billion and benefit/cost ratios of 0.35, 0.37 and 0.31, respectively. Due to the extremely flat nature of the floodplain, it appears that it is not efficient to address flooding on an individual structure basis over the entire Fargo-Moorhead study area. Non-structural measures were retained for possible application in smaller areas not benefited by other features of the final plan where they could be economically justified. The entire non-structural analysis can be found in Appendix P.

3.4.6.2 Flood storage and wetland and grassland restoration were eliminated as stand-alone alternatives because they would be both less effective and less cost effective than diversion plans in providing a high level of risk reduction. Estimates of potential stage reduction that could be achieved with flood storage varied from less than 1.6 feet to 5 feet for a 1-percent chance event, depending on various assumptions. To achieve a stage reduction of 1.6 feet, 200,000 to 400,000 acre feet of storage would need to be constructed. If the pool was assumed to be 10 feet deep it would require 40,000 acres of land upstream of the Fargo-Moorhead area to achieve 400,000 acre feet of storage. Stage reductions during floods larger than the 1-percent chance event would be less than 1.6 feet. The study team and sponsors agreed that such a level of stage reduction would leave unacceptable residual flood risk in the study area and would not be able to meet the purpose and need of this study. The diversion plans could provide much larger and more reliable stage reductions for a similar financial investment. These measures were retained for possible application where they could be economically justified.

3.4.6.3 Bridge replacement or modification was eliminated as a stand-alone alternative because it would not be effective in substantially reducing flood risk in the study area. This concept was retained for possible application as part of an overall plan where it could be economically justified.

3.4.6.4 Cut-Off Channels were eliminated as a stand-alone alternative because they would not be effective in substantially reducing flood risk in the study area. This concept was retained for possible application as part of an overall plan where it could be economically justified.

3.4.7 Preliminary plans retained for further evaluation

The following stand-alone alternatives were recommended for further evaluation:

- Future without Project Condition--No Action
- Diversion Channels

3.4.7.1 The no action alternative was retained as the baseline condition to which all other alternatives are compared.

3.4.7.2 The diversion channel concept was retained for further refinement. The preliminary analysis indicated that the Minnesota Short diversion was the most cost effective of all plans considered and would be implementable and highly effective. All of the diversions studied produced lower residual damages than the levee alternatives. Since the most cost effective plan identified was the smallest capacity diversion considered, it was noted that a smaller capacity might be optimal. It was also noted that none of the North Dakota alignments provided positive net benefits, but the preliminary economic analyses omitted potential economic benefits from tributary flooding that would be uniquely addressed by a North Dakota diversion. The preliminary analyses omitted other benefit categories that could significantly increase the benefits for any diversion plan. Potential benefit categories included transportation and flood proofing cost avoidance. Any diversion could impact fish passage and riverine habitat. Further analysis was needed to optimize the capacity and alignment of the diversion concept and address potential impacts to the aquatic habitat.

3.4.7.3 The preliminary analyses produced information that supported further screening of the diversion alternatives at this screening step. The following paragraphs discuss conclusions drawn from the preliminary analyses that reduced the number of diversion plans retained for further analysis.

3.4.7.3.1 The initial diversion concept presented in May 2009 was a passive diversion channel without an operable river control structure; this concept was not economically justified with a benefit to cost ratio of approximately 0.65. All of the subsequent diversion concepts included a river control structure that dramatically improved performance with a modest increase in cost. Therefore, no diversions lacking a control structure were carried forward.

3.4.7.3.2 The Minnesota Short alignment outperformed the Minnesota Long alignment, and there were no significant unique benefits or avoidance of any adverse environmental effects associated with the Minnesota Long alignment, so that alignment was dropped from consideration.

3.4.7.3.3 The North Dakota East alignment outperformed the North Dakota West alignment, and there were no significant unique benefits or avoidance of any adverse environmental effects associated with the North Dakota West alignment, so the west alignment was dropped from consideration.

3.5 PHASE 2, SCREENING #2

<u>3.5.1 Refined Array of Alternatives</u>

An array of remaining alternatives was formulated using those management measures or plans that remained following the screening described above. Between October 2009 and February 2010 these plans were refined in order to determine the NED plan and to develop a locally preferred plan to more fully address the planning objectives. The second screening in Phase 2 incorporated a traditional hydrologic analysis based on the full period of record, including the 2009 event. The hydraulic modeling was calibrated to the 2006 flood event. The alternatives were differentiated by 1) their location in either Minnesota or North Dakota, and 2) their capacity. Non-structural measures were considered as additional features in the areas immediately upstream of the diversions and in the areas near the downstream end of the diversions, where the diversions provided little or no benefit. The array of alternatives developed to greater detail was as follows:

- MN20k: Minnesota Short Diversion, 20,000 cubic feet per second (cfs) capacity
- MN25k: Minnesota Short Diversion, 25,000 cfs capacity
- MN30k: Minnesota Short Diversion, 30,000 cfs capacity
- MN35k: Minnesota Short Diversion, 35,000 cfs capacity
- ND30k: North Dakota East Diversion, 30,000 cfs capacity
- ND35k: North Dakota East Diversion, 35,000 cfs capacity
- The preceding plans with the addition of non-structural measures

3.5.1.1 Minnesota versus North Dakota location: There were several issues related to the location of the diversion that were pertinent to plan formulation:

- Phase 2, Screening #1 showed that the Minnesota alignment appeared to provide optimal net benefits (noting that additional analysis was needed to capture known but omitted benefits of the North Dakota plans).
- The Minnesota alignment was constrained on the east by the Buffalo Aquifer and on the west by the city of Dilworth, Minnesota.
- The Minnesota alignment crosses a railyard east of Dilworth, Minnesota
- Significantly more economic benefits accrue to properties in North Dakota regardless of channel location. That led to a public perception that Minnesota would suffer disproportionate harm if the diversion were located in Minnesota.
- North Dakota alignments cross five tributaries (Wild Rice, Sheyenne, Maple, Lower Rush, and Rush Rivers); Minnesota alignments cross none.
    - Tributary crossings introduce additional environmental impacts.
    - Tributary crossings provide flood risk reduction for flood events on the tributaries as well as the Red River.
- The North Dakota alignment benefits a greater geographic area and removes 50 more square miles from the 1-percent chance event floodplain than the Minnesota alignment.
- The sponsors and a majority of stakeholders preferred a North Dakota alignment.

3.5.1.2 The Phase 2, Screening #1 analysis completed in October 2009 indicated that the smallest capacity Minnesota plan considered (25,000 cfs) provided the largest net economic benefits. That suggested that an even smaller plan could optimize the net economic benefits. The final array of plans must include at least one plan smaller than the National Economic Development (NED) plan to show that the benefits cannot be maximized at a lower cost. To address this issue, a 20,000 cfs capacity Minnesota alternative was added to the array. Channel capacity is directly related to the project's effectiveness in reducing flood stages. The initial design data (presented in Table 6, above), indicated that a capacity of approximately 30,000-35,000 cfs would be needed to reduce the 0.2-percent chance event at the Fargo gage to a stage of 36 feet. The non-federal sponsors indicated that a project of that size would be needed to provide a tolerable level of residual risk, and they requested that these capacities be included in the array for both Minnesota and North Dakota alignments as potential locally preferred alternatives.

<u>3.5.2 No Action</u>

The "no action" alternative assumes that no project would be implemented by the federal government to achieve the planning objectives. The "no action" alternative is described in section 3.2.1 and in Chapter 2.

<u>3.5.3 Minnesota Short Diversion alternatives</u>

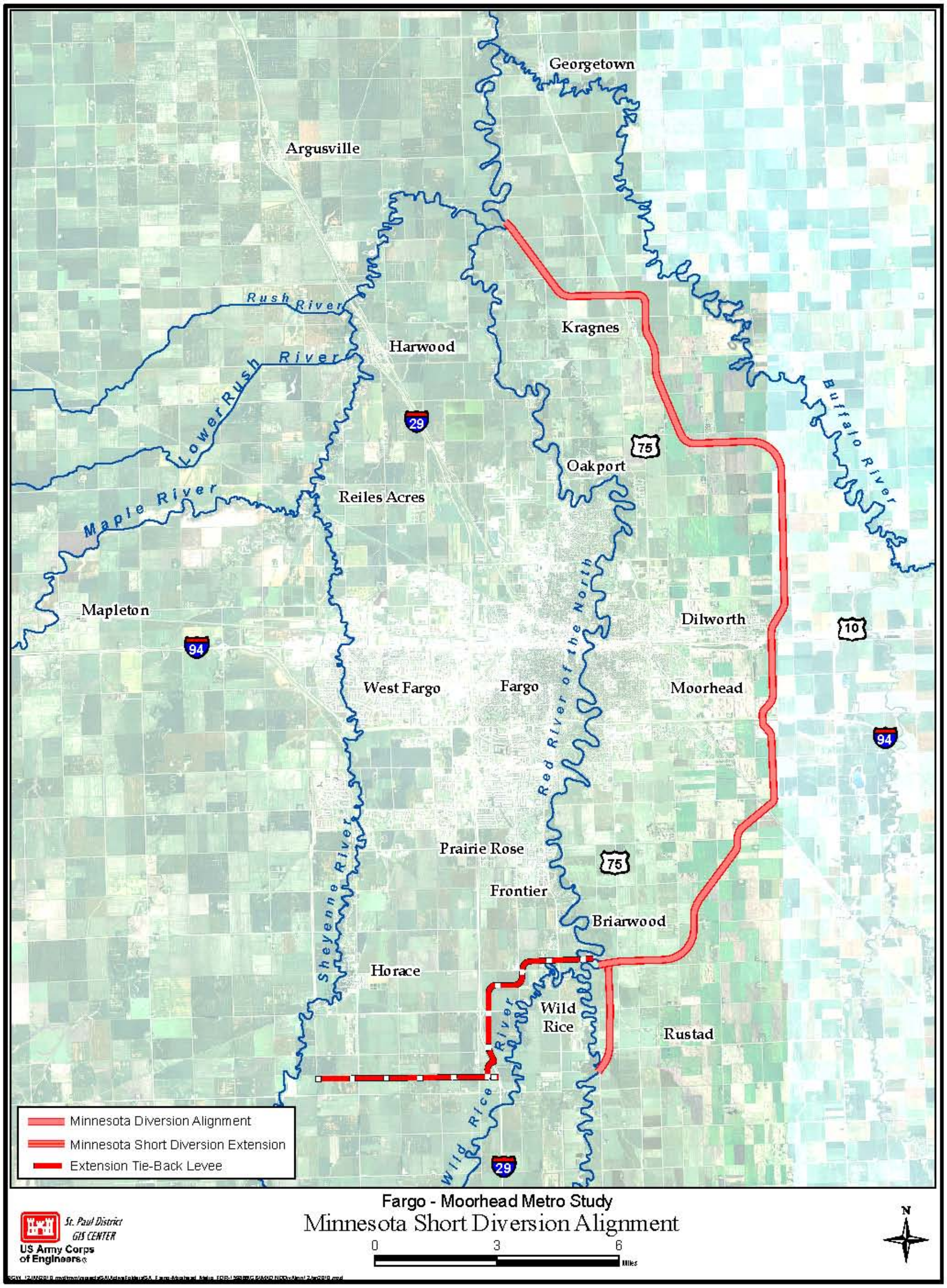
3.5.3.1 Diversion system features

The Minnesota short diversion alignment started just north of the confluence of the Red and Wild Rice Rivers and extended east and north around the Cities of Moorhead and Dilworth and ultimately re-entered the Red River near the confluence of the Red and Sheyenne Rivers. The alignment of the main diversion channel was approximately 25 miles long. All four of the Minnesota plans followed the same alignment and differed only in their hydraulic capacity. The alignment and basic design features remained the same as in the earlier screening phase. The project consisted of the following primary features:

- Red River control structure
- Diversion inlet weir
- Main diversion channel
- Supplemental diversion channels
- Tie-back levee
- Side ditch inlet structures
- Highway bridges
- Railroad bridges

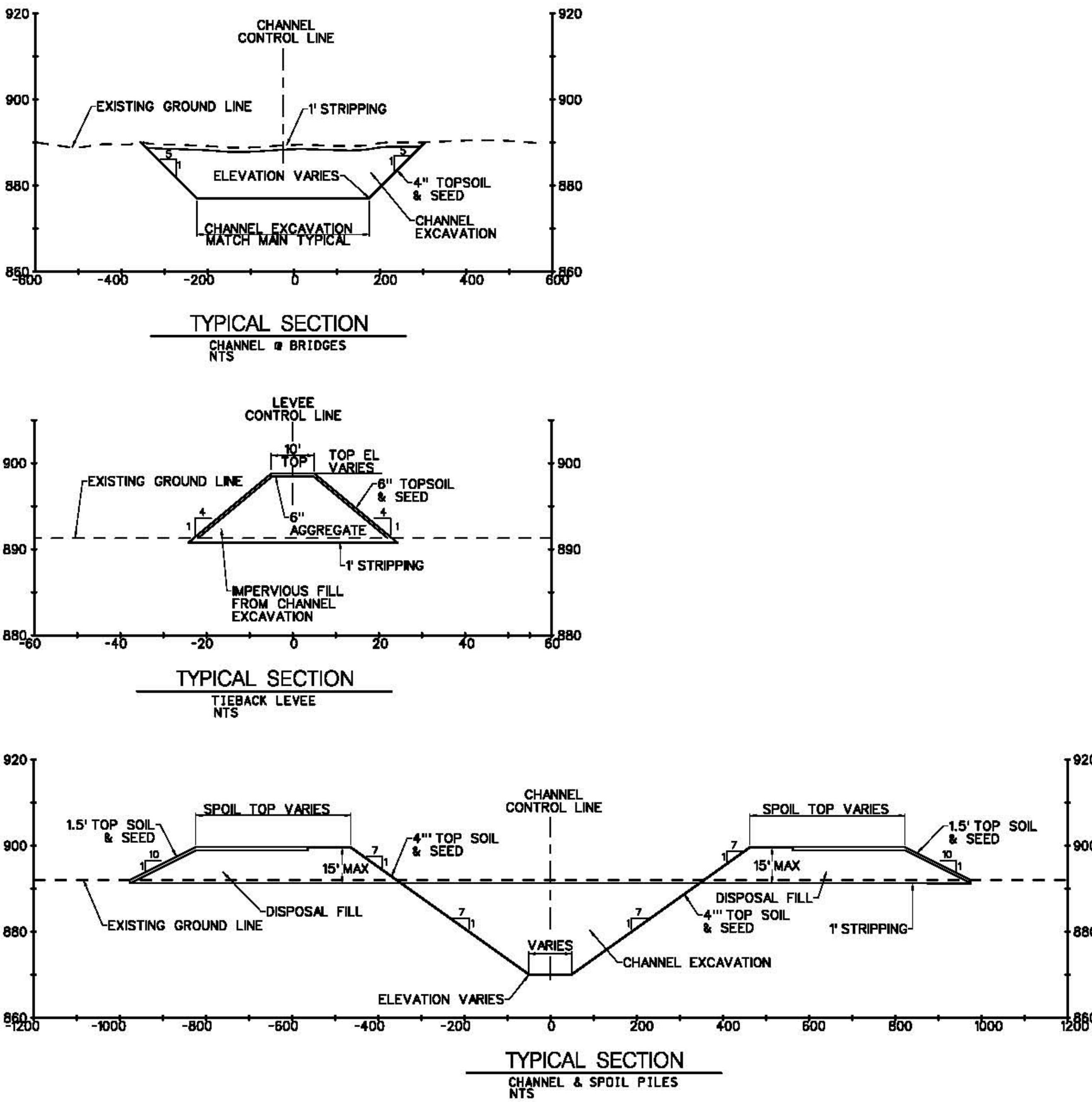
Figure 13 shows the alignment of the major features.

Figure 13 - Minnesota Short Diversion alignment



3.5.3.2 Four separate diversion capacities were initially analyzed for the Minnesota short alignment including 20,000 cfs, 25,000 cfs, 30,000 cfs, and 35,000 cfs. At the end of Phase 2, two additional capacities were evaluated in an effort to bracket the NED plan: 15,000 cfs and 10,000 cfs. The channel configuration for each alternative was largely determined by constraining the maximum excavation depth to approximately 30 feet. This constraint was imposed to address geotechnical concerns based upon preliminary slope stability analyses. The channel bottom widths for the 20,000 cfs, 25,000 cfs, 30,000 cfs, and 35,000 cfs channels were 175 feet, 240 feet, 300 feet, and 360 feet respectively. Side slopes on the excavation were generally set at 1 vertical on 7 horizontal (1V on 7H) except at bridges where slopes were steeper at 1V on 5H and short reaches where other exceptions were required to achieve slope stability. Excavation quantities, being the largest portion of the construction for the diversion alternatives, were approximately 36 million, 42 million, 49 million, and 55 million cubic yards for the 20,000 cfs, 25,000 cfs, 30,000 cfs, and 35,000 cfs channels respectively. The Minnesota short alignment also included 20 highway bridges and four railroad bridges. Cross sections of the typical bridges, tie-back levees, and diversion channels can be seen in Figure 14.

Figure 14 – Typical cross section, bridges, tieback levee, and diversion channel.



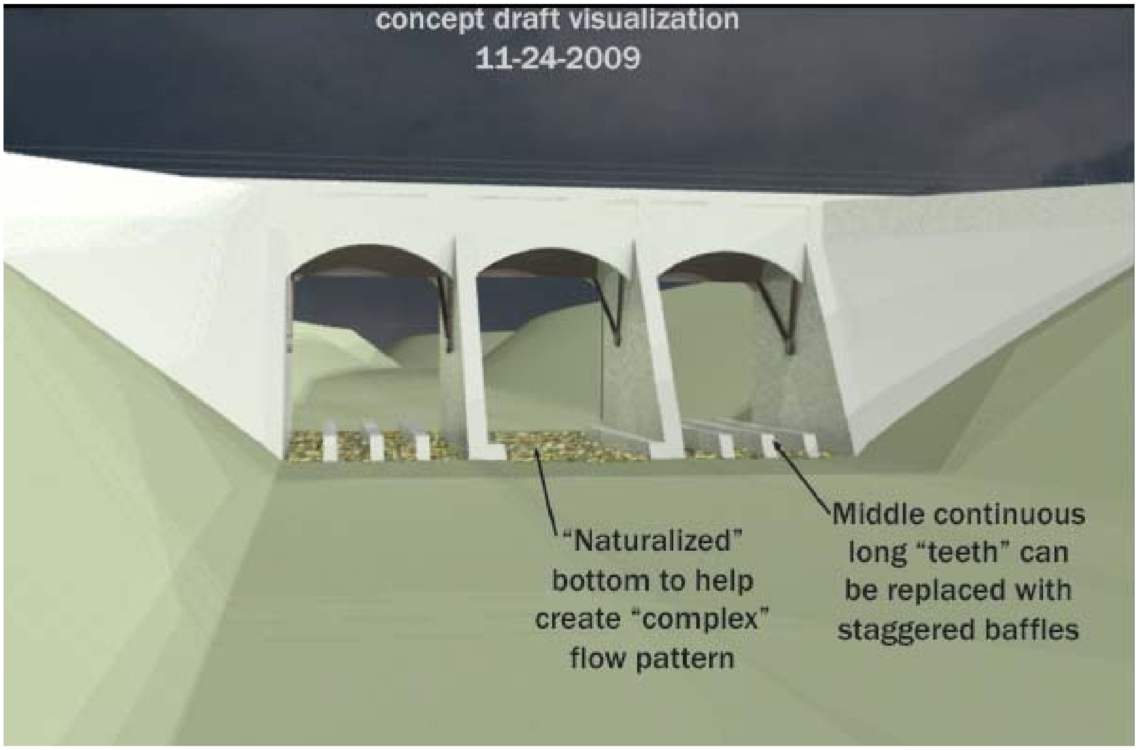
3.5.3.3 Soil excavated to construct the channel would be piled adjacent to the channel to a maximum height of 15 feet. The soil disposal piles would be as wide as necessary to contain the excavated material. The spoil slopes were 1V on 7H and 1V on 10H for the diversion side and outside slopes respectively. Portions of the soil disposal piles would be constructed to serve as levees when the water surface in the channel is higher than the natural grade. The total footprint of the MN35k plan had a maximum width of 2150 feet including areas for spoil piles. The affected acreages ranged from 4,485 acres to 6,415 acres for the MN20k and MN35k plans, respectively.

3.5.3.4 In addition to the main diversion channel, the Minnesota plans included two smaller channels upstream of the Red River control structure to prevent stage increases upstream of the project along the Red and Wild Rice Rivers. A supplementary channel paralleled the Red River upstream of the entrance to the diversion channel to allow for additional capacity to offset the breakouts to Drains 27 and 53. This secondary “Minnesota short extension channel” was approximately 3 miles long and had a 50 foot bottom width. A second, shorter channel, the Wild Rice River breakout channel, was added near the intersection of I-29 and Cass County Highway 16. The breakout channel was less than one mile long and had a 50 foot bottom width. It crossed under I-29 to convey water across I-29 that would have naturally broken out to Drain 27. These two supplemental features were also included in the previous analysis of this alignment.

3.5.3.5 The plan included a control structure on the Red River at the south end of the project. The Red River control structure allowed for the maximum benefit for a given diversion channel capacity by reducing water surface elevations immediately downstream of the structure. Additionally, the control structure allowed the water surface elevation upstream of the project to remain at a near natural elevation to prevent erosion-causing velocities in the Red River at the upstream end of the project. The flow split between the diversion channel and the Red River would be controlled by a combination of the control structure on the Red River and a weir at the entrance to the diversion channel. The diversion inlet weir crest would be set at an elevation that would allow all flows up to 9,600 cfs (between the 50-percent chance and the 20-percent chance events) to pass through Fargo-Moorhead. The weir would be constructed of sheet pile and rock.

3.5.3.6 The proposed Red River control structure would be an operable structure with three tainter gates 40 feet wide and 40 feet high. The gates would normally be fully open, and the structure would not impede flow more than a typical highway bridge up to a flow of 9,600 cfs. At that flow, the gates would be lowered to direct some of the flow into the diversion channel. The lowest four feet of each gate bay would remain open even when the gates were closed to allow flow into the natural channel under all conditions. The structure would allow small boat navigation when the gates are open. Figure 15 illustrates the conceptual control structure.

Figure 15 – Conceptual Red River control structure, looking upstream



3.5.3.7 The Red River control structure was designed with consideration for fish passage during most flow conditions. The bottom of the structure would be constructed to simulate natural roughness. The openings would be sized to maintain passable flow velocities until the gates were put into operation. After the gates were closed, smaller openings through the structure would direct some water into a fish ramp system (not shown) that would continue to allow fish passage during flood events up to about the 2-percent chance event.

3.5.3.8 The plan also included a tie-back levee at the southern limits of the project. The tie-back levee would connect the Red River control structure to high ground and prevent flood water from flowing overland to the north and west into the protected area. Figure 13 shows the alignment for the tie-back levee. No tie-back levees at the north end of the project were included. The typical section for the tie-back levee had a top width of ten feet and side slopes of 1V on 4H. The tie-back levee would be constructed of impervious fill obtained from the channel excavation and covered with topsoil and turf.

3.5.3.9 A number of side ditch inlet drop structures would be included where the diversion crossed existing agricultural and highway drainage ditches. These structures would allow drainage to enter the channel and prevent water in the diversion channel from escaping to adjacent areas during high flow events.

3.5.3.10 The downstream end of the diversion channel would be protected with rock riprap where it returned to the Red River.

3.5.3.11 The primary constraints on the Minnesota alignment were the City of Dilworth, Minnesota, located immediately east of Moorhead, and the Buffalo Aquifer, located approximately 2.5 miles east of Dilworth. Two railroad switchyards were further considerations in determining the channel alignment in this area. The proposed alignment balanced these three constraints to minimize potential impacts to existing structures in Dilworth, avoid excavating into the aquifer, and minimize the number of railroad bridges and related impacts to the railyards.

3.5.3.12 A critical path analysis was completed on the Minnesota diversion channel, and it was determined that the Dilworth railyard relocation would be on the critical path. This resulted in an estimated construction period of 7.5 years for all of the Minnesota diversion alternatives, assuming funding was available as needed. The various sized plans would not have different construction schedules, because the railyard would be the controlling factor rather than the excavation of the diversion channel.

3.5.3.13 There were opportunities to incorporate wetland creation into the bottom of portions of the channel. These features could be developed at little to no cost and could provide additional wildlife habitat for the region.

3.5.4 North Dakota East Diversion

3.5.4.1 Diversion system features

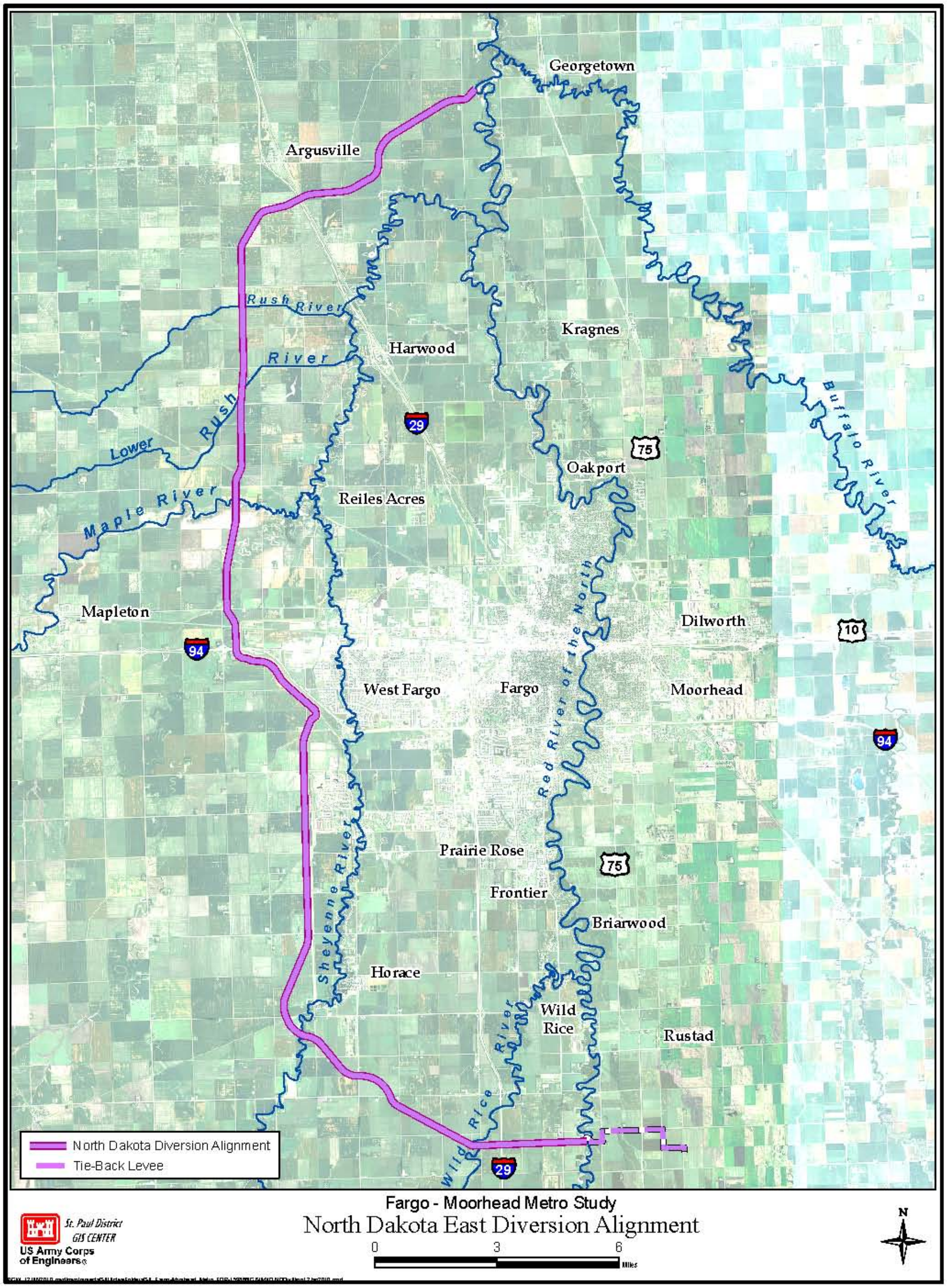
The North Dakota east diversion alignment started approximately four miles south of the confluence of the Red and Wild Rice Rivers and extended west and north around the Cities of Horace, Fargo, West Fargo, and Harwood and ultimately re-entered the Red River north of the confluence of the Red and Sheyenne Rivers near the City of Georgetown, MN. The alignment was approximately 36 miles long and incorporated the existing Horace to West Fargo Sheyenne River diversion channel. The basic alignment remained the same as in the earlier screening phase, but significant changes were made to optimize the channel cross section, reduce cost, and improve the efficiency of the hydraulic structures. The plans consisted of the following primary features:

- Red River control structure
- Connecting channel (Red River to Wild Rice River)
- Wild Rice River control structure
- Diversion inlet weir (at Wild Rice River)
- Main diversion channel
- Sheyenne River crossing structure
- Maple River crossing structure
- Lower Rush River diversion structure
- Rush River diversion structure

- Tie-back levee
- Side ditch inlet structures
- Highway bridges
- Railroad bridges

Figure 16 shows the alignment of the major features.

Figure 16 - North Dakota East diversion alignment



The North Dakota east alignment was analyzed at 30,000 cfs and 35,000 cfs capacities based on the non- federal sponsors' request for them to be considered as a locally preferred plan. The channel configuration for each plan was largely determined based on the minimum excavation quantity for a given capacity rather than by the maximum recommended excavation depth as was used for the Minnesota alignment. The maximum depth for the North Dakota plans was 32 feet, as opposed to 30 feet for the Minnesota plans. The channel bottom width between the Red and Wild Rice Rivers was 300 feet for both capacities. For the ND30k plan, the channel bottom width was 80 feet between the Wild Rice River and the downstream end of the diversion. For the ND35k plan, the channel bottom width was 100 feet between the Wild Rice and Sheyenne Rivers and 125 feet between the Sheyenne River and the downstream end of the diversion. Side slopes on the excavation were set at 1V on 7H except at bridges where slopes were steeper at 1V on 5H. Both North Dakota plans included 18 highway bridges and four railroad bridges. Cross sections of the typical bridges, tie-back levees, and diversion channels can be seen in Figure 14.

Soil excavated to construct the channel would be piled adjacent to the channel to a maximum height of 15 feet. The soil disposal piles would be as wide as necessary to contain the excavated material. The spoil slopes were 1V on 7H and 1V on 10H for the diversion side and outside slopes respectively. Portions of the soil disposal piles would be constructed to serve as levees when the water surface in the channel is higher than the natural grade. The total footprint of the ND35k plan had a maximum width of 2150 feet including areas for spoil piles. The affected acreage was 6,105 acres and 6,560 acres for the ND30k and ND35k plans, respectively.

Because this alignment began south of the confluence of the Red and Wild Rice Rivers, a connecting channel was included between the Red and Wild Rice Rivers. The connecting channel would convey flow from the Red River to the diversion channel inlet on the west side of the Wild Rice River.

A combination of control structures on the Red and Wild Rice Rivers at the south end of the project, along with weirs at the west end of the connecting channel and at the entrance to the diversion channel near the Wild Rice River, would control the flow split between the Red and Wild Rice River channels and the diversion channel. The diversion inlet weir crest would be the controlling weir and would be set to allow flows up to 9,600 cfs to pass through Fargo-Moorhead. The 9,600 cfs flows were intended to maintain existing geomorphologic processes and existing habitat conditions in the natural channels.

The proposed Red River control structure would be an operable structure similar to the one proposed for the Minnesota diversion plans, except the three tainter gates would be 40 feet wide and 30 feet high. (See Figure 15 and discussion in section 3.5.3.6 and 3.5.3.7)

The proposed Wild Rice River control structure, similar to the Red River control structure, would be an operable structure with two tainter gates 30 feet wide and 20 feet high. The gates would normally be fully open, and the structure would not impede flow more than a typical highway bridge. The gates would be operated to allow flows up to 9,600 cfs to pass through Fargo-Moorhead. At that flow, the gates would be lowered to direct some of the flow into the diversion channel. The lowest two feet of each gate bay would remain open even when the gates were closed to allow flow into the natural channel under all conditions. The structure would allow small boat navigation when the gates were open. The Wild Rice River control structure would be conceptually the same as the Red River control structure illustrated in Figure 15, except that the Wild Rice structure would have only two gates. This structure also incorporates features for fish passage as generally described in section 3.5.3.7.

The tie-back levee associated with this alternative would connect the Red River control structure to high ground approximately 2.5 miles to the east and prevent flood water from flowing over land to the north and east into the protected area. No tie-back levees at the north end of the project were included. The typical section for the tie-back levee had a top width of ten feet and side slopes of 1V on 4H. The tie-back levee would be constructed of impervious fill obtained from the channel excavation and covered with topsoil and turf.

The ND30k and ND35k plans crossed the Sheyenne, Maple, Lower Rush, and Rush Rivers. Systems of hydraulic structures were necessary at the points where the diversion channel crossed these rivers. The tributary crossing structure systems would limit the amount of water that could pass over the diversion channel with the rest of the water being diverted into the diversion channel. This resulted in additional flood damage reduction benefits adjacent to the tributaries downstream of the intersection. Careful consideration was given to the crossing structure systems to minimize impacts to fish passage on the tributary streams. This is described in Chapter 5 of this report, Environmental Consequences.

The Rush and Lower Rush Rivers, which currently consist of constructed trapezoidal channels, would flow into the diversion channel, resulting in abandonment of the downstream portion of these rivers. The structures at the junction of the Rush and Lower Rush Rivers and the diversion channel were also designed to allow fish passage from the diversion channel into the upstream tributary channels during most flow conditions. From the Lower Rush River to the Red River the bottom of the diversion channel would be designed to provide wildlife habitat. This would be accomplished by including a meandering pilot channel and using native species. There would also be opportunities to incorporate wetland creation into the bottom of other portions of the channel. These features could be developed at little to no cost and could provide additional wildlife habitat for the region.

The hydraulic structure systems proposed on the Sheyenne and Maple Rivers would allow a minimum of a 50-percent chance event flow to continue down the rivers while diverting excess water during flood events to the diversion channel. The 50-percent chance event flows are intended to maintain existing geomorphologic processes and existing habitat conditions in the natural channels. The Sheyenne and Maple River structures would remain biologically connected and maintain fish passage to those rivers nearly all of the time, except possibly for events larger than the 1-percent chance event. The two crossing structure systems were similar in concept; each included a drop structure to prevent headcutting on the tributary, a spillway and channel to control diversion of tributary flows, and a hydraulic structure to pass a limited flow over the diversion channel to maintain the desired flow in the tributary beyond the diversion channel.

The primary difference between the Sheyenne system and the Maple system was the presence of gated openings on the Maple system's hydraulic structure. The gates were necessary because the structure was designed to allow flows in the diversion channel to overtop the Maple River crossing structure. The gates would operate to prevent excessive flows from passing into the Maple River during extreme flood events. Figure 17 through Figure 23 illustrate the conceptual structures on the Sheyenne and Maple Rivers.

Figure 17 – Flow in Sheyenne River, no flow over spillway or in diversion

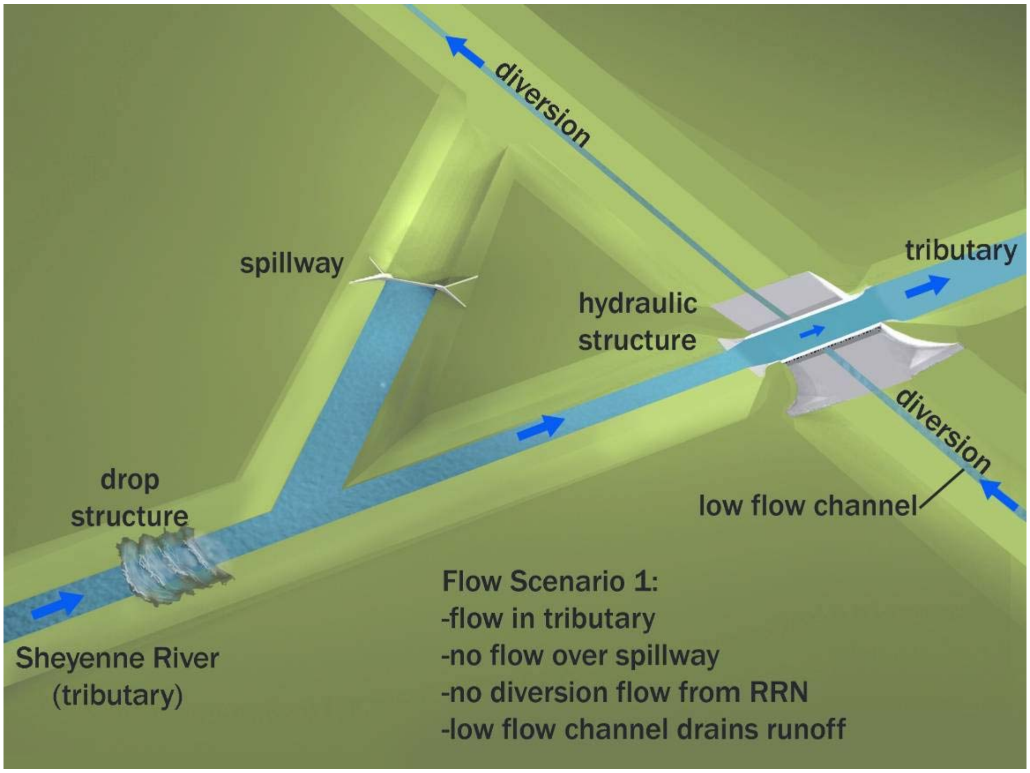


Figure 18 – Flow in Sheyenne, flow over spillway and flow in diversion

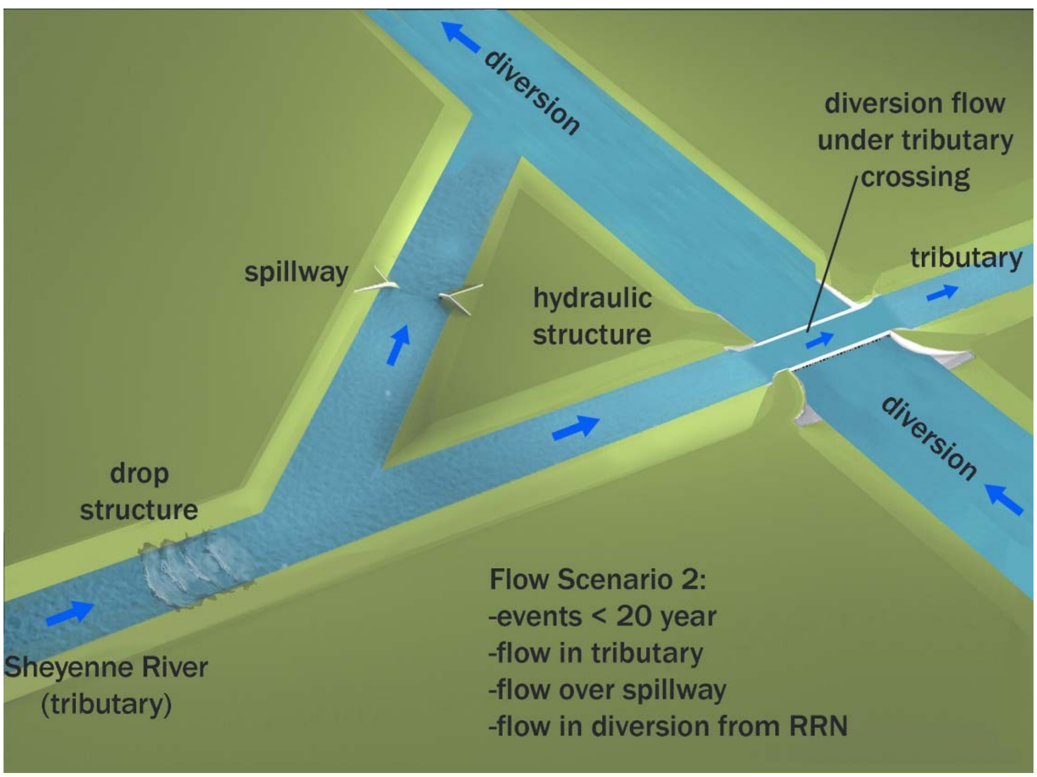


Figure 19 - Flow in Sheyenne River, no flow over spillway or in diversion looking at structure

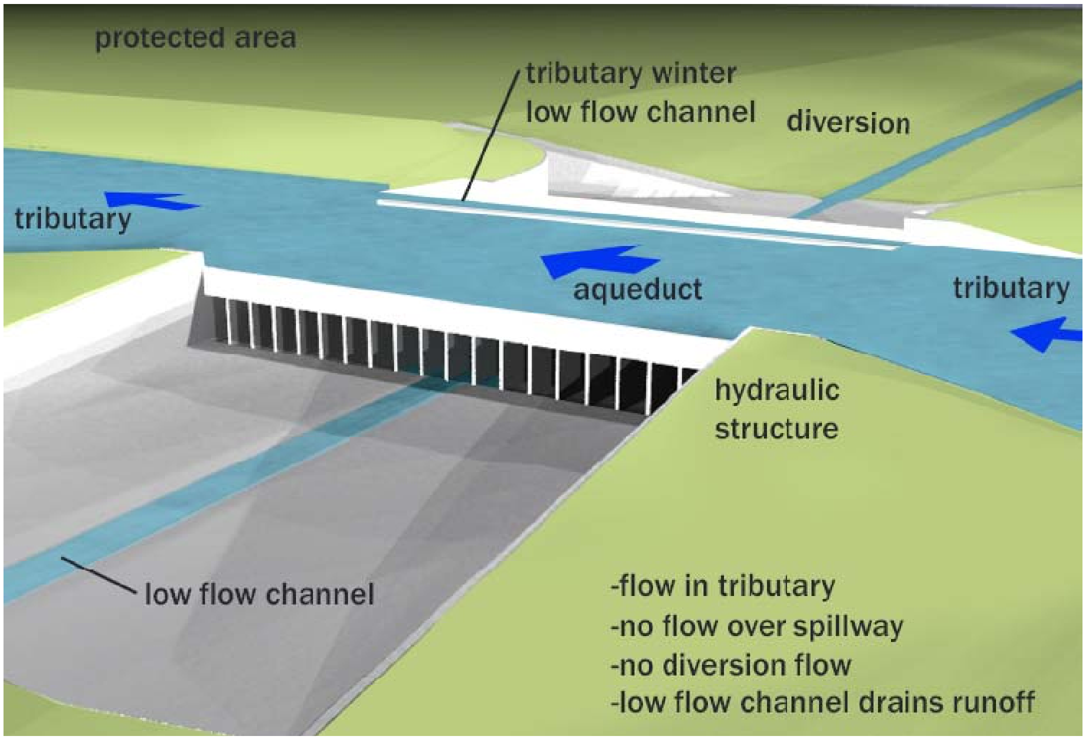


Figure 20 - Flow in Maple River, no flow over spillway or in diversion.

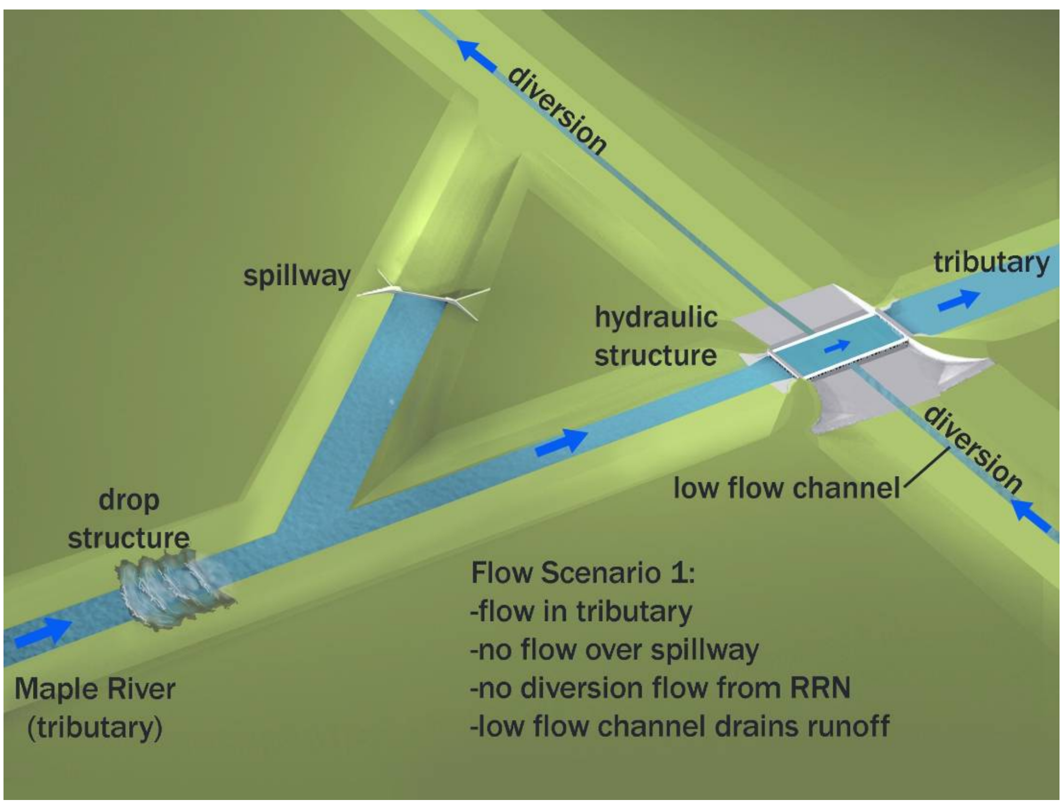


Figure 21 – Flow in Maple River, flow over spillway, and flow in diversion

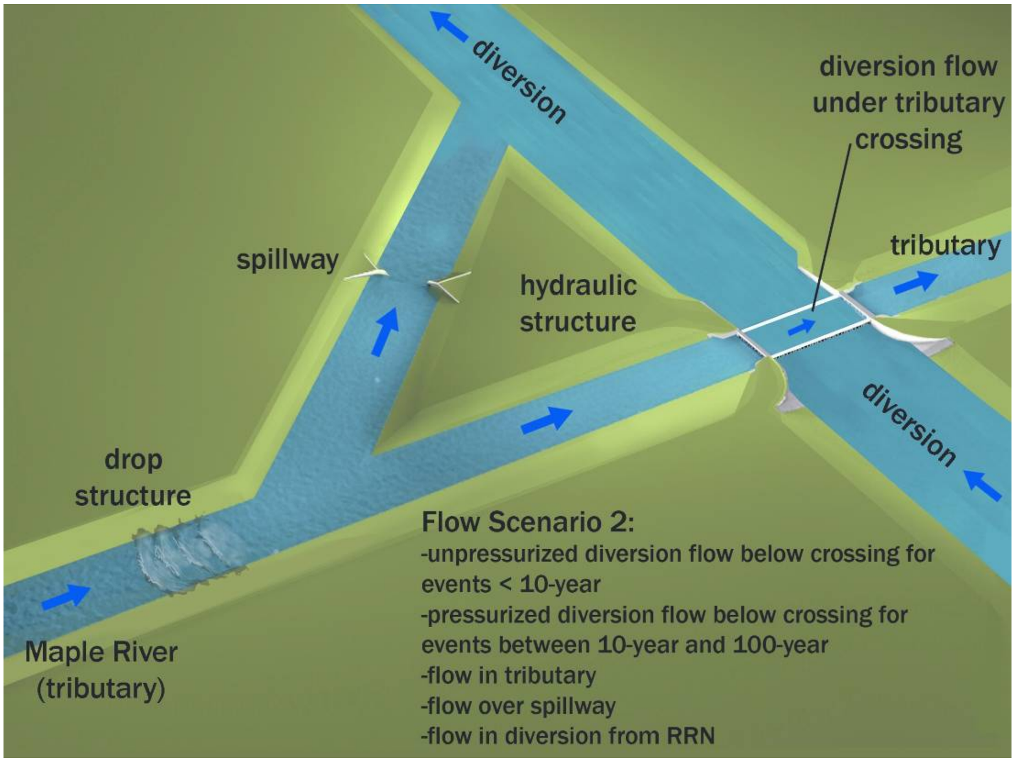


Figure 22 – Maple River and Diversion flows, Diversion overtops Maple River.

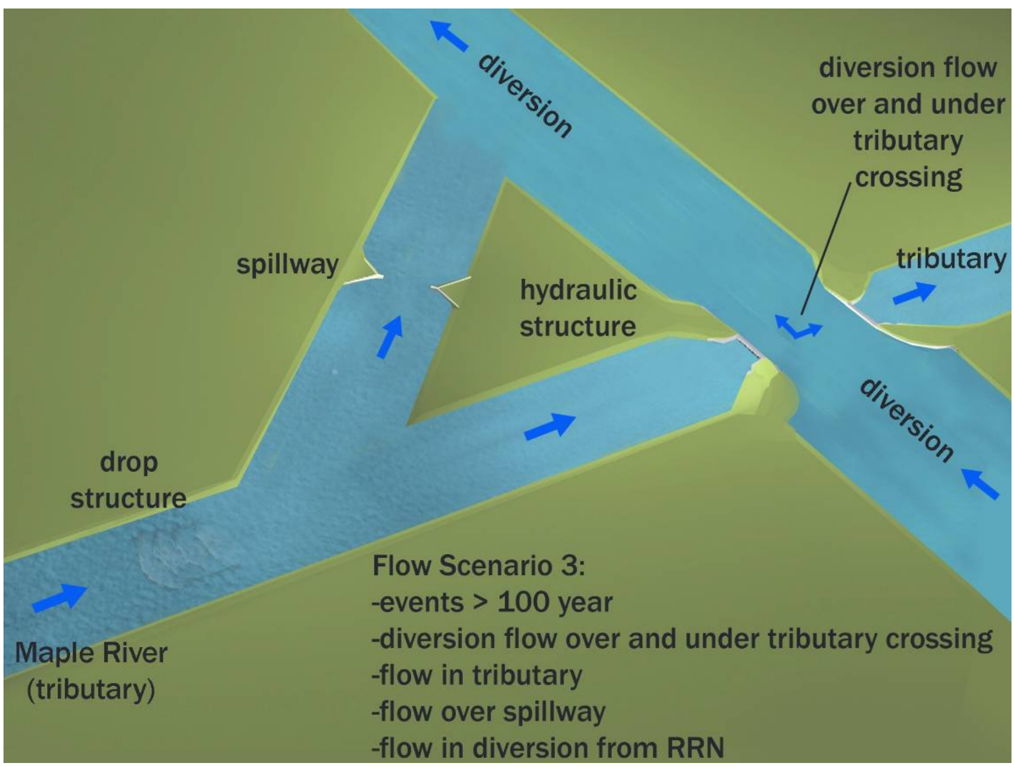
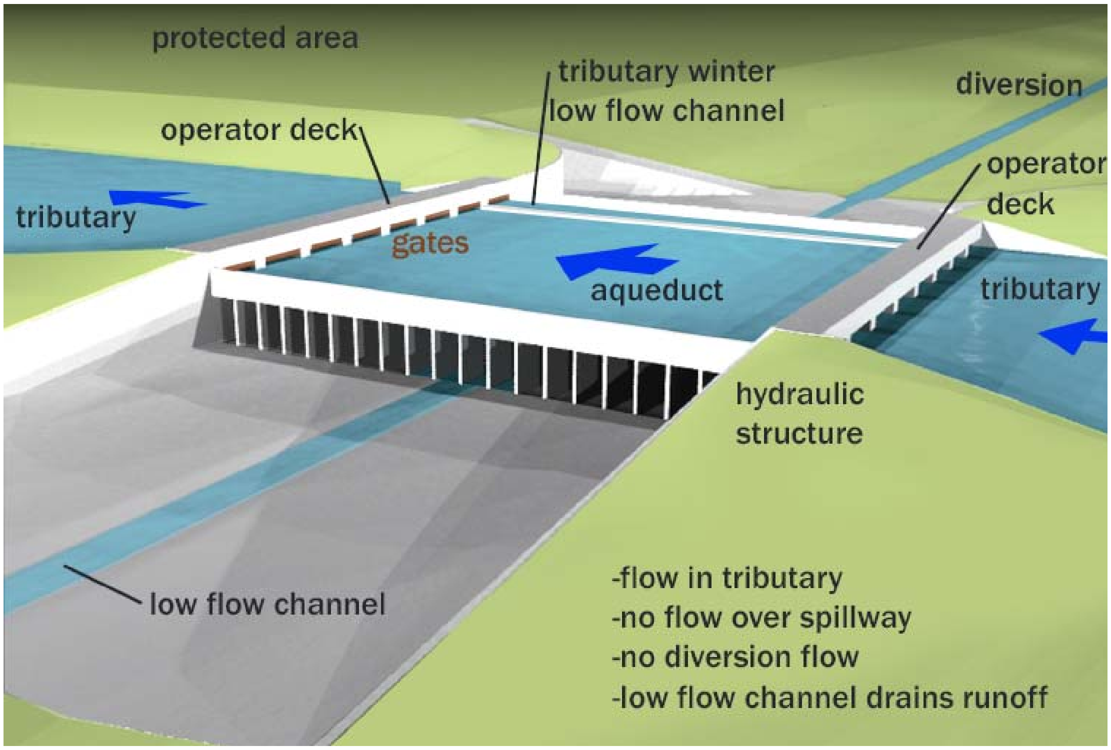


Figure 23 – Flow in Maple River, no flow over spillway or in diversion, looking upstream at structure.



A number of side ditch inlet drop structures would be included where the diversion crosses existing agricultural and highway drainage ditches. These structures would allow drainage to enter the channel and prevent water in the diversion channel from escaping to adjacent areas during high flow events.

The downstream end of the diversion channel would be protected with rock riprap where it returned to the Red River.

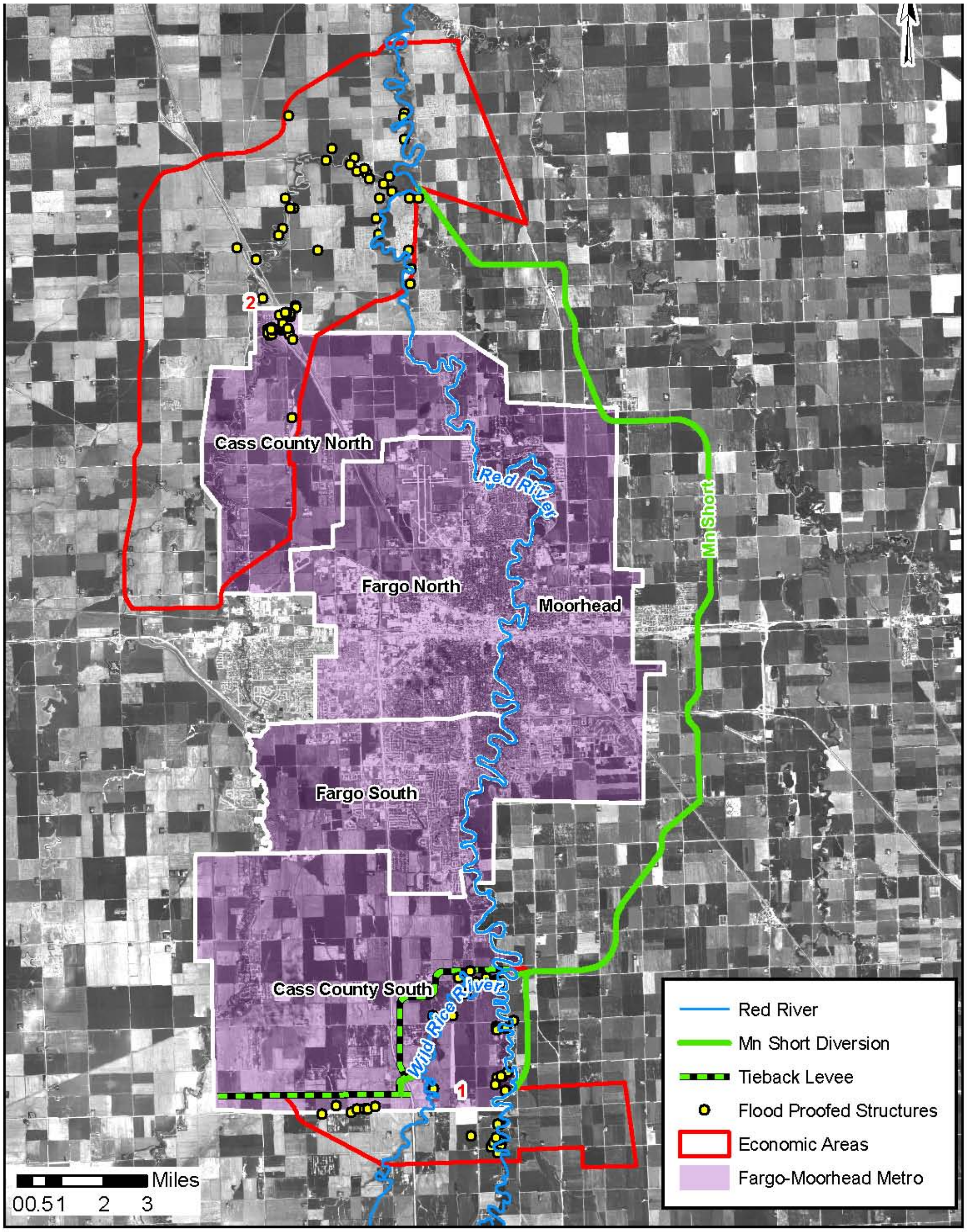
3.5.4.2 A critical path analysis was completed on the North Dakota diversion channel, and it was determined that the Maple River structure would be on the critical path. This resulted in an estimated construction period of 8.5 years for all of the North Dakota diversion alternatives, assuming funding was available as needed. The various sized plans would not have different construction schedules, because the Maple River structure would be the controlling factor rather than the excavation of the diversion channel.

3.5.5 Non-structural measures

Non-structural measures were analyzed as an additional incremental feature to be included in any of the diversion plans. Two areas were evaluated for residual flood impacts that could be addressed with non-structural measures: Economic Area 1 upstream and Economic Area 2 downstream. Economic Area 1 was the area upstream of the proposed Minnesota diversion channel inlet to approximately four miles south of the Wild Rice River confluence with the Red

River. Economic Area 2 was the area along the downstream reach of the Sheyenne River near the proposed diversion channel outlets. The areas analyzed are shown on Figure 24.

Figure 24 - Location of potential non-structural measures



Economic Area 1 included 48 residential structures. Potential non-structural measures applicable in this area were buyouts and elevation of structures. This area was only considered in conjunction with the Minnesota plans, because the area is located downstream of the North Dakota diversion inlet, meaning it would be within the area benefited by the diversion and non-structural measures would not be necessary. It was determined that non-structural measures for Economic Area 1 were not justified for the Minnesota diversion alignments and had a benefit to cost ratio of 0.45 with net benefits of negative ($314,313).

The non-structural mitigation measures proposed for Economic Area 2 consisted of buyouts, elevation of structures, and construction of flood walls. For the MN20k plan there were 57 residential structures, one commercial structure, and one critical facility (ID 400802 public school) included. For the larger Minnesota plans there are 51 residential structures and one critical facility (ID 400802 public school) included. For the ND30k and ND35k plans, there were 29 residential structures included.

Non-structural measures were incrementally justified for Economic Area 2 in conjunction with all Minnesota alternatives. The non-structural measures had benefit to cost ratios of 1.04 for the MN20k plan and 1.14 for the MN25k, MN30k and MN35k plans. The non-structural features would add average annual net benefits of $17,156 for MN20k and $49,903 for the other three Minnesota plans (see Appendix P). Therefore, with the selection of any Minnesota diversion alternative the non-structural measures in Economic Area 2 would be added as a justified increment to that plan and would become part of the NED plan.

Non-structural measures were not economically justified for either North Dakota alternative. With the North Dakota diversions in place, additional non-structural measures had a benefit to cost ratio of 0.64 and net benefits of negative ($73,354) (see Appendix P).

<u>3.5.6 Incremental measures eliminated from further consideration</u>

Following the development of the diversion alternatives, additional consideration was given to flood storage, wetland and grassland restoration, bridge replacement or modification, and the use of cut-off channels. It was determined that these measures would not provide any additional justified increment. This is due to the fact that the diversion alternatives provided a very high level of flood risk reduction, and they captured a large portion of the benefits that could be captured by a project.

<u>3.5.7 Phase 2, Screening #2 Results</u>

The results from the second Phase 2 screening are presented in Table 7.

Table 7 – Phase 2, Screening #2 cost-effectiveness analysis results

Screened Alternatives Ranked by Net Benefits with Cost and Schedule Risk Assessment				
Alternative	Cost [1]	Avg Annual Net Benefits [1]	Residual Damages [1]	B/C Ratio
MN Short Diversion 10K[2]	$730	$1.3	$40.3	1.03
MN Short Diversion 15K[2]	$800	$11.4	$31.0	1.28
MN Short Diversion 20K	$871	$16.2	$22.7	1.41
MN Short Diversion 25K	$980	$15.5	$18.1	1.36
MN Short Diversion 30K	$1,050	$15.1	$14.8	1.33
MN Short Diversion 35K	$1,143	$12.2	$13.3	1.26
ND East Diversion 30K	$1,231	$13.3	$11.4	1.26
ND East Diversion 35K	$1,295	$11.7	$9.7	1.22

1. In millions of dollars
2. Linear Cost Extrapolations used.
Expected average annual damages without a project are $77.1 million.

3.5.8 Phase 2, Screening #2 Conclusions

The key findings of the second screening were:

- The Minnesota 20k plan was the apparent NED plan.
- The difference in net benefits between the Minnesota plans was relatively small, so minor changes to costs or benefits could affect identification of the NED plan.
- The North Dakota plans had positive net economic benefits, so they were economically viable as potential locally preferred plans.

3.5.9 Hydraulic and Hydrologic assumptions

Throughout the second part of Phase 2, work continued to update the hydraulic models and hydrologic data to reflect the 2009 flood event. At the completion of Phase 2, it was determined that a non-traditional hydrologic method (see Appendix A, Hydrology) would most accurately represent the expected future flow conditions during the period of analysis. In addition, the hydraulic model was re-calibrated to the 2009 event. Both changes were expected to increase estimated flood stages for any given frequency of event and potentially affect the economic analyses.

3.5.10 Selection of alternatives for further analysis

The results of the second screening were presented to the public in February 2010 and discussed with the non-federal sponsors and stakeholders at several subsequent meetings. On March 29, 2010, the Cities of Fargo and Moorhead, Cass County, North Dakota and Clay County Minnesota jointly requested that the ND35k plan be pursued as a locally preferred plan (LPP). Because of the relatively small magnitude of the differences in net benefits between the Minnesota plans, and the potential impacts of the revised hydrology and hydraulic models, it was necessary to retain the MN20k, MN25k, MN30k and MN35k plans as possible NED plans to be considered in the final array in Phase 3.

3.6 FEASIBILITY PHASE 3

3.6.1 General

Phase 3 began in March 2010. Primary activities were to refine the plans and identify which of the Minnesota plans would maximize net economic benefits. These refinements included additional analysis of the impacts to the railroads and to the cross sections on the diversion channels. This analysis used the hydrologic assumptions recommended by the EOE panel and the hydraulic model which was calibrated to the 2009 event, which increased estimated flood stages for the larger flood events. The analysis was completed on the MN20, 25, 30, and 35k alternatives and the ND35k alternative. The ND30k alternative was dropped from further consideration when the non-federal sponsors identified the ND35k as the Locally Preferred Plan as indicated in section 3.8.2.

3.6.2 Revised Cross Section for North Dakota Diversion

The cross section of the North Dakota diversion as described in section 3.5.4.1 was modified to account for weak soils that were identified as part of the soil investigations. This resulted in the depth of the channel being raised three feet, to a maximum depth of approximately 29 feet. The channel bottom widths remained unchanged. Side slopes on the excavation were modified to be 1V on 10H up to a 10 foot high 50 foot wide bench then 1V on 7H to the top of the channel.

Soil excavated to construct the channel would be piled and set back 50 feet from the top of the diversion channel to a maximum height of 15 feet. The soil disposal piles would be as wide as necessary to contain the excavated material. The spoil slopes were 1V on 7H and 1V on 10H for the diversion side and outside slopes respectively. Portions of the soil disposal piles would be constructed to serve as levees when the water surface in the channel is higher than the natural grade. The total footprint of the ND35k plan would have a maximum width of approximately 2450 feet including areas for spoil piles.

3.6.3 Phase 3 Economic Analysis Results

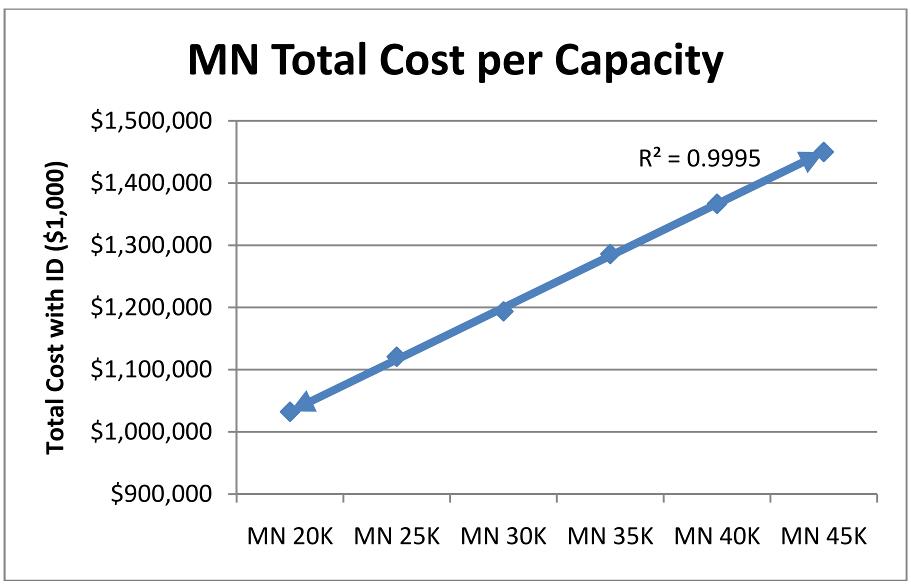
3.6.3.1 The Phase 3 final array of alternatives was analyzed in May 2010 to identify the NED plan. The initial Phase 3 work showed that the MN35k plan, the largest plan analyzed in detail, maximized net economic benefits. As a result, it was necessary to consider larger alternatives to identify the NED plan. Hydraulic models were developed for the MN40k and MN45k alternatives to fully define the with-project flood stages and economic benefits for those alternatives. Table 8 shows the estimated peak stage at the Fargo gage.

Table 8 - Phase 3 estimated flood stages assuming various diversion capacities

	Stage at Fargo Gage (ft)	
	1% Chance (100- year)	0.2% Chance (500- year)
Existing Condition (Stage)	42.4	46.7
Existing Condition (CFS)	34,700	61,700
Work Group Goal	30	36
20K Diversion Channels	36.9	43.7
25K Diversion Channels	34.8	42.4
30K Diversion Channels	33.6	41.9
35K ND Diversion Channel	30.6	40.0
35K MN Diversion Channel	31.9	39.6
40K Diversion Channels	31.9	37.6
45K Diversion Channels	31.9	35.3

3.6.3.2 Costs for the MN40k and MN45k plans were estimated based upon linear extrapolation from the detailed estimates of the smaller Minnesota alternatives. Figure 25 illustrates the linear nature of the cost curve for these alternatives and supports the methodology used.

Figure 25 - Linear Extrapolation of Costs for the MN40k and MN45k Alternatives



3.6.3.2 The Phase 3 analyses determined that the NED plan was the MN40k plan, with maximum average annual net benefits of $105.6 million. The results of the Phase 3 cost-effectiveness analysis are presented in Table 9.

Table 9 – Phase 3 cost-effectiveness analysis results

Screened Alternatives Ranked by Net Benefits with Cost and Schedule Risk Assessment					
Alternative	Cost [1]	Avg Annual Net Benefits [1]	Avg Annual Benefits [1]	Residual Damages [1]	B/C Ratio
MN Short Diversion 20K	$1,032	$87.0	$140.0	$55.9	2.64
MN Short Diversion 25K	$1,121	$98.8	$156.4	$39.5	2.71
MN Short Diversion 30K	$1,194	$101.7	$163.1	$32.8	2.66
MN Short Diversion 35K	$1,286	$104.9	$171.0	$24.9	2.59
MN Short Diversion 40K [2]	$1,367	$105.6	$175.9	$20.0	2.50
MN Short Diversion 45K [2]	$1,450	$104.9	$179.5	$16.4	2.41
ND East Diversion 35K	$1,462	$95.4	$171.1	$24.8	2.26
1. In millions of dollars with interest during construction and discounting included					
2. Estimate based on linear extrapolation					
Expected average annual damages without a project are $195.9 million.					

3.6.3.3 It is interesting to note that the NED plan does not produce the highest benefit-cost ratio. The definition of the NED plan is based upon maximizing net benefits rather than maximizing benefit-cost ratio.

3.6.4 Reconsideration of the Locally Preferred Plan (LPP)

On April 28, 2010, the Assistant Secretary of the Army for Civil Works authorized the Corps to recommend the non-federal sponsors' LPP, as described section 3.8.2 of this report. After considering the Phase 3 results, the non-federal sponsors reaffirmed their preference for the ND35k plan as the LPP. It was noted that the revised hydrology and hydraulics affected the nominal performance of the LPP, and the ND35k plan would no longer produce the locally desired stage of 36.0 on the Fargo gage for a 0.2-percent chance event.

3.6.5 Dismissal of the MN40k (NED) plan and the MN45k plan

Selection of the ND35k plan as the LPP made further consideration of the NED plan (MN40k) unnecessary. Federal cost sharing for the LPP could not be based on the NED plan, because the LPP produced fewer total average annual benefits than the NED plan, at $171.1 million and $175.9 million, respectively. Instead, federal cost sharing would be based upon a smaller Minnesota alternative that produced a comparable level of benefits to the LPP. Table 9 shows that the MN35k plan and the LPP produced comparable benefits, at $171.0 million and $171.1 million respectively. Since the MN35k plan would serve as the basis for federal cost sharing, there was no need to fully develop the MN40k (NED) plan. For purposes of the feasibility study, it was only necessary to demonstrate that the NED plan was larger than the MN35k plan. For that reason, the MN40k (NED) plan and the MN45k plan were dismissed from further consideration, and the MN35k plan would be refined for comparison with the LPP for cost-sharing purposes. The MN35k plan was therefore identified as the Federally Comparable Plan (FCP).

3.6.6 Validation of earlier screening steps

The Phase 3 economic analyses completed in May 2010 validated the October 2009 and January 2010 screening steps. Decisions made at earlier steps were based on the best available hydraulic and hydrologic data available at that time. Subsequent information indicated that the earlier assumptions underestimated both the flow frequency and expected flood stages. As a result, all of the plans previously considered and screened out during the earlier screening steps, including levee and storage alternatives, would provide a lower level of flood risk reduction than was identified at the time. The best available data at the conclusion of the feasibility study confirmed that the diversion channel concept was the only concept that could achieve the planning objective to provide a high level of flood risk reduction in the study area.

3.6.7 Downstream impacts

Downstream impacts, as described in section 5.2.1.4, were only analyzed for the MN35k and the ND35k alternatives. All of the proposed diversions would have similar performance up to their design capacity; for any given flood, each channel would divert the same amount of water up to its full capacity. All of the diversions would convey similar flows for more frequent events, and differences in downstream impact would primarily occur in the larger less frequent events. Economic damages due to downstream impacts would not vary significantly with the size of channel, because the infrequent events would add relatively little to the annualized damages. Since downstream impacts would be relatively similar for all of the alternatives, downstream impacts would not affect the identification of the NED plan, and it was not necessary to quantify the impacts from the smaller plans.

3.7 COMPARISON OF ALTERNATIVES

Comparison of alternatives is the fifth step in the planning process, which is based on the evaluation of the impacts of the alternatives, the fourth step in the planning process. The more detailed evaluations of the impacts of the alternatives are presented in Chapter 5, Environmental Consequences.

3.7.1 Comparison of Plan Features

Features of the alternative plans are displayed in a comparative format on Table 10. The costs of these features are included on Table 11, also in a comparative format.

Table 10 – Comparison of Alternative Plan Features

CHANNEL ALIGNMENT PARAMETERS	Minnesota Short Alignment				ND East Alignment
	20K	25K	30K	35K	35K
Top Width (feet)					
Red River to Wild Rice	1880	2020	2000	2150	2450
Wild Rice to Sheyenne					2320
Sheyenne to Outfall					2300
Bottom Width (feet)					
Red River to Wild Rice	175	240	300	360	300
Wild Rice to Sheyenne					100
Sheyenne to Outfall					125
Depth (max. excavation feet)	30	30	30	30	29
Excavation quantities (million yd^3)	36	42	49	55	67
Low flow channel required: Depth 3 ft Bottom Width 10 ft	√	√	√	√	√
Length of Alignment (miles)	25	25	25	25	36
Channel extension needed	3.7	3.7	3.7	3.7	
Length of tie back levee (miles)	9.9	9.9	9.9	9.9	3.3
Height of Levee (feet)	8	8	8	8	8
Hydraulic Structures					
Drop Structures	1	1	1	1	3
River Crossings	0	0	0	0	5
Highway Bridges	20	20	20	20	18
Rail Road Bridges	4	4	4	4	4
Number of Houses Impacted	5	5	5	5	6
Number of Acres Impacted	4,485	5,455	5,965	6,415	6,560
Acres of Wetlands Impacted - worst case					
Directly	13				33
Indirectly (due to lowering of groundwater)	85				193
Stage @ Fargo Gage					
0.2 % Event (500yr) (ft)	43.7	42.4	41.9	39.6	40
1% Event (100yr) (ft)	36.9	34.8	33.6	31.9	30.6
Max. Downstream Stage Increase (inches) 1% Event	TBD			9.4	10.4
Land removed from 1% floodplain ($miles^2$)	30				80

Table 11 – Comparison of Alternative Plan Costs including Recreation (December 2009Unit Pricing)

		Minnesota Short Alignment				ND East Alignment
Account	Item	20K	25K	30K	35K	35K
01	Lands & Damages	36,954	41,108	45,195	49,282	60,593
02	Relocations	76,534	84,396	92,911	94,050	82,251
06	Fish and Wildlife Facilities	50,920	50,920	50,920	50,920	82,960
08	Roads, Relocations and Bridges	147,708	148,271	148,834	149,397	54,971
09	Channels & Canals	380,177	429,732	466,924	524,576	741,990
11	Levees, Floodwalls, & Floodproofing	16,101	14,922	14,922	14,922	2,386
14	Recreation Facilities	28,067	28,067	28,067	28,067	28,486
30	Planning, Engineering and Design	104,926	113,446	120,387	129,290	148,957
31	Construction Management	48,965	52,942	56,181	60,335	69,514
	Total First Costs	**$890,352**	**$963,804**	**$1,024,341**	**$1,100,839**	**$1,272,108**
	Annual OMRR&R Diversion Cost	$1,883	$2,057	$2,217	$2,375	$3,318
	Annual OMRR&R Recreation Cost	$47	$47	$47	$47	$47
	Toal Annual OMRR&R	$1,930	$2,104	$2,264	$2,422	$3,069
	All costs in thousands ($1,000)					

3.7.2 System of Accounts

3.7.2.1 Methodology

The Economic and Environmental Principles for Water and Related Land Resources Implementation Studies, established by the Water Resources Council in 1983, created four accounts to facilitate evaluation and effects of alternative plans:

- The national economic development (NED) account displays changes in the economic value of the national output of goods and services
- The environmental quality (EQ) account displays non-monetary effects on significant natural and cultural resources
- The Regional economic development account registers changes in the distribution of regional economic activity that result from each alternative plan.
- The other social effects (OSE) account registers plan effects from perspectives that are relevant to the planning process, but are not reflected in the other three accounts.

3.7.2.2 National Economic Development (NED)

The intent of comparing alternative flood risk management plans in terms of national economic development is to identify the beneficial and adverse effects that the plans may have on the national economy. Beneficial effects are considered to be increases in the economic value of the national output of goods and services attributable to a plan. Increases in NED are expressed as the plan's economic benefits, and the adverse NED effects are the investment opportunities lost by committing funds to the implementation of a plan. Comparison of the plans under consideration using the NED account is shown on Table 9 and Table 12. The values for net benefits shown on the tables are the differences between the average annual economic benefits and the average annual cost associated with each plan. Table 9 indicates the current annual net benefits of the MN40k plan are the greatest and the MN40k plan is therefore the NED plan. However, as explained in section 3.6.5, it was not necessary to fully describe the NED plan once it was demonstrated that the LPP was a smaller capacity plan, and the NED plan was dropped from further consideration. The MN35k plan was kept for comparison to the LPP for cost-sharing purposes.

The no action alternative has zero net benefits and results in average annual damages in excess of $195.9 million.

Table 12 - National Economic Development (NED) Account (all dollar values in thousands)

	Minnesota Short				North Dakota
	20K	25K	30K	35K	East 35K
Total Diversion First Cost	$856,110	$929,562	$990,099	$1,066,597	$1,237,355
Interest During Construction and Discounting	$176,066	$191,183	$203,634	$219,368	$224,549
Present worth of Investment	$1,032,176	$1,120,745	$1,193,733	$1,285,965	$1,461,904
Annualized Investment Cost	$51,172	$55,563	$59,182	$63,754	$72,477
Annual OMRR&R Cost	$1,883	$2,057	$2,217	$2,375	$3,318
Average Annual Diversion Charges	$53,055	$57,620	$61,399	$66,129	$75,795
Total Recreation First Cost	$34,242	$34,242	$34,242	$34,242	$34,753
Interest During Construction and Discounting	$2,280	$2,280	$2,280	$2,280	$760
Present worth of Investment	$36,522	$36,522	$36,522	$36,522	$35,513
Annual Recreation First Cost	$1,811	$1,811	$1,811	$1,811	$1,761
Annual Recreation OMRR&R Cost	$47	$47	$47	$47	$47
Average Annual Recreation Charges	$1,858	$1,858	$1,858	$1,858	$1,808
Flood Damage Reduction Benefit	$132,629	$148,756	$155,438	$163,372	$160,197
Flood Proofing Cost Savings	$5,960	$6,240	$6,240	$6,240	$9,993
Flood Insurance Adminstrative Cost Saving	$1,000	$1,000	$1,000	$1,000	$958
Incremental Non-Structural Flood Risk Benefit	$430	$414	$414	$414	
Avg. Annual Diversion Benefit	$140,019	$156,410	$163,092	$171,026	$171,148
Avg. Annual Recreation Benefit	$5,355	$5,355	$5,355	$5,355	$5,130
Annual Net Diversion Benefit	**$86,964**	**$98,790**	**$101,693**	**$104,897**	**$95,353**
Annual Net Recreation Benefit	$3,497	$3,497	$3,497	$3,497	$3,322
Total Annual Net Benefit	$90,461	$102,287	$105,190	$108,394	$98,675
Diversion Benefit-Cost Ratio	**2.64**	**2.71**	**2.66**	**2.59**	**2.26**
Recreation Benefit-Cost Ratio	2.88	2.88	2.88	2.88	2.84
Benefit-Cost Ratio	**2.65**	**2.72**	**2.66**	**2.59**	**2.27**

1. Costs and Benefits are given in $1,000's
2. Assumes a 50 year period of analysis - 4 3/8% interest rate.
3. Assumes a 7.5 year period of construction for MN diversions and 8.5 years for ND diversions
4. No credit is given to flood fight reliability

3.7.2.3 Environmental Quality (EQ)

The environmental quality account is another means of evaluating the alternatives to assist in making a plan recommendation. The EQ account is intended to display the long-term effects that the alternative plans may have on significant environmental resources. Significant environmental resources are defined by the Water Resources Council as those components of the ecological, cultural and aesthetic environments which, if affected by the alternative plans, could have a material bearing on the decision-making process. Significance is derived from institutional, public, or technical recognition that a resource or an effect is significant. A comparison of the effects that the proposed plans may have on the EQ resources is shown in Table 13.

Table 13 – Environmental Quality (EQ) Account

Resources	No Action	MN Diversion 20K	MN Diversion 25K	MN Diversion 30K	MN Diversion 35K	ND Diversion 35K
Flooding	Expected Annual Flood Damage of $195.9 million	Expected Annual Flood Damage reduced by $140.0 million	Expected Annual Flood Damage reduced by $156.4 million	Expected Annual Flood Damage reduced by $163.1 million	Expected Annual Flood Damage reduced by $171.0 million	Expected Annual Flood Damage reduced by $171.1 million
Air Quality	No Effect	Minor degradation from extensive and lengthy construction period	Minor degradation from extensive and lengthy construction period	Minor degradation from extensive and lengthy construction period	Minor degradation from extensive and lengthy construction period	Minor degradation from extensive and lengthy construction period
Water Quality	No Effect	Temporary minor adverse impacts on surface w ater quality during construction.	Temporary minor adverse impacts on surface w ater quality during construction.	Temporary minor adverse impacts on surface w ater quality during construction.	Temporary minor adverse impacts on surface w ater quality during construction.	Temporary minor adverse impacts on surface w ater quality during construction.
Erosion and Sedimentation	Continued Erosion during flooding	Less Erosion and Sedimentation During Flooding, possible geomorphologic issues on Red River.	Less Erosion and Sedimentation During Flooding, possible geomorphologic issues on Red River.	Less Erosion and Sedimentation During Flooding, possible geomorphologic issues on Red River.	Less Erosion and Sedimentation During Flooding, possible geomorphologic issues on Red River.	Less Erosion and Sedimentation During Flooding, possible geomorphologic issues on Red River and tributaries.
Water Quantity	No Effect	Dow nstream stage increase expected to be less than the MN35k diversion	Dow nstream stage increase expected to be less than the MN35k diversion	Dow nstream stage increase expected to be less than the MN35k diversion	Dow nstream stage increase 4.6-9.4 inches 1 percent event	Dow nstream stage increase 5.3-10.4 inches 1 percent event
Ground Water	No Effect	Slightly low ered w ater table near diversion channel	Slightly low ered w ater table near diversion channel	Slightly low ered w ater table near diversion channel	Slightly low ered w ater table near diversion channel	Slightly low ered w ater table near diversion channel
Aquifers	No Effect	Small potential to influence aquifers	Small potential to influence aquifers	Small potential to influence aquifers	Small potential to influence aquifers	Small potential to influence aquifers
Aquatic Habitat	Improved due to ongoing efforts to improve fish passage	Loss of 10 acres of habitat w ith large closure structure at Red River. Less than significant impacts to aquatic species migrational corridors	Loss of 10 acres of habitat w ith large closure structure at Red River. Less than significant impacts to aquatic species migrational corridors	Loss of 10 acres of habitat w ith large closure structure at Red River. Less than significant impacts to aquatic species migrational corridors	Loss of 10 acres of habitat w ith large closure structure at Red River. Less than significant impacts to aquatic species migrational corridors	Loss of habitat of approximately 37 acres w ith large structures at 6 rivers. Less than significant impacts to aquatic species migrational corridors

Resources	No Action	MN Diversion 20K	MN Diversion 25K	MN Diversion 30K	MN Diversion 35K	ND Diversion 35K
Riparian Habitat	No Effect	Increase in habitat value for approximately 1,200 acres in the form of grass swale near the bottom of the diversion. Loss of 74.5 acres at river connections	Increase in habitat value for approximately 1,600 acres in the form of grass swale near the bottom of the diversion. Loss of 74.5 acres at river connections	Increase in habitat value for approximately 1,800 acres in the form of grass swale near the bottom of the diversion. Loss of 74.5 acres at river connections	Increase in habitat value for approximately 2,000 acres in the form of grass swale near the bottom of the diversion. Loss of 74.5 acres at river connections	Increase in habitat value for approximately 1,000 acres in the form of grass swale near the bottom of the diversion. Loss of 137.75 acres at river connections
Wetlands	No Effect	Direct impact to 17 acres of wetlands by construction of project, Indirect impact to 85 acres from lowering of groundwater elevation	Direct impact to 17 acres of wetlands by construction of project, Indirect impact to 85 acres from lowering of groundwater elevation	Direct impact to 17 acres of wetlands by construction of project, Indirect impact to 85 acres from lowering of groundwater elevation	Direct impact to 17 acres of wetlands by construction of project, Indirect impact to 85 acres from lowering of groundwater elevation	Direct impact to 32.5 acres of wetlands by construction of project, Indirect impact to 192 acres from lowering of groundwater elevation
Upland Habitat	No Effect	Potential for increased habitat benefit	Potential for increased habitat benefit	Potential for increased habitat benefit	Potential for increased habitat benefit	Potential for increased habitat benefit
T and E species	No Effect	No Effect	No Effect	No Effect	No Effect	No Effect
Floodplains (E.O. 11988)	112 sq miles in floodplain during .01 year event out of 261 sq miles in project area	Not analyzed for the environmental quality account	81.7 sq miles remain in floodplain, 30.5 sq miles taken out during a 1-percent chance event	Not analyzed for the environmental quality account	80.9 sq miles remain in floodplain, 31.3 sq miles taken out during a 1-percent chance event	30.7 sq miles remain in floodplain. 81.3 sq miles taken out of floodplain during 1-percent chance event
Cultural Resources	No Effect	Potential for impacts along diversion channel. Higher potential for impacts along the river banks	Potential for impacts along diversion channel. Higher potential for impacts along the river banks	Potential for impacts along diversion channel. Higher potential for impacts along the river banks	Potential for impacts along diversion channel. Higher potential for impacts along the river banks	Potential for impacts along diversion channel. Higher potential for impacts along the river banks
Prime and Unique Farmland	No Effect	Not analyzed	Approximately 5500 acres of prime and unique farmland will be removed	Not analyzed	Approximately 5700 acres of prime and unique farmland will be removed	Approximately 5400 acres of prime and unique farmland will be removed
Economic Resources	Continued potential for property damage and business losses due to damaging flood events.	Significant reduction in property damage and lost business.	Significant reduction in property damage and lost business.	Significant reduction in property damage and lost business.	Significant reduction in property damage and lost business.	Significant reduction in property damage and lost business.

3.7.2.4 Regional Economic Development (RED)
The regional economic development account is intended to illustrate the effects that the alternatives would have on regional economic activity, specifically, regional income and regional employment. The comparison of possible effects that the plans may have on these resources is shown in Table 14. The completed RED analysis is included in Appendix C, Economics. The RED analysis only analyzed the MN20K, MN35K, and ND35K plans. These plans were selected based on the likelihood of one of those plans ultimately being selected as the recommended plan. This analysis was completed based on the information contained in Table 7 and was not updated to reflect the final analysis. The RED analysis shows that the regional changes in economic output for the MN20K, MN35K, and ND35K range between $323 and $332 million annually.

Table 14 – Regional Economic Development (RED) Account

	Without Project Conditions	North Dakota East 35k cfs	Minnesota Short 35k cfs	Minnesota Short 20k cfs
Changes in Economic Output*		$332,455	$329,715	$323,755
Annual Net Change in Employment	(1,665)	895	815	677
Changes in Tax Revenues*	$(5,900) - (18,600)	$12,109	$11,968	$10,922
Average Annual Benefits*		$67,355	$63,795	$54,390
Annual Regional Flood Damages*	$61,676	$8,007	$11,042	$18,666
Changes in Annual Tax Revenue *	$(7,781)	$4,327	$3,917	$3,140
Annual Loss of Business Income*	$65,000			
Gross Regional Product Annual Growth Rate^	1.29 - 2.18	3.09 - 4.11	3.09 - 4.11	3.09 - 4.11

* $1,000 ^ %

3.7.2.5 Other Social Effects (OSE)
The other social effects (OSE) account typically includes long-term community impacts in the areas of public facilities and services, public safety, recreational opportunities, transportation and traffic and man-made and natural resources.

A loss of life analysis was completed for the future without project condition. (See Appendix D, Other Social Effects). The analysis showed that a failure of emergency levees during large flood events could cause considerable loss of life. Assuming that the floodplains were 98% evacuated prior to an anticipated levee breach or overtopping, four deaths could be expected during a 1-percent chance event; the toll increases to 12 deaths for a 0.2-percent chance event. History has shown that residents in the study area do not evacuate, preferring to stay and maintain the emergency flood barriers. Assuming that the floodplains were not evacuated and an unanticipated failure of emergency levees occurred, expected deaths were estimated at 200 and 594 for the 1-percent chance and 0.2-percent chance floods, respectively. With a diversion project in place, the potential for loss of life is expected to be significantly lower. An engineered permanent project would be far less likely to fail and would significantly reduce the frequency, duration and magnitude of flood events in the developed areas.

A comparison of the effects that the proposed alternatives would have on OSE resources is shown on Table 15. The diversion alternatives considered all provide a high level of flood risk management, which results in the OSE impacts being similar for all of the diversion alternatives, with the larger diversions performing better than the smaller diversions.

Table 15 – Other Social Effects (OSE) Account

		Minnesota Short Alignment				ND East Alignment
	No Action	20K	25K	30K	35K	35K
Public Health and Safety	Emergency floodfight activities w ould still be required, posing high risk of injury and death.	Project w ould improve public safety by reducing flood risk and the need for emergency actions.	Project w ould improve public safety greater than the smaller plans by reducing flood risk and the need for emergency actions.	Project w ould improve public safety greater than the smaller plans by reducing flood risk and the need for emergency actions.	Project w ould improve public safety greater than the smaller plans by reducing flood risk and the need for emergency actions.	Project w ould improve public safety greater than the smaller plans by reducing flood risk and the need for emergency actions.
Public Facilities and Services	Public facilities and services w ould continue to be impacted from floods.	Project w ould reduce impacts to public facilities and services.	Project w ould reduce impacts to public facilities and services greater than the smaller plans.	Project w ould reduce impacts to public facilities and services greater than the smaller plans.	Project w ould reduce impacts to public facilities and services greater than the smaller plans.	Project w ould reduce impacts to public facilities and services greater than the smaller plans.
Recreation and Public Access	Recreation w ould continue to be part of the community as currently plan.	Recreational features w ould be added to the project to enhance existing services.	Recreational features w ould be added to the project to enhance existing services.	Recreational features w ould be added to the project to enhance existing services.	Recreational features w ould be added to the project to enhance existing services.	Recreational features w ould be added to the project to enhance existing services.
Traffic and Transportation	Traffic and transportation w ould continue to be largely disrupted during flood events.	Some local traffic patterns w ill change as part of the project, overall traffic and transportation w ill see large benefits.	Some local traffic patterns w ill change as part of the project, overall traffic and transportation w ill see large benefits.	Some local traffic patterns w ill change as part of the project, overall traffic and transportation w ill see large benefits.	Some local traffic patterns w ill change as part of the project, overall traffic and transportation w ill see large benefits.	Some local traffic patterns w ill change as part of the project, overall traffic and transportation w ill see large benefits.

3.7.3 Formulation Criteria

The final array of alternative plans is compared using four formulation criteria established by the United States Water Resources Council in the Economic and Environmental Principles and

Guidelines for Water and Related Land Resources Implementation Studies (P&G). These criteria are completeness, effectiveness, efficiency and acceptability.

3.7.3.1 Completeness

The P&G defines completeness as the extent to which a given alternative plan provides and accounts for all necessary investments or other actions to ensure the realization of the planned effects. A complete plan includes all elements necessary to function independently to achieve the planning objectives. It is an indication of the degree to which the outputs of the plan are dependent upon the actions of others or on factors beyond the control of the planners.

The no action alternative requires extensive emergency construction to prevent flood damage for all floods larger than a 10-percent chance event.

All of the diversion channel alternatives have a high likelihood of significantly reducing flood damage and flood risk, but none of the plans will eliminate flood risk. Any of the Minnesota or North Dakota 30k and 35k alternatives would substantially reduce the need for emergency floodfighting up to the 1-percent chance event on the Red River. For larger and less frequent events, diversion plans allow for additional in-town flood barriers (either permanent or temporary) to be constructed. The combination of the diversion channel and emergency flood fighting for those extremely rare events provides a very high level of risk reduction to the communities of Fargo and Moorhead. Diversions smaller than the 30k alternatives would need more extensive additional flood barriers in town more frequently than the larger diversions would.

The North Dakota diversions are more complete solutions to the regional flood problem, because they would reduce the risk of flooding from the major tributaries in the North Dakota portion of the study area that are not addressed by the Minnesota diversions.

The diversion channel alternatives require relatively minimal operations. Operations are necessary at the control structure on the Red River for the Minnesota plan. The North Dakota plan will require operations at the Red River control structure, Wild Rice control structure, and the Maple River tributary structure. The operations and maintenance of these structures and all project features will be dictated in the Operations and Maintenance manual that will be provided to the non-federal sponsors upon transfer of the project.

The non-federal sponsors will be responsible for the long-term maintenance of the project along with the eventual repair, rehabilitation, and replacement of project features. Maintenance would include but not be limited to mowing and vegetation management, repair of erosion, debris removal, and routine maintenance of mechanical equipment. Failure to maintain the project over the long-term could impact the completeness of the plan. It is unlikely that the non-federal sponsors would neglect the long-term maintenance requirements for any of the plans considered in the final array of alternatives.

The diversion plans are complete plans that, once constructed, would include all features necessary to produce the estimated economic benefits described in this report.

3.7.3.2 Effectiveness

The P&G defines effectiveness as a measure of the extent to which a plan achieves its objectives. All of the plans in the final array partially achieve the planning objectives.

All of the alternatives considered in the final array of alternatives meet the criteria of effectiveness to varying degrees, see Table 16. The objectives of this study as described in Section 2.5 of this report and repeated here were to:

- Reduce flood risk and flood damages in the Fargo-Moorhead metropolitan area.
- Restore or improve degraded riverine and riparian habitat in and along the Red River of the North, Wild Rice River (North Dakota), Sheyenne River (North Dakota), and Buffalo River (Minnesota) in conjunction with other project features.
- Provide additional wetland habitat in conjunction with other project features.
- Provide recreational opportunities in conjunction with other project features.

Table 16 – Effectiveness in meeting planning objectives.

	Minnesota Short Alignment				ND East Alignment
	20K	25K	30K	35K	35K
Reduce Flood Risk	Reduces flood damages by 71%.	Reduces flood damages by 80%.	Reduces flood damages by 83%.	Reduces flood damages by 87%.	Reduces flood damages by 87%.
Residual Damages*	$55,881	$39,490	$32,808	$24,874	$24,752
River system afforded flood risk benefits	Red and Wild Rice Rivers	Red and Wild Rice Rivers	Red and Wild Rice Rivers	Red and Wild Rice Rivers	Red, Wild Rice, Sheyenne, Maple, Rush and Lower Rush Rivers
Restore/ Improve Riverine and Riparian Habitat	No specific improvement to the Riverine or Riparian habitat	No specific improvement to the Riverine or Riparian habitat	No specific improvement to the Riverine or Riparian habitat	No specific improvement to the Riverine or Riparian habitat	No specific improvement to the Riverine or Riparian habitat
Provide additional Wetland Habitat	Provides additional 530 acres of wetlands in the project area.	Provides additional 725 acres of wetlands in the project area.	Provides additional 910 acres of wetlands in the project area.	Provides additional 1090 acres of wetlands in the project area.	Provides additional 593 acres of wetlands in the project area.
Provide Recreational Opportunities.	Provides multiple recreational features including multi-purpose trails.	Provides multiple recreational features including multi-purpose trails.	Provides multiple recreational features including multi-purpose trails.	Provides multiple recreational features including multi-purpose trails.	Provides multiple recreational features including multi-purpose trails.
* In thousands					

3.7.3.3 Efficiency

As defined in the P&G, efficiency is a measure of the cost-effectiveness of an alternative. Cost-effectiveness considers not only economic costs, but also other intangible costs such as environmental impacts and opportunity costs. All of the diversion alternatives have net benefits greater than 1 and are considered to be efficient. A breakdown of the net benefits and residual damages associated with each of the diversion alternatives is provided in Table 17. The larger diversions also result in a lower frequency of emergency flood fights, lower risk to lives and property, and considerably better effectiveness during extreme flood events.

Table 17 – Efficiency of plans – Net Benefits (all dollar values are in thousands)

		Minnesota Short Alignment				ND East Alignment
	NO Action	20K	25K	30K	35K	35K
Net Benefits of Plan (NED)	$0	$86,964	$98,790	$101,693	$104,897	$95,353
Residual Damages	$195,900	$55,881	$39,490	$32,808	$24,874	$24,752

3.7.3.4 Acceptability

Acceptability is defined in the P&G as the workability and viability of the alternative plan with respect to acceptance by State and local entities and the public and compatibility with existing laws, regulations, and public policies. All of the plans in the final array are in accordance with Federal law and policy. All of the alternatives are considered acceptable for implementation, however there are slight differences in the level of acceptability. This information is summarized in the sections below.

3.7.3.4.1 Alignment

There is a strong desire from the non-federal sponsors and the public to have the diversion plan constructed in North Dakota. The North Dakota alignment would be considered highly acceptable to the non-federal sponsors. The Minnesota alignments are also acceptable, as the non-federal sponsors and the public have indicated that doing nothing is not an option; however they generally prefer the North Dakota alignment and officially requested the ND35k plan as a locally preferred plan.

3.7.3.4.2 Downstream Effects

Note for the May 2010 Draft Report: Additional analysis will be completed on the downstream impacts. The information presented in this draft report was presented at public meetings in February 2010. Updated downstream impact information will be fully quantified in the final feasibility report and environmental impact statement.

The diversion plans would all have potential downstream effects, and public concerns have been raised regarding those effects. All of the diversions in the final array could cause increased flood stages downstream of the project. Analysis was conducted only for the MN35k and ND35k alternatives to determine the maximum extent of downstream impacts. The assumption was that the smaller diversions would have smaller downstream impacts for events at which their capacity was exceeded.

Downstream of the MN35k plan, the increase to the peak stage during a 1-percent chance event, with no emergency protection in place, is estimated to be 6.8 inches or less, depending upon location. The 1-percent chance event peak would arrive and recede about one day earlier than under existing conditions. The increase to the peak stage during a 10-percent chance event, with no emergency protection in place, is estimated to be 4.3 inches or less, depending upon location. The timing of the 10-percent chance event peak would be nearly unchanged.

Downstream of the ND35k plan, the increase to the peak stage during a 1-percent chance event, with no emergency protection in place, is estimated to be 7.9 inches or less, depending upon location. The 1-percent chance event peak would arrive and recede about 1.5 days earlier than under existing conditions. The increase to the peak stage during a 10-percent chance flood event, with no emergency protection in place, is estimated to be 24.7 inches or less, depending upon location. The 10-percent chance event peak would arrive and recede up to about one day earlier than under existing conditions immediately downstream of the diversion, but the timing at Halstad would be nearly unchanged.

The North Dakota alignment has greater downstream effects than the Minnesota alignments and would therefore be less acceptable to downstream interests.

3.7.3.4.3 Tolerable level of risk

The non-federal sponsors indicated in November 2009 that a flood stage of approximately 36.0 on the Fargo gage for a 0.2-percent chance event would be tolerable. The non-federal sponsors indicated that this level is tolerable because they are confident that they would be successful with flood fighting efforts up to the stage of 36.0. Lesser stage reductions would be undesirable. Larger plans reduce flood risk to a greater degree and are, therefore, more acceptable than smaller plans from the perspective of tolerable level of risk. The analysis completed in May 2010 shows that a diversion capacity of 45,000 cfs would be required to achieve the desired stage reduction for both the Minnesota and North Dakota alignments. The 45,000 cfs alignments in both Minnesota and North Dakota would result in a 0.2-percent chance stage of 35.3. The 35,000 cfs alternatives result in a 0.2 percent chance stage of 40.0. The non-federal sponsors indicated that such a stage reduction would be acceptable.

3.7.3.4.4 Natural Resource Impacts

Impacts to the natural resources are a concern to the public and many organizations. The North Dakota alternatives generally have more natural resource impacts than the Minnesota alternatives because they cross five tributary streams. However, the two alignments provide flood benefits to different geographic areas. See Section 5, Environmental Consequences, of this report for more detail.

3.7.3.4.5 Floodplain Impacts

Executive Order 11988 requires federal agencies to avoid direct or indirect support of floodplain development wherever there is a practicable alternative. This study has shown that a diversion channel in either Minnesota or North Dakota is the only feasible concept that will sufficiently reduce flood risk along the Red River in Fargo and Moorhead. Therefore, there is not a practicable alternative located outside the floodplain, and locating the project in the floodplain is necessary to achieve the project purpose. The primary planning objective was to reduce flood risk in the entire metropolitan area, including areas adjacent to the Wild Rice, Sheyenne, Maple, Rush and Lower Rush rivers. The North Dakota alignment significantly reduces flood frequency on approximately 80 square miles currently located in the 1-percent chance event floodplain. The North Dakota alignment reduces flood risk from all of the rivers in the North Dakota portion of the study area. The Minnesota alignment significantly reduces flood frequency on approximately 30 square miles currently located in the 1-percent chance event floodplain, but it does not address the North Dakota tributaries to the Red River. Because of the different impacts on existing floodplain, the Minnesota plans are more acceptable than the North Dakota plans to people and agencies concerned with expanding floodplain development and protection of existing floodplain function. However, as detailed in the Economics Appendix (Appendix C), the Fargo-Moorhead metropolitan area is expected to grow at a rate of 266 acres per year, regardless of whether a flood risk management project is constructed. Any floodplain impacts created by either of the possible alternatives will be minimized as much as possible. All of the proposed diversion plans are in compliance with Executive Order 11988 and are acceptable from that perspective.

3.7.4 Trade-off Analysis

The first trade-off to be considered in evaluating the final alternative plans is to distinguish between the No Action Alternative and the other action alternatives. This is followed by the trade-off between the action alternatives.

3.7.4.1 Action versus No Action

The no action alternative does not meet any of the planning objectives. It has no positive benefits or impacts, since it is the basis from which the impacts and benefits are measured. The no action alternative leaves the study area at significant and unacceptable risk from flooding. Federal involvement in future flood-fighting can be expected in the absence of a federal flood risk management project. This feasibility study has shown from a variety of perspectives that there is a federal and non-federal interest in taking action to reduce the flood risk in the study area.

3.7.4.2 Trade-Offs between Action Alternatives

The second level of trade-offs to consider is those between the action alternatives. Of the action alternatives considered, there are two key elements that result in trade-offs: the size of the alternative selected and the location of the alternative.

In comparing the size of the diversion channels it is apparent that the largest plans (35,000 cfs) meet the four criteria in the P&G better than any of the smaller plans. In each of the four accounts (completeness, effectiveness, efficiency and acceptability) the 35,000 cfs plans outperform the smaller plans. Based on the comparison of the four criteria the larger alternatives should be selected over the smaller alternatives.

In comparing the location of the diversion channels, the tradeoffs are not clear cut. The North Dakota plans meet the completeness, effectiveness, and local acceptability criteria better than the Minnesota plans. The Minnesota plans meet the criteria of efficiency better than the North Dakota plans. The Minnesota plans are more acceptable regarding the natural resources and downstream impacts.

Both size and location affect the cost of the alternatives. The North Dakota alternatives are more expensive than their comparably-sized Minnesota alternatives. The larger capacity channels cost more than smaller channels regardless of location. Thus, there is a trade-off between cost and both effectiveness and acceptability. Higher cost improves effectiveness, but at some point cost becomes unacceptable. Determination of the NED plan is tied directly to costs and economic benefits, but the determination of a locally preferred plan may take other tradeoffs into consideration. Tradeoffs related to cost are primarily non-federal political considerations that cannot be resolved with a technical analysis.

3.8 PLAN SELECTION

The following designations are made in the selection process:

3.8.1 NED Plan

The Corps of Engineers Planning Guidance Notebook, ER 1105-2-100 states "A plan that reasonably maximizes net national economic development benefits, consistent with the Federal objective, is to be formulated. This plan is to be identified as the NED plan." Based on the current economic analysis and information contained in Table 9, the MN40k plan is the plan that reasonably maximizes the net national economic development benefits and is therefore the NED plan.

3.8.2 Locally Preferred Plan (LPP) and Tentatively Selected Plan

The ND35K Plan is the plan that, in the opinion of the non-federal sponsors, best meets the needs of the local community. As described in section 3.5.10, the Cities of Fargo and Moorhead, Cass County, North Dakota and Clay County Minnesota jointly requested that the ND35k plan be pursued as a locally preferred plan (LPP) on March 29, 2010. The request to designate the LPP as the tentatively selected plan was approved by the Assistant Secretary of the Army for Civil Works [ASA(CW)] on April 28, 2010. The approval letter can be found in Appendix O, Plan Formulation. The request to approve the LPP as the tentatively selected plan was based on the following considerations:

1. The non-federal sponsors requested in writing that a LPP be pursued, and approval was obtained from the ASA(CW) to tentatively recommend the LPP.
2. The plan has net flood risk management benefits of $95,400,000 annually.
3. The plan provides average annual benefits of $171,100,000 annually.
4. The plan provides additional benefits from multiple river systems including the Red, Wild Rice, Sheyenne, Maple, Lower Rush, and Rush Rivers.
5. The plan provides benefits to a larger area and protects a larger number of people than the NED plan.
6. It significantly reduces the expected loss of life from flooding and provides the communities with the ability to react in times of emergencies.
7. It is a more robust solution than smaller plans considering the potential for future flood flows and frequencies to be larger than reflected in the historic record.
8. It significantly reduces the risk of catastrophic damage for very large events.
9. The non-federal sponsors are prepared to pay the additional costs associated with the LPP.

3.8.3 Federally Comparable Plan (FCP)

The LPP is a smaller capacity plan than the NED plan. Therefore, as described in section 3.6.5, it was necessary to develop a plan smaller than the NED plan that could be compared to the LPP for cost-sharing purposes. Table 9 and Table 17 show that the MN35k plan would provide similar total average annual benefits and residual damages compared to the LPP. Therefore, the federal investment in the LPP should be capped at the investment that would have been made for the comparable MN35k plan. The MN35k plan is fully developed and described below for comparison with the LPP.

3.9 RISK AND UNCERTAINTY

Areas of risk and uncertainty are analyzed and described so that decisions can be made with knowledge of the degree of reliability of the estimated benefits and costs and of the effectiveness of alternative plans.

3.9.1 Climate Variability – Expert Opinion Elicitation

The hydrologic record of the Red River of the North shows a trend of increasing magnitude and frequency of flooding in recent decades. A panel of experts in hydrology and climate change was convened to elicit opinions on how to appropriately reflect this trend in the current analysis (see Appendix A, Hydrology). The panel concluded that the hydrologic record showed a "dry" period in the early decades of the twentieth century and a "wet" period in later years continuing to the present. The panel recommended using non-standard hydrologic methods, because it appears that the traditional analysis underestimates the expected frequency of flooding.

To account for the uncertainty in climate variability, revised flow frequency curves were developed in accordance with the expert panel's recommendations, and this analysis was used for the final screening ensure that the tentatively selected plan would be able to adequately perform in the future. This analysis used the revised flow frequency curves which changed the 1-percent chance event flow to be approximately 34,700 cfs at present; 32,900 cfs in 2035; and 31,300 cfs in 2060.

3.9.2 Cost and Schedule Risk Assessment

A cost and schedule risk assessment was completed on both the Minnesota and North Dakota alternatives. This assessment is in compliance with ECB No. 2007-17, dated September 2007 and was completed using the "Cost and Schedule Risk Analysis Guidance" dated May 17, 2009 and developed by the Directory of Expertise for Civil Works Cost Engineering (Walla Walla District). The Directory of Expertise completed the cost and schedule risk assessment with assistance from the study team and non-federal sponsors. The assessment resulted in the overall project contingencies for the Minnesota alternatives increasing from 25 percent to 34 percent and from 24 percent to 36 percent on the North Dakota alternatives. The contingencies developed from this assessment are included in the final costs. This assessment identified a number of areas where future study efforts should be focused to reduce uncertainties.

For the Minnesota alignments efforts need to be focused on:

1. Project Schedule
2. Time to plan (Feasibility)

3. Number of Construction Contracts
4. Uncertainty with Geotechnical Conditions
5. Variation in estimated quantities
6. Concerns with Dilworth railyard
7. Environmental Mitigation
8. Potential fluctuation in labor costs
9. Uncertainty with funding stream – Federal and Local

For the North Dakota Alignments efforts need to be focused on:

1. Project Schedule
2. Time to plan (Feasibility)
3. Unplanned work – additional project features
4. Natural Resources Issues
5. Number of Construction Contracts
6. Uncertainty with Geotechnical Conditions
7. Variation in estimated quantities
8. Environmental Mitigation
9. Control and Diversion of water during construction
10. Potential fluctuation in labor costs
11. Uncertainty with funding stream – Federal and Local

The items in the cost and schedule risk assessment that can be minimized in the future based on technical analysis only account for 4.8 percent of the total contingencies. The remaining 95.2 percent of risk items are outside of the technical analysis, and further analysis will not be able to reduce those costs any further. Uncertainty about the future funding stream accounts for more than 70-percent of the risk addressed in the contingency amounts.

3.9.3 Flood Fights and Emergency Levees

As described in the In Progress Review Memorandum for Record dated June 23, 2009, included in Appendix O - Plan Formulation, the economic analysis will not give credit to the emergency flood fighting efforts. However, it is acknowledged that the probability of success with an emergency flood fight is not zero but is very low. To account for this, a sensitivity analysis was completed on the tentatively selected plan to determine how successful flood fights could impact the project benefits. To accomplish this task, various increments of probable failure were assigned to the flood fight. This information was included in HEC-FDA and additional runs were performed. It was determined that a flood fight success rate of 70% or greater would be required to make the NED plan not feasible. A success rate of 30% would be required to make the tentatively selected plan not feasible. The results of this are based on the hydraulic model calibrated to the 2006 event and Phase 2 hydrology, as described in Appendix A, hydrology. The results are likely to change after incorporating the new hydrologic and hydraulic (H&H) models. Using new H&H results would likely make flood fight success less significant for feasibility. Additional refinements to this analysis based on the new models was not conducted.

3.10 DESCRIPTION OF THE MN35K PLAN (FEDERALLY COMPARABLE PLAN)

The MN35k plan is the federally comparable plan (FCP) to be compared to the locally preferred plan for purposes of cost sharing, as discussed in section 3.8.3.

3.10.1 Plan Components (including mitigation)

Overview and list of major components:

- Diversion channel and associated structures
- Non-structural features
- Environmental mitigation

3.10.1.1 Diversion channel and associated structures

The Minnesota 35k short diversion alignment starts just north of the confluence of the Red and Wild Rice Rivers and extends a total of 25 miles east and north around the Cities of Moorhead and Dilworth ultimately re-entering the Red River near the confluence of the Red and Sheyenne Rivers.

The plan includes a large control structure on the Red River which is an operable structure with three tainter gates 40 feet wide and 40 feet high. The gates would normally be fully open, and the structure would not impede flow more than a typical highway bridge up to about a 9,600 cfs flow event (approximately 20-percent chance event) when the structure would be put into operation. Once stages exceeded the 20-percent chance plus 1-foot flows would begin to go over the diversion inlet weir which has a total length of 1,114 feet. The weir has two levels where flows begin to pass into the diversion channel and would be constructed of sheetpile and rock.

The diversion channel has a maximum excavation depth of 30 feet with a bottom width of 360 feet. The diversion has 1V on 7H side slopes at most locations with steeper 1V on 5H slopes at the 20 highway and 4 railroad bridges. The diversion channel will require the excavation of approximately 55 million yards of material. Upon returning to the Red River the diversion channel would be protected with rock riprap.

Soil excavated to construct the channel would be piled adjacent to the channel to a maximum height of 15 feet. The soil disposal piles would be as wide as necessary to contain the excavated material. The spoil slopes are 1V on 7H and 1V on 10H for the diversion side and outside slopes respectively. Portions of the soil disposal piles would be constructed to serve as levees when the water surface in the channel is higher than the natural grade. The total footprint has maximum width of 2150 feet, and will affect 6,415 acres of land.

In addition to the diversion channel, the plan includes two smaller channels upstream of the Red River control structure to prevent stage increases upstream of the project along the Red and Wild Rice Rivers. A supplementary channel parallels the Red River upstream of the entrance to the diversion channel to allow for additional capacity to offset the breakouts to Drains 27 and 53. This secondary “Minnesota short extension channel” is approximately 3 miles long and has a 50 foot bottom width, with side slopes similar to the diversion channel. A second, shorter channel, the Wild Rice River breakout channel, was added near the intersection of I-29 and Cass Highway

16. This channel, which is less than one mile long and crosses under I-29, will convey water across I-29 that would have naturally broken out to Drain 27 and has a 50 foot bottom width, with side slopes similar to the diversion channel.

The Red River control structure was designed with consideration for fish passage during most conditions. The bottom of the structure would be constructed to simulate natural roughness. The openings would be sized to maintain passable flow velocities until the gates were put into operation. After the gates were closed, smaller openings through the structure would direct some water into a fish ramp system that would continue to allow fish passage during flood events up to about the 2-percent chance event.

The plan also includes a 9.9 mile tie-back levee at the southern limits of the project. The tie-back levee connects the Red River control structure to high ground and prevents flood water from flowing over land to the north and west into the protected area. The typical section for the tie-back levee has a top width of ten feet and side slopes of 1V on 4H. The tie-back levee would be constructed of impervious fill obtained from the channel excavation and covered with topsoil and turf.

A number of side ditch inlet drop structures would be included where the diversion crosses existing agricultural and highway drainage ditches. These structures would allow drainage to enter the channel and prevent water in the diversion channel from escaping to adjacent areas during high flow events.

3.10.1.2 Non-structural features

The non-structural mitigation measures recommended consist of buyouts, elevation, and construction of flood walls. This includes 7 buyouts, elevating the main floor on 22 structures, elevating the entire structure on 22 and construction of a flood wall around 1 critical facility, the public school in Harwood, North Dakota. The details of the proposed non-structural features are described in Appendix P – Non-Structural.

3.10.1.3 Environmental mitigation

Mitigation actions for footprint impacts were based on the concept of replacing the value of the habitat lost with an equal or greater value of restored or improved habitat value. For geomorphic impacts, the proposed mitigation would target to improve other habitat or geomorphic functions along the same length of stream for which an impact was identified. Lastly, for impacts related to connectivity and fish passage, best professional judgment was used to further implement measures that would reduce impacts to fish connectivity to levels that were less than significant. Section 5.5 of this report contains a detailed analysis of the mitigation measures.

3.11 DESCRIPTION OF THE TENTATIVELY SELECTED PLAN

The tentatively selected plan is the North Dakota 35k diversion alternative.

3.11.1 Plan Components (including mitigation)
Overview and list of major components:

- Diversion channel and associated structures
- Environmental mitigation
- Recreation features

3.11.1.1 Diversion channel and associated structures
The North Dakota east diversion alignment starts approximately four miles south of the confluence of the Red and Wild Rice Rivers and extends west and north around the Cities of Horace, Fargo, West Fargo, and Harwood ultimately re-enters the Red River north of the confluence of the Red and Sheyenne Rivers near the City of Georgetown, MN. Along the 36 mile path it crosses the Wile Rice, Sheyenne, Maple, Lower Rush, and Rush rivers and incorporates the existing Horace to West Fargo Sheyenne River diversion channel. The plan includes a large control structure on the Red River which is an operable structure with three tainter gates 40 feet wide and 30 feet high. The gates would normally be fully open, and the structure would not impede flow more than a typical highway bridge up to about a 20-percent chance event flow (flows of 9,600 cfs at the Fargo gage) when the structure would be put into operation. Once stages reached the 20-percent chance event plus 1-foot, flows would begin to go over the diversion inlet weir.

The proposed Wild Rice River control structure, similar to the Red River control structure would be an operable structure with two tainter gates 30 feet wide and 20 feet high. The gates would normally be fully open, and the structure would not impede flow more than a typical highway bridge up to about a 20-percent chance event flow (flows of 9,600 at the Fargo gage). At that flow, the gates would be lowered to direct some of the flow into the diversion channel. The lowest two feet of each gate bay would remain open even when the gates were closed to allow flow into the natural channel under all conditions. The Wild Rice River control structure would be conceptually the same as the Red River control structure illustrated in Figure 15, except that the Wild Rice Structure would have only two gates.

Hydraulic structures are necessary at the points where the diversion channel crosses the Sheyenne, Maple, Lower Rush, and Rush Rivers. The tributary crossing structure systems limit the amount of water that can pass over the diversion channel with the rest of the water being diverted into the diversion channel. This results in additional flood risk reduction benefits adjacent to the tributaries downstream of the intersection. The Rush and Lower Rush Rivers, which currently consist of constructed trapezoidal channels, would be allowed to flow into the diversion channel, resulting in abandonment of the downstream portion of these rivers. The structures at the junction of the Rush and Lower Rush Rivers and the diversion channel are also designed to allow fish passage from the diversion channel into the upstream tributary channels during most flow conditions.

The hydraulic structure systems proposed on the Sheyenne and Maple Rivers would allow a minimum of a 50-percent chance event flow to continue down the rivers while diverting excess water during flood events to the diversion channel. The Sheyenne and Maple River structures would maintain fish passage to those rivers most of the time, except possibly for events larger than the 1-percent chance event. The two crossing structure systems are similar in concept; each includes a drop structure to prevent headcutting on the tributary, a spillway and channel to control diversion of tributary flows, and a hydraulic structure to pass a limited flow over the diversion channel to maintain the desired flow in the tributary beyond the diversion channel. The primary difference between the Sheyenne system and the Maple system is the presence of gated openings on the Maple system's hydraulic structure. The gates are necessary because the structure is designed to allow flows in the diversion channel to overtop the Maple River crossing structure. The gates would operate to prevent excessive flows from passing into the Maple River during extreme flood events. Figure 17 through Figure 23 illustrate the conceptual structures on the Sheyenne and Maple Rivers.

The channel bottom width between the Red and Wild Rice Rivers is 300 feet. The channel bottom width is 100 feet between the Wild Rice and Sheyenne Rivers and 125 feet between the Sheyenne River and the downstream end of the diversion. Side slopes on the excavation are 1V on 10H up to a 10 foot high 50 foot wide bench then 1V on 7H to the top of the channel.

Soil excavated to construct the channel would be piled adjacent to the channel to a maximum height of 15 feet. The soil disposal piles would be as wide as necessary to contain the excavated material. The spoil slopes are 1V on 7H and 1V on 10H for the diversion side and outside slopes respectively. Portions of the soil disposal piles would be constructed to serve as levees when the water surface in the channel is higher than the natural grade. The total footprint of the plan has a maximum width of approximately 2450 feet including areas for spoil piles. The affected acreage is approximately 6,560 acres.

The tie-back levee associated with this alternative connects the Red River control structure to high ground approximately 2.5 miles to the east and prevents flood water from flowing over land to the north and east into the protected area. The typical section for the tie-back levee has a top width of ten feet and side slopes of 1V on 4H. The tie-back levee would be constructed of impervious fill obtained from the channel excavation and covered with topsoil and turf.

A number of side ditch inlet drop structures would be included where the diversion crosses existing agricultural and highway drainage ditches. These structures would allow drainage to enter the channel and prevent water in the diversion channel from escaping to adjacent areas during high flow events.

3.11.1.2 Non-structural features

There would be no non-structural measures included in the tentatively selected plan.

3.11.1.3 Environmental mitigation

Mitigation actions for footprint impacts were based on the concept of replacing the value of the habitat lost with an equal or greater value of restored or improved habitat value. For geomorphic impacts, the proposed mitigation would target to improve other habitat or geomorphic functions along the same length of stream for which an impact was identified. Lastly, for impacts related to connectivity and fish passage, best professional judgment was used to further implement measures that would reduce impacts to fish connectivity to levels that were less than significant. Section 5.5 of this report contains a detailed analysis of the mitigation measures.

3.11.1.4 Recreation features

Note for May 2010 Draft Report: The information presented here for recreation features is based on the plan for the Minnesota diversion alignment. A plan specific to the North Dakota alignment will be developed in the final report.

Recreational features include 48 miles of multipurpose trails for walking, running, bicycling, and cross country skiing. The plan includes 18 miles of trails for horseback riding and snowmobiling, 3 picnicking areas at trail heads, and 24 sites along the trails with benches, trash receptacles and interpretive signage wildlife viewing stations. As indicated in Table 12 the recreation features are economically justified with average annual net benefits of $5,355,000 and an incremental benefit/cost ratio of 2.88. Details are described in Appendix M, Recreation.

3.11.2 Design and Construction Considerations

Please refer to the individual engineering appendices for this discussion.

3.11.3 Real Estate Requirements

A preliminary Real Estate Plan was developed as part of this project and it can be found in Appendix G, Real Estate. The Real Estate plan identifies the plans under consideration. The types of interest that may be used as part of this project, and a cost breakout for the MN35k, and ND35k alternatives.

Note for the May 2010 Draft Report: Additional analysis will be completed on the downstream impacts. The information presented in this draft report was presented at public meetings in February 2010. Updated downstream impact information will be fully quantified in the final feasibility report and environmental impact statement.

3.11.4 Local Betterments

The non-federal sponsors have not indicated that any additional betterments are necessary at this time.

3.11.5 Operation, Maintenance, Repair, Rehabilitation and Replacement Considerations

The non-federal sponsors will be responsible for all operations, maintenance, repair, rehabilitation and replacement (OMRR&R) of project features. This will include annual maintenance of the diversion channel and associated structures including the Red River control structure, Wild Rice River control structure, Maple River gated river crossing structure, Sheyenne River crossing structure, drop structures, bridges, and recreation facilities. See Appendix L, Costs for a detailed breakout of the estimated OMRR&R costs for each of the alternatives. Overall cost can be found in Table 11 and Table 12. See Section 5 of this report for information on monitoring plans.

3.11.6 Economic Summary

The estimated first costs and OMRR&R costs have been developed using the Corps micro-computer aided cost estimating system (MCACES). The costs are allocated between the project purposes. These costs, along with total annual costs, annual benefits, net economic benefits and the benefits-to-cost ratios are shown on Table 18. These values are based on December 2009 price levels, an interest rate of 4.375 percent and a 50-year period of economic analysis.

Table 18 – Economic Analysis of the Tentatively Selected Plan

Estimate of Project First Costs ND 35K				
Account	**Item**	**Flood Risk Management**	**Recreation**	**Total**
01	Lands & Damages	60,593		60,593
02	Relocations	82,251		82,251
06	Fish and Wildlife Facilities	82,960		82,960
08	Roads, Railroads and Bridges	54,971		54,971
09	Channels & Canals	741,990		741,990
11	Levees and Floodwalls	2,386		2,386
14	Recreation Facilities		28,486	28,486
Subtotal		$ 1,025,151	$ 28,486	$ 1,053,637
30	Planning, Engineering and Design	144,684	4,273	148,957
31	Construction Management	67,520	1,994	69,514
Subtotal		$ 212,204	$ 6,267	$ 218,471
	Interest During Construction	224,549	760	225,309
	Total Investment Costs	**$ 1,461,904**	**$ 35,513**	**$ 1,497,417**
Estimate of Annual Costs				
	Annualized Project Costs	72,477	1,761	74,238
	Annual OMRR&R Cost	3,318	47	3,365
	Total Annual Costs	**$ 75,795**	**$ 1,808**	**$ 77,603**
Average Annual Benefits				
	Flood Damage Reduction	160,197	0	160,197
	Flood Proofing Cost Savings	9,993	0	9,993
	Flood Insurance Administrative Costs	958	0	958
	Non Structural Flood Risk Benefit	-		-
	Recreation	-	5,130	5,130
	Total Annual Benefits	**$ 171,148**	**$ 5,130**	**$ 176,278**
	Net Annual Benefits	$ 95,353	$ 3,322	$ 98,675
	Benefit to Cost Ratio	2.26	2.84	2.27
All costs and benefits in thousands ($1,000)				

3.11.7 Environmental Commitments

Environmental commitments that are incorporated into the tentatively selected plan are listed as follows:

- The opportunity for inter-agency partnerships to develop areas for improved habitat would be explored with the non-federal sponsors, interested Federal, state and local agencies, Indian Tribes, and interest groups during preparation of plans and specifications. These would be measures that could be incorporated into the project without additional authorization.
- Future coordination on constructing the Red River control structure and tributary structures. This would be coordinated with the Resource Agency Team identified in Section 6.2.
- The mitigation plan includes geomorphic assessments, physical aquatic habitat assessments, and fisheries surveys on the Red, Wild Rice, Sheyenne, Maple, Rush and Lower Rush rivers to verify that project assumptions have been met over time.

3.11.8 Relationship to environmental requirements

This Environmental Impact Statement was prepared in compliance with Federal environmental laws, executive orders, and policies, and with State and local laws and policies as shown below including: the Clean Air Act, as amended; the Clean Water Act as amended; the Endangered Species Act of 1973, as amended; the National Historic Preservation Act of 1966, as amended; the Land and Water Conservation Fund Act of 1965, as amended; the National Environmental Policy Act of 1969, as amended; the Fish and Wildlife Coordination Act of 1958, as amended; the Farmland Protection Policy Act; Executive Order 11990, Protection of Wetlands; Executive Order 11988, Floodplain Management; and Executive Order 12898 Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations.

APPLICABLE ENVIRONMENTAL LAWS AND REGULATIONS

Table 19 summarizes the status of project actions proposed by the Corps of Engineers in relation to applicable environmental laws and regulations.

Table 19 - Status of Project Compliance with Applicable Laws and Statutes

STATUTES OR DIRECTIVES	STATUS
Federal Statutes	
Archeological and Historic Preservation Act	Partial
Clean Air Act as amended	Full
Clean Water Act as amended	Full
Coastal Zone Management Act	N/A
Endangered Species Act of 1973, as amended	Full
Farmland Protection Policy Act of 1984	Full
Federal Water Project Recreation Act, as amended	Full
Fish and Wildlife Coordination Act, as amended	Partial

Full Estuary Protection Act	N/A
Land and Water Conservation Fund Act, as amended	Full
Marine Protection, Research and Sanctuaries Act, as amended	N/A
National Environmental Policy Act of 1969, as amended	Partial
National Historic Preservation Act of 1966, as amended	Partial
Resource Conservation and Recovery Act	N/A
Full Watershed Protection and Flood Prevention Act, as amended	Full
Wild and Scenic Rivers Act, as amended	N/A
Bald and Golden Eagle Protection Act	Full
Executive Orders, Memorandums, etc.	
Floodplain Management (E.O. 11988)	Full
Full Protection of Wetlands (E.O. 11990)	Full
Full Environmental Effects Abroad of Major Federal Actions (E.O. 12114)	N/A
Analysis of Impacts on Prime and Unique Farmlands (CEQ Memorandum, August 11, 1980)	Full
Protection and Enhancement of Environmental Quality (E.O. 11514, as amended by E.O. 11991)	Full
Protection and Enhancement of the Cultural Environment (E.O. 11593)	Full
Environmental Justice (E.O. 12898)	Full

3.11.9 Environmental Operating Principles

The Corps' seven Environmental Operating Principles, listed in Appendix O, Section 8.2, were followed during the entire planning process as indicated in the paragraph below.

The tentatively selected plan **strives to achieve environmental sustainability** by incorporating features to facilitate fish passage, minimize impacts to geomorphology, and minimize any other environmental impacts caused by the project. The feasibility study team coordinated extensively with the appropriate environmental agencies in order to **proactively consider environmental consequences** so that appropriate measures could be included in the project design and as mitigation where necessary. The project provides an appropriate **balance and synergy among human development activities and natural systems** by reducing the risk of flooding to the largest urban area in North Dakota and western Minnesota, thereby avoiding the significant environmental and economic damage that would be caused by repeated flood fighting actions and eventual catastrophic flooding of the Fargo-Moorhead metropolitan area. The plan is consistent with all applicable laws and policies, and the Corps and its non-federal sponsors **accept corporate responsibility and accountability** for the project in accordance with those laws and policies. The study team has used **appropriate ways and means to assess cumulative impacts to the environment** through the use of engineering models, environmental surveys, and discussion with natural resource agencies. The project design has evolved to address as many concerns as possible, and **appropriate mitigation** will be included to address remaining impacts. Study activities including hydrologic, hydraulic, economic, geomorphic, geotechnical, cultural resource, and HTRW surveys will **increase the integrated scientific knowledge base** for the Red River Basin. The feasibility study process included numerous public and agency meetings as well as a project website to interact with **individuals and groups interested in the study activities**. Through those meetings and written interactions, the study team **listened actively and respectfully** to project proponents and opponents alike in an effort to find innovative solutions to the flooding problems in the study area.

3.11.10 Campaign Plan

The four goals and underlying objectives of the Corps of Engineers campaign plan, listed in Appendix O, Section 8.3, were followed during the entire planning process as indicated in the paragraph below.

The development of the plan and the information contained in the report is a **integrated, sustainable, water resource solution** that was developed through the use of collaborative approaches to effectively address the problem of flood risk management in the Fargo-Moorhead Metropolitan area. The information was presented to the non-federal sponsors and the public through the use of clear and strategic communications with an emphasis on transparency. This resulted in a plan that would sustain the aquatic resources of the nation while providing a high level of flood risk management to the citizens of the Fargo-Moorhead Metropolitan area.

3.12 IMPLEMENTATION REQUIREMENTS

3.12.1 Institutional Requirements

The schedule for project implementation assumes authorization in the proposed Water Resources Development Act (WRDA) of 2010 if enacted, or a future WRDA. After project authorization, the project would be eligible for construction funding. The project would be considered for inclusion in the President's budget based upon national priorities, magnitude of the federal commitment, economic and environmental feasibility, level of local support, willingness of the non-federal sponsors to fund their share of the project cost, and the budget constraints that may exist at the time of funding. Once Congress appropriates federal construction funds, the Corps and the non-federal sponsors would enter into a project partnership agreement (PPA). This PPA would define the federal and non-federal responsibilities for implementing, operating and maintaining the project.

The Corps would officially request that the non-federal sponsors acquire the necessary real estate immediately after the signing of the PPA. The advertisement of the construction contract would follow the certification of the real estate. The final acceptance and transfer of the project to the non-federal sponsors would follow the delivery of an operation and maintenance (O&M) manual and as-built drawings. The estimated schedule for project implementation is shown below:

Receive project Authorization	December 2010
Received construction funds	October 2011
Initiate construction	April 2012
Complete Construction	October 2020

Note for the May 2010 Draft Report: A detailed project schedule, including phases, will be included in the final report.

3.12.2 Cost Apportionment

Table 21 indicates the allocation of funds between the non-federal sponsors and the federal government for the Federally Comparable Plan (FCP). Table 22 indicates the allocation of funds between the non-federal sponsors and the federal government for the LPP. The project cost share is based on the FCP and the additional costs attributed to the LPP. The federal share of the project will be limited to 65 percent of the FCP for the flood risk management features. This results in a federal cost of $693,289,000 which is 65 percent of the FCP first costs of $1,066,597,000. The non-federal sponsors are responsible for the costs of the lands, easements, relocations, rights-of-way, and disposal areas (LERRDs), not to exceed 50 percent of the total project cost, and for a minimum cash contribution of five percent. The LERRDs are anticipated to cost $164,023,000, which is less than the project minimum 35 percent contribution that is required. Therefore the remaining non-federal share will be a cash contribution of 209,285,000; this exceeds the minimum cash contribution meaning no additional cash is needed.

The non-federal sponsors are required to pay the increment between the FCP costs ($1,066,597,000) and the LPP costs ($1,237,355,000), which are $170,758,000. The recreation features are cost shared 50/50 resulting in federal and non-federal costs of $17,376,000 each.

Table 20 identifies the incremental cost difference by line item between the FCP and LPP plans. This incremental difference is 100 percent the responsibility of the non-federal sponsors.

Table 20 – Incremental cost table FCP versus LPP, without recreation.

		Minnesota Short Alignment	ND East Alignment	Incremental Difference
Account	Item	**35K**	**35K**	**(LPP-NED)**
01	Lands & Damages	49,282	60,593	11,311
02	Relocations	94,050	82,251	-11,799
06	Fish and Wildlife Facilities	50,920	82,960	32,040
08	Roads, Relocations and Bridges	149,397	54,971	-94,426
09	Channels & Canals	524,576	741,990	217,414
11	Levees and Floodwalls	14,922	2,386	-12,536
30	Planning, Engineering and Design	125,080	144,684	19,604
31	Construction Management	58,370	67,520	9,150
	Total First Costs	**$1,066,597**	**$1,237,355**	**$ 170,758**
	All costs in thousands ($1,000)			

Table 21 – Allocation of funds table FCP.

MN 35,000 cfs			
Item	Federal ($)	Non-Federal ($)	Total ($)
Flood Risk Management			
Lands and Damages		49,282	49,282
Relocations	149,397	94,050	243,447
Fish and Wildlife Facilities	50,920		50,920
Channels and Canals	524,576	0	524,576
Levees and Floodwalls	14,922	0	14,922
Planning, Engineering, & Design	110,972	14,108	125,080
Construction Management	51,787	6,584	58,371
Cash Contribution	-209,285	209,285	0
Total FRM	693,289	373,308	1,066,597
Recreation			
Lands and Damages	0	0	0
Relocations	0	0	0
Recreation Facilities	28,067	0	28,067
Planning, Engineering, & Design	4,210	0	4,210
Construction Management	1,965	0	1,965
Cash Contribution	-17,121	17,121	0
Total Recreation	17,121	17,121	34,242
Total Project	710,410	390,429	1,100,839
All costs in thousands ($1,000)			

Table 22 – Allocation of funds Table LPP.

ND 35,000 cfs			
Item	Federal ($)	Non-Federal ($)	Total ($)
Flood Risk Management			
Lands and Damages		60,593	60,593
Relocations	54,971	82,251	137,222
Fish and Wildlife Facilities	82,960		82,960
Channels and Canals	741,990	0	741,990
Levees and Floodwalls	2,386	0	2,386
Planning, Engineering, & Design	132,346	12,338	144,684
Construction Management	61,761	5,758	67,519
Cash Contribution	-383,126	383,126	0
Total FRM	693,289	544,065	1,237,354
Recreation			
Lands and Damages	0	0	0
Relocations	0	0	0
Recreation Facilities	28,486	0	28,486
Planning, Engineering, & Design	4,273	0	4,273
Construction Management	1,994	0	1,994
Cash Contribution	-17,376	17,376	0
Total Recreation	17,376	17,376	34,753
Total Project	710,665	561,441	1,272,107
All costs in thousands ($1,000)			

3.12.3 Fully Funded Cost Estimate

The fully funded estimate for the tentatively selected plan includes price escalation using Office of Management and Budget inflation factors. Project inflation factors, midpoint of construction features, and fully funded costs can be found in the total project cost summary in Table 23. Project funding requirements by fiscal year are summarized in Table 24, as fully funded estimates.

Table 23 – Total Project Cost Summary (LPP)

TOTAL PROJECT COST SUMMARY									
	PROJECT: Fargo Moorhead Metro Feasiblity Study								
	LOCATION: Red River of the North Basin								
							FULLY FUNDED ESTIMATE		
ACCOUNT NUMBER	FEATURE DESCRIPTION	Estimated Cost ($K)	Contigency ($K)	Contigency (%)	Total First Cost($K)	Midpoint of Feature	Estimated Cost ($K)	Contigency ($K)	Fully Funded plus Contigency ($K)
01	Lands & Damages	44,554	16,039	36%	60,593	Oct-14	48,054	17,299	65,353
02	Relocations	60,478	21,772	36%	82,250	Dec-15	66,632	23,988	90,620
06	Fish and Wildlife Facilities	61,000	21,960	36%	82,960	Apr-16	67,575	24,327	91,902
08	Roads, Relocations and Bridges	40,420	14,551	36%	54,971	Apr-16	44,776	16,120	60,896
09	Channels & Canals	545,581	196,409	36%	741,990	Apr-16	604,390	217,581	821,971
11	Levees and Floodwalls	1,755	632	36%	2,387	Apr-16	1,943	700	2,643
14	Recreation Facilities	20,946	7,541	36%	28,487	Apr-16	23,204	8,353	31,557
30	Planning, Engineering and Design	109,527	39,430	36%	148,957	Apr-16	140,725	50,661	191,386
31	Construction Management	51,113	18,401	36%	69,514	Apr-16	65,672	23,642	89,314
	Total	935,374	336,735	36%	1,272,109		1,062,972	382,670	1,445,642
All costs in thousands ($1,000)									

Table 24 – Fully Funded estimate by fiscal year

ND 35K LPP	Fully Funded Amount Plus Contingency									
		FY11	FY12	FY13	FY14	FY15	FY16	FY17	FY18	FY19	Total Project
Federal											
E&D	$ 175,613	$ 15,000	$ 45,000	$ 40,000	$ 35,000	$ 30,000	$ 3,000	$ 3,000	$3,000	$1,613	$175,613
S&A	$ 84,006		$2,291	$6,416	$11,457	$13,015	$16,498	$14,665	$10,999	$8,663	$84,006
Construction	$ 916,516		$ 25,000	$ 70,000	$ 125,000	$ 142,000	$ 180,000	$ 160,000	$ 120,000	$94,516	$916,516
Non-Federal Cash	$ (480,404)	$ -	$ (20,000)	$ (20,000)	$ (66,151)	$ (75,000)	$ (75,000)	$ (75,000)	$ (75,000)	$ (74,253)	$ (480,404)
Federal LERRD	$ 60,896		$ 45,000	$ 10,000	$ 5,000	$ 896					$60,896
Recreation	$ 31,557							$ 10,000	$10,000	$11,557	$31,557
											$0
Total Federal	$ 788,184	$15,000	$97,291	$106,416	$110,306	$110,911	$124,498	$112,665	$68,999	$42,096	$788,184
Non-Federal											
E&D	$ 15,773	$ 5,000	$ 4,000	$ 3,000	$2,000	$1,773					$15,773
S&A	$ 5,308		$2,050	$2,050	$879	$329	$0	$0	$0	$0	$5,308
Relocation	$ 90,620		$ 35,000	$ 35,000	$15,000	$5,620					$90,620
Lands	$ 65,353		$ 30,000	$ 25,000	$ 7,000	$3,353					$65,353
Non-Federal Cash	$ 480,404		$ 20,000	$ 20,000	$ 66,151	$ 75,000	$ 75,000	$ 75,000	$ 75,000	$ 74,253	$480,404
											$0
Total Non-Federal	$ 657,458	$ 5,000	$ 91,050	$ 85,050	$91,030	$86,075	$75,000	$75,000	$75,000	$74,253	$657,458
Total Project	$ 1,445,642	$ 20,000	$ 188,342	$ 191,466	$201,336	$196,987	$199,498	$187,665	$143,999	$116,349	$1,445,642
All costs in thousands ($1,000)											

3.12.4 Permits

As part of this project the non-federal sponsors will be required to obtain a Minnesota Department of Natural Resources protected waters permit, a water quality permit from North Dakota Department of Health and a Sovereign Lands Permit through the North Dakota State Water Commission. The construction contractors will be responsible for acquiring all local licenses/permits required to comply with state and municipal laws, codes and regulations (road, borrow, construction, etc,) and for acquiring the National Pollutant Discharge Elimination System (NPDES) permit from the Minnesota Pollution Control Agency. http://www.pca.state.mn.us/water/stormwater/stormwater-c.html, or the North Dakota Department of Health.

3.12.5 Views of non-federal sponsors and any other agencies having implementation responsibilities.

The City of Fargo and City of Moorhead have expressed the desire to implement the project and sponsor project construction in accordance with the items of local cooperation that are set forth in the recommendations chapter of this report. The non-federal sponsors will complete the necessary financial self-certifications to indicate that they are financially capable of implementing the tentatively selected plan.

4.0 AFFECTED ENVIRONMENT*

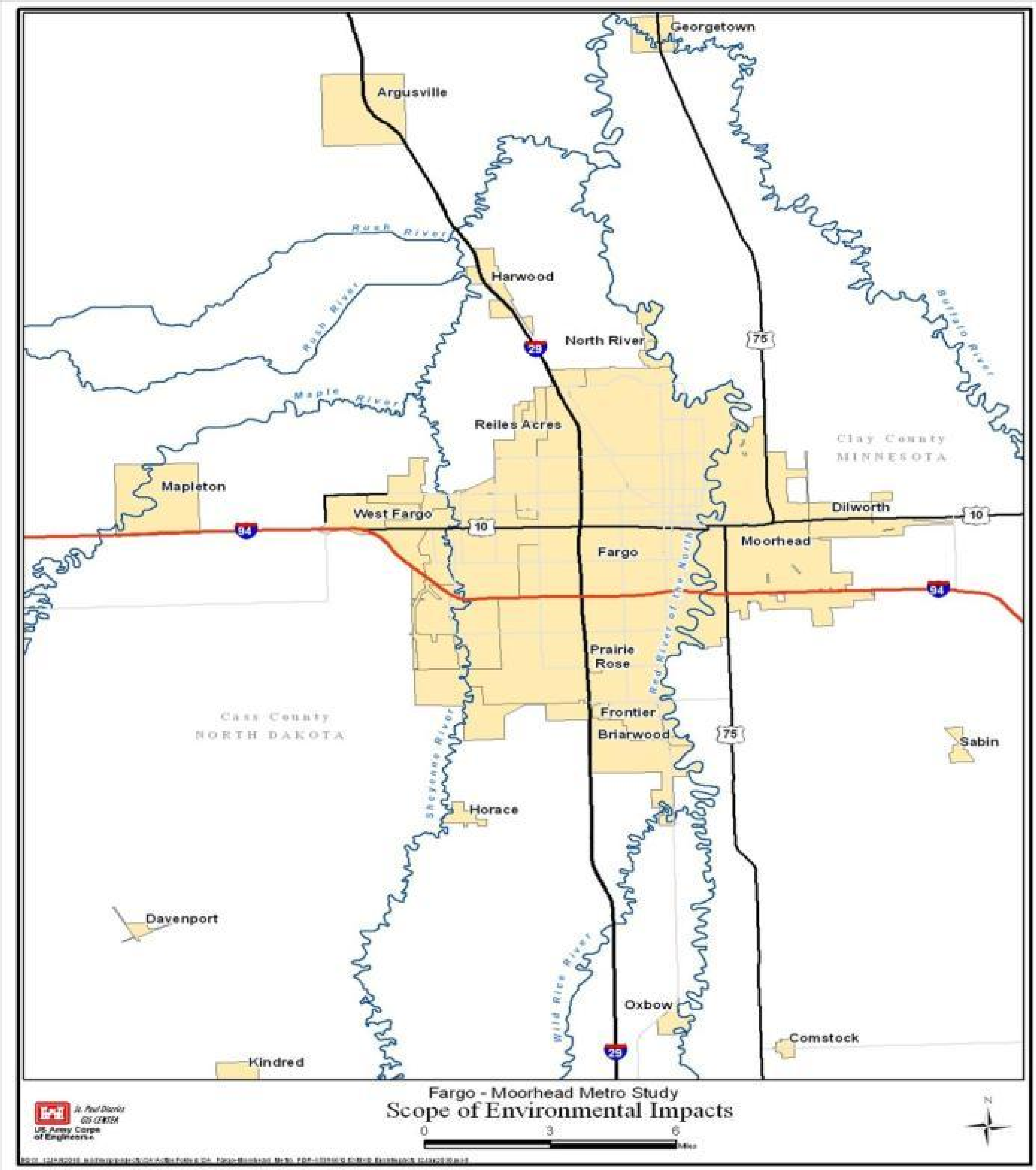
4.1 ENVIRONMENTAL SETTING OF THE STUDY AREA

The affected environment is the area and resources that might be affected by the alternatives discussed in this report. This chapter also serves to describe the existing and future "without-project" conditions.

The Red River of the North flows generally northward in the fertile Red River Valley, forming a meandering border between North Dakota and Minnesota. The river valley is the bed of the former glacial Lake Agassiz. At its maximum extent, Lake Agassiz was about 700 miles long, 200 miles wide and 650 feet deep. The Red River of the North drains into Lake Winnipeg, which is a remnant of Lake Agassiz. The characteristic fertile soil and exceptionally flat topography in this area are a result of its glacial history. At Fargo-Moorhead, the river bottomland is very narrow, generally 1,000 to 2,500 feet, and the adjacent terrain rises only 25 to 30 feet before becoming part of a plain that slopes toward the river at an average of 3 to 7 feet per mile. The north-south axis of the river valley bed has a gradient of about 1½ feet per mile. As a result of meandering, the river at Fargo-Moorhead has a channel gradient of about 1/2 foot per mile. The annual mean flow of the Red River of the North at Fargo-Moorhead for the period of record (1901 to the present) averages approximately 677 cubic feet per second (cfs). The channel capacity of the Red River of the North in the Fargo-Moorhead area is about 7,000 cfs.

The geographic scope of analysis for the environmental impacts of the proposed action and alternatives consists of the Fargo-Moorhead Metropolitan region, located within the area from approximately 12 miles west to 5 miles east of the Red River and from 20 miles north to 20 miles south of Interstate Highway 94. This area includes the Red River and the downstream portions of the Buffalo River, Wild Rice River (North Dakota), Sheyenne River, Maple River, Rush River and other contributing streams that enter the Red River in the study area (Figure 26). In North Dakota the study area includes a portion of Cass County and the cities of Fargo, West Fargo, Hickson, Oxbow, Wild Rice, Frontier, Briarwood, Prairie Rose, Horace, Reiles Acres, and Harwood. In Minnesota the study area includes a portion of Clay County and the cities of Moorhead, Dilworth, Oakport, Rustad, Kragnes and Georgetown.

Figure 26 – Project Study Area



4.2 SIGNIFICANT RESOURCES

This section will describe the existing and without project conditions for the project area. In cases where no without project condition is described it is assumed that the existing project condition will remain relatively unchanged.

Resources that could be affected by the Project's proposed alternatives occur throughout the geographic scope of the project as shown in Figure 26. Issues identified through the scoping process or resources that potentially could be affected by the Project are:

Natural Resources

- Climate
- Air Quality
- Water Quality
- Sedimentation and Erosion
- Water Quantity
- Slope stability along Red River Corridor
- Ground Water
- Aquifers
- Fisheries and Aquatic Habitat
- Riparian Habitat
- Wetland Habitat
- Upland Habitat
- Terrestrial Wildlife
- Endangered Species
- Prime and Unique Farmland

Cultural Resources

- Cultural Resources
  - Historic Conditions
  - Previous Cultural Resources Investigations
  - Known Cultural Resources Sites

Socioeconomic Resources

4.2.1 Natural Resources

4.2.1.1 Climate

The study area is in a region classified as a subhumid to humid continental climate with cold winters and moderately warm summers. Rapid changes in daily weather patterns are common. Frequent passage of weather fronts and high and low pressure systems result in a wide variety of weather. The average temperature between November and March is below 32^{o} F, resulting in an average of 185 days per year at or below 32^{o}F. The average temperature of the warmest month, July, is 71.1°F. The annual average normal temperature of 41.2°F reflects the northern location of the study area. On an annual basis, the prevailing wind at Fargo is from the north and northwest. The average annual precipitation in the Fargo area is about 19.5 inches. Nearly three-fourths of the annual precipitation occurs between April and September, with the remainder occurring during the winter. The average annual snowfall is about 50 inches.

The existing and future without project conditions are assumed to be the same, however an expert opinion elicitation (EOE) panel was used to determine the effects of climate change or variation on the proposed project. Information regarding this panel can be found in Appendix A, Hydrology.

4.2.1.2 Air Quality

The United States Environmental Protection Agency (USEPA) has established primary and secondary National Ambient Air Quality Standards (NAAQS) under the provisions of the Clean Air Act (CAA). The CAA not only established the NAAQS, but also set emission limits for certain air pollutants from specific sources, set new source performance standards based on best demonstrated technologies, and established national emissions standards for hazardous air pollutants.

The USEPA classifies the air quality within an air quality control region according to whether the region meets or exceeds Federal primary and secondary NAAQS. Primary standards define levels of air quality necessary to protect public health with an adequate margin of safety. Secondary standards define levels of air quality necessary to protect public welfare (i.e., soils, vegetation, and wildlife) from any known or anticipated adverse effects of a pollutant. Federal NAAQS are currently established for seven pollutants (known as "criteria pollutants"); including carbon monoxide (CO), nitrogen dioxide (NO_2), ozone (O_3), sulfur dioxide (SO_2), lead (Pb), particulate matter equal to or less than 10 micrometers in aerodynamic diameter (PM_{10}), and very fine particulate matter ($PM_{2.5}$).

The Fargo-Moorhead area is considered a NAAQS Attainment Area for all air quality parameters (USEPA 2009). This indicates existing concentrations of air pollutants are below the established standard(s) and limited increases in emissions are allowable. Therefore, the General Conformity Rule under the CAA does not apply.

The North Dakota air quality standards are the same as those established by the CAA, except for SO_2, which is more restrictive. North Dakota's Air Quality Program includes a Fugitive Dust Control Regulation, Chapter 33-15-17 which is primarily complaint driven (North Dakota Department of Health 2009; Bachman 2009). Cass County, North Dakota's Dust Control Guidelines pertain to dust control on county or local roads (Cass County Highway Department 2004). Fargo has a Nuisance Ordinance that includes the generation of fugitive dust. However, no particulate values are included in the ordinance. Implementation of the ordinance is complaint driven. If complaints are received, the City works with parties involved to resolve the issue. The ordinance is interpreted more loosely for construction related dust issues (Shocker 2009).

The Minnesota air quality standards are the same as those established by the CAA, except for Sulfur Dioxide, Small Particulates, and Lead, which are more restrictive. Clay County, Minnesota does not have a specific air quality regulation or fugitive dust ordinance. Fugitive dust is regulated under permits issued when doing construction/development. Fugitive dust issues are also addressed on a complaint basis. That is, when residents make a complaint to the County regarding dust issues from construction activities in their area, the County will go out and investigate. If a fugitive dust problem is identified, the County would work with the contractor to remedy the situation (Magnusson 2009)

4.2.1.3 Water Quality

Water quality in the Red River of the North main stem is generally impaired from Breckenridge, MN down to the Marsh River confluence near Shelly, MN in Norman County, a distance of approximately 191 river miles. Point and non-point sources of pollution result in high pH, fecal coliform, nutrients, biochemical oxygen demand (BOD), suspended solids, turbidity, and conductivity resulting in non-support of aquatic life and overall use; and partial support of swimming, agriculture, and wildlife uses. From the Marsh River confluence downstream, the general water quality improves to threatened, with the exception of two segments, just upstream from Grand Forks, ND-East Grand Forks, MN and near Pembina, ND-St. Vincent, MN, where water quality is impaired. Cropland use, feedlots, livestock holding facilities, agricultural chemicals, urban runoff, septic systems, channelization, dredging, streambank modification, landfills, and dams contribute to oxygen depletion, eutrophication, bacterial contamination, sedimentation, toxicity from pesticides, turbidity, and habitat alteration on the Red River.

4.2.1.3.1 Red River at Fargo

Many constituent concentrations downstream of Fargo have exceeded water quality guidelines, standards, and criteria. The maximum sulfate concentration of 303 mg/L was greater than the 250 mg/L EPA (2005b) secondary drinking water standard. Other exceedances, including cadmium, copper, lead, and selenium concentrations, generally occurred during the 1970s or earlier. These exceedances could be attributed to natural occurrences, pollution, or to sample contamination. Tornes (2005) used available data from July, 1969 to September, 1994 to arrive at median values for TDS, sulfate, chloride, and sodium downstream of Fargo of 356, 69, 11, and 20 mg/L, respectively. A median value of 8.1 was also identified for pH.

Section 1.3 of Appendix F, Environmental contains a Water Quality Spreadsheet which summarizes data provided by the Minnesota Pollution Control Agency (MPCA) load monitoring site, located on Clay County highway 26 at the Red River about 7 miles north of Moorhead and about 2 miles east of Harwood, ND. The field data were collected with an YSI multi-parameter sonde. The other samples were collected via a mid-stream mid depth single grab with a Van Dorn type sampler and analyzed using EPA approved lab methods.

Minnesota Pollution Control Agency classifies the reach of the Red River through the study area as Class 1C, 2Bd, and 3C for domestic consumption, aquatic life and recreation, and industrial use, respectively (State of Minnesota 2009). Class 1C waters are such that with treatment consisting of coagulation, sedimentation, filtration, storage, and chlorination, or other equivalent treatment processes, the treated water will meet both the primary (maximum contaminant levels) and secondary drinking water standards issued by the United States Environmental Protection Agency (USEPA). Class 2Bd waters are such as to permit the propagation and maintenance of a healthy community of cool or warm water sport or commercial fish and associated aquatic life and their habitats. These waters shall be suitable for aquatic recreation of all kinds, including bathing, for which the waters may be usable. This class of surface waters is also protected as a source of drinking water. Class 3C waters are such as to permit their use for industrial cooling and materials transport without a high degree of treatment being necessary to avoid severe fouling, corrosion, scaling, or other unsatisfactory conditions.

In the future water quality in the Red River would be expected to improve slightly due to more stringent environmental laws and several ongoing initiatives in the area.

The Red River Basin Commission has been working with the local soil and water conservation districts, watershed districts and Pheasants Forever on the Red River Basin Buffer initiative. Goals of this are to demonstrate a process for restoring strategically targeted riparian buffers within a small watershed so the process can be duplicated throughout the Red River Basin. This project will also demonstrate the water quality benefits to these restorations. Measurable goals include establishing buffers, restoring prescribed wetlands within the watersheds, reducing sediment concentrations/loads at stream sites, reducing total phosphorus concentrations/loads at stream sites, and educating the public about benefits of buffers to promote their implementation.

4.2.1.3.2 North Dakota Tributaries

Based on the North Dakota State stream classification system the Sheyenne River is a Class IA, the Maple River and Wild Rice River are Class II, and the Rush River (upper and lower) are Class III. Class I waters are such that the quality of the waters shall be suitable for the propagation or protection, or both, of resident fish species and other aquatic biota and for swimming, boating, and other water recreation. The quality of the waters shall be suitable for irrigation, stock watering, and wildlife without injurious effects. After treatment consisting of coagulation, settling, filtration, and chlorination, or equivalent treatment processes, the water quality shall meet the bacteriological, physical, and chemical requirements of the department for municipal or domestic use. Class IA are such that the quality of the waters shall be the same as the quality of Class I streams, except that treatment for municipal use may also require softening to meet the drinking water requirements of the North Dakota Department of Health. Class II waters are such that the quality of the waters shall be the same as the quality of Class I streams, except that additional treatment may be required to meet the drinking water requirements of the department. Streams in this classification may be intermittent in nature which would make these waters of limited value for beneficial uses such as municipal water, fish life, irrigation, bathing, or swimming. Class III waters are such that the quality of the waters shall be suitable for agricultural and industrial uses. Streams in this class generally have low average flows with prolonged periods of no flow. During periods of no flow, they are of limited value for recreation and fish and aquatic biota. The quality of these waters must be maintained to protect secondary contact recreation uses (e.g., wading), fish and aquatic biota, and wildlife uses.

4.2.1.4 Sedimentation and Erosion

The land surface and stream channels of the Red River Basin are composed primarily of clay-rich, unconsolidated (erodible) glacial sediments. Suspended sediment in streams results primarily from erosion and transport of upland soils in agricultural areas and less from stream erosion of channel (bank and streambed) sources. Suspended-sediment concentrations can vary in the rivers and streams in the study area due to factors such as landscape characteristics, streamflow, season, and land use. High suspended-sediment concentrations characterize streams that flow through heavily cropped, erodible lands (majority of the project area) and erodible stream channels. In contrast, low sediment concentrations characterize most streams that drain upland areas that are not dominated by agriculture.

Water in the Red River is turbid, resulting from the fine nature of the suspended sediments (clay and silt). This is the natural state of a river that meanders through a flat valley composed of very fine material. More importantly, a watershed-scale geomorphologic evaluation of the Red River indicates that it can be considered a stable riverine system, as channel migration rates over the past 1,000 years have been relatively small and there is no evidence of bed aggradation or degradation over long reaches. In addition, the vertical distribution of the Red River clays and silts being transported in suspension is significantly more uniform than that characteristic of sand dominated systems, therefore the proposed diversion channel alternatives should not lead to an appreciable change in suspended sediment concentrations along the flood risk management area.

The Sheyenne River flows through glacial till in the upper and middle reaches, through sand deposits in the glacial Sheyenne Delta of the lower basin, and finally through the extremely flat clay deposits of the glacial Lake Agassiz basin. From Kindred to its confluence with the Red River, the Sheyenne River crosses the Red River floodplain that consists mainly of deep clays. Different from the Red River, the Sheyenne River mobilizes fine to very fine sand (with the likely upstream source being the glacial Sheyenne Delta) in addition to clays and silts, hence the effect of diverting water on the morphodynamic stability of this river could be more significant than in the Red River. However, a comparison of channel cross sections pre- and post-construction of the Horace-West Fargo diversion does not show any considerable changes. In general, the Sheyenne River can be considered a stable riverine system near the proposed location of the diversion works.

The Wild Rice River flows through glacial till in the upper reaches, through eolian sand deposits (wind eroded from the glacial Sheyenne Delta) in the middle reaches, and finally through the extremely flat clay deposits of the glacial Lake Agassiz basin. From Mantador (several miles upstream of Abercrombie) to its confluence with the Red River, the Wild Rice River crosses the Red River floodplain that consists mainly of deep clays. Different from the Sheyenne River, the Wild Rice River mobilizes mostly coarse to medium sand in suspension as well as bedload (but with somewhat smaller suspended sediment concentrations than in the Sheyenne River, likely because an appreciable fraction of the sediment transported by the Wild Rice River is as bedload). Furthermore, the Sheyenne River is significantly longer and has significantly (close to an order of magnitude) lower peak flood flows than the Wild Rice River near the proposed diversion structures, therefore the latter has a greater sediment transport capacity of coarser material that exerts a bigger control on channel morphology. For these reasons, the effect of diverting water on the morphodynamic stability of this river could be very important (more than in the Sheyenne River).

The Maple River flows through glacial till in the upper reaches, through sand deposits in the glacial Maple Delta and Sheyenne Delta in the middle reaches, and finally through the extremely flat clay deposits of the glacial Lake Agassiz basin. From a few miles downstream of the Maple River dam to its confluence with the Sheyenne River, the Maple River crosses the Red River floodplain that consists mainly of deep clays. It is reasonable to assume that most of the sand transported by this river is trapped in the Maple River dam, therefore the sediment mobilized near the diversion structures will likely correspond to clays and silts, possibly with some fine sands.

4.2.1.5 Water Quantity

The Red River is a meandering river that begins where the Otter Tail River and Bois de Sioux River join at Wahpeton, North Dakota, and Breckenridge, Minnesota. The Red River has 548 river miles of which 394 are in the United States. Parts of South Dakota, North Dakota, and Minnesota are drained by the Red River.

The Red River is unusual for the northern plains because it flows northward through the center of an ancient lakebed, glacial Lake Agassiz. The remnant lakebed has extremely flat topography, which characterizes the Red River Valley. The valley covers a strip of land about 35 miles wide on either side of the Red River in North Dakota and Minnesota. The Red River Valley is part of the larger Red River Basin.

The Red River receives most of its flow from its eastern tributaries because of regional patterns in precipitation, evapotranspiration, soils, and topography. The Red River Valley has a sub-humid to humid climate with an average annual precipitation of about 20 inches. Major tributaries entering the Red River in the United States include the Sheyenne River, Red Lake River, and Otter Tail River.

Most of the annual precipitation and annual evaporation occurs from April through September. As a result, most of the time precipitation is absorbed in the soil and transpired or evaporated back to the atmosphere and very little results in runoff or groundwater recharge. Most runoff is in the early spring when snowmelt and precipitation generally exceed evapotranspiration (Sloan 1972). Maximum flow occurs in the spring, decreases throughout the summer and fall, and is lowest during the winter months.

Currently, there are several lowhead dams along the Red River that pool water for Municipal, Rural & Industrial (MR&I) intakes during times of low flow. A lowhead dam is a dam of low height, usually less than 15 feet, that extends from bank to bank across a stream channel. Lowhead dams are located on the river at Wahpeton, Wolverton, Hickson, Fargo, Grand Forks-

East Grand Forks, and Drayton. Some of the dams have been modified for safety reasons and to allow fish passage (MNDNR and North Dakota Game and Fish Department 1996).

The Red River is the primary source of water for municipal, industrial, and irrigation purposes in the Red River Valley. It is the principal water supply for cities such as Moorhead, Minnesota, and Fargo, Grand Forks, Grafton, and Drayton, North Dakota, among others.

4.2.1.6 Slope Stability along Red River

The general bank along the Red River is composed of a primary bank and a secondary bank. The primary bank exists some 5 to 15 feet above the normal water surface of the Red River. Above the primary banks the ground slopes in either a gentle, flat or somewhat hummocky fashion to the foot of a secondary bank. The secondary bank usually rises relatively steeply 20 to 25 feet above the primary bank, before flattening out into the ancient glacial lake bottom that forms a majority of the modern watershed. Most of the present-day human activity begins within tens of feet of the top of the secondary bank.

The stability of the primary bank is largely dependent on the elevation of the Red River. The stability of the bank decreases as the Red River elevation decreases. Slides generally occur when there are low water conditions.

The scarps from riverbank slides are typically located on the flat or gently sloped portion between the primary bank and the secondary bank. Often the slides progress up slope, away from the river, thereby leading to a hummocky appearance between the tops of the primary and secondary banks. The slides may extend for several hundred feet along the river bank.

It has been noted that slides in the Red River Valley are most typically found to exist on the outside of river bends. These slides are likely initiated, in part, by the scouring action of the river on the toe of the primary or lower river bank. In addition to slides in the upper or secondary banks, smaller scale sloughing of the lower river banks is frequently observed.

4.2.1.7 Ground Water

Borings have been conducted to delineate the stratigraphy and for conducting laboratory testing of the soils. A nested set of 3 vibration wire piezometers has been installed with an automated datalogger, approximately 1 mile east and 2 miles north of the City of Dilworth to better understand the shallow versus deeper groundwater system. The piezometer transducers are at the approximate depths of 20’, 50’, and 75’ below ground surface. In May and June, 2010 additional exploration is being conducted and additional vibrating wire piezometers installed along the proposed Minnesota and North Dakota diversion alignments. The piezometers will be nested in the lower, middle and upper elevations and/or sandy layers encountered to further understand the ground water regime. Nested piezometers with dataloggers are also being placed at proposed structure locations. Once a more precise alignment is selected additional subsurface information will be needed for inclusion into plans and specifications.

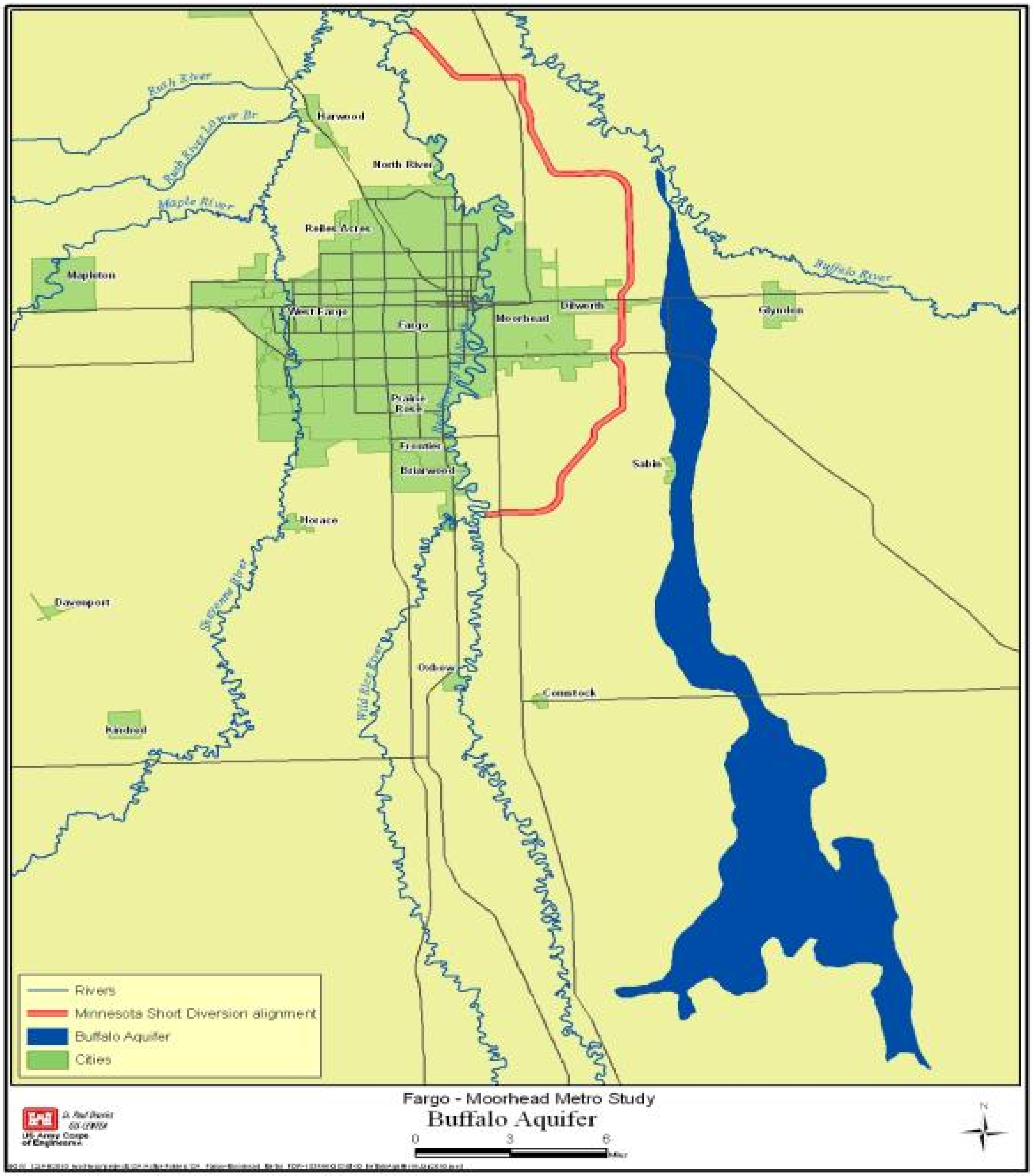
The Corps has obtained a 3-Dimensional geological model compiled by the Minnesota Geological Survey in 2005. The model used existing well and subsurface data to map the groundwater bearing deposits within the project area. The Corps is utilizing this geological data to verify the channel alignments relative to the identified aquifers. The additional subsurface investigations are also being used to help identify the presence, location, and limits of any smaller scale aquifers along the proposed alignments.

4.2.1.8 Aquifers

For the Minnesota alignment alternatives the Buffalo Aquifer was identified as a planning constraint early in the feasibility study. Water usage from the aquifer is extensive, including individual, irrigation, and municipal water wells. Agencies and the public expressed a desire to avoid impacting the aquifer. Located five to seven miles east of Moorhead, the Buffalo Aquifer is north-south trending sand and gravel filled channel that was placed during the last glacial epoch (Figure 2). The deposit is interpreted to have been formed in a tunnel valley by glacial meltwater exiting the southern end, or snout, of a glacier. The exiting meltwater was under pressure and occurred in multiple events which are indicated by the vertical and horizontal meandering of the deposit. The aquifer is about 25-30 miles long, 1 to 2 miles wide and as deep as 250-feet. The top of the aquifer is at ground surface in some areas and buried in glacial lake clays in others. The Buffalo River, which runs parallel to and along the east side of the aquifer contributes significant recharge to the aquifer; especially in the northern reach of the aquifer near the City of Moorhead's' north well field. Groundwater flow in the clayey lake plain soils on the west side of the Buffalo aquifer is generally flowing west, or toward the Red River of the North; variations due to local hydrology, such as over-pumping, drought conditions, and adjacent wetlands can alter the groundwater flow directions. In 1994 the City of Moorhead opened a new water treatment plant and began taking more water from the Red River of the North. Water levels in the aquifer came up 15-feet over the following 10 years. Over the last 30 years significant studies have been conducted on the Buffalo Aquifer; additional groundwater management initiatives and studies are currently being undertaken by federal, state, and local agencies.

For the North Dakota alignment alternatives the West Fargo Aquifer exists at depth of approximately 70 to 110 feet below ground surface. The aquifer is a north-south trending sand and gravel filled channel placed during the last glacial epoch The deposit is interpreted to have been formed in a tunnel valley by glacial meltwater exiting the southern end, or snout, of a glacier, in the same manner as the Buffalo aquifer. The exiting meltwater was under pressure and occurred in multiple events. The additional subsurface investigations will be collecting site specific soil and ground water data.

Figure 27 – Buffalo Aquifer



4.2.1.9 Fisheries and Aquatic Habitat

Areas potentially affected directly by the proposed action include the Red River of the North and adjacent tributaries around Fargo-Moorhead. These include the Wild Rice, Sheyenne, Maple, Rush and Lower Rush rivers in North Dakota. The Lower Rush is intermittent and typically does not have flow year-round, but for the purpose of this EIS, will be considered one of five tributaries that could provide fisheries habitat. The project also could affect other small intermittent tributaries and drainage ditches in North Dakota. However, these likely provide limited, if any, fisheries habitat value. In Minnesota, the Buffalo River is a significant tributary located in the project area. However, the Buffalo River and other tributaries in Minnesota will not be directly impacted by the proposed action.

The Red River originates at the confluence of the Otter Tail and Bois de Sioux Rivers south of Fargo, ND. It flows northward into Canada and forms most of the boundary between Minnesota and North Dakota. Monthly median flows range from a low of about 250 cfs during the winter months, to a high of 1,300 to 1,400 cfs during April.

The Red River has high sinuosity and extremely low gradient over most of its range, with slopes ranging from 0.04-percent upstream of Fargo, to 0.003-percent near the Canadian border (Aadland et al. 2005). Substrates are dominated by silts and clays, though a few areas of rock or gravel are known to exist. The Red River is a warm water system that is dominated by turbid conditions during the open-water months. Its habitat consists largely of a main channel, with little to no side-channels, islands or backwaters. The vast majority of the habitat for the Red River would be considered “pool” or “run” habitat. Little submerged aquatic plant growth occurs due to the river’s turbid conditions. Fallen trees, log jams and snags provide important physical habitat for Red River fishes.

Aadland et al (2005) performed an extensive review of literature and historical fisheries surveys for the Red River basin. Their observations provide a valuable reference for historical and existing conditions for fisheries resources in the Red River Basin. Aadland et al (2005) reported 57 fish species were identified in the Red River mainstem for surveys conducted from 1962 thru 2000 (Table 25). By comparison, the Sheyenne River had a similar number of fish species collected (56), while the Wild Rice (23), Maple (30) and Rush (22) rivers had fewer species observed (Table 25).

The Red River is known as perhaps the best trophy channel catfish fishery in the world. Other important sportfish include walleye and sauger. Goldeye are abundant in the Red River and appear to be an important forage base for channel catfish, and potentially other species. Common species to the Red River include members of the Cyprinid (minnow) and Catastomid (sucker) families.

Lake sturgeon is a species that was historically found in the Red River Basin, but until recently were extirpated from the watershed. Aadland et al. (2005) recounts the history of the lake sturgeon within the basin. Though the species was found periodically until the 1950s, it was likely extirpated from much of the basin by the early 1900s. Likely factors for extirpation include overharvest, habitat destruction and fragmentation. In 1997, the Minnesota DNR and White Earth Indian Reservation began a 20-year program to reintroduce lake sturgeon to the basin. The program calls for the annual release of 34,000 fingerling and 600,000 lake sturgeon fry in key sub-basins of the Red River watershed. Habitat enhancement and improved habitat connectivity are likely key factors on the long-term success of this reintroduction program.

The river darter also has apparently been extirpated from the Red River mainstem. Several other species have been extirpated from various tributaries but still occur elsewhere in the watershed.

In addition, the Red River and its tributaries also contain communities of freshwater mussels. Species commonly found have included threeridge, pocketbook, mapleleaf and pink heelsplitter (Jensen et al. 2001).

To date, there has been a relatively minimal influx of invasive aquatic species to the Red River Basin. The common carp is the most widely established invasive. Several species have been stocked outside their native range, including white bass and white crappie.

Table 25 includes information on the Fish Species Observed in the Red River Basin during the period 1962 thru 2000. "X" indicates a species presence in a tributary. "E" indicates species extirpated from the indicated waterbody. No mark represents a species within the Red River Basin, but not found in the indicated waterbody. Source: Aadland et al. 2005.

Table 25 – Fish Species Observed in the Red River Basin.

Taxon								
Petromyzontidae	**Scientific Name**	**Common name**	**N or I[1]**	**Red**	**Wild Rice**	**Sheyenne**	**Maple**	**Rush**
1	*Ichthyomyson castaneus*	chestnut lamprey	N	X				
2	*Ichthyomyson unicuspis*	silver lamprey	N	X				
Acipenseridae								
3	*Acipenser fulvescens*[2]	lake sturgeon	N	E				
Lepisosteidae								
4	*Lepistoseus osseus*[2]	longnose gar	N					
Amiidae								
5	*Amia calva*	bowfin	N					
Hiodontidae								
6	*Hiodon alosoides*	goldeneye	N	X		X		
7	*Hiodon tergisus*	mooneye	N	X		X		
Salmonidae								
8	*Coregonus artedii*	ciscoe	N					
9	*Coregonus clupeaformis*	whitefish	N	X				
10	*Oncorhynchus mykiss*	rainbow trout	I			X		
11	*Salmo trutta*	brown trout	I					
12	*Salvelinus fontinalis*	brook trout	I					
13	*Salvelinus namaycush*	lake trout	I					

Catostomidae								
14	*Carpiodes cyprinus*	quillback carpsucker	N	X		X	X	X
15	*Catostomus commersonii*	white sucker	N	X	X	X	X	X
16	*Hypentelium nigricans*	northern hog sucker	N					
17	*Ictiobus bubalus*	smallmouth buffalo	N					
18	*Ictiobus cyprinellus*	bigmouth buffalo	N	X	X	X	X	
19	*Moxostoma anisurum*	silver redhorse	N	X	X	X		
20	*Moxostoma erythrurum*	golden redhorse	N	X		X		
21	*Moxostoma macrolepidotum*	shorthead redhorse	N	X	X	X	X	
22	*Moxostoma valenciennesi*	greater redhorse	N	X		X	X	
Cyprinidae								
23	*Campostoma anomalum*	central stoneroller	N					
24	*Campostoma oligolepis*	largescale stoneroller	N					
25	*Carassius auratus*	goldfish	I	X				
26	*Cyprinella spiloptera*	spotfin shiner	N	X	X	X	X	X
27	*Cyprinus carpio*	common carp	I	X	X	X	X	X
28	*Hybognathus hankinsoni*	brassy minnow	N			X	X	
29	*Luxilus cornutus*	common shiner	N	X		X	X	X
30	*Macrhybopsis storeriana*	silver chub	N	X		X		
31	*Margariscus margarita*	pearl dace	N					
32	*Nocomis biguttatus*	hornyhead chub	N	X		E	E	
33	*Notemigonus chrysoleucas*	golden shiner	N	X		X		
34	*Notropis anogenus*	pugnose shiner	N			E		
35	*Notropis atherinoides*	emerald shiner	N	X		X	X	X
36	*Notropis blennius*	river shiner	N	X	X	X	X	X
37	*Notropis dorsalis*	bigmouth shiner	N	X		X	X	X
38	*Notropis heterodon*	blackchin shiner	N			X		
39	*Notropis heterolepis*	blacknose shiner	N			X		
40	*Notropis hudsonius*	spottail shiner	N	X		X		
41	*Notropis percobromus*	carmine shiner	N			X		
42	*Notropis rubellus*	rosyface shiner	N					
43	*Notropis stramineus*	sand shiner	N	X		X	X	
44	*Notropis texanus*	weed shiner	N					
45	*Notropis volucellus*	mimic shiner	N					
46	*Phoxinus eos*	northern redbelly dace	N			X		X
47	*Phoxinus neogaeus*	finescale dace	N					
48	*Pimephales notatus*	bluntnose minnow	N	X		X	X	X
49	*Pimephales promelas*	fathead minnow	N	X	X	X	X	X
50	*Platygobio gracilis*	flathead chub	I	X				
51	*Rhinichthys atratulus*	blacknose dace	N					
52	*Rhinichthys cataractae*	longnose dace	N	X		X		
53	*Rhinichthys obtusus*	western blacknose dace	N			X	X	
54	*Semotilus atromaculatus*	creek chub	N	X		X	X	X
Ictaluridae								
55	*Ameiurus melas*	black bullhead	N	X	X	X	X	X

56	*Ameiurus natalis*	yellow bullhead	N	X				
57	*Ameiurus nebulosus*	brown bullhead	N	X		X		
58	*Ictalurus punctatus*	channel catfish	N	X	X	X	X	X
59	*Noturus flavus*	stonecat	N	X		X		
60	*Noturus gyrinus*	tadpole madtom	N	X	X	X	X	
Umbridae								
61	*Umbra limi*	central mudminnow	N	X				
Esocidae								
62	*Esox lucius*	northern pike	N	X	X	X	X	X
63	*Esox masquinongy*	muskellunge	I			X		
Osmeridae								
64	*Osmerus mordax*	rainbow smelt	N	X				
Cyprinodontidae								
65	*Fundulus diaphanus*	banded killfish	N	X		E		
Gadidae								
66	*Lota lota*	burbot	N	X				
Percopsidae								
67	*Percopsis omiscomaycus*	trout-perch	N	X	X	X	X	X
Moronidae								
68	*Morone chrysops*	white bass	I	X		X		
Centrarchidae								
69	*Ambloplites rupestris*	rock bass	N	X	X	X		
70	*Lepomis cyanellus*	green sunfish	N	X		X	X	
71	*Lepomis gibbosus*	pumpkinseed	N		X	X		
72	*Lepomis humilis*	orangespotted sunfish	N	X		X		
73	*Lepomis macrochirus*	bluegill	N	X		X		
74	*Micropterus dolomieu*	smallmouth bass	N	X		X		
75	*Micropterus salmoides*	largemouth bass	N			X		
76	*Pomoxis annularis*	white crappie	N	X		X	X	
77	*Pomoxis nigromaculatus*	black crappie	N	X	X	X	X	
Percidae								
78	*Etheostoma caeruleum*	rainbow darter	N					
79	*Etheostoma exile*	Iowa darter	N		X	X	X	X
80	*Etheostoma microperca*	least darter	N					
81	*Etheostoma nigrum*	johnny darter	N	X	X	X	X	
82	*Perca flavescens*	yellow perch	N	X	X	X		
83	*Percina caprodes*	logperch	N	X				
84	*Percina maculata*	blackside darter	N	X	X	X	X	X
85	*Percina shumardi*	river darter	N	E		E		
86	*Sander canadensis*	sauger	N	X		X	X	X
87	*Sander vitreus*	walleye	N	X	X	X		X
Scianidae								
88	*Aplodinotus grunniens*	freshwater drum	N	X	X	X		X
Cottidae								
89	*Cottus bairdi*	mottled sculpin	N					
90	*Cottus cognatus*	slimy sculpin	N					

91	*Cottus ricei*	spoonhead sculpin	N					
Gasterosteidae								
92	*Culaea inconstans*	brook stickleback	N		X	X	X	X
93	*Pungitius pungitius*	ninespine stickleback	N					
[1] Species that are native (N) or introduced (I) to the Red River Basin.								
[2] Species which are known only from historical records and most likely no longer exist in the Red River basin.								

Previous studies have characterized the biotic health of the Red River, including Index of Biotic Integrity (IBI) studies of fish and macroinvertebrates. EPA (1998) evaluated fish communities in the Red River, and characterized river health as ranging between "poor" to "good" based on fish community composition. The survey reach observed at Fargo would be characterized as "fair" based on their IBI criteria (EPA 1998, Figure 28).

Previous studies also have characterized the biotic health of many Red River tributaries. However, observations within tributary areas that would be directly affected by the project have been more limited. EPA (1998) evaluated fish communities in Red River tributaries within or close to the project area for the Wild Rice, Maple and Rush rivers. While Red River tributaries contain some reaches of quality habitat, areas within or close to the project area appear more degraded. EPA (1998) observations of biotic health, based on fish observations, classified biotic health as "very poor" or "poor" for sites on the Wild Rice, Maple and Rush rivers that were within or closest to the project area (Figure 28). The nearest survey reach on the Sheyenne was classified as "fair" but was considerably upstream of the project area. Biotic health for the Sheyenne in the project area is probably more degraded, similar to the other tributaries with information closer to the project area. Tributary habitat upstream of the project area appears to improve for some tributaries, with habitat classified as "fair" or "good" in some sections of the Rush, Maple and Sheyenne rivers.

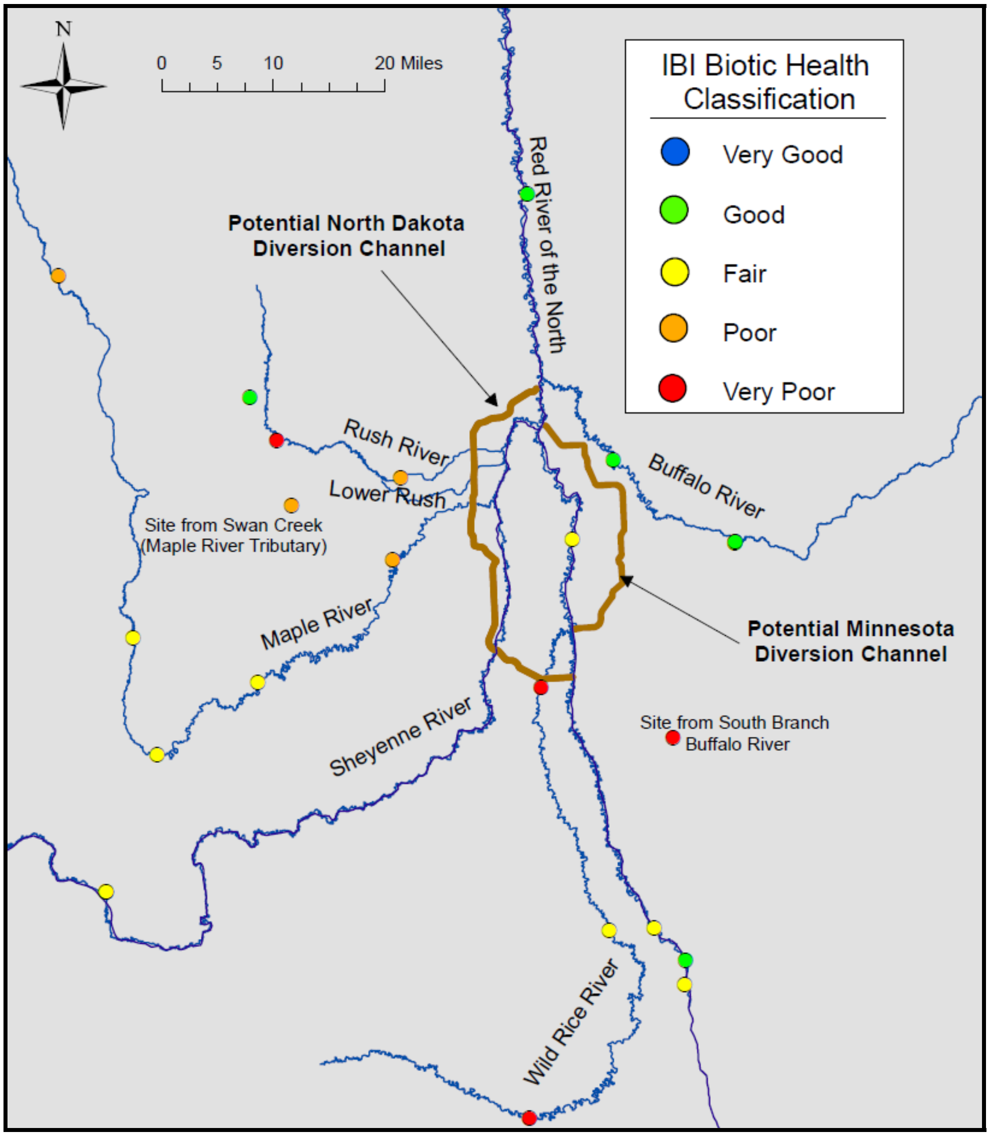
Physical tributary habitat in the project area has been heavily modified, which is probably reflected in the IBI scores. The Rush and Lower Rush rivers have been channelized and straightened through the project area to its confluence with the Sheyenne River. The Sheyenne River has been heavily modified from several actions. The Horace/West Fargo flood project includes multiple control structures and diversion channels that are operated with flows as low as a 50-percent chance event. During low-level flood events, flows are actually blocked at West Fargo, with the entire river routed through a flood diversion channel. Additional features along the lower Sheyenne River include a low-head dam and several bridge crossings that may constrict flow. Ultimately, these features cumulatively result in highly-modified hydraulic and geomorphic conditions in the Sheyenne, which adversely affect its aquatic habitat.

Additional actions such as tiling, ditching and draining have been widely done across the project area, resulting in altered hydraulic and geomorphic conditions in area tributaries. Several tributary reaches in the project area also have limited or no riparian habitat along their corridor.

These altered conditions directly affect aquatic habitat quality, and may be most apparent with tributary areas on the Red River valley floor, within or adjacent to the project area.

Although tributary habitat may be degraded around the project area, tributaries appear important for many species within the Red River basin. Areas of greatest value are typically upstream of the valley floor in areas with more diverse habitat. Much of the Red River mainstem is void of rock/cobble habitat that would be utilized by fishes that spawn in riffle habitat. However, such habitat is found in adjacent tributaries, particularly within high-gradient areas upstream of the project area where streams descend through old beach ridges of glacial Lake Agassiz and glacial moraines (Aadland et al 2005).

Figure 28 - Index of Biotic Integrity classification for select sites on the Red River and adjacent tributaries (from EPA 1998).



4.2.1.9.1 Aquatic Habitat Connectivity

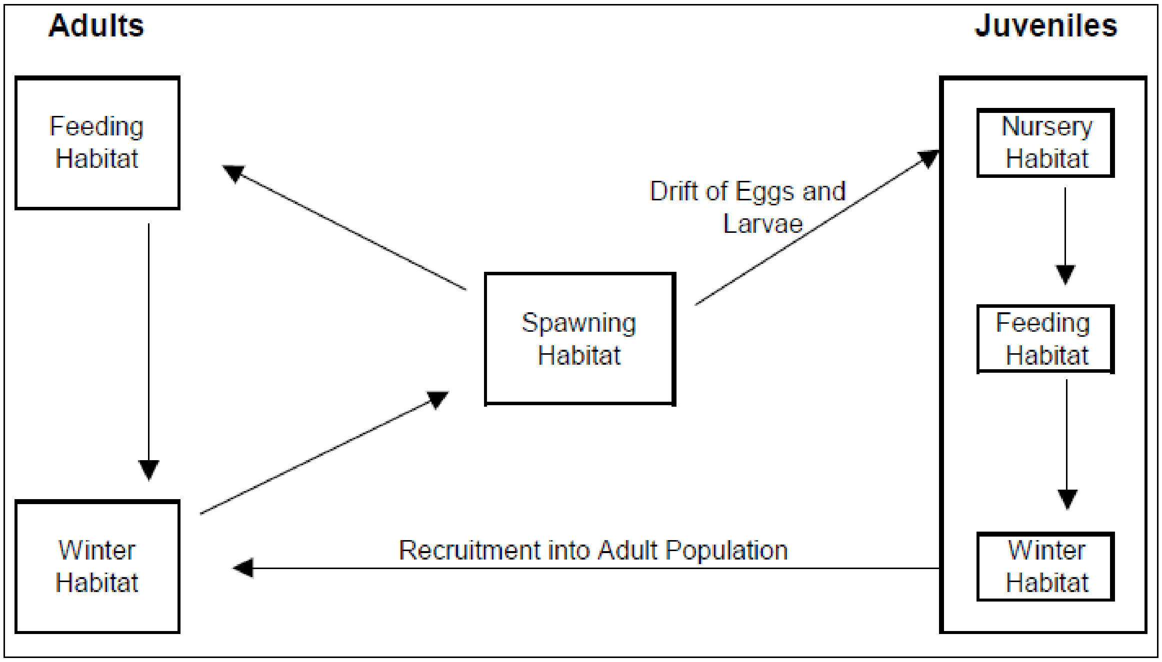
An important attribute of aquatic habitat for river fishes is connectivity, the continuous nature of aquatic habitats in main channels, floodplain water bodies and tributaries. Natural rivers contain a heterogeneous mosaic of aquatic habitats that are very dynamic in both a spatial and temporal sense. River habitats can substantially vary over scales from short- (e.g., flood events), medium- (e.g., seasonal), and long-term (annual, decadal, or longer). Fish in rivers have evolved migratory and life history strategies that take advantage of these complex, changing riverscapes.

Habitat connectivity is important in terms of fulfilling seasonal and life stage-specific habitat needs for river fishes. Fish undergo alimental (food procurement), climatic (seasonal habitat movements), and gametic (reproduction) migrations in rivers (McKeown 1984) (Figure 29). In addition to the conceptual model by McKeown, others (e.g., Fauch et al. 2002; Schlosser 1991) have identified refinements regarding migrations that are common features of fish life histories including migrations that occur between different feeding habitats, and migrations associated with refugia during catastrophic events such as floods, droughts, and extreme water quality conditions (i.e., high temperature, low dissolved oxygen).

Dams and similar structures reduce the connectivity of aquatic habitat by restricting movements of river fishes. Impeded fish movements resulting from dams have been implicated in altered fish community structure and declines of many fish populations in rivers throughout the world (Northcote 1998; Pringle et al. 2000). Restrictions on movements of migratory fish in a river system can potentially limit the extent and quality of habitats that they can occupy. Effects of reduced access to habitats can be expressed at the individual, population, and community levels.

Information on the effects of dams and reduced connectivity of most inland fish populations is generally scarce. However, impeding migrations that freshwater fish use to optimize growth, reproduction, and survival can ultimately affect fish production (Northcote 1978). Reduced access to prime foraging habitat can result in greater expenditure of energy for foraging and reduce growth of individual fish. Reduced access to suitable winter habitat can limit over-winter survival. Restrictions on movements of migratory fish can have significant adverse effects on pre-spawning movements, limit access to suitable spawning habitats, and limit the size of spawning aggregations.

Figure 29 – Pattern of seasonal movements of many Red River of the North fishes (after Mckeown 1984)



A wide range of fish species potentially migrate long distance to fulfill life-history requirements in the Red River basin. In many cases, it may be difficult to define whether or not a species is specifically "migratory." Species in the basin that likely perform regular migrations include, but are not limited to, lake sturgeon, channel catfish, walleye, sauger, goldeye, mooneye, northern pike and several Catastomid (sucker) species. In addition to the tributaries listed above in the project area, tributaries throughout the basin may have fish populations that migrate back and forth from the Red River.

Aadland et al. (2005) provided a summary of fish migration observations through a fish bypass channel on the Otter Tail River, a Minnesota tributary upstream of the project area. The sampling location was about eight miles upstream of the confluence of the Otter Tail and the Bois de Sioux River; the confluence of these rivers forms the Red River. Sampling was done during the spring 1998 and 2000 over a period of a couple months. Though the study included typical limitations due to sampling gears and methodology, the observations provide insight into seasonal upstream fish migrations from the Red River into the Otter Tail River.

Aadland et al (2005, Table 26) noted 21 species of fish had been captured at the upstream end of the fishway. The timing and duration of migration varied by species, but often occurred over a period of several weeks between late March and early June. The date of peak catch was also variable, but was often in late April, or the first couple weeks of May. Table 26 shows the upstream migrating fishes caught in a trap net at the upstream end of the Breckenridge fishway on the Otter Tail River in 1998 and 2000. Catches represent 14 net-days from April 7 to June 4, 1998 and 22 net-days from March 23 to June 1, 2000. Aadland et al. 2005.

Table 26 – Upstream migrating fishes caught on Otter Tail River.

Species	Common Name	Total Catch	% of Total	Date of Peak Catch	Earliest Catch	Latest Catch
Hiodon alosoides	goldeneye	2	<1	May 19	May 19	Jun 1
Hiodon tergisus	mooneye	204	5	May 18	Mar 24	Jun 1
Esox lucius	northern pike	6	<1	Apr 26	Mar 24	May 3
Cyprinus carpio	common carp	5	<1	May 11	Apr 14	May 26
Carpiodes cyprinus	quillback carpsucker	181	4	May 14	Mar 24	Jun 1
Ictiobus cyprinellus	bigmouth buffalo	2	<1	May 26	Mar 30	May 26
Catostomus commersonii	white sucker	75	2	Mar 30	Mar 23	May 25
Moxostoma anisurum	silver redhorse	369	9	May 3	Mar 23	May 26
Moxostoma erythrurum	golden redhorse	435	11	May 3	Mar 23	Jun 4
Moxostoma macrolepidotum	shorthead redhorse	1707	43	May 3	Mar 23	May 26
Moxostoma valenciennesi	greater redhorse	133	3	May 3	Mar 23	Jun 1
Ameiurus melas	black bullhead	4	<1	May 11	Apr 23	May 12
Ameiurus nebulosus	brown bullhead	1	<1	May 3	May 3	May 3
Ictalurus punctatus	channel catfish	679	17	Apr 29	Apr 14	Jun 3
Noturus flavus	stonecat	4	<1	Apr 15	Apr 14	Apr 15
Ambloplites rupestris	rock bass	27	1	May 11	Apr 9	Jun 4
Micropterus dolomieu	smallmouth bass	34	1	Apr 23	Apr 21	Jun 4
Pomoxis nigromaculatus	black crappie	4	<1	May 25	Apr 26	May 12
Sander canadensis	sauger	1	<1	Apr 21	Apr 21	Apr 21
Sander vitreus	walleye	65	2	Apr 22	Mar 23	May 26
Aplodinotus grunniens	freshwater drum	65	2	May 26	Apr 22	Jun 3

Connectivity in the Red River basin has been interrupted through the construction of numerous dams. This has included eight low-head dams constructed on the Red River mainstem within the United States (Table 27), as well as the Lockport dam in Manitoba, Canada. Aadland et al (2005) reported over 500 dams existed on Red River tributaries within the U.S. This has limited the ability for fish populations to move throughout the Red River basin, including movement between the Red River and upstream tributary habitats.

Table 27 – Distribution of low-head dams on the Red River of the North.

The Red River crosses the international border into Canada at River Mile 158.0.

River Mile	Location	Fish Passage Status
207.1	Drayton, North Dakota	Planning Study Underway
296.1	Grand Forks, North Dakota-East Grand Forks, Minnesota	Rock-Rapids Fishway Completed 2001
448.9	North Dam, Fargo-Moorhead (12th/15th Avenue)	Rock-Rapids Fishway Completed 2002
452.2	Midtown Dam, Fargo-Moorhead (4th Street)	Rock-Rapids Fishway Completed 1999
458.1	South Dam, Fargo-Moorhead (32nd Avenue)	Rock-Rapids Fishway Completed 2003
482.7	Hickson, North Dakota	Planning Study Underway
496.6	Christine Dam, North Dakota	Planning Study Underway
546.4	Wahpeton, North Dakota-Breckenridge, Minnesota	Rock-Rapids Fishway Completed 2000

Extensive work has been done to improve connectivity and fish passage within the Red River Basin. Of the eight dams on the Red River mainstem, five have implemented rock-riffle structures to facilitate fish passage (Table 27 and Picture 7). Resource agency biologists believe these projects provide the opportunity for free migration to all species of fish approaching 100-percent of the time. The remaining three dams currently have planning studies underway that are also looking to implement similar fish passage opportunities. If implemented, these projects would facilitate the reconnection of over 300 miles of Red River mainstem habitat. The likelihood of implementation of these three projects is unknown. The projects at Christine and Hickson dams are currently being evaluated by the City of Fargo, and the City has reaffirmed an interest in seeing fish passage implemented at these sites.

Connectivity between the Red River and adjacent tributaries in the project area is variable. The Sheyenne River has very limited connectivity between the Red River and habitat upstream of the project area. A low-head dam in West Fargo on the lower Sheyenne limits or eliminates connectivity during low-flow conditions. Conversely, connectivity during high flow conditions is also limited or non-existent due to the flood project at Horace and West Fargo. This includes multiple control structures that divert all river flow into a flood diversion channel when flows approach a 50-percent chance event. Any biotic connectivity would require fish to migrate upstream through this flood channel, then through a small denil-style fishway at the Horace control weir. The effectiveness of this fishway has not been evaluated. Ultimately, there is likely poor biotic connectivity between the lower Sheyenne and Red rivers under existing conditions.

The Maple and Wild Rice rivers appear to maintain connectivity in the project area. The Maple joins the Sheyenne River downstream of the existing structures discussed above. Thus, the Maple River does maintain connectivity with the Red River. The Maple River does have a dam further upstream of the project area that limits connectivity to headwater areas.

The Rush River includes at least one rock and culvert structure that limits biotic connectivity (Picture 8). Fish migrations are possible when this structure is overtopped. However, under most conditions, fish would have to migrate through one of two culverts to pass this structure.

Outside of the project area, Red River tributaries have received focus for improving fish passage opportunities. These include 30 projects to provide for improved fish movement (Picture 9). Although many dams still remain, future efforts will certainly continue to improve migratory corridors within these basin tributaries.

Picture 7 - Example of a rock-rapids fish passage structure at North Dam, Red River of the North, Fargo, ND. Project completed in 2002.

Picture 8 - Rock and culvert structure on the Rush River within the project area. Photo from April 22, 2010.

Picture 9 - Example of a fish bypass channel at a dam on the Otter Tail River near Fergus Falls, MN. Project completed in 2002. Photo and information source: Aadland 2002.

4.2.1.10 Riparian Habitat

A riparian zone is the area between a body of water and the adjacent upland, identified by soil characteristics and distinctive vegetation that requires an excess of water. It includes wetlands and those portions of the floodplain that support riparian vegetation. Generally it is comprised of trees and shrubs as well as understory vegetation, including a variety of grasses and forbs. Eastern North Dakota riparian zones are dominated by green ash and elm trees where cottonwoods are prevalent in western zones of the state. The riparian zones along the Wild Rice, Maple, Rush and Lower Rush Rivers consist of mostly open farm land. The riparian zones along the Sheyenne and Red River consist of small strips of bottomland hardwoods including, but not limited to, cottonwood, green ash, bur oak, basswood, American elm, silver maple, and hackberry. Although this habitat type makes up a small area it is an important home to numerous wildlife species and is vital to stream health.

4.2.1.11 Wetland Habitat

There are 4,626 acres of wetlands in the project area; the majority of these lands are adjacent to the rivers and streams in the area (Figure 30). This number represents less than 0.05-percent of the area within the project area. Table 28 lists the existing wetlands in the project area by type and size. Definitions of wetland types can be found in Appendix F.

There are numerous wetland restoration programs within the Red River Basin, but implementation has often been hindered by cost and/or land availability. The objectives of the wetland restoration programs include providing flood storage, improving water quality, and increasing wildlife and recreation opportunities.

Due to increasing pressure to either urbanize or improve drainage on cropland, it is anticipated that wetland acreage will either remain the same or decrease within the project area under the without project condition.

Figure 30 – Existing Wetlands

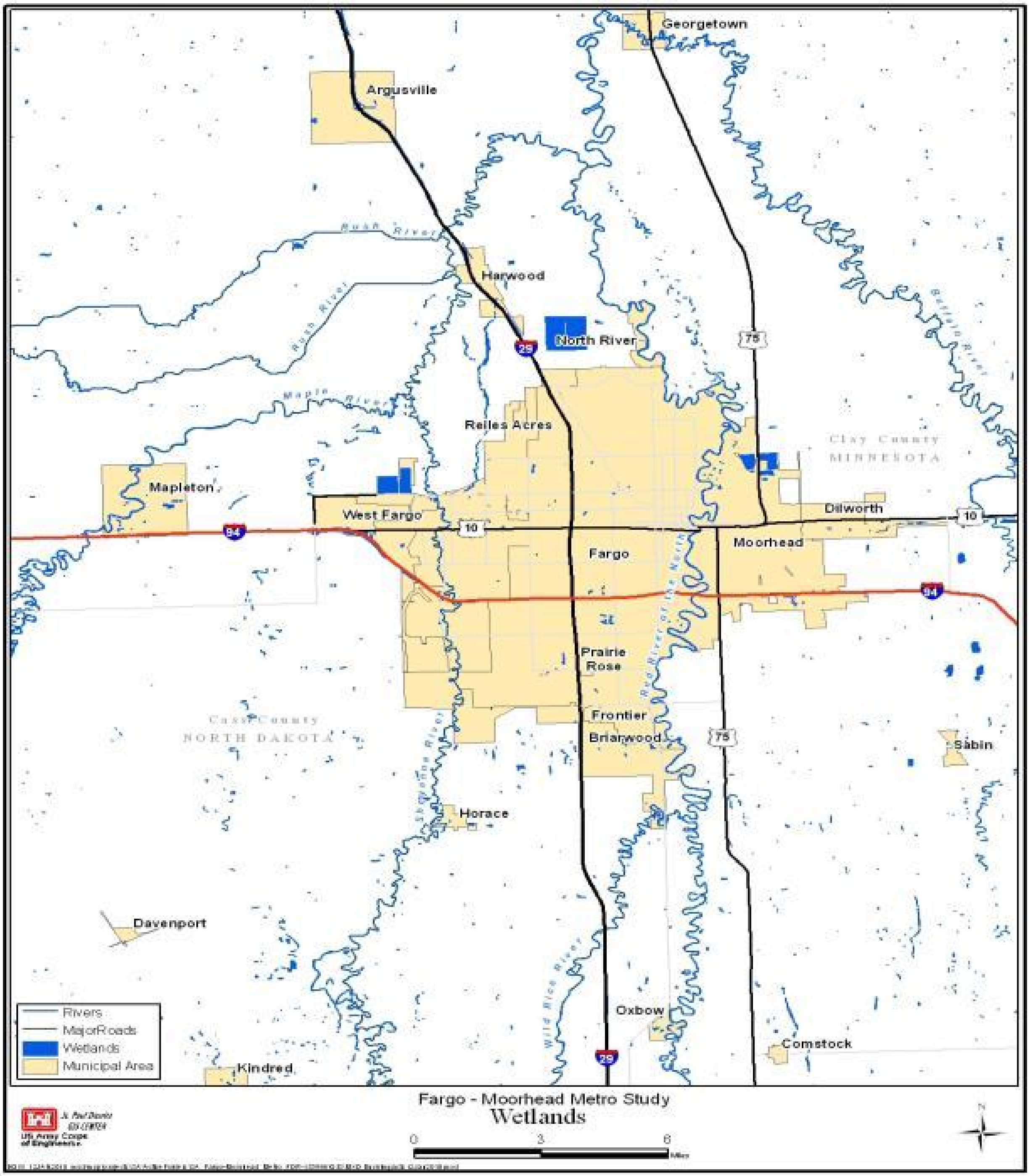


Table 28 - List of existing wetlands by type and number of acres.

Type	Wetland Code	Acres
Lacustrine, Littoral, Aquatic Bed, Intermittently Exposed, Excavated	L2ABGx	761.44
Lacustrine, Littoral, Unconsolidated bottom, Artificially Flooded, Intermittently Exposed, Excavated	L2UBKGx	91.01
Palustrine, Aquatic Bed, Semipermanently Flooded	PABF	77.25
Palustrine, Aquatic Bed, Semipermanently Flooded, Diked/Impounded	PABFh	1.04
Palustrine, Aquatic Bed, Semipermanently Flooded, Excavated	PABFx	26.61
Palustrine, Emergent, Aquatic Bed, Semipermanently Flooded	PEM/ABF	24.28
Palustrine, Emergent, Forested, Broad-Leaved Deciduous, Seasonally Flooded	PEM/FO1C	7.07
Palustrine, Emergent, Forested, Seasonally Flooded	PEM/FOC	28.64
Palustrine, Emergent/Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded	PEM/SS1C	26.34
Palustrine, Emergent/ Unconsolidated Bottom, Semipermanently Flooded	PEM/UBF	2.09
Palustrine, Emergent, Temporarily Flooded	PEMA	163.05
Palustrine, Emergent, Temporarily Flooded, Partially Drained/Ditched	PEMAd	181.92
Palustrine, Emergent, Temporarily Flooded. Excavated	PEMAx	24.83
Palustrine, Emergent, Seasonally Flooded	PEMC	174.59
Palustrine, Emergent, Seasonally Flooded, Partially Drained/Ditched	PEMCd	71.22
Palustrine, Emergent, Seasonally Flooded, Excavated	PEMCx	242.63
Palustrine, Emergent, Semipermanently Flooded	PEMF	69.33
Palustrine, Emergent, Semipermanently Flooded, Partially Drained/Ditched	PEMFd	7.13
Palustrine, Emergent, Semipermanently Flooded, Excavated	PEMFx	32.12
Palustrine, Forested/ Emergent, Seasonally Flooded	PFO/EMC	3.98
Palustrine, Forested, Broad-Leaved Deciduous/ Emergent, Seasonally Flooded	PFO1/EMC	0.55
Palustrine, Forested, Broad-Leaved Deciduous, Temporarily Flooded	PFO1A	7.58
Palustrine, Forested, Broad-Leaved Deciduous, Seasonally Flooded	PFO1C	5.21
Palustrine, Forested, Temporarily Flooded	PFOA	31.53
Palustrine, Forested, Temporarily Flooded, Drained/Ditched	PFOAd	3.20
Palustrine, Forested, Seasonally Flooded	PFOC	10.56
Palustrine, Scrub-Shrub, Emergent, Seasonally Flooded	PSS/EMC	7.17
Palustrine, Scrub-Shrub, Emergent, Seasonally Flooded, Excavated	PSS/EMCx	10.33
Palustrine, Scrub-Shrub, Forested, Seasonally Flooded	PSS/FOC	5.38
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Emergent, Seasonally Flooded	PSS1/EMC	1.33
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded	PSS1C	11.41
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded, Partially Drained/Ditched	PSS1Cd	0.91
Palustrine, Scrub-Shrub, Temporarily Flooded	PSSA	13.25
Palustrine, Scrub-Shrub, Seasonally Flooded	PSSC	2.57
Palustrine, Unconsolidated Bottom, Semipermanently Flooded	PUBF	6.47
Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Diked/Impounded	PUBFh	2.97
Palustrine, Unconsolidated Bottom, Semipermanently Flooded, Excavated	PUBFx	21.79
Palustrine, Unconsolidated Bottom, Intermittently Exposed	PUBG	0.31
Palustrine, Unconsolidated Bottom, Intermittently Exposed, Excavated	PUBGx	15.54
Palustrine, Unconsolidated Bottom, Artificially Flooded, Intermittently Exposed,	PUBKGx	74.71

Excavated		
Riverine, Lower Perennial, Unconsolidated Bottom, Intermittently Exposed	R2UBG	241.53
Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	R2UBH	2114.90
Riverine, Lower Perennial, Unconsolidated Shore, Temporarily Flooded	R2USA	2.08
Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	R2USC	2.10
Riverine, Intermittent, Streambed, Semipermanently Flooded	R4SBF	0.69
Riverine, Intermittent, Streambed, Semipermanently Flooded, Excavated	R4SBFx	15.33
Total Wetland Acres		4625.97

4.2.1.12 Upland Habitat

Upland habitat in the project area is mainly cropland, with a mixture of hayed pasture, hobby farms and suburban dwellings. Wooded areas include mostly a mixture of bottomland hardwood tree species and low vegetation. The narrow riparian zone is in a relatively natural condition. The remaining wooded riparian areas are an important wildlife and aesthetic resource. The riparian woodlands are essentially the only wooded habitat remaining in this predominantly agricultural area. Tree species identified in these areas include bur oak, American linden, eastern cottonwood, American elm, boxelder, green ash, silver maple, buckthorn, and hackberry. Woodland was never very common in the prairie environment, but it is extremely important as nesting, breeding, and overwintering habitat for a number of birds, mammals, and reptiles. Wildlife species present within the project vicinity include typical urban and farmland species such as rabbits, squirrels, raccoons, white-tailed deer, and various songbirds.

4.2.1.13 Terrestrial Wildlife

Birds and mammals that inhabit the rural portions of the project area include raptors, gray partridge, pheasant, mourning dove, waterfowl, fox squirrel, white-tailed deer, red fox, raccoon, mink, badger, striped skunk, white-tailed jackrabbit, beaver, muskrat, and numerous song birds. The riparian vegetation (forested floodplain) associated with the Red, Wild Rice, and Sheyenne Rivers represents most of the terrestrial wildlife habitat that presently exists within the study area. Other than this limited riparian habitat, wildlife resources in the study area are limited to those species that can reside in drainage ways, cultivated fields, and road right-of-ways (ROWs).

Habitat within the urban areas is limited to manicured lawns and landscaped areas. These areas provide only limited habitat for wildlife species. Thus, wildlife resources are limited to songbirds, reptiles, amphibians, and small mammals.

4.2.1.14 Endangered Species

4.2.1.14.1 North Dakota Federal

According to United States Fish and Wildlife Service's (USFWS), there are two Federally listed threatened or endangered species listed for Cass County North Dakota: the whooping crane (*Grus americanus*) and the gray wolf (*Canis lupus)*, both of which are endangered.

4.2.1.14.1.1 Whooping Crane

The whooping crane was listed as endangered by the USFWS on June 2, 1970. The whooping crane is the tallest bird in North America. It is a white bird with black wingtips and red markings on the head. Young birds have a brown-mottled appearance until their second summer. Whooping cranes are 5 feet tall and have wingspans of 7 feet. They fly with a slow downward flap and a rapid upstroke, and often migrate with the smaller, gray, sandhill crane. Their trumpet like call carries for miles (United States Geological Survey [USGS] 2009b).

Whooping cranes inhabit shallow wetlands that are characterized by cattails, bulrushes and sedges. They can also be found in upland areas, especially during migration. Whooping cranes feed on crabs, crayfish, frogs, and other small aquatic life as well as plants (USGS 2009b).

The historical breeding range of the whooping crane extended from Illinois, northwest through North Dakota, and up to the Northwest Territories. The last nesting record for North Dakota was in McHenry County in 1915. The birds historically wintered along the Gulf of Mexico (USGS 2009b). In the 1940s, there were an estimated 21 whooping cranes left in the world. Most were from a flock that wintered at the Aransas National Wildlife Refuge on the coast of Texas. These birds are known to breed in the Wood Buffalo National Park. Today, there are approximately 145 whooping cranes in the wild. About 132 birds are in the Aransas-Wood Buffalo flock. The Aransas-Wood Buffalo population migrates through North Dakota. The fall migration occurs from late September to mid-October and the spring migration occurs from late April to mid-June. Although the bird can show up in all parts of North Dakota, most sightings occur in the western 2/3 of the state (USGS 2009b).

Loss of habitat and poaching are the main reasons for the whooping cranes decline (USGS 2009b).

4.2.1.14.1.2 Gray Wolf

The gray wolf was listed as endangered by USFWS on March 11, 1967. It is the largest of the canines weighing up to 80 lbs and can reach a length of 6.5 feet. The gray wolf is also known as the “timber wolf,” “arctic wolf” in the arctic, and “tundra wolf” in the tundra. It has a gray fur coat with long tawny colored legs, a narrow chest, and tawny-colored flanks; it can live up to 13 years.

The gray wolf can reach speeds up to 45 mph and has excellent sense of smell and hearing. They are excellent hunters often hunting in packs where they seek large prey, such as moose, elk, or deer, when they hunt alone they focus on smaller prey, such as beavers, rabbits, or hare. The can travel up to 30 miles a day searching for prey.

There are an estimated 7,000 to 9,000 wolves in Alaska and more than 3,500 in the lower 48 states. The main threats to the survival of the gray wolf were mainly due to the hunting and trapping of the wolf because it was thought of as a nuisance, and habitat loss due to human encroachment into wolf territories. The gray wolf population was nearly wiped out, but now the gray wolf is legally protected and is said to be thriving and may even be taken off the endangered species list.

4.2.1.14.1.3 Bald Eagles

Bald eagles and their nests are protected from take and disturbance, respectively, per the Bald and Golden Eagle Protection Act. The Fish and Wildlife Service verified the location of two bald eagle nests within the project area. One of the nests is located along the Sheyenne River on the northwest edge of the City of Fargo. This nest was verified to be a successful active nest during the 2009 nesting period. The other nest is located near the confluence of the Sheyenne River and Red River. It is unknown whether this nest was active during the 2009 nesting period.

4.2.1.14.2 North Dakota State

The North Dakota Natural Heritage Program within the North Dakota Parks and Recreation Department was contacted to obtain information on North Dakota's species of concern that had the potential to occur in Cass County (Dirk 2006a; 2006b). Based on the supplied information, it was determined that 52 plant and animal species of concern in North Dakota have the potential to occur in Cass County. These 52 species and the type of habitat utilized/required by each species are provided in Section 1.9.3 of Appendix F**.** Supplied maps and legal description of each species were used to identify documented occurrence of each species in Cass County, which was used to determine the potential for each of the species to be present in the project area. Three of the 52 species that have the potential to occur in Cass County have documented occurrences in the project area. These three species included one plant (blue cohosh) and two bird species (whip-poor-will and northern cardinal).

4.2.1.14.3 Minnesota Federal

Clay County, Minnesota has one species listed on the Federal threatened species list, the Western prairie fringed orchid (*Platanthera praeclara*), and one species on the candidate species list, the Dakota skipper (*Hesperia dacotae*).

4.2.1.14.3.1 Western Prairie Fringed Orchid

The western prairie fringed orchid was listed as threatened by the USFWS on September 28, 1989. The orchid is perennial and distinguished by large, white flowers that come from a single stem. Up to 20 flowers may occur on a single plant and two to five narrow leaves hug the stem. The flower is fringed on the margins, giving it a feathery appearance. The orchid can grow up to three feet high (USGS 2009a).

The vegetative shoots of the western prairie fringed orchid emerge in late May. Flowers do not emerge until mid-June to late July. The entire plant can display flowers for about 21 days with individual flowers lasting up to 10 days. Flowers must be pollinated for seed production. Pollination appears to be accomplished only by hawkmoths with the microscopic seed being dispersed by the wind in early fall (USGS 2009a).

The western prairie fringed orchid occurs most often in remnant native prairies and meadows, but has also been observed at disturbed sites. In the southern parts of its range it is more likely to be found in mesic upland prairies and in the north more frequently in wet prairies and sedge meadow. It is also known from prairies swales in sand dune complexes that are fed by shallow groundwater (Sather 1991). The orchid is well adapted to survive fires (USGS 2009a).

The western prairie fringed orchid was historically found throughout the tall grass regions of North America. This included the Dakotas, Nebraska, Kansas, Oklahoma, Missouri, Iowa, Minnesota, and Manitoba. The Mississippi River was the eastern limit of its range (USGS2009a). The Red River Valley of Manitoba, Minnesota, and North Dakota represented the heart of the orchid's range (Sather 1991). Presently, there are at least 37 separate populations remaining in seven states. In North Dakota, there is a large scattered population in the Sheyenne National grasslands in the southeastern part of the state (USGS 2009a). In Minnesota, there are two populations known: one in Pipestone National Monument and one in Pembina Trail Preserve Scientific and Natural Area (Minnesota Seasons 2009).

The main reason for the decline of the western prairie fringe orchid is the conversion of native prairie lands to cropland (USGS 2009a).

4.2.1.14.3.1 Dakota Skipper

The Dakota skipper is a candidate for listing under the Endangered Species Act. It is a small to medium-sized butterfly with a 1-inch wingspan. The butterfly inhabits wet lowland prairie dominated by bluestem grasses and dry upland prairie dominated by mixed bluestem grasses and needle stem grasses. The Dakota Skipper was once widely distributed throughout the northern tallgrass, Dakota mixed grass, and a portion of the central tallgrass prairie ecoregions. Its distribution once included tallgrass and mixed grass prairies of Illinois, Iowa, Minnesota, South Dakota, North Dakota, Manitoba and Saskatchewan. The distribution is now largely centered in western Minnesota, northeastern South Dakota and the eastern half of North Dakota.

4.2.1.14.4 Minnesota State

Based on information available from the Minnesota Department of Natural Resources' Natural Heritage program, 15 Minnesota-listed threatened and endangered species have the potential to occur in Clay County (Appendix F) (Minnesota Department of Natural Resources 2009). These identified state-listed species include eight bird species (six endangered and two threatened species), four invertebrate species (two endangered and two threatened), and three plant species (all threatened). As shown in section 1.9.2 of Appendix F, six of the bird species and all four of the invertebrate species are found in areas with native upland prairies, while the remaining two bird species and the three plant species are found in wetlands, wet meadows, lake shores, and other wet/moist area including peatlands. With their mobility, it can also be assumed that the listed bird and invertebrates may on occasion be found in areas adjacent to their preferred habitat.

Minnesota's special concern species that have the potential to occur in Clay County are shown in section of 1.9.1 Appendix F. As shown, 34 special concern species have the potential to occur in Clay County including two mammal species, five bird species, one reptile species, one fish species, two mussel species, five insect species, and 18 plant species. With the exception of the bald eagle, lake sturgeon, and two mussel species, identified species are found in native upland grasslands, savanna, and prairies or in wetland areas including wet meadows, fens, swamps, and other wet/moist areas. A recovery program has been initiated to restore lake sturgeon to the Red River drainage, and the two mussel species are found in rivers and streams. Bald eagles frequent riparian areas associated with lakes and large rivers, especially riparian forests that contain large trees that can be used as nest sites, roosts, and perches. As discussed previously, the mobile species (mammals, birds, and insects) can be expected to infrequently occur in areas adjacent to areas that contain habitat preferred by a species.

4.2.1.15 Prime and Unique Farmland

The Federal Farmland Protection Policy Act (FPPA) was enacted in 1981 (Public Law [PL] 98-98) to minimize the unnecessary conversion of farmland to nonagricultural uses as a result of federal actions. In addition, FPPA seeks to assure federal programs are administered in a manner compatible with state and local policies and programs that have been developed to protect farmland.

The policy of the Natural Resources Conservation Service (NRCS) is to protect significant agricultural lands from conversions that are irreversible and result in the loss of an essential food and environmental resource. Prime farmland has been identified by NRCS as a significant agricultural resource that warrants protection. The FPPA defines prime farmland as land that has the physical and chemical characteristics for producing food, feed, fiber, forage, and oilseed crops and is available for these uses. Prime farmland has the soil quality, growing season, and moisture supply needed to economically produce sustained high yields of crops when treated and managed, including water management, according to acceptable farming methods.

Three of the Cass County, North Dakota soils are considered prime farmland by the NRCS. Eight other soils are considered prime farmland if they are drained. For the North Dakota alternatives footprint area over 95 percent of the land is considered to be prime and unique farmland; this equates to up to approximately 6,000 acres. For the Clay County, Minnesota study area, four soils are considered prime farmland by the NRCS and five are considered prime farmland if they are drained. One soil type is prime farmland if protected from flooding or not frequently flooded during the growing season. One soil type is considered farmland of state importance. For the Minnesota alternatives footprint area over 95 percent of the land is considered to be prime and unique farmland; this equates to up to approximately 5,700 acres.

4.2.2 Cultural Resources

4.2.2.1 Historic Conditions

Paleoindian tradition cultures based on the hunting of large Late Pleistocene/early Holocene game animals dated to 11,500 B.P. (years before present) are the earliest documented cultures in North America. No early Paleoindian sites are expected in the Project area due to the presence of glacial Lake Agassiz in what is now the Red River valley and northwestern Minnesota. The Sheyenne River valley to the west was a glacial meltwater channel which emptied into the lake until ca. 10,900 B.P. By 10,000 B.P., however, areas of boreal forest surrounding Lake Agassiz and the lake's beaches would have become increasingly available for use by Paleoindian peoples.

Small seasonal camps, kill sites, and isolated projectile points from Late Paleoindian times have been found on the Lake Agassiz beach ridges and buried in the river terraces in the Red River Basin (USACE 1998).

Glacial Lake Agassiz had receded well north into Canada by 8,000 B.P. and the large Pleistocene mammals (mammoth, camel, horse, bison) hunted by the earlier Paleoindians had become extinct. The boreal forest of the Red River valley was replaced by prairie grassland to the west of the Red River and first by pine and then by mixed deciduous forests to the east of the Red. By 7,000 B.P., the climate had entered a long, dry period during which prairie grasslands spread eastward as far as northeastern Minnesota. The prairie/forest border shifted several times through the subsequent years, but the Red River valley remained prairie grasslands. The expansion of the prairie grassland eastward resulted in a change to more regionally oriented cultures that are part of the Archaic tradition (8,000-3,000 B.P.), which is based on gathering wild plants and hunting bison and smaller animals. Prairie Archaic cultures were adapted to the tall grass prairie of western Minnesota and Plains Archaic cultures were adapted to the mixed grass prairie of eastern North Dakota. Archaic sites have been found along small streams, at pothole lakes, on the beach ridges of glacial Lake Agassiz, and buried on the terraces and floodplain of the Red River and its tributaries (USACE 1998).

The following Woodland tradition (3,000-900 B.P.) is characterized by the initial appearance and manufacture of grit-tempered pottery vessels and the use of earthen mounds for burial purposes. Bison hunting and plant gathering formed the basic Woodland economy. The bow and arrow with its small triangular points were introduced at this time. Woodland sites have been found near lakes and rivers and on the uplands overlooking river valleys. Late Prehistoric Period Woodland hunting and gathering cultures continued from 1,100 B.P. (A.D. 900) up to the time of contact (A.D. 1660 in Minnesota; A.D. 1738 in North Dakota) in all but the southernmost Red River valley. Village sites of the Northeastern Plains Village complex occur on river terraces along the Sheyenne River, while Cambria complex village sites occur on river terraces in southwestern Minnesota. Both complexes are based on a dual corn horticulture and bison hunting-wild plant gathering economy (USACE 1998).

Native American groups known to have lived in the Red River valley include the Hidatsa, Arapaho/Atsina, Plains Ojibwe (Chippewa), Assiniboin, and Yanktonai Dakota. The Arapaho/Atsina are believed to have occupied the Red River valley prior to and during the early 1600s though no archeological sites found to date have been attributed to them. The village-dwelling Hidatsa originated in southwestern Minnesota and migrated northward down the west side of the Red River. Their home territory prior to A.D. 1650 centered on Devils Lake, but extended from the Red River west to the Souris River. They left the Red River-Devils Lake area for the Missouri River valley when the gun-equipped, bison hunting Plains Ojibwe moved into northeastern North Dakota from northern Minnesota and southern Manitoba in the 1700s. The Plains Ojibwe occupied tipi camps from the Red River west to the Turtle Mountains and hunted bison out on the Plains even prior to their acquisition of the horse (USACE 1998).

The Yankton and Yanktonai Dakota lived in central Minnesota in the mid-1600s where they practiced a hunting-gathering-gardening lifestyle. The Assiniboin, having gradually split off from the Dakota, occupied northwestern Minnesota and the Red River valley in Canada at that time. The prehistoric and protohistoric Blackduck culture in northern Minnesota is considered ancestral to the Assiniboin. The encroachment of the Ojibwe from the north and east between A.D 1679 and 1750 forced both the Dakota and Assiniboin westward. After 1750 the Yanktonai Dakota occupied the southeastern quarter of North Dakota east of the Missouri River. The Assiniboin moved to northwestern North Dakota and adjacent Canada west of the Souris River loop (USACE 1998).

The fur trade flourished in the Red River valley from 1738 to around 1860. French fur trade activities lasted from their initial contact with the Dakota in Minnesota in A.D. 1660 to their 1763 loss of the French and Indian War, and thereby Canada, to the British. From A.D. 1763 to 1803, the British controlled the fur trade in the Red River Basin. Posts were established at Pembina in 1797 by Chaboillez and by David Thompson and Alexander Henry for trade with the Plains Ojibwe in the Red River valley. Independent British trader Robert Dickson established a post at Lake Traverse in the 1790s. A North West Company fur trading post was established at Grand Forks/East Grand Forks in the early 1800s. In 1811, the Scottish Earl of Selkirk, with a land grant from the Hudson’s Bay Company, started an agricultural colony at the confluence of the Red and Assiniboine rivers in Manitoba. In 1816 the colony was attacked by the large Metis population of the area. Subsequent to this, Lord Selkirk purchased from the Ojibwe and Cree a strip of land extending from the mouth of the Red River upstream to where Grand Forks is now located, with the main settlement at the 49th parallel in the Pembina area (USACE 1998).

The development of the Red River oxcart trails was a direct result of the fur trade and the need for transporting goods between settlers in the Red River region and St. Paul, Minnesota. These cart trails were used from the 1830s to 1871 when the railroads replaced them. The Red River Trail followed the east side of that river from Lake Traverse to Pembina. The North Dakota Trail ran north-south to the west of and roughly paralleling the Red River (USACE 1998). A branch of the Red River Trail crossed the Red River between these two trails at Georgetown, roughly 12 miles north of Moorhead (Gilman et al. 1979).

A land cession treaty between the United States government and the Ojibwe in 1863 resulted in the Ojibwe giving up most of their land and mineral rights in northern Minnesota and the Red River valley in North Dakota. The Dakota ceded most of their lands in southwestern Minnesota and the Red River Basin in North Dakota in 1872 (USACE 1998).

Minnesota was organized as a territory in 1849 and the Dakota Territory was organized in 1861. Minnesota statehood came in 1858. North and South Dakota became states in 1889 (USACE 1998). Clay County, Minnesota was established in 1862 and Cass County, North Dakota in 1872. Both Fargo’s and Moorhead’s origins date to 1871 with the Northern Pacific Railway’s arrival at and first crossing of the Red River into North Dakota (Upham 1969:117; Williams 1966:63). Fargo acquired a post office that same year and soon became the hub for a large agricultural area. Fargo was incorporated in 1875 (Williams 1966:63-64) and Moorhead in 1881 (Upham 1969:117). The Northern Pacific Railway built a siding spur, water station, and stockyards on the west side of Fargo in the 1870s. In 1882, the spur was extended five miles west and the stockyards and water station were moved to the east bank of the Sheyenne River. The rail station, originally named Haggert, was renamed West Fargo in 1925 when a company town grew up around the newly established Armour meat packing plant. West Fargo was incorporated in 1931 and is now a suburb of Fargo (Williams 1966:72-73).

Settlement of western Minnesota and the Dakotas was directly tied to the arrival of the Northern Pacific Railroad in Moorhead in 1871 and the St. Paul, Minneapolis and Manitoba (Great Northern) Railroad in Grand Forks in 1880. The 1878-1887 influx of settlers from Germany, Scandinavia, Great Britain, Ireland, and the Great Lakes region into the Red River valley was the direct result of the chance for free land under the Homestead Act of 1862 and the active promotions of the railroads. A second influx of settlers occurred from the late 1890s to 1920 and involved eastern, central, and southern Europeans. Improvements to highways and country roads occurred after 1910 with the increasingly common use of the automobile. The drought and depression of the late 1920s and 1930s resulted in the loss of many farms in the Red River valley due to an inability to pay mortgages and/or taxes because of successive crop failures (USACE 1998).

4.2.2.2 Previous Cultural Resources Investigations

Due to the large project area the information gathered from previous cultural resources investigations was limited for each of the diversion channel alternatives as described below. For the North Dakota East diversion alternatives, gathered information was limited to a one-mile corridor centered on the alignment. The previous investigations include a 1978 survey of parts of the lower Sheyenne River Basin (Vehik 1978), a 1986 survey of the West Fargo Flood Control Project (Floodman 1988), a 1986 archeological survey and test excavations in Cass County (Michlovic 1986), a 1990 Cenex pipeline survey (Schweigert 1990), and the 2009 survey of the Fargo Southside Study Area (URS Group 2009). Generally less than ten percent of the North Dakota East diversion alignment has been covered by these prior cultural resources surveys, the exception is where it intersects the existing West Fargo diversion channel area, which has been completely investigated.

There have been no previous cultural resources surveys along a one-eighth-mile wide corridor centered on the North Dakota East Diversion Tie-Back Levee alignment and within a one-half-mile wide corridor centered on the Minnesota Short Diversion Channel Extension alignment, both of which are in Minnesota.

Previous Phase I cultural resources investigations within the one-mile-wide corridor centered on the Minnesota Short Diversion alignment includes a 1978 archeological survey along the Red River in Clay County, Minnesota (Michlovic 1978, 1979). A historic standing structures inventory of the city of Moorhead took place in 1979 (Moorhead Community Development Department 1979). Less than five percent of the alignment has been previously checked for cultural resources.

The 2009 Phase I cultural resources survey of the Fargo Southside Study Area (URS Group 2009) includes small areas of the one-eighth-mile wide corridor centered on Minnesota Short Diversion Tie-Back Levee alignment.

4.2.2.3 Known Cultural Resources Sites

Cultural resources include any prehistoric or historic archeological site, building, standing structure, or object at least 50 years old relating to the history, architecture, archeology, or culture of an area. A historic property is a site, structure, building, object, or district which has been listed on or has been determined eligible for inclusion on the National Register of Historic Places. An unverified site lead refers to a potential prehistoric or historic archeological site based on verbal or written information which has not been field verified by a professionally qualified archeologist or historian.

Known cultural resources within the one-mile corridor centered on the North Dakota East Diversion alignment include four prehistoric archeological sites (32CS42, 32CS43, 32CS44, 32CS201) and four historic standing structures (32CS4461-Maple River bridge in Raymond Township, 32CS4462-Sheyenne River bridge in Warren Township, 32CS5090-rural residence, 32CS5091-rural residence). In addition, there is an unverified lead to one historic archeological site (32CSX238b-Red River Trail segment). There are no National Register of Historic Places listed historic properties along the North Dakota East alignment as of April 7, 2010. The only National Register eligible property is the Sheyenne River Bridge in Warren Township (32CS4462). Phase II testing to evaluate the National Register of Historic Places eligibility of archeological sites 32CS42 and 32CS44 for the West Fargo Flood Control Project resulted in determinations that they were not eligible to the National Register (Persinger 1988).

The only known cultural resource within the one-eighth-mile wide corridor centered on of the North Dakota East Diversion Tie-back Levee centerline is an unverified lead to one historic archeological site (21CYr), the Red River Trail. The tie-back levee centerline crosses the historic oxcart trail in one location in Clay County, Minnesota. No National Register listed or eligible historic properties are present along this alignment as of April 7, 2010.

Known cultural resources within the one-mile-wide corridor centered on the Minnesota Short Diversion alignment includes three prehistoric archeological sites (21CY3, 21CY19, 21CY55) and four historic standing structures (CY-DWG-003-Northern Pacific shop buildings at Dilworth, CY-KRG-001-John Olness House at Kragnes, CY-KRG-004-Kragnes Bar, CY-KRG-005-warehouse at Kragnes). The Minnesota Short diversion alignment crosses the unverified locations of three historic archeological sites: the ghost towns of Ruthruff (21CYk) and Lafayette (21CYl[el]), and the Red River Trail (21CYr). The latter historic oxcart trail is crossed three times by theiversion centerline. The Minnesota Short Diversion alignment also crosses the unverified historic archeological ghost town site of Burlington (21CYo). The John Olness House (CY-KRG-001) at Kragnes is the only National Register listed property found along the Minnesota Short diversion alignment as of April 7, 2010.

There are unverified leads to two historic archeological sites, the ghost town of Burlington (21CYo) and the Red River Trail (21CYr), within the one-half-mile wide corridor centered on the Minnesota Short Diversion Channel Extension alignment. The channel extension centerline follows the historic oxcart trail for three-quarters of a mile. No National Register listed or eligible historic properties are present along this alignment as of April 7, 2010.

There is an unverified lead to one historic archeological site, the Holy Cross Mission (32CSX1), within the one-eighth-mile wide corridor centered on the Minnesota Short Diversion Tie-Back Levee alignment. No National Register listed or eligible historic properties are located along this alignment as of April 7, 2010.

4.2.3 Socioeconomic Resources

This section presents an overview of major socioeconomic characteristics and trends, including demographics and economics in order to provide a context from which to assess impacts of the proposed project. The project area was defined to include the entire Fargo Metropolitan Statistical Area (MSA), which includes Moorhead, MN, Clay County, MN, Fargo, ND, and Cass County, ND. Quantitative data reported by the U.S. Bureau of the Census were utilized to analyze the socio-demographic characteristics of the MSA. The dataset used for the analysis includes the 3-year estimates (2006, 2007, and 2008; pooled data) from the Population and Housing Narrative Profile of the American Community Survey (ACS). These ACS data provide the highest-quality, most generalizable current data on the Fargo-Moorhead area. Data to report population growth is from annual population estimates produced by the Bureau of the Census.

4.2.3.1 Population size and composition

According to the 2000 census, the total population of the MSA was 174,367. The ACS pooled 2006–2008 data, indicated the population of the MSA was at 192,000, an increase of 17,633 persons. The gender ratio was 1:1—50 percent male and 50 percent female—and the median age was at 31.6 years. Nationally, the population is 51 percent female and the median age is 36.7 years. The percentage under 18 years of age (23 percent) is lower the national percentage (25 percent), as is the percent under 65 years of age (10 percent in the Fargo-Moorhead metropolitan area, 13 percent nationally).

4.2.3.2 Household structure

The ACS pooled data from 2006-2008 indicated that of the 82,000 households in the MSA, the average size was 2.2 people (which compares to an average size of 2.6 nationally). In 2000, the MSA reported nearly 70,000 households. Over half (58 percent) of these households were families (46 percent married couples and 12 percent other). The majority of nonfamily households were individuals living alone (32 percent of all households were people living alone). The proportion of married-couple families mirrors closely ACS estimates for the United States as a whole (that figure stands at 50 percent); the proportion of households containing individuals living alone is higher than the estimate for the United States (which is 27 percent), and the proportion of other nonfamily households in the United States is correspondingly lower (6 percent nationally).

4.2.3.3 Race and ethnic diversity
Of those who reported only one race in the MSA, 93 percent were White (compared to 74 percent nationally), 2 percent were Black or African American (compared to 12 percent nationally), 1 percent were Asian (4 percent nationally), less than 0.5 percent were Native Hawaiian or Other Pacific Islander (comparable to the national rate), and 1 percent were some other race (compared to 6 percent nationally).

Ethnic diversity in the area stands markedly lower than in the United States as a whole. Whereas an estimated 13 percent of U.S. residents were foreign born in 2006–2008, only 4 percent of people living in MSA in that period were foreign born. The proportion of area residents who spoke a language other than English at home stood markedly lower than in the United States as a whole (20 percent of individuals over 5 years of age nationally, 6 percent in this metropolitan area). Approximately one-third of these individuals spoke Spanish.

4.2.3.4 Education
Citizens in this area have a higher level of education than their counterparts nationally. Fully 93 percent of people 25 years and older held at least a high school degree (compared to 85 percent nationally) and 35 percent held a bachelor's degree or higher (compared to 27 percent nationally). Whereas the dropout rate (people who were not high school graduates and not enrolled in school) stood at 15 percent nationally, the percentage in the Fargo-Moorhead metropolitan area was less than half that (7 percent). During the 2006–2008 period, total school enrollment in the Fargo-Moorhead metropolitan area stood at 57,000 (4,700 nursery school and kindergarten, 27,000 elementary or high school, and 26,000 college or graduate school). Disability statistics could not be reported because the number of sampled cases was too small, threatening confidentiality.

4.2.3.5 Housing
According to the ACS pooled data from 2006–2008, there were 82,000 occupied housing units in the Fargo-Moorhead metropolitan area, compared to 69,985 in 2000. Of the total housing units, 6 percent of stood vacant (markedly lower than the 12 percent vacant in the United States as a whole). Of total housing units, 58 percent were single-unit structures, 39 percent were multi-unit, and 3 percent were mobile homes (nationally, 67 percent were single-unit, 26 percent were multi-unit, and 7 percent were mobile homes). The median monthly housing cost for mortgaged owners was lower than the comparable national statistic ($1,331 in the Metro area; $1,508 nationally). For non-mortgaged owners, the cost was $451 (which is comparable to the national cost of $425) and for renters the cost was $591 (markedly lower than the $819 national statistic). Nearly 14 percent of non-mortgaged owners spent 30 percent of their household income on housing, compared to 16 percent nationally; 46 percent of renters (50 percent nationally) fell into this category. More than three-quarters (77.7 percent) of residents lived in the same house they had lived in one year prior.

4.2.3.6 Industrial and occupational structure, journey to work
According to the ACS pooled data from 2006–2008, the most prominent industries among the population in the Fargo-Moorhead metropolitan area included educational services and health care and social assistance (24 percent) and retail trade (13 percent). Agriculture accounted for less than 2

percent of the employed population and information accounted for 2 percent. The most prevalent occupations included management, professional, and related occupations (35 percent); sales and office occupations (26 percent); service occupations (16 percent); production, transportation, and material moving occupations (13 percent); and construction, extraction, maintenance, and repair occupations (9 percent). The public sector employed 13 percent of the population, 5 percent were self-employed.

For commutes to work in Fargo-Moorhead metropolitan area, the proportion of workers who drove alone was somewhat higher than in the United States as a whole (82 percent compared to 76 percent nationally), and the proportion who carpooled (9 percent) or used public transportation (1 percent) were somewhat lower. Notably, an estimated 7.1 percent of occupied households had no vehicle available (ACS pooled data from 2006–2008).

According to the ACS pooled data from 2006–2008, the unemployment rate in the Fargo-Moorhead metropolitan area was low, estimated at 2.9 percent of individuals 16 years and older. Nearly three-quarters (74.8 percent) of those 16 and over were in the labor force; 70 percent of women 16 and over were in the labor force and 67.4 percent of those were employed. Of children under 6 years old, 77.3 percent had all parents in the labor force; of children between the ages of 6 and 17 years, 83.1 percent had all parents in the labor force.

Although the area is typically described by residents as relatively prosperous and evidencing low levels of poverty, the median household income of the Fargo-Moorhead metropolitan area was somewhat lower ($47,636) than for the United States as a whole ($52,175) and the poverty rate of individuals (12 percent) mirrored closely the national rate (13 percent). However, the child poverty rate was lower than the national rate: 11 percent of children under 18 years of age lived in poverty in the Fargo-Moorhead metropolitan area, compared to 18 percent nationally. The poverty rate among families (7 percent) was slightly lower than the national rate of 10 percent; the poverty rate among female-headed households (31 percent) was very close to the national rate (29 percent of families that had a female-headed household and no husband present). Whereas 27 percent of households received Social Security nationally, 20 percent of Fargo-Moorhead metropolitan area households did.

4.2.3.7 City Government

The Fargo City Commission consists of four commissioners and the mayor, who acts as the commission president. Commissioners are elected to four-year terms from the city at large, not from specific precincts. Two commission seats are elected biennially. Each commissioner is responsible for specific portfolios of city departments and projects. Commissioners and mayors are limited to three consecutive four-year terms. The city has 84 full-time fire department personnel and 83 full-time city police officers.

The City of Moorhead operates under the "city manager" form of government, with an elected City Council serving as decision makers for the community. Their policies focus on long-range goals such as community growth, land use development, capital improvement plans, capital financing and strategic development. The City Manager, who reports directly to the Mayor and the City Council, is responsible for carrying out the established policies and oversees the daily operation of the City of Moorhead.

In Moorhead, the City Manager supervises four departments, each with its own divisions and directors: Community Services, Operations, Fire, and Police. The city has 37 full-time fire department personnel and 55 full-time and 6 part-time city police officers.

4.2.3.8 Recreational Opportunities

The metropolitan area offers a wide variety of parks and recreational facilities for all ages. The area features more than 115 public parks covering 2,800 acres, 22 golf courses, 40 miles of recreational and walking paths, soccer and softball complexes. The Minnesota lakes region, within an hour's drive of Fargo-Moorhead, provides thousands of lakes and a wide variety of four-season recreational activities from which to choose. Five area state parks provide year-around outdoor recreational activities within a short driving distance of Fargo-Moorhead. Appendix M, Recreation has additional information on the existing recreational opportunities in the region.

4.2.3.9 Cultural Opportunities

Fargo-Moorhead is home to several art museums, a growing zoo, an active community theater organization, a symphony orchestra and an opera company. The three universities in town host a wide variety of activities ranging from prominent visiting lecturers to internationally-known performing artists. The Fargodome is a 28,000-seat arena adjacent to the North Dakota State University (NDSU) campus and hosts activities ranging from concerts and ice shows to rodeos and monster truck races. Bonanzaville, located in West Fargo, celebrates the region's history through displays and events. The 1926 restored Fargo Theatre is a vintage movie palace with a vaudeville stage. The theatre serves as a multi-purpose facility with capacity for film showings, live productions and meetings, and is a registered historic landmark. It also houses a restored theatre pipe organ, the "Mighty Wurlitzer." The home stadium for the area minor league baseball team, the Fargo Moorhead Redhawks, is located on the NDSU campus. The cities host collegiate athletic events ranging from Division I football to women's basketball. The Fargo Force major junior hockey team plays in the newly constructed Urban Plans Center, which hosted the U-18 World Junior Hockey Championship in April, 2009.

4.2.3.10 Transportation

Transportation planning is done in conjunction with the Fargo-Moorhead Council of Government (Metro COG). Metro COG is the primary transportation planning agency for the metropolitan area. Metro COG coordinates the development of a comprehensive and coordinated transportation system for the area. In addition to roadway networks, Metro COG also works on transit and bicycle routes.

Moorhead has 175 miles in its local street system, of which 156.5 miles, almost 90 percent, are under the City's jurisdiction. Twelve of the remaining miles are under state jurisdiction which 6.5 miles are under Clay County's jurisdiction.

Fargo has approximately 552 miles of roadway divided into the following functional classifications: 338 miles of local or residential; 53 miles of local collectors; 77 miles of minor arterial; and 84 miles of principal arterial roadways.

The median commute time in the Fargo-Moorhead area is less than 20 minutes.

4.2.3.10.1 Major Highways

Fargo Moorhead is connected with northern markets across the United States and Canada via Interstate-94. The I-94/I-90 corridor reaches from Boston and Quebec on the east coast to Seattle on the west coast linking major metropolitan areas, such as Buffalo, N.Y., Cleveland, Detroit, Chicago, Milwaukee, Minneapolis, Montreal and Toronto.

The community is also connected with central markets through the United States via I-29. I-29 reaches from Winnipeg to Kansas City, Missouri, where I-35 continues to the border of Mexico. I-29 also provides direct links to major east-west connections such as I-40, I-70, I-80 and I-90.

4.2.3.10.2 Air Service

Hector International Airport in Fargo is serviced by Delta Airlines, United Airlines, Allegiant Air, and American Eagle Airlines with daily jet service to/from Chicago, Salt Lake City, Minneapolis and Denver. Frequent seasonal charter flights are available to points in Nevada and Mexico. Hector also features multiple cargo/freight carriers; six on-site car rental companies; 24-hour full service aviation line services including fueling, aircraft maintenance and avionics repair station; aircraft charter service; flight school; aircraft rental; heated hanger space; and a U.S. Port of Entry with on-site customs services.

4.2.3.10.3 Railroads

Burlington Northern Santa Fe (BNSF) has its Dakota division headquartered in Fargo and serves North Dakota, Northwest South Dakota, Eastern Montana, Western Minnesota and the Canadian province of Manitoba with 60 trains per day. An Intermodal Port operated by Burlington Northern Santa Fe, located 3 miles east of downtown Fargo-Moorhead in Dilworth, MN handles flatcar shipments of trailers, containers and other freight.

Railroad service is offered to multiple industrial park sites within the Fargo-Moorhead area, providing convenience and efficiency to the businesses using the services.

Otter Tail Valley Railroad is a short-line railroad serving industrial parks and rural communities throughout Clay County, MN. The Otter Tail Valley Railroad interchanges with the Burlington Northern Santa Fe Railroad and Dilworth yard in Fargo-Moorhead.

Red River Valley & Western Railroad is a short-line regional railroad serving industrial parks and properties in rural communities throughout Cass County, ND. The Red River Valley & Western interchanges with the Burlington Northern Santa Fe Railroad in Casselton, ND and with the Canadian Pacific Railroad just west of Cass County.

Amtrak provides service to the Fargo-Moorhead area with its Chicago - St. Paul - Portland/Seattle route. Two trains arrive and depart daily, one east bound and one west bound.

4.2.3.10.4 Bus

Metro Area Transit, or MAT, Fargo Moorhead's public bus system, operates 6 days per week on 18 different routes though Fargo, Moorhead and West Fargo, accumulating over 1 million miles each year. Bus travel begins at 6 am (Monday- Friday) and ends as late as 10:15 pm (Monday-Friday). Saturday operations are from 7 am until 7 pm. Services provided by MAT include: Para-transit, wheelchair accessibility, bike racks, fare-free rides for college students, and park-and-ride.

Fargo-Moorhead has a Greyhound bus station in the central station of the MAT, located in downtown Fargo. Fargo-Moorhead's Greyhound routes run east to Minneapolis/St. Paul, MN; west through Bismarck, ND to Billings, MT; south to Sioux Falls, SD; and north to Grand Forks, ND.

5.0 ENVIRONMENTAL CONSEQUENCES*

5.1 ENVIRONMENTAL EVALUATION METHODOLOGY

An environmental analysis was conducted for the proposed project and a discussion of those impacts is presented below. As specified in Section 122 of the 1970 Rivers and Harbors Act, the categories of impacts listed in Chapter 4 were evaluated. In accordance with the Clean Water Act, a Section 404(b)(1) evaluation has been prepared. The no action alternative assumes no Federal action but does assume full implementation of emergency protection actions so that some level of flood risk management will continue for the community.

This chapter describes the predicted impacts of the alternatives, including the consequences of the no action alternative, on the relevant environmental resources described in Chapter 4. It evaluates direct, indirect, and cumulative effects, and quantifies these effects whenever possible. Measures and commitments intended to mitigate adverse environmental impacts are also described.

5.2 EFFECTS ON SIGNIFICANT RESOURCES

The analyses recognize that there are links between resources. For example, if an alternative affects streamflows, it may also in turn affect aquatic communities and riparian areas. Changes in these resources could, over time, impact wildlife and cultural resources. Throughout these impact assessments, linkages are discussed where appropriate and are quantified when possible. The significant resources were identified during the scoping process and outlined in the Scoping Document in Appendix F. The effects on these resources are identified in this chapter. Not all resources are highlighted from the scoping document since they will not be affected by the evaluated alternatives.

The "diversion channel alternatives" are the six diversion channel alternatives under consideration, including the North Dakota East 30,000 cfs (ND30k), North Dakota East 35,000 cfs (ND35k), Minnesota Short 20,000 cfs (MN20k), Minnesota Short 25,000 cfs (MN25k), Minnesota Short 30,000 cfs (MN30k), and the Minnesota Short 35,000 cfs (MN35k). Analysis for the Minnesota diversion channel alternatives will include all four plans[1] unless otherwise stated; the analysis for the North Dakota diversion channel alternatives will include both plans unless otherwise stated. The smaller diversion alternatives will have similar but slightly reduced impacts then the larger MN35k and ND35k alternatives. Impacts for the no action alternative are only discussed for the resources where there is expected to be an impact; these include water quality, wetlands and floodplain.

Natural Resources

- Air Quality
- Water Quality
- Sedimentation and Erosion

[1] "Alternative" and "plan" are used interchangeably in this report.

- Downstream Water Quantity
- Slope Stability
- Wetlands
- Groundwater
- Aquatic Habitat
- Fish Passage
- Upland Habitat/Riparian Habitat
- Endangered Species
- Prime and Unique Farmland
- Hazardous, Toxic and Radioactive Waste (HTRW)

Cultural Resources

- Cultural Resources

Socioeconomic Resources

- Social Effects
- Economic Issues
- Environmental Justice

5.2.1 Natural Resources

5.2.1.1 Air Quality

The Fargo-Moorhead area is considered a National Ambient Air Quality Standards (NAAQS) Attainment Area for all air quality parameters (USEPA 2009). The air quality effects of all six diversion channel alternatives would be the same or similar. Heavy equipment would produce small amounts of hydrocarbons in exhaust emissions compared to total hydrocarbon emission in the area. The construction contractor would be required to maintain the vehicles on the sites in good working order to minimize exhaust emissions. Fugitive dust could also result from construction activities so the contractor would be required to conduct dust suppression activities. Adverse impacts to air quality resulting from the activities would be minor and short term in nature regardless of the alternative that is implemented.

5.2.1.2 Water Quality

5.2.1.2.1 No Action Alternative

There are many initiatives and programs in place in the project area that have and will continue to improve water quality. The Red River Basin Commission has been working with the local soil and water conservation districts, watershed districts and Pheasants Forever on the Red River Basin Buffer initiative. The goals of this initiative are to demonstrate a process for restoring strategically targeted riparian buffers within a small watershed so the process can be duplicated throughout the Red River Basin. This project will also demonstrate the water quality benefits of these restorations. Measurable goals include establishing buffers, restoring prescribed wetlands within the watersheds, reducing sediment concentrations/loads at stream sites, reducing total phosphorus concentrations/loads at stream sites, and educating the public about benefits of buffers to promote their implementation. Water quality is expected to improve under the no action alternative.

5.2.1.2.2 All diversion channel alternatives

All of the diversion channel alternatives would likely have temporary minor adverse impacts on surface water quality. The removal of the river substrate and the placement of rock would result in moderate increases in suspended solids in the river water during the construction period. Once the construction has been completed, water quality would return to pre-project conditions. Erosion from storm water runoff from the terrestrial construction areas also could have the potential to negatively impact surface water quality during construction and until the area has developed a protective ground cover. In order to minimize any erosion and sedimentation that could occur, a Storm Water Pollution Prevention Plan (SWPPP) would be prepared for the site, and the measures indicated in the plan would be implemented for any alternative that is implemented. The SWPPP would contain specific construction measures (e.g., silt curtains, silt fences, drainage swales, hay bales, etc.) to reduce or eliminate runoff impacts during construction activities and reduce the potential for soil erosion after construction. Best management practices (BMPs) as provided by the Environmental Protection Agency (EPA), Storm Water Pollution Prevention Plan Guidance from the North Dakota Department of Health NDPDES program, or in the Minnesota Pollution Control Agency’s “Protecting Water Quality in Urban Areas: A Manual” would be used. The construction contractor would also be required to implement protective measures to prevent spillage of chemicals, fuels, oils, greases, bituminous materials, waste washings, herbicides, insecticides, or any other materials associated with construction activities, and keep these materials from entering drainages. With implementation of measures identified in the SWPPP and the incorporation of BMPs to reduce spillage, all of the diversion channel alternatives would be anticipated to have only temporary, minor adverse impacts on surface waters.

5.2.1.3 Sedimentation and Erosion

The sediment transport of the Red River appears to be dominated by clay and silt. Sand contributions, although present, appear minimal. Thus, sediment transport is less dominated by bedload, and more by suspended solids. Sediment will be conveyed proportionately through both the respective Red River control structure, as well as down the diversion channel. Bankfull discharges (e.g., approximately a 50-percent chance event) are often considered a critical point for maintenance of sediment transport. By comparison, the Red River control structure will convey 9,600 cfs (approximately a 20-percent chance event) before going into operation. Given this, the likelihood for drastic changes to sediment scour and deposition downstream of the Red River control structure appears small. This would likely be adequate to maintain most geomorphic processes that shape and maintain fisheries habitat in these sections of the river. In addition, the vertical distribution of the Red River clays and silts being transported in suspension is significantly more uniform than that characteristic of sand dominated systems, therefore the proposed diversion structures should not lead to an appreciable change in suspended sediment concentrations along the project area.

None of the diversion channel alternatives should have significant impacts on geomorphic processes for the Red River, relative to existing conditions. However, the Red River within the project area will be further evaluated to verify any potential impacts. This would include pre- and post-project monitoring for geomorphic conditions of the Red River. Monitoring would be done in close coordination between the sponsors and appropriate Federal and State agencies. The exact methodology will be developed during this coordination. The coordination also should include discussion whether future actions would be needed if adverse significant impacts were identified.

Unlike the Red River, the Sheyenne River mobilizes fine to very fine sand (with the likely upstream source being the glacial Sheyenne Delta) in addition to clays and silts. Therefore, the effect of diverting water on the morphodynamic stability of this river could be more significant than in the Red River. However, a comparison of channel cross sections pre- and post-construction of the Horace-West Fargo diversion does not show any considerable changes. In general, the Sheyenne River can be considered a stable riverine system near the proposed location of the diversion alternatives. Additional evaluation is needed to determine the reason for observed increases in suspended sediment concentrations from Kindred (upstream of proposed diversion) to Harwood (downstream of diversion). An initial explanation is that the Sheyenne River reach between Kindred and Harwood is subject to greater runoff and sediment supply from the contiguous urban-dominated watershed, accounting for the increase in suspended sediment concentration.

It is reasonable to assume that most of the sand transported by the Maple River is trapped in the Maple River dam; therefore the sediment mobilized near the diversion structure will likely correspond to clays and silts, possibly with some fine sands. This hypothesis is also based on a watershed-scale geomorphologic evaluation indicating that the lower reach of the Maple River is of post-glacial origin and is characterized by the absence of sand deposits. Similar to the Red River, the vertical distribution of the Maple River clays and silts being transported in suspension is significantly more uniform than that characteristic of sand dominated systems, therefore the proposed diversion alternatives should not lead to an appreciable change in suspended sediment concentrations along the study area.

5.2.1.4 Downstream Water Quantity

Note for the May 2010 Draft Report: Additional analysis will be completed on the downstream impacts. The information presented in this draft report was presented at public meetings in February 2010. Updated downstream impact information will be fully quantified in the final feasibility report and environmental impact statement.

All of the diversion channel alternatives will change the timing and flows of water, significantly reducing the quantity of water flowing through the communities of Fargo and Moorhead. As a result of the modifications to the timing of the flows, downstream impacts are anticipated. These impacts are identified in Table 29.

In these tables, column 1 represents the increase in inches of water depths downstream at four locations with the project in place versus existing conditions with no emergency measures in place. Column 2 represents the increase in inches of water depths downstream at the four locations with the project in place versus existing conditions with emergency measures in place.

The downstream impacts will undergo additional study based on the results of the Expert Opinion Elicitation (EOE) panel; these results will be included in future versions of the report.

5.2.1.4.1 MN35k Plan

The MN35k alternative was the only alternative analyzed for downstream impacts; it is assumed that the smaller plans will have fewer downstream impacts. Table 29 indicates the difference in water quantity for the 10, 2, and 1-percent chance flood events between the conditions with the MN35k plan in place and (1) the existing conditions with no emergency protection in place and (2) the existing condition with full emergency protection in place (Figure 31, Figure 33, and Figure 35).

The affected area for the Minnesota Diversion alignment was based on the diversion outlet entering the Red River at RM427. The analysis extends downstream 52 river miles to Halstad at RM 375. This defines the area analyzed for the MN35k plan. The number of acres currently affected, with no emergency protection in place, for the 10-percent chance event within the area analyzed is 31,768 acres. The area affected during a 10-percent chance event with the MN35k plan in place would be 35,296 acres, for an increase of 3,528 acres. The depth of increase will vary throughout the area with increases from 2.7 inches to 5.5 inches expected. The number of acres currently affected for the 2-percent chance event within this area is 79,626 acres. The area affected during a 2-percent chance event with the MN35k plan in place would be 81,434 acres, for an increase of 1,808 acres. The depth of increase will vary throughout the area with increases from 1.3 inches to 4.3 inches. The number of acres currently affected for the 1-percent chance event within this area is 92,645 acres. The area affected during a 1-percent chance event with the MN35k plan in place would be 98,453 acres, for an increase of 5,808 acres. The depth of increase will vary throughout the area with increases from 4.6 inches to 9.4 inches (Table 2, Figure 2, Figure 4, and Figure 6).

The difference in structures affected between existing conditions and with the MN35k plan for each percent chance event would be: 10-percent chance event - 2 houses and 33 outbuildings; 2-percent chance event - 5 houses and 23 outbuildings; and 1-percent chance event - 19 houses, 41 outbuildings, and 2 other buildings (Table 29). Structures were identified using aerial photography: homes were clearly identifiable as a home; outbuildings are structures such as silos, barns, garages, or sheds; and other buildings are buildings that are large industry related structures such as factories or schools.

Increases in the level and duration of downstream flooding would have no appreciable effects on natural resources, but may result in significant adverse effects on social resources.

Table 29 – Structures affected downstream of River Mile 427.

	10-percent chance event		2-percent chance event		1-percent chance event	
Total	existing condition	With MN 35K div in place	existing condition	With MN 35K div in place	existing condition	With MN 35K div in place
Homes	7	9	154	159	300	319
Other	0	0	3	3	9	11
Outbuilding	60	93	686	709	787	828
Total	67	102	843	871	1096	1158
Homes = Clearly could tell that the structure was a house						
Outbuildings = Structures such as silos, barns, gargages or sheds						
Other = clearly could tell it was a large industry related structure i.e. factory, school Definitely not a home or personal property						

Table 30 - Downstream water quantity, Minnesota Short 35k

Minnesota Short 35K – 10-percent chance event		
Location	Difference in inches between with Project and Existing with No Emergency Protection in Place	Difference in inches between with Project and Existing with Full Emergency Protection in Place
Halstad Gage	5.5	6
Near Hendrum	4	4.3
Perley	3.4	3.7
Georgetown	2.7	3
Minnesota Short 35K - 2-percent chance event		
Halstad Gage	1.3	1.1
Near Hendrum	4.3	3.5
Perley	2.6	1.9
Georgetown	2.1	1.3
Minnesota Short 35K - 1-percent chance event		
Halstad Gage	4.6	3.7
Near Hendrum	9.4	6.8
Perley	6	4.2
Georgetown	7.7	5.3

Figure 31 – 10 percent (10-Year) downstream extent with Minnesota Short 35k

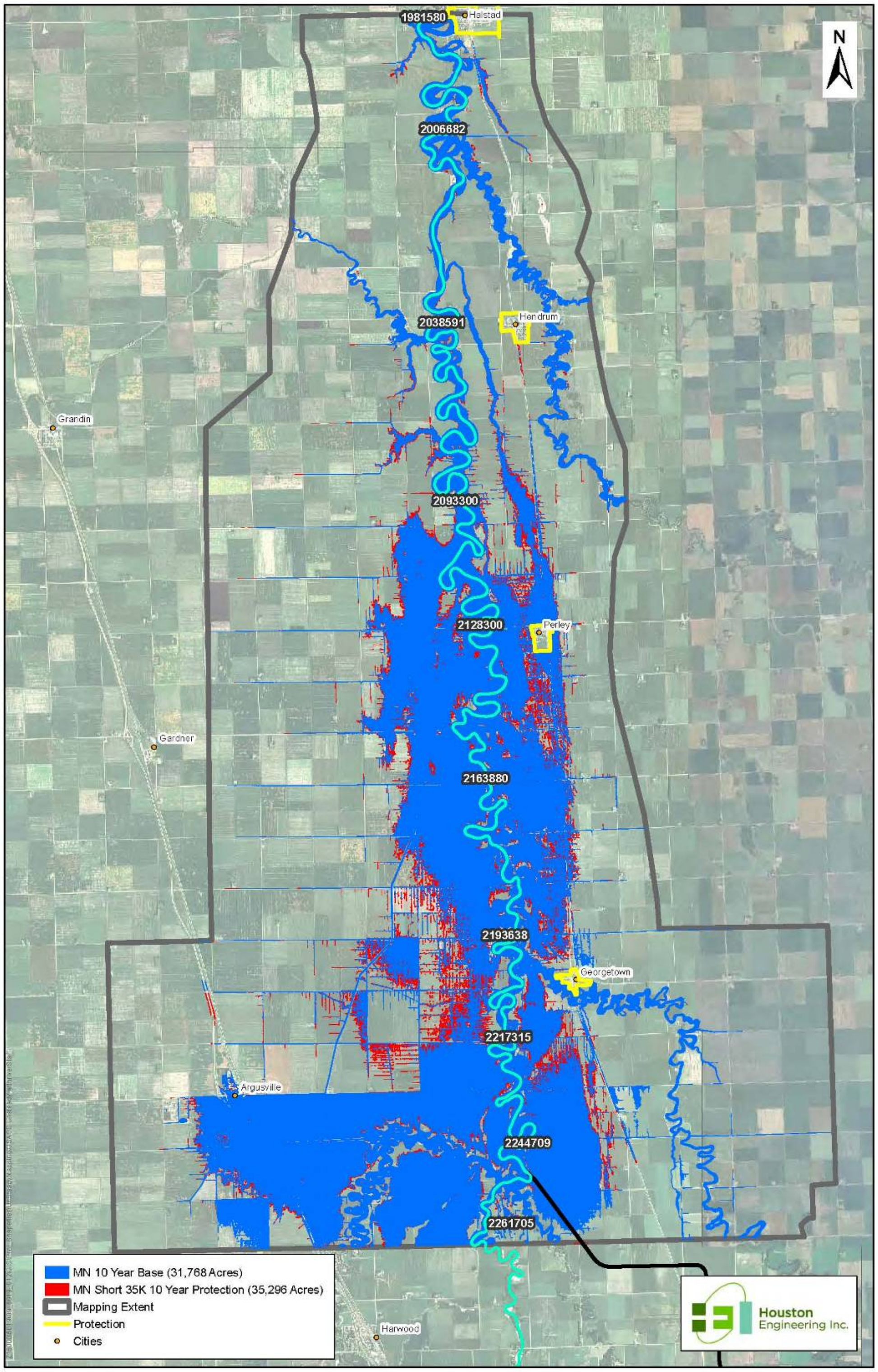


Figure 32 - 10 percent (10-Year) downstream depth with Minnesota Short 35k

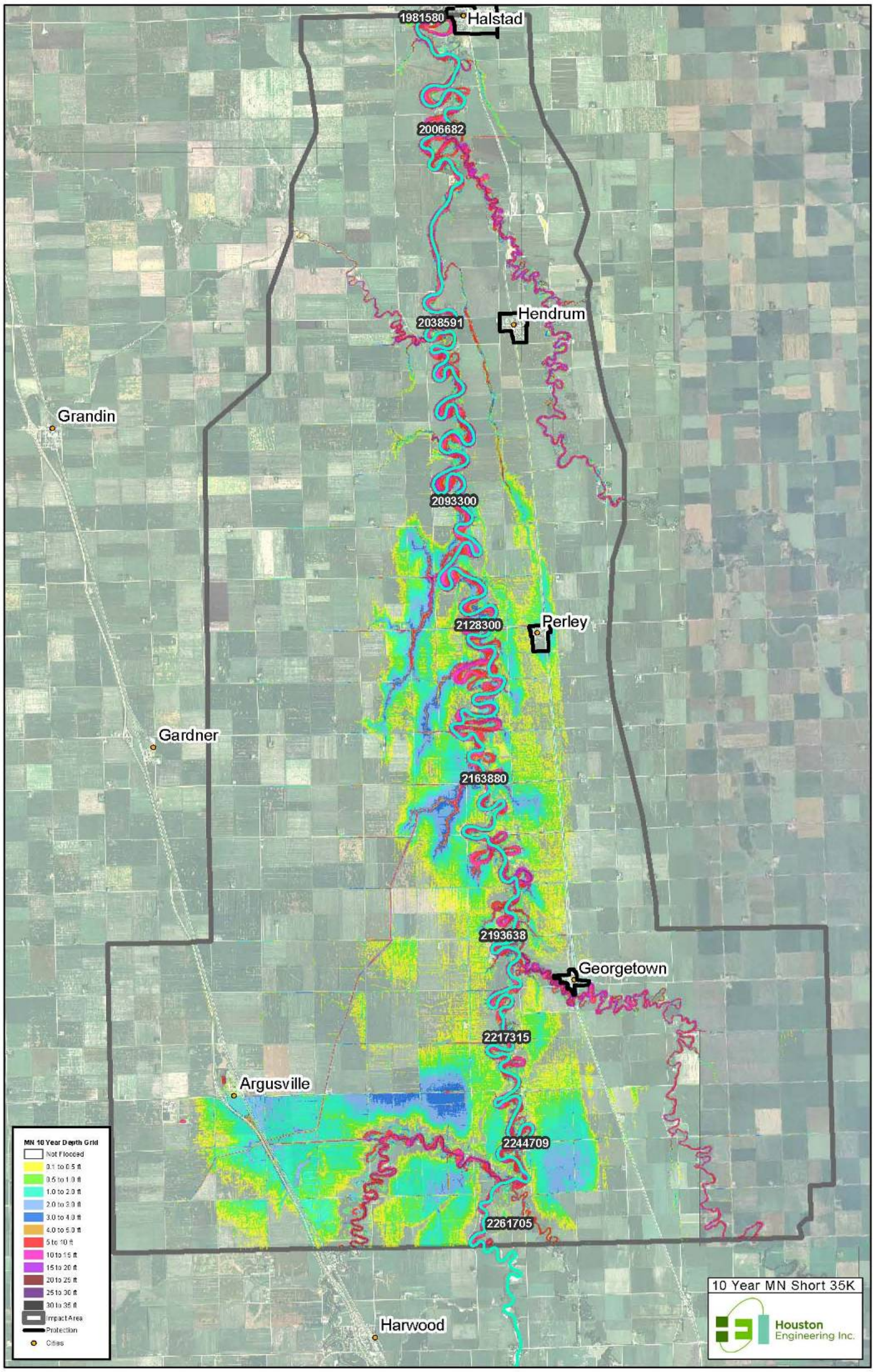


Figure 33 - 2 percent (50-Year) downstream extent with Minnesota Short 35k

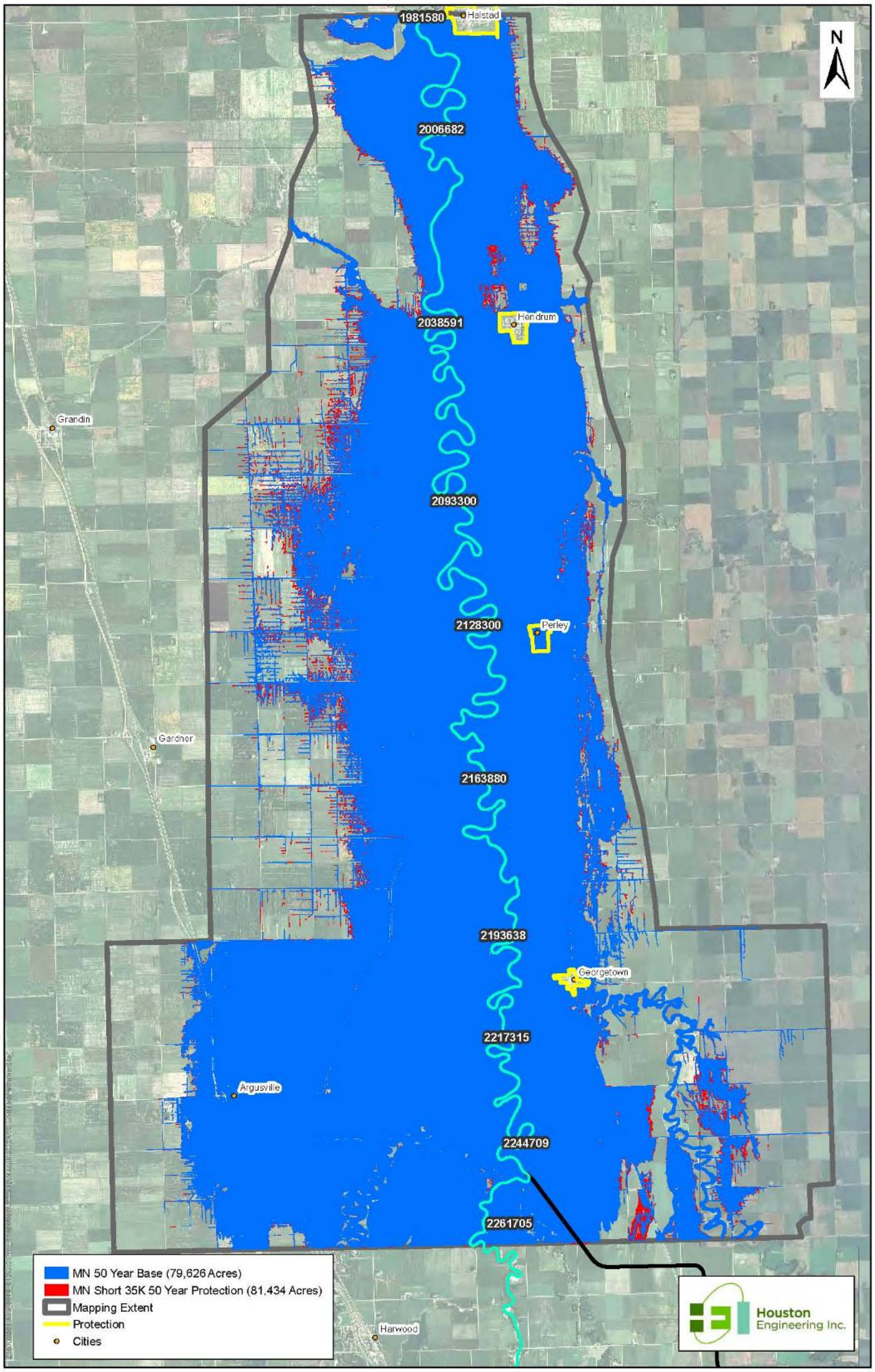


Figure 34 - 2 percent (50-Year) downstream depth with Minnesota Short 35k

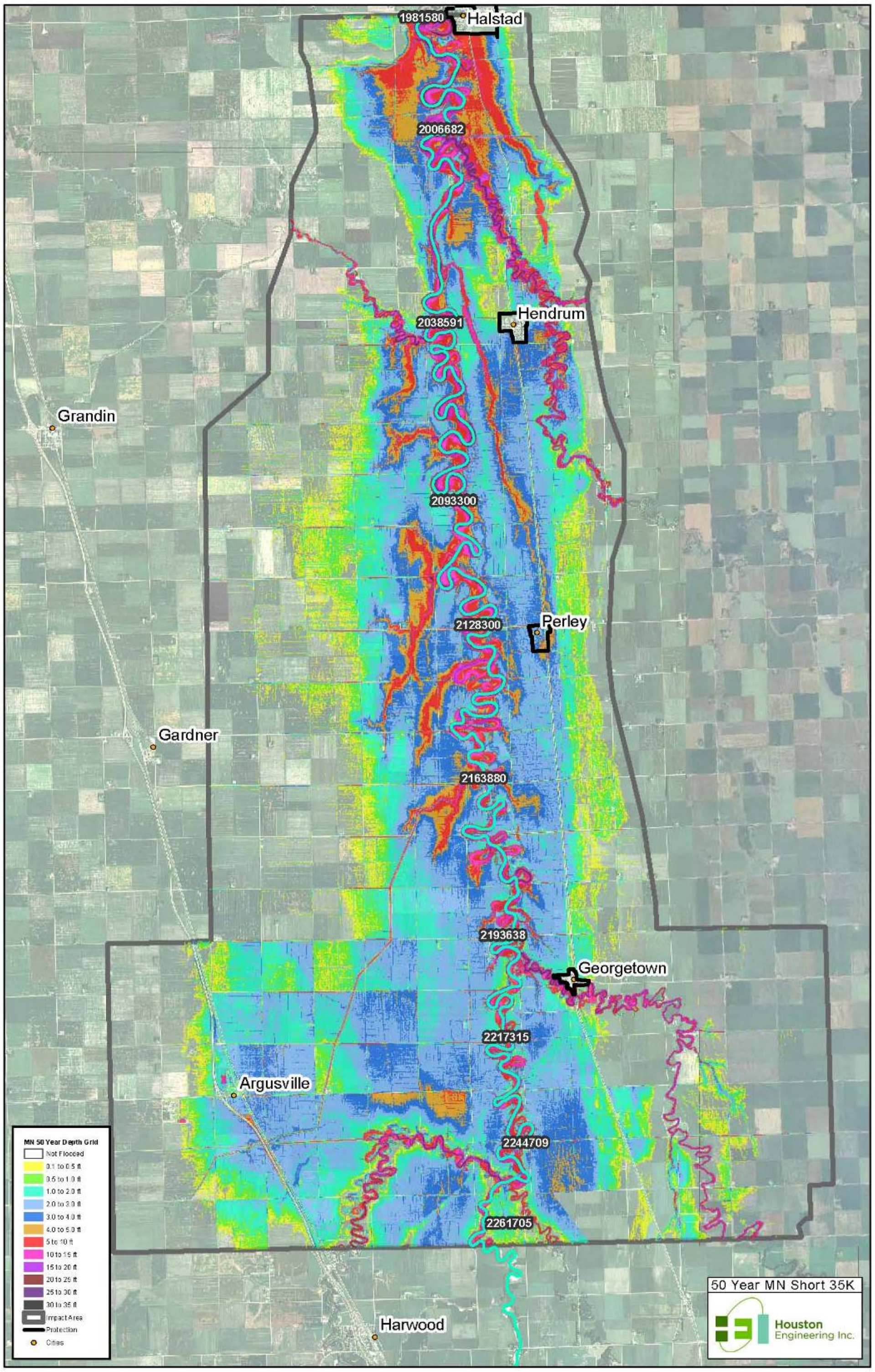


Figure 35 - 1 percent (100-Year) downstream extent with Minnesota Short 35k

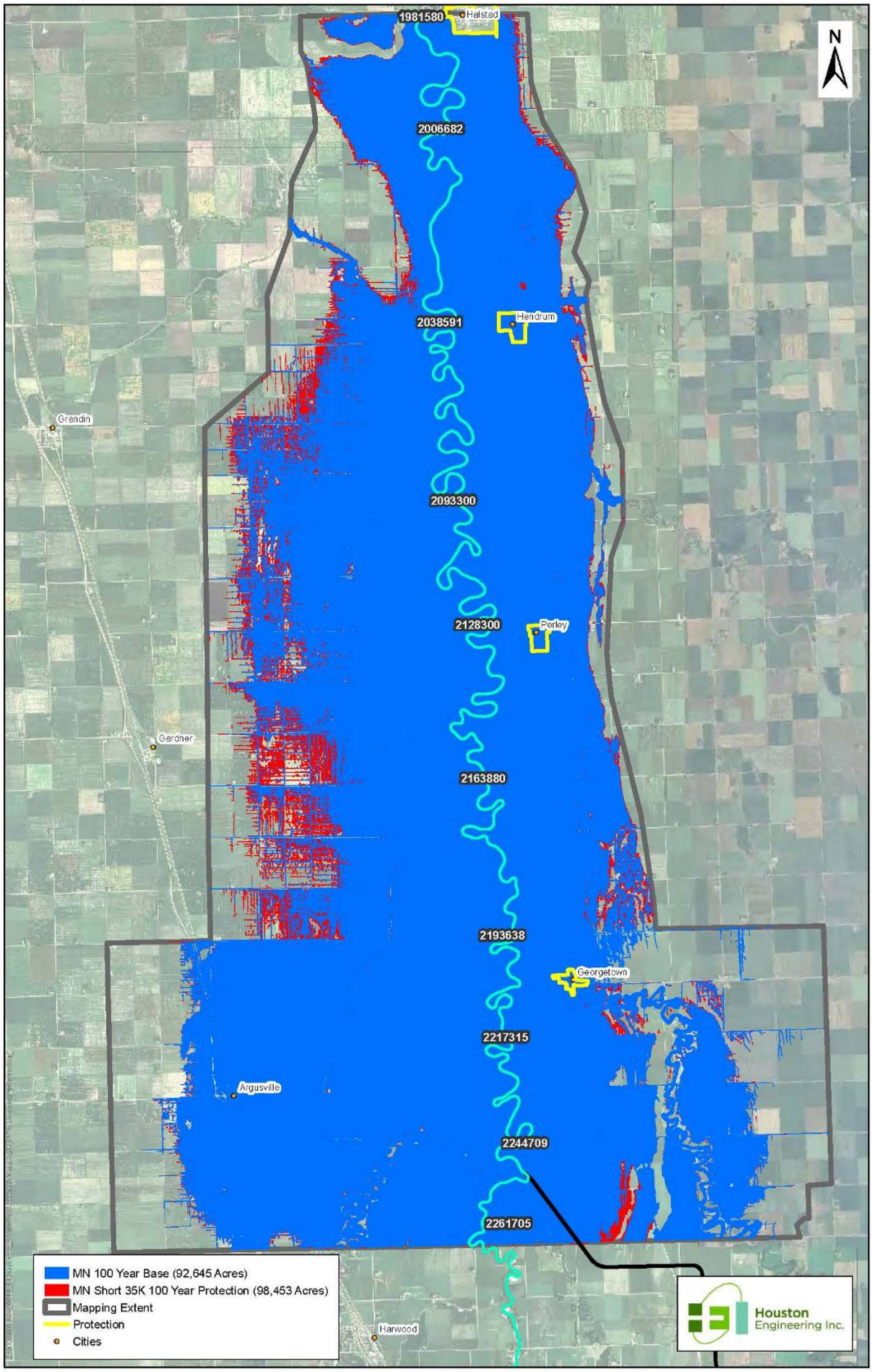
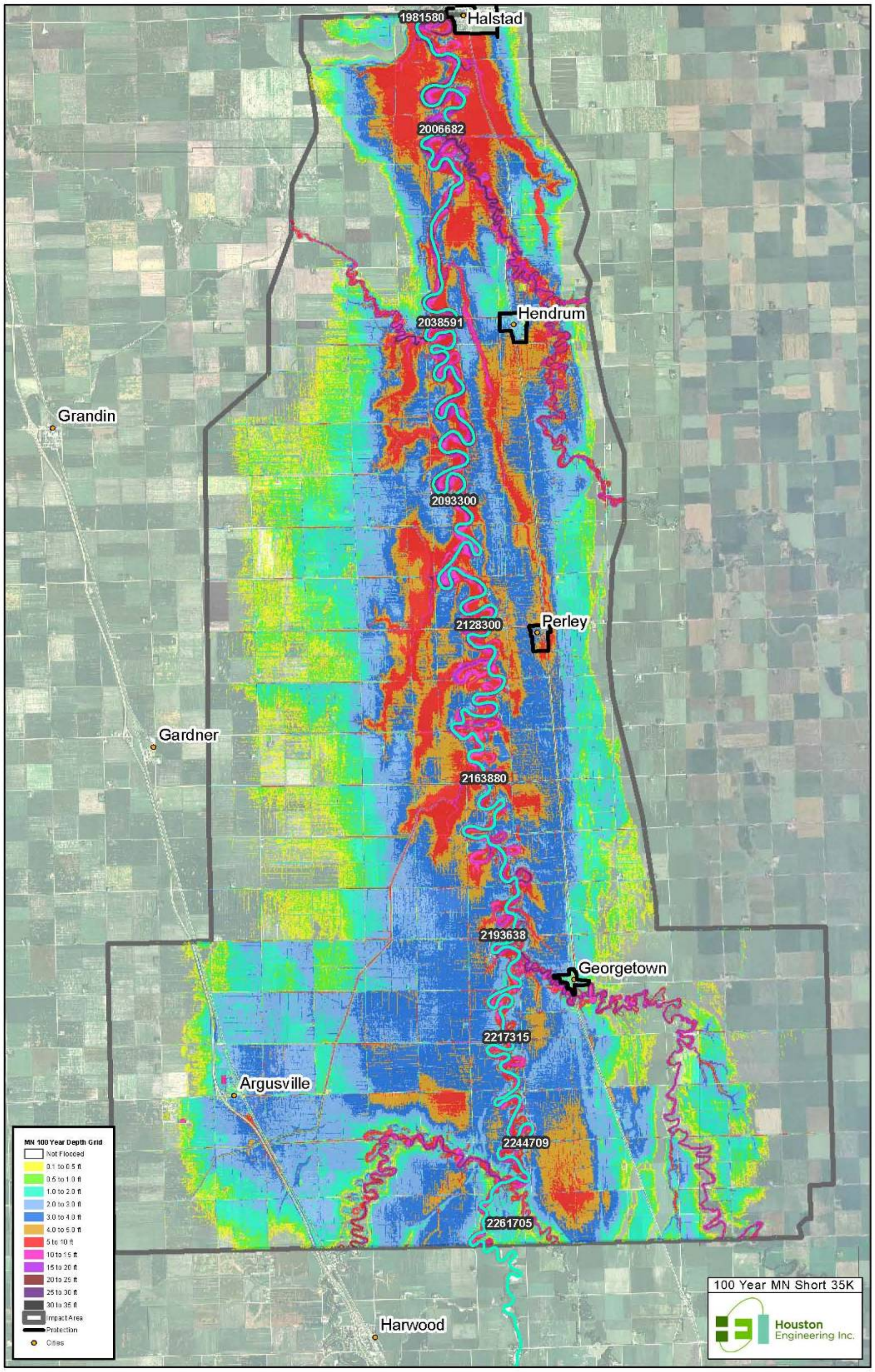


Figure 36 - 1 percent (100-Year) downstream depth with Minnesota Short 35k



5.2.1.4.2 ND35k Plan

The ND35k alternative was the only alternative analyzed for downstream impacts; it is assumed that the smaller plans will have fewer downstream impacts. Table 32 indicates the difference in water quantity for the 10, 2, and 1-percent chance flood events between the conditions with the ND35k plan in place and (1) the existing conditions with no emergency protection in place and (2) the existing conditions with full emergency protection in place (Table 32, Figure 37, Figure 39, and Figure 41).

The affected area for the North Dakota Diversion alignment was based on the diversion outlet entering the Red River RM418.5. The analysis extends downstream 43.5 river miles to Halstad at RM 375. This defines the area analyzed for the ND35k plan. The number of acres currently affected, with no emergency protection in place, for the 10-percent chance event within the area analyzed area is 18,164 acres. The area affected during a 10-percent chance event with the ND35k plan in place would be 25,217 acres, for an increase of 7,053 acres. The depth of increase will vary throughout the area with increases from 7.1 inches to 24.7 inches. The number of acres currently impacted for the 2-percent chance event within this area is 51,815 acres. The area affected during a 2-percent chance event with the ND35k plan in place would be 54,245 acres, for an increase of 2,430 acres. The depth of increase will vary throughout the area with increases from 1.8 inches to 6.8 inches. The number of acres currently affected for the 1-percent chance event within this area is 61,496 acres. The area affected during a 1-percent chance event with the ND35k plan in place would be 67,030 acres, for an increase of 5,534 acres. The depth of increase will vary throughout the area with increases from 5.3 inches to 10.4 inches (Table 32, Figure 38).

The difference in structures affected between existing conditions and with the ND35k plan for each percent chance event would be: 10-percent chance event - 11 houses and 94 outbuildings; 2-percent chance event - 6 houses and 44 outbuildings; and 1-percent chance event - 23 houses, 25 outbuildings, and 3 other buildings (Table 31).

Structures were identified using aerial photography: homes were clearly identifiable as a home; outbuildings are structures such as silos, barns, garages, or sheds; and other buildings are buildings that are large industry related structures such as factories or schools.

Increases in the level and duration of downstream flooding would have no appreciable effects on natural resources, but may result in significant adverse effects on social resources.

Table 31 – Structures affected downstream of River Mile 418.5

	10-percent chance event		2-percent chance event		1-percent chance event	
Total	existing condition	With ND 35K div in place	existing condition	With ND 35K div in place	existing condition	With ND 35K div in place
Homes	5	16	142	148	285	308
Other	0	0	3	3	9	12
Outbuilding	49	143	592	636	681	706
Total	54	159	737	787	975	1026
Homes = Clearly could tell that the structure was a house						
Outbuildings = Structures such as silos, barns, gargages or sheds						
Other = clearly could tell it was a large industry related structure i.e. factory, school Definitely not a home or personal property						

Table 32 – Downstream water quantity, North Dakota East 35k

North Dakota East 35K - 10-percent chance event		
Location	Difference in inches between with Project and Existing with No Emergency Protection in Place	Difference in inches between with Project and Existing with Full Emergency Protection in Place
Halstad Gage	24.7	25.2
Hendrum	16.7	17
Perley	10.9	11.3
Georgetown	7.1	7.3
North Dakota East 35K - 2-percent chance event		
Halstad Gage	2.3	2
Near Hendrum	6.8	6
Perley	3	2.3
Georgetown	1.8	1.1
North Dakota East 35K - 1-percent chance event		
Halstad Gage	5.3	4.4
Near Hendrum	10.4	7.9
Perley	5.4	3.6
Georgetown	7.6	5.2

Figure 37 - 10 percent (10-Year) downstream extent with North Dakota East 35k

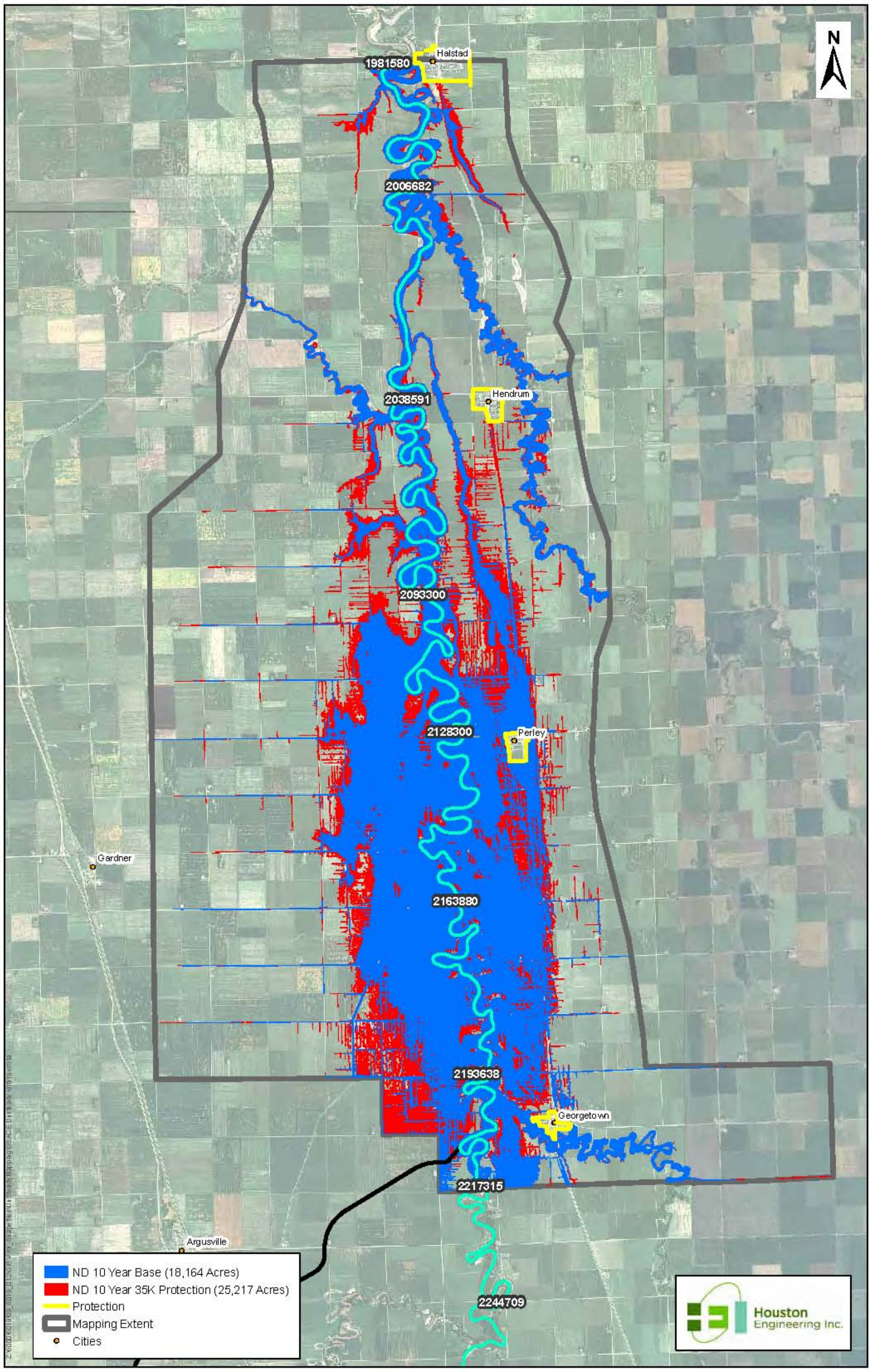


Figure 38 - 10 percent (10-Year) downstream depth with North Dakota East 35k

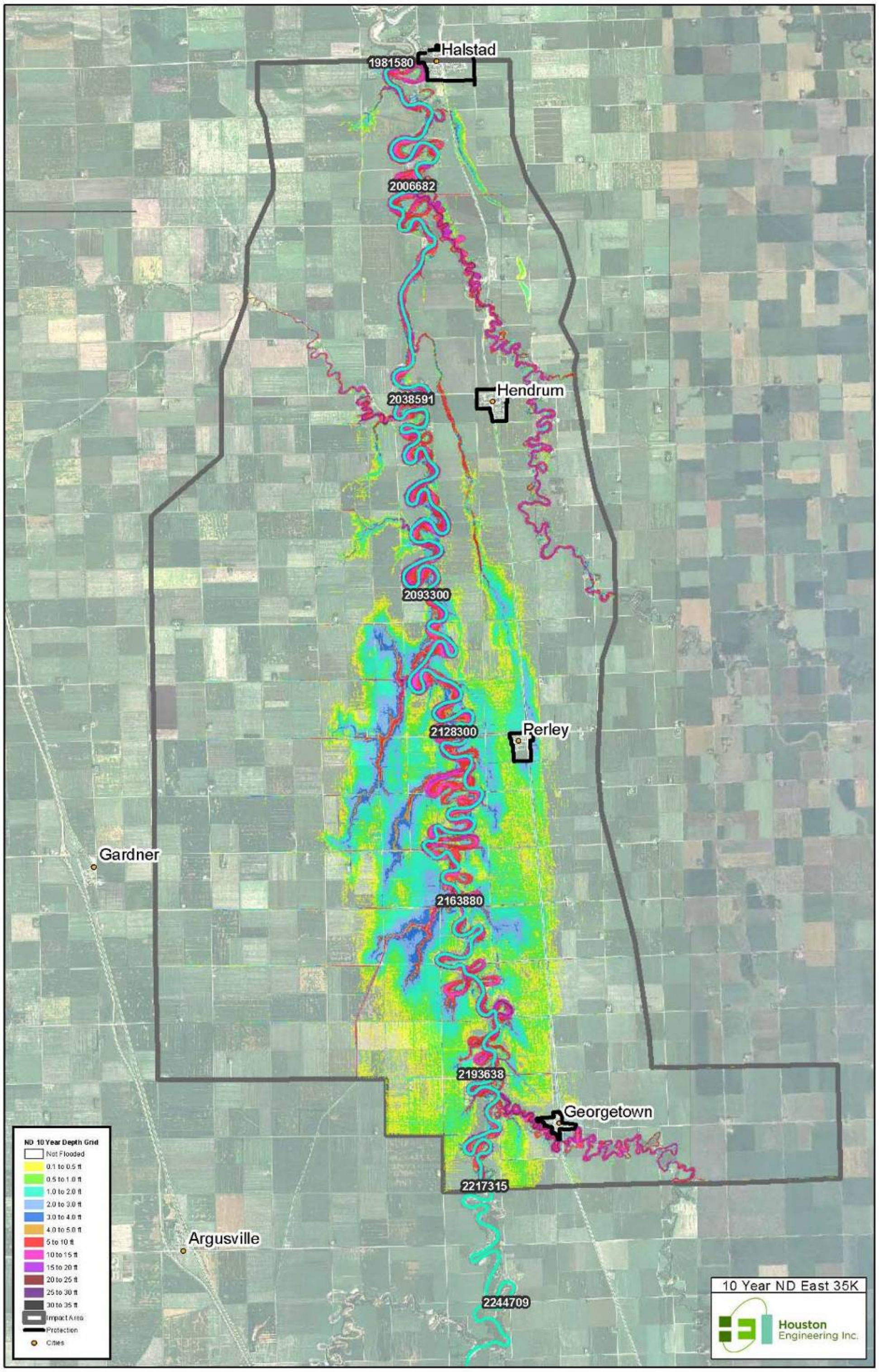


Figure 39 - 2 percent (50-Year) downstream extent with North Dakota East 35k

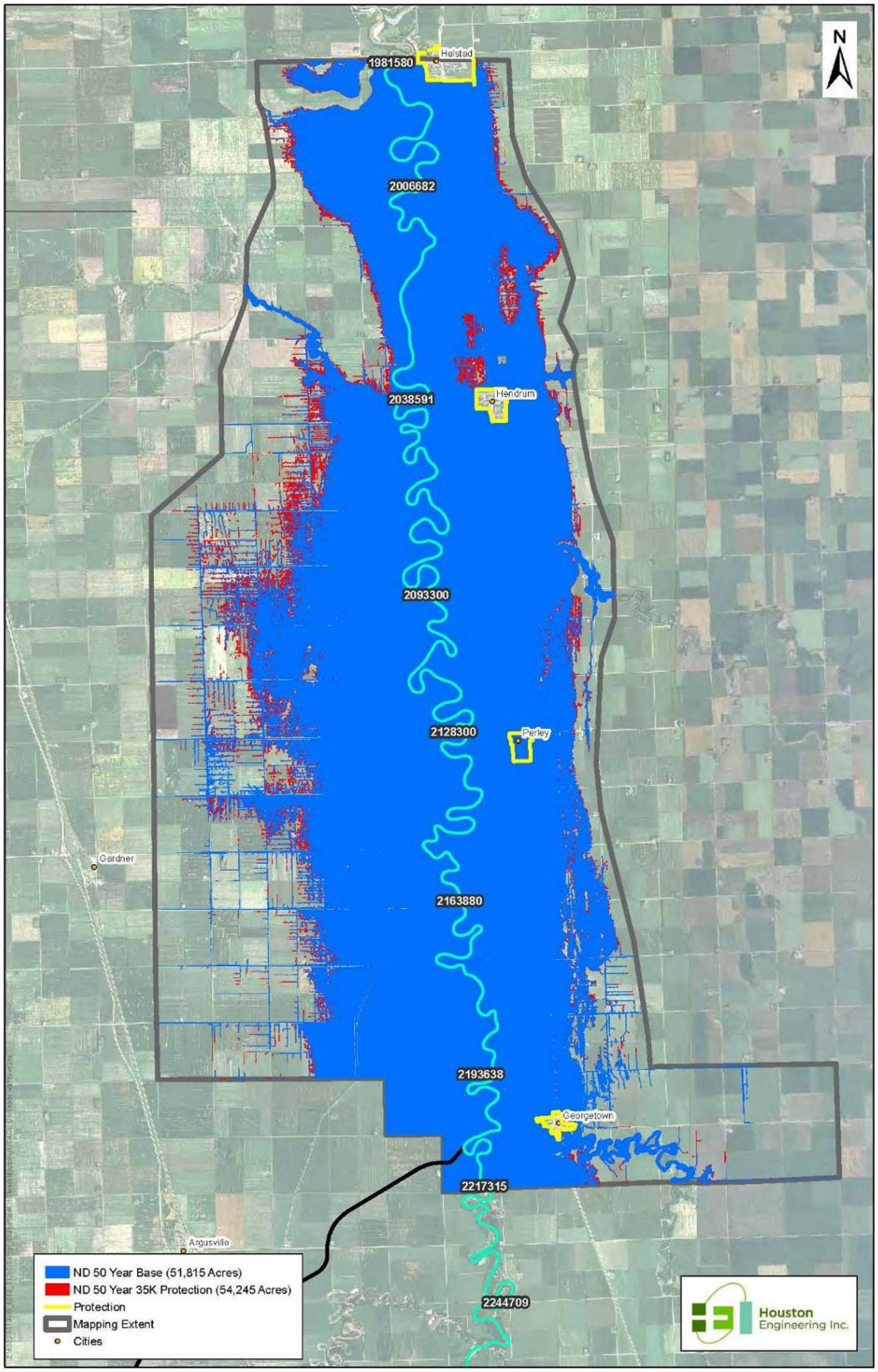


Figure 40 - 2 percent (50-Year) downstream depth with North Dakota East 35k

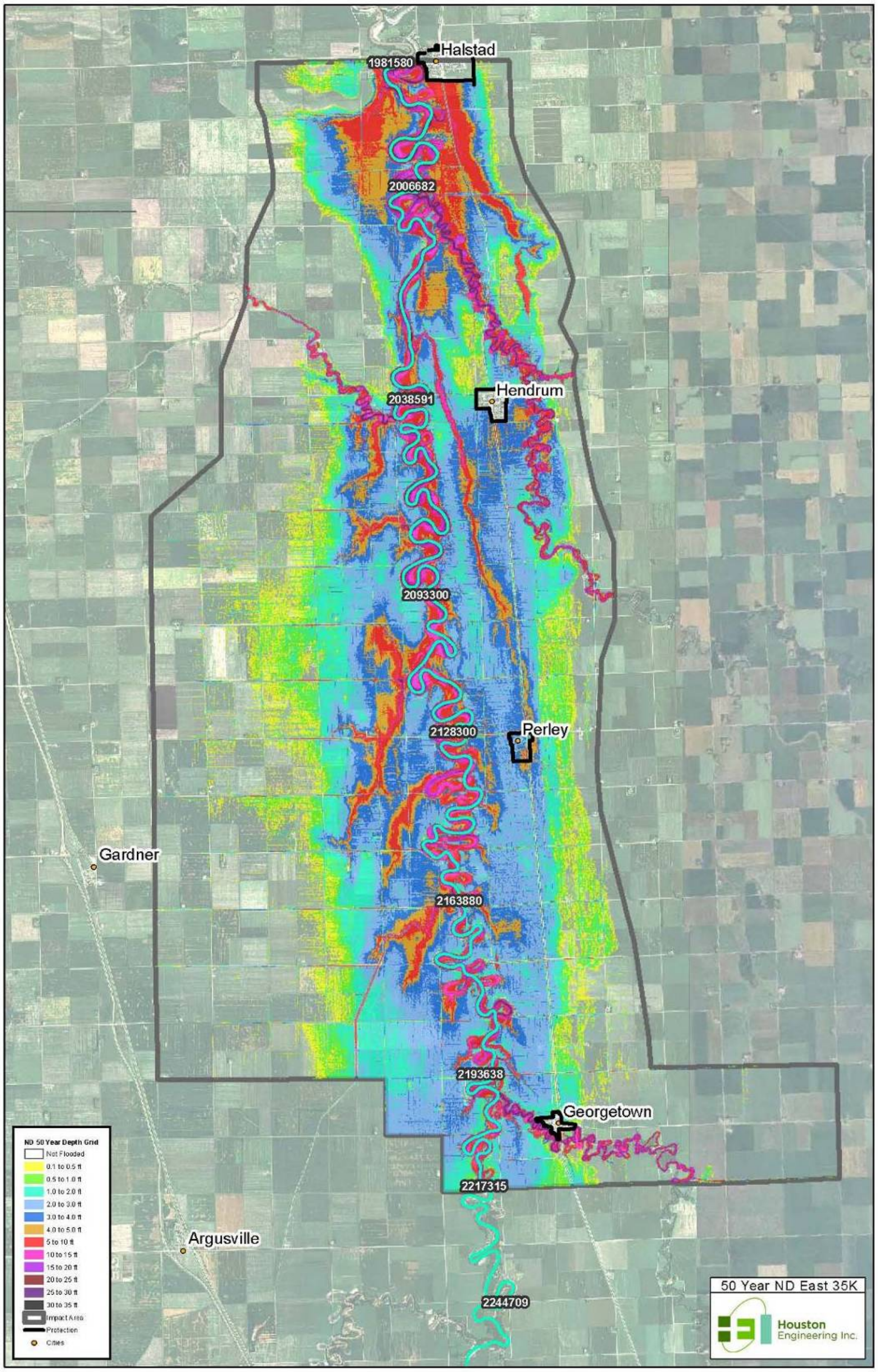


Figure 41 - 1 percent (100-Year) downstream extent with North Dakota East 35k

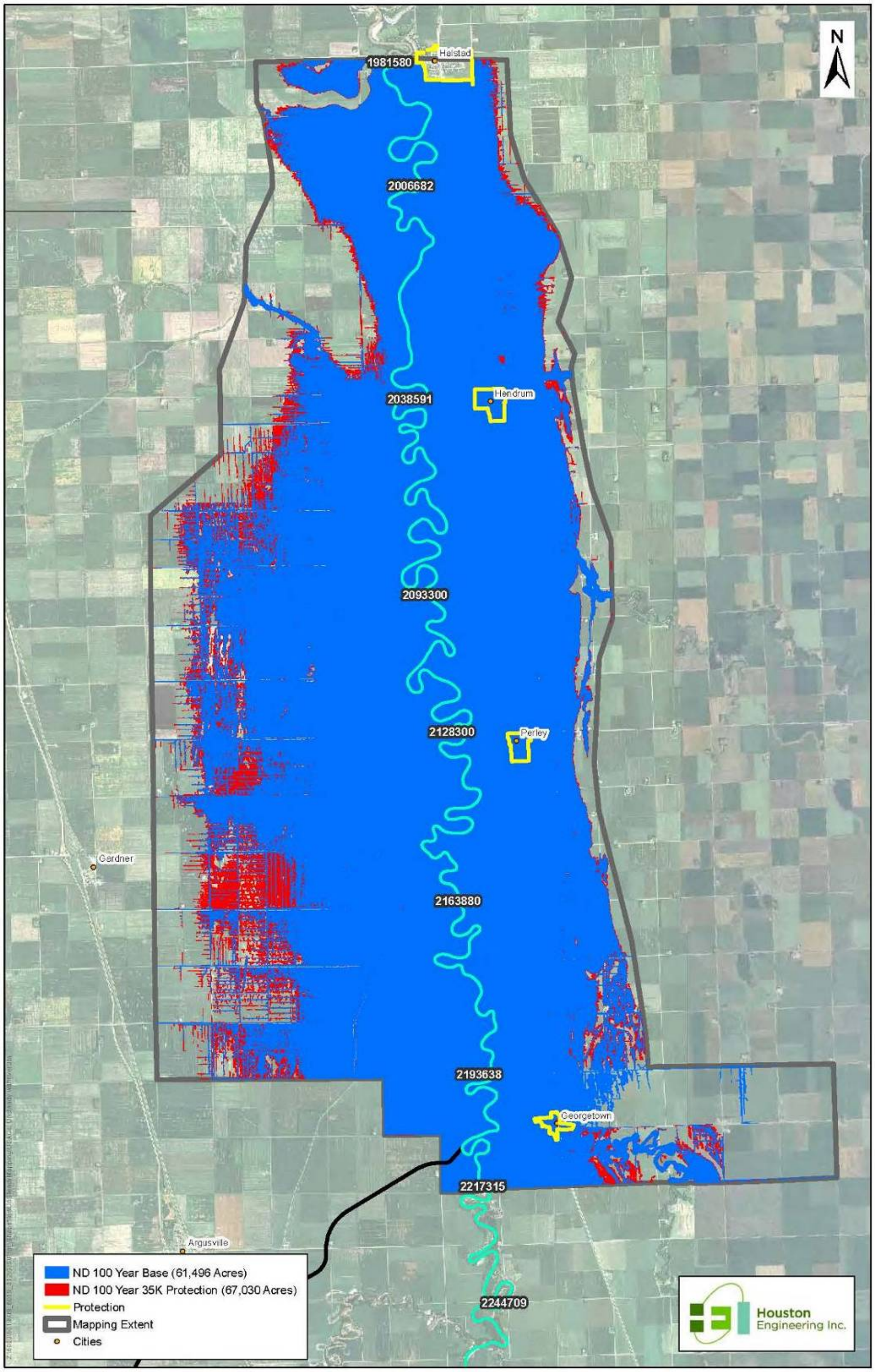
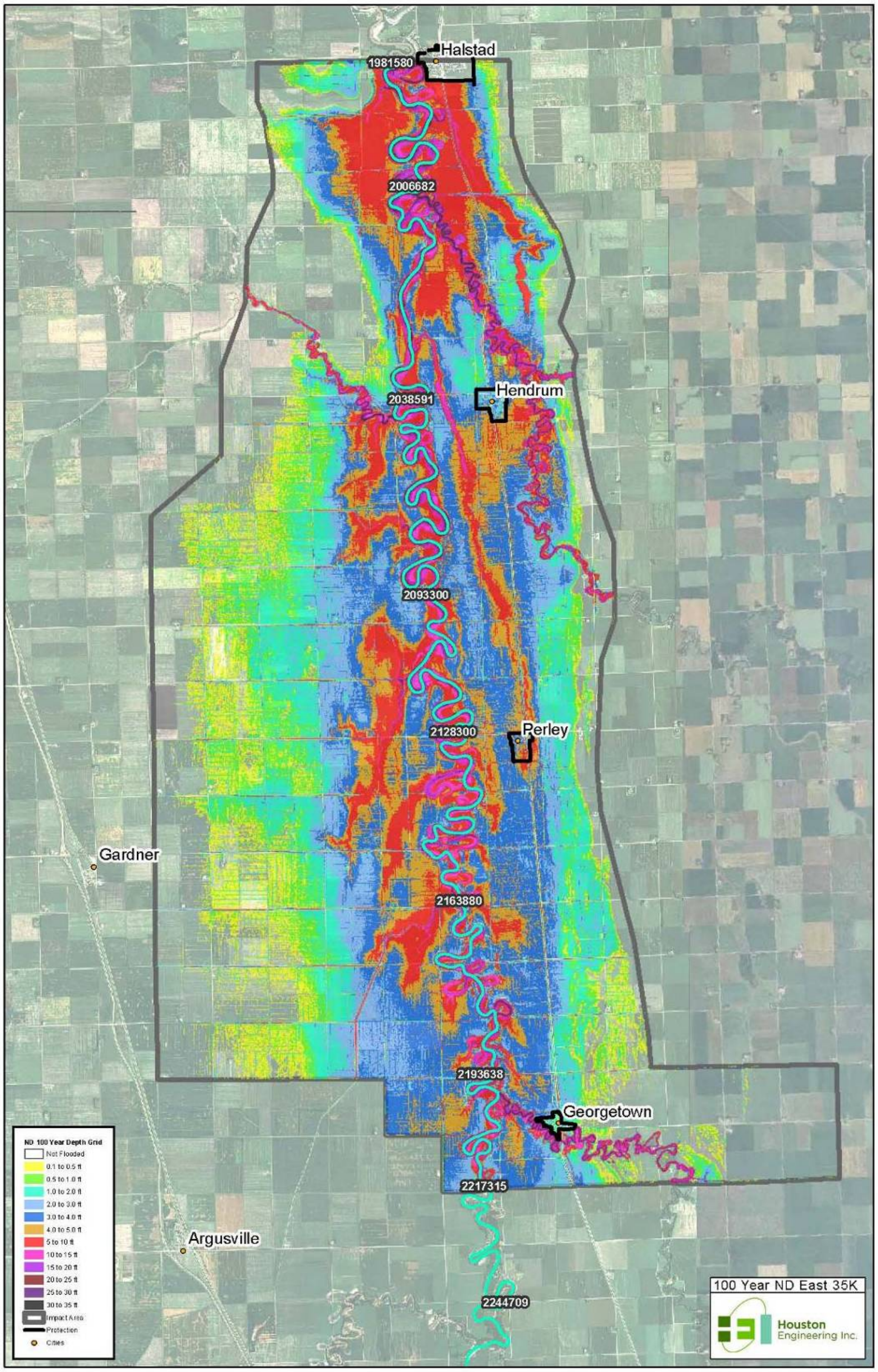


Figure 42 - 1 percent (100-Year) downstream depth with North Dakota East 35k



5.2.1.5 Slope Stability

The diversion channel alternatives would prevent large increases in the Red River water surface elevation during flood events and would not affect the river elevation for normal everyday conditions. Thus, the stability of the Red River bank would not be adversely impacted by any of the diversion alternatives. Slope stability issues could occur where the diversion channel re-enters the Red River at mile marker 417.5 (ND alternatives) or mile marker 427 (MN alternatives). However, this is not a concern for this project because the outlet would be armored to protect against erosion, which would prevent slope stability issues from occurring. Areas downstream of the outlet will have similar velocities to existing conditions; therefore there will be no impact to slope stability downstream. The reduction of flow through the metro area during flood events may reduce the amount of erosion that would occur on the primary bank, thus increasing the overall stability of the bank.

5.2.1.6 Wetlands

5.2.1.6.1 No Action Alternative

There are numerous wetland restoration programs in place within the project area but many of which are slowed by cost and/or land availability. The objectives of the wetland restoration programs include flood risk management, improving water quality, and wildlife and recreation opportunities. Due to increasing pressure to either urbanize or improve drainage on cropland, it is anticipated that wetland acreage will either remain the same or decrease within the study area.

5.2.1.6.2 Minnesota Diversion Plans

The construction of the MN20k, MN25k, MN30k, or MN35k plan will cause a direct loss of wetlands due to either excavation of the wetlands within the diversion channel or placement of spoil in the wetlands adjacent to the diversion channel. The Minnesota diversion alignment could directly impact approximately 17 acres of wetlands (Table 33), while indirectly impacting up to 85 acres of wetlands (Table 34). Direct impacts were calculated by using the footprint of the MN35k diversion channel. This area included the footprint of the 25 mile long diversion channel and spoil piles for the MN35k plan. The smaller plans will still be 25 miles long but narrower in width and would impact less acreage of wetlands (Figure 43). This analysis also included the tieback levee and extension channels.

Wetlands could also be lost indirectly through the construction of the diversion channel. The natural drainage patterns could be changed due to the placement of the spoil adjacent to the diversion channel. These changes could either be: 1) the drainage pattern to the wetlands is cutoff, eliminating the recharge of the wetland, or 2) a drainage pattern is created to the diversion, allowing the wetland to drain. In addition, the diversion channel creates a lower hydraulic potential area toward which water will try to seep. The seepage into the diversion channel could cause the wetlands adjacent to the diversion channel to dry up. This action would either change the function of the wetland or eliminate it. A 5,250 foot wide corridor along the diversion (Figure 44) was used to analyze the quantity of wetlands that could be impacted indirectly; this is a very conservative distance based on the soil types in the area, and could be minimized after further analysis is complete.

Table 33 - Wetlands directly impacted by construction of Minnesota Short Diversion

Type	Wetland Code	Acres
Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	R2UBH	8.71
Palustrine, Emergent, Temporarily Flooded	PEMA	5.82
Palustrine, Emergent, Seasonally Flooded	PEMC	1.93
Palustrine, Forested, Broad-leaved Deciduous, Seasonally Flooded	PFO1C	.83
Total		17.29

For Wetland Type definitions see Appendix F

Table 34 - Wetlands indirectly impacted by construction of Minnesota Short Diversion.

Type	Wetland Code	Acres
Palustrine, Emergent/Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded	PEM/SS1C	5.60
Palustrine, Emergent, Temporarily Flooded	PEMA	17.35
Palustrine, Emergent, Seasonally Flooded	PEMC	3.67
Palustrine, Emergent, Seasonally Flooded, Partially Drained/Ditched	PEMCd	0.96
Palustrine, Forested, Broad-Leaved Deciduous, Temporarily Flooded	PFO1A	4.46
Palustrine, Forested, Broad-Leaved Deciduous, Seasonally Flooded	PFO1C	0.57
Palustrine, Scrub-Shrub, Broad-Leaved Deciduous, Seasonally Flooded	PSS1C	0.25
Palustrine, Unconsolidated Bottom, Intermittently Exposed, Excavated	PUBGx	0.66
Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	R2UBH	51.48
Total		85

For Wetland Type definitions see Appendix F.

Figure 43 – Wetlands along Minnesota Short diversion channel.

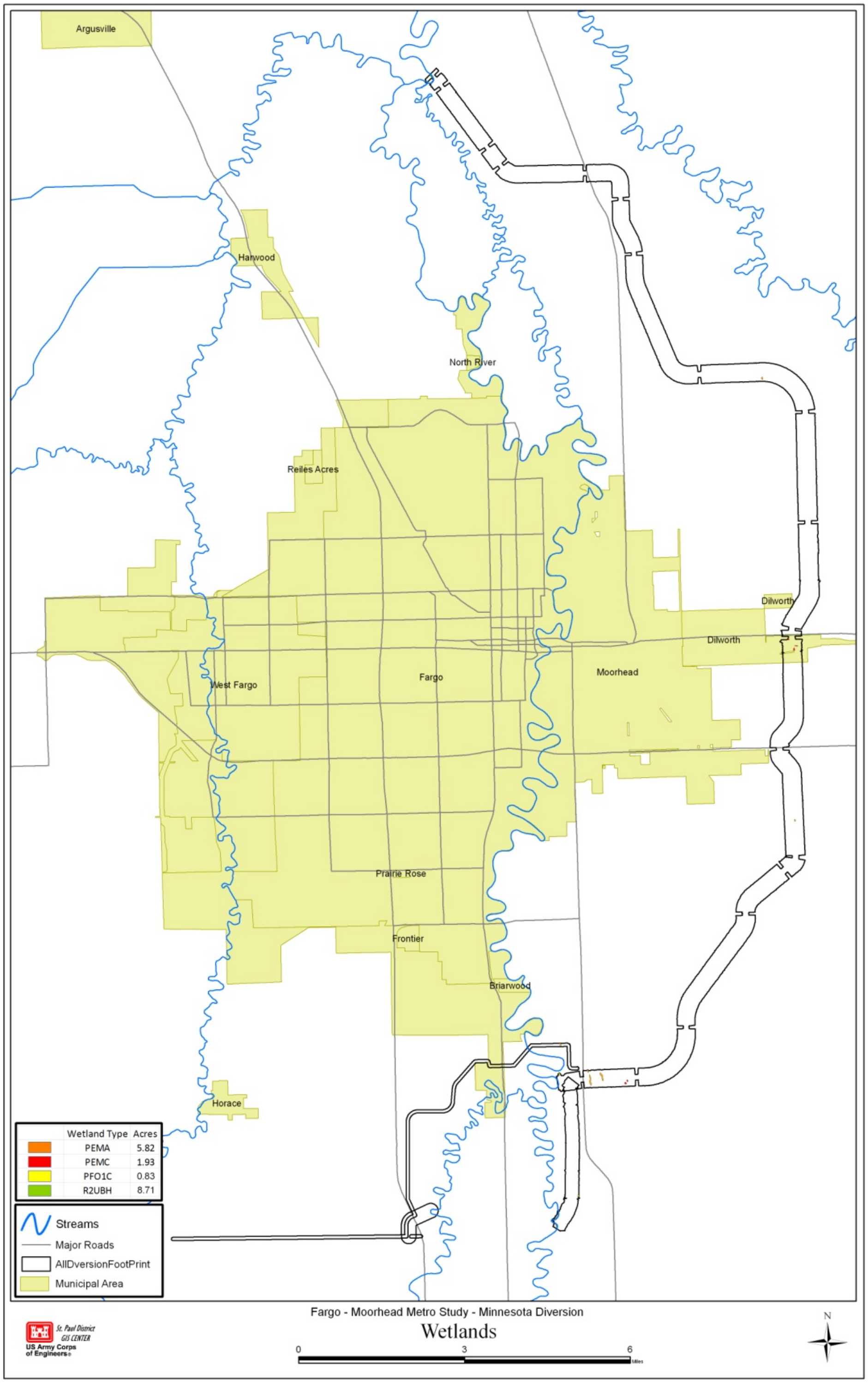
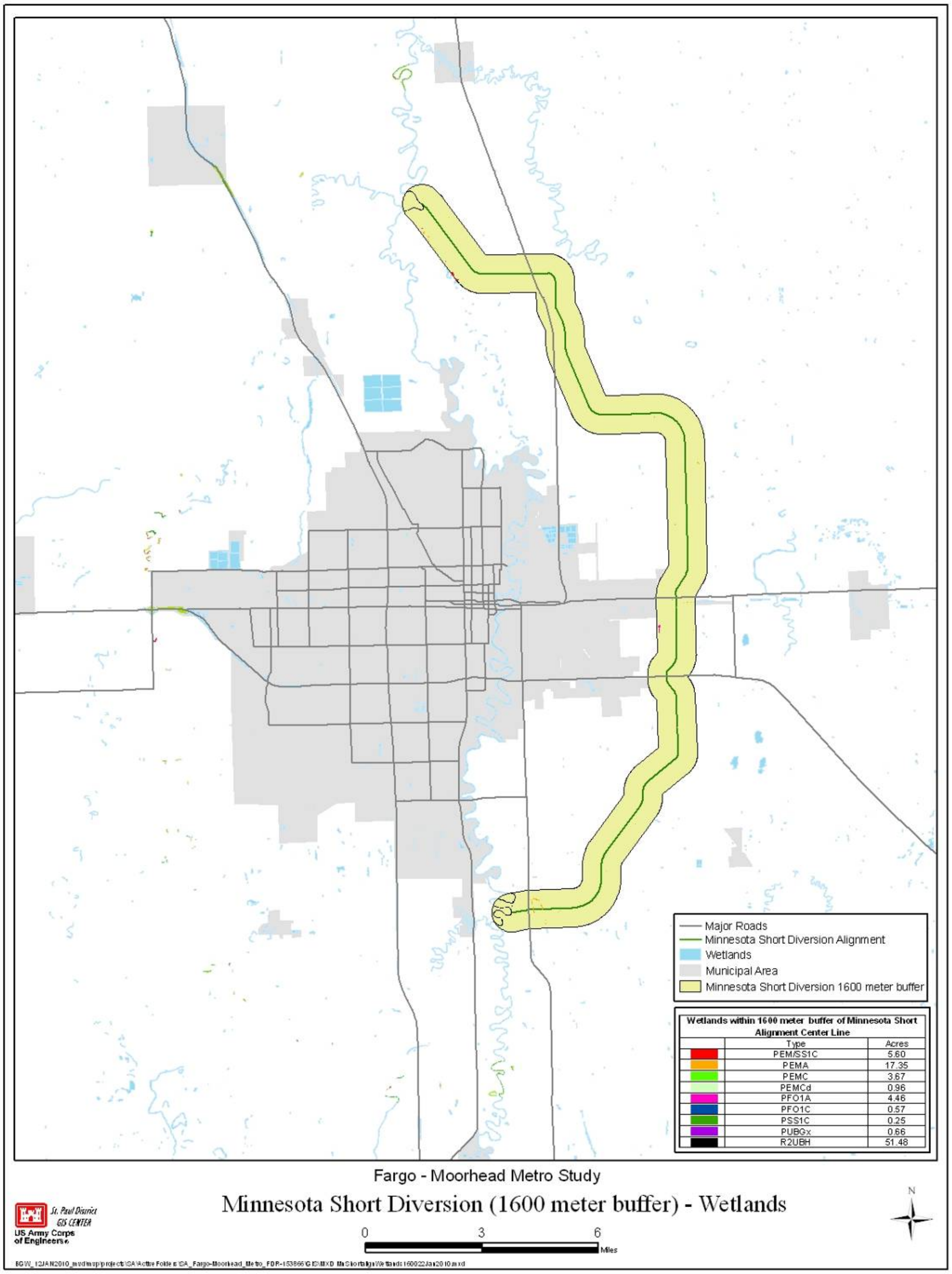


Figure 44 - Wetlands along Minnesota Short diversion channel 5,250 foot wide corridor.



Examination of aerial photography shows that the area had considerably more wetlands prior to conversion to agriculture. The direct loss of the wetlands is certain and unavoidable within the footprint of the channel and spoil piles. Wetland acres that will be adversely affected by diversion channel construction will be offset by the creation of wetlands within the diversion channel bottom. Features that will be used to facilitate the creation of wetlands will include meandering the low flow channel; constructing rock riffles in locations to create ponding; and other features developed during the design of the project. Vegetative species would be planted that are appropriate to temporarily flooded wetlands. A low flow channel is a channel that is typically in the center of a larger channel which is sized to handle small flows from drains, ditches or groundwater. The low flow channel would be approximately a 10 foot wide, 3 foot deep channel located in the middle of the larger diversion channel, and could meander back and forth within the 300 foot wide diversion channel bottom. The opportunity for inter-agency partnerships to develop areas for improved habitat would be explored with the non-federal sponsors, interested Federal, state and local agencies and interest groups during preparation of plans and specifications.

The risk associated with the indirect loss of wetlands is low for two reasons. First, the spoil could possibly be placed such that it would not affect the natural drainage pattern, either away from or into the wetlands. Second, the flow of water from the wetlands into the diversion channel through the subsurface will be minimal due to the impervious nature of the surrounding soils. It is likely that seasonal fluctuation and precipitation patterns will have a greater effect on the wetlands than the subsurface drainage. The indirect loss of any wetlands is expected to be minimal and would be offset by the creation of wetlands within the diversion channel bottom. The impacts to wetlands are not considered significant.

5.2.1.6.3 North Dakota Diversion Plans

The construction of the ND30k or ND35k plan will cause a direct loss of wetlands due to either excavation of the wetlands within the diversion channel or placement of spoil in the wetlands adjacent to the diversion channel. The North Dakota East diversion alignment could directly impact approximately 32.5 acres of wetlands (Table 35), while indirectly affecting approximately 193 acres of wetlands (Table 36). Direct impacts were calculated by using the footprint of the ND35k diversion channel. This area is the 36 mile long diversion channel and spoil pile for the ND35k plan. The smaller plans will still be 36 miles long but narrower in width and would impact less acreage of wetlands. This analysis also includes the tie-back levees for the ND35k plan (Figure 45).

Wetlands could also be lost indirectly through the construction of the diversion channel. The natural drainage patterns could be changed due to the placement of the spoil adjacent to the diversion channel. These changes could either be: 1) the drainage pattern to the wetlands is cutoff, eliminating the recharge of the wetland, or 2) a drainage pattern is created to the diversion, allowing the wetland to drain. In addition, the diversion channel creates a lower hydraulic potential area toward which water will try to seep. The seepage into the diversion channel could cause the wetlands adjacent to the diversion channel to dry up. A 5,250 foot wide corridor along the diversion (Figure 46) was used to analyze the quantity of wetlands that could be impacted indirectly; this is a very conservative distance based on the soil types in the area, and could be shortened after further analysis is complete.

Similar to the Minnesota diversion plan, an examination of aerial photography shows that the area had considerably more wetlands prior to conversion to agriculture. The direct loss of the wetlands is certain and unavoidable within the footprint of the channel and spoil piles. Wetland acres that will be adversely affected by diversion channel construction will be offset by the creation of wetlands within the diversion channel bottom. Features that will be used to facilitate the creation of wetlands will include meandering the low flow channel; constructing rock riffles in locations to create ponding, and other features developed during the design of the project. Vegetative species would be planted that are appropriate to temporarily flooded wetlands. A low flow channel is a channel that is typically in the center of a larger channel which is sized to handle small flows from drains, ditches or groundwater. The low flow channel would be approximately a 10 foot wide, 3 foot deep channel located in the middle of the larger diversion channel, and could meander back and forth within the 300 foot wide diversion channel bottom. The opportunity for inter-agency partnerships to develop areas for improved habitat would be explored with the non-federal sponsors, interested Federal, state and local agencies and interest groups during preparation of plans and specifications.

The risk associated with the indirect loss of wetlands is low for two reasons. First, the spoil could possibly be placed such that it would not affect the natural drainage pattern, either away from or into the wetlands. Secondly, the flow of water from the wetlands into the diversion channel through the subsurface will be minimal due to the impervious nature of the surrounding soils. It is likely that seasonal fluctuation and precipitation patterns will have a greater effect on the wetlands than the subsurface drainage. The indirect loss of any wetlands is expected to be minimal and would be offset by the creation of wetlands within the diversion channel bottom.

Additional wetland impacts from the ND30k and ND35k are possible because the design of the tributary structures only allows a minimum of 50-percent chance flow (2-year) to pass through the structures on the Wild Rice, Sheyenne and Maple rivers. Additionally, the existing channels downstream of the diversion for the Lower Rush River and the Rush River will be abandoned. Wetlands near these tributaries inside of the diversion channel could be impacted by not getting the same recharge from overland flooding that they have received in the past. Recent information indicates that this will not have much of an effect for the Wild Rice, Sheyenne and the Maple Rivers but there is still concern for the Rush and Lower Rush Rivers since those channels will be abandoned.

Table 35 - Wetlands directly impacted by North Dakota East Diversion Construction.

Type	Wetland Code	Acres
Palustrine, Emergent, Temporarily Flooded, Partially Drained/Ditched	PEMAd	3.42
Palustrine, Emergent, Temporarily Flooded	PEMA	.73
Palustrine, Emergent, Seasonally Flooded	PEMC	2.34
Palustrine, Emergent, Seasonally Flooded, Excavated	PEMCx	10.53
Palustrine, Emergent, Semipermanently Flooded, Excavated	PEMFx	1.93
Palustrine, Forested, Seasonally Flooded	PFOC	2.42
Palustrine, Scrub-Shrub, Temporarily Flooded	PSSA	6.52
Palustrine, Forested, Emergent, Seasonally Flooded	PFO/EMC	1.15
Palustrine, Scrub-Shrub, Emergent, Seasonally Flooded, Excavated	PSS/EMCx	3.32
Total		32.36

For Wetland Type definitions see Appendix F

Table 36 - Wetlands indirectly impacted by North Dakota East Diversion channel.

Type	Wetland Code	Acres
Palustrine, Aquatic Bed, Semipermanently Flooded, Excavated	PABFx	0.52
Palustrine, Emergent, Temporarily Flooded	PEMA	7.70
Palustrine, Emergent, Seasonally Flooded	PEMC	11.12
Palustrine, Emergent, Temporarily Flooded, Partly Drained	PEMAd	16.01
Palustrine, Forested, Temporarily Flooded	PFOA	7.74
Palustrine, Forested, Seasonally Flooded	PFOC	7.54
Palustrine, Emergent, Seasonally Flooded, Excavated	PEMCx	47.09
Palustrine, Emergent, Semipermanently Flooded, Excavated	PEMFx	6.75
Palustrine, Forested, Emergent, Seasonally Flooded	PFO/EMC	3.98
Palustrine, Scrub-Shrub, Emergent, Seasonally Flooded, Excavated	PSS/EMCx	10.33
Palustrine, Scrub-Shrub, Temporarily Flooded	PSSA	11.71
Riverine, Intermittent, Streambed, Semipermanently Flooded	R4SBF	0.69
Palustrine, Emergent, Forested, Seasonally Flooded	PEM/FOC	7.00
Palustrine, Emergent, Semipermanently Flooded	PEMF	2.39
Riverine, Lower Perennial Unconsolidated Bottome, Intermittently Exposed	R2UBG	6.04
Riverine, Lower Perennial, Unconsolidated Bottom, Permanently Flooded	R2UBH	44.04
Riverine, Lower Perennial, Unconsolidated Shore, Seasonally Flooded	R2USC	1.02
Riverine, Intermittent, Streambed, Semipermanently Flooded	R4SBF	0.69
Total		192.36

For Wetland Type definitions see Appendix F

Figure 45 - Wetlands along North Dakota East diversion channel

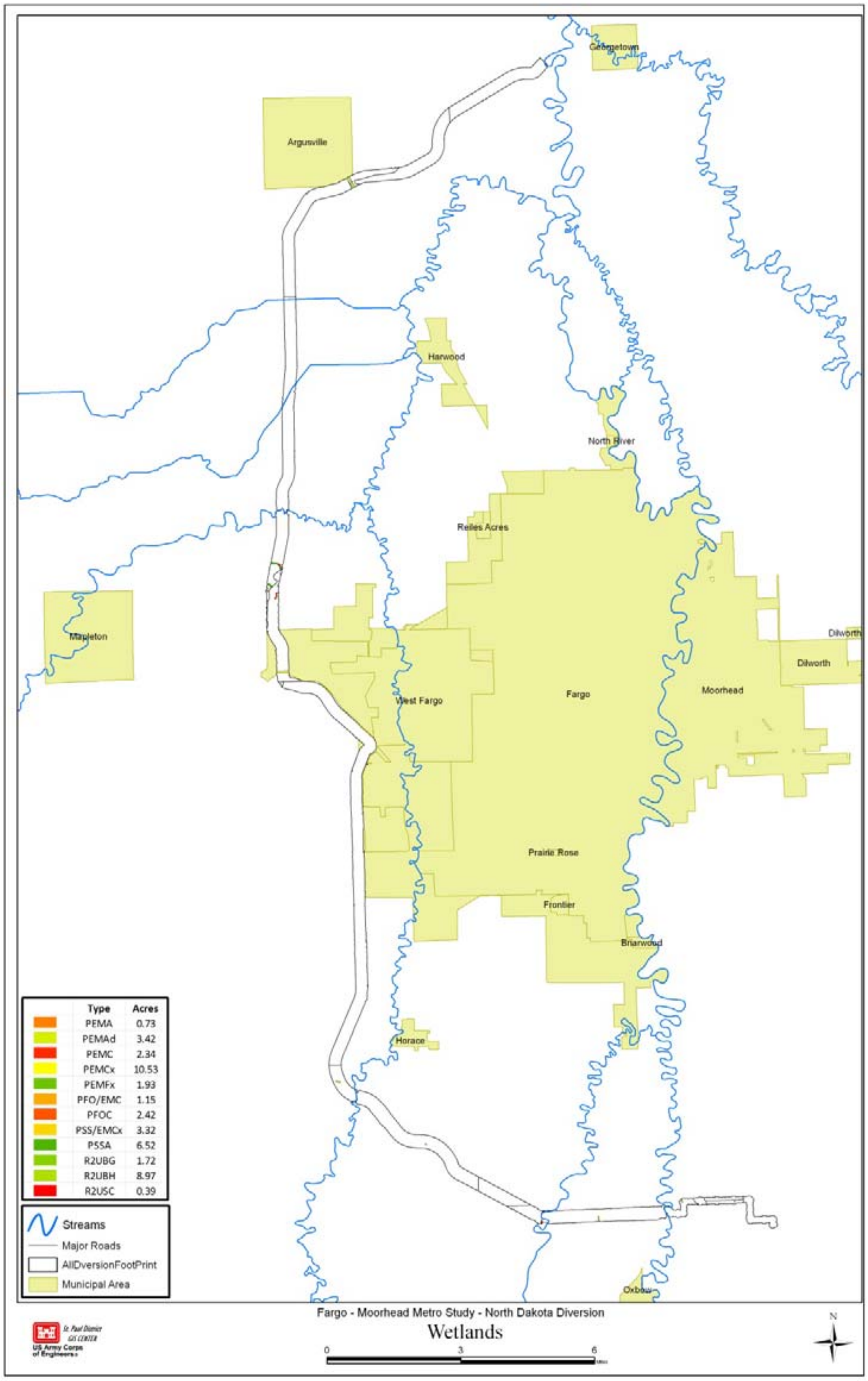
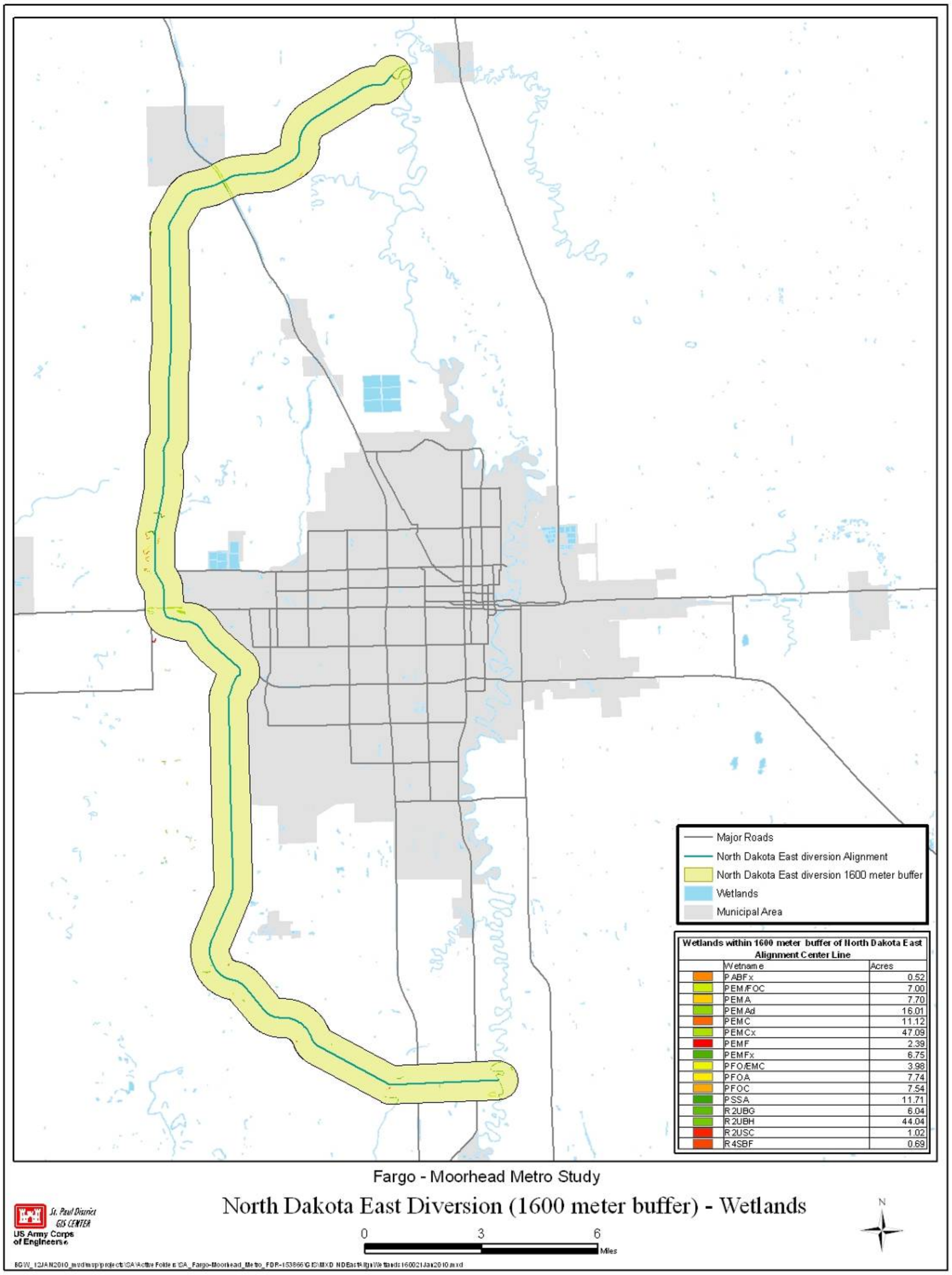


Figure 46 - Wetlands along North Dakota East diversion channel.



5.2.1.7 Groundwater

All of the diversion channel alternatives would have a similar effect on groundwater. The groundwater table is the locally observed groundwater table near the ground surface, typically located within the first 15 feet below the ground surface. The groundwater table fluctuates seasonally, depending on the precipitation and weather conditions experienced throughout the year or years. The fluctuation of the groundwater table is assumed to occur even without the construction of a diversion channel. Groundwater is not considered a source for water in the area due to the relatively low permeability of soils and the low volume of water expected to flow through these soils.

The flow of the groundwater is always to the lower hydraulic potential area. After the excavation of a diversion channel is completed, the groundwater will flow to the lowest potential area, which would be the bottom of the diversion channel. This flow could potentially lower the groundwater table near the diversion channel but only to the depth of the excavated diversion channel. The lateral extents of the lowered groundwater table would likely be confined to areas immediately adjacent to the diversion channel. Areas outside the extent of the spoil piles would likely see very little to no change. The groundwater flow quantities through clayey soils would be relatively small compared to pumping of an irrigation well, or recharge that occurs in an aquifer from upgradient sources such as the Buffalo River.

A lowered groundwater table could potentially reduce the capacity of local wells that are recharged by the groundwater table. The risk that the groundwater table would reduce the capacity of local wells is low to moderate as the area that is affected would be concentrated adjacent to the diversion channel, would not extend regionally, and would be relatively shallow compared to local wells. The lowering of the groundwater table could cause consolidation of the surrounding soils and settlement of structures within the area affected. Only structures near the diversion channel would have the potential to settle. Since the area affected is not expected to extend beyond the channel and spoil piles it is unlikely that any structures remaining after construction would be impacted. If local wells experience reduction in capacity, the depth of the well could be increased or an additional well be installed to mitigate for the reduced capacity. In the case of structures, a program would be initiated to monitor the settlement of the structures and any other signs for distress. Wells and structures that are near the diversion channel would be identified and monitored to ensure no impact, and if there are impacts they will be mitigated for.

5.2.1.7.1 Aquifers

All of the diversion channel alternatives would have a similar effect on aquifers. The aquifers in the project area are pervious, water-bearing geological formations that are located at depth and covered by a relatively impermeable formation. Aquifers can provide a major source of water. The aquifers are assumed to have some amount of artesian pressures. The major aquifers in the project area are the Buffalo Aquifer in Minnesota and the West Fargo Aquifer in North Dakota. A 2005 3-D physical geological model (compiled by the Minnesota Geological Survey) shows the majority of the Buffalo aquifer is over 1000 feet from the proposed diversion channel. Measureable impacts to the aquifer with this separation are very unlikely. Sandy beds within the lake clays may also be present along the alignment; verifying if and how they are hydraulically connected to the Buffalo Aquifer is on-going. Additional subsurface exploration and vibrating wire piezometer installations in May and June, 2010 along with review of existing data will alleviate the uncertainty in areas where the sandy seams occur. The West Fargo aquifer is generally at depths over 70 to 100 feet below ground surface. This appears to be deep enough to avoid impacts that could occur from project structures or excavation associated with either of the North Dakota alternatives, and measurable impacts are unlikely.

The first potential effect that construction of a diversion channel could have is the lowering of the artesian pressures in the aquifer. With the construction of the diversion channel, the seepage path length from the aquifer to the ground surface would be reduced approximately by the depth of the channel excavation. This reduced seepage path length and creation of a lower potential area would increase the flow of the water out of the aquifer. If the quantity of flow out of the aquifer was greater than the quantity of flow recharging the system, the artesian pressures would be reduced. The result of the lowered artesian pressures would be less water available for private and municipal use. The lowering of the artesian pressures could be increased if the diversion channel excavation exposes pervious material that is directly connected to the aquifer.

The second potential effect of a diversion channel is that contamination of the aquifer could occur. The diversion channel excavation would reduce the length that contaminates would have to travel from the ground surface to the aquifer. The contamination of the aquifer would lead to the loss of water supply to those dependant on it. If a pervious material that is directly connected to the aquifer is exposed in the diversion channel, contaminates could easily migrate into the aquifer.

Due to the impervious nature of the subsurface materials the flow of water from the aquifer due to artesian pressures and the migration of contaminates into the aquifer are minimized. The risk is greater if pervious materials are encountered during the excavation of the diversion channel.

There are two mitigation/adaptive management measures that could be taken to reduce the risk of lowering the artesian pressures in the aquifer or migration of contaminates into the aquifer. The first adaptive management measure would be to monitor the aquifer and the areas surrounding the diversion channel to see if the artesian pressures are being lowered after excavation of the diversion channel and what direction the water is flowing. If an impact to the aquifer was detected the second mitigation measure would be to place an impervious buffer between the aquifer and the channel excavation to minimize the flow of water into the diversion channel or contaminates into the aquifer. If a pervious material was encountered during channel excavation, over-excavation of this material would be required and impervious fill placed to provide this buffer.

Additional data analyses and design refinements are recommended to verify alignment choices considering the local variations in the hydrogeology. Based on the literature and some of the borings conducted for this study, there are smaller scale sand and gravel beds that could be considered aquifers if the beds are extensive enough to provide potable water for a residence or farmstead. The existence of these smaller aquifers needs to be matched with existing water wells to prevent or compensate for the loss of individual water wells along the alignment. Potential impacts if the diversion encroached upon an aquifer include drawdown of the groundwater, and/or decreasing the pressure in a confined aquifer due to seepage into the diversion excavation.

5.2.1.8 Fisheries and Aquatic Habitat

The discussion below addresses potential impacts of the various alternatives to fisheries resources and aquatic habitats. Because of similarities among alternatives, the discussion below will generally discuss effects common to all of the diversion channel alternatives, unless specifically noted.

5.2.1.8.1 Red River

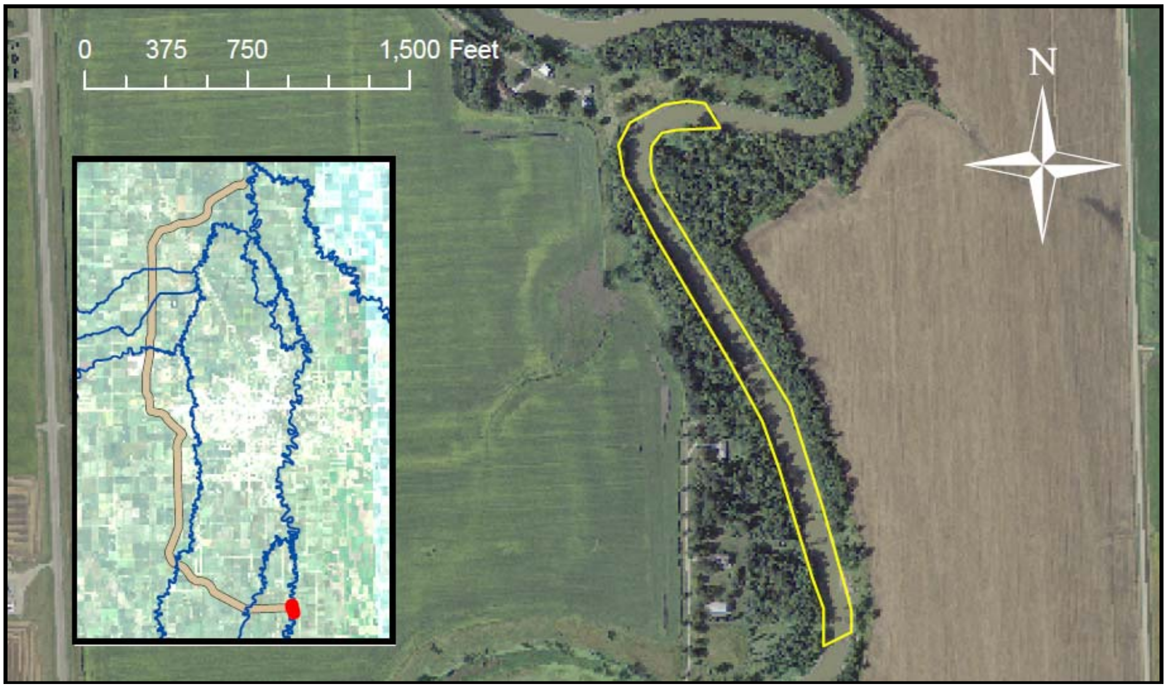
5.2.1.8.1.1 Red River Control Structure Footprint Impacts

A concrete Red River control structure would be constructed for each of the six diversion channel alternatives. The exact location of the structure is not yet known but would be different between the North Dakota alignment and the Minnesota alignment. All alternatives would generally have similar footprint impacts.

Because of logistical challenges and construction risks, the likely construction method is to build the control structure "in the dry" adjacent to the existing Red River. Following completion the Red River would be permanently routed through the structure. A new channel would be excavated and permanent berms would be constructed to direct flow into the new channel.

This approach would result in the permanent abandonment of approximately 0.5 miles of Red River channel habitat. This could equate to 10 acres of river habitat lost (Figure 47). The exact location and footprint impact are not known, and will be refined in future NEPA documentation. The North Dakota alignment is shown in Figure 47, the Minnesota alignment would have similar impacts and is not shown. Some habitat would be created within the newly constructed channel through the control structure. However, the habitat created is not expected to replace that which is lost. As such, mitigation would be implemented to offset this impact. Potential mitigation measures are discussed in Section 5.5 Mitigation and Adaptive Management at the end of this chapter.

Figure 47 - Potential footprint impact area on the Red River for a North Dakota diversion alignment.



Construction activities would result in temporary avoidance of the project area by fish during periods when in-water construction causes disturbance. However, this should be temporary, and would not be expected to have any meaningful long-term effect on Red River fisheries.

5.2.1.8.1.2 Effects on Red River Geomorphic Processes and Aquatic Habitat

All of the diversion channel alternatives involve similar structures that facilitate routing of floodwater from the Red River into the diversion channel. All alternatives will reduce Red River flood heights for events in excess of a 20-percent chance event. Flood flows up to 9,600 cfs (approximately a 20-percent chance event) would pass through the control structure. Above that, additional Red River flows would be diverted into the diversion channel. This could potentially affect sediment transport, accretion, and erosion, which are critical forces in shaping and maintaining aquatic habitat. For the Minnesota alignment, this could influence approximately 42 miles or more of Red River habitat. For the North Dakota alignment, this could influence approximately 60 miles of Red River habitat.

The likelihood of significant impact appears small. The general characteristics of sediment transport are discussed above. Sediment transport of the Red River appears to be dominated by clay and silt, while sand contributions, although present, appear minimal. Thus, sediment transport is less dominated by bedload, and more by suspended solids. Sediment will be conveyed proportionately through the Red River control structure, as well as down the diversion channel. Also, bankfull discharges (e.g., approximately a 50-percent chance event) are often considered a critical point for maintenance of sediment transport. By comparison, the Red River control structure will convey flows up to 9,600 cfs (approximately a 20-percent chance event). Given this, the likelihood for drastic changes to sediment scour and deposition downstream of the Red River control structure appears small. This would likely be adequate to maintain most geomorphic processes that shape and maintain fisheries habitat in these sections of the river.

None of the diversion channel alternatives should have significant impacts on geomorphic processes for the Red River, relative to existing conditions. However, as discussed in the Mitigation/Adaptive Management Section at the end of this chapter, the Red River within the project area will be further evaluated to verify any potential impacts. This would include pre- and post-project monitoring for both geomorphic condition and biotic use of the Red River. Monitoring would be done in close coordination between the sponsors and appropriate Federal and State agencies. The exact methodology will be developed during this coordination. The coordination also should include discussion whether future actions would be needed if adverse significant impacts were identified. No mitigation is planned here given that significant impacts appear unlikely.

5.2.1.8.1.3 Effects on Red River Floodplain Access Within the Project Area

Many fish species use floodplain areas during flood events. These uses can include spawning, feeding, shelter from high velocities and other functions. All alternatives would reduce flood elevations for events that are above a 20-percent chance event. This would be observed on the Red River from the control structure, downstream to the confluence of the Red River with the diversion channel. The general locations of the diversion channel for the Minnesota and North Dakota alignments are shown in Figure 48 and Figure 49. The Minnesota alignment includes approximately 42 miles of river between the control structure and the downstream confluence with the diversion channel. The North Dakota alignment includes approximately 60 miles of river between the control structure and the downstream confluence with the diversion channel.

Flood elevations, and the quantity of area inundated by the river during floods will change under all alternatives. This would reduce the availability of floodplain habitat for fish use within the project area during flood events with flows in excess of 9,600 cfs. The loss in floodplain availability would be relatively small for more frequent events above the 9,600 cfs event (approximately 20-percent chance). Losses would differ between diversion alignments and alternatives. For example, with the MN35k Diversion, there would be a loss of about 10-11-percent in the inundated floodplain for a 10-percent chance event, relative to existing conditions (Figure 48). Conversely, for the ND35k Diversion, there would be a loss of about 50-percent of the inundated floodplain for a 10-percent chance event, relative to existing conditions (Figure 49).

Under existing conditions, access to the floodplain in the project area, and its overall value, may be somewhat limited during floods given its urban nature, and that the Cities of Fargo and Moorhead implement emergency flood protection. With the project in place, floodplain access for events up to 9,600 cfs event would still occur with the same frequency and flood elevation. Only more extreme and less frequent events would affect floodplain access. During larger floods, biota downstream of the project would be subjected to conditions similar to a 9,600 cfs event, and would still have access to floodplain areas inundated at that event.

Figure 48 - Differences in floodplain area between a 10-percent chance event under existing conditions and with the Minnesota alternatives.

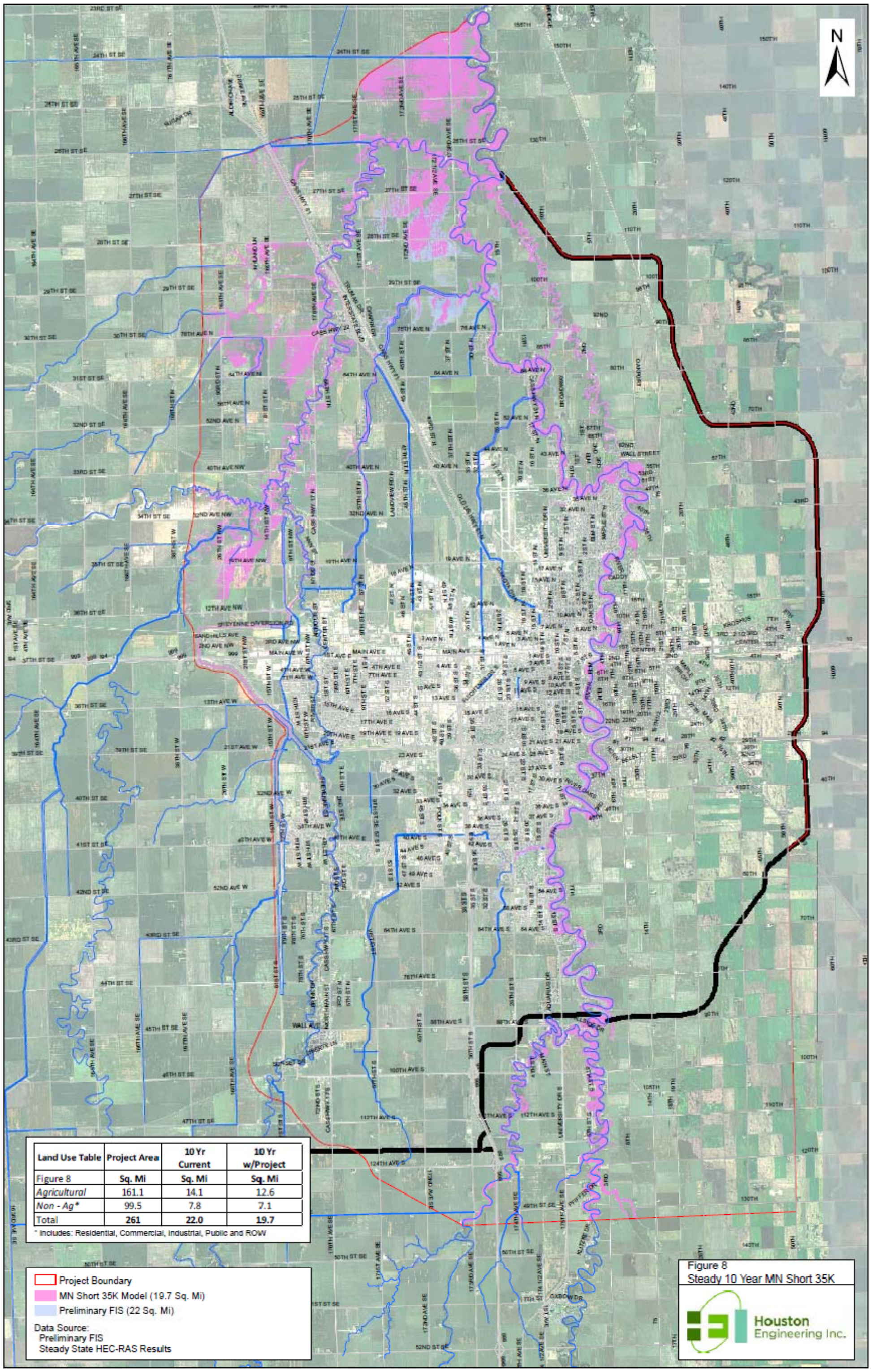
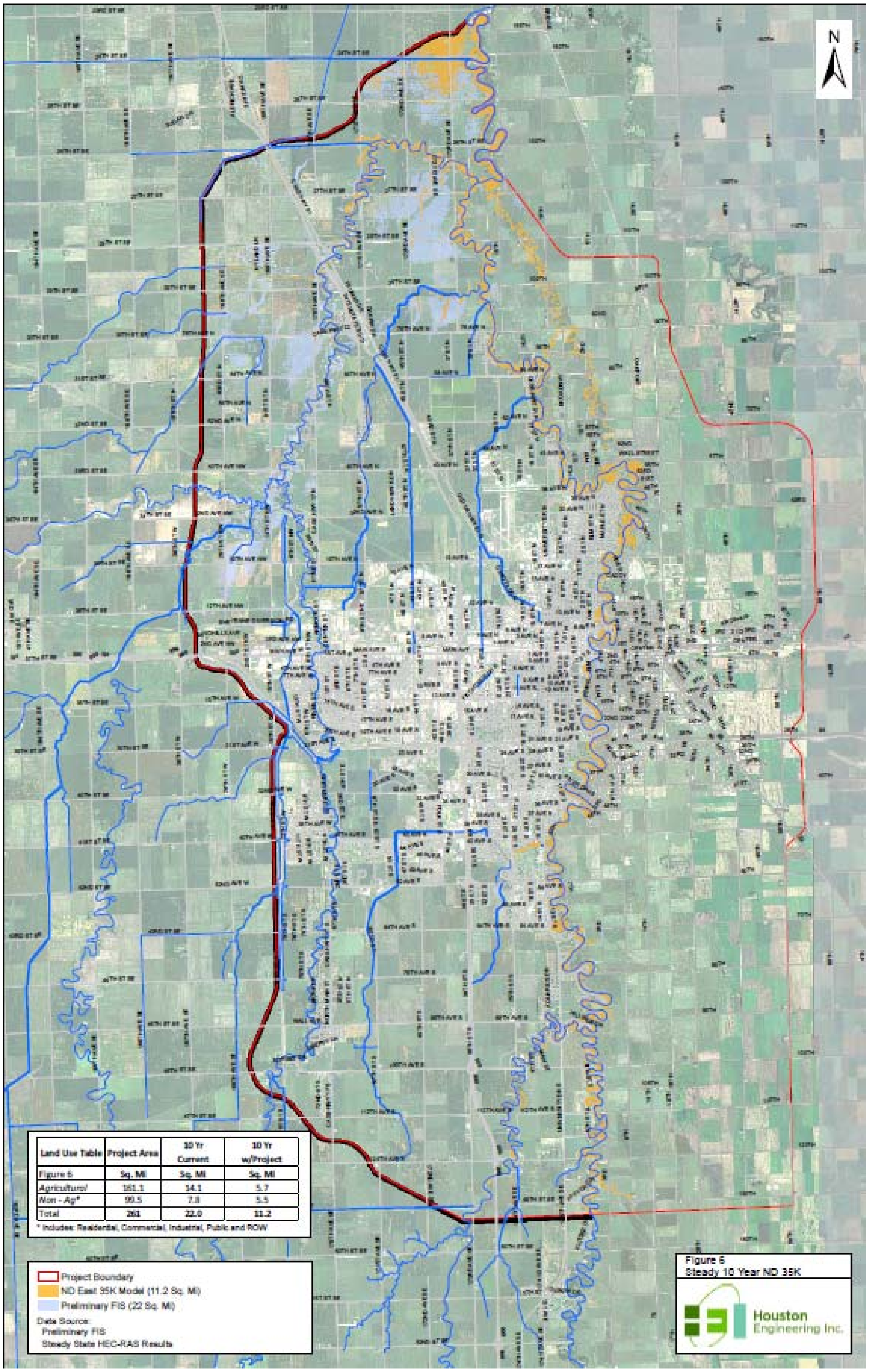


Figure 49 - Differences in floodplain area between a 10-percent chance event under existing conditions and with the North Dakota alternatives.



Floodplain access would remain unchanged upstream and downstream of the project site, providing large areas of habitat during flooding. Also, no scientific evidence has been found that suggests floodplain access is a limiting factor for fish populations or communities in the Red River basin. Any localized effect to the fish community due to reduced floodplain access in the project area would most likely be undetectable in terms of a population or community response. Thus, the changes in floodplain habitat access would be expected to have a less-than-significant impact to the fish community of the Red River and adjacent tributaries.

5.2.1.8.1.4 Effects of a Diversion Channel on Biota

The diversion channel alternatives include construction of a diversion channel that will convey significant river flows during flood events above 9,600 cfs (approximately a 20-percent frequency discharge). For the Minnesota alignment, the diversion channel would be approximately 25 miles long, compared to approximately 36 miles long for the North Dakota alignment.

For the Minnesota alignment, the diversion channel will not cross any tributaries or other surface waters with fisheries resources. Thus, the diversion channel would not result in any direct significant impacts to fisheries resources or habitat under alternatives of the Minnesota alignment.

Conversely, for the North Dakota alignment, the diversion channel will cross five tributaries: Wild Rice River, Sheyenne River, Maple River, Lower Rush River and Rush River. Impacts to these tributaries are discussed in section 5.2.1.8.2 North Dakota Tributaries.

With either diversion alignment, the diversion channel could be used by fish during flood periods when fish may be drawn into the channel. However, this would happen relatively infrequently, and would not be considered a benefit. Given the nature of the diversion channel the habitat value would be extremely limited. During periods when the diversion channel is not in operation, there may be a small amount of water present at the bottom of the diversion due to ditches and drainage tiles discharging to the channel. However, this is not expected to provide any meaningful fisheries habitat.

Concern has been expressed that fish stranding could be an issue under any diversion alternative. As river levels fall, fish in the diversion channel could become trapped if water levels fall too quickly. This could result in fish mortality from isolation and stranding, poor water quality and predation.

To aid in assessing the potential for fish stranding, the Corps performed modeling of stage hydrographs at three locations within the ND35k alignment alternative. These three locations are situated between the Sheyenne River and Maple River crossings. The Corps HEC-RAS hydraulic model for unsteady flow conditions produced the stage hydrographs using hydrology developed during this study. Potential flood events representing a 10 and 2 percent chance event were simulated. These simulated floods demonstrate water levels for various durations and frequencies within the diversion channel.

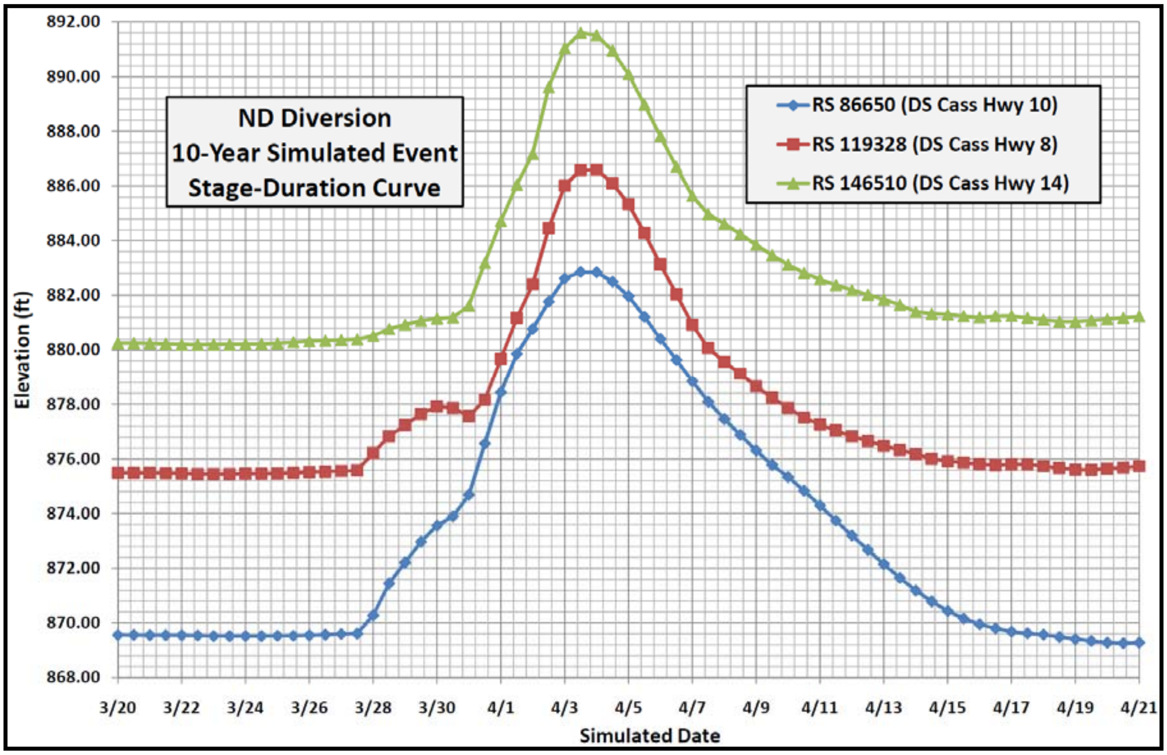
Before developing water levels for these events, the unsteady hydraulic model was calibrated to the 2009 flood event and also verified to the 1997 and 2006 flood events. Then the simulated flood event hydrology using balanced hydrographs was developed, this was used to analyze the proposed Red River diversion alternatives.

Every flood event is unique in terms of its peak discharge, timing, and duration. A simulated, balanced hydrograph makes statistical use of all these events to configure a hydrograph that is consistent for all durations in regard to the specified exceedence frequency. The hydrograph is "balanced" for all durations within the hydrograph based on volume and frequency and so they represent the flood that could be anticipated at the various frequency risk levels and durations.

Review of modeling output for the simulated 10-percent chance event suggests that water elevations within the diversion channel would decline at different rates along the descending hydrograph (Figure 50). The initial decline in water surface elevations could be up to 2.3ft per day. This rate of decline would decrease with the descending hydrograph. As water depths become shallower, water elevations would decrease at rates up to about a foot per day or less.

Review of modeling output for the simulated 2-percent chance event provides similar results. Rates of decline may be even less than those observed for a 10-percent chance event.

Figure 50 - Water surface elevations within the North Dakota diversion channel (ND35k alternative) for a simulated 10-percent chance event hydrograph.



Discharge and water elevations in the diversion channel will decrease with the flood hydrograph. As water levels decrease, fish would be expected to respond by migrating downstream out of the diversion channel. The upstream control weir would be designed to have a low-flow notch to avoid an instant cut-off of flow once river elevations drop to the elevation of the control weir. In addition, a low-flow channel would be created at the base of the diversion channel under either diversion alignment. This low-flow channel would run the entire length of the diversion channel, and is necessary to account for the water that is expected to flow from the diversion channel under most conditions. This water would originate from field and tile drains into the diversion channel. This low flow channel and additional discharge would help remaining fish exit the diversion channel. While it is possible that a few larger fish could be lost in isolated pools within the diversion channel, it is not believed that this would be a significant issue during project operations. No significant impacts would be anticipated from fish stranding under any diversion channel alternative.

5.2.1.8.1.5 Effects on Fish Passage and Biotic Connectivity for Red River

Fish passage on the Red River could be impacted by the Red River control structure and diversion channel proposed for all diversion channel alternatives. Flow velocities and patterns would be modified with implementation of the Red River control structure, which could in turn influence the ability for fish to migrate. The diversion channel could affect how fish migrate upstream through the Red River during flood events given the channel will convey a large percentage of total-river flow. In addition to fish, the diversion channel alternatives could also affect organisms such as freshwater mussels that rely on fish as a host species during portions of their lifecycle. Impacts are discussed below for both the control structure and the diversion channel.

5.2.1.8.1.5.1 Red River Control Structure Effects on Connectivity

Flow velocities through the control structure must remain low enough that fish can successfully migrate upstream. This is especially important during months when fish tend to migrate, though the ability for free fish movement can be important during all months of the year. It is also important to provide a variety of flow velocities and patterns, as opposed to providing uniform flow. Under natural conditions, rivers typically have a range of flow velocities within the channel, providing lower-velocity zones fish can use to successfully migrate upstream.

A complete description of the proposed Red River control structure is provided in Chapter 3 section 3.3.3.7 (also see Figure 51 and Figure 52). A complete discussion of hydraulic modeling and analyses for project alternatives is included in Appendix B, Hydraulics. Hydraulic conditions at the Red River control structure would generally be similar for all diversion channel alternatives. The location of the control structure will vary between the North Dakota and Minnesota alignments, namely its location above or below the Wild Rice River. This could result in slightly different designs and hydraulic conditions between the North Dakota and Minnesota alignments. However, for the analyses covered within this report, it is assumed the Red River control structure would be designed to provide similar hydraulics regardless of diversion alignment. For example, the control structure under both alignments would convey approximately a 20-percent chance event through the structure, even though a 20-percent chance event for the North Dakota alignment has less water quantity at the control structure than the Minnesota alignment. The designs used here for the different alignments generally result in the same flow velocities and patterns through the structure.

Under most conditions, the proposed control structure on the Red River will essentially function as a bridge with flows passing below without constriction. The structure, as designed for this study, includes three gates that are 40 ft wide. Each bay will be approximately 90 ft long, meaning fish would have a 90-ft span from downstream to upstream to migrate through the structure. A combination of rocks, and possibly concrete baffle blocks, placed in the concrete bottom sill of the control structure will provide flow complexity along the bottom of the channel. This will provide fish a variety of velocities and flow patterns with which they can migrate upstream, provided velocities remain suitable. Water depth through the structure would not be a concern, as even under low summer flows water depths through the structure would be on the order of several feet.

Figure 51 - Schematic of proposed Red River Control Structure without flow.

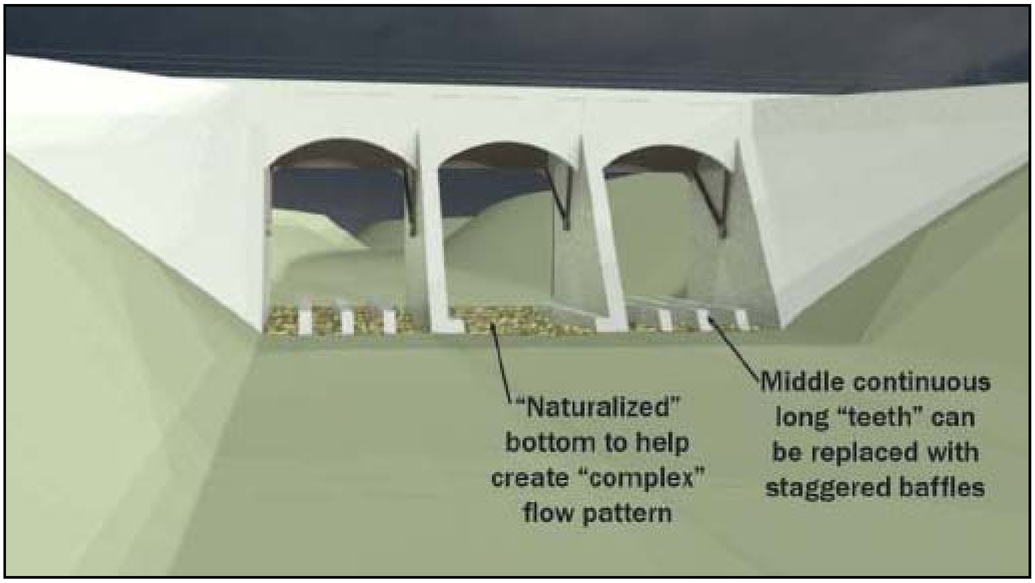
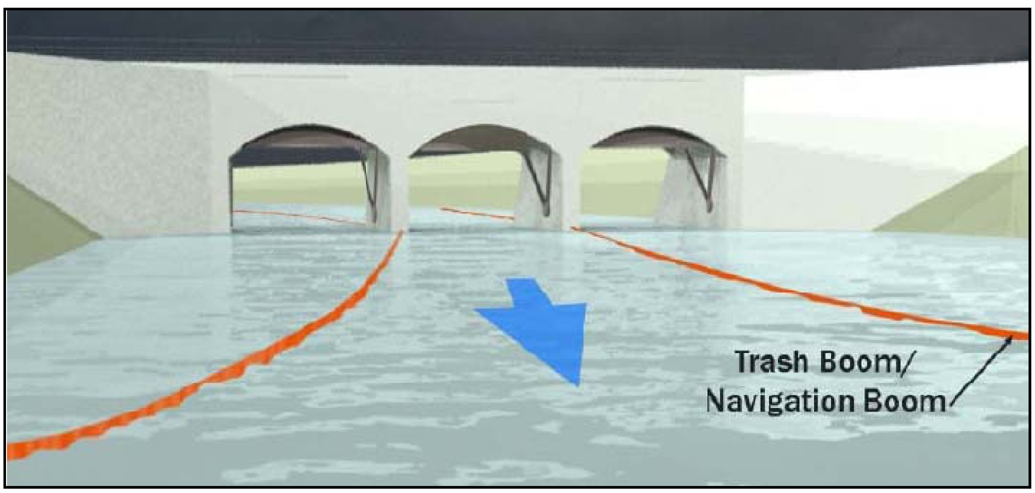


Figure 52 - Schematic of proposed Red River Control Structure with flow. Gates are out of the water, and the project is not in operation.



Under existing conditions, average flow velocities at Fargo are well under 1 foot per second (ft/s) for the annual median flow of 360 cfs, and usually average 1-2 ft/s for flows around 3,500 cfs (a 50-percent chance event). Velocities increase to an average of 1.5 to 4 ft/s for flows around 9,600 cfs (a 20-percent chance event), and can increase more for larger events (Figure 53 to Figure 55). Velocities observed across a transect at Fargo, ND during flood events include areas of higher velocity mid-channel (e.g., flows greater than 3 ft/s). However, lower velocity areas (e.g., 1-2 ft/s) also occur near the channel perimeter, and up onto the floodplain (Figure 54 and Figure 55).

Figure 53 - Observed average channel velocities for the Red River at Fargo, North Dakota, USGS gauge 05054000, for various river discharges. Source: USGS.

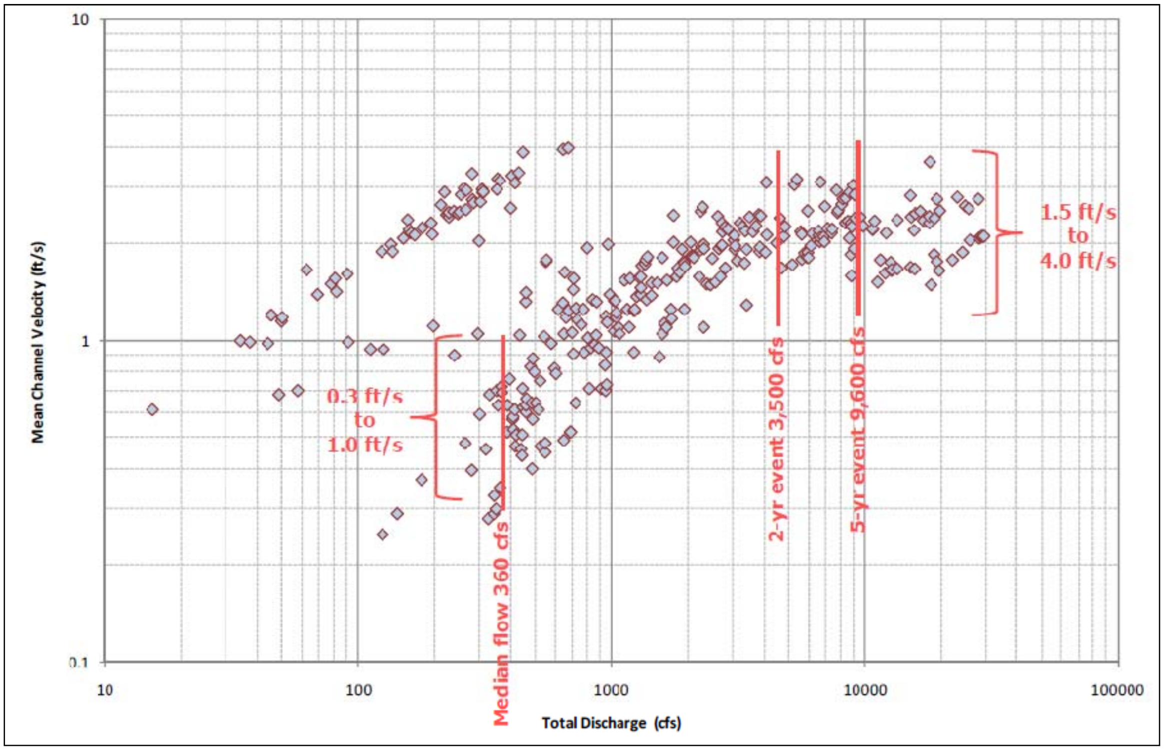


Figure 54 - Observed average channel velocities across a channel transect for the Red River at Fargo, North Dakota, USGS gauge 05054000, for a river discharge of 12,600 cfs (i.e., discharge between a 20-percent and 10-percent chance event). Source: USGS.

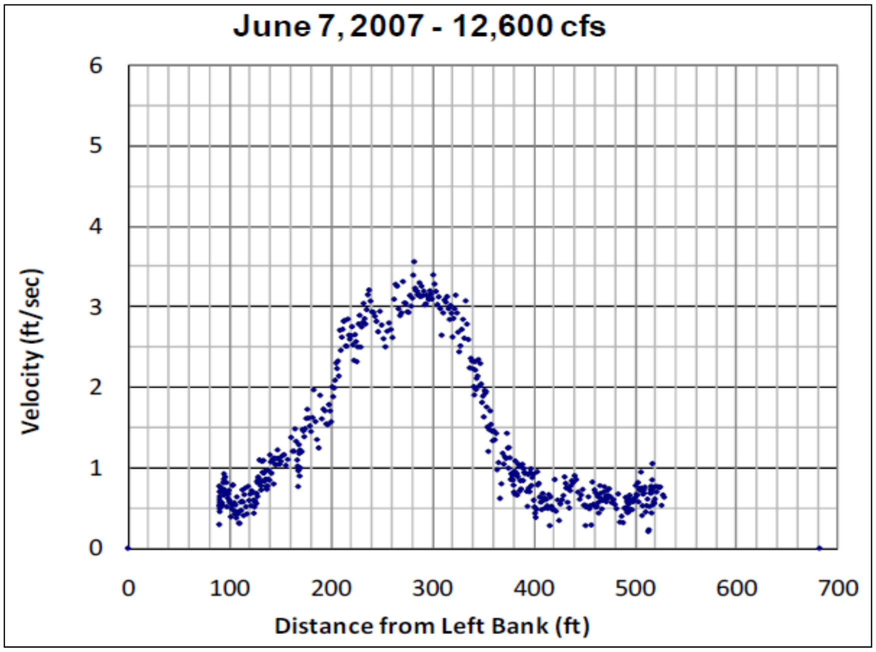
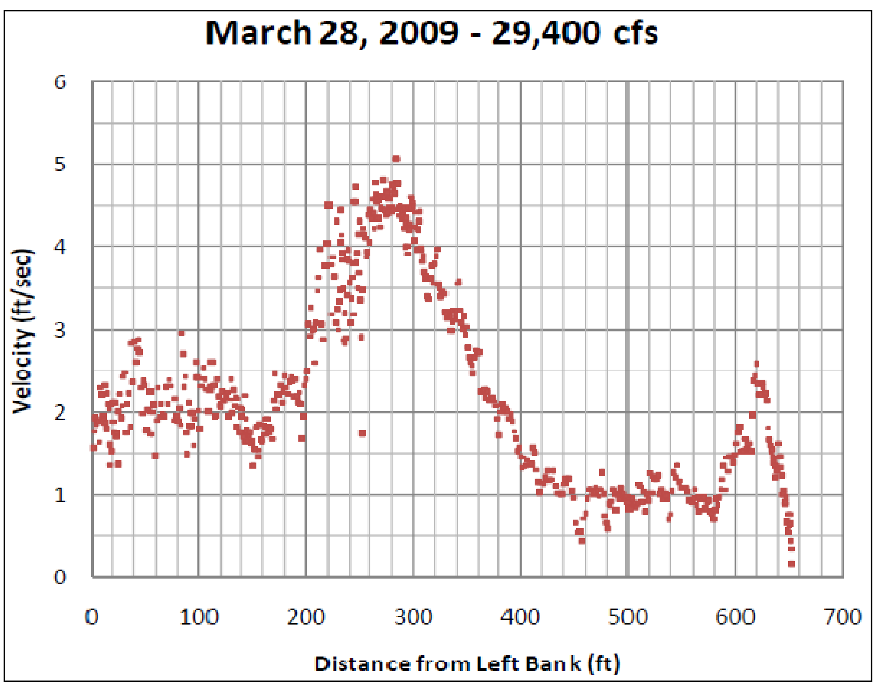


Figure 55 - Observed average channel velocities across a channel transect for the Red River at Fargo, North Dakota, USGS gauge 05054000, for a river discharge of 29,400 cfs (i.e., discharge approaching a 2-percent chance event). Source: USGS.



A complete discussion of hydraulic modeling and analyses for the project is provided in Appendix B, Hydraulics. Hydraulic modeling of the various alternatives under the Minnesota alignment predicted average flow velocities through the structure of about 1 ft/s at flows of 3,500 cfs; and an average velocity of about 2.1 ft/s for flows at a 20-percent chance event (i.e. about 9,600 cfs at the control structure for this alignment) (Appendix B). Similarly, modeling of alternatives under the North Dakota alignment predicted average flow velocities of 2.0 ft/s for a 20-percent chance event (i.e., about 7,300 cfs at the control structure for this alignment) (Appendix B). This suggests that average flow velocities through the structure, for any alternative, will generally be similar to existing conditions for typical river discharge, with a slight increase in velocity for a 20-percent chance event. Review of velocity plots suggests some of the flow complexity associated with the structure (Figure 56 and Figure 57). During a 20-percent chance event, flows through the structure would include areas of both higher velocity (around 2.5 ft/s) and lower velocity (around 1.0 ft/s) (Figure 57). These average velocities, in combination with rock and concrete placed in the bottom of the channel to increase flow complexity, should ensure the proposed structure is functional for fish passage similar to existing conditions, for river discharges up to a 20-percent chance event (e.g., 9,600 cfs (MN alignment) or 7,300 cfs (ND alignment) at Fargo, ND).

To further improve the potential success of the fish migration through the Red River control structure, the size of the gate bays may be increased (see Mitigation Section). If possible, individual gate bays will be further widened to 50 feet. This could further reduce average velocities through the gate bays from 2.1 to 1.7 ft/s for a 20-percent chance event for either of the diversion alignments.

Figure 56 - Depth-averaged velocity for Red River Control Structure for a 50-percent chance event (3,500 cfs at Fargo, ND). Modeling assumes increased roughness along river bottom via baffle blocks or rock boulders. Modeling presented is for alternatives under the Minnesota alignment. Velocity profiles would be similar for alternatives under a North Dakota alignment.

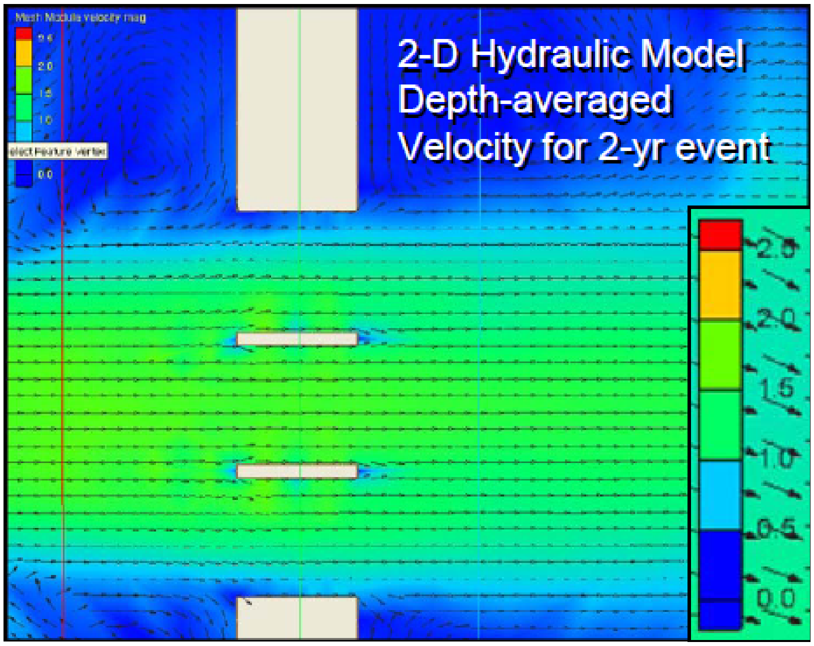
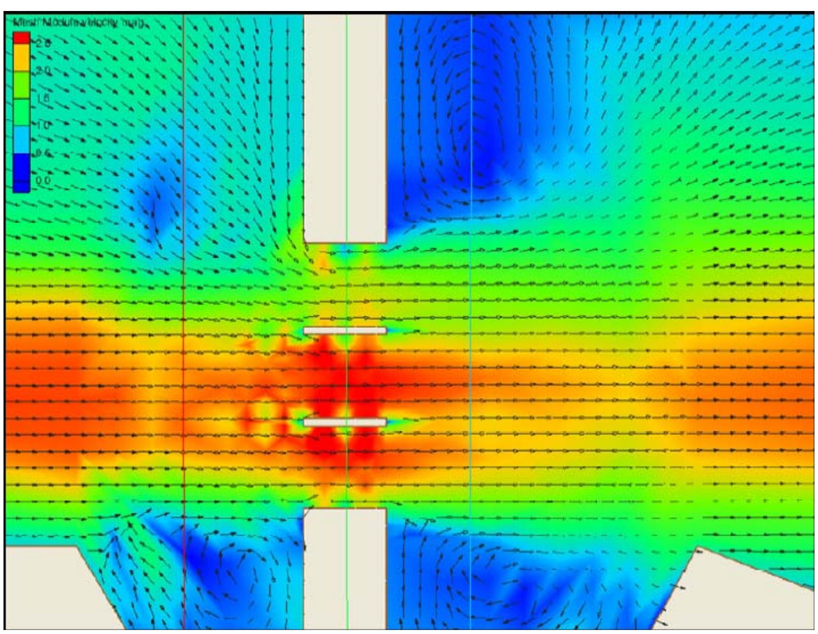


Figure 57 - Depth-averaged velocity for Red River Control Structure at a 20-percent chance event (9,600 cfs at Fargo, ND). Modeling assumes increased roughness along river bottom via baffle blocks or rock boulders. Modeling presented is for alternatives under the Minnesota alignment. Velocity profiles would be similar for alternatives under a North Dakota alignment.



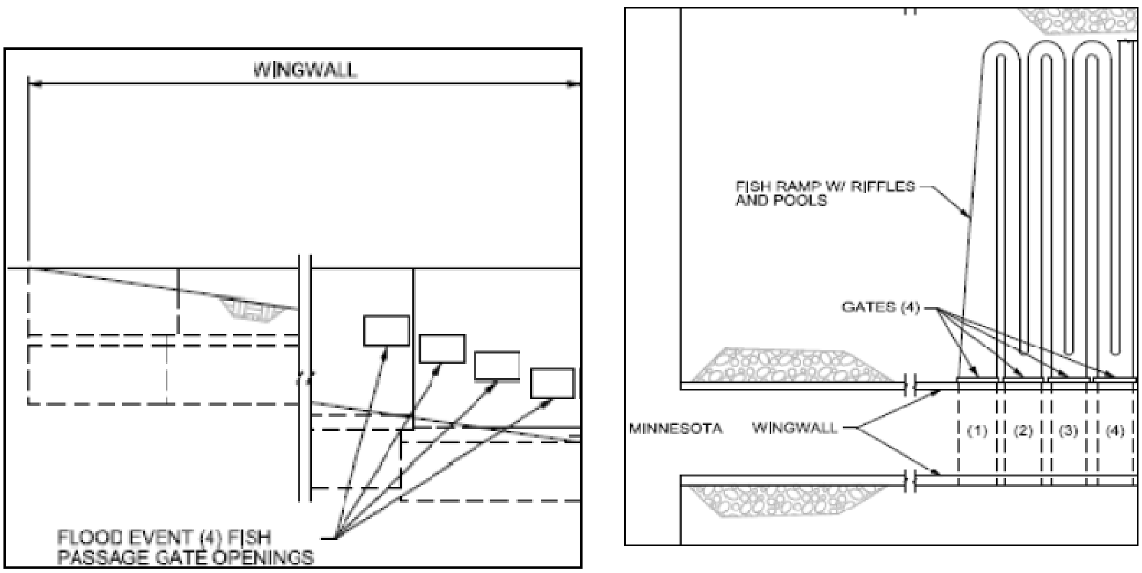
Above a 20-percent chance event, the proposed Red River control structure would be placed into operation, meaning the gates would be lowered to activate the flood risk management project. This would result in constricted flows through the structure, with a substantial increase in current velocities. For alternatives under the Minnesota alignment, average flow velocities increase from 2.1 ft/s at a 20-percent chance event, to over 12 ft/s at a discharge of 14,500 cfs (10-percent chance event; Appendix B). Alternatives under the North Dakota alignment increase from 2.0 ft/s at a 20-percent chance event, to over 8 ft/s at a 10-percent chance event (Appendix B). These velocities are well above existing conditions, and are above what can be assumed would be passable for all fish species on the Red River. As such, it can be assumed that fish would not be able to pass through the proposed Red River control structure for flows above a 20-percent chance event.

To minimize impacts to fish migration during flood events where discharge is above a 20-percent chance event, a fish bypass channel would be constructed at the control structure. The tentative, preliminary plans of the fish bypass channel are described below. These are basic designs made for the purpose of cost-estimation, and more refined designs will be needed in the next phase of planning. This will include collaboration with State and local biologists, and other fish passage experts as necessary, to design an effective structure. The fish bypass channel will be designed to maximize the opportunity for fish passage, to the extent practical, during high-flow events. The structure would provide an avenue for fish passage beginning at a 20-percent chance event, and extending up to a 2-percent chance event. Above a 2 percent chance event, no fish passage would be possible as the bypass channel would be closed to protect the structure from extreme hydraulic conditions.

The preliminary fish bypass channel includes four gates to facilitate flow through the Red River control structure (Figure 58). The preliminary plans include a channel that has a general grade of less than 1-percent and achieves average velocities most often less than 3 ft/s through the control gate. The fish bypass channel is tentatively planned to be approximately 30 ft wide, 3,500 feet long. However, the length would likely become shorter as the design incorporates riffle-pool sequences into the design. Depending on design and upstream stage, total discharge conveyed would be between approximately 50 and 300 cfs. This would be approximately 0.5 to 3 percent of total flow that would pass through the fish bypass channel during 20 to 2-percent chance events. The fish bypass channel will include a downstream entrance as close as possible to the Red River control structure to maximize the potential for fish to find and use the fish bypass channel. The upstream exit of the channel would be placed well upstream of the Red River control structure to ensure that fish do not get drawn back into the control structure at high velocities. It is recognized that a fish bypass channel is not as effective for fish passage as an open, un-constricted channel with natural flows. However, with careful design, this fish bypass channel should provide another route for fish to migrate upstream past the control structure.

To further improve the potential success of the fish bypass channel the size of the fish bypass channel may be increased. Although the logistical constraints are unclear, additional measures should further improve the effectiveness of the bypass. In addition, as discussed in Section 5.5 Mitigation and Adaptive Management, fish passage through the control structure (including the fish bypass channel) will be further evaluated to verify effectiveness. This would include post-project monitoring to gauge the effectiveness of these structures in facilitating fish migration.

Figure 58 - Tentative design of the fish passage channel for the Red River control structure. Channel would function between a 20-percent and 2-percent chance event.



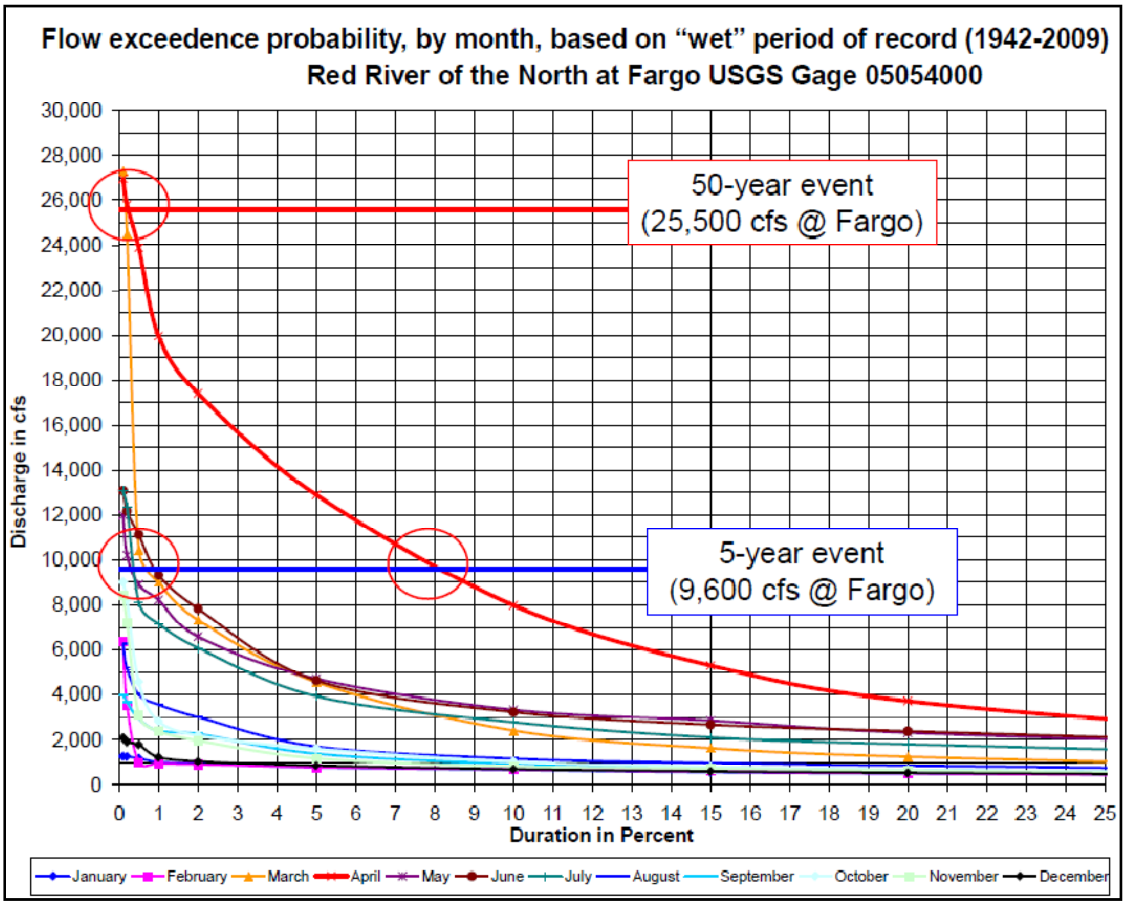
Overall, Red River fish passage most likely would not be impacted under most flow conditions. However, some limitations would exist. A fish's ability for migration could be limited for river flows between a 20-percent chance event and a 2-percent chance event. Fish passage would be halted completely for flows above a 2-percent chance event. To better understand the context of these impacts requires understanding the timing and frequency of when these limitations would occur.

Discharge frequency was analyzed for available USGS gauge data collected at Fargo, North Dakota. Historical daily flow data exists for this gage site dating back to 1901 (108-year period of record). However, hydrologic conditions in the early 20th century are very different from conditions in the later part of this period. Thus, the entire period of record may not be a good indicator of flow frequencies. A statistical analysis was performed to assess a period of record that may better approximate more recent flow regimes (see Appendix A). From this effort, the period 1942 through 2009 was identified as the period of record (Appendix A). This period better represents more recent conditions, thus providing a more realistic representation of given flow frequencies.

When considering the period 1942 through 2009, Red River flows at Fargo, ND are at or below a 20-percent chance event (i.e., 9,600 cfs at Fargo, ND) over 99-percent of the time annually. When considering flow data on a monthly basis for the wet period (1942-2009), flows exceed a 20-percent chance event 1-percent or less of the time during all months except April (Figure 59).

During the month of April, flows exceed a 20-percent chance event about 8-percent of the time (an average of about two to three days), and exceed a 2-percent chance event) (25,500 cfs at Fargo, ND) less than 1-percent of the time (Figure 59).

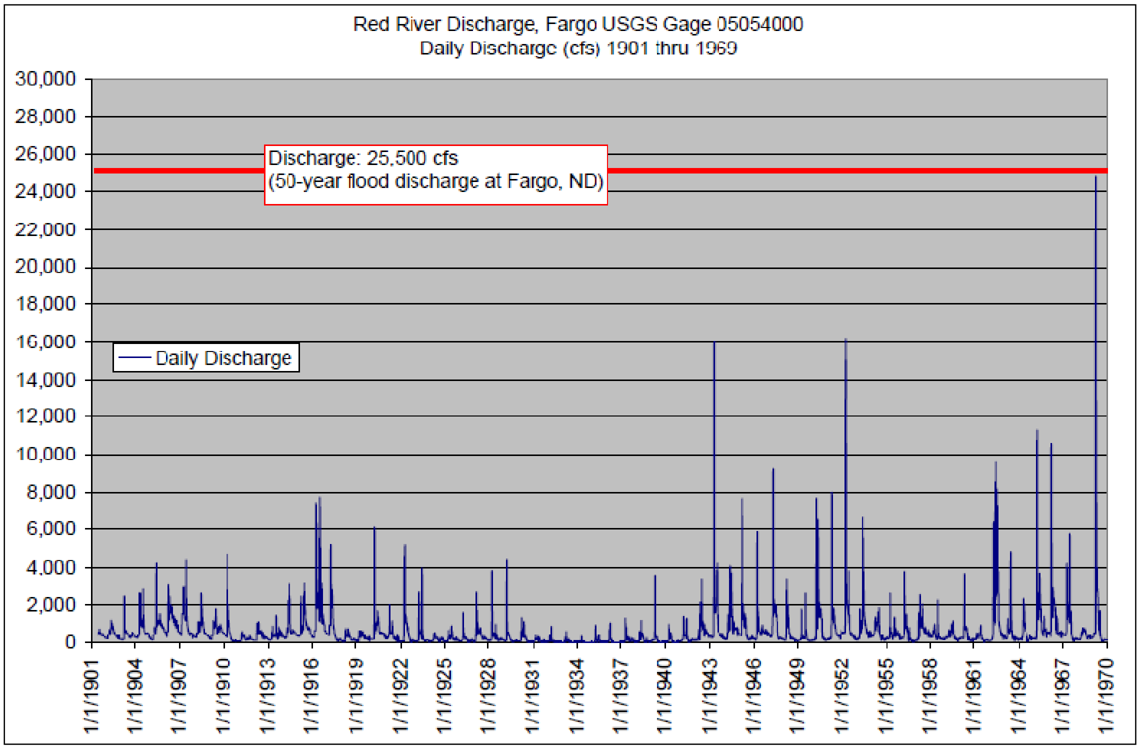
Figure 59 - Percent of the time various flows are exceeded, by month, for the USGS flow gauge at Fargo, ND (USGS Gage 05054000) for the period 1942 through 2009. Comparison is made among the percent of the time flows exceed 20-percent chance event (9,600 cfs at Fargo, ND) and a 2-percent chance event (25,500 cfs at Fargo, ND).

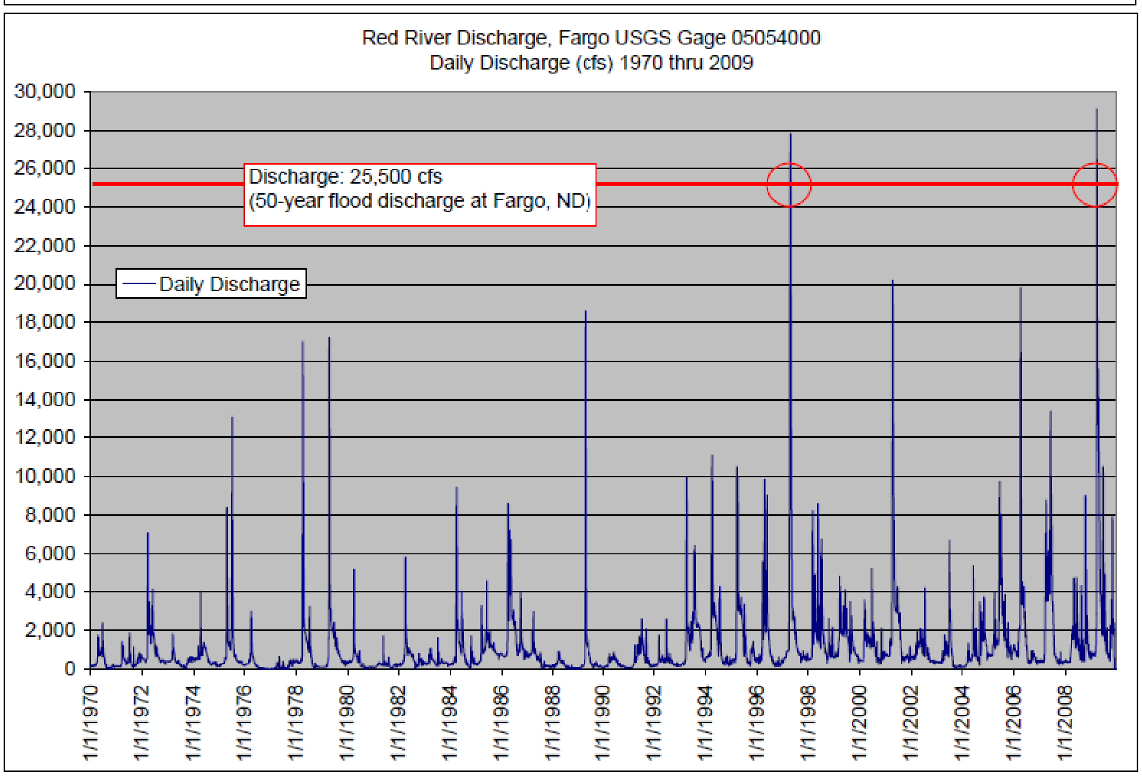


Daily discharge data, for the period 1901 through December 2009 (this includes provisional data from 2009), was further reviewed for the Red River USGS gauge at Fargo to understand potential impacts. Under all alternatives, upstream fish migration would not occur above a 2-percent chance event. However, such conditions would occur extremely infrequently. In 108 years, there have been two events that exceeded a 2-percent chance event at Fargo, ND: 1997 and 2009. These events totaled nine days, over 108 years, where flows exceeded a 2-percent chance event at Fargo, ND (Figure 60).

Under all diversion channel alternatives, upstream fish migration could be more limited between approximately a 20-percent and 2-percent chance event. Since 1942 there have been 21 events that exceeded a 20-percent chance event at Fargo, ND. Of these, 13 events had conditions where flows at Fargo, ND were above a 20-percent chance discharge (9,600 cfs) for at least a week. Three events (floods of 1997, 2001 and 2009) had conditions where flows were above a 20-percent chance discharge for at least two weeks.

Figure 60 - Daily flow values for the Red River at the USGS flow gauge at Fargo, ND (USGS Gage 05054000) for the period 1901 through 1969; and 1970 through 2009. Events exceeding a 2-percent chance event (25,500 cfs at Fargo, ND) are noted.





Fish migrating upstream during the month of April would have the greatest likelihood of being restricted by the proposed control structure. April is important for fish migration, as species often migrate in spring in response to flood pulse events. Those species that spawn earlier in the spring could be more susceptible to limited connectivity during important migrational periods, and include species such as northern pike, walleye and sauger. Other species such as goldeye, white sucker, redhorse species and smallmouth buffalo may spawn slightly later in spring, but could make pre-spawn movements during April. Other species such as channel catfish could be migrating between overwintering habitat and areas they may inhabit during the pre-spawn and spawning period. If reestablished in the Red River mainstem, lake sturgeon also could potentially migrate during the month of April. Thus, a wide range of species could potentially experience limited capability for migration during certain conditions with the diversion channel alternatives. However, as outlined above, the frequency and duration for limiting fish movement is small. The only conditions where fish movement would be completely impeded is during flood events in excess of a 2-percent chance event. As noted above, these conditions are extremely infrequent, and over the last 108 years have only occurred two different times at Fargo, for a total of nine days, all during late-March and April.

Fish migrations could be affected when flows exceed a 20-percent chance event. Although connectivity could be reduced, fish passage would still be possible via the fish bypass channel. Also, the frequency of flows equal to or above a 20-percent chance event is low. Flows exceed a 20-percent chance event only 8 percent of the time in April (an average of two to three days), and less than 1 percent of the time in all other months. Moreover, though variable by species and yearly conditions, fish migrations and spawning activities often occur over a period of a few weeks or more. Thus even if fish movements are briefly restricted, these conditions would typically be of short duration, and not substantially affect an entire migrational period for a given population.

Floods of a longer duration (e.g., weeks) could have more of an effect on the migrational success of fish populations. However, floods that exceed a 20-percent chance event for a period of a week or more are relatively infrequent. Such floods have been captured in the exceedence statistics outlined above. Fish passage also would be possible during such events, up to a 2-percent chance event.

In conclusion, all diversion channel alternatives would largely avoid and minimize significant adverse impacts to fish migration. As outlined above, the diversion channel alternatives would have a small adverse effect on biotic connectivity. However, although connectivity would be slightly affected, it appears unlikely this effect would result in a detectable response in terms of a measurable population change by fish. Thus, any of the diversion channel alternatives would have a less-than-significant impact to fish population levels in the Red River basin as a result of slightly reduced connectivity.

5.2.1.8.1.5.2 Red River Diversion Channel Effects on Connectivity

During periods when flows are directed into the diversion channel, fish could potentially migrate upstream through the diversion channel. The diversion channel would convey several thousand cfs during major discharge events (Table 37). Diversions would only occur above a 20-percent chance event. Above that, the percent of flow diverted under all alternatives would range from roughly 30-percent to over 65-percent. As indicated in Table 37, flow conditions are similar for the Minnesota alternatives and the North Dakota diversion alignments would divert slightly less water

Hydraulic modeling suggests that velocities within the diversion channel would vary based on diversion alignment and alternative (Figure 61 and Figure 62). At a 10-percent chance event, velocities under the MN35k would generally be between 1 to 2.5 ft/s. Some spikes in velocity up to 3 ft/s are possible at bridges or similar constriction points. At a 5-percent chance event, the diversion channel would have average velocities between 2 to 2.5 ft/s. At a 2-percent chance event, average velocities would be between approximately 2.5 to 3.5 ft/s. Velocities increase further for even greater flood events (Figure 61). Velocity patterns are generally similar for the smaller Minnesota alternatives.

The range of diversion channel velocities for the ND35k alternative would generally be more variable than the Minnesota diversion and would range from 1 to 6 ft/s (Figure 62). This is because the North Dakota diversion would include additional constrictions that result in greater flow spikes compared to the Minnesota alignment (Figure 61 and Figure 62). The ND35k also sees lower velocities at the downstream end of the diversion channel compared to the MN35k. Velocity patterns are generally similar for the smaller North Dakota alternatives.

Table 37 - Flow distribution (in cfs) between diversion channel and Red River below the proposed control structure. Flood risk management project is not in operation below a 20-percent chance event (5-year). Data is presented for the MN35k alternative. Flow conditions are similar for other Minnesota alternatives. North Dakota diversion alignments divert slightly less water (See Appendix B).

Event	Flow in Diversion Channel	Flow Through Control Structure	Total Red River Discharge	% Flow diverted to bypass
5-year	11	9,589	9,600	0%
10-year	4,164	10,377	14,500	29%
20-year	9,192	9,808	19,000	48%
50-year	15,888	9,612	25,500	62%
100-year	20,114	9,886	30,000	67%
500-year	35,049	17,951	53,000	66%

Figure 61 - Average velocities for Red River Diversion channel, MN35k alternative, during various discharge events. Velocity estimates begin at the confluence of the diversion channel and the Red River, and extend upstream to the diversion weir. Spikes in velocity plots are due to constrictions at bridge crossings. Velocity patterns are generally similar for the smaller Minnesota diversion alternatives.

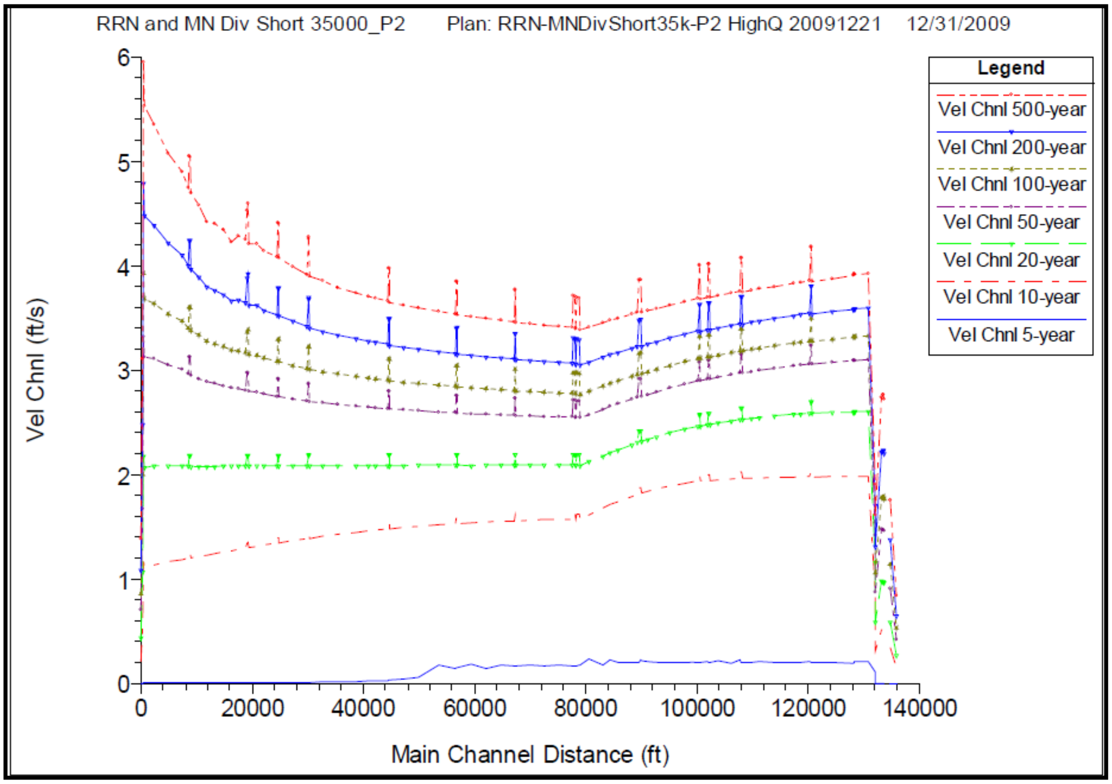
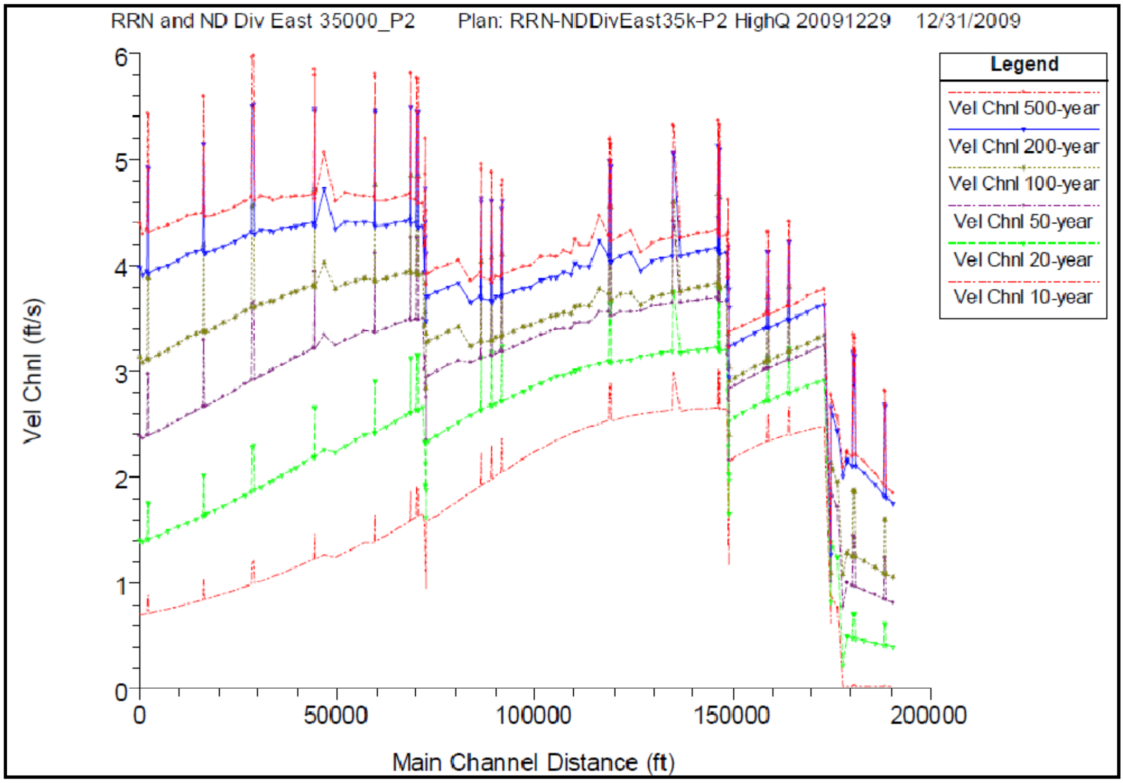


Figure 62 - Average velocities for Red River diversion channel, ND35k alternative, during various discharge events. Velocity estimates begin at the confluence of the diversion channel and the Red River, and extend upstream to the Wild Rice diversion weir. Spikes in velocity plots are due to constrictions at bridge and stream crossings. Fish could migrate up to the weir on the Wild Rice River (far upstream extent of diversion channel), then need a fish bypass channel to navigate around that weir.



The diversion channel would be 25 miles long for the Minnesota alignment alternatives, and 36 miles for the North Dakota alternatives. It is unknown how successfully fish would migrate upstream through a long straight channel with the indicated average velocities. However, under either diversion alignment, it is possible the diversion channel would be passable to fish up to about a 5-percent chance event, and possibly even up to a 2-percent chance event.

Once at the upstream end of the diversion channel, fish would need to pass over either a weir (Minnesota alignment) or through a fish bypass channel (North Dakota alignment) to access back into the Red River. For the Minnesota alignment, this weir would be designed to accommodate fish passage by building a series of rock rapids at the weir, similar to what has been done at other Red River dams. For the North Dakota alignment, a fish bypass channel would be constructed similar to that proposed for the Red River control structure. No significant design work has been performed on either of these structures that would provide for fish passage out of the diversion channel. However, these would be designed to provide fish passage up to at least a 5-percent chance event, and if possible, passage up to a 2-percent chance event. Because such a structure at the weir has not been accounted for in the current plans, this will be included as a mitigation feature in the Mitigation Section.

Fish migrating upstream during the month of April would have the greatest likelihood of being influenced by the diversion channel. April is important for fish migration, and is also the month most likely for operation of the diversion channel. As outlined above, the frequency and duration for influencing fish movement is small. Fish migrations could be influenced when the diversion channel is in operation, which would occur when flows exceed a 20-percent discharge event. Flows exceed a 20-percent event only 8 percent of the time in April (an average of two to three days), and less than 1 percent of the time in all other months. Thus even if fish movements are briefly affected, these conditions would typically be expected to last less than a week, and thus would not substantially affect an entire migrational period for a given population.

As outlined above, floods that exceed a 20-percent chance event for a period of a week or more are relatively infrequent. Even during such events, project features will be implemented to help fish migrate out of the diversion channel back into the Red River.

The ability for fish to migrate up the diversion channel is unknown. It is possible fish could migrate the entire length of the diversion channel, even during brief periods of operation (e.g., a few days). However, fish that do get to the upper end of the diversion channel would have an opportunity to migrate out of the diversion channel. Fish that do not completely migrate to the upstream end of the diversion would have the opportunity to migrate back out (see discussion above regarding potential impacts for fish stranding in the diversion channel).

Although connectivity would be slightly affected, it appears unlikely this effect would result in some detectable change in terms of measurable population change or response by fish. Thus, diversion channel would have a less-than-significant impact to fish population levels in the Red River basin as a result of altered connectivity.

5.2.1.8.2 North Dakota Tributaries

Tributaries provide valuable fisheries habitat for the Red River Basin. Species may move between tributaries and the Red River mainstem to fulfill different life history requirements (e.g., spawning, overwintering, etc). For the Minnesota diversion alternatives, all project features will be limited to the Red River mainstem, and the diversion channel will pass on the Minnesota side of the Red River. The diversion channel will not cross any tributaries, or modify their hydraulic or biotic connectivity. The only possible adverse effect that could occur is with fish being attracted into the diversion channel. Fish migrating up this channel, as opposed to the Red River mainstem, would not have access to the five tributaries on the North Dakota side of the project area. While that biotic connectivity will still exist with those five tributaries, it may be limited given that fish may be drawn up the diversion channel, especially given that the diversion channel will convey more flow than the Red River mainstem under many flood conditions. However, as outlined above, flow events equal to or above 20-percent chance events would not frequently affect fish movements. Fish that are drawn up the diversion channel would still be able to pass back into the Red at the head of the diversion channel, and continue seeking acceptable habitats. The significance of this impact appears small, and is unavoidable for the Minnesota diversion alternatives.

The discussions below apply specifically to the North Dakota diversion alternatives (ND30k and ND35k). It is assumed that all impacts are generally similar between the North Dakota alternatives.

5.2.1.8.2.1 Tributary Habitat and the Diversion Channel

Both of the North Dakota diversion alternatives include construction of a diversion channel on the North Dakota side of the Red River. The North Dakota diversion channel will convey significant river flows during flood events above a 20-percent chance event. This channel will be 36 miles long, and extend north (downstream) to near Georgetown, MN (Figure 49). The diversion channel will cross five tributaries: Wild Rice River, Sheyenne River, Maple River, Rush River and Lower Rush River.

5.2.1.8.2.2 Control Structures Footprint Impacts

5.2.1.8.2.2.1 Wild Rice River Control Structures Footprint Impact

Both of the North Dakota diversion alternatives will have three different structures constructed at the confluence of the diversion channel and the Wild Rice River. First, a control structure would be built on the Wild Rice River just downstream of the confluence with the diversion channel (Section 3.3.4.1). The structure would be similar to that for the Red River mainstem. The key difference is that the Wild Rice structure would include two gates, each with a width of 30 feet.

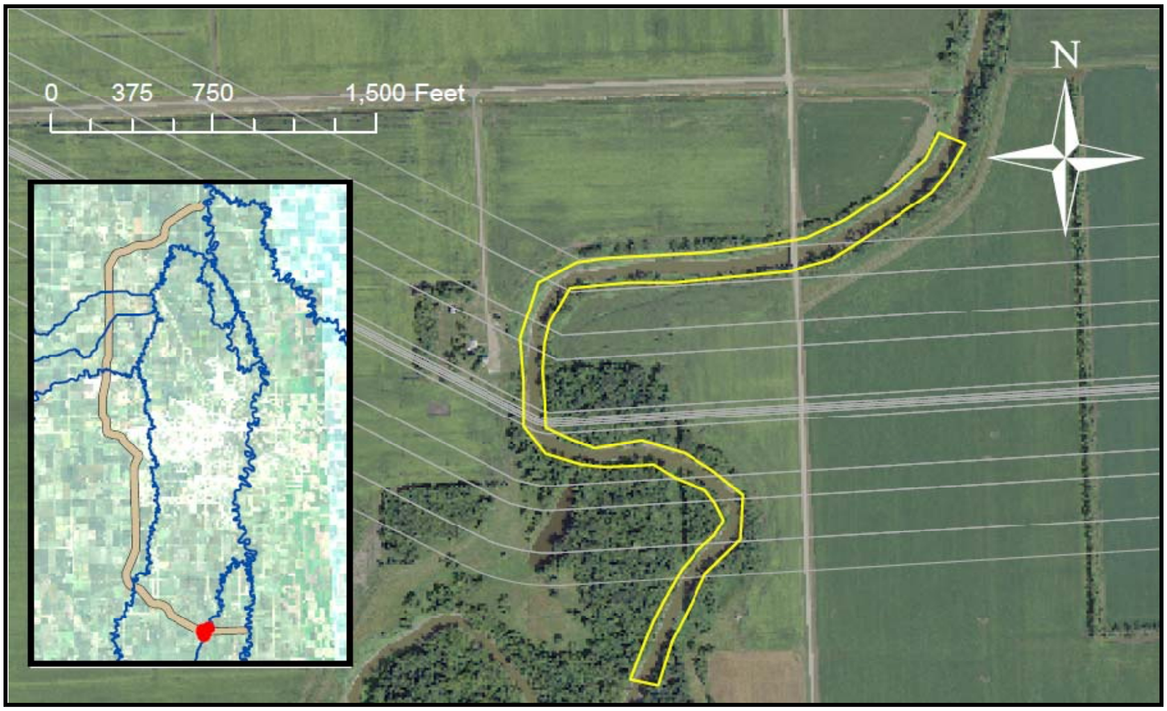
Next, two control weirs would be constructed on opposite banks of the Wild Rice River just upstream of the Wild Rice River control structure. The two weirs would control flows passing back and forth between the diversion channel and the Wild Rice River.

The Wild Rice control structure would be operated in concert with the control structure on the Red River. Flood flows would enter the diversion channel from the Red River, and approach the first control weir on the east bank of the Wild Rice River. Flood flows would spill over the weir into the Wild Rice River, above the Wild Rice control structure. The Wild Rice control structure would then control discharge through the structure, and thus upstream water stage. As water elevations increase, flood flows would pass over the second control weir on the Wild Rice River, and spill back into the diversion channel.

The construction method for the Wild Rice River control structure would likely be similar to that for the Red River. The control structure would be built "in the dry" adjacent to the river. Upon completion, a new channel would be excavated and permanent berms would be constructed to direct flow into the new channel. The exact location of this control structure is uncertain, and thus will require additional coordination and disclosure within future supplemental NEPA documentation

Constructing the control structure in the dry would result in the permanent loss of up to almost a mile of Wild Rice River channel habitat (Figure 63). This could equate to up to about 12 to 13 acres of river habitat lost. Some habitat would be created within the newly constructed channel through the control structure. However, the habitat created is not expected to replace that which is lost. As such, mitigation would be implemented to offset this impact. Potential mitigation measures are discussed in the Mitigation and Adaptive Management Section at the end of this chapter. Mitigation measures would be finalized within future supplemental NEPA documentation for construction of the Wild Rice River control structure. Figure 63 shows the potential footprint impact area on the Wild Rice River for the North Dakota diversion alignment. A preliminary, proposed diversion alignment is shown in gray, though the exact footprint location has yet to be determined and will vary based on the alignment.

Figure 63 - Potential footprint impact area on the Wild Rice River.



5.2.1.8.2.2.2 Sheyenne and Maple River Tributary Flow Structures Footprint Impact

For both of the North Dakota alternatives, the diversion channel must cross the Sheyenne and Maple rivers. To accomplish this task, the Corps proposes to construct a concrete structure on each tributary that facilitates tributary flows over the diversion channel. These control structures are described in Section 3.3.4.1. Both structures would be designed for a similar channel width and depth, compared to existing conditions at the chosen sites. Both structures would be a concrete channel, with a preliminary planned length of about 350 feet from the upstream to downstream edge of the concrete footprint.

The proposed structures would provide the channel for all tributary flow, up to a 50-percent chance flow, over the diversion channel and back into the respective tributaries. Flows in excess of a 50-percent chance event would flow over an adjacent control weir, and be routed into the diversion channel.

Both structures are currently planned as a concrete channel that would have little aquatic habitat value. Given the logistical challenges of constructing these structures concurrently with the diversion channel, the Corps proposes to build these features adjacent to the tributaries. Similar to control structures on the Red River and Wild Rice River, these two tributaries would then be permanently diverted through the flow structures. Although the exact design has yet to be finalized, these tributary structures would impact several acres of aquatic habitat within both the Sheyenne and Maple rivers (Figure 64 and Figure 65). Impacts could be on the order of 8 to 10 acres of permanently lost habitat on each of the Sheyenne and Maple rivers. Mitigation would be implemented to compensate for this direct loss of habitat. Potential mitigation measures are discussed in the Mitigation and Adaptive Management section. Figure 64 and Figure 65 show the potential footprint impact area on the Sheyenne River and Maple River, respectively, for the North Dakota diversion alignment. A preliminary, proposed diversion alignment is shown in gray, though the exact footprint location has yet to be determined and will vary based on the alignment.

Figure 64 - Potential footprint impact area on the Sheyenne River.

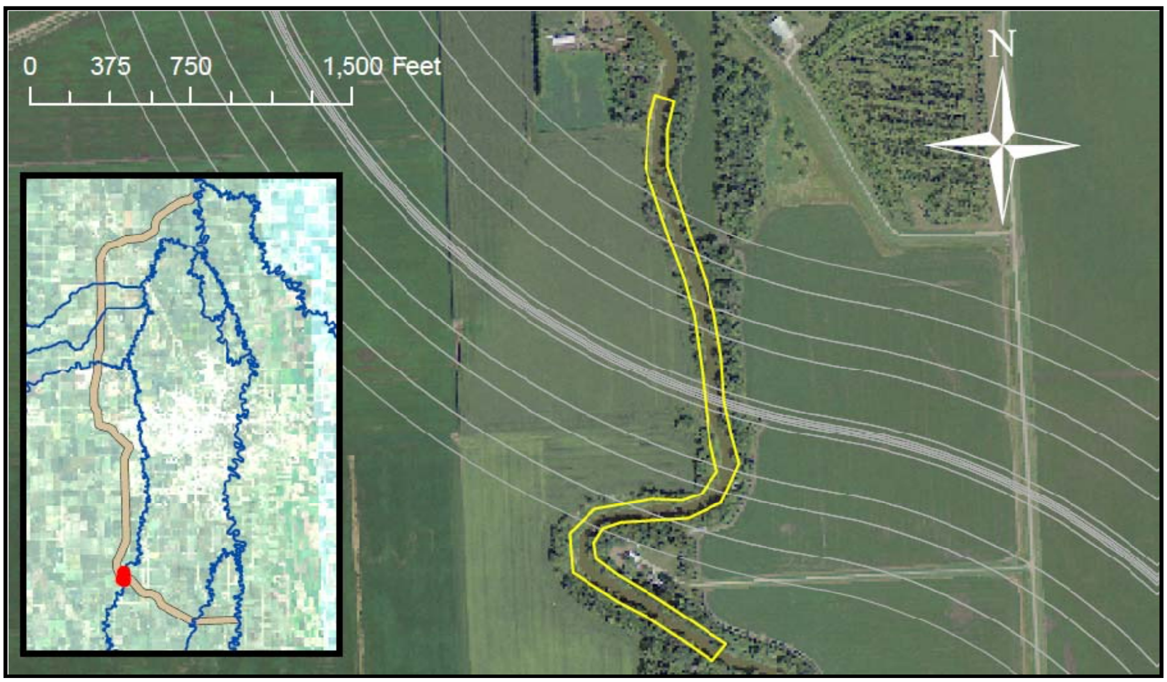
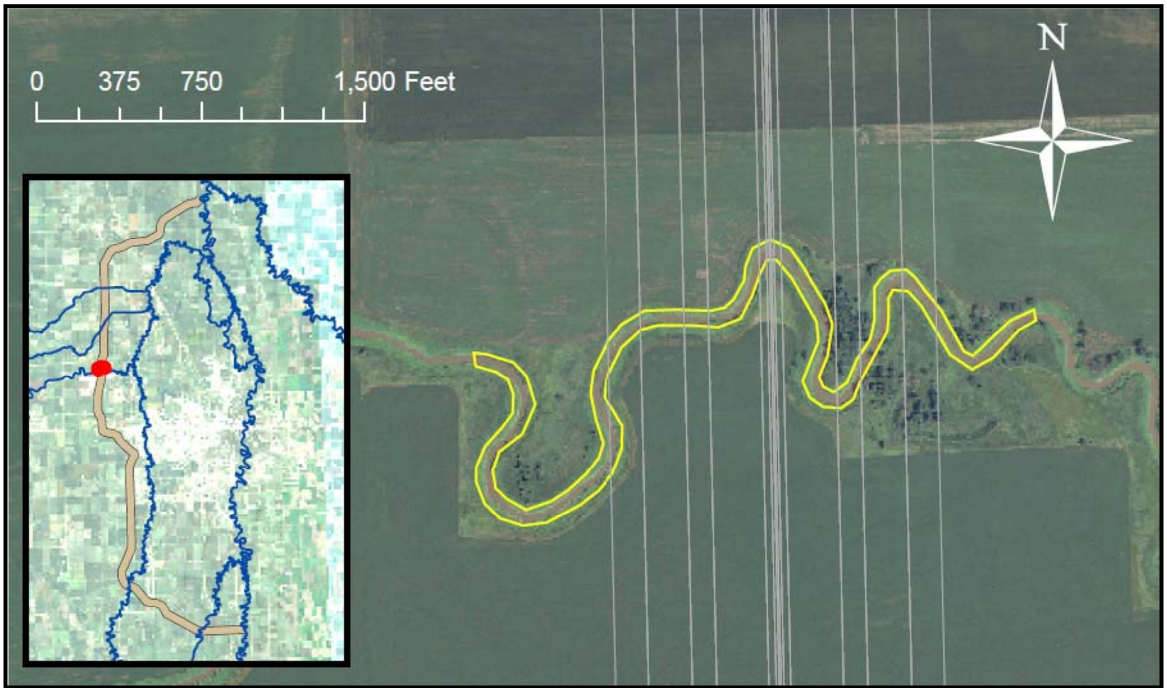


Figure 65 – Potential footprint area on the Maple River.



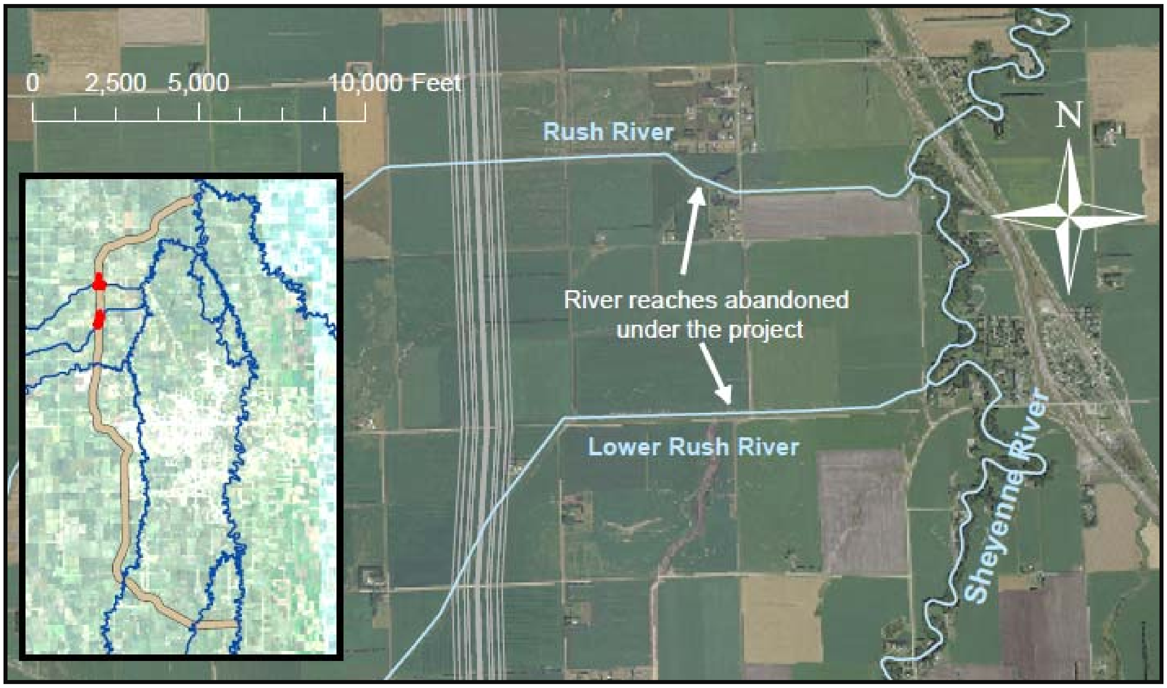
5.2.1.8.2.2.3 Rush and Lower Rush Control Structures Footprint Impact

For both of the North Dakota alternatives, the diversion channel must also cross the Rush and Lower Rush rivers. Within the project area, these two rivers are channelized and appear to have limited habitat value. The Lower Rush River is intermittent, and at best will only be used seasonally as a fisheries resource. Given this, the Corps proposes to direct both of these tributaries into the diversion channel, as opposed to constructing tributary flow structures to convey flows over top of the diversion channel. In short, both tributaries would include a series of weirs to provide grade control to drop the tributaries from their current elevation down to the diversion channel. The base of the diversion channel, starting at the Lower Rush River, would include a winding channel design along the remaining length of the diversion channel down to its confluence of the Red River. This winding channel would thus convey flows from these two tributaries, and provide river habitat in the bottom of the diversion channel.

The plan for the North Dakota alternatives would result in abandoning 2.7 miles of the Rush River, and 3 miles of the Lower Rush River, between the diversion channel and their respective confluences with the Sheyenne River. This river habitat would be directly lost as a result of the project. However, these sections of both tributaries are channelized and likely of limited habitat value. Conversely, the North Dakota alternatives would create several miles of flowing habitat in the base of the diversion channel. This habitat would be more abundant, and potentially of better quality, than the habitat lost from abandonment. For these reasons, no mitigation is currently planned for this impact. However, as identified in Section 5.5 Mitigation and Adaptive Management, it has been proposed that habitat quality will be further evaluated both pre-project and post-project, within these areas. This will help verify, in the future, if effects on the Rush River and Lower Rush River were minimal.

The abandoned channels would likely be identified as areas not to be developed in the future. These areas would thus remain as green space, and likely as functional wetland habitat. The area would probably remain wet in the future due to tiling, drainage and stormflow runoff. Figure 66 shows the potential impact areas for the Rush and Lower Rush rivers for the North Dakota diversion alignment. Rivers would be permanently routed into the diversion channel (preliminary alignment in gray). River channel downstream of diversion would be permanently abandoned.

Figure 66 – Potential impact areas for the Rush and Lower Rush rivers.



5.2.1.8.2.3 Effects on Geomorphic Processes and Aquatic Habitat

5.2.1.8.2.3.1 Effects on Wild Rice River Geomorphic Processes and Aquatic Habitat

The collective structures on the Wild Rice River facilitate routing of floodwater from the Red River diversion channel through the Wild Rice River. This would result in a mixing of flows in the area above the Wild Rice control structure and between the two weirs. The project will reduce Wild Rice River flood elevations for events in excess of a 20-percent chance event. Flood flows up to a 20-percent chance event would pass through the structure. Above that, additional Wild Rice River flows would be diverted into the diversion channel. During flood conditions above a 20-percent chance event, water passing through the Wild Rice River control structure would include a mix of Wild Rice River flows, and water from the diversion channel. Although the location of the control structure is unknown, the North Dakota alternatives could influence approximately 12-13 miles of river between the Wild Rice River control structure and the Red River. The area immediately upstream of the Wild Rice River control structure also will see altered hydraulics and sediment transport as the area is subjected to a mixing of all flows passing through from the diversion channel.

The sediment transport of the Wild Rice River appears to include sand, clay and silt. Thus, sediment transport includes important components of both suspended material (finer silts and clays) and bedload (coarser sands). Since the control structure will convey water beneath its control gates, the project may not significantly affect the quantity of coarse sediment transported downstream. However, during flood events above a 20-percent chance event, it will influence the quantity of water conveying this sediment load. There is an increased potential for significant impacts to the geomorphic processes (e.g., sediment scour and deposition) that shape and form fisheries habitat in the Wild Rice River. This could be a potentially significant impact to geomorphic processes for the Wild Rice

Potential mitigation measures are discussed Section 5.5 Mitigation and Adaptive Management. Mitigation measures would be finalized within future supplemental NEPA documentation for construction of the control structure. Measures include pre- and post-project monitoring to study future impacts. Possible mitigation is also discussed since the potential for significant geomorphic impacts is relatively high.

5.2.1.8.2.3.2 Effects on Sheyenne and Maple River Geomorphic Processes and Aquatic Habitat
For both of the North Dakota alternatives, the project would reduce flood flows on the Sheyenne River and Maple River. For the Maple River, flood flows up to at least a 50-percent chance event would pass through the Maple River tributary flow structure. Above that, additional flows would be diverted into the diversion channel. The Sheyenne River flow structure would pass all flows up to a 50-percent chance event for the lower Sheyenne River which includes the Maple, Lower Rush, and Rush rivers. This is to account for flows from the Rush River and Lower Rush River that would be permanently diverted into the diversion channel, and away from the Sheyenne River. With the current layout of the diversion channel, this means that about 43 miles of the Sheyenne and 3.5 miles of the Maple River could be affected between their respective structures and their downstream confluence with the Red River.

These alterations could potentially affect sediment transport and geomorphic processes that drive the formation and maintenance of fisheries habitat. However, the likelihood of significant impact appears small. The Sheyenne river includes silts, clays and sands as a part of its sediment transport. However, a comparison of channel cross sections pre- and post-construction of the Horace-West Fargo diversion does not show any considerable changes. In general, the Sheyenne River can be considered a stable riverine system near the proposed location of the diversion works. It appears that disturbance to geomorphic processes above existing conditions, appears unlikely.

The sediment transport of the Maple River appears to be dominated by clay and silt. Sand contributions appear minimal. Thus, sediment transport is less dominated by bedload, and more by suspended solids. Sediment will be conveyed proportionately through the tributary structure, as well as down the diversion channel during overflow events.

As opposed to the Wild Rice River, the likelihood for appreciable changes to sediment scour and deposition downstream of the tributary structures on both the Maple River and Sheyenne River appears small. The structures also will convey a minimum of a 50-percent chance event flow, and possibly more, to downstream areas. This would likely be adequate to maintain most geomorphic processes that shape and maintain fisheries habitat in these sections of the rivers.

The North Dakota alternatives should not have significant impacts on geomorphic processes for the Maple River and Sheyenne River. It is not anticipated that the geomorphic processes of the Sheyenne River would be any further disturbed, relative to the level of disturbance under existing conditions. Thus, we would not expect significant impacts to fisheries habitat or biotic use of these two tributaries, relative to existing conditions. However, as discussed Section 5.5 Mitigation and Adaptive Management, these two tributaries will be further evaluated to verify any potential impacts. This would include pre- and post-project monitoring for both geomorphic condition and biotic use of both the Maple River and Sheyenne River. This monitoring would be done in close coordination between the sponsor and appropriate North Dakota State agencies. The exact methodology will be developed during this coordination. The coordination also should include discussion whether future actions would be needed should adverse significant impacts be identified. No mitigation is planned here given significant impacts appear unlikely.

5.2.1.8.2.4 Connectivity

5.2.1.8.2.4.1 Wild Rice River Connectivity

Fish passage on the Wild Rice River would be impacted by the Wild Rice control structure and proposed North Dakota diversion channel. Flow velocities and patterns would be modified with implementation of the flow control structure, which could in turn influence the ability for fish to migrate upstream and downstream

A complete description of the Wild Rice River control structure is provided in section 3.5.4.1. Under most conditions, the control structure on the Wild Rice River would essentially function as a bridge with flows passing below without constriction. The structure, as designed for this study, includes two gates that are 30 ft wide. A combination of rocks, and possibly concrete baffle blocks, placed in the river bottom at the control structure will provide flow complexity along the bottom of the channel. This will provide fish a variety of velocities and flow patterns with which they can migrate upstream, provided velocities remain suitable. Water depth through the structure generally would not be a concern, as even under low summer flows, water depths through the structure would be about 2 feet deep. This is similar to existing channel cross sections.

A complete discussion of hydraulic modeling and analyses for the project is provided at Appendix B. Hydraulic modeling of the North Dakota alternatives predicted average flow velocities through the structure at about 2 ft/s for flows equal to a 50-percent chance event; and an average velocity of 2.5 ft/s for flows equal to a 20-percent chance event (Table 38). These average velocities, in combination with rock and concrete placed in the bottom of the channel to increase flow complexity, should ensure the proposed structure is functional for fish passage, similar to existing conditions, for river discharges up to a 20-percent chance event.

Table 38 - Hydraulic data for the Wild Rice River tributary structure.

Local Event (yr)	Flow U/S of Structure (cfs)	Flow into Protected Area (cfs)	Flow into Diversion Channel (cfs)	Water Depth at Control Structure (ft)	Average Velocity through Control Structure(ft/s)
Average August Flow	44	44	0	1.91	0.38
Annual Mean Flow	110	110	0	3.28	0.56
2	1388	1388	0	11.62	1.99
5	3700*	2230	81	14.86	2.50

*The remaining flow for the 20-percent event (5-year) flows into the channel back towards the Red River

For flows above a 20-percent chance event, the Wild Rice River control structure would be placed into operation, meaning the gates would be lowered to activate the flood risk management project. This would result in constricted flows through the structure, with a substantial increase in current velocities similar to what would be observed on the Red River control structure. As such, it can be assumed that fish would not be able to pass through the proposed flow control structure for flows above a 20-percent chance event.

To minimize impacts to fish migration that would occur during flood events where discharge is above a 20-percent chance event, the Corps proposes that a fish passage channel would be constructed at the Wild Rice control structure. This structure would provide an avenue for fish passage beginning at flows equal to a 20-percent chance event, and extending up to a 5-percent chance event. The design of this structure will need to be refined, but will be designed to maximize the opportunity for fish passage, to the extent practical, during these high-flow events. The tentative, preliminary plans of the fish passage channel are described below.

The preliminary plan for the Wild Rice River fish passage channel includes two gates, each 20-ft wide, to facilitate flow through the control structure. The fish passage channel for the Wild Rice River includes a general grade of less than 1-percent and achieves average velocities of less than 3 ft/s. The fish passage channel is tentatively planned to be approximately 20 ft wide, 1,100 feet long. This will include several rock riffles with pools placed between riffles to provide resting areas for fish during migration. It will include providing a downstream entrance as close as possible to the Wild Rice River control structure to maximize the potential for fish to find and use the fish passage channel. The upstream exit of the channel would be placed well upstream of the Wild Rice River control structure to ensure that fish do not get drawn back into the control structure via the high velocities. With careful design, this fish passage channel should provide another route for fish to migrate upstream past the Wild Rice River control structure.

In conclusion, the North Dakota alternatives would largely avoid and minimize significant adverse impacts to fish migration on the Wild Rice River. Any remaining adverse effects to fish connectivity would likely be undetectable in terms of measurable population changes or response. Thus, the North Dakota alternatives would have a less-than-significant impact to fish population levels in the Wild Rice River.

5.2.1.8.2.4.2 Maple and Sheyenne River Connectivity

Fish passage and aquatic habitat connectivity on the Maple River and Sheyenne River could be impacted by the Maple River and Sheyenne River tributary flow structures that pass stream flows over the diversion channel. The tributary structures would be concrete channels with similar widths to the natural channel. The concrete structures would be about 350 ft long from upstream to downstream. Water depths through the structure would remain similar to existing conditions (Table 39 and Table 40). Likewise, water velocities passing through the structure would remain within the general range of what occurs under existing conditions. Water velocities would generally be less than 2 ft/s for discharges up to a 50-percent chance event flow, with lower velocities for lower discharges.

Table 39 - Hydraulic data for tributary flows through the Sheyenne River tributary structure.

Local Event (yr)	Flow U/S of Structure (cfs)	Flow into Protected Area (cfs)	Flow into Diversion Channel (cfs)	Water Depth in Open Aqueduct (ft)	Average Velocity in Open Aqueduct (ft/s)
Annual Mean Flow	236	236	0	4.57	1.11
2	1200	1200	0	14.01	1.85
5	2400	1477	923	16.23	1.96

Table 40 - Hydraulic data for tributary flows through the Maple River tributary structure.

Local Event (yr)	Flow U/S of Structure (cfs)	Flow into Protected Area (cfs)	Flow into Diversion Channel (cfs)	Water Depth in Open Aqueduct (ft)	Average Velocity in Open Aqueduct (ft/s)

Annual Mean Flow	74.9	74.9	0	0.42	<2.0[1]
2	970	970	0	9.68	2.07
2+LR+R[2]	1345	1345	0	11.18	2.49
5	3550	1760	1790	13.47	2.71

1. Flow velocities for annual mean flow will be reduced to less than 2 ft/s through future design.
2. This represents a 50-percent chance event on the Sheyenne, plus additional flow to account for a 50-percent chance event on the Rush and Lower Rush rivers.

The tributary flow structures would reduce flood flows on the Sheyenne and Maple rivers. Flood flows up to at least a 50-percent chance event would pass through these structures. Above that, additional flows would be diverted into the diversion channel. As such, flows through the structures would not exceed those levels identified for a 50-percent chance event. Given this, and the potential velocities through the structure, it appears fish migration through the structure generally would not be significantly affected.

The diversion channel could affect how fish migrate upstream through the Red River during flood events given the channel will convey a large percentage of total-river flow. It could also affect the number of fish that migrate up tributary streams. The proposed tributary structures would have overflow channels that divert excess tributary flows into the diversion channel. These overflow channels will include rock as grade control. Further design will attempt to make these structures passable to fish, which would allow fish to migrate from the diversion channel into the Maple and Sheyenne rivers. However, if a cost-effective design cannot be developed, then fish that pass upstream into the diversion channel would not have access to the Maple and Sheyenne rivers. Although the proposed system would result in altered hydraulics and an unnatural condition, both the Sheyenne River and Maple River would remain biologically connected at all times. This would likely not be a significant impact to tributary fish communities.

In conclusion, although some minor disturbance to connectivity could occur under the project, the North Dakota alternatives would largely avoid and minimize significant adverse impacts to fish migration within the Sheyenne and Maple rivers. Any disturbance to fish connectivity would be minor and should have little, if any effect on fish populations of these tributaries, or the adjacent Red River.

5.2.1.8.2.4.3 Rush and Lower Rush River Connectivity

Fish passage and aquatic habitat connectivity on the Rush and Lower Rush rivers could be impacted by the North Dakota Alternatives. Weirs will likely be constructed to step flows from the existing channels, down to the base of the flood diversion channel. To the extent possible, these weirs will be designed to facilitate fish movement. If this is not possible, fish passage channels would be considered to allow fish movement around the proposed weirs, and facilitate migration between the Rush and Lower Rush rivers and downstream habitat. A fish passage channel may be necessary given the large elevation drop needed to lower the two rivers down to the base of the diversion channel. Current plans call for lowering the Rush and Lower Rush Rivers approximately 23 feet from their upstream elevation down to the diversion channel.

Given the upstream habitat available on the Rush River, full effort will be made to implement fish passage as a project feature. The ability to do this will be evaluated in future NEPA documentation. It is not anticipated that any mitigation would be needed to offset impacts to connectivity for the Rush River.

Conversely, the Lower Rush River is an intermittent river, and may be dry during periods of the year. The concept of fish passage will be evaluated further to determine whether the Lower Rush provides any habitat values for migratory fish. This will be discussed further in subsequent NEPA documentation. It is not anticipated that any mitigation would be needed to offset impacts to connectivity for the Lower Rush River.

5.2.1.9 Upland/Riparian Habitat

The surface areas needed for the project features are as follows: MN20k plan, approximately 4,485 acres; MN25k plan, approximately 5,455 acres; MN30k plan, approximately 5,965 acres; MN35k plan, approximately 6,415 acres; ND30k plan, approximately 6,105 acres; and ND35k plan, approximately 6,560 acres. Of these areas, disturbance caused by project related construction would be restricted to the diversion channel, soil disposal area, and the outlet channel on the northern end of the project.

There would be some areas where upland forest and riparian forested areas would be cleared or otherwise impacted. For the Minnesota diversion alignments the Red River control structure would impact approximately 30 acres of riparian forest; the diversion channel would impact approximately 30 acres of a mix of upland forest and riparian forest, and the Red River outlet structure would impact approximately 16 acres of riparian forest. For the North Dakota diversion alignments the Red River control structure would impact approximately 17 acres of riparian forest; the diversion channel would impact 64.5 acres of a mixture of upland forest and riparian forest; the Wild Rice River hydraulic structures would impact approximately 24 acres of riparian forest, the Sheyenne River hydraulic structure would impact approximately 10 acres of riparian forest, and the Maple River hydraulic structure would impact approximately 3 acres of riparian forest; and the Red River outlet structure would impact 21 acres of riparian forest. There would be no impacts to forests at the Lower Rush and Rush rivers.

The loss of these wooded areas would be permanent but would be mitigated for by tree plantings along the recreational corridor. The other areas to be disturbed are currently farmed and have reduced natural resource value. Portions of the spoil areas would be available for farming after completion. All other disturbed areas would be replanted with native species, primarily grasses that would have positive impacts on the area's overall habitat value. Overall, the construction activities would have temporary adverse impact on the terrestrial habitat but the eventual changes in vegetative cover would have long term beneficial impacts on the avian and small mammal groups which are found in areas on the periphery of residential development and agricultural plots.

5.2.1.10 Endangered Species
Two Federally-listed threatened or endangered species are listed for Cass County: the whooping crane (*Grus americanus*) and the Gray Wolf (*Canis lupus*), both of which are endangered. One Federally-listed threatened or endangered species is listed for Clay County: the Western prairie fringed orchid (*Platanthera praeclara*), which is threatened. One species is on the candidate species list for Clay County, the Dakota skipper (*Hesperia dacotae*). The Fish and Wildlife Service's records do not indicate any individuals of any of these species within the project area for any of the diversion channel alternatives (FWS letter in Chapter 6).

Bald eagles and their nests are protected from take and disturbance, respectively, per the Bald and Golden Eagle Protection Act. The Fish and Wildlife Service verified the location of two bald eagle nests within the project area. Both nests will be monitored during the spring of 2010.

Neither nest will be impacted by the project construction due to location, but the project area will continue to be monitored during the upcoming years to ensure that no new nests will be impacted by project construction. There will be raptor nest surveys completed in the spring of the year preceding construction within or near any affected wooded areas.

5.2.1.11 Prime and Unique Farmland
Maps of the diversion alternatives for the ND35k plan, MN25k plan and MN 35k plan were sent to the Natural Resources Conservation Services (NRCS) in both North Dakota and Minnesota. NRCS evaluated these footprints for the Farmland Conversion Act and made determinations for each of these alternatives. For the ND35k plan up to 5,400 acres of prime and unique farmland would be impacted, for the MN25k plan approximately 5,500 acres would be impacted, and for the MN35k plan approximately 5,700 acres of would be impacted. This information will be updated as the plans continue to be refined. (Appendix F 1.4 and 1.5)

For all of the diversion channel alternatives there will be a great deal of prime and unique farmland impacted, as the majority of the land impacted is farmland, and of that farmland over 95-percent of it is considered prime and unique for any of the six alternatives. This impact is considered to be less than significant based on the large quantity of farmland in the project area.

5.2.1.12 Hazardous, Toxic and Radioactive Waste (HTRW)
The HTRW analysis is being conducted for both the MN35k and ND35k alternatives, and this information will be presented in the final report. Any impacts from the 35k alternatives would encompass the smaller alternatives.

5.2.2 Cultural Resources
Most lands in Cass County, North Dakota, and Clay County, Minnesota, have not been surveyed for cultural resources. Previous cultural resources surveys conducted in these two counties have usually been related to specific projects or studies, e.g., Red River bank stabilization in Fargo and Moorhead; Cenex pipeline construction; Fargo Southside Study Area; and West Fargo Flood Control Project. Inventories of potentially historic standing structures were undertaken in Cass

County in 1979 and the City of Fargo in 1985 under the sponsorship of the Historic Preservation Division of the State Historical Society of North Dakota (Fiege 1986; Granger 1986; Ramsey 1979), and in the City of Moorhead in 1979 and other Clay County communities in the 1980s under the sponsorship of the State Historic Preservation Office of the Minnesota Historical Society (Moorhead Community Development Department 1979). Few of those structures have been evaluated for eligibility to the National Register of Historic Places (National Register). Since the 1980s additional structures have reached 50 years old and need to be recorded and evaluated as well. Specific effects on cultural resources for each of the diversion channel alternatives are given below. Appendix E, Cultural Resources, contains more detailed information on known cultural resources sites, reported but unverified site leads, and previous cultural resources investigations for each diversion channel alternative.

The area of potential effect for each alternative includes one-half mile on either side of the diversion channel centerline, one-quarter mile either side of the extension channel centerline, and one-sixteenth mile either side of a tie-back levee centerline. A Programmatic Agreement for the project will be negotiated between the St. Paul District, U.S. Army Corps of Engineers, the Minnesota State Historic Preservation Officer, and the North Dakota State Historic Preservation Officer, with the City of Fargo and the City of Moorhead, being the non-federal sponsors, as concurring parties. Certain Indian Tribes may also elect to be concurring parties. The Programmatic Agreement will cover the Section 106 of the National Historic Preservation Act responsibilities of the Corps for this project A draft of the Programmatic Agreement is included as Attachment #3.

5.2.2.1 North Dakota East Diversion Alternative

As of April 7, 2010, there are no National Register listed historic properties in this alignment. The Sheyenne River Bridge (32CS4462) in Warren Township has been determined eligible to the National Register. Prehistoric archeological sites 32CS42 and 32CS44 have been determined not eligible to the National Register. Prehistoric archeological sites 32CS43 and 32CS201 and historic standing structures 32CS4461 (Maple River bridge in Raymond Township), 32CS5090 (rural residence), and 32CS5091 (rural residence) have not had their National Register eligibility evaluated. A lead to one historic archeological site—32CSX238b-Red River Trail segment in North Dakota—needs to be field verified. None of these known sites or structures is crossed by the diversion channel. The tie-back levee alignment crosses where the historic oxcart trail (21CYr-Red River Trail) ran north-south along the Minnesota side of the Red River. The continued existence of the Red River Trail in this area needs to be field verified. Of the known sites and structures in the North Dakota East Diversion alignment, only site 32CS42 is crossed by the diversion channel. Site 32CS42 has been determined not eligible for the National Register. This diversion alignment needs a Phase I cultural resources survey, except for where it intersects the existing West Fargo diversion channel. The entire tie-back levee footprint needs to be surveyed.

5.2.2.2 Minnesota Short Diversion Alternative

As of April 7, 2010, the John Olness House (CY-KRG-001) on U.S. Highway 75 at Kragnes is the only National Register listed historic property in this alignment. Prehistoric archeological sites 21CY3, 21CY19 and 21CY55 and three historic standing structures (CY-DWC-003-Northern Pacific shop buildings; CY-KRG-004-Kragnes Bar; CY-KRG-005-warehouse in Kragnes) have not had their eligibility to the National Register evaluated. Leads to three historic ghost towns (21CYk-Ruthruff, 21CYl[el]-Lafayette, and 21CYo-Burlington) and to 21CYr, the Red River Trail, an historic oxcart running along the east side of the Red River, need to be field verified. This diversion alignment crosses the locations of the historic ghost towns of Ruthruff and Lafayette as well as crossing the Red River Trail three times. The breakout channel alignment crosses the location of the historic ghost town of Burlington (21CYo) and follows the Red River Trail (21CYr) for roughly one mile and crosses it once further south as well. The location of an unverified lead to one historic archeological site (32CSX1-Holy Cross Mission) is crossed by the Minnesota Short Diversion Tie-Back Levee alignment, which is in North Dakota. The diversion alignment, the breakout channel alignment, and the tie-back levee alignment all need a Phase I cultural resources survey. The existence of the various ghost towns, the mission site, and the Red River Trail in this area needs to be field verified if this alternative is selected.

5.2.3 Socioeconomic Resources

5.2.3.1 Social Effects for all North Dakota and Minnesota Alternatives

5.2.3.1.1 Noise

During project construction temporary increases in noise are expected from the operation of construction equipment. No increases in noise are expected during project operation.

5.2.3.1.2 Aesthetics

Any of the six alternatives would result in changes to the landscape near Fargo or Moorhead. The diversion channel would be vegetated with native species but would still be visible as man-made structures. Since the structures provide protection from flooding they may be viewed in a positive way.

5.2.3.1.3 Recreational Opportunities

Recreational opportunities will not be adversely impacted by any of the diversion channel alternatives, but will be increased under all of them. Recreational features are included for all of the alternatives; these features contain multipurpose trails, interpretive signage, benches, trash receptacles, two pedestrian bridges, three trailheads with parking facilities and two car/trailer parking facilities. The trailheads would also include potable water, picnicking, restrooms, interpretive kiosks and landscaping. The recreation plan could result in a healthier, more vibrant community accenting the current growth trends of the region. The plantings associated with the recreation will make the recreational opportunities more visually pleasing and will help to enhance the overall experience. (Appendix M) The local community is enthusiastic about the recreational opportunities being presented in the proposed alternatives. The same recreation plan is considered for both the Minnesota and North Dakota alternatives.

5.2.3.1.4 Transportation

Several rural section line roads will be impacted with the construction of the diversion channel alternatives, with them ending at the diversion channel. The North Dakota and Minnesota alternatives would each intersect approximately 30 roads. New bridges across the diversion channel are being planned a minimum of every three mile increment for all of the diversion channel alternatives. This includes 20 bridges for the MN35k alternative and 18 bridges for the ND35k alternative. Local traffic patterns would be modified primarily for local residences and farmsteads. Few residences or farmstead are proximate to the diversion alignments. Arterial roads will have bridges across the channel for both alignments. Therefore, transportation impacts are expected to be minimal. In some cases, farm fields will be bisected by the diversion alignments. The non-federal sponsors may try to facilitate farm owners to trade land from one side of the channel for land on the other in order to minimize additional costs associated with commuting across the diversion.

No existing highway or railroad bridges would be modified with either the Minnesota or North Dakota alignment. With any of the diversion channel alternatives in place, the need to close highway and railroad bridges and the airport during high water events would be significantly diminished when compared to the without project condition.

Project construction could have some short-term minor negative impacts on normal community traffic patterns due to the construction activity and truck hauling. These effects would be attenuated through the appropriate placement of construction and safety signage and use of road detours. These effects would be temporary and would terminate when project construction is complete.

5.2.3.1.5 Public Health and Safety

All of the diversion channel alternatives would have significant beneficial effects on public health and safety by significantly reducing the risks of loss of life and property damage attributable to the effects of flooding. Flood risk management would minimize the adverse effects that have occurred to communities in the Red River Valley during recent flood events including: large-scale community evacuation, potential contamination of the drinking water supply, spoilage of food through loss of refrigeration or floodwater contamination, lack of access to health care, evacuation of hospitals and nursing homes, and stress and trauma. Flooding of buildings introduces multiple contaminants into the water including sewage, fuel oil, pesticides, and solvents. The cleanup of flooded structures exposes individuals to potential adverse health effects from exposure to contaminants, bacteria, and molds. All of the diversion channel alternatives would reduce the likelihood of these adverse effects of flooding.

5.2.3.1.6 Community Cohesion (Sense of Unity)

All of the diversion channel alternatives, by providing increased protection from future floods, would enhance community stability. With increased security, residents would be less likely to relocate. Similarly, they would be able to devote greater attention to other community issues and needs. The Fargo-Moorhead Metropolitan Area as a whole should become more cohesive after project construction, but some areas would lose the cohesion that they have had. In particular, the areas bisected by the diversion channel will have loss of cohesion. These include rural areas with farmsteads and farm fields. Other areas that may experience loss of cohesion include downstream communities experiencing stage increases.

5.2.3.1.7 Community Growth and Development

All of the diversion channel alternatives are expected to have a beneficial effect on the growth and development of the Fargo-Moorhead Metropolitan Area. Provision of this level of flood risk management will likely foster investment in homes, businesses, and community infrastructure. This would be greater for the North Dakota alignments as they remove a much larger area from the existing floodplain.

5.2.3.1.8 Business and Home Relocations

All of the diversion channel alternatives would have no substantial effect on business and home relocations in the project area as the number of impacted structures is extremely small compared to the number of structures in the area. There are an estimated six residential or farmstead relocations in the proposed project right-of-way for the North Dakota East diversion alignment, or five residential or farmstead relocations in the proposed project right-of-way for the Minnesota Short diversion alignment. The structures will be purchased, and the affected landowners will be compensated for their relocation.

The subject of relocations can be controversial, especially because some of the homes and farmsteads slated for relocation received either no damage or only minor damage from the recent flood events. Some of those affected by planned relocations have expressed feelings that plan formulation has been hasty, some alternatives under consideration have been screened out too quickly, and that diversion should be constructed on the other side of the river.

Because the affected owners will be covered by P.L. 91-646 (Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970), they should not experience direct financial loss from the relocations. However, there is no way to quantify any stress and anguish that some may experience over these relocations.

5.2.3.1.9 Existing and Potential Land Use

All of the diversion channel alternatives would have no significant effect on land use. Along with the aforementioned relocations, land use changes could occur along and near the proposed diversion alignments with the purchase of project right-of-way, although farming will be allowed on the landward side slopes of the diversion channel spoil banks.

An estimated 5,400 acres of prime farmland would be directly or indirectly impacted with the construction of the North Dakota alternatives, while an estimated 5,500 – 5,700 acres of prime farmland would be directly or indirectly impacted with the construction of the Minnesota alternatives. This includes less than ½-percent of the total cropland in Cass and Clay counties. Owners of agricultural lands that are purchased for the project would be compensated at fair market value.

The proposed alignments are expected to split or divide farms into separate parcels. In some cases, farmers would have to detour around the proposed diversion channel using established roadways or specially constructed access roads to access their property and conduct farming operations. The number of farms under active use that would be divided by the proposed right-of-way is unknown at this stage. Mitigation measures would be incorporated into the final design to minimize impacts to farmland.

5.2.3.2 Economic Effects

5.2.3.2.1 Property Values

All of the diversion channel alternatives are expected to have a beneficial effect on currently developed community property values because of the decreased risk of flood damage, along with the removal of restrictions on improvements that can be made to existing developments in the floodplain. Developable lands within the project area would retain or increase in property value through removal of the risk of flood damage. There would no longer be a need to raise or flood-proof new construction. New development or intensification of existing development should be pursued only in a manner that retains awareness and sensitivity to the residual flood threat. These beneficial effects will be greater for the North Dakota diversion alternatives as they provide flood risk management for a larger area.

Property values outside of the protected area should not be substantially adversely affected by the construction of the project. For landowners outside the project area that experience increased flood stages when compared to the current without project condition, further analysis will be undertaken to determine if there has been a taking. For any properties that are deemed to have incurred a taking, compensation would be required.

5.2.3.2.2 Tax Revenues

All of the diversion channel alternatives are expected to have a minor beneficial effect on tax revenues. The project would preserve property values in protected developed and developable areas, allow for the redevelopment of marginal properties, and remove restrictions on capacity to attract additional businesses and industry. These beneficial effects will be greater for the North Dakota diversion alternatives as they provide flood risk management for a larger area. New development or intensification of existing development should be pursued only in a manner that retains awareness and sensitivity to the residual flood threat. Future tax revenues would be lost from the properties that would be acquired for project construction.

5.2.3.2.3 Public Facilities and Services

All of the diversion channel alternatives could have a substantial beneficial impact on public facilities and services because under the with-project condition the potential for damage to public facilities would be reduced, the potential for disruption in the delivery of public services would be reduced, and the public works response to future flood threat would not be as great.

5.2.3.2.4 Regional Growth

All of the diversion channel alternatives would enhance the capacity of Fargo-Moorhead to function as a trade, medical, financial, and cultural center of the region. These will be greater for the North Dakota diversion alternatives as they provide flood risk management for a larger area. Growth would continue as projected as indicated in Chapter 4.

5.2.3.2.5 Employment

For all of the diversion channel alternatives there will be an increase in construction employment during project construction. In addition, the protection provided by the project should contribute to community growth and along with it the associated increases in employment opportunities.

5.2.3.2.6 Business Activity
For all of the diversion channel alternatives, project construction could stimulate local business activity and the protection provided by the project upon completion could provide a climate for business expansion and attraction.

5.2.3.2.7 Farmland/Food Supply
An estimated 5,400 to 5,700 acres of prime farmland would be directly or indirectly impacted with the construction of the proposed diversion channel alternatives. None of the diversion channel alternatives would have no appreciable effect on food supply. A diversion channel would require the purchase of approximately 5,500 to 6,000 acres of agricultural land and disrupt the farming operation of approximately 10 to 15 landowners. Most of the agricultural land is considered to be prime farmland with soybeans and corn as the major crops. Owners of agricultural lands that are purchased for the project would be compensated at fair market value. For situations where the diversion channel would split individual's farmland, the non-federal sponsors may try to facilitate trades so that individuals can keep their property on the same side of the diversion.

5.2.3.2.8 Flooding Effects
All of the diversion channel alternatives would have a significant beneficial impact on flooding effects. The project is intended to provide flood risk management from floods, such as the one experienced in 2009, by reducing flood stages within the project area when compared to the without project condition.

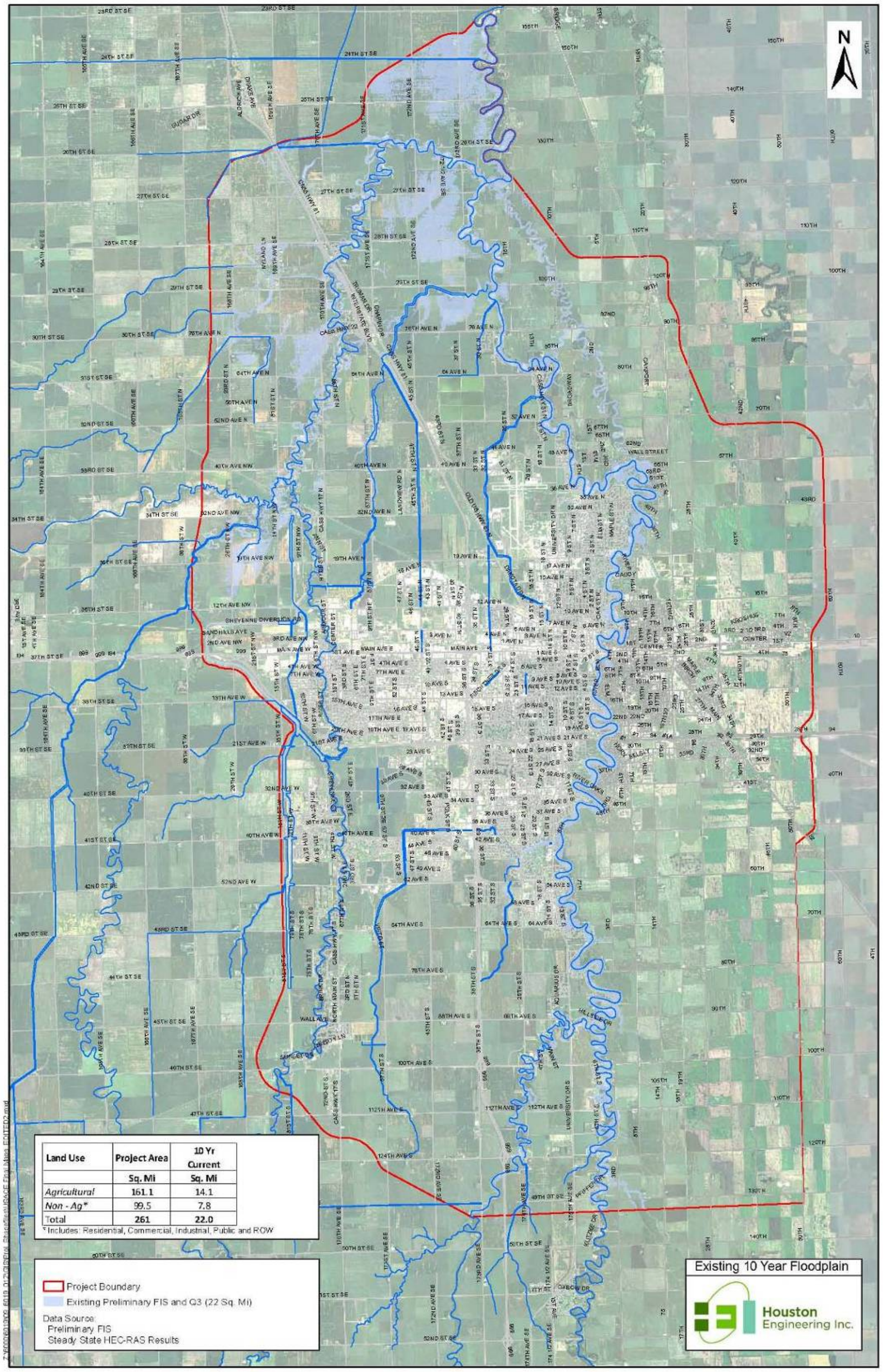
5.2.3.2.9 Energy Needs and Resources
All of the diversion channel alternatives would have no appreciable effect on energy needs and resources.

5.2.3.2.10 Floodplain (Executive Order 11988)
Executive order (EO) 11988 was issued by President Jimmy Carter on May 24, 1977 and is entitled "Floodplain Management". In issuing the EO the President stated "in order to avoid to the extent possible the long and short term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative, it is hereby ordered that each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities…".

5.2.3.2.10.1 No Action Alternative
The project area used for the floodplain analysis is 261 square miles: 161 square miles of agriculture land and 99.5 acres of non-agriculture land which includes residential, commercial,

industrial, and public right-of-way lands. With no project or emergency levees in place the current 10-percent chance event will impact 22 square miles of total land within the project area; of that land, 14.1 square miles is agriculture land. For the 2-percent chance event the number increases to 83.3 square miles of total land and 65.8 square miles of agriculture land. For the 1-percent chance event the number increases to 112.2 square miles of total land impacted, of which 82.4 square miles are agricultural lands. For the 0.2-percent chance event the number of acres impacted increases to 204.4 square miles out of a possible 261 square miles, of which 122.6 square miles is agricultural land (Figure 67, Figure 68, Figure 69, and Figure 70).

Figure 67 – Existing 10-percent chance event (10-year) Floodplain.



Land Use	Project Area	10 Yr Current
	Sq. Mi	Sq. Mi
Agricultural	161.1	14.1
*Non - Ag**	99.5	7.8
Total	261	22.0

Figure 68– Existing 2-percent chance event (50-year) floodplain.

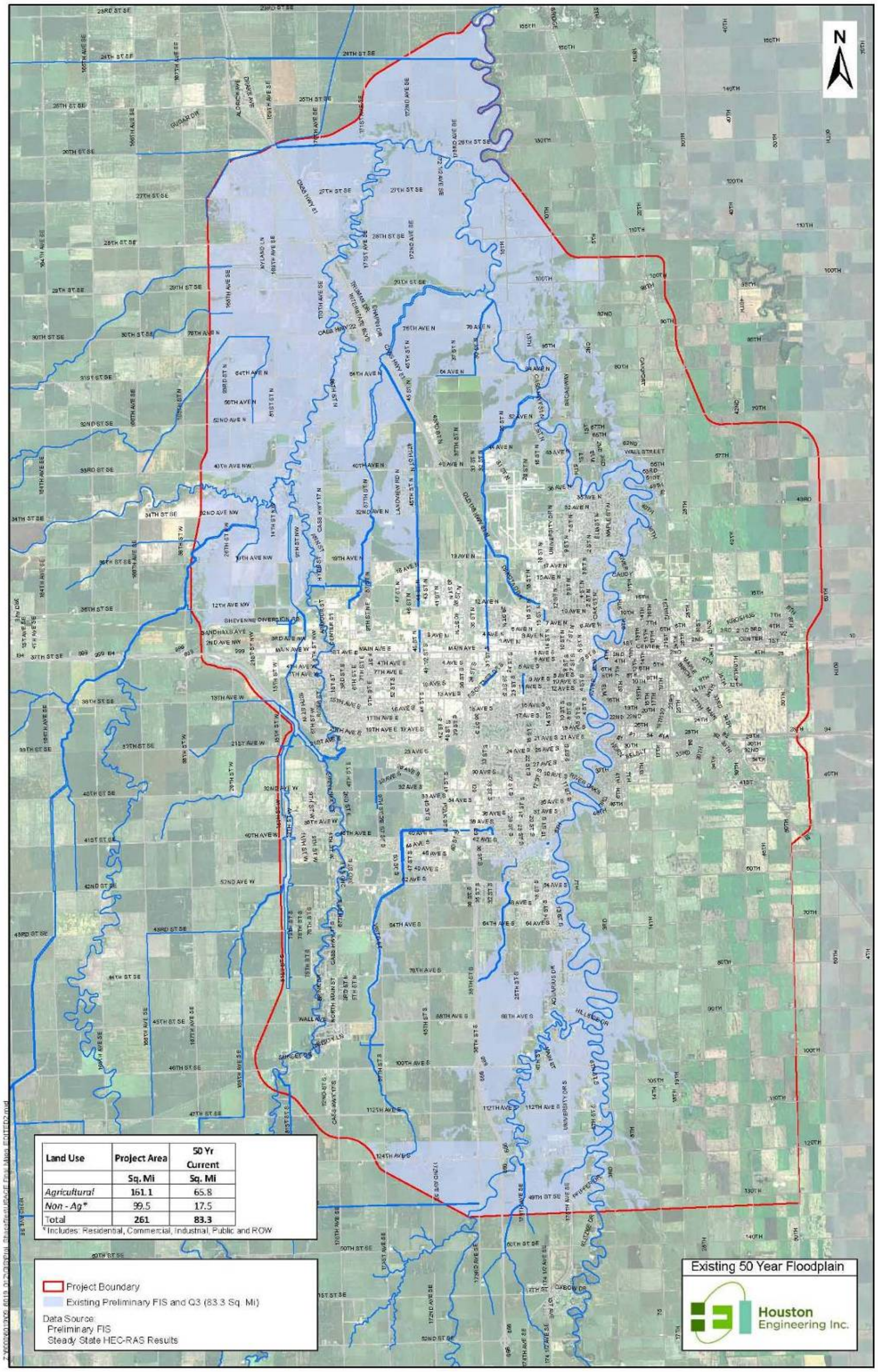


Figure 69 – Existing 1-percent chance event (100-year) floodplain.

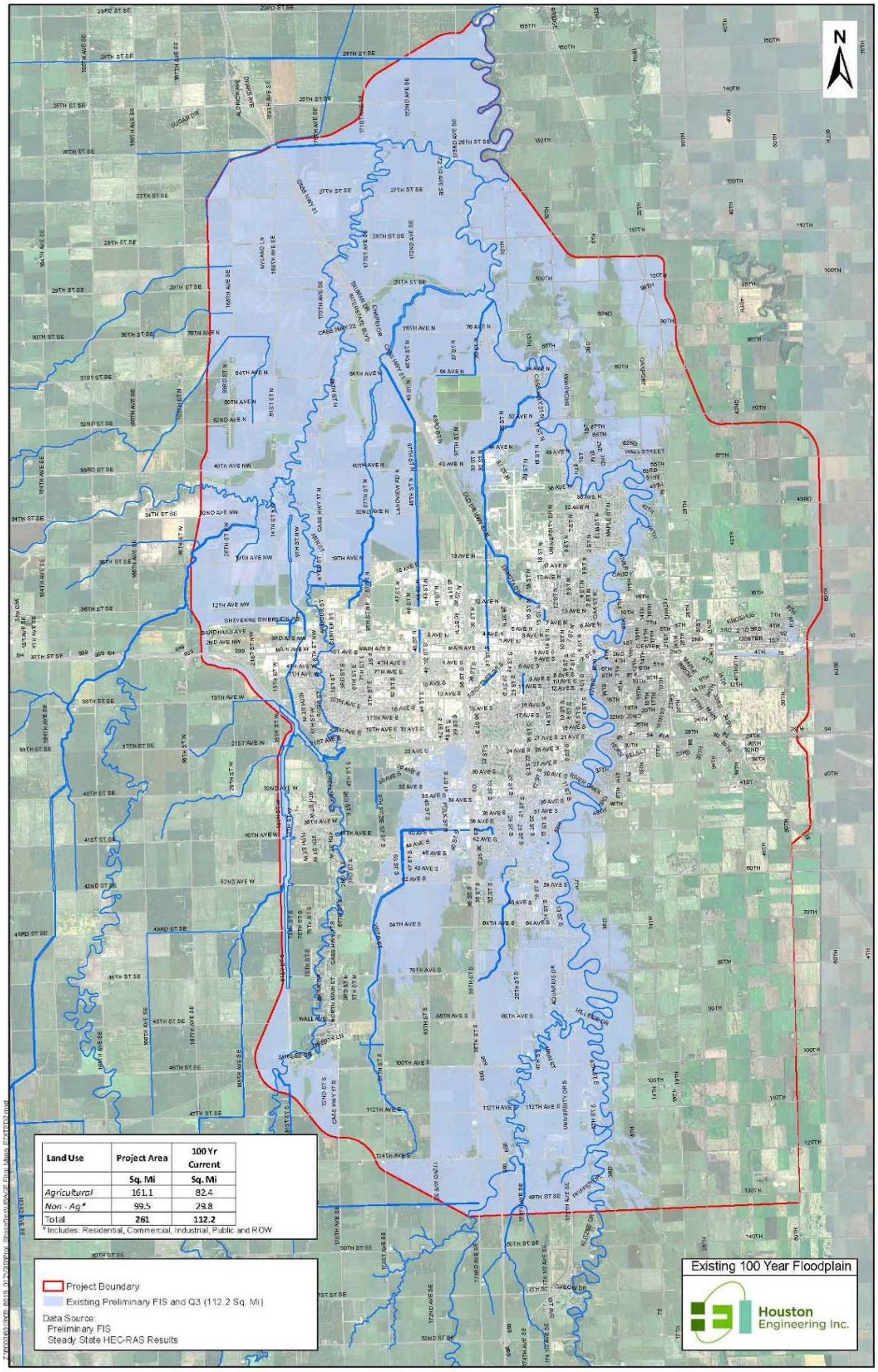
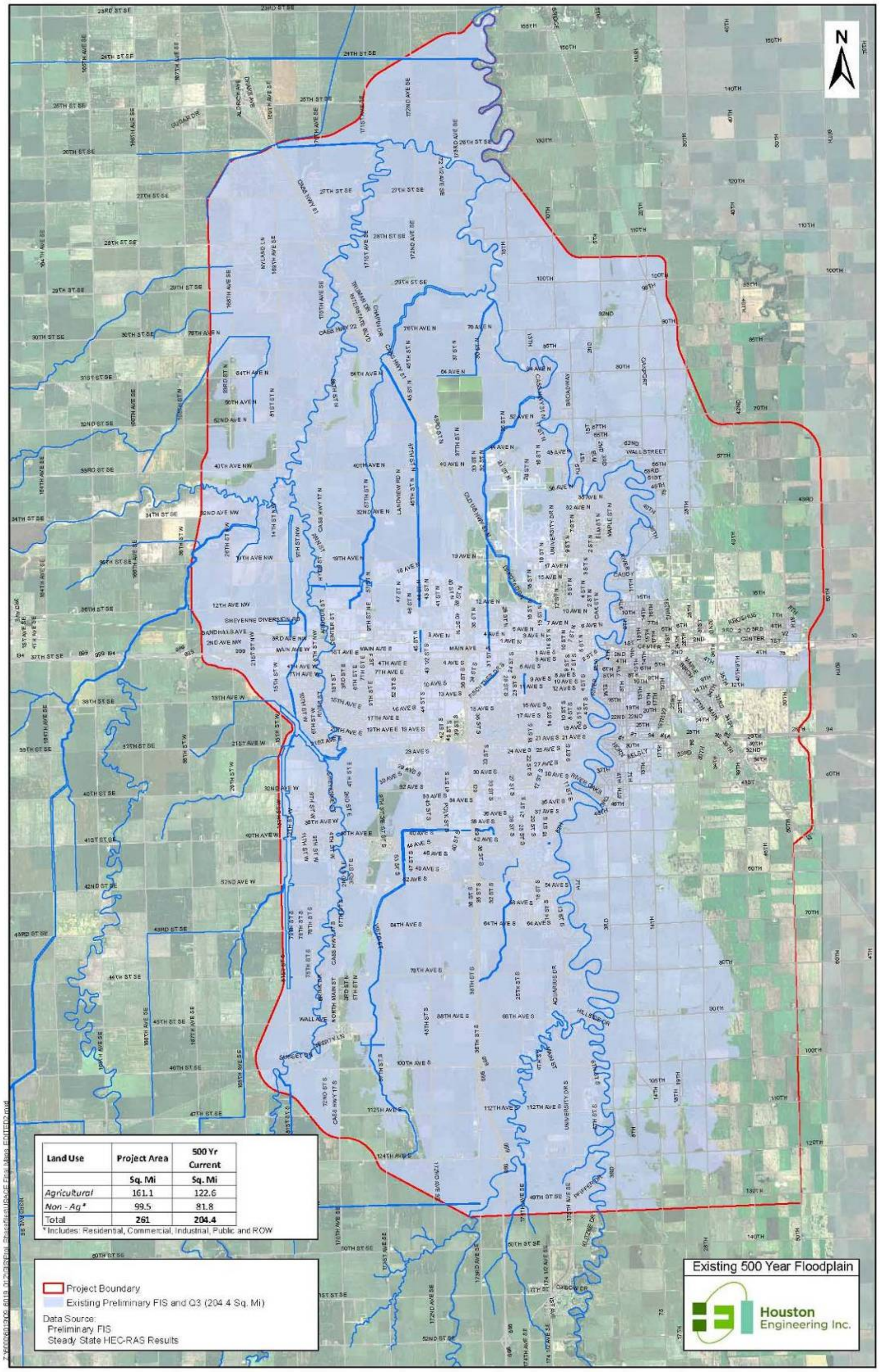


Figure 70 – Existing 0.2-percent chance event (500-year) floodplain.



A Steady State HEC-RAS hydraulic model was used to determine the impact of different size flood events within the project area. All of the diversion channel alignments will take several square miles out of the floodplain; the number of square miles will vary depending on which alternative is selected, as further discussed below.

5.2.3.2.10.2 Minnesota alternatives

The MN25k plan and MN35k plan were looked at for this analysis; the MN20k plan and MN30k plan were not looked at in time for this draft, and may not be analyzed.

5.2.3.2.10.2.1 MN25k plan

For the MN25k alternative the model was run for the 10-percent chance event, 2-percent chance event, 1-percent chance event and 0.2-percent chance event (see Table 41). The results for the 10-percent chance event show 2.2 square miles would be taken out of the floodplain, of which 1.5 square miles are agricultural lands. The results for the 2-percent chance event show 16.4 square miles will be taken out of the floodplain, with 12.2 square miles of this being agriculture lands. The results for the 1-percent chance event show 30.5 square miles will be taken out of the floodplain, with 18.1 square miles of this being agriculture lands. The results for the 0.2-percent chance event indicate that 45.5 square miles will be taken out of the floodplain, with 15.3 square miles of this being agriculture lands (Figure 71, Figure 72, Figure 73, and Figure 74).

Table 41 – Floodplain impacts with project

	Total Area Removed from Floodplain (in square miles)			
Diversion Alternatives	10% Event	2% Event	1% Event	0.20% Event
MN25K	2.2	16.4	30.5	45.5
MN35K	2.3	16.5	31.3	80.5
ND35K	10.8	60.0	81.5	146.0

Figure 71 – Minnesota Short 25K 10-percent chance event (10-year) floodplain

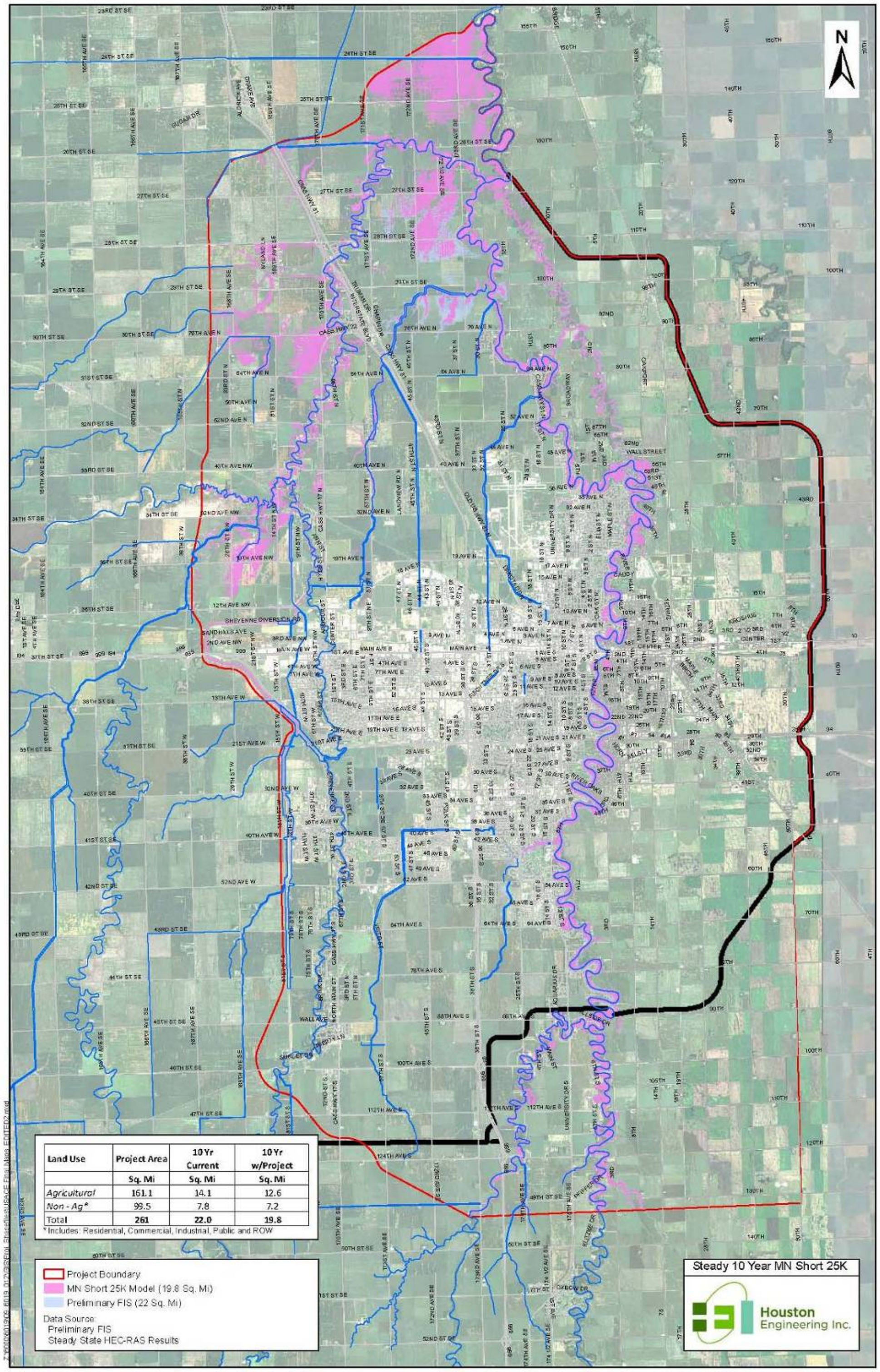
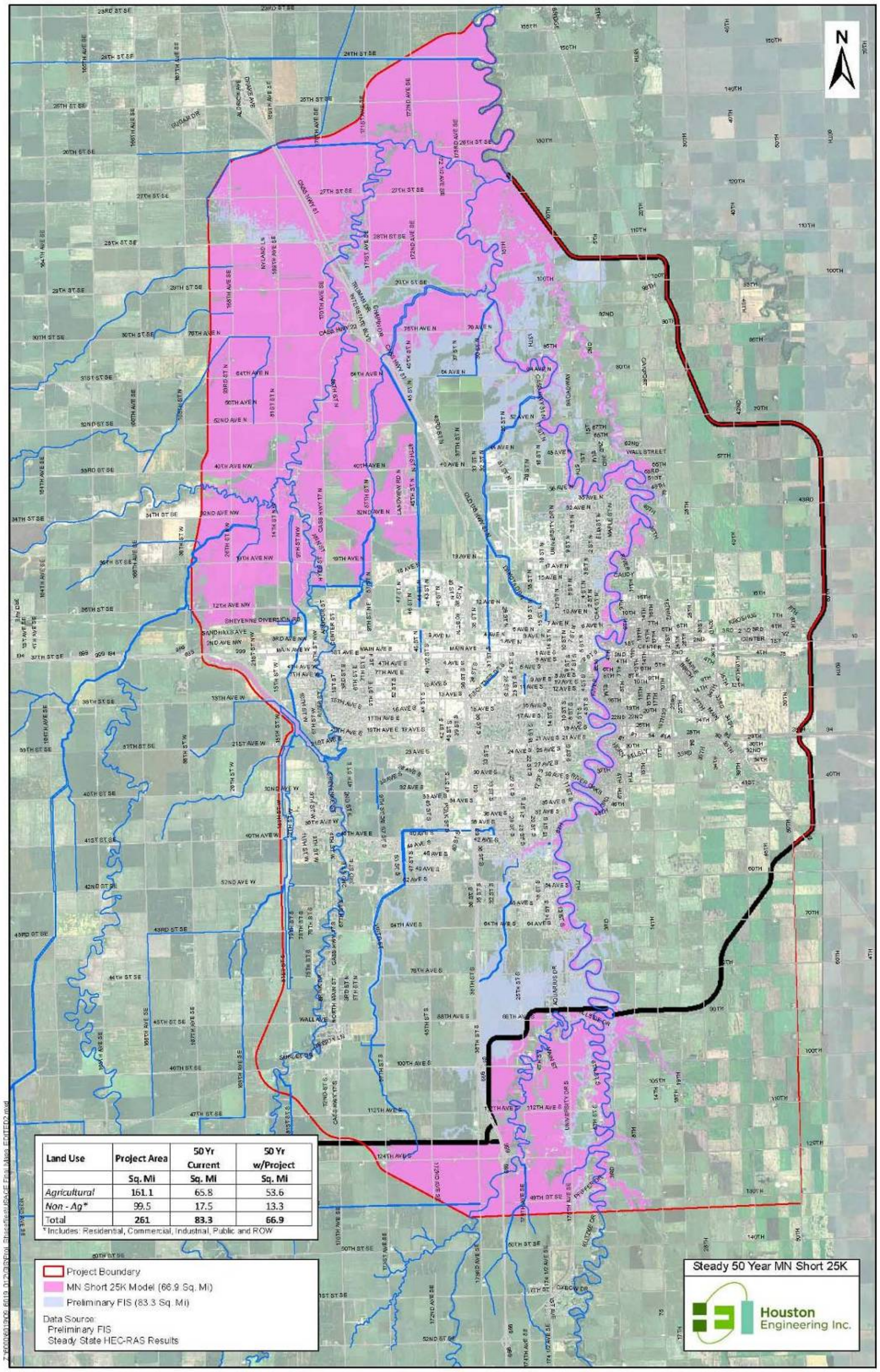


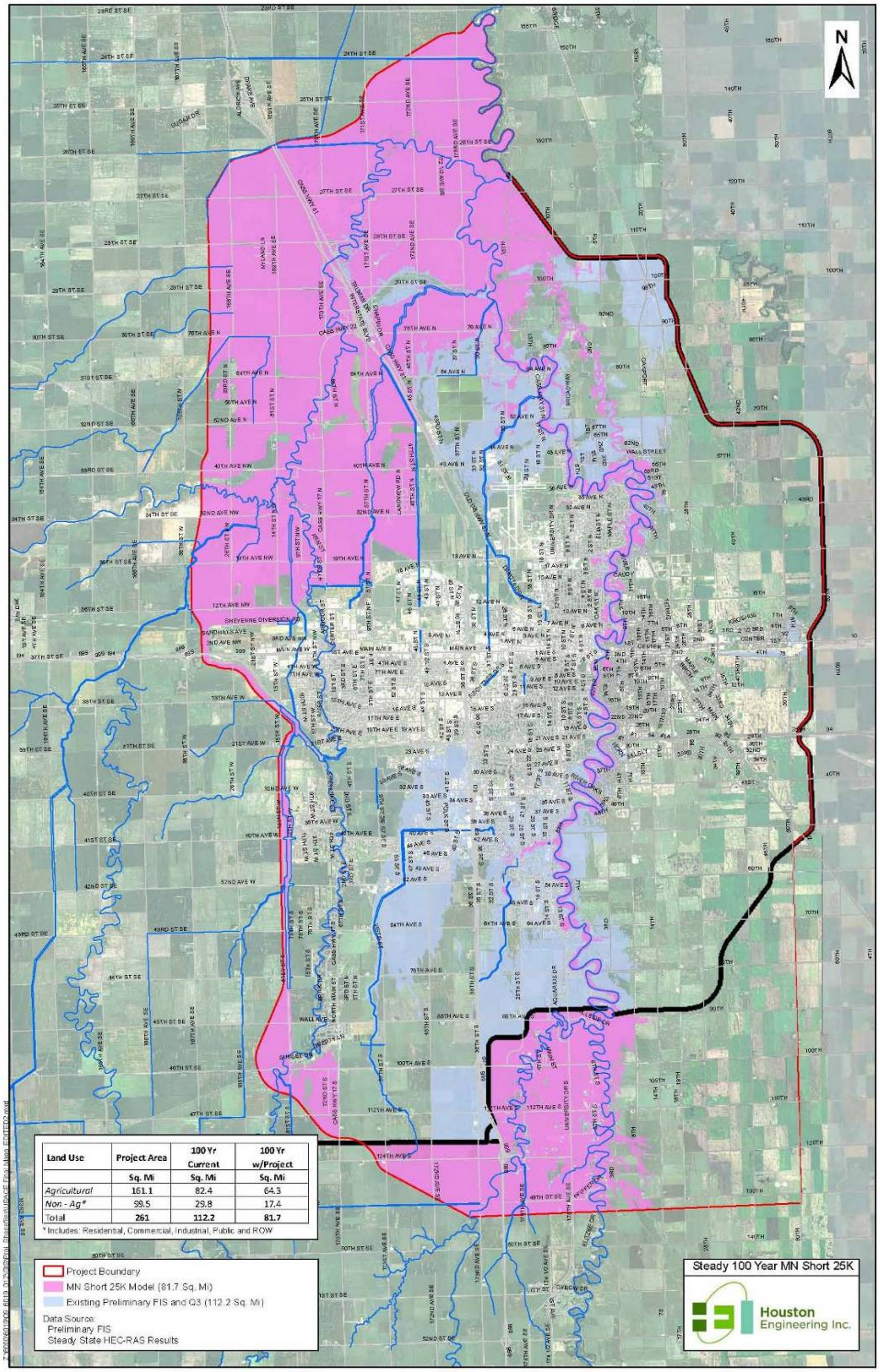
Figure 72 - Minnesota Short 25K 2-percent chance event (50-year) floodplain



Land Use	Project Area	50 Yr Current	50 Yr w/Project
	Sq. Mi	Sq. Mi	Sq. Mi
Agricultural	161.1	65.8	53.6
*Non - Ag**	99.5	17.5	13.3
Total	**261**	**83.3**	**66.9**

* Includes: Residential, Commercial, Industrial, Public and ROW

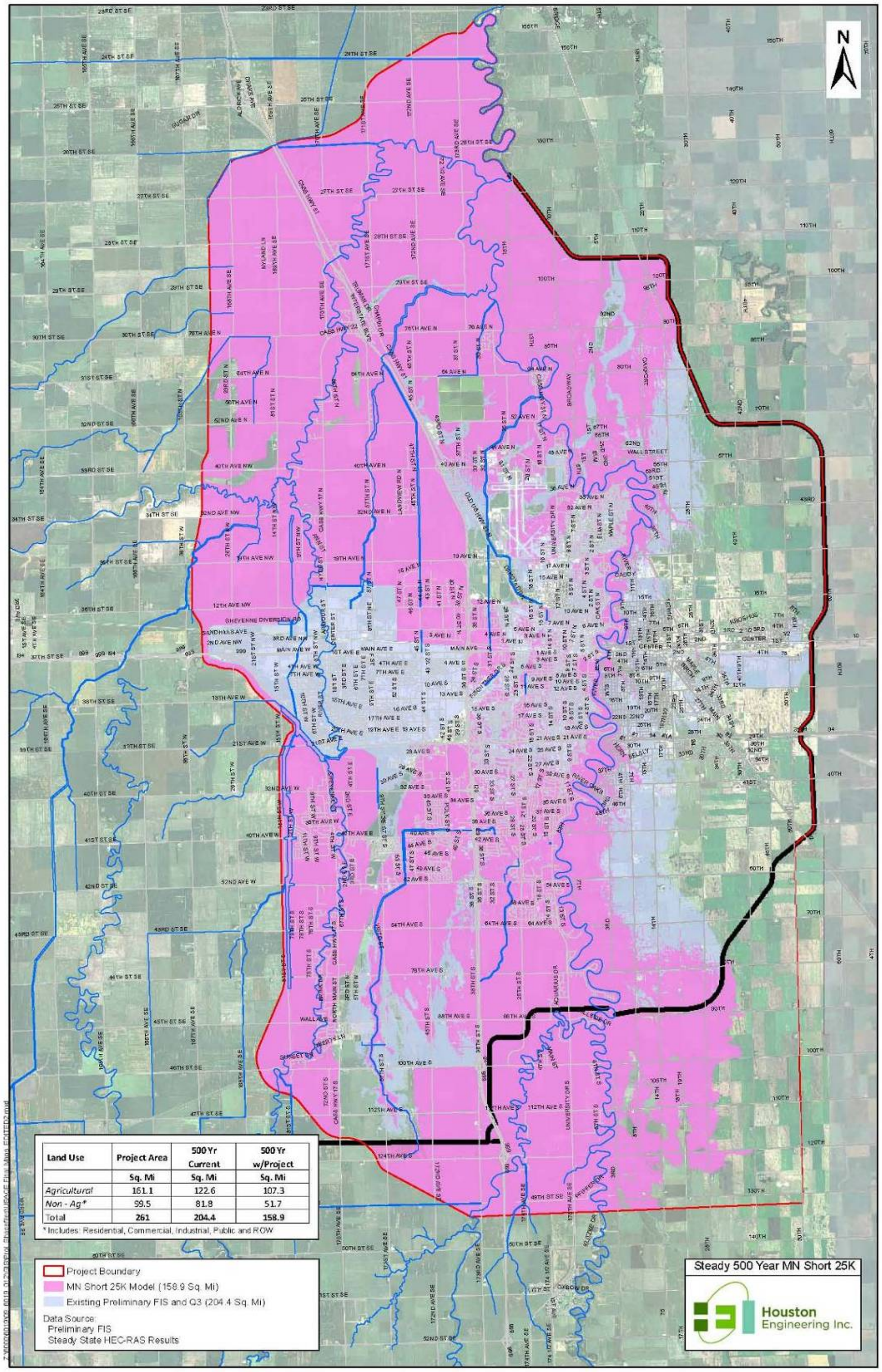
Figure 73 - Minnesota Short 25K 1-percent chance event (100-year) floodplain



Land Use	Project Area	100 Yr Current	100 Yr w/Project
	Sq. Mi	Sq. Mi	Sq. Mi
Agricultural	161.1	82.4	64.3
*Non - Ag**	99.5	29.8	17.4
Total	**261**	**112.2**	**81.7**

* Includes: Residential, Commercial, Industrial, Public and ROW

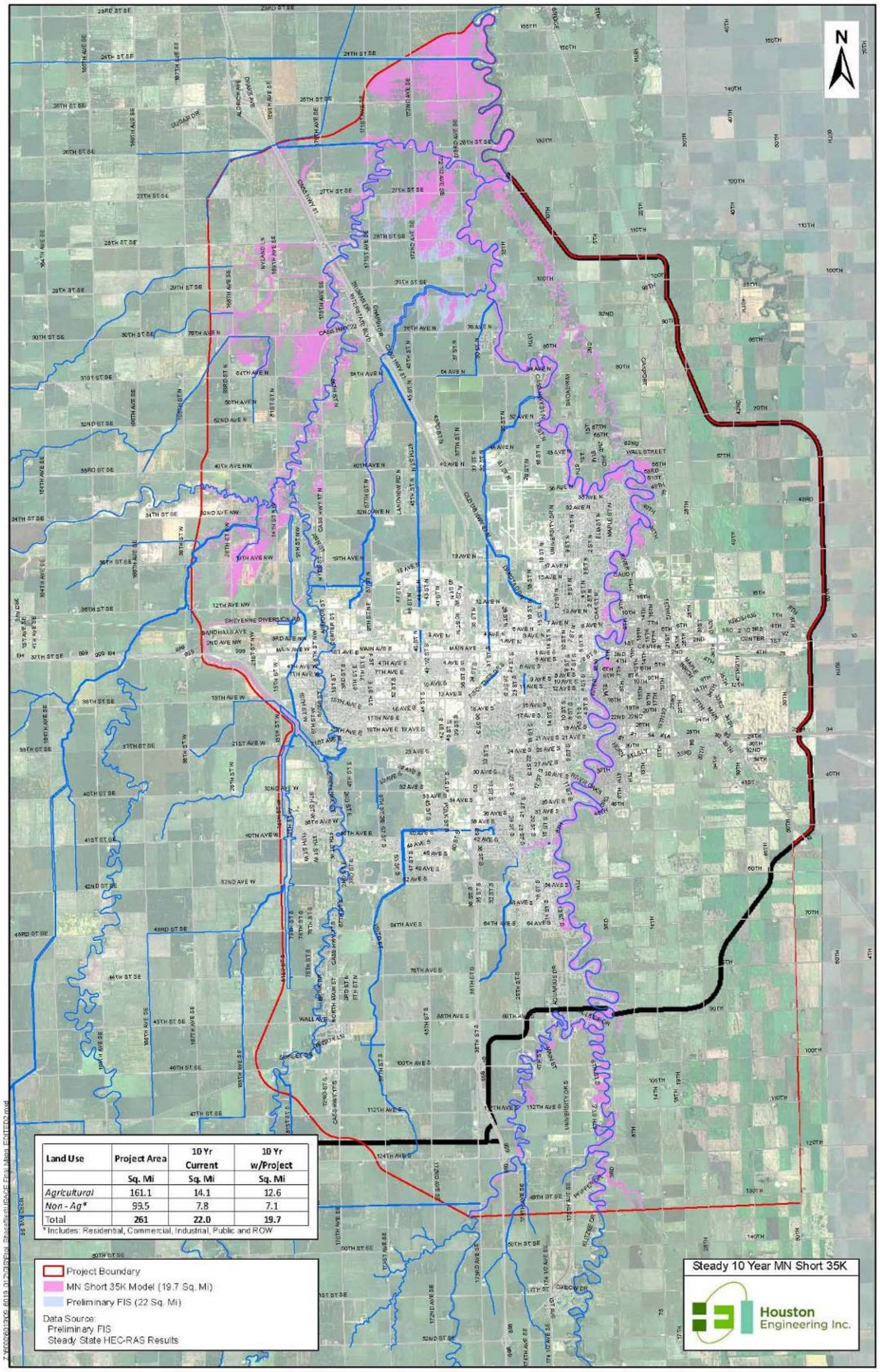
Figure 74 - Minnesota Short 25K 0.2-percent chance event (500-year) floodplain



5.2.3.2.10.2.2 MN35k plan

For the MN35K alternative the model was run for the 10-percent chance event, 2-percent chance event, 1-percent chance event and 0.2-percent chance event (see Table 41). The results for the 10-percent chance event show 2.3 square miles would be taken out of the floodplain, of which 1.5 square miles are agricultural lands. The results for the 2-percent chance event show 16.5 square miles will be taken out of the floodplain, with 12.3 square miles of this being agriculture lands. The results for the 1-percent chance event show 31.3 square miles will be taken out of the floodplain, with 18.6 square miles of this being agriculture lands. The results for the 0.2-percent chance event show 80.5 square miles will be taken out of the floodplain, with 33.1 square miles of this being agriculture lands (Figure 75, Figure 76, Figure 77, and Figure 78).

Figure 75 - Minnesota Short 35k 10-percent chance event (10-year) floodplain



Land Use	Project Area	10 Yr Current	10 Yr w/Project
	Sq. Mi	Sq. Mi	Sq. Mi
Agricultural	161.1	14.1	12.6
*Non - Ag**	99.5	7.8	7.1
Total	**261**	**22.0**	**19.7**

Figure 76- Minnesota Short 35k 2-percent chance event (50-year) floodplain

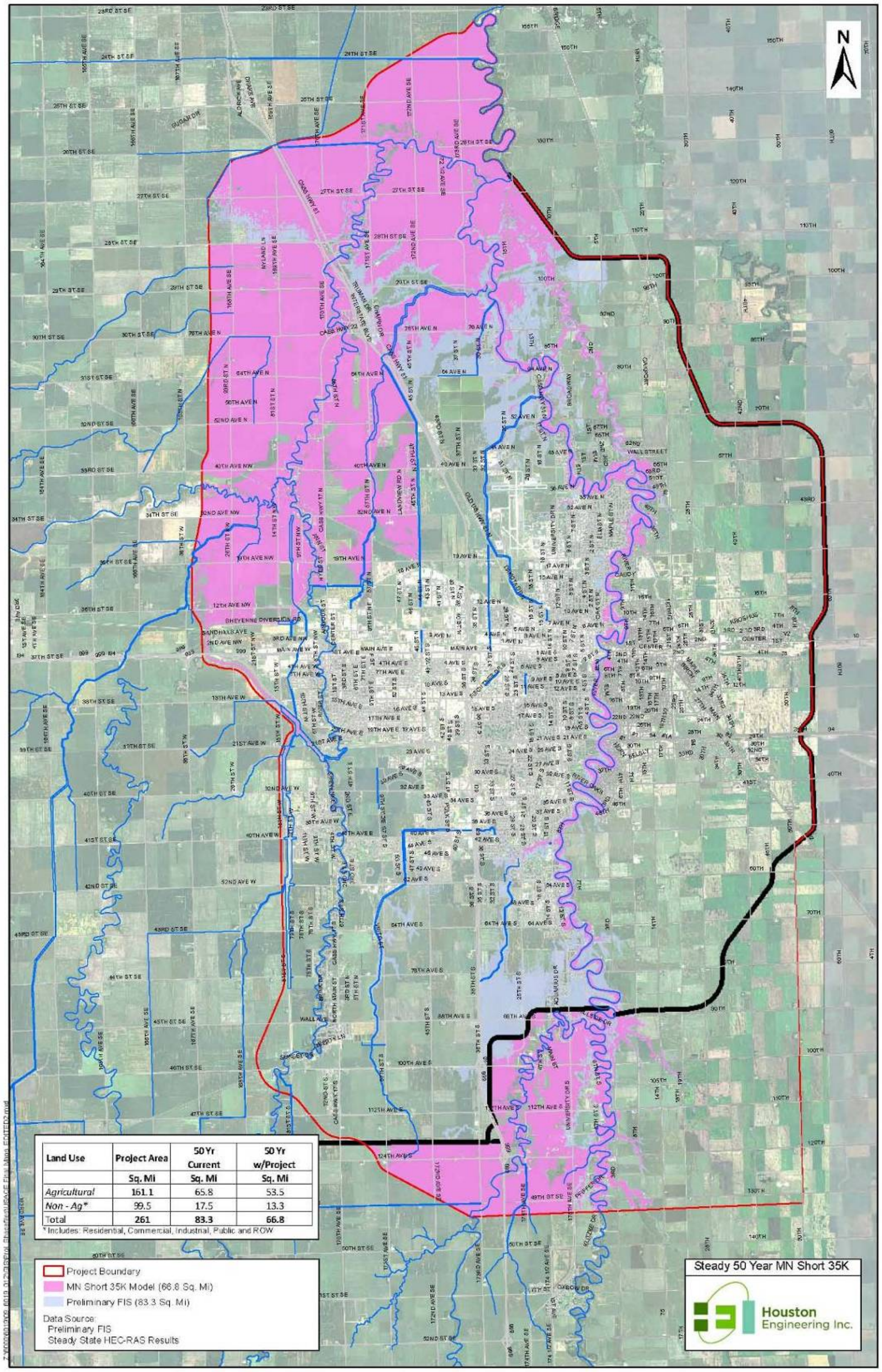


Figure 77 - Minnesota Short 35k 1-percent chance event (100-year) floodplain

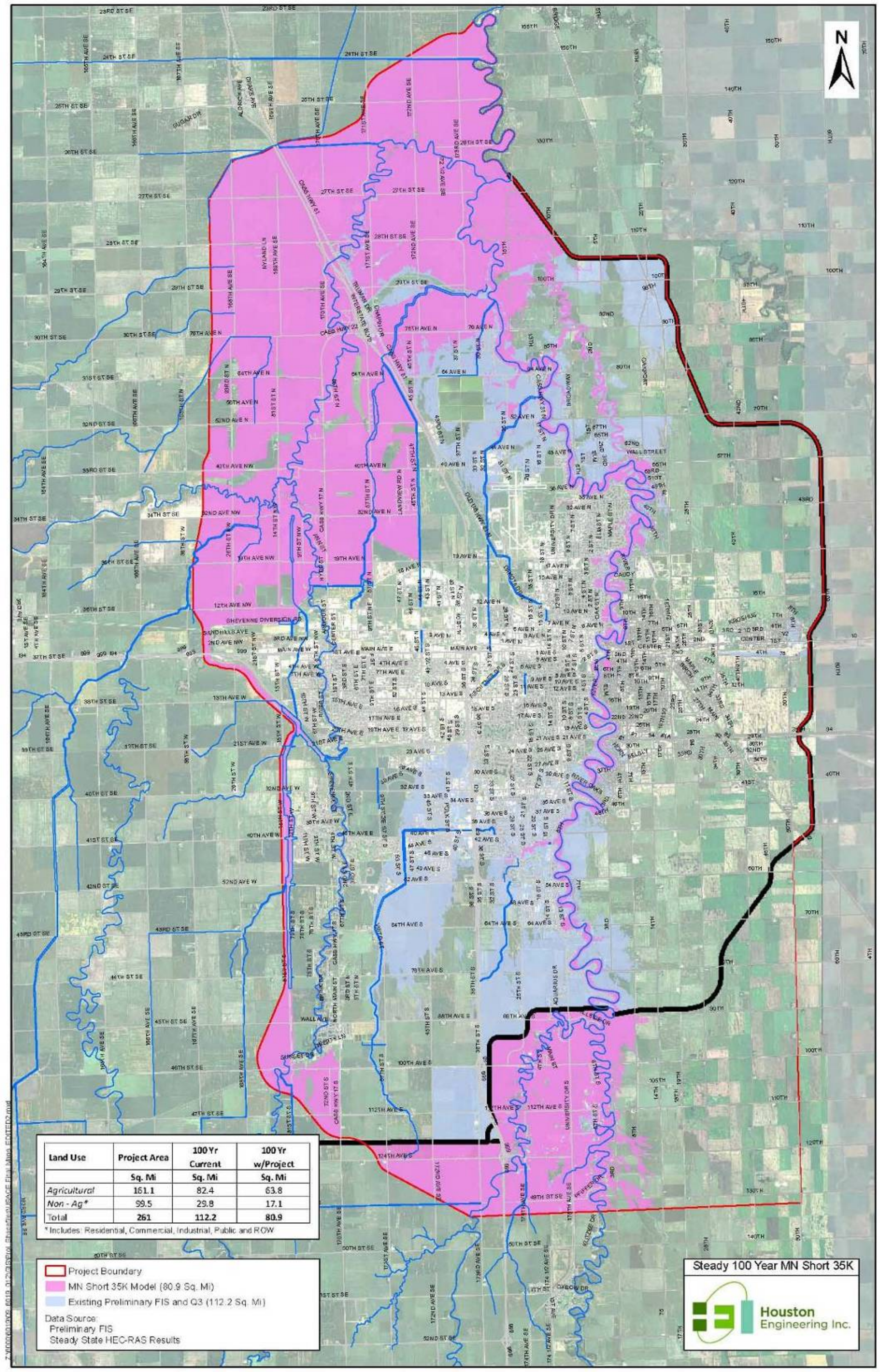
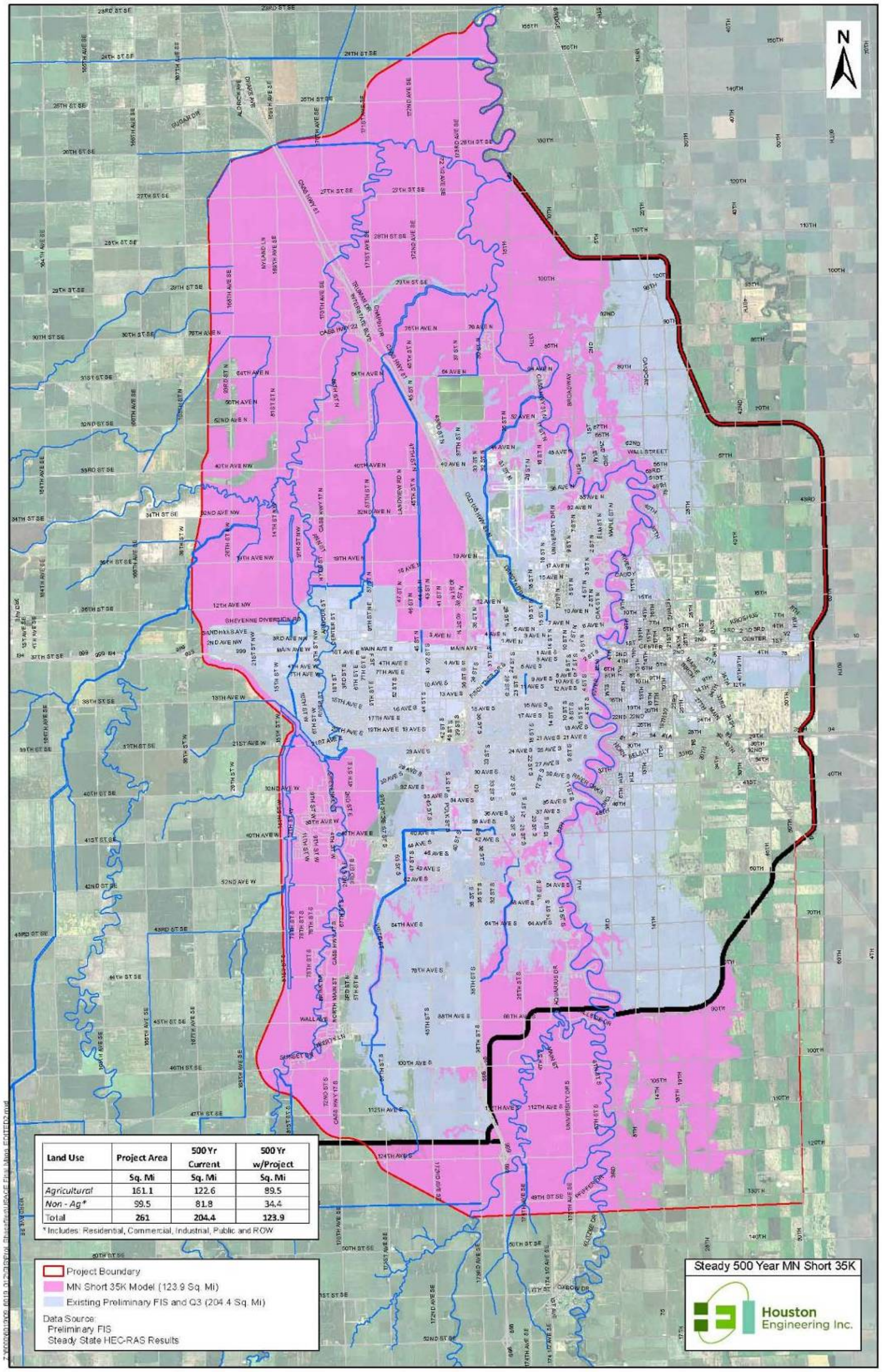


Figure 78 - Minnesota Short 35k 0.2-percent chance event (500-year) floodplain



5.2.3.2.10.3 North Dakota Alternatives

The ND35K plan is the only plan that was looked at in detail for this analysis.

5.2.3.2.10.3.1 ND35K plan

For the ND35k alternative the model was run for the 10-percent chance event, 2-percent chance event, 1-percent chance event and 0.2-percent chance event (see Table 41). The results for the 10-percent chance event show 10.8 square miles would be taken out of the floodplain, of which 8.4 square miles are agricultural lands. The results for the 2-percent chance event show 60 square miles will be taken out of the floodplain, with 49 square miles of this being agriculture lands. The results for the 1-percent chance event show 81.5 square miles will be taken out of the floodplain, with 59.6 square miles of this being agriculture lands. The results for the 0.2-percent chance event show 146 square miles will be taken out of the floodplain, with 77.3 square miles of this being agriculture lands. (Figure 79, Figure 80, Figure 81, and Figure 82)

Figure 79 – North Dakota East 35k 10-percent chance event (10-year) floodplain

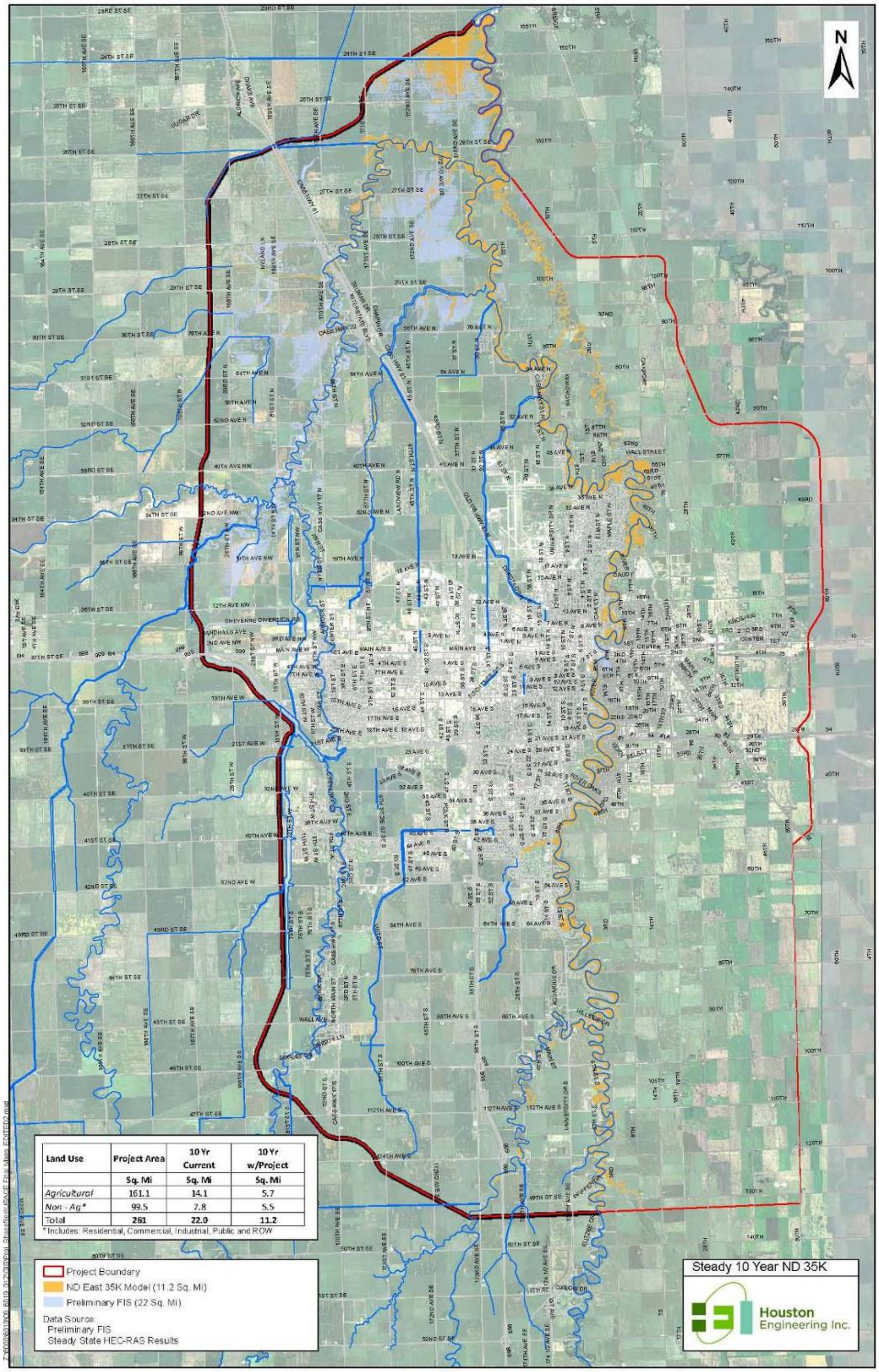
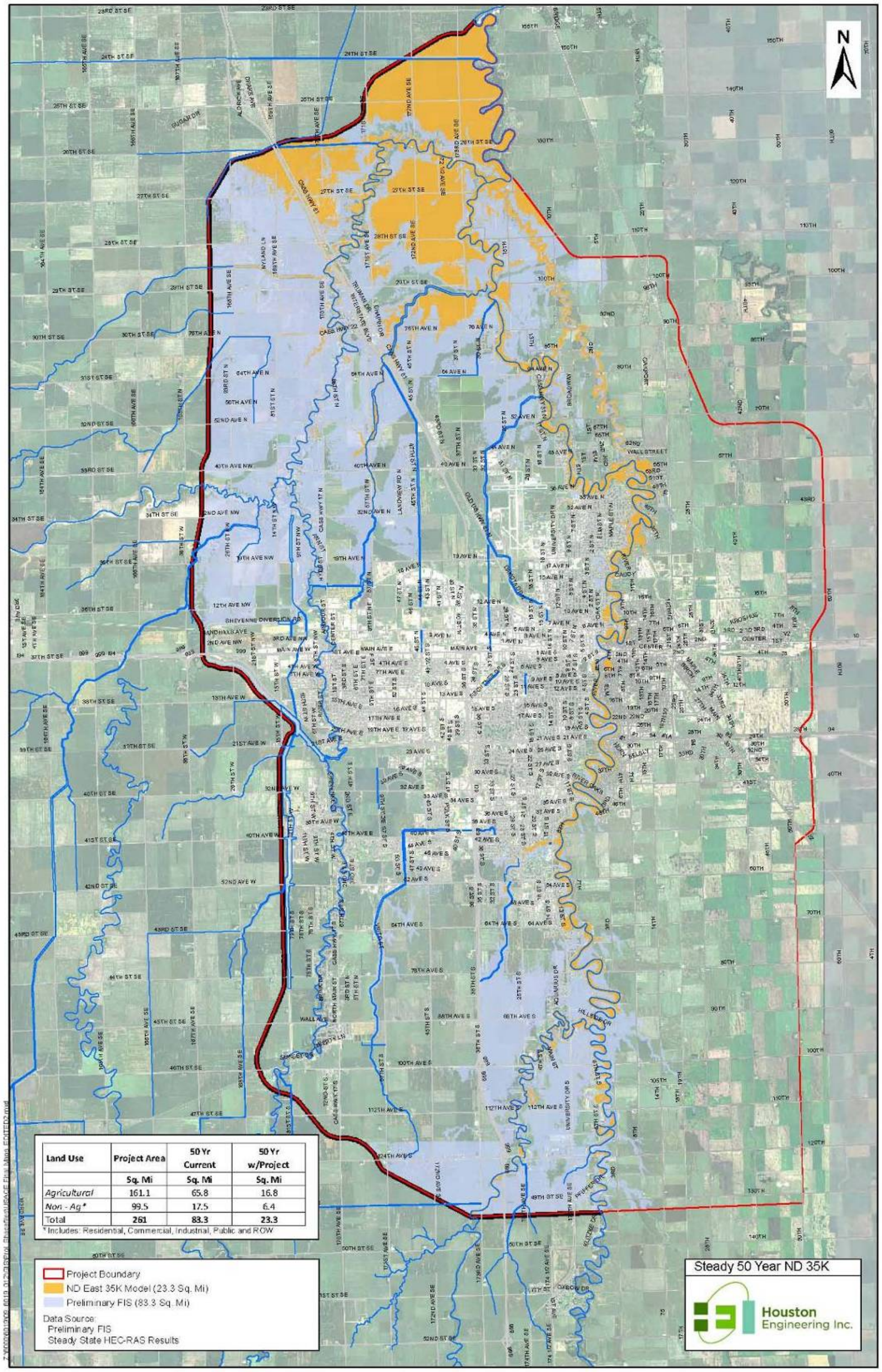


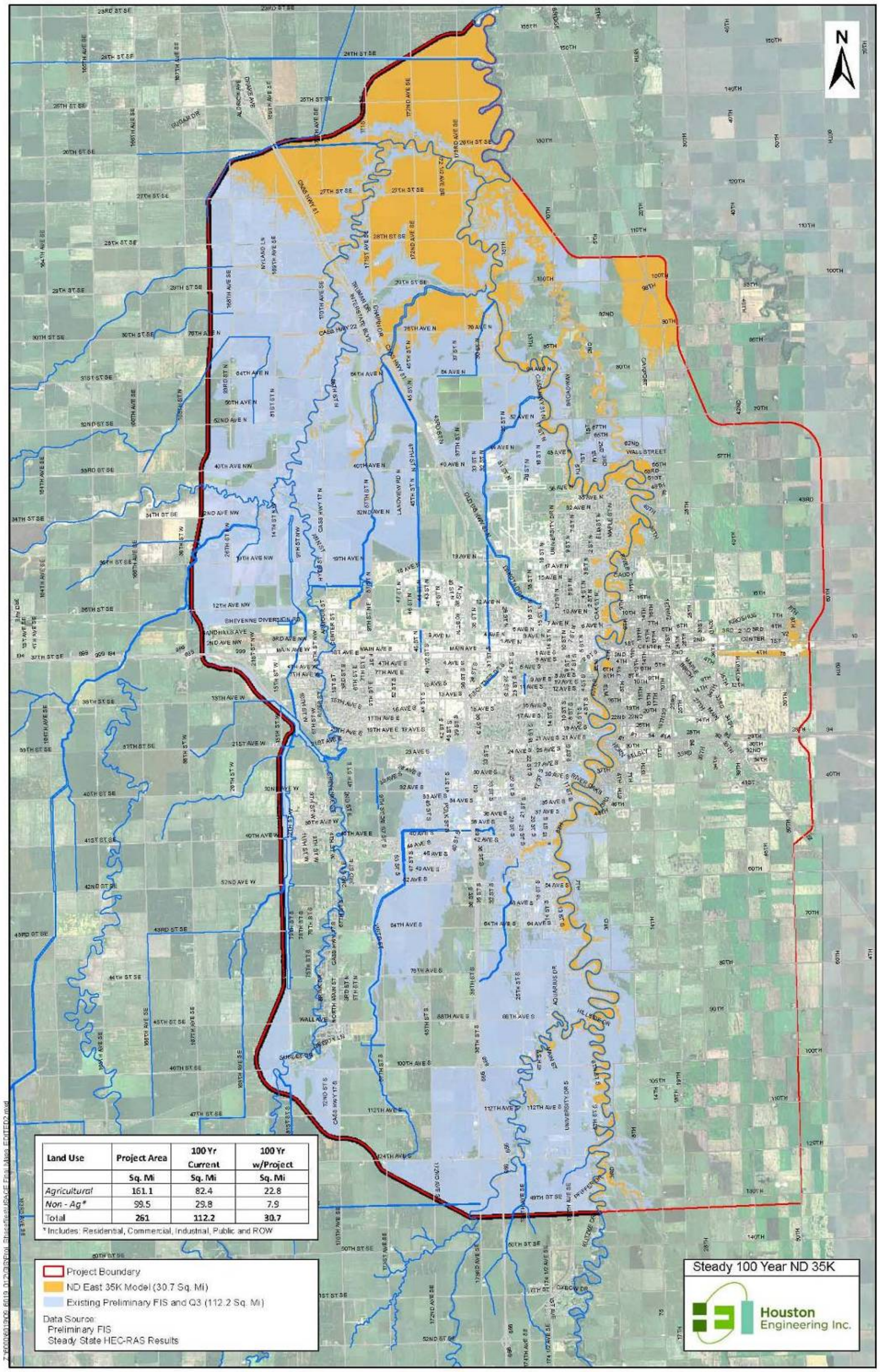
Figure 80 - North Dakota East 35k 2-percent chance event (50-year) floodplain



Land Use	Project Area	50 Yr Current	50 Yr w/Project
	Sq. Mi	Sq. Mi	Sq. Mi
Agricultural	161.1	65.8	16.8
*Non - Ag**	99.5	17.5	6.4
Total	**261**	**83.3**	**23.3**

* Includes: Residential, Commercial, Industrial, Public and ROW

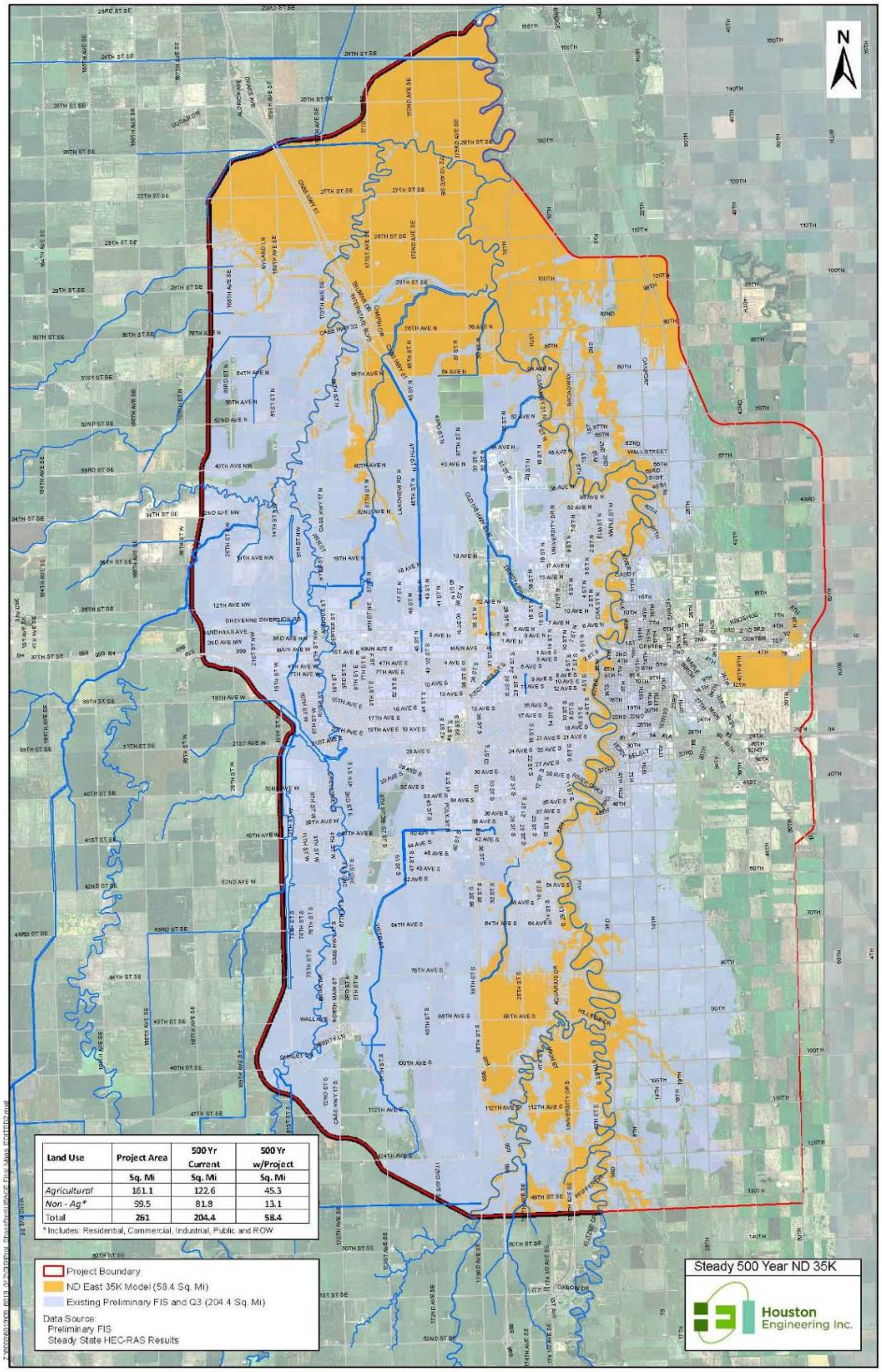
Figure 81- North Dakota East 35k 1-percent chance event (100-year) floodplain



Land Use	Project Area	100 Yr Current	100 Yr w/Project
	Sq. Mi	Sq. Mi	Sq. Mi
Agricultural	161.1	82.4	22.8
*Non - Ag**	99.5	29.8	7.9
Total	**261**	**112.2**	**30.7**

* Includes: Residential, Commercial, Industrial, Public and ROW

Figure 82- North Dakota East 35k 0.2-percent chance event (500-year) floodplain



Land Use	Project Area	500 Yr Current	500 Yr w/Project
	Sq. Mi	Sq. Mi	Sq. Mi
Agricultural	161.1	122.6	45.3
*Non - Ag**	99.5	81.8	13.1
Total	261	204.4	58.4

* Includes: Residential, Commercial, Industrial, Public and ROW

5.2.3.3 Environmental Justice

5.2.3.3.1 Introduction

The purpose of this environmental justice (EJ) review is to determine if a disproportionate share of a project's adverse socioeconomic and other environmental impacts are borne by low-income and minority communities. This review examines the extent to which populations of concern concentrated in or immediately adjacent to the project alternatives would experience a disproportionate and high level of adverse environmental impacts as a result of the project.

5.2.3.3.2 Applicable Rules and Guidelines

Because the U.S. Army Corps of Engineers (USACE) is a Federal agency, USACE must comply with Title VI of the Civil Rights Act, 42 U.S.C., Sec. 2000 et seq. This law states that "No person in the United States shall, on the ground of race, color or national origin be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any program or activity receiving Federal financial assistance." The importance of considering environmental justice issues in Federal actions was elevated with the February 11, 1994, signing of Executive Order (EO) 12898, entitled "Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations." EO 12898 requires that "…each Federal agency shall make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies and activities on minority populations and low-income populations…" [Subsection 1-101]. The Executive Order also requires that each Federal agency shall:

> conduct its programs, policies and activities that substantially affect human health or the environment in a manner that ensures that such programs, policies and activities do not have the effect of excluding persons and populations from participation in, denying persons and populations the benefits of, or subjecting persons or populations to discrimination under such programs, policies and activities because of their race, color or national origin [Subsection 2-2].
>
> work to ensure that public documents, notices, and hearings relating to human health or the environment are concise, understandable, and readily accessible to the public [Subsection 5-5(c)].

5.2.3.3.3 Identification of Minority and Low-Income Populations

The following section presents an evaluation of the demographic composition of minority and low-income persons living around the project area. As the project area includes portions of Cass County, ND, and Clay County, MN, information from both counties was compiled as part of the analysis. Race characteristics at the census block level and income characteristics at the block group level from the 2000 U.S. Census of Population and Housing were analyzed to identify populations of concern with respect to potential EJ issues. Detailed information at the block group and block level are computed based on the decennial census and are not provided in between census periods. The following information was collected for specific blocks and block groups and aggregated to represent the study area:

- Racial and Ethnic Characteristics—Population in each census block of the study area was characterized using the following racial categories: White Hispanic, Black or African American, American Indian and Alaska Native, Asian, Native Hawaiian and Other Pacific Islander, Other and Persons of Hispanic Origin. These categories are consistent with the affected populations requiring study under EO 12898.
- Percentage of Minority Population—As defined by the U.S. Census Bureau, the minority population includes all non-Whites and White-Hispanic persons. Consistent with Council of Environmental Quality guidelines "Minority populations should be identified where either: (a) the minority population of the affected area exceeds 50 percent or (b) the minority population percentage of the affected area is meaningfully greater than the minority population percentage in the general population or other appropriate unit of geographic analysis."
- Low-Income Population—The percentage of persons living below the poverty level, as defined in the 2000 U.S. Census, was one of the indicators used to determine the low-income population in a given census block or census tract. The median household income and per-capita income were also used to characterize the income levels.

Estimates of race- and ethnicity-related data are based on 2000 U.S. Census block boundaries and Summary File 1 (SF1) data tables. Estimates for population living below the poverty level and income levels are based on census block group boundaries and Summary File 3 (SF3) census data tables. Block group level data were utilized to report poverty- and income-related statistics as these data are not reported at the census block level. For purposes of this analysis, population characteristics of Clay County, MN, and Cass County, ND, are used as a reference population for comparative purposes throughout this analysis. Table 42 presents estimates for minority and low-income population characteristics within the two study area counties.

Table 42 - Population and Economic Characteristics of Study Areas

	Clay County, Minnesota		Cass County, North Dakota	
	Number	%	Number	%
Race				
White Alone	48,149	94.0%	117,106	95.1%
Non-Hispanic White	47,330	92.4%	116,263	94.4%
Hispanic White	819	1.6%	843	0.7%
Non-White Alone	3,080	6.0%	6,032	4.9%
Black or African American alone	268	0.5%	996	0.8%
American Indian and Alaska Native alone	740	1.4%	1,325	1.1%
Asian alone	449	0.9%	1,551	1.3%
Native Hawaiian and Other Pacific Islander alone	14	0.0%	43	0.0%
Some other race alone	857	1.7%	530	0.4%
Two or more races	752	1.5%	1,587	1.3%
Total	51,229	100.0%	123,138	100.0%
Persons of Hispanic Origin	1,872	3.7%	1,518	1.2%
Minority Population	3,899	7.6%	6,875	5.6%
Persons Below Poverty		13.2%		10.1%
Per-Capita Income	$17,557		$20,889	
Median Household Income	$37,889		$38,147	

Source: U.S. Department of Commerce, Bureau of the Census, 2000. SF1 and SF3 Tables.

5.2.3.3.4 Minority Analysis

As presented in Table 42 minority persons within Clay County, MN, account for 7.6 percent of the total population (U.S. Census, 2000). In order to better understand the location of minority persons within the county, percentages of minority persons by census block were calculated and mapped. As presented in Figure 83, small pockets of minority persons are spread throughout the City of Moorhead and the eastern portion of the City of Dilworth. Pockets of minority persons are also located towards the northern and southern portions of the County. Along the Minnesota alignment just four census blocks were identified that show a greater proportion of minority persons than the county threshold of 7.6 percent.

Within Cass County, ND, minority persons account for 5.6 percent of the total population (U.S. Census, 2000). Greater concentrations of minority persons were identified south of I-94 and in areas located along the intersection of I-94 and I-29. As presented in Figure 84, the North Dakota alignment does not appear to intersect any census blocks with minority persons present at a higher concentration than the county threshold of 5.6 percent.

5.2.3.3.5 Poverty and Income Analysis

Based on U.S. Census 2000 data, the percentage of persons below the poverty level within Clay County, MN, is 13.2 percent of the total population. Within Cass County, ND, the percentage of persons below the poverty level is 10.1 percent of the total population.

Figure 85 and Figure 86 show the locations of block groups with a higher percentage of persons below the poverty level compared to the county thresholds. In both counties, higher percentages of persons below the poverty level appear to be located in urban areas away from the diversion channels. Neither of the proposed alignments intersect any census block groups showing higher percentage of persons below the poverty level than the county thresholds.

Figure 83 -Clay County, MN, Minority Levels

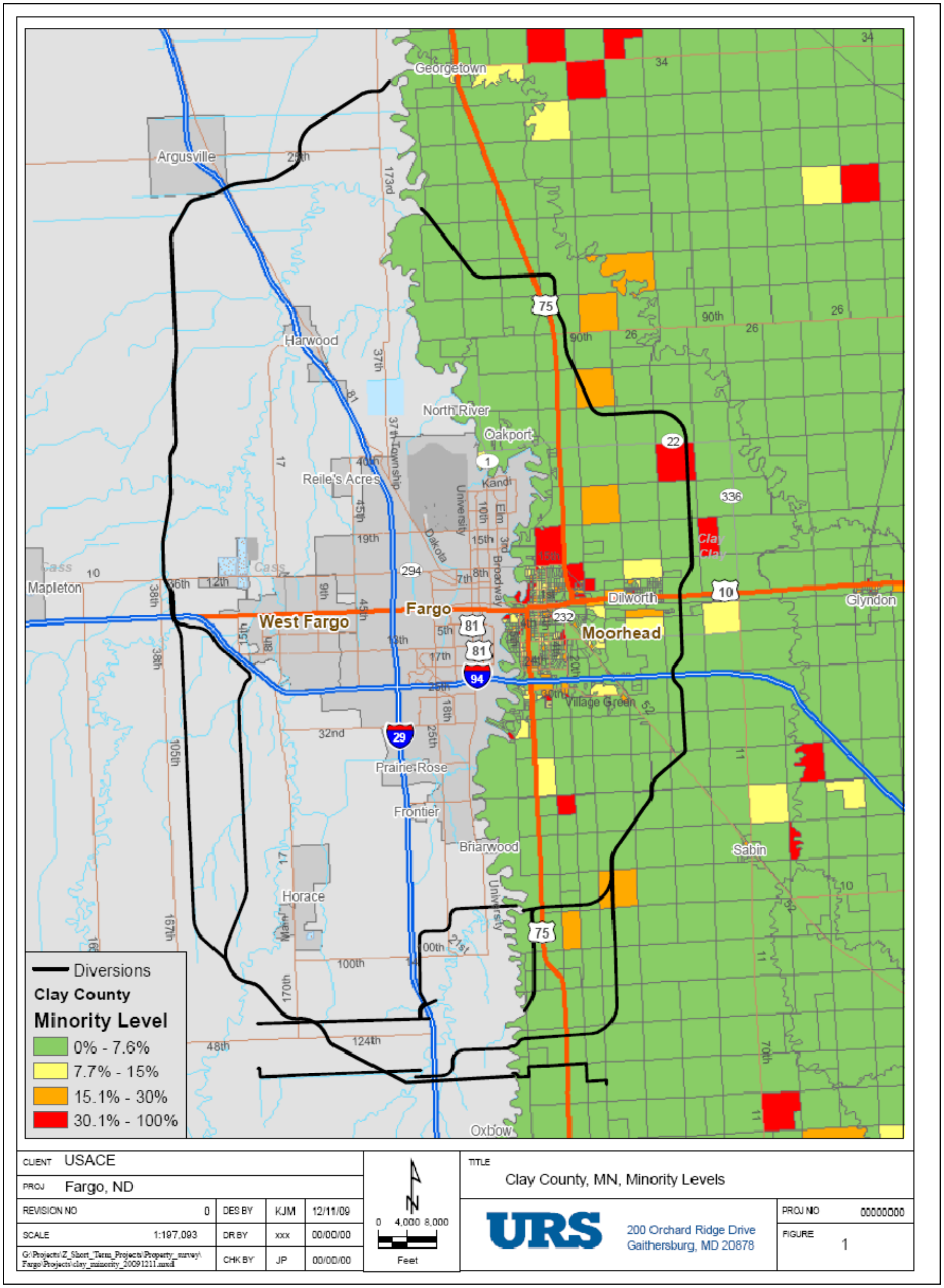


Figure 84 - Cass County, ND, Minority Levels

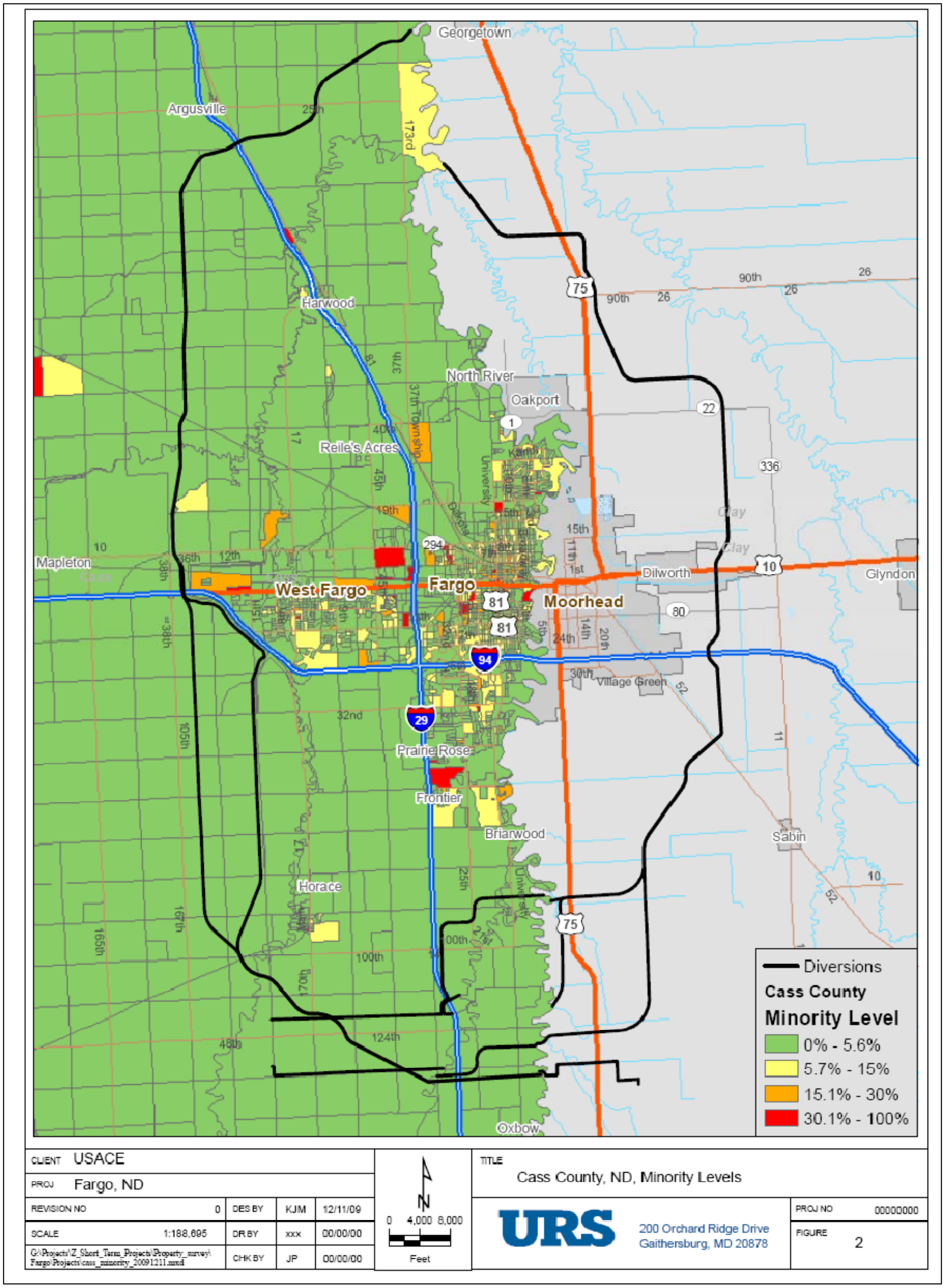


Figure 85- Clay County, MN, Poverty Levels

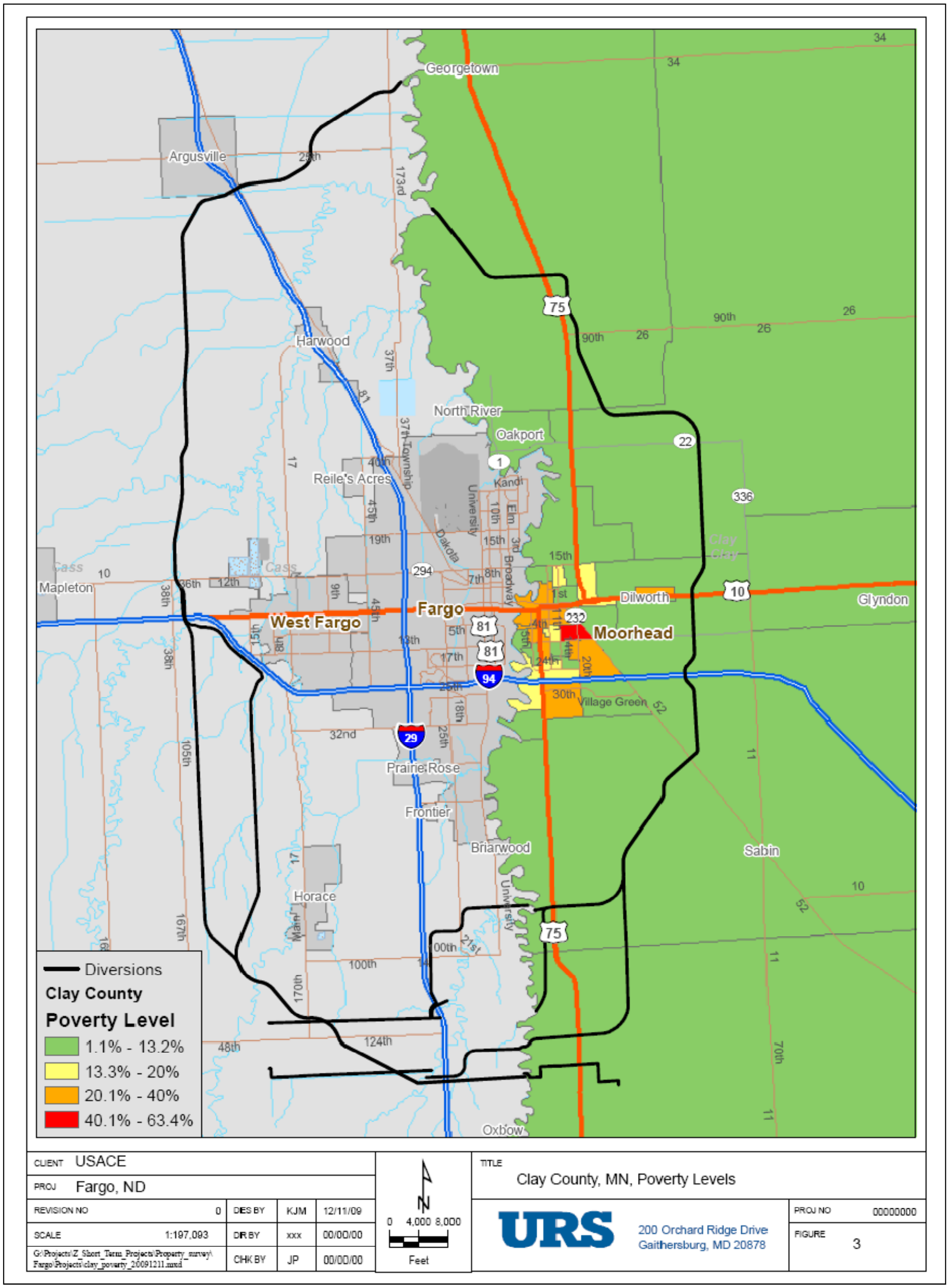
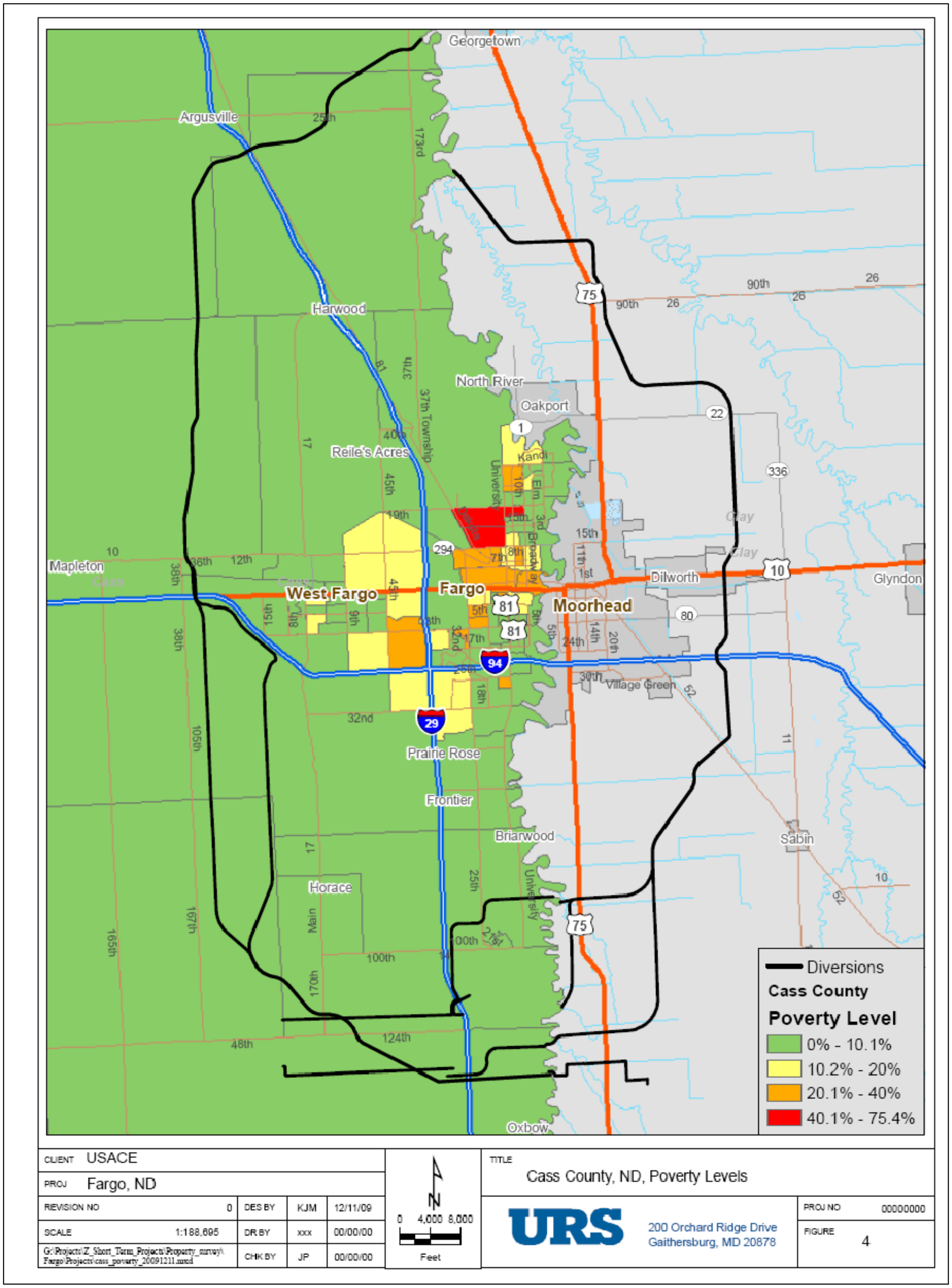


Figure 86- Cass County, ND, Poverty Levels



5.2.3.3.6 Determination of Disproportionately High and Adverse Effects on Population of Concern

The determination of whether the populations of concern are subject to disproportionately high and adverse environmental impacts involves two principal considerations: evidence of previous disproportionate environmental degradation caused by past major projects or pre-existing sources of environmental contamination; and, a disproportionate distribution of impacts caused by the proposed project. The first consideration deals with projects or impacts that have occurred in the past and may still be affecting these persons. One of the purposes of EO 12898 is to ensure that areas of low-income and high-minority concentrations have not previously been "dumping grounds" for land uses that cause substantial adverse environmental impacts. The second consideration involves a determination of whether plans for the proposed project have been directed toward low-income and high-minority areas because of factors such as lower property values or expectations that citizen opposition might be less effective in these areas.

Making a determination of whether affected areas with a high proportion of minorities or low-income populations have been disproportionately impacted involves comparing the magnitude of impacts within and outside these areas. The impacts are inventoried and quantified to the extent possible within and outside these areas. Then mitigation measures are recommended to address these impacts if necessary. The following types of impacts were evaluated in this analysis:

- Previous Environmental Degradation—previous degradation to the physical or social environment in a minority or low-income community can arise from past projects that had major impacts, or an accumulation of land uses that have a negative impact on the environment. Additional impacts related to the proposed project, however small, can have a greater cumulative effect in areas where previous levels of degradation are high.
- Impacts Related to the Proposed Project—Impacts identified in this and other technical studies have been evaluated to determine whether their effect is borne disproportionately by communities of concern. Issues considered include:
  - Residential and business displacement due to right-of-way acquisition
  - Changes in accessibility and mobility afforded by the proposed project
  - Noise

Planning staff at county planning departments in Cass County and Clay County were consulted to determine if any major projects have been carried out within areas along the proposed alignments that might have caused adverse environmental impacts. Emphasis was placed on identifying projects that required environmental reviews under the National Environmental Policy Act, or major local or State construction projects. Such projects could include, for example, solid waste disposal facilities, incinerators, trash disposal or transfer facilities, or major transportation projects.

Major private projects were not considered unless they involved significant environmental effects, in which case they likely would have an environmental review.

Based on discussions with local staff, land area along the alignment is predominantly farmland with little or no development. No projects were identified that met the significant impact criteria. Therefore, no development disproportionately located in or near low-income and high-minority areas was identified.

The U.S. Environmental Protection Agency (EPA) maintains a detailed database of point sources of environmental contaminants.[2] This database is a good indicator of the degree of pre-existing environmental degradation throughout the country. EPA-regulated sites data is provided by zip code area and street address. The analysis of this data included a study of the density of EPA-regulated sites within zip code areas that overlap the proposed project study area. The analysis found that, other than establishments that handle hazardous wastes, no other environmentally sensitive establishments, such as active or archived Superfund sites, are located within the project area[3].

5.2.3.3.7 Project Generated Effects

Long-term impacts from the proposed alignments would include loss of farmland and business income. Based on the results from the Farmland Conversion Impact Rating for each alternative in North Dakota and Minnesota, the proposed diversion channel on the North Dakota side would remove approximately 5,400 acres of prime and unique farmland. The proposed diversion channel on the Minnesota side would remove a range of approximately 5,500 acres of Prime and Unique farmland for the MN25K plan to 5,700 acres of Prime and Unique farmland for the MN35K plan. (Appendix F)

In addition to acquisition of land for the proposed right-of-way, the alternatives for the diversion channels would cause changes in accessibility and mobility across farms and noise and air quality related impacts during construction. The proposed alignments are expected to split or divide farms into separate parcels. In some cases, farmers would have to detour around the proposed diversion channel using established roadways or specially constructed access roads to access their property and conduct farming operations. The number of farms under active use that would be divided by the proposed right-of-way is unknown at this stage. Mitigation measures would be incorporated into the final design to minimize impacts to farmland.

Mitigation measures would be taken to limit the potential for adverse air quality and particulate emissions during construction. Contractors would have to comply with all relevant local, State, and Federal air quality regulations. In order to limit the potential for adverse particulate emissions, mitigation would include the following best management practices:

- Watering of exposed earth surfaces during excavation, grading, and construction activities.

---

2 http://www.epa.gov/enviro/html/cerclis/cerclis_query.html

3 A Superfund site is an uncontrolled or abandoned place where hazardous waste is located, possibly affecting local ecosystems or people. Sites are listed on the National Priorities List (NPL) upon completion of Hazard Ranking System (HRS) screening, public solicitation of comments about the proposed site, and after all comments have been addressed. (Source: http://www.epa.gov/superfund/sites/index.htm)

- Watering of all active portions of the construction site to limit vehicular and wind-blown dust
- Covering or watering material transported off site
- Periodic review and inspection of construction practices to ensure mitigation strategies are properly implemented

Noise-related impacts due to any of the diversion channel alternatives would be temporary in nature and would be experienced only during the construction phase of the project. Construction noise would be of a fixed duration and would cease at the completion of the construction phase. Construction noise, usually limited to daylight hours, differs from normal vehicular traffic noise, which continues throughout the day- and night-time hours. Equipment such as bulldozers, scrapers, pavers, backhoes, graders, loaders, cranes, trucks, compressors, vibratory compactors, generators, and pile drivers are typically utilized during construction, and would be subject to State and local construction noise specifications. Mitigation measures would be incorporated into the contract documents to mitigate potential construction noise impacts.

5.2.3.3.8 Environmental Justice Conclusion

The proposed alternatives would result in acquisition of farmland in both Clay County, MN, and Cass County, ND. The county percentages of minority residents and persons living below the poverty level were used as the basis for determining those areas with high-minority and low-income concentrations. The proposed alignment on the Minnesota side could result in potential impacts to farmlands in Clay County owned by minority persons, as the alignment passes through the four census blocks with a high concentration of minority persons. The proposed alignment on the North Dakota side runs along the western portions of Cass County and passes through census blocks with minority persons below the County average, therefore no adverse impacts are anticipated. However, the proposed alignments do not appear to disproportionately impact only areas with high minority persons in either State. The proposed alignments also do not intersect any census block groups in either State showing a higher percentage of persons below the poverty level than the county thresholds. The alignment selected after detailed engineering studies would impact all farmers who own farmland irrespective of race and income. Individual owners would be identified during the course of the project and relocation of affected parties would be performed in accordance with the Uniform Relocation Act. After completion of the project, all communities in the project area are expected to experience the beneficial impact of a reduction in future flood events due to the proposed project. This would lead to reduced disruption of future agricultural activity. All agriculturists in the area would benefit from the action. This information is presented in Table 43.

Table 43 – Environmental Justice Considerations.

	North Dakota Plan (any capacity)	Minnesota Plan (any capacity)
Active Farmland Acquired	5,400 acres	5,700 acres
Areas with High Minority Concentration	No Disproportionate effects	Land from 4 census blocks acquired-No Disproportionate effects
Areas with High Poverty Rate	No Disproportionate effects	No Disproportionate effects

5.3 CONTROVERSY

Most of the controversial aspects of the project are related to the selection of the proposed plan and the location of the diversion alignments. Individual areas of controversy are discussed in various sections of the EIS and those pertaining to the socioeconomic resources are summarized here.

Some landowners within the project alignments are uncomfortable with the project in their backyard, but most landowners believe that a flood risk management project is important to the area's survival. Owners of agricultural lands that are purchased for the project would be compensated at fair market value.

Landowners outside the project area are concerned about induced flooding damages to their property, but all of the diversion channel alternatives have been designed to minimize increased stages in areas outside the project limits where possible. Steps will be taken to avoid, minimize, or mitigate any negative impacts to these landowners. As described above, there will downstream impacts with all of the diversion channel alternatives, and further analysis is needed to determine whether there is a taking.

Some concern has been expressed at public meetings that the level of protection provided by the project should be equal to that provided by the existing diversion channel in Winnipeg, Manitoba, which is a 700-year level. Other concerns regarding flood water storage have been raised by the public; this is primarily in response to the induced flooding that will occur downstream of the project area.

Concerns from the City of Dilworth Minnesota have been raised that the Minnesota diversion alternatives have serious adverse impacts to the future growth of the town.

5.4 CUMULATIVE EFFECTS

The Council on Environmental Quality (CEQ) regulations (40 CFR §§ 1500-1508) implementing the procedural provisions of the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. § 4321 et seq.) define cumulative impact as:

> "…the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non federal) or person undertakes such other actions" (40 CFR § 1508.7).

Cumulative effects analysis recognizes that the most serious environmental impacts may result from the combination of individually minor effects of multiple actions over time, rather than the direct or indirect effects of a particular action (CEQ 1997). The challenges in assessing cumulative impacts derive in part from (1) incomplete identification of the ecological stressors or actions that alter ecological processes (USEPA 1997); (2) limited data and information of suitable quality that describe the individual stressors; (3) imperfect and uncertain understanding of the potential interactions among stressors in determining cumulative ecological impacts; (4) spatial and temporal scales relevant to the overall assessment; and (5) limited understanding of the resilience of potentially affected resources to past, present, and future stress.

The CEQ has suggested frameworks for incorporating cumulative effects analyses (CEA) into the environmental impact assessment process, and steps for conducting the CEA (CEQ 1997). These frameworks are shown in Table 44 and Table 45 Incorporation of CEA, and indicate that the CEA should begin with the NEPA scoping process, and continue throughout the descriptions of the affected environment and the environmental effects of the action. Individual steps in conducting a CEA are also tied to these three major components of the NEPA process. Three fundamental elements typically characterize CEA (Spaling and Smit 1993 in Canter 1999): 1) a cause or source of change (perturbations); 2) the process of change as reflected via the pertinent system structure or processes; and 3) the result of the change (effect).

Table 44 – CEQ framework for conducting cumulative impact assessments.

1. Cumulative effects are caused by the aggregate of past, present, and reasonably foreseeable future actions. The effects of a proposed action on a given resource, ecosystem, and human community include the present and future effects added to the effects that have taken place in the past. Such cumulative effects must also be added to effects (past, present, and future) caused by all other actions that affect the same resource.
2. Cumulative effects are the total effect, including both direct and indirect effects, on a given resource, ecosystem, and human community of all actions taken, no matter who (Federal, non-Federal, or private) has taken the actions. Individual effects from disparate activities may add up or interact to cause additional effects not apparent when looking at the individual effects one at a time. The additional effects contributed by actions unrelated to the proposed action must be included in the analysis of cumulative effects.
3. Cumulative effects need to be analyzed in terms of the specific resource, ecosystem, and human community being affected. Environmental effects are often evaluated from the perspective of the proposed action. Analyzing cumulative effects requires focusing on the resource, ecosystem, and human community that may be affected and developing an adequate understanding of how the resources are susceptible to effects.
4. It is not practical to analyze the cumulative effects of an action on the universe; the list of environmental effects must focus on those that are truly meaningful. For cumulative effects analysis to help the decision-maker and inform interested parties, it must be limited through scoping to effects that can be evaluated meaningfully. The boundaries for evaluating cumulative effects should be expanded to the point at which the resource is no longer affected significantly or the effects are no longer of interest to affected parties.
5. Cumulative effects on a given resource, ecosystem, and human community are rarely aligned with political or administrative boundaries. Resources typically are demarcated according to agency responsibilities, county lines, grazing allotments, or other administrative boundaries. Because natural and sociocultural resources are not usually so aligned, each political entity actually manages only a piece of the affected resource or ecosystem. Cumulative effects analysis on natural systems must use natural ecological boundaries and analysis of human communities must use actual sociocultural boundaries to ensure including all effects.
6. Cumulative effects may result from the accumulation of similar effects or the synergistic interaction of different effects. Repeated actions may cause effects to build up through simple addition (more and more of the same type of effect), and the same or different actions may produce effects that interact to produce cumulative effects greater than the sum of the effects.
7. Cumulative effects may last for many years beyond the life of the action that caused the effects. Some actions cause damage lasting far longer than the life of the action itself (e.g., acid mine drainage, radioactive waste contamination, species extinctions). Cumulative effects analysis needs to apply the best science and forecasting techniques to assess potential catastrophic

consequences in the future.
8. Each affected resource, ecosystem, and human community must be analyzed in terms of its capacity to accommodate additional effects, based on its own time and space parameters. Analysts tend to think in terms of how the resource, ecosystem, and human community will be modified given the action's development needs. The most effective cumulative effects analysis focuses on what is needed to ensure long-term productivity or sustainability of the resource.

[1]From: CEQ. 1997. Considering cumulative effects under the National Environmental Policy Act. Council on Environmental Quality, Executive Office of the President, Washington, D.C. 64 pages + appendices.

Table 45 – Steps in cumulative effects analysis to be addressed in each component of environmental impact assessment.

EIA Components	CEA Steps
Scoping	1. Identify the significant cumulative effects issues associated with the proposed action and define the assessment goals. 2. Establish the geographic scope for the analysis. 3. Establish the time frame for the analysis. 4. Identify other actions affecting the resources, ecosystems, and human communities of concern.
Describing the Affected Environment	5. Characterize the resources, ecosystems, and human communities identified in scoping in terms of their response to change and capacity to withstand stresses. 6. Characterize the stresses affecting these resources, ecosystems, and human communities and their relation to regulatory thresholds. 7. Define a baseline condition for the resources, ecosystems, and human communities.
Determining the Environmental Consequences	8. Identify the important cause-and-effect relationships between human activities and resources, ecosystems, and human communities. 9. Determine the magnitude and significance of cumulative effects. 10. Modify or add alternatives to avoid, minimize, or mitigate significant cumulative effects. 11. Monitor the cumulative effects of the selected alternative and adapt management.

[1]From: CEQ. 1997. Considering cumulative effects under the National Environmental Policy Act. Council on Environmental Quality, Executive Office of the President, Washington, D.C. 64 pages + appendices.

The geographical extent is broadly defined by the Red River of the North Drainage Basin. The pertinent time scale for assessing cumulative impacts spans approximately 160 years, and dates from 1901, the beginning of the existing discharge records for the USGS gauge at Fargo, through 2060, the end of the project planning horizon.

This section will briefly review the affected environment, which was described in detail earlier in Chapter 4, describe the stressors that have shaped and will continue to shape the natural and human environments of the Red River Basin (RRB), and then consider the cumulative effects of the impacts presented earlier in this chapter.

5.4.1 Cumulative Impact with Project Alternatives

The CEA will focus on the same resource categories described in Existing Conditions, Chapter 4, and further evaluated for likelihood of direct and/or indirect impacts in this chapter. These include the following:

Natural Resources
Air Quality
Water Quality
Downstream Water Quantity
Slope Stability
Wetlands
Groundwater
Aquatic Habitat
Fish Passage
Upland Habitat/Riparian Habitat
Endangered Species
Prime and Unique Farmland
Hazardous, Toxic and Radioactive Waste (HTRW)

Cultural Resources
Cultural Resources

Socioeconomic Resources
Social Effects
Economic Issues
Environmental Justice

5.4.1.1 Air Quality

The Fargo-Moorhead area is considered a NAAQS Attainment Area for all air quality parameters (USEPA 2009). Heavy equipment would produce small amounts of hydrocarbons in exhaust emissions. The construction contractor would be required to maintain the vehicles on the sites in good working order to minimize exhaust emissions. Fugitive dust could also result from proposed construction activities so the contractor would be required to conduct dust suppression activities. Adverse impacts to air quality resulting from the proposed activities would be minor and short term in nature regardless of the alternative that is implemented.

5.4.1.2 Water Quality

As outlined above, water quality in the Red River of the North main stem is generally impaired for much of its length in the continental U.S. Point and non-point sources of pollution result in high concentrations of several pollutants. This results in non-support of aquatic life and overall use; and partial support of swimming, agriculture, and wildlife uses. These impairments are largely due to various agricultural activities, urban runoff, septic systems, channelization, dredging, streambank modifications, dams and other stressors. Water quality within tributaries of the project area face similar water quality limitations discussed above.

The diversion channel alternatives considered here could slightly affect water quality that has already been greatly reduced. Construction of any of the alternatives could result in minor reductions in water quality, although the effects would be temporary. Potential geomorphic effects could result in slight increases in turbidity. However, the likelihood of geomorphic effects appears small, and for areas where such effects are more likely, mitigation would be applied to reduce those effects. None of the diversion channel alternatives would further contribute to other pollutants affecting water quality, such as nutrients, pH, fecal coliform or Biological Oxygen Demand. Thus, the diversion channel alternatives should not significantly contribute to further cumulative degradation of water quality in the basin.

5.4.1.3 Downstream Water Quantity

The quantity of water flowing through the Red River system has changed over time. As outlined above, review of annual peak discharge data suggests that flooding at Fargo, ND has increased over time. This includes a general increase in the frequency and magnitude of flood events. Causes of this are a likely combination of increased precipitation over time, as well as increased tiling and draining of the watershed. This has resulted in more water flowing through the system more quickly.

All of the diversion channel alternatives will change the timing and flows of water, significantly reducing the quantity of water flowing through the communities of Fargo and Moorhead. However, all diversion channel alternatives also include an increase in water quantity for areas immediately downstream of Fargo-Moorhead. These impacts are outlined above, and include anticipated impacts for the 10, 2, and 1-percent chance events. Impacts would extend approximately 45 miles downstream. Ultimately, all diversion channel alternatives would result in varying improvements in the cumulative condition of water quantity and flood elevations for the Fargo-Moorhead Metropolitan area. Conversely, all alternatives will increase water quantity and flood elevations for areas immediately downstream of the Fargo-Moorhead Metropolitan Area.

5.4.1.4 Slope Stability

The diversion channel alternatives will prevent drastic raises in the Red River water surface elevation during flood events and would not affect the river elevation for normal everyday conditions. Thus, the stability of the Red River bank will not be adversely impacted by any of the diversion alternatives. The reduction of flow through the metro area during flood events may reduce the amount of erosion that would occur on the primary bank, thus increasing the overall stability of the bank.

5.4.1.5 Wetlands

There are 4,626 acres of wetlands in the project area, less than 0.05% of the area within this project boundary. Anderson and Craig (1984, as reported in Aadland et al 2005) estimated over 95% of the wetlands in the Agassiz Lake Plain ecoregion have been drained. This number may have increased since that evaluation in 1984. Clearly, wetlands are a natural resource that has been severely impacted through human development. Due to increasing pressure to either urbanize or improve drainage on cropland, it is anticipated that wetland acreage will either remain the same or decrease within the project area in the future even without implementation of any of the project alternatives.

Wetland areas would be impacted under either the Minnesota or North Dakota alignment. These impacts are outlined above. Impacts would occur either directly through impacts from the project footprint, or indirectly through reduced hydraulic connectivity of wetlands to the river because of reduced river flood discharge. However, as outlined above, these impacts should be offset. Wetlands that will be adversely affected by the footprint of the diversion channel would be more than offset by creation of wetlands within the diversion channel bottom. Wetlands potentially impacted because of altered connectivity will be mitigated through wetland creation.

Ultimately, all the diversion channel alternatives would include appropriate measures to minimize or mitigate potential losses to wetland areas. Any of the alternatives considered here would not contribute to further cumulative degradation of wetland habitats in the basin.

5.4.1.6 Groundwater

Groundwater in the project area includes the Buffalo Aquifer to the east, and the West Fargo Aquifer to the west. The Buffalo Aquifer is located five to seven miles east of Moorhead, trending north-south. The aquifer is about 25-30 miles long, 1 to 2 miles wide and as deep as 250-feet. The top of the aquifer is at ground surface in some areas and buried in glacial lake clays in others. The West Fargo aquifer occurs around West Fargo. However, this aquifer is at least 70 feet deep.

Based on the available data, the Minnesota diversion alignment alternatives are approximately a mile west of the Buffalo Aquifer, which provides a reasonable buffer between the aquifer and an excavated diversion channel. Measureable impacts to the aquifer with this separation are very unlikely. The West Fargo aquifer appears to be deep enough to avoid impacts that could occur from project structures or excavation associated with either of the North Dakota alternatives.

Additional data analyses and design refinements are recommended to verify alignment choices versus the local variations in the hydrogeology. However, none of the diversion channel alternatives should have adverse impacts to the cumulative condition of aquifers in the region.

5.4.1.7 Aquatic Habitat

Aquatic habitat includes the Red River mainstem and tributaries. This riverine habitat is occupied by many species of fish and invertebrates. This habitat also has been affected by many human influences. Activities such as stream channelization, damming and other alternations over the last 100 years have influenced hydrology, geomorphic processes and physical aquatic habitat. Additionally, alterations to the watershed, including changing to agricultural landcover, artificial drainage and tiling, have further influenced these processes. Today, habitat quality on the Red River and adjacent tributaries appears greatly reduced over that of pre-European settlement. Tributaries such as the Rush River, Lower Rush River and Wild Rice River appear greatly affected. The Sheyenne River, Maple River and Red River mainstem may be in slightly better condition, though habitat here is also degraded relative to pre-settlement conditions.

All of the diversion channel alternatives could further degrade aquatic habitat quality that has already been greatly reduced. Impacts from the project footprint, as described above, would directly remove additional habitat. Project features also could influence hydrology and associated geomorphic processes. Impacts would be greater for the North Dakota diversion alternatives, and lesser for the Minnesota diversion alternatives. However, as outlined above, significant impacts from the project footprint for either alignment would be mitigated through improvement of similar habitat within the basin. Geomorphic impacts generally appear small, and will be further evaluated following construction to verify potential changes. Mitigation will be included to offset impacts if the geomorphic impacts appear to be significant. Ultimately, all diversion channel alternatives include measures to avoid and minimize impacts. They also include mitigation to further reduce any remaining significant impacts. Thus, the diversion channel alternatives should not significantly contribute to further cumulative degradation to aquatic habitat in the basin.

5.4.1.8 Fish Passage and Biological Connectivity

Biological connectivity has changed greatly over time in the Red River Basin. Prior to European settlement, fish had full access to move throughout the Red River mainstem, and between its tributaries. Following settlement, many dams were constructed to facilitate water supply, floodwater storage and other goals. This included eight dams on the Red River, and many dams on tributaries throughout the basin. Dam construction began in the late 1800s, and continued through 1970.

Over approximately the last 15 to 20 years, biological connectivity has begun to improve in the basin. Fish passage projects have improved biological connectivity on five dams of the Red River Basin, with the three remaining dams currently in the planning stages for potential future fish passage improvements. An additional 30 projects have been implemented to improve fish movement on Red River tributaries. Although many impediments still remain, the level of biological connectivity has slowly improved in the basin.

The diversion channel alternatives could slightly reduce the level of biological connectivity relative to existing conditions. However, any effects would be small. All alternatives include extensive measures to minimize impacts to connectivity to levels that would be less than significant in terms of effects to Red River fish populations and communities. Minnesota diversion alternatives will have the least effect to connectivity, as impacts are limited to the Red River mainstem. The North Dakota diversion alternatives would be slightly worse as connectivity could affect the Red River and up to five tributaries. However, for alternatives under the North Dakota alignment, significant efforts were made to minimize impacts to connectivity. Any reductions to biological connectivity would be small and not anticipated to noticeably affect fish populations or communities of the Red River or associated tributaries. Ultimately, the diversion channel alternatives could slightly reduce levels of biological connectivity to varying degrees. However, these reductions would not significantly affect fish populations or communities, relative to existing conditions.

5.4.1.9 Upland Habitat

European settlement resulted in the conversion of landcover type over the vast majority of the basin. Previous upland habitats have almost entirely been converted to cropland, with a mixture of hayed pasture, hobby farms and some urban development around larger cities. The remaining wooded areas, which are primarily riparian corridors, are an important wildlife and aesthetic resource.

For all the diversion channel alternatives, there would be some areas where forested habitat would be cleared. The loss of these wooded areas would be permanent but would be offset, at no less than a 1:1 ratio, by tree plantings that would be done along the recreational corridor. The other areas to be disturbed are currently farmed and have reduced natural resource value. Portions of the spoil areas adjacent to the diversion channel would be available for farming after completion. All other disturbed areas would be replanted with native species, primarily grasses that would have positive impacts on the area's overall habitat value. Overall, the construction activities would have temporary adverse impact on the terrestrial habitat but the eventual changes in vegetative cover would have long term beneficial impacts on the avian and small mammal groups which are found in areas on the periphery of residential development and agricultural plots. All diversion channel alternatives would have a small, beneficial effect to the existing condition of upland habitat.

5.4.1.10 Endangered Species

Degradation of habitat in the basin has contributed to reduced abundance and federal listing of select species. This has included the whooping crane (*Grus americanus*; endangered), the gray wolf (*Canis lupus;* endangered*)* the Western prairie fringed orchid (*Platanthera praeclara*; threatened), and the Dakota skipper (*Hesperia dacotae*; candidate). The project would not contribute to cumulative impacts on these species.

5.4.1.11 Prime and Unique Farmland

Prime farmland is a valuable resource for the region. This farmland has developed through the conversion of previous natural landcovers, and through improvements such as tiling and draining. A large percentage of the project area includes prime and unique farmland.

Long-term impacts from the proposed alignments would include loss of farmland and business income. The alternatives discussed here would result in the loss of 5,400 to 5,700 acres of prime and unique farmland (Appendix F). All alternatives would contribute to the cumulative loss of this resource.

5.4.1.12 Hazardous, Toxic and Radioactive Waste (HTRW)
To be determined.

5.4.2 Cultural Resources

5.4.2.1 Cumulative Effects on Historic Properties

Because cultural resources surveys to identify archeological sites and standing structures, and testing and research to evaluate their National Register eligibility, have not yet been completed for any of the diversion channel alternatives, it is unknown how many archeological sites and standing structures eligible to the National Register will ultimately be directly affected by the Project. Based on known site and structure data only, construction on the Minnesota Short diversion channel alignment would adversely affect one National Register of Historic Places listed historic property, while construction on the North Dakota East diversion channel would adversely affect one National Register eligible historic property.

Project features (diversion channel with associated spoil piles, the associated tie-back levee, and the breakout channel with associated spoil piles) may also have indirect visual impacts on any National Register eligible or listed historic properties located within one-half mile of the features. Conversely, once constructed, project features would have a beneficial effect for historic properties in the Cities of Fargo and Moorhead and some smaller communities in Cass and Clay counties as they would protect the historic properties from future flood related damages.

Based on cultural resources investigations along other stretches of the Red, Sheyenne, and Maple rivers, prehistoric archeological sites tend to occur on the edge of uplands overlooking the river valley and within one-quarter mile of riverbanks, with older, buried sites likely on river terraces. Any archeological sites lost as a result of project construction will be an addition to those lost to past urban and/or agricultural development in the Fargo, Cass County, North Dakota and Moorhead, Clay County, Minnesota portion of the Red River Basin.

5.4.3 Socioeconomic Resources

5.4.3.1 Economic Issues

With any of the diversion channel alternatives in place, development could increase slightly, with the added protection provided by the project features. This increase in development would also come at a cheaper cost because of the requirements for developing will change because of the provided protection.

5.4.3.2 Recreational Opportunities

Recreational opportunities will not be adversely impacted by any of the diversion channel alternatives, but will be increased under all of them. Recreational amenities will be part of the project design and will be incorporated into whichever alternative is selected.

5.5 MITIGATION AND ADAPTIVE MANAGEMENT

This section describes the potential to avoid, minimize and mitigate adverse impacts; and provides mitigation cost estimates (in year 2010 dollar values) for implementation of any of the diversion plans considered. It also discusses the adaptive management approach to evaluating impacts over time, and assessing the effectiveness of mitigation measures. Mitigation strategies were developed for each diversion channel alternative to support the National Economic Development (NED) analysis. Mitigation strategies were not developed for the no-action alternative because this alternative would have no construction or site-specific impacts.

The Council on Environmental Quality (CEQ) has identified five components to mitigation. These include: 1) avoiding the impact altogether by not taking a certain action or parts of an action; 2) minimizing impacts by limiting the degree or magnitude of the action and its implementation; 3) rectifying the impact by repairing, rehabilitating, or restoring the affected environment; 4) reducing or eliminating the impact over time by preservation and maintenance operations during the life of the action; and 5) compensating for the impact by replacing or providing substitute resources or environment.

Measures to avoid or minimize adverse impacts were considered as part of this analysis through modification of project designs. Ideally, project designs would be tailored to avoid all impacts. However, that is not practicable. Alternatives under the Minnesota diversion alignment have fewer ecological impacts than alternatives under the North Dakota diversion alignment. However, several factors are involved with selection of a preferred plan, including ecological, economic and social impacts; public input; sponsor preferences; and other related factors. In cases where significant impacts could not be avoided or minimized to levels that were less than significant, mitigation actions are proposed to compensate for the loss of habitat or ecological function.

There are many restoration measures that could be used to compensate for unavoidable impacts of project alternatives. These mitigation measures are described briefly in this mitigation plan. Exact mitigation measures and locations are still uncertain for this draft report. However, mitigation plans will continue to be developed thru 2010, with an increased level of detail to be provided in the final feasibility report. As required by Corps policy, mitigation planning will include a Cost Effectiveness and Incremental Cost Analysis (CE/ICA) to optimize the amount of mitigation actions.

Mitigation plans in the final feasibility report and EIS, particularly the exact mitigation sites, will not be final as additional planning and evaluation will be performed. However, plans through this feasibility phase should provide assurance on the types of mitigation that would be implemented, that the mitigation would offset project impacts, and provide an estimate of costs required for mitigation and adaptive management actions for the study. Further refinement of the combinations, timing, and placement of mitigation actions and adaptive management will occur during detailed planning for individual mitigation projects and during monitoring. Any future mitigation planning would go through additional agency coordination and, including possible future supplemental NEPA documentation for specific construction features. However, this plan is proposed here as an initial plan for mitigating any remaining impacts, adaptively evaluating impacts in the future, and providing a cost basis to include as a part of overall project costs. The cost estimates below are rough estimates, and will be refined over time.

For this plan, mitigation actions for impacts from the project footprint were based solely on the concept of replacing each acre of habitat with a similar acreage of similar restored or improved habitat. For geomorphic impacts, the proposed mitigation actions would target improving other habitat or geomorphic functions along the same length of stream for which an impact was identified. Lastly, for impacts related to connectivity and fish passage, best professional judgment was used to further implement measures that would reduce impacts to fish connectivity to levels that were less than significant.

The Corps is committed to performing appropriate mitigation for lost ecosystem functions and values resulting from the project and implementing an adaptive management approach to evaluating impacts over time. As a part of an adaptive approach to mitigation, detailed pre-construction and/or post-construction surveys will be performed to better assess impacts and effectiveness of mitigation. Additional future actions could be performed, if needed, to modify, improve or optimize mitigation actions.

This plan is based on preliminary meetings with the natural resource agencies during the fall, winter and spring of 2009/2010. The Corps is committed to collaboratively working in the future with our federal and State agency partners and non-federal sponsors to implement project mitigation and adaptive management. Partners involved with planning for mitigation and adaptive management include the non-federal sponsors, U.S. Fish and Wildlife Service (USFWS), North Dakota Game and Fish (NDGF), North Dakota State Water Commission (NDSWC), North Dakota Department of Health, Minnesota Department of Natural Resources (MDNR) and Minnesota Pollution Control Agency (MPCA). Additional partners may be involved as needed.

The discussion below is broken into two sections. First, mitigation measures are proposed to offset impacts discussed for each resource category. Second, adaptive management is discussed to further evaluate potential impacts over time, and mitigation effectiveness. It also discusses possible actions that can be taken if mitigation does not prove effective, or if unforeseen impacts arise from the project.

5.5.1 Mitigation Measures

Identified adverse impacts that would require mitigation are briefly described below, and are summarized in Table 46. The discussion below includes actions to minimize impacts, as well as actions to offset impacts that cannot be avoided or minimized.

5.5.1.1 Increase Width of Red River Control Structure Gates

For all of the diversion channel alternatives, this action would increase the gate width at the Red River control structure from the current planned width of 40 feet up to a width of 50 feet. Increasing the gate width will further reduce current velocities through the structure when the structure is not in operation. This would improve the passability for fish, as well as the passability for ice and debris. A preliminary cost for this action is $5,000,000 (Table 46). This would be an action to further minimize the impact to connectivity and fish passage.

5.5.1.2 Rock Rapids for Minnesota Diversion Channel

For the Minnesota diversion channel alternatives, rock rapids would be placed at the upstream control weir of the diversion channel. Such a feature was not included in the preliminary design, and thus would be included as an additional feature to minimize potential adverse effects. The rock rapids would be designed similar to those on Red River dams, and will facilitate upstream movement of fish that pass upstream through the diversion channel. Since upstream fish movement through the flood diversion channel is likely limited beyond a 2-percent chance event, the rock rapids would similarly be designed to pass fish up to a 2-percent chance event within the diversion channel. A preliminary cost for this action is $10,000,000.

5.5.1.3 Fish passage channel for North Dakota Diversion Channel.

For North Dakota diversion alternatives, a fish passage channel would be constructed along the western weir on the Wild Rice River for the diversion channel. Red River fish could potentially be drawn upstream into the diversion channel during flood events. With a head difference of 20 feet, constructing a series of rock rapids to facilitate fish passage over this weir is problematic. As a way of minimizing impacts to fish movement, the Corps proposes to construct a fish passage channel around this weir. The logistics are not clearly known on how easily this can be accomplished. However, the Corps proposes to construct such a structure to further minimize the impact on fish movement that would occur for fish that are drawn that far upstream into the diversion channel. A preliminary cost for this action is $10,000,000 (Table 50). If this action cannot be implemented in a feasible fashion, implementing fish passage at one or more dams on the Red River would be considered as a way to offset lost connectivity under the North Dakota alternatives.

5.5.1.4 Increase Width of Red River Fish Bypass Channel

For all of the diversion channel alternatives, the width of the proposed fish passage channel around the Red River control structure could be increased. It is not clearly known how this may affect project design. However, the Corps will consider increasing the width of this channel. This should allow the conveyance of additional flow, and further minimize the impact of fish movement that would occur during river discharges between a 20-percent and a 2-percent chance event. A preliminary cost for this action is $3,000,000 (Table 50). This would be an action to further minimize the impact to connectivity and fish passage.

5.5.1.5 Stream Re-meandering

For all of the diversion channel alternatives, stream re-meandering is one method to offset site-specific loss of aquatic habitat from impacts from the project footprint. This includes loss of aquatic habitat that would occur at the proposed Red River control structure, the proposed control structure on the Wild Rice River, as well as the hydraulic structures for the Maple and Sheyenne rivers. Habitat loss is outlined in Table 19. The Corps proposes to restore channelized (i.e., straightened) sections of stream to provide enough aquatic habitat to offset this loss.

Quality would be assessed as a part of the pre-construction surveys discussed below for adaptive management.

This mitigation action would restore stream or river habitat by recreating meanders and riparian habitat that have been lost through stream straightening. To the extent possible, stream re-meandering would follow the previously abandoned stream channel, as identified by topography, historical aerial photographs, or other means. The specific areas for restoration have not been identified, but would be in the Red River basin, preferably near the project area. There are multiple other efforts that are considering stream meandering as a possible project. These include projects on the Mustinka, Buffalo and Wild Rice rivers, all in Minnesota. Review of aerial photographs suggests several other potential sites exist within the watershed. Preference would be given to sites first on the Red River, then on nearby tributaries (e.g., Sheyenne, Maple or Wild Rice rivers), and as a last resort, other tributaries elsewhere in the watershed.

As identified in Table 46, stream remeandering was assumed as the preferred method for mitigating for footprint impacts that result in lost aquatic habitat. To estimate the cost of mitigation, it was assumed that a 0.5 mile corridor of land would be needed to account for re-meandering, including 0.25 mile on each side of the existing river selected for the mitigation. This equates to 320 acres of land per mile of channelized stream. Given the real estate challenges that can emerge with these types of actions, a 25-percent contingency was applied for the amount of land needed for purchase or an easement to support these actions. With the contingency in place there would need to be 400 acres of land per mile of channelized stream that would be needed for purchase or easement to allow for the remeandering to be completed.

To complete the remeandering it was assumed that the riparian zone would also need to be restored as part of the mitigation. It was assumed that 150 feet on each side of the restored river (300 feet total) would be necessary for restoration of the riparian zone. This equates to 60 acres of riparian land area per mile of river.

Real estate costs were assumed to be $4,000 per acre for purchase or easements. It was assumed that re-vegetation costs for the riparian zone would be $3,000 per acre. A cost of $750,000 was assumed for any structural work, earthwork, or other features necessary per mile to re-meander a stream. A 20-percent contingency cost was then applied to this total. This results in a total cost of $3,036,000 per mile of restored/re-meandered stream (Table 47). Projected mitigation costs are provided in Table 46.

5.5.1.6 Riparian Buffer Strips

For the North Dakota diversion alternatives, riparian buffer strips may be considered for potential impacts resulting from altered geomorphic processes. As discussed above, this will first be studied for indicated tributaries. However, the potential for geomorphic effects is great enough on the Wild Rice River that mitigation would be proposed upfront for potential impacts. As described earlier in this chapter, there is potential for geomorphic impacts to about 12.3 miles of the Wild Rice River. To offset this loss, it is proposed to provide riparian buffers to areas along the Wild Rice River currently lacking a buffer. Given that about 12.3 miles of Wild Rice

River could be impacted, it is proposed that 12.3 miles of Wild Rice River would have riparian buffer areas restored. Review of aerial photographs suggests many potential sites exist along the Wild Rice River. Preference would be given to sites along the Wild Rice River within the area of geomorphic change. Other areas of the Wild Rice River near the project area also could be considered.

It should be noted that the level of mitigation will ultimately be determined based on the geomorphic monitoring proposed above. However, mitigation of up to 12.3 miles of restored riparian buffers could be performed. Final determination for Wild Rice River geomorphic impacts and necessary mitigation would be made between the non-federal sponsors and agency team. The riparian buffer strips mitigation action would include the restoration of stream riparian cover by obtaining easements to riparian property, and planting desirable vegetation and trees.

Lastly, this method could also be used to mitigate geomorphic impacts for the Sheyenne and Maple rivers, should future monitoring identify significant geomorphic impacts for those streams. Final determination for Sheyenne and Maple river geomorphic impacts and necessary mitigation would be made between the non-federal sponsor and agency team. However, such impacts are not anticipated at this time, and thus will not be included as a part of the project cost estimate.

Real estate costs were assumed to be $4,000 per acre for purchase or easements. It was also assumed that re-vegetation costs would be $3,000 per acre. A 20-percent contingency cost was then applied to this total. Using these assumptions, the total cost would be $382,000 per mile of river (Table 48). A preliminary total cost for this action is included in Table 46.

5.5.1.7 Fish Passage

Improving fish passage is a mitigation technique that also could be used to offset footprint or other habitat-related impacts. This technique is different in that it provides more systemic benefits, rather than improvements at a specific site. The techniques discussed above are easier to assess in terms of their effectiveness in offsetting impacts. It is easier to calculate the area improved, and measure biotic response. Assessment of mitigation effectiveness is more challenging with implementing fish passage. However, the benefits also could be more substantial, and benefit a broader group of organisms. Aquatic habitat quality in the project area, particularly on tributary streams impacted, appears to be of relatively poor quality. Mitigation actions in nearby areas could improve quality, but quality may still be limited. However, improving fish passage could improve connectivity across a broader area, and provide biota with access to more valuable habitats further upstream. It is possible fish passage could have broader and more meaningful benefits than site-specific mitigation.

Fish passage is currently being studied at the three remaining dams on the Red River that have not already been modified for fish passage. The ability for the projects to be implemented in the future is not known and is largely contingent on funding. If pursued here as mitigation, it is possible these sites could be implemented without substantial issues with dam ownership or social impacts.

For the purpose of estimating costs of this mitigation action, other planning actions were reviewed to get an idea on potential project costs. While the costs could be variable, it is possible that fish passage could be implemented at each of the remaining Red River dams for a cost of $5,000,000 each. This cost has not been included in the mitigation estimates provided in Table 18. However, it is possible that the benefits from providing fish passage may be greater than other mitigation measures discussed, with costs that are similar.

The Corps continues to discuss the options for mitigation with the non-federal sponsors and agency partners. Greater detail will be provided in the final report on the preferred method of mitigation. This will include a CE/ICA to help evaluate the most cost-effective form of mitigation.

Table 46 - Overview of mitigation actions for fisheries-related impacts under the proposed action.

Resource	Impact Type	Impact Size/Type	Mitigation Action	Cost
Red River	Control Structure footprint impact	10 acres, footprint impact	Stream re-meandering	$3,400,000
Red River	Fish Passage	Connectivity	Increase gate width on control structure	$5,000,000
Red River	Fish Passage	Connectivity	Increase size of fish passage channel at control structure	$3,000,000
Red River/Wild Rice River	Fish Passage	Connectivity	Implement rock weir at upstream control structure for the diversion channel.	$10,000,000
Wild Rice River	Control Structure footprint impact	12-13 acres, footprint impact	Stream re-meandering	$4,400,000
Wild Rice River	Geomorphic impact	12.3 river miles, geomorphic impact	Stream buffering along equivalent areas impacted.	$4,701,000
Sheyenne River	Tributary Structure	8-10 acres, footprint	Stream re-meandering	$3,400,000

	footprint impact	impact		
Maple River	Tributary Structure footprint impact	8-10 acres, footprint impact	Stream re-meandering	$3,400,000
Total:				$37,301,000

Table 47 - Overview of cost assumptions for mitigation by stream re-meandering.

[1]Real Estate:	$1,600,000
[2]Revegetation:	$180,000
Structures/Earthwork:	$750,000
Contingency 20-percent	$506,000.0
Total Cost per Mile:	$3,036,000

[1] Real Estate costs assumed to be $4,000 per acre for easement
[2] Re-vegetation costs assumed to be $3,000 per acre

Table 48 - Overview of cost assumptions for mitigation by stream buffering.

[1]Real Estate:	$182,000
[2]Revegetation:	$136,500
Contingency 20-percent	$63,700.0
Total Cost per Mile Buffered:	$382,200

[1] Real Estate costs assumed to be $4,000 per acre for easement
[2] Re-vegetation costs assumed to be $3,000 per acre

5.5.1.8 Wetland Mitigation

Wetland acres that will be adversely affected by diversion channel construction will be offset by the creation of wetlands within the diversion channel bottom. Features that will be used to facilitate the creation of wetlands will include meandering the low flow channel; constructing rock riffles in locations to create ponding; and other features developed during the design of the project. Vegetative species would be planted that are appropriate to temporarily flooded wetlands. A low flow channel is a channel that is typically in the center of a larger channel which is sized to handle small flows from drains, ditches or groundwater. The low flow channel would be approximately a 10 foot wide, 3 foot deep channel located in the middle of the larger diversion channel, and could meander back and forth within the 300 foot wide diversion channel bottom. The opportunity for inter-agency partnerships to develop areas for improved habitat would be explored with the non-federal sponsors, interested Federal, state and local agencies and interest groups during preparation of plans and specifications. The area available on the bottom of the diversion channel for all alternatives far exceeds the amount of wetland acres that would be impacted. In accordance with Corps policy, the Corps also considered the use of mitigation banks to mitigate for wetland impacts, but the number of available credits in the watershed does not come close to the mitigation credits needed.

5.5.1.9 Riparian Forest Mitigation
There would be unavoidable impacts to riparian forest habitat for all diversion alternatives. Impacts for the MN35k include approximately 45 acres for the Red River control structure and approximately 30 acres for diversion channel for a total of 75 acres (Table 49). Impacts for the smaller MN diversion alternatives would be similar or less than 75 acres. Impacts for the ND35k alternative include approximately 37 acres for the Red River control structure, 64.5 acres for the diversion channel, 24 acres for the Wild Rice River hydraulic structure, 10 acres for the Sheyenne River hydraulic structure and 3 acres for the Maple River hydraulic structure for a total of approximately 138 acres (Table 49).

The compensatory mitigation for these impacts would involve the restoration of existing floodplain agricultural land to floodplain forest. This land would be floodplain agricultural land that has been cleared of trees, would be adjacent to and hydraulically connected by seasonal surface flow to a river within or near the project area, with a target hydrologic regime for a flood recurrence interval from 2-5 years.

The objective would be to restore riparian forest vegetation on the mitigation land similar to the vegetation types that have been lost. Targets would be to restore stand density with an average of 108 trees per acres (an average of 1 tree every 400 square feet) over 80 percent of the mitigation site(s) with diameter at breast height (DBH) of 2 inches within 10 years.

Table 49 – Riparian Forest Impacted.

Riparian Forest Impacted			
North Dakota 35k	Acres	Minnesota 35k	Acres
Red River Control Structure Impacts ND	36.6	Red River Control Structure Impacts MN	44.92
Diversion Channel North Dakota 35K	64.5	Diversion Channel Minnesota 35K	29.64
Wild Rice River Hydraulic Structure Impacts ND	23.75		
Sheyenne River Hydraulic Structure Impacts ND	9.8		
Maple River Hydraulic Structure Impacts ND	3.1		
Total	137.75	Total	74.56

5.5.2 Adaptive Management
The discussion below addresses adaptive management and project monitoring, including overview of activities to be done both prior to and following construction. An overview of costs associated with monitoring and adaptive management are summarized in Table 50.

5.5.2.1 Red River:
As discussed above, impacts were identified for footprint impacts that would result in direct loss of aquatic habitat. Beyond that, it is believed that the potential for any future impacts to geomorphology, physical habitat, biotic use or biotic connectivity is low. However, these conditions would be further verified before and after construction to ensure that these impacts have been adequately addressed.

For the Red River, the following survey assessments would be performed both pre- and post-construction:

- Geomorphic Assessment, including description of physical habitat
- Biotic Assessment to include fish and macroinvertebrate surveys
- Freshwater mussel surveys

The area assessed would generally be identified as the Red River between the upstream and downstream junctions of the diversion channel. Additional area below the downstream extent of the diversion could be assessed primarily for potential geomorphic effects. The exact number and location of survey sites for both geomorphic and biotic assessments is still under discussion, but would likely include several sites along approximately 60 miles of Red River that could be influenced by the project. The protocols for these assessments also are still under development. The biotic assessment would likely follow the assessment protocol developed by the Minnesota Pollution Control Agency (MPCA) for fish and invertebrate surveys. The protocol for mussel surveys will require its own specific protocol.

Geomorphic surveys would be performed once prior to construction, and at least once following construction. The timing of post-construction monitoring is still being considered, but would potentially be five to ten years following project completion. Additional geomorphic surveys could be warranted further into the future, the need for which would be decided by the non-federal sponsors and agency partners.

Biotic surveys would be performed at least once prior to construction, with additional surveys under consideration. Given the variability in species distribution and abundance, and with sampling effectiveness, multiple biotic surveys are desirable. The exact number of pre-construction surveys is still under discussion, and could be influenced by results of the initial survey, how quickly construction begins, field conditions and possibly funding. The timing of post-construction monitoring also is under discussion, but could include multiple surveys performed over the first 20 years following project completion.

Monitoring also would be performed post-construction to assess fish migration through the Red River control structure, and associated fish bypass channel. The exact methodology for assessing this issue is under discussion, but could include activities such as netting and/or radio telemetry. Netting could be done immediately above the control structure or fish bypass channel, and would provide insight into which species are able to migrate through these features. Netting is a fairly easy and inexpensive method to use to evaluate whether fish are able to pass through project structures. However, it is not as complete as radio telemetry work. Conversely, radio telemetry could be used to assess how many fish approach the identified structures, and what portions of those fish are able to migrate through these features. This information would be extremely beneficial for not only assessing fish movement through project structures, but could provide general knowledge on effectiveness of features like fish bypass channels and nature-like fishways that have not been evaluated in great detail. 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. It is also biased toward larger bodied fish that can better handle the radio transmitter.

For cost estimation purposes, it was assumed the Red River would have completed a geomorphic assessment, two fish and macroinvertebrate surveys, and one mussel survey. These actions would be done prior to construction to characterize existing conditions. Precise cost estimates would be developed during planning over the next few months. A preliminary cost estimate for all pre-construction surveys was $1,250,000 (Table 50). Post-construction surveys would be similar in cost, and would include $500,000 to evaluate fish passage through the Red River control structure.

5.5.2.2 Rush and Lower Rush Rivers:

For the ND30K and ND35K plans the Rush River and Lower Rush River would be redirected to flow into the diversion channel, abandoning almost six miles of tributary habitat. Given their channelized nature, habitat value may be limited. The Lower Rush habitat may be especially limited given it is intermittent. It is believed that impacts from this action would be offset because both tributaries would flow through a new meandering channel at the bottom of the diversion channel. The habitat value and biotic use, following construction, would need to be further verified to assure that these impacts have been adequately offset.

Monitoring for biotic use would be performed prior to construction within sections of the Rush and Lower Rush rivers proposed for abandonment. The exact study plan is under development, but would likely involve sampling for fish and macroinvertebrates following the MPCA protocol. For these two tributaries, pre-project sampling is currently proposed for a single event. Additional discussion may be warranted for pre-project surveys of the Lower Rush. If this tributary is in fact intermittent, surveys following the MPCA protocol, which includes sampling during summer and late summer, may not be appropriate. The type of surveys, or need to do fish or macroinvertebrate surveys, may need to be reevaluated. This decision would be coordinated with the agency partners. For pre-construction monitoring, it was assumed that all pre-construction biotic surveys for the Rush and Lower Rush would cost $80,000.

Following construction of the project, additional surveys for biotic use would be performed within the new channel at the base of the diversion channel. For cost estimation purposes, it was assumed this would include at least two surveys for fish and macroinvertebrates. The non-federal sponsors and agency team would determine how long after construction the surveys would be performed. For post-construction monitoring, the estimated cost for biotic surveys was $200,000.

5.5.2.3 Maple River, Sheyenne River and Wild Rice River:
For the ND30K and ND35K plans these three tributaries would include various hydraulic structures that modify tributary flood discharges between the diversion channel and the Red River. The level of hydraulic change is discussed in the aquatic habitat section including the potential for adverse effects. However, the geomorphic condition and biotic use would need to be further verified before and after construction to ensure that these impacts have been adequately offset.

For these tributary rivers, the following survey assessment would be performed both pre- and post-construction:

- Geomorphic Assessment, including description of physical habitat
- Biotic Assessment to include fish and macroinvertebrate surveys
- Freshwater mussel surveys

The exact number and location of survey sites for both geomorphic and biotic assessments is still under discussion, but would likely include multiple sites along each tributary. This would likely include one site within the potential footprint area, and one or more downstream reaches. It is also possible that an upstream site could be included for biotic surveys to better assess whether the project has influenced biotic connectivity and upstream diversity. The protocols for these assessments also are still under development. The biotic assessment would likely follow the assessment protocol developed by the Minnesota Pollution Control Agency (MPCA) for fish and invertebrate surveys. The protocol for mussel surveys will require its own specific protocol.

Geomorphic surveys would be performed in all three tributaries once prior to construction, and at least once following construction. The timing of post-construction monitoring is still being considered, but would potentially be five to ten years following project completion. Additional geomorphic surveys could be warranted further in the future, the need for which would be decided by the project sponsor and agency partners.

Biotic surveys would be performed at least once prior to construction, with additional surveys under consideration. Given the variability in species distribution and abundance, and with sampling effectiveness, multiple biotic surveys are desirable. The exact number of pre-construction surveys is still under discussion, and could be influenced by results of the initial survey, how quickly construction begins, field conditions and possibly funding. The timing of post-construction monitoring also is under discussion, but could include multiple surveys performed over the first 20 years following project completion.

For cost estimation purposes, it was assumed both pre-construction and post-construction monitoring would include one geomorphic assessment, and at least two biotic surveys. These actions would be done in all three tributaries to characterize conditions pre- and post-project. Precise cost estimates would be developed during planning for the pre-construction surveys. A preliminary cost estimate for all pre-construction surveys was $840,000, for the three tributaries

(Table 50). The same cost estimate would apply to post-construction surveys for these three tributaries (Table 21).

5.5.2.4 Monitoring at Mitigation Sites:
Implementation of any diversion channel alternative would require implementation of mitigation. As outlined above, the type and location of mitigation is still being determined. Greater resolution on at least the type of mitigation for each impact will be provided in the final feasibility study. It is recognized that whatever type of mitigation is selected, monitoring will be needed to verify effectiveness.

The type of monitoring would likely be along the lines of what has been discussed here. For stream remeandering efforts, monitoring would likely include pre-project assessment for geomorphic and biotic conditions similar to what has been proposed for the Red River and North Dakota tributaries. Conversely, if fish passage is implemented, a monitoring approach similar to that outlined above for the Red River control structure could be implemented. Monitoring for site-specific habitat actions would be focused in the specific area mitigation is performed. Conversely, if improved fish passage is implemented, monitoring could be more broad. Monitoring would ideally be performed both pre-construction and post-construction. The ability to do this largely depends on how quickly mitigation sites are identified and how quickly construction commences.

A preliminary cost estimate for post-construction mitigation surveys was $1,000,000 (Table 50). This is strictly a preliminary estimate of what survey costs could be to assess mitigation for the impacts outlined above. The actual monitoring costs for mitigation will be refined for the final report, and could increase or decrease for monitoring mitigation sites.

Table 50 - Overview of additional studies for fisheries-related impacts for proposed action.

Studies	Cost
Red River Geomorphic Assessment: Pre-construction	$750,000
Red River Geomorphic Assessment: Post-construction	$750,000
Red River Control Structure Fish Passage Assessment: Post Construction	$500,000
Red River Biotic Use: Pre-construction	$500,000
Red River Biotic Use: Post-construction	$500,000
Wild Rice River Geomorphic Assessment: Pre-Construction	$120,000
Wild Rice River Geomorphic Assessment: Post-Construction	$120,000
Wild Rice River Biotic Use: Pre-construction	$150,000
Wild Rice River Biotic Use: Post-construction	$150,000
Sheyenne River Geomorphic Assessment: Pre-construction	$250,000

Sheyenne River Geomorphic Assessment: Post-construction	$250,000
Sheyenne River Biotic Use: Pre-construction	$250,000
Sheyenne River Biotic Use: Post-construction	$250,000
Maple River Geomorphic Assessment: Pre-construction	$30,000
Maple River Geomorphic and Physical Habitat Assessment: Post-construction	$30,000
Maple River Biotic Use: Pre-construction	$40,000
Maple River Biotic Use: Post-construction	$40,000
Rush River Biotic Use: Pre-construction	$40,000
Lower Rush River Biotic Use: Pre-construction	$40,000
Diversion Channel Habitat Replacement Biotic Use: Post-construction	$200,000
Post-Construction Mitigation Evaluation	$1,000,000
Total	$5,960,000

5.5.2.5 Wetlands

The National Wetland Inventory was used as a preliminary method to identify impacted wetlands; this information is what has been reported in the EIS. More detailed wetland delineations will be conducted along all impacted areas associated with all of the diversion alternatives. This delineation will include identifying existing wetlands and the function of the wetlands. This information will be used for the mitigation of the wetlands.

5.5.3 Future Project Modification

Future monitoring will verify the impact conclusions reached during this feasibility study, and evaluate the effectiveness of mitigation. Monitoring activities, including review of results, will be performed collaboratively between the non-federal sponsors and the agency partners. If future impacts are identified that were not mitigated for, or if mitigation has proven ineffective, then the non-federal sponsors will work with the Corps and the partner agencies to identify what can be done to rectify any remaining issues.

If significant project modifications are needed, or if further construction actions are needed, the non-federal sponsors will work with the Corps and agency partners to identify the correct funding source. The non-federal sponsors could choose to take action and modify the project, or implement further mitigation on their own. They also could work with the Corps to secure potential funds under the Corps' Continuing Authorities Program (CAP) to modify an existing project. It also could include seeking congressional action to secure additional Federal funds.

6.0 PUBLIC INVOLVEMENT, REVIEW AND CONSULTATION*

6.1 PUBLIC INVOLVEMENT PROGRAM

This chapter describes public involvement activities, agency consultation and coordination, and acknowledges the agencies that have been involved with this NEPA process.

6.1.1 Scoping Notice

A scoping notice was prepared to provide the public with information on the project and an opportunity for people to express their thoughts and comments. The notice announced the intent to prepare an Environmental Impact Statement and was published in the May 5, 2009, *Federal Register* Volume 74, Number 85. Maps showing locations of the project area and alternative features were made available for inspection. Dates and locations of public scoping meetings were identified in the notice.

6.1.2 Public and Agency Scoping Meetings

The intent of the scoping meetings was to inform people about the project and to collectively identify key issues. The *Federal Register* notice and news releases to local media announced a series of public meetings. The locations and dates for these meetings were:

Table 51 – Public and Agency Scoping Meetings

Location	Date	Time	Attendees	Meeting Location
Moorhead , MN (Public)	November 17, 2008	7:00 p.m.	50	City Council Chambers
Fargo, ND (Public)	November 18, 2008	7:00 p.m.	40	Prairie Rose Inn
Fargo, ND (Public)	May 19, 2009	5:30 p.m.	115	The Centennial Hall, Fargo N.D.
Fargo, ND (Agency)	May 20, 2009	10:00 a.m.	44	The Centennial Hall, Fargo N.D
Moorhead, MN (Public)	May 20, 2009	5:30 p.m.	140	Hanson Theatre, University of Minnesota Moorhead Campus, MN

Several written comments were received in response to the public scoping effort. Several additional comments were received in response to the agency scoping effort. All comments have been reviewed and compiled in a scoping document which is included in Appendix F. The scoping document summarizes, consolidates, and organizes the public and agency comments.

6.1.3 Public Meetings

In addition to the public scoping meetings, public meetings were held to keep the public informed on the project and the path forward. These meetings were used to present the public with information and to gather feedback. The dates and locations of the public meetings are presented in Table 52. Presentations, handouts, and other general information from the meetings can be found in Appendix Q, Public Involvement. The non-federal sponsors developed the Metro Flood Management Committee (MFMC) which consisted of all members from the Fargo City Council, Moorhead City Council, Clay County Board, and Cass County Board. As a subset to the MFMC a working group was developed consisting of members from the MFMC. The working group had a number of meetings and the Corps provided information and public presentations at each of these meetings. The working group meetings were held on: August 26, 2009; November 5, 2009; November 12, 2009; December 17, 2009; January 15, 2010; February 4, 2010; February 11, 2010; February 18, 2010; February 25, 2010; March 4, 2010; March 11, 2010; March 18, 2010; April 22, 2010; April 25, 2010; and May 13, 2010.

Table 52 – Public Meetings

Location	Date	Time	Attendees*	Meeting Location
Moorhead, MN (MFMC)	October 19, 2009	8:00 a.m.	100	Marriott Hotel, Moorhead MN
Fargo, ND (Public)	October 20, 2009	6:00 p.m.	400	Howard Johnson Inn, Fargo ND
Moorhead, MN (Public)	October 21, 2009	6:00 p.m.	400	Hagan Hall, University of Minnesota Moorhead Campus, MN
Fargo, ND (MFMC)	November 24, 2009	7:30 a.m.	100	Ramada Plaza Suites, Fargo ND
Fargo, ND (MFMC)	February 1, 2010	11:00 a.m.	200	The Centennial Hall, Fargo ND
Fargo, ND (Public)	February 2, 2010	6:00 p.m.	400	The Centennial Hall, Fargo ND
Moorhead, MN (Public)	February 3, 2010	6:00 p.m.	200	Hanson Theatre, University of Minnesota Moorhead Campus, MN
Moorhead, MN (Public)	June 9, 2010	6:00 p.m.		Minnesota Moorhead Campus, Student Ballroom, MN
Fargo, ND (Public)	June 10, 2010	6:00 p.m.		The Centennial Hall, Fargo ND
Fargo, ND (Landowner)	June 14, 2010	6:00 p.m.		The Centennial Hall, Fargo ND
Moorhead, MN (Landowner)	June 15, 2010	6:00 p.m.		The Hjemkomst Center, Moorhead MN
Hendrum, MN	June 16, 2010	6:00 p.m.		Hendrum Civic Center, Hendrum MN

(Downstream stakeholder)				

*Approximate

6.1.3 Website

A website (http://www.internationalwaterinstitute.org/feasibility/index.htm) was established as the project's primary website. The purpose of the site was to deliver information to the public that was made available at public meetings and for distribution of information as part of the NEPA process. The website also gave the interested public opportunities to ask questions, submit comments through e-mail, or be added to an email mailing list. The Corps standard webpage was a secondary site which was also used to distribute information. This site is located at: http://www.mvp.usace.army.mil/fl_damage_reduct/default.asp?pageid=907. In addition to the two project websites, the City of Moorhead provided live video of the February 3, 2010 meetings on its webpage.

6.2 RESOURCE AGENCY TEAM

The Corps established a resource agency team to facilitate transfer of information among agencies and between the agencies and the Corps through meetings and frequent communications at key steps of the process. The resource agencies provided information on their special expertise or jurisdiction related to the project, assisted with analyses, and reviewed draft report chapters and analyses. The following organizations participated during the process:

- Minnesota Department of Natural Resources (MDNR)
- Minnesota Pollution Control Agency (MPCA)
- U.S. Fish and Wildlife Service (USFWS)
- Environmental Protection Agency (EPA)
- North Dakota Game, Fish and Parks (NDGFP)
- Fargo-Moorhead Metropolitan Council of Governments (FM COG)
- North Dakota State Water Commission (ND SWC)
- North Dakota Department of Health
- Federal Emergency Management Agency (FEMA)
- North Dakota Wildlife Federation
- Buffalo Red River Watershed District (BRRWD)
- Cass County, North Dakota
- Clay County, Minnesota
- Southeast Cass Water Resources District (SE Cass WRD)
- Federal Aviation Administration (FAA)
- Minnesota Natural Resource Conservation Service (MN NRCS)
- North Dakota Natural Resource Conservation Service (ND NRCS)
- National Wildlife Federation (NWF)

- Minnesota Board of Water and Soil Resources (BWSR)

Resource Agency Team meetings were held on the following dates and at the following locations:

- May 20, 2009 Fargo, North Dakota (scoping document)
- September 2, 2009 Fargo, North Dakota
- October 29, 2009 Fargo, North Dakota
- November 10, 2009 Fargo, North Dakota
- December 10, 2009 Fergus Falls, Minnesota
- December 22, 2009 St. Paul, Minnesota (conference call)
- February 3, 2010 Fargo, North Dakota
- February 19, 2010 Fargo, North Dakota
- April 22, 2010 Fargo, North Dakota

Meeting notes can be found in Appendix F.

6.2 INSTITUTIONAL INVOLVEMENT

The non-federal sponsors for this study are the City of Fargo, North Dakota and the City of Moorhead, Minnesota. The cities have been supported and have received input during the study from the Southeast Cass Water Resource District, Cass County, Buffalo-Red Watershed District, and Clay County. The sponsors have worked closely with the other local entities to develop a consensus on the path forward including the optimal levels of protection afforded by the project, the desire for a locally preferred plan, identifying which entities will be responsible for signing the Project Partnership Agreement with the Corps, and discussions on setting up a special joint powers agreement to ensure that the long-term operations and maintenance of the project is continued in perpetuity. Recommendations on these topics were made by the Metro Flood Management Committee, and forwarded to each of the individual entities for formal adoption and approval.

6.3 ADDITIONAL REQUIRED COORDINATION

6.3.1 Coordination with Minnesota and North Dakota State Historic Preservation Office, the Advisory Council, and Other Interested Parties

A Programmatic Agreement will be negotiated between the St. Paul District, U.S. Army Corps of Engineers, the Minnesota State Historic Preservation Officer, and the North Dakota State Historic Preservation Officer. The City of Fargo and the City of Moorhead, the non-federal sponsors of the project, will be concurring parties to the Programmatic Agreement and will be consulted during its development. The Fargo Historic Preservation Commission will also be invited to sign the Programmatic Agreement as a concurring party if the alternative selected includes City of Fargo lands. The Programmatic Agreement will cover the Corps' responsibilities to ensure compliance with Section 106 of the National Historic Preservation Act (NHPA), as amended, and its implementing regulations, 36 CFR Part 800, Protection of Historic Properties. Stipulations in the Programmatic Agreement will provide for the continued consultation with these parties during historic preservation activities covered by the agreement. The Advisory Council on Historic Preservation was contacted by letter dated May 29, 2009, requesting their participation in the Programmatic Agreement for this Project. In an email response dated June 17, 2009, the Advisory Council declined to become involved in this project.

6.3.2 Coordination with Indian Tribes

Indian tribes with historic connections to the project area, including the Sisseton-Wahpeton Oyate of the Lake Traverse Reservation, the White Earth Band of Minnesota Chippewa, the Leech Lake Band of Ojibwe, the Turtle Mountain Band of Chippewa, the Upper Sioux Community of Minnesota, the Lower Sioux Indian Community of Minnesota, the Spirit Lake Nation of North Dakota, and the Red Lake Band of Chippewa Indians, were initially contacted by letter dated April 8, 2009. The letters were from the St. Paul District's District Engineer to the tribal chairman or chairwoman of each Indian tribe, and sought to determine if they wished to consult under Section 106 of the National Historic Preservation Act regarding effects of the project on properties of traditional cultural or religious importance to them. A copy of the signed letter to the tribal chairperson was also furnished to each tribe's Tribal Historic Preservation Officer (THPO) or designated cultural resources point of contact. Any consulting tribe(s) may also be concurring parties to the Project's Programmatic Agreement. The THPO for the Leech Lake Band of Ojibwe responded on May 1, 2009, that the Leech Lake Band did not have any concerns regarding cultural or religious sites in the project area. None of the other tribes have responded as of May 1, 2010.

6.4 REPORT RECIEPIENTS

The following Federal, State, County, local and regional agencies, environmental organizations, and interested groups will receive notice of availability of this document:

- Red River Basin Commission (RRBC)
- International Red River Board (IRRB)
- Red River Watershed Management Board (RRWMB)
- North Dakota Red River Joint Water Resource District (NDJWRD)
- Minnesota Department of Natural Resources (MDNR)
- Minnesota Pollution Control Agency (MPCA)
- U.S. Fish and Wildlife Service (USFWS)
- Environmental Protection Agency (EPA)
- North Dakota Game, Fish and Parks (NDGFP)
- Fargo-Moorhead Metropolitan Council of Governments (FM COG)
- North Dakota State Water Commission (ND SWC)
- North Dakota Department of Health
- Federal Emergency Management Agency (FEMA)
- North Dakota Wildlife Federation
- Buffalo Red River Watershed District (BRRWD)
- Cass County, North Dakota
- Clay County, Minnesota
- Southeast Cass Water Resources District (SE Cass WRD)

- Federal Aviation Administration (FAA)
- Minnesota Natural Resource Conservation Service (MN NRCS)
- North Dakota Natural Resource Conservation Service (ND NRCS)
- National Wildlife Federation (NWF)
- Minnesota Board of Water and Soil Resources (BWSR)

6.5 PUBLIC VIEWS AND RESPONSES

A complete list of public comments and responses regarding the scoping process is contained in Section 1.11 of Appendix F, Environmental.

6.6 AGENCY CORRESPONDENCE

Agency correspondence and communications are included in Appendix Q, Public Involvement and Coordination. The correspondence included in Appendix Q only includes the correspondence that occurred after the Scoping Document was completed; the earlier correspondence can be found in section 1.11 of Appendix F.

6.6.1 Status of Environmental Coordination Activities

The Corps has had a number of meetings with the resource agencies as described in section 6.2. The coordination is an ongoing activity that will continue throughout the feasibility study.

6.6.2 Resource Agency Views

The views of the resource agencies will be included after the Corps has received their comments on this draft report.

7.0 LIST OF PREPARERS*

Name	Discipline	Years Experience (years)	Role in Preparing Report
Jonathan Sobiech	Environmental/Forester	2 Years	Writing EIS
Elliot Stefanik	Environmental/Fisheries	12 Years	Fisheries-related Impact assessment and Mitigation Planning
Craig Evans	Planner/Project Management	10 Years discipline/23 years Corps	Main Report and Planning Appendix
Aaron Snyder	Planner/Project Management	7 Years	Main Report and Planning Appendix
Byron Williams	Geographic Information System Specialist	10.5 Years	Preparing Maps and Figures
Renee McGarvey	Landscape Architect	10 Years	Recreational Plan
Mike Lesher	Hydraulic Engineer	31 Years in discipline/32 years Corps	Hydraulic and Hydrology Appendix
Corby Lewis	Hydraulic Engineer	7 Years	Hydraulic and Hydrology Appendix
Eric Wittine	Structures Engineer	11 Years	Structures
Tony Fares	Structures Engineer	20 Years	Structures
Jeff Hansen	Cost Engineer	10 years discipline/28 years Corps	Cost Estimator
John Albrecht	Real Estate	30 years	Real Estate
Virginia Gnabasik	Archeologist	26.5 Years	Cultural/Historic Section
Rick Carlson	Economist	20 Years	Economics/Social
Lance Awsumb	Economist	1 Year	Economics
Jeff McGrath	Economist	30 Years	Economics Appendix and Social - Economic input for EIS
Kevin Bluhm	Economist	24 Years	Economics
Kurt Heckendorf	Geotechnical Engineering	7 Years	Geotech
Terry Jorgenson	Engineering Geologist	26 Years	Ground Water/Buffalo Aquifer Geotech Appendix
Edith Pang	General Engineering	24 Years	General
Grant Riddick	Geologist	24 Years	Geologist

8.0 RECOMMENDATIONS

As District Engineer, I have considered the environmental, social, and economic effects, the engineering feasibility, and comments received from the other resource agencies, the non-federal sponsors, and the public, and have determined that the tentatively selected plan presented in this report is in the overall public interest and is technically sound, environmentally acceptable, and economically feasible. I recommend that the tentatively selected plan and associated features described in this report be authorized for implementation as a federal project.

The tentatively selected plan is the North Dakota East 35,000 cfs diversion channel and is the Locally Preferred Plan. The plan includes flood risk management features consisting of a 36-mile diversion channel, 3.3 miles of tie-back levees, a control structure on the Red River of the North, a control structure on the Wild Rice River, two aqueduct tributary structures—one on the Sheyenne River and one on the Maple River, two tributary drop structures, a diversion inlet structures at each river, 18 highway bridges, four cost shared railroad bridges, and other appurtenant facilities and primary recreation features consisting of multipurpose trails, restrooms, potable water, picnic facilities, parking areas, and landscaping and tree plantings. The total estimated first cost of the tentatively selected plan based on October 2009 price levels is $1,272,108,000, with the Federal and non-federal shares of total first cost estimated at $710,666,000 and $561,442,000, respectively. The flood risk management features have an estimated total first cost of $1,237,354,000, with the Federal and non-federal shares estimated at $693,289,000 and $544,065,000, respectively. The recreation features have an estimated total first cost of $34,753,000, with the Federal and non-federal shares estimated at $17,376,000 and $17,376,000 respectively. The annual operation and maintenance costs are $3,365,000. The tentatively selected plan has an overall benefit-cost ratio of 2.27 and would provide in excess of 1-percent chance level of risk reduction for the majority of the region.

The project will modify two existing Federal projects: The Rush River Channel Improvement project authorized by the Flood Control Acts of 1948 and 1950; and the Lower Rush River Channel Improvement project authorized under provisions of Section 205 of the 1948 Flood Control Act, as amended. The modifications to these projects will not impact their authorized purposes, however portions of these projects will be abandoned.

These recommendations are made with the provision that, prior to implementation, the non-federal sponsors will agree to comply with the following requirements:

Federal implementation of the recommended project would be subject to the non-federal sponsors agreeing to comply with applicable federal laws and policies, including but not limited to:

a. Provide a minimum of 35 percent, but not to exceed 50 percent of total FCP flood risk management costs as further specified below:

    1. Provide 25 percent of design costs allocated by the Government to flood risk management in accordance with the terms of a design agreement entered into

prior to commencement of design work for the flood risk management features;
2. Provide, during the first year of construction, any additional funds necessary to pay the full non-federal share of design costs allocated by the Government to flood risk management;
3. Provide, during construction, a contribution of funds equal to 5 percent of total FCP flood risk management costs;
4. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the flood risk management features;
5. Provide, during construction, any additional funds necessary to make its total contribution for flood risk management equal to at least 35 percent of total FCP flood risk management costs;
6. Provide 100 percent of all incremental costs of the Locally Preferred Plan.

b. Provide 50 percent of total recreation costs as further specified below:

    1. Provide 25 percent of design costs allocated by the Government to recreation in accordance with the terms of a design agreement entered into prior to commencement of design work for the recreation features;
    2. Provide, during the first year of construction, any additional funds necessary to pay the full non-federal share of design costs allocated by the Government to recreation;
    3. Provide all lands, easements, and rights-of-way, including those required for relocations, the borrowing of material, and the disposal of dredged or excavated material; perform or ensure the performance of all relocations; and construct all improvements required on lands, easements, and rights-of-way to enable the disposal of dredged or excavated material all as determined by the Government to be required or to be necessary for the construction, operation, and maintenance of the recreation features;
    4. Provide, during construction, any additional funds necessary to make its total contribution for recreation equal to 50 percent of total recreation costs;

c. Provide, during construction, 100 percent of the total recreation costs that exceed an amount equal to 10 percent of the Federal share of total FCP flood risk management costs;

d. Shall not use funds from other Federal programs, including any non-federal contribution required as a matching share therefor, to meet any of the non-federal obligations for the project unless the federal agency providing the Federal portion of such funds verifies in writing that expenditure of such funds for such purpose is authorized;

e. Not less than once each year, inform affected interests of the extent of protection afforded by the flood risk management features;

f. Agree to participate in and comply with applicable Federal floodplain management and flood insurance programs;

g. Comply with Section 402 of the Water Resources Development Act of 1986, as amended (33 U.S.C. 701b-12), which requires a non-federal interest to prepare a floodplain management plan within one year after the date of signing a project cooperation agreement, and to implement such plan not later than one year after completion of construction of the flood risk management features;

h. Publicize floodplain information in the area concerned and provide this information to zoning and other regulatory agencies for their use in adopting regulations, or taking other actions, to prevent unwise future development and to ensure compatibility with protection levels provided by the flood risk management features;

i. Prevent obstructions or encroachments on the project (including prescribing and enforcing regulations to prevent such obstructions or encroachments) such as any new developments on project lands, easements, and rights-of-way or the addition of facilities which might reduce the level of protection the flood risk management features afford, hinder operation and maintenance of the project, or interfere with the project's proper function;

j. Keep the recreation features, and access roads, parking areas, and other associated public use facilities, open and available to all on equal terms;

k. Comply with all applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, Public Law 91-646, as amended (42 U.S.C. 4601-4655), and the Uniform Regulations contained in 49 CFR Part 24, in acquiring lands, easements, and rights-of-way required for construction, operation, and maintenance of the project, including those necessary for relocations, the borrowing of materials, or the disposal of dredged or excavated material; and inform all affected persons of applicable benefits, policies, and procedures in connection with said Act;

l. For so long as the project remains authorized, operate, maintain, repair, rehabilitate, and replace the project, or functional portions of the project, including any mitigation features, at no cost to the Federal Government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal and State laws and regulations and any specific directions prescribed by the Federal Government;

m. Give the Federal Government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-Federal sponsor owns or controls for access to the project for the purpose of completing, inspecting, operating, maintaining, repairing, rehabilitating, or replacing the project;

n. Hold and save the United States free from all damages arising from the construction, operation, maintenance, repair, rehabilitation, and replacement of the project and any betterments, except for damages due to the fault or negligence of the United States or its contractors;

o. Keep and maintain books, records, documents, or other evidence pertaining to costs and expenses incurred pursuant to the project, for a minimum of 3 years after completion of the accounting for which such books, records, documents, or other evidence are required, to the extent and in such detail as will properly reflect total project costs, and in accordance with the standards for financial management systems set forth in the Uniform Administrative Requirements for Grants and Cooperative Agreements to State and Local Governments at 32 Code of Federal Regulations (CFR) Section 33.20;

p. Comply with all applicable Federal and State laws and regulations, including, but not limited to: Section 601 of the Civil Rights Act of 1964, Public Law 88-352 (42 U.S.C. 2000d) and Department of Defense Directive 5500.11 issued pursuant thereto; Army Regulation 600-7, entitled "Nondiscrimination on the Basis of Handicap in Programs and Activities Assisted or Conducted by the Department of the Army"; and all applicable Federal labor standards requirements including, but not limited to, 40 U.S.C. 3141- 3148 and 40 U.S.C. 3701 – 3708 (revising, codifying and enacting without substantial change the provisions of the Davis-Bacon Act (formerly 40 U.S.C. 276a *et seq.*), the Contract Work Hours and Safety Standards Act (formerly 40 U.S.C. 327 *et seq.*), and the Copeland Anti-Kickback Act (formerly 40 U.S.C. 276c *et seq.*);

q. Perform, or ensure performance of, any investigations for hazardous substances that are determined necessary to identify the existence and extent of any hazardous substances regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), Public Law 96-510, as amended (42 U.S.C. 9601-9675), that may exist in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project. However, for lands that the Federal Government determines to be subject to the navigation servitude, only the Federal Government shall perform such investigations unless the Federal Government provides the non-federal sponsors with prior specific written direction, in which case the non-federal sponsors shall perform such investigations in accordance with such written direction;

r. Assume, as between the Federal Government and the non-federal sponsors, complete financial responsibility for all necessary cleanup and response costs of any hazardous substances regulated under CERCLA that are located in, on, or under lands, easements, or rights-of-way that the Federal Government determines to be required for construction, operation, and maintenance of the project;

s. Agree, as between the Federal Government and the non-federal sponsors, that the non-federal sponsors shall be considered the operator of the project for the purpose of CERCLA liability, and to the maximum extent practicable, operate, maintain, repair, rehabilitate, and replace the project in a manner that will not cause liability to arise under CERCLA; and

t. Comply with Section 221 of Public Law 91-611, Flood Control Act of 1970, as amended (42 U.S.C. 1962d-5b), and Section 103(j) of the Water Resources Development Act of 1986, Public Law 99-662, as amended (33 U.S.C. 2213(j)), which provides that the Secretary of the Army shall not commence the construction of any water resources project or separable element thereof, until each non-federal interest has entered into a written agreement to furnish its required cooperation for the project or separable element.

This plan is being recommended with such modifications thereof as in the discretion of the Commander, HQUSACE, may be advisable.

The recommendation contained herein reflects the information available at this time and current departmental policies governing formulation of individual projects. It does not reflect program and budgeting priorities inherent in the formulation of a national civil works construction program nor the perspective of higher review levels within the executive branch. Consequently, the recommendation may be modified before it is transmitted to the Congress as a proposal for authorization and implementation funding. However, prior to transmittal to Congress, the non-federal sponsors, the State of Minnesota, the State of North Dakota, interested Federal agencies, and other parties will be advised of any modifications and will be afforded the opportunity to comment further.

JON L. CHRISTENSEN
St. Paul District
District Engineer

Attachment 1

Fargo Moorhead Metro

Draft

Feasibility Report

and

Environmental Impact Statement

Section 404(b)(1) Evaluation

Section 404(b)(1) Evaluation

Preliminary

SECTION 404(B)(1) EVALUATION
FARGO MOORHEAD METROPOLITAN
FLOOD RISK MANAGEMENT STUDY
CASS COUNTY, NORTH DAKOTA AND CLAY COUNTY, MINNESOTA

I PROJECT DESCRIPTION

A. Background – The U.S. Army Corps of Engineers (Corps) has prepared an integrated feasibility report and Environmental Impact Statement (Feasibility/EIS document) to present the results of its studies to address flooding problems in the Fargo Moorhead Metropolitan Area and describe possible consequences of implementing various alternatives. The Fargo Moorhead Metropolitan study area includes the Fargo-Moorhead metropolitan area and communities in the vicinity. Fargo and Moorhead are on the west and east banks, respectively, of the Red River of the North which flows north approximately 453 river miles to the mouth of the river at Lake Winnipeg in Manitoba, Canada. The Fargo-Moorhead metropolitan area has a relatively high risk of flooding. Flooding in Fargo-Moorhead typically occurs in late March and early April as a result of spring snowmelt. Average annual flood damages in the Fargo-Moorhead metropolitan area are estimated to be over $195.9 million. The Red River of the North has exceeded the National Weather Service flood stage of 18 feet in 47 of the past 108 years, and every year from 1993 through 2010. In addition to the Red River, the Wild Rice River (North Dakota), Sheyenne River, Maple River, Lower Rush River and the Rush River contribute to the flooding issues in the study area.

The study analyzed a number of possible alternatives that could potentially achieve the original purpose and need identified for the feasibility study: reducing flood risk, flood damages and flood protection costs related to the flooding in the Fargo-Moorhead Metropolitan Area. These measures included: no action - continue emergency measures; nonstructural measures; flood barriers; increased conveyance; and flood storage. These alternatives are described in detail in sections 3.4 and 3.5 of the Feasibility/EIS document.

The alternatives went through an initial screening that used the following criteria: effectiveness, environmental effects, social effects, acceptability, implementability, cost, risk, separable mitigation, and cost-effectiveness. Initial screening results were presented in the Alternatives Screening Document dated December 2009 which is attached to Appendix O of the feasibility report. The analysis resulted in two diversion concepts being carried forward: a diversion in Minnesota and a diversion in North Dakota.

Diversion capacities ranging from 10,000 cubic feet per second (cfs) to 45,000 cfs were analyzed. The design, alignments, and features were refined, baseline cost estimates for each plan were completed, and an economic analysis was performed. The study identified a 40,000 cfs diversion along the Minnesota Short alignment as the National Economic Development (NED) plan, which is the plan that meets the purpose and need identified in the feasibility study and provides the most net national economic benefits.

During the course of the planning process, non-federal sponsors sought to refine the overall project purpose to include reducing flood risk, flood damages and flood protection costs related to the flooding in the Fargo-Moorhead Metropolitan Area caused by the Red River of the North, as well as the Sheyenne, Wild Rice (ND), Maple, Rush, and Lower Rush rivers. The non-federal sponsors identified a 35,000 cfs diversion along the North Dakota East alignment (ND35k) as a locally preferred plan (LPP) that would achieve this refined purpose. The LPP is the plan that, in the opinion of the non-federal sponsors, best meets the needs of the local community. Corps regulations allow recommendation of a LPP if the plan has a benefit to cost ratio greater than 1.0 and if a waiver to allow recommendation of the LPP is approved by the Assistant Secretary of the Army for Civil Works. The cities of Fargo and Moorhead, Cass County, North Dakota and Clay County Minnesota jointly requested that the ND35k plan be pursued as the LPP on March 29, 2010. The request to designate the LPP as the tentatively selected plan was approved by the Assistant Secretary of the Army for Civil Works on April 28, 2010. The ND35k plan provides flood stage reductions to a greater geographic area and for approximately 6,250 additional citizens than does the NED plan. It achieves this result by reducing flood risk from the five previously noted tributaries to the Red River. This added level of risk reduction is not available from any of the other analyzed alternatives because they cannot address flooding on the tributaries.

The LPP is the preferred alternative that achieves the refined overall project purpose. This Section 404(b)(1) evaluation pertains to the ND35k plan fully described in section 3.5 of the Feasibility /EIS document.

B. Location – The project area affected by the diversion construction is located in Cass County, North Dakota and Clay County, Minnesota. The proposed fill activities will take place in the Red River of the North, Wild Rice River, Sheyenne River, Maple River, Lower Rush River and the Rush River. Fill activities on the Red River are at three locations; at river mile 479 where the diversion channel is diverted away from the Red River, a little upstream of river mile 478 where the control structure is constructed, and at river mile 419 where the diversion channel would re-enter the main channel of the Red River (Figure 16 of the Feasibility/EIS document). Fill activities would also occur in wetlands along the diversion alignment and at the general location of the hydraulic structures in the Wild Rice, Sheyenne, Maple, Rush and Lower Rush Rivers; these locations are shown on Figure 16 of the Feasibility/EIS document.

C. General Description – This evaluation addresses the effects that would result from the placement of fill in waters of the United States in conjunction with the construction of a North Dakota diversion channel and the construction of hydraulic structures necessary for the operation of the diversion channel. The effects associated with the operation of the diversion channel and hydraulic structures are discussed in detail in chapter 5 of the Feasibility /EIS document. The diversion plan includes a 36 mile long diversion channel with a varying bottom width of 100 – 300 feet; the diversion channel would divert a portion of the Red River flow upstream of the metro area, pick up flow at the Wild Rice, Sheyenne, Maple, Lower Rush and Rush rivers, and return it to the Red River downstream of the Fargo Moorhead metro area. A control structure (Figure 15 of the Feasibility/EIS document) would be constructed adjacent to the Red River immediately downstream of the diversion inlet; the Red River would then be diverted through the control structure and back into the Red River. This structure would limit flows downstream in the natural channel and increase the efficiency of the diversion channel. The outlet of the diversion channel will consist of riprap over the downstream 300 feet of the diversion channel. In addition, there would be hydraulic structures located at each tributary crossing. At the Wild Rice River crossing there would be two weirs and a control structure similar to the Red River control structure, also built in the dry. At the Maple River and Sheyenne River crossings there would be an open aqueduct that crosses over the top of the diversion channel and a weir spillway that would direct flows into the diversion channel (Figures 17-23 of the Feasibility/EIS document), these structures would also be built in the dry. At the Lower Rush River and Rush River, a stepped concrete spillway will be used to divert the entire flow into the diversion channel while abandoning the remaining channel between the diversion channel and the Sheyenne River. The proposed fill activities associated with the construction of the hydraulic structures and the excavation of the diversion channel will include: partially filling the abandoned channels; excavation for the diversion channel and sidecasting material into wetlands approximately 600 feet on either side of the diversion channel; placing riprap in the Red River where the diversion channel would re-enter the Red; and fill associated with diverting the flow through the constructed hydraulic structures.

D. Authority and Purpose – This study is authorized by a September 30, 1974, Resolution of the Senate Committee on Public Works. A Reconnaissance Report for the Fargo-Moorhead Metropolitan Area was approved by the Corps' Mississippi Valley Division on April 8, 2008. Based on the recommendations contained in the Reconnaissance Report, the City of Fargo North Dakota; the City of Moorhead Minnesota, and the Federal Government entered into a Feasibility Cost Share Agreement on September 22, 2008. The feasibility study is cost shared 50/50 between the two non-federal sponsors and the Federal Government. As explained above, the refined overall project purpose is to reduce flood risk, flood damages and flood protection costs related to the flooding in the Fargo-Moorhead Metropolitan Area caused by the Red River of the North, as well as the Sheyenne, Wild Rice (ND), Maple, Rush, and Lower Rush rivers.

E. General Description of Dredged or Fill Material

1. General Characteristics of Material – Final determinations for the source of material have not been made. Rock for the project would be obtained from existing sources. Stone for riprap would be durable material free from cracks, blast fractures, bedding, seams and other defects that would tend to increase deterioration from natural causes. Bedding used for the base layer would be clean rock 8-inch diameter, or smaller, produced from an existing facility. Levee fill would be obtained as part of project excavation.

2. Quantity of Material – For the purpose of this analysis quantities were calculated based on the ordinary high water mark (OHWM) being the 50-percent chance event. There would be approximately 430,000 cubic yards of earth fill placed below the OHWM, approximately 25,000 cubic yards of rip rap placed below the OHWM, and 30,000 tons of boulders placed below the OHWM; Table 1 describes quantities for each area of impact. Geotextile fabric would be placed on river banks prior to stabilization with riprap for all hydraulic structure features.

Table 1. Impacts

Impact Location: ND East 35K structures	Impact Type	Impact Magnitude	Units
Red River Control Structure			
Red River Control Structure	Fill below OHWM impact (plan area)	8.6	acre
Red River Control Structure	Earth fill below OHWM	186,000	cy
Red River Control Structure	Excavate below OHWM impact (plan area)	4.5	acre
Wild Rice River Hydraulic Structure			
Hydraulic Structure at Wild Rice River	Fill below OHWM impact (plan area)	13.3	acre
Hydraulic Structure at Wild Rice River	Earth fill below OHWM	126,000	cy
Hydraulic Structure at Wild Rice River	Excavate below OHWM impact (plan area)	6.4	acre
Sheyenne River Hydraulic Structure			
Hydraulic Structure at Sheyenne River	Fill below OHWM impact (plan area)	3.1	acre
Hydraulic Structure at Sheyenne River	Earth fill below OHWM	46,000	cy
Hydraulic Structure at Sheyenne River	Excavate below OHWM impact (plan area)	2.5	acre
Sheyenne River Rock Boulder Grade Control with Aggregate Bedding	OHWM impact area (plan)	15,000	tons
Maple River Hydraulic Structure			
Hydraulic Structure at Maple River	Fill below OHWM impact (plan area)	5.8	acre
Hydraulic Structure at Maple River	Earth fill below OHWM	48,000	cy
Hydraulic Structure at Maple River	Excavate below OHWM impact (plan area)	2.7	acre

Impact Location: ND East 35K structures	**Impact Type**	**Impact Magnitude**	**Units**
Maple River Rock Boulder Grade Control with Aggregate Bedding	OHWM impact area (plan)	15,000	tons
Lower Rush River Hydraulic Structure			
Hydraulic Structure at Lower Rush River	Fill below OHWM impact (plan area)	2.6	acre
Hydraulic Structure at Lower Rush River	Earth fill below OHWM	13,000	cy
Hydraulic Structure at Lower Rush River	Excavate below OHWM impact (plan area)	0.9	acre
Rush River Hydraulic Structure			
Hydraulic Structure at Rush River	Fill below OHWM impact (plan area)	2.8	acre
Hydraulic Structure at Rush River	Earth fill below OHWM	11,000	cy
Hydraulic Structure at Rush River	Excavate below OHWM impact (plan area)	1.4	acre
Diversion Outlet			
Diversion Outlet to Red River	Fill below OHWM impact area (plan)	15	acre
Diversion Outlet to Red River	Riprap below OHWM	25,000	cy

Earthwork Estimates

Diversion Channel	Channel Stripping	3,600,000	cy
	Berm Stripping	6,600,000	cy
	Dry Excavation	14,600,000	cy
	Wet Excavation	43,800,000	cy
	Channel Topsoil	1,500,000	cy
	Berm Topsoil	12,400,000	cy
	Low Flow Channel Excavation	500,000	cy
	TOTAL EARTHWORK	83,000,000	cy
Tie-back Levee	Excavation and Fill	184,000	cy

3. Source of Material - All stone would be clean and reasonably free from soil, quarry fines, and would contain no refuse. Materials would be obtained from approved pits/quarries in the project vicinity and would be free of chemical contaminants.

F. Description of the Proposed Discharge Sites

1. Location – For Red River control structure construction, material would be placed just upstream of river mile 478, but off to the side of the channel and would only have fill impacts when the channel gets diverted into the structure. For the diversion outlet construction material would be placed between river miles 418 and 419 on the Red River across the 200 foot width of the river and approximately 500 feet length. For the diversion channel, construction material would be placed into the Red River for approximately 200 feet just downstream of river mile 479 then again at the crossings of the Wild Rice, Sheyenne, Maple, Lower Rush and Rush rivers (Figure 16 of the Feasibility/EIS document). Thirty-three acres of wetlands would be filled or excavated along the diversion channel path (Figure 45 of the Feasibility/EIS document).

2. Size - Approximately 10 acres of riverine habitat would be affected by the abandonment of river channel for the construction of the Red River control structure. Approximately two acres of riverine habitat on the Red River would be affected by fill activities for the construction of the diversion channel where it exits and re-enters the Red River. Approximately 33 acres of wetlands would be affected by either fill activities or excavation along the diversion channel route. Approximately 13 riverine acres at the Wild Rice River crossing, four riverine acres at the Sheyenne River crossing, six riverine acres at the Maple River crossing, three riverine acres at the Lower Rush River crossing and three riverine acres at the Rush River crossing would be affected by the proposed fill activities. A total area of approximately 39 riverine acres and approximately 33 wetland acres would be affected.

3. Type of Site/Type of Habitat – Habitat affected by the proposed fill activities is a mix of shallow wetland and riverine habitat. The aquatic habitats located within the project area are typical of the Red, Wild Rice, Sheyenne, Rush, Lower Rush and Maple rivers. Depths on the Red River and the tributaries generally vary from 1 to 2 feet near shoreline areas to about 5-20 feet at mid-channel locations. Substrates present include a mixture of silt, sand, and clay. The channel is approximately 200 feet wide in the vicinity of the Red River control structure and 20-80 feet wide at the other tributary crossings.

4. Timing and Duration - Subject to approvals and appropriation of funds, construction could potentially begin in the year 2012. Construction is expected to last approximately eight and a half years, if sufficient funding is appropriated.

G. Description of Disposal Method – Material would be moved and placed mechanically. Cranes, backhoes, scrapers, dump trucks and other heavy machinery suited to working with rock would be used to deliver and place rock materials and other levee fill during construction. Riprap would generally be placed in a systematic manner to ensure a continuous uniform layer of well-graded stone. Stone placed underwater would not be cast across the surface of the water.

II. FACTUAL DETERMINATIONS

A. Physical Substrate Determinations

1. Substrate Elevation and Slope - Substrate would be excavated before placement of riprap to ensure that the existing substrate elevation was maintained. Riprap placed on slopes for erosion protection would follow the existing contour.

2. Sediment Type - Substrates in the Red River basin are composed primarily of clay rich, unconsolidated glacial sediments. Placement of riprap for erosion protection would convert existing substrates to rock.

3. Dredged/Fill Material Movement – The fill material would be placed directly into the rivers. The fill material will be sufficiently large or protected with riprap so as to preclude downstream movement of the placed material.

4. Actions Taken to Minimize Impacts - Standard construction procedures in compliance with Federal and State requirements and best management practices would be used during construction to minimize impacts. Work on the rivers would be done during low flow periods so as to limit downstream sedimentation.

B. Water Circulation, Fluctuation, and Salinity Determinations

1. General Water Chemistry - The use of clean fill material would preclude any significant impacts on water chemistry during project construction. Some minor, short-term decreases in water clarity are expected from the proposed fill activities. No significant impacts on water color, odor, taste, dissolved oxygen levels, temperature or nutrient levels are anticipated.

2. Water Circulation, Fluctuation, and Salinity Determination

a. Current Patterns and Flow – The hydraulic structures on the Red River and Wild Rice River will not increase upstream water surface elevations. Water will start to flow into the diversion channel when the total Red River flow exceeds 9,600 cubic feet per second (cfs) which is approximately the 20-percent chance event. Above a flow of 9,600 cfs, the control structure gates will be closed as necessary to limit the flow continuing in the Red River through Fargo and Moorhead and to divert flow into the diversion channel. There would be no significant change to current patterns and circulation for flows less than 9,600 cfs. The Sheyenne River and Maple River hydraulic structures will not increase upstream water surface elevations on the tributaries and will allow a minimum of the 50-percent chance event flow to pass through into the protected area. The pass through flow into the protected area will increase for larger events, but will always be less than the 20-percent chance event tributary flow. All excess flows will be directed into the diversion channel. Flow would be cut-off at the hydraulic structures on the Lower Rush and Rush Rivers and would be directed into the diversion.

b. Velocity - The proposed fill activities would decrease velocity downstream of the hydraulic structures on the Red River, Wild Rice River, Sheyenne River and Maple River during certain flood events. For the Red River structure the velocities would decrease approximately 0.4 – 2 feet per second at various locations downstream of the structure. These velocities vary based on the size of the event; the events that were modeled were the 20-percent, 10-percent, 5-percent, 2-percent, 1-percent, 0.5-percent, and 0.2 percent chance events. For the Wild Rice River, Sheyenne River and Maple River the velocities would also decrease downstream but to a lesser amount then the Red River.

c. Sedimentation Patterns- The project is not expected to affect sedimentation patterns within or downstream of the project area. Stabilization of streambanks is included in the project plan and should result in reduced streambank erosion in the immediate project vicinity. These assumptions would be validated through a monitoring plan created in cooperation with interested parties and agencies.

3. Actions Taken to Minimize Impact - Standard construction procedures in compliance with Federal and State requirements would be used. Design features for the hydraulic structures have been modified to minimize impacts, for example the control gates on the Red River structure have been widened to 50 feet from 40 feet.

C. Suspended Particulate/Turbidity Determination

1. Suspended Particulates and Turbidity - Turbidity and the concentration of suspended solids would be expected to increase temporarily during construction of project features. However, increases would be relatively minor and restricted to a relatively localized area. No long-term adverse impacts on water quality are expected.

2. Effects on Chemical and Physical Properties of the Water Column - Some minor short-term impacts on light penetration and aquatic organisms would occur during riprap placement. However, these effects would be rapidly dissipated upon project completion. No effects are expected on toxic metal concentrations, pathogens, or the aesthetics of the water column.

3. Actions Taken to Minimize Impacts – Impacts would be minimized by requiring that best management practices to limit the extent of turbidity plumes, such as silt curtains, would be followed during construction.

D. Contaminant Determinations - The use of clean, quarry-run rock riprap for construction would not introduce contaminants into the aquatic system. Neither the materials used nor the placement method would cause relocation or increases of contaminants in the aquatic system.

E. Aquatic Ecosystem and Organism Determinations

1. Effects on Plankton - During construction, increases in turbidity and suspended solids near the proposed fill activities might have a short-term localized effect on phytoplankton productivity. The plankton populations should recover quickly once the fill and other construction activities have ceased. In the long-term, overall aquatic habitat quality would improve, with resulting positive effects on plankton.

2. Effects on Benthos - Placement of rock during construction would cover and smother benthic communities located within the footprint of these structures, or would require excavation of substrates within the footprint. However, rapid colonization of newly placed rock substrates would be anticipated with resulting minimal long-term effects.

3. Effects on Fish - Increases in turbidity and suspended solids during construction would temporarily displace fish occupying project areas. Fish are more mobile than benthic invertebrates and would likely simply avoid construction areas during project completion. Fish migration would be impeded during larger events which would be mitigated for by adding fish passage around the hydraulic structures that would take effect at the 20-percent chance event. Any event larger then a 2-percent chance event would completely block fish passage; however this size of an event occurs very infrequently. For a more detailed discussion on effects on fish see section 5.2.1.8 of the Feasibility/EIS document.

4. Effects on Aquatic Food Web - The proposed fill activities are not expected to affect the total productivity of the Red River although there would be a temporary disruption to the aquatic biota present during project construction.

5. Effects on Special Aquatic Sites - There would be 33 acres of wetlands impacted by the diversion channel. These impacts would be either by the filling of wetlands or the excavation of wetlands.

6. Threatened and Endangered Species - No known Federally-listed threatened or endangered species would be affected by the project. The project has been coordinated with the U.S. Fish and Wildlife Service and it concurs with this determination.

7. Other Wildlife - The proposed fill activities would not result in the significant loss of aquatic or terrestrial habitat. Any habitat that will be lost as a result of the proposed fill activities will be mitigated for as outlined in section 5.5 Mitigation and Adaptive Management of the Feasibility/EIS document. The general diversity and productivity of the affected areas would be maintained.

8. Actions Taken to Minimize Impacts – The diversion alignment was selected to avoid, to the extent practicable, existing wetlands. Wetlands will be established along the bottom of the diversion channel during construction. During the design phase there will be features added to create wetlands; features used to facilitate the creation of wetlands will include meandering the low flow channel, constructing rock riffles in locations to create ponding, and other features developed during the design phase. A mitigation plan (section 5.5 of the Feasibility/EIS document) is also in place to mitigate for impacts caused by the construction of the hydraulic structures. Fish passages would be constructed around the hydraulic structures.

F. Proposed Disposal Site Determinations

1. Mixing Zone Determination - The proposed fill activities would have minimal mixing zones. The fill material used for the project would be large and relatively clean so that very little exposed material could be suspended in the water column.

2. Determination of Compliance with Applicable Water Quality Standards The fill materials used for this project would be obtained from approved quarries in the project area or excavated on-site. The area does not have a history of contamination, which should insure that State water quality standards would not be violated because of project-related activities. Water quality certification from Minnesota and North Dakota would be obtained prior to project construction.

3. Potential Effects on Human Use Characteristics - The proposed project would provide community flood protection without adversely affecting the river. The land acquired for the project would provide locations for the installation of recreational features. Water related recreational use of the project area would not be adversely affected by the project at normal flows. During high flows when the control structures are under operation, recreational use (boaters, jet skis, canoes, kayaks, etc.) will not be allowed to pass through the structure due to safety concerns.

G. Determination of Cumulative Effects on the Aquatic Ecosystem - See section 5.4 Cumulative Effects in the Feasibility/EIS document.

H. Determination of Secondary Effects on the Aquatic Ecosystem – There could be some indirect impacts to wetlands adjacent to the 36 mile diversion channel. This is unlikely because the soil types are not very permeable, which limits the potential for percolation, and any wetlands within 600 feet of the excavated channel will have already been accounted for as filled by the side cast of material from the diversion excavation. The Lower Rush River and Rush River will have 5.7 miles of abandoned channel which will be managed as wetland habitat. Disturbed aquatic habitat would be expected to quickly recover after construction.

III. FINDING OF COMPLIANCE WITH RESTRICTIONS ON DISCHARGE

The proposed fill activities would comply with Section 404(b)(1) guidelines of the Clean Water Act, as amended. No significant adaptations of the guidelines were made for this evaluation. Other alternatives considered to reduce the flood risk to the Fargo Moorhead Metropolitan area included no action - continue emergency measures; nonstructural measures; flood barriers; increased conveyance; flood storage; and other diversion channel alignments. Other alternatives were not selected because they were prohibitively more costly, were significantly less effective in reducing flood risk, or did not meet the overall project purpose of reducing flood risk from both the Red River and the five North Dakota tributaries. A discussion of the effects associated with the operation of the project and project features is presented in the Feasibility/EIS document. The placement of dredged and fill material for the proposed project is required to achieve the project purpose. The proposed project is the least environmentally damaging practicable alternative that would achieve the overall project purpose of reducing flood risk from both the Red River and the five North Dakota tributaries. The NED plan described above would reduce flood risk from the Red River, but not the five North Dakota tributaries.

The proposed fill activities would comply with all State water quality standards, Section 307 of the Clean Water Act, and the Endangered Species Act of 1973, as amended. The proposed fill activities would not have significant adverse effects on human health and welfare, including municipal and private water supplies, recreation and commercial fishing, plankton, fish, shellfish, wildlife, and special aquatic sites. The life stages of aquatic life and other wildlife would not be adversely affected. Significant adverse effects on aquatic ecosystem diversity, productivity, and stability and on recreational, aesthetic, and economic values would not occur.

To minimize the potential for adverse impacts, the fill would be placed during periods of normal to low water levels. Since the proposed action would result in few adverse effects, no additional measures to minimize impacts would be required.

On the basis of this evaluation, I have determined that the proposed action complies with the requirements of the 404(b)(1) guidelines for the discharge of fill material.

____
Date

Jon L. Christensen
Colonel, Corps of Engineers
District Engineer

Attachment 2

Fargo Moorhead Metro

Draft

Feasibility Report

and

Environmental Impact Statement

U.S. Fish and Wildlife Service Coordination Act Report

DRAFT REPORT

Fish and Wildlife Coordination Act Report
Fargo-Moorhead Metropolitan Area
Flood Risk Management Project

May 27, 2010

INTRODUCTION

The Red River of the North and its associated watershed has experienced several large-scale flood events in the past decade. Significant financial damage resulting from these events has led to several coordinated local, state, and federal agency attempts to address flood-related impacts within the Red River Basin. In September 2008, officials from the City of Fargo, North Dakota and City of Moorhead, Minnesota along with the U.S Army Corps of Engineers (Corps) entered into a Feasibility Cost Share Agreement. The Corps then issued a Notice of Intent to complete an Environmental Impact Statement (EIS) in the May 5, 2009 Federal Register. Accordingly, the Fargo – Moorhead Metropolitan Area Flood Risk Management Feasibility Study focused on alternatives that would alter flood levels and/or protect the Cities of Fargo and Moorhead against elevated flood levels from the Red River.

The U.S. Fish and Wildlife Service (Service) is authorized under the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) to provide reports on federally funded water development projects. The Fish and Wildlife Coordination Act (FWCA) states that fish and wildlife resources shall receive equal consideration with other project purposes in federal water resource development program activities. In accordance with the October 2009, Scope of Work (SOW) for this project, the Service agreed to provide continuous review of project details and documents and a FCWA report based on coordination efforts and final alternative designs provided by the Corps. The Service's February 1, 2010, project review and comment letter was provided to the Corps, which provides a review of fish and wildlife resources within the proposed project area, and potential environmental and ecological impacts associated the proposed project activities. The Service's February 1, 2010 letter satisfies the requirements of the Planning Aid Letter (PAL) per the FWCA. This report constitutes the report of the Secretary of the Interior as required by Section 2(b) of the FWCA and, when finalized, will fulfill the Service's commitment as outlined in the SOW.

The Minnesota Department of Natural Resources (MNDNR) provided valuable information regarding resources in the Red River and the Red River Valley and the project area for incorporation into this report. The MNDNR and the North Dakota Game and Fish Department participated in several joint agency discussions on project alternatives.

STUDY AREA

The rich soils and extremely flat terrain of ancient glacial Lake Agassiz located in and around Fargo and Moorhead supports a largely rural and agricultural community with the majority of development occurring in the metropolitan area. Human activities have induced significant environmental changes within the watershed, engineered by numerous drainage ditches, stream channelization, and subsurface tile drainage. The average annual precipitation for Fargo, North Dakota is 21.29 inches.

The proposed project could influence the following major watersheds in North Dakota: western Wild Rice River, Lower Sheyenne River, and the Maple River. The Marsh River and Red River major watersheds are in North Dakota and Minnesota, and could be influenced by the proposed project. The Buffalo River major watershed in Minnesota could also be influenced by the proposed project.

Large wetland complexes are rare within the proposed project area, and the affected portions of the surrounding watersheds. Smaller wetlands are scattered throughout the interior of the watershed and have been heavily impacted by human activities.

The main collection point for surface runoff and drainage in the project area is the Red River, which is also influenced by the in-flows of the Wild Rice (ND), Sheyenne (ND), Maple (ND), Lower Rush (ND), Rush (ND), and the Buffalo (MN) Rivers (Figure 1). The Red River originates at Lake Traverse to the south, and flows north where it enters Lake Winnipeg. The Red River and the associated Valley are generally flat with a south to north, channel gradient slope that averages a one-half foot fall per mile.

Stream flow measurements taken at a USGS gauge station in the Red River at Fargo, North Dakota show mean monthly flows in winter months (2009-2010) of 1,000 cubic feet per second (cfs). However, stream flow data collected in mid March of 2010 showed flows exceeding 20,000 cfs in the Fargo, ND area. Portions of the Red River and its tributaries, affected by this project, have been channelized or impacted by flood reduction and drainage improvement projects in the past which include bank armoring, floodplain levees, ditching, and tiling.

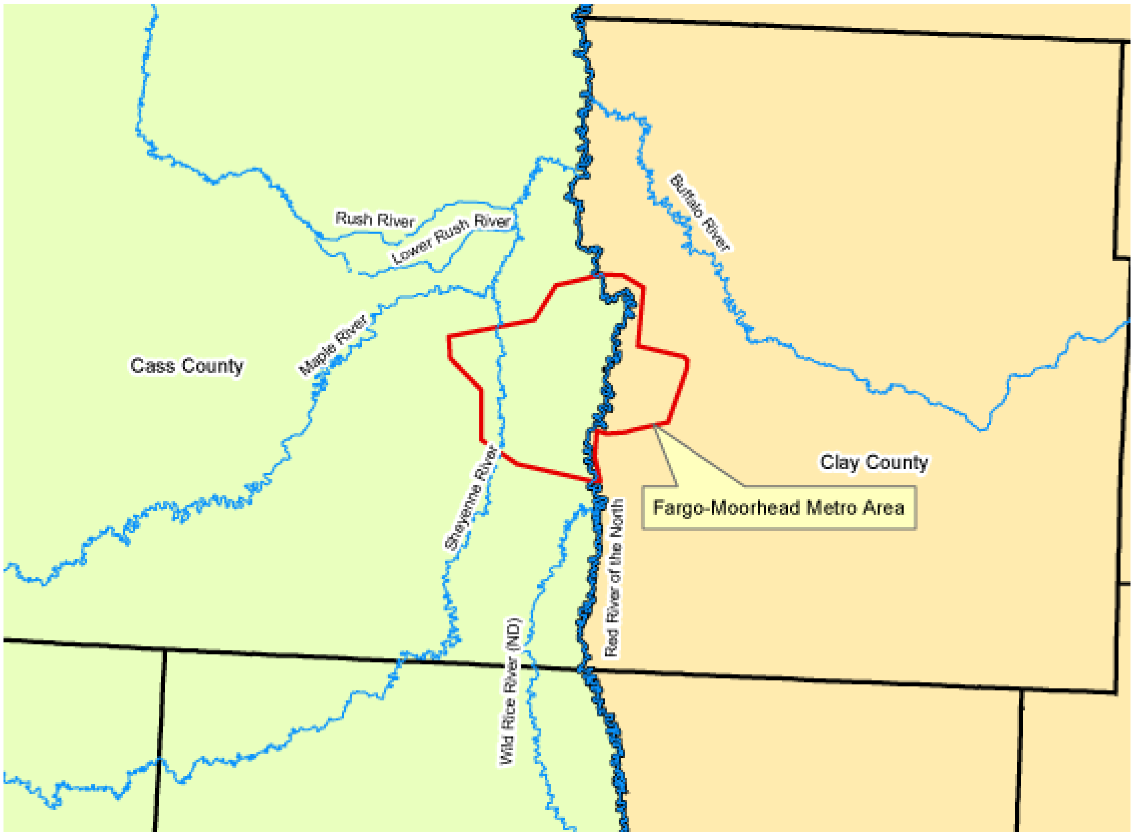


Figure 1. Rivers in close proximity to or within the Fargo-Moorhead Metropolitan Area.

FISH AND WILDLIFE RESOURCES

This section describes existing conditions for fish, wildlife, and habitat resources within the project area that may be either directly or indirectly impacted by the alternatives considered. This area includes the various diversion channel alternatives around Fargo/Moorhead (Figure 2) as well as the riparian corridors along the Red, Wild Rice (North Dakota), Sheyenne, Maple, Lower Rush, and the Rush River.

Riparian vegetation along the Red River and tributaries is heavily influenced by the extensive amount of agriculture in the area and the frequent flood events. Tree canopy and understory species typical of disturbed habitats are the primary dominates in the vegetated riparian zone. The riparian corridor provided by the Red River is the most protected method of travel for wildlife species in the project area. Wildlife capable of adapting to a variety of changing habitats, such as raccoon, skunk, and deer, are common closer to the metropolitan area. A list of wildlife species found through the project site is in Appendix 1.

The landscape surrounding Fargo/Moorhead, outside the Red River riparian zone, provides only small pockets wildlife habitat in the form of woods, wetlands, and grasslands. There are many agricultural fields that harbor important short-term open water habitat for migratory birds in the spring. Although the extent of these ephemeral, open water areas has not been mapped, aerial photography suggests they are prevalent throughout the area. These areas provide critical feeding and resting areas for migratory birds, especially if precipitation or snowmelt has inundated other shallow water habitats in their migratory path.

The Red, Wild Rice (North Dakota), Sheyenne, Maple, Lower Rush, and Rush Rivers, support both game and non-game fish (Appendix 1). Diversity, abundance, and distribution are largely dependent upon existing barriers, water quality issues and winterkill due to low flow events. The Fargo/Moorhead area is known for its sport fishing opportunities, including channel catfish, walleyes, and northern pike. The sport fishery has benefited greatly from MNDNR efforts in removal of low head dams and stocking efforts.

Several mussel species have also been documented within the Red River and tributaries. Some survey work was completed in 2008, in the Fargo/Moorhead area, by the MNDNR, but minimal data currently exists for mussels species present within the Red, Wild Rice (ND), Sheyenne, Maple, Lower Rush, and Rush Rivers.

Biotic surveys within the Red, Wild Rice (ND), Sheyenne, Maple, Lower Rush, and Rush Rivers are currently underway or scheduled to occur in the Spring/Summer of 2010. Results of these surveys, as provided to the Service, will be incorporated into the Final FWCA Report for the Fargo/Moorhead Project.

Wetlands

The majority of the wetlands within the proposed project area are palustrine emergent, palustrine forested, and riverine wetlands. The majority of the wetlands within the project area are located along the river corridors. Many of the small isolated wetlands outside the riparian zone are influenced by agriculture activities (drainage, tillage, grazing, etc.). Temporarily flooded basins, including actively farmed basins, have the potential to provide excellent “stop-over” habitat for spring migrating birds.

Federal Candidate, Threatened, and Endangered Species

Four listed or candidate species under the Endangered Species Act of 1973 (ESA), as amended, occur within Clay County, Minnesota and Cass County, North Dakota. The Dakota skipper (Candidate) and western prairie fringed orchid (threatened) occur in Clay County, Minnesota, and the whooping crane (Endangered) and the gray wolf (Endangered) occur in Cass County, North Dakota.

Our current records do not indicate the presence of any individuals of the federally listed species within the proposed project area. If at any point during project planning, construction, or operation should additional information on listed species become available, or should a new species be listed, the Corps will reinitiate consultation with the Twin Cities Field Office of the USFWS.

Bald Eagle Nests

Bald eagles and their nests are protected from take and disturbance, respectively, per the Bald and Golden Eagle Protection Act. The Service verified the location of two bald eagle nests within the proposed project area. One nest is located on the northwest edge of the City of Fargo along the Sheyenne River in close proximity to a housing development. It was also verified with local private residents in the area that the nest was active and successful in 2009. The other nest is located north of the Cities of Fargo and Moorhead, close to the confluence of the Sheyenne River and the Red River. Verification of the second nest's 2009 activity was not possible at the time of the field visit. The Service will attempt to verify 2010 activity of both these nests, and include nest activity information in the Final FWCA Report.

During the planning and construction phases of the Fargo-Moorhead project the Service's National Bald Eagle Management Guidelines (May 2007) should be utilized to reduce impacts to any and all bald eagles nesting within the proposed project area. Because of the long timeline associated with this project (eight plus years) the Service recommends that raptor nest surveys be completed in all wooded areas potentially affected by this project. The raptor nest surveys should be completed at a minimum in the spring of the year proceeding construction within or near any affected wooded areas.

Migratory Bids

Due to the varied habitat and cover types throughout the project site, in both Minnesota and North Dakota, there is the potential to impact wetlands, grasslands, and woodlands during the construction or excavation phases necessary to complete this type of project. The aforementioned habitat types can provide preferred nesting habitat for a variety of migratory bird species. Upon final selection of a path for the diversion channel and levee alignments, mapping of significant migratory bird nesting areas should be coordinated with the Service.

Development of a construction timeline to minimize impacts to these areas during prime nesting times should be considered. The Service recommends that proposed construction and excavation within potential bird nesting habitat be completed outside of the primary nesting period (April 1^{st} to August 31^{st}) when possible and feasible. Attempts to minimize impacts to potential migratory bird nesting habitats should be made at all times during construction and excavation.

ALTERNATIVES

During the original screening process of the proposed project, 11 alternatives were evaluated to determine which would be most the implementable, and which alternatives would move forward for further analysis. The Corps Alternative Screening Document, December 2009, provides explanation of the screening process, and provided the recommendation that the No Action and Diversion Channel alternatives should be carried forward for further evaluation as stand-alone alternatives.

No Action

This alternative represents future conditions without the project. Major flood events, such as 100-year events and higher, would continue to occur on a periodic basis. Land use in and surrounding the Cities of Fargo and Moorhead would remain the same. The alternative also anticipated that both Cities would continue to expand as population growth and economy allowed. The Cities would continue to rely on emergency flood protection measures; existing levee protection, temporary levees and floodwalls, and sand bagging activities that are completed as needed in response to flooding.

Flood Barriers

This alternative includes the use of permanent flood barrier measures such as levees, floodwalls, invisible floodwalls, gate closures, and pump stations. For analysis purposes the flood barriers alternative would have resulted in levees on both the Fargo and Moorhead sides of the Red River. Two levee top profiles were considered by the Corps, which could reliably contain the 2% chance and the 1% chance of flooding. This alternative was not pursued further as a stand-alone alternative by the Corps for the purposes of this project.

Diversion Channel

A diversion channel would direct flood waters from the Red River into a constructed channel around the Cities of Fargo and Moorhead, and eventually the diverted waters would enter back into the Red River downstream of Fargo/Moorhead. During early planning stages of the project the Corps developed multiple diversion channel alignments on both the Minnesota and North Dakota side of the Red River. Originally the Corps staff determined that the Minnesota 20,000 cubic feet per second (cfs) (MN 20K Alternative) was the National Economic Development (NED) plan, which had the best benefit: cost ratio. Hydraulics modeling was then updated and calibrated to the 2009 event, hydrology data was updated to include 2009, and the Expert Opinion Elicitation (EOE) Panel identified a distinct "wet" period of record. This combination of items led to an increase in anticipated annual damages, which in turn led to greater benefits resulting from a larger plan. At this point it was then determined that the 35,000 cfs (MN 35K Alternative) is the appropriate NED plan. The Corps recommended the Minnesota 35,000 cfs (MN 35K Alternative) to the local sponsor as the Preferred Alternative. The local sponsors of the Fargo/Moorhead project requested that the Corps move forward with the North Dakota 35,000 cfs (ND 35K Alternative). Both the MN 35K Alternative and the ND 35K Alternative would provide diversion of flood waters, around the metropolitan area, starting at a 5 year storm event. The local sponsors felt that the ND 35K Alternative provided more local flood reduction benefits then the MN 35K Alternative.

Under the MN 35K Alternative, the majority of the impacted lands along a diversion channel alignment in Minnesota would consist of agricultural lands. The ND 35K Diversion Channel Alternative will impact five tributaries to the Red River; the Wild Rice River (North Dakota), Sheyenne River, Maple River, Lower Rush River, and the Rush River. Common resource concerns between the Minnesota and North Dakota Alternatives include the Red River channel impacts, construction of a control structure within the Red River, loss of fish passage within the main stem of the Red River, sedimentation issues in the Red River, loss of riparian habitat, wetland impacts, and the fate of fish entering the diversion channel during flood events.

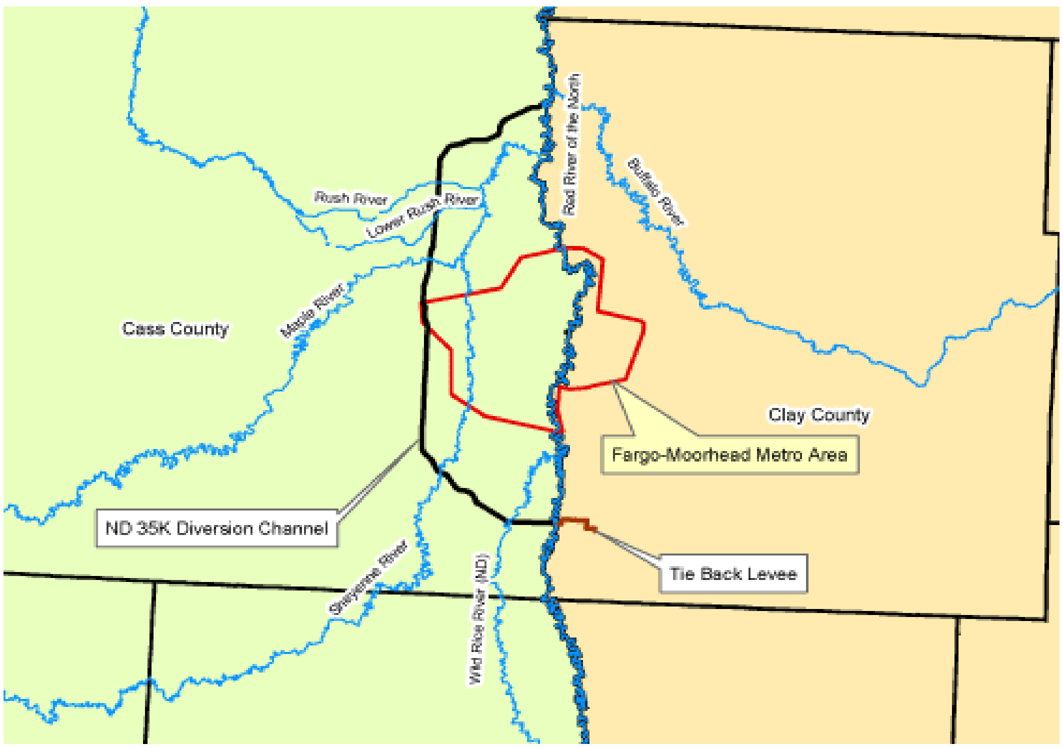


Figure 2. Proposed ND 35K Diversion Channel Alternative

ND 35K Diversion Channel (Locally Selected Alternative)

This alternative is located west of the Cities of Fargo and Moorhead, with an inlet planned to be constructed south of the Fargo/Moorhead metropolitan area on the Red River approximately 4 miles south of the confluence of the Red River and the Wild Rice River (North Dakota), see Figure 2. The outlet of the diversion channel into the Red River is planned to be constructed north of the Fargo/Moorhead metropolitan area on the Red River approximately 3.5 miles north of the confluence of the Red River and the Sheyenne River.

The diversion channel will have an average bottom width of 360 feet, and internal 1(vertical):7(horizontal) side slopes. The internal side slopes will be increased to 1:5 at highway and railroad intersections. The peak of the spoil piles adjacent to the diversion channel will not exceed 15 feet above existing grade, and external side slopes of the diversion channel will range from 1:7 to 1:10. Total width of the diversion channel construction including; bottom width, internal slopes, and external side slopes will be approximately 2,150 feet. With a total length of approximately 36 miles, the total affected footprint of the diversion channel is approximately 9,382 acres.

The inlet of the diversion channel on the west bank of the Red River will consist of a metal sheet pile and rock weir structure. The inlet of the weir structure is set one foot above the 5 year storm event. A second weir structure will be constructed within the diversion channel on the east bank of the Wild Rice River (ND). This second weir structure will be over topped by diverted flows from the Red River once a 5 year storm event flow is exceeded. A gated control structure will be constructed in the Wild Rice River (ND), with two tainter gates (30 feet wide and 20 feet high). The gates will generally be fully open, but during large flow events the gates will be lowered to restrict the flow into the Fargo-Moorhead Metro to the 5 year storm event flows. Flows above the 5 year event would overtop a third weir, on the west bank of the Wild Rice River (ND) into the diversion channel. Diverted flood waters will flow west and north around the Fargo/Moorhead metropolitan area. The diversion channel will affect four additional tributaries rivers; the Sheyenne River, the Maple River, the Lower Rush River, and the Rush River. The diversion channel will outlet into the Red River over a weir and rip rap structure.

Concrete bypass structures will be built to convey waters within the diversion channel under the Sheyenne and Maple Rivers. The structures will allow the Sheyenne and Maple Rivers to flow through under normal conditions. However, flows exceeding the 2 year storm event within the Sheyenne and Maple will overtop small weir structures and flow through constructed channels into the main diversion channel. The Lower Rush and Rush Rivers will be routed, via drop structures, directly into the diversion channel. The channels of the Lower Rush and Rush Rivers between the diversion channel and downstream to their confluences with the Sheyenne River will be abandoned, and allowed to function as temporary flooded open ditches and as wetland habitat during the drier periods of the growing season.

A large control structure is proposed to be placed in the Red River channel, approximately 1,600 feet downstream of the diversion channel inlet. The concrete structure will have three gates, each 40 feet wide by 40 feet tall. During normal flows the control structure would be completely open, and during flow events exceeding the 5 year storm event the gates would close and the structure would act as a barrier that would back water into the diversion channel. A concrete fish ramp is proposed for construction to allow fish passage from during flows between the 5 year storm event and the 50 year storm event.

A three mile tie back levee will need to be constructed to connect the Red River control structure to high ground. The levee will prevent flood waters from flowing over land to north and east into the Fargo/Moorhead metropolitan area.

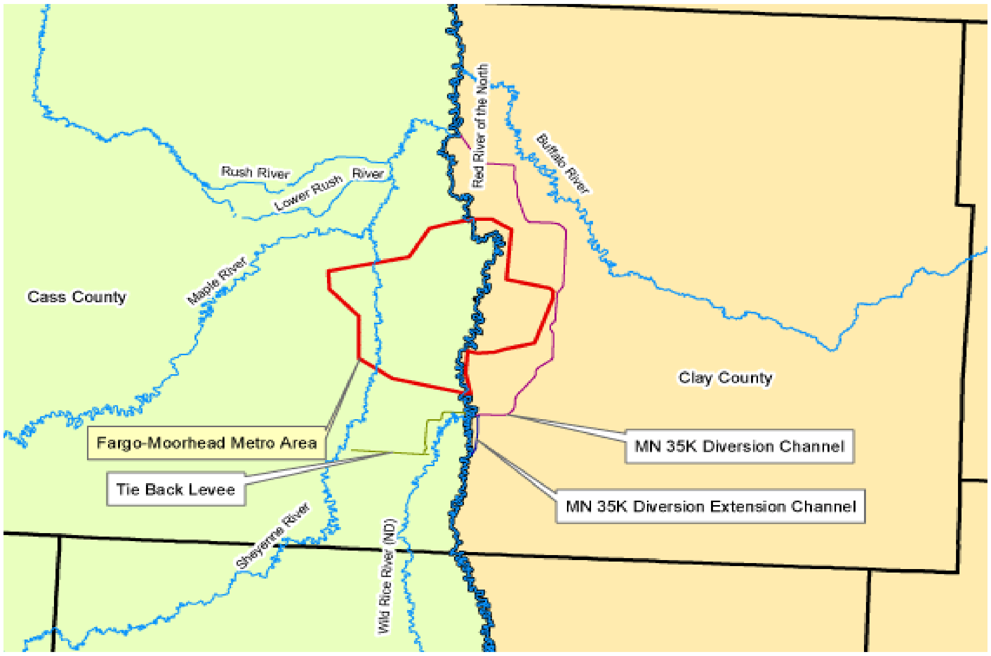


Figure 3. Proposed MN 35K Diversion Channel Alternative

MN 35K Diversion Channel (Corps Recommended Alternative)

This alternative is located east of the Cities of Fargo and Moorhead, with an inlet planned to be constructed south of the Fargo/Moorhead metropolitan area on the Red River north of the confluence of the Red River and the Wild Rice River (North Dakota), see Figure 3. The outlet of the diversion channel into the Red River is planned to be constructed north of the Fargo/Moorhead metropolitan area on the Red River, north of the confluence of the Red River and the Sheyenne River.

The diversion channel will have an average bottom width of 360 feet, and internal 1(vertical):7(horizontal) side slopes. The internal side slopes will be increased to 1:5 at highway and railroad intersections. The peak of the spoil piles adjacent to the diversion channel will not exceed 15 feet above existing grade, and external side slopes of the diversion channel will range from 1:7 to 1:10. Total width of the diversion channel construction including; bottom width, internal slopes, and external side slopes will be approximately 2,150 feet. With a total length of approximately 25 miles, the total affected footprint of the diversion channel is approximately 6,415 acres.

The inlet of the diversion channel on the east bank of the Red River will consist of a metal sheet pile and rock weir structure. Water from the Red River will begin to flow over the weir structure after a 5 year storm event flow is exceeded. Once the water has overtopped the weir structure the diversion channel will go east and north around the Fargo/Moorhead metropolitan area. The diversion channel will primarily bisect land currently used for agricultural production. The diversion channel will outlet into the Red River over a rip rap structure.

The diversion channel will function as a temporary flooded open ditch during the conveyance of flood waters, and as mix of channel habitat and wetland habitat during low flow periods.

A large control structure is proposed to be placed in the Red River channel, approximately 1,600 feet downstream of the diversion channel inlet. The concrete structure will have three gates, each 40 feet wide by 40 feet tall. During normal flows the control structure would be completely open, and during flow events exceeding the 5 year storm event the gates would close and the structure would act as a barrier that would back water into the diversion channel. A concrete fish ramp is proposed for construction to allow fish passage during flows between the 5 year storm event and the 50 year storm event.

A 9.9 mile tie back levee will need to be constructed to connect the Red River control structure to high ground. The levee will prevent flood waters from flowing over land to the north and west into the Fargo/Moorhead metropolitan area.

In addition to the main diversion channel this alternative would include two smaller channels upstream of the Red River structure. A three mile long supplementary channel will run south parallel to the Red River to allow for additional capacity, see Figure 3. This channel will have a bottom width of 50 feet. A second supplementary channel, less then one mile long, is located near the intersection of I-29 and Cass County Highway 16, not shown in any Figures. This second supplementary channel also has a bottom width of 50 feet.

	ND 35K Diversion	**MN 35K Diversion**
Length of Channel	36 miles	25 miles
Total Width of Channel	2,150 feet	2,150 feet
Impact of Primary Diversion Channel	9,382 acres	6,515 acres
Secondary Diversion Channels	0	2
Length of Tie Back Levee	3.3 miles	9.9 miles

Table 1. Comparison of ND 35K and MN 35K Alternative specifics.

<u>Non-structural Measures</u>

This alternative encompasses various flood-proofing measures such as the relocation of businesses and residential structures to an area outside the floodplain, elevation of structures, land acquisition and buyouts, basement removals, dry and wet flood proofing, and additional flood preparedness plans and warnings. Due to highly negative social impacts and the extremely high costs associated with this alternative, non-structural measures were not further considered as a stand-alone alternative by the Corps for the purposes of this project. The Corps did make the recommendation that the non-structural alternative should be considered for possible inclusion as a feature of the overall plan where it could be incrementally justified.

Flood Storage

The storage alternative would have involved preservation of natural floodplain, restoration of wetlands, and the construction of dams and other water retention facilities throughout the watershed. Utilization of agricultural fields for flood water retention would need to be a major component of this alternative. Through modeling the Corps determined that the storage alternative would have low effectiveness in larger flood events, but may be helpful in small flood events. Due to the low level of effectiveness during large flood events and the high costs associated with this alternative, flood storage was not further considered as a stand-alone alternative by the Corps for the purposes of this project. The Corps did make the recommendation that the flood storage alternative should be considered for possible inclusion as a feature of the overall plan where it could be incrementally justified, and it should be considered by the local communities within the basin.

Tunneling

This alternative would entail the construction of a series of tunnels under the Cities of Fargo and Moorhead to convey floodwaters, and reduce the water levels in the Red River. This alternative would provide similar benefits to the diversion channel alternatives, but with a much greater cost. There would also be significant negative impacts to aquatic habitats and fish passage associated with the tunneling alternative. Due to the high costs and uncertainties of long term maintenance associated with this alternative, tunneling was not further considered as a stand-alone alternative by the Corps for the purposes of this project.

Bridge Replacement or Modification

Bridge replacement or modification was considered because in some cases this can increase water conveyance and reduce flood stages within the river. However, in the case of Fargo/Moorhead and the Red River, the Corps determined that complete removal of the bridges had only a minor affect on flood levels. Due to the low level of effectiveness and the high costs associated with this alternative, bridge replacement or modification was not further considered as a stand-alone alternative by the Corps for the purposes of this project. The Corps did make the recommendation that the bridge replacement or modification alternative should be considered for possible inclusion as a feature of the overall plan where it could be incrementally justified.

Interstate 29 Viaduct

This alternative would involve reconstruction of the existing Interstate 29 corridor to function as an open viaduct during flood events. During non-flood times the corridor would then function as an interstate highway. This alternative would have significant negative impacts for fish passage and sedimentation, and there would be minimal environmental benefit as the interstate corridor would function as a highway during non-flood periods. Due to the low level of cost effectiveness and unacceptable transportation impacts associated with this alternative, the Interstate 29 viaduct was not further considered as a stand-alone alternative by the Corps for the purposes of this project.

Dredging and Widening the River

An alternative to deepen and widen the Red River to accommodate great flow conveyance through the Fargo/Moorhead area was considered. This alternative would result in substantial environmental impacts including; increased sedimentation, loss of suitable fish and mussel habitats, riparian habitat loss, wildlife mortality during excavation activities, and a high likelihood of riverbank instability issues. There would also be social impacts as homes and property would need to be acquired to insure the Red River could be widened to accommodate the new river depths. This alternative would also violate a number of local and national policies. Due to associated policy violations and the high costs associated with long term maintenance of this alternative, dredging and widening of the Red River was not further considered as a stand-alone alternative by the Corps for the purposes of this project.

Wetland and Grassland Restoration

Wetland and grassland restoration areas could be established to provide flood storage and also reduce peak runoff. Costs of this alternative were anticipated to be high due to large land acquisition needs to implement restoration activities. The Corps staff determined that the benefits of wetland restoration would be localized, and the flood storage needs of the Fargo/Moorhead area would not be met. Due to the low level of effectiveness to offset flood damages, high costs, and the large land acquisitions associated with this alternative, wetland and grassland restoration was not further considered as a stand-alone alternative by the Corps for the purposes of this project. The Corps did make the recommendation that the wetland and grassland restoration alternative should be considered for possible inclusion as a feature of the overall plan where it could be incrementally justified.

Throughout the project and comment process the Service has recommended that the Corps consider the utilization of wetland restoration within the watershed of the project to increase flood water storage and attenuation.

Cut-off Channels

Cut-off channels would be excavated across meanders within the Red River channel in the Cities of Fargo and Moorhead. Straightening the channel would allow greater conveyance of water through the Cities, and potentially reduce peak flood stages. This alternative would impact riparian habitat, wetlands, and potentially fisheries resources that are adjacent to or utilize these meanders. According to Corps staff this alternative would not provide substantial flood risk reduction. There would also be the potential for this alternative to violate state and federal policies. Due to the low reduction of flood risk and the environmental impacts associated with this alternative, cut-off channels was not further considered as a stand-alone alternative by the Corps for the purposes of this project. The Corps recommended that the cut-off channels alternative be considered for possible inclusion as a feature of the overall plan where it could be incrementally justified.

IMPACT ANALYSIS

This Report focuses on potential impacts that would result from the activities involved with the construction, excavation, and operation of the Locally Selected Alternative. Environmental impacts from the ND 35K Diversion Channel Alternative (the Locally Selected Alternative) and the MN 35K Diversion Channel Alternative, may be separated into two categories: direct impacts (those caused by project construction), and indirect impacts (those associated with project operation). Several resource concerns were detailed in the Service's February 1, 2010 letter.

Direct Impacts of the ND 35K Diversion Channel Alternative

Habitat Loss

Construction and excavation associated with the proposed project will result in the removal or degradation of riparian forests, wetlands (various types), grasslands, and riverine aquatic habitat. The current plan for structure placement and diversion channel route will result in the following impacts; 137 acres of forested habitat, 33 acres (direct) and 157 acres (indirect) of wetlands, and 39 acres of riverine aquatic habitat. Activities resulting in direct impacts include; diversion channel excavation, Red River control structure construction, weir construction, levee constructions, tributary crossing construction, and tributary flow diversion and abandonment (Lower Rush and Rush Rivers).

The exact acreage of the various habitats impacted by the project should be calculated once the extent and location of the alternatives are determined.

Fisheries

Construction and excavation within the riverine aquatic habitats could kill adult or juvenile fish. Sediment discharges caused by the aforementioned work could result in adult and juvenile individuals being killed if their gills become filled with sediment, spawn bed abandonment by adult fish, and also the covering of spawning beds with silts and fines resulting in the loss of eggs within the bed. Large sediment loads could also lead to disruptions in foraging success for fish directly downstream of excavation and construction areas within the rivers or areas of bank construction or excavation. Disruption of foraging success could result in the death of juvenile individuals, or prohibit adult fish from spawning due to malnutrition.

Wildlife

Excavation and construction within forested areas, wetlands, and grasslands may be expected to potentially kill or displace nesting adult birds if construction activities occur during the primary nest seasoning (April 1st – August 31st). Abandonment of nests and crushing of eggs within construction and excavation areas is also considered a direct wildlife impact.

Mammal species within the excavation and construction areas will be displaced or killed during project activities. The majority of adult individuals should be mobile enough to move out of the construction/excavation areas prior to being injured or killed by equipment. The exception may be borrowing species that may be injured or killed during excavation activities. Juvenile individuals may not be able to avoid construction and excavation activities resulting in injury or death of certain individuals.

Mussel species within the riverine aquatic habitats may be killed by direct construction or excavation activities within mussel beds. Feeding activities and gill function may be interrupted by large sediment loads during construction and excavation activities. This could result in the death of individuals, or a reduction in or lack of reproduction by adult individuals.

Indirect Impacts of the ND 35K Diversion Channel Alternative

Habitat Loss and Conversation

With additional sediment load and deposition occurring the Red, Wild Rice (ND), Sheyenne, and Maple Rivers will experience some alteration of their bed composition. Also, because of structure placement and reductions in the current regular flood flows through these Rivers, sediments could accumulate and alter the aquatic habitat. This could also result in the need for regular mechanical clean out, which would disturb riparian habitat, aquatic habitat, and fish and wildlife species in the area of the clean out.

Wetlands within the floodplains of the Red, Wild Rice (ND), Sheyenne, and Maple Rivers, and downstream of the proposed structures and diversion channel, may be converted to non-wetland or a drier hydrologic regime if they are heavily influenced hydrologically by regular flood events that currently occur. Wetlands found at the confluences of the Lower Rush and Rush Rivers with the Sheyenne River would likely be converted to non-wetland or a drier hydrologic regime once the Lower Rush and Rush River channels are abandoned.

Fisheries

Movement of fish species within the Red, Sheyenne, and Maple Rivers will be impeded by structures constructed within the river channels as part of this project. These fish passage impacts will be noticeable during larger flood flow events when the gates on the

Red River control structure are closed, and when flow velocities through the structures on the Sheyenne and Maple Rivers become high enough to impede fish passage, primarily for smaller species.

Aquatic organisms displaced by flood events would also be affected by operation of a diversion channel. Fish carried into the diversion may be vulnerable to stranding during lower but more frequent flood events (e.g. 5 or 10 year event) if 1) they are unable to find their way back to the river as water levels recede or 2) the flow dissipates before reconnecting to the Red River. Flood-formed scour pools may provide refugia for these fish but they would not survive the winter in such habitat. During planning it has been mentioned that a base flow will be maintained throughout the entire diversion channel. A base flow would be beneficial, but larger species may not be able to effectively move even with a base flow channel.

Given the scenario above, it appears that a certain degree of fish mortality is unavoidable. The level of mortality is dependant upon the number of fish entering the diversion channel, abundance of water in the channel, and the life stage (juvenile or adult) of the affected individuals.

Wildlife

Once the project is in the operational phase mussels could be affected by additional direct impacts of operation. In large flood flows the gates on the Red River control structure will close, resulting in deposition of sediment on the upstream side of the structure. A large sediment load could bury and kill individuals. Sediment deposition will also occur on the Wild Rice River (ND) at the point of confluence with the proposed diversion channel and down stream of this point. The structures on the Sheyenne and Maple Rivers will restrict flows during flood events, and a portion of the water will be directed into the diversion channel. Water that remains within the river channels will continue to carry the bulk of the sediment load, however the quantity and flow of water will be diminished. This will result in additional sediment deposition downstream of the proposed structures. These areas of additional sediment deposition could bury and kill mussels if significant mussel beds are present.

Mussel species dispersal may be restricted during the operational phases of this project. Mussels infest host fish with glychodia, larval stage of mussel, which results in the host fish potentially transporting the glychodia to new suitable aquatic habitat. If fish passage is restricted during large flood events potentially infested fish will not be able to disperse the glychodia. Infested fish may also move up the diversion channel and become stranded, or the glychodia could drop off in the diversion channel in unsuitable permanent habitat. Infested fish moving in the diversion channel could result in the loss of larval stage mussels, and reduce the reproductive success and dispersion of various mussel species.

Direct Impacts of the MN 35K Diversion Channel Alternative

Habitat Loss

Construction and excavation associated with the proposed project will result in the removal or degradation of riparian forests, wetlands (various types), grasslands, and riverine aquatic habitat. The current plan for structure placement and diversion channel route will result in the following impacts; 75 acres of forested habitat, 17 acres (direct) and 85 acres (indirect) of wetlands, and 10 acres of riverine aquatic habitat. Activities resulting in direct impacts include; diversion channel excavation, Red River control structure construction, weir construction, and levee constructions.

The exact acreage of the various habitats impacted by the project should be calculated once the extent and location of the alternatives are determined.

Fisheries

Construction and excavation within the Red River could kill adult or juvenile fish. Sediment discharges caused by the aforementioned work could result in adult and juvenile individuals being killed if their gills become filled with sediment, spawn bed abandonment by adult fish, and also the covering of spawning beds with silts and fines resulting in the loss of eggs within the bed. Large sediment loads could also lead to disruptions in foraging success for fish directly downstream of excavation and construction areas within the rivers or areas of bank construction or excavation. Disruption of foraging success could result in the death of juvenile individuals, or prohibit adult fish from spawning due to malnutrition.

Wildlife

Excavation and construction within forested areas, wetlands, and grasslands may be expected to potentially kill or displace nesting adult birds if construction activities occur during the primary nest seasoning (April 1st – August 31st). Abandonment of nests and crushing of eggs within construction and excavation areas is also considered a direct wildlife impact.

Mammal species within the excavation and construction areas will be displaced or killed during project activities. The majority of adult individuals should be mobile enough to move out of the construction/excavation areas prior to being injured or killed by equipment. The exception may be borrowing species that may be injured or killed during excavation activities. Juvenile individuals may not be able to avoid construction and excavation activities resulting in injury or death of certain individuals.

Mussel species within the Red River may be killed by direct construction or excavation activities within mussel beds. Feeding activities and gill function may be interrupted by large sediment loads during construction and excavation activities. This could result in the death of individuals, or a reduction in or lack of reproduction by adult individuals.

Indirect Impacts of the MN 35K Diversion Channel Alternative

Habitat Loss and Conversation

With additional sediment load and deposition occurring, the Red River will experience some alteration of bed composition. Also, because of structure placement and reductions in the current regular flood flows through the Red River, sediments could accumulate and alter the aquatic habitat. This could also result in the need for regular mechanical clean out, which would disturb riparian habitat, aquatic habitat, and fish and wildlife species in the area of the clean out.

Wetlands within the floodplain of the Red River, and downstream of the proposed structures and diversion channel, may be converted to non-wetland or a drier hydrologic regime if they are heavily influenced hydrologically by regular flood events that currently occur.

Fisheries

Movement of fish species within the Red River will be impeded by the construction of the control structure within the river channel as part of this project. Fish passage impacts will be noticeable during larger flood flow events when the gates on the Red River control structure are closed.

Aquatic organisms displaced by flood events would also be affected by operation of a diversion channel. Fish carried into the diversion may be vulnerable to stranding during lower but more frequent flood events (e.g. 5 or 10 year event) if 1) they are unable to find their way back to the river as water levels recede or 2) the flow dissipates before reconnecting to the Red River. Flood-formed scour pools may provide refugia for these fish but they would not survive the winter in such habitat. During planning it has been mentioned that a base flow will be maintained throughout the entire diversion channel. A base flow would be beneficial, but larger species may not be able to effectively move even with a base flow channel.

Given the scenario above, it appears that a certain degree of fish mortality is unavoidable. The level of mortality is dependant upon the number of fish entering the diversion channel, abundance of water in the channel, and the life stage (juvenile or adult) of the affected individuals.

Wildlife

Once the project is in the operational phase mussels could be affected by additional impacts of operation. In large flood flows the gates on the Red River control structure will close, resulting in deposition of sediment on the upstream side of the structure. A large sediment load could bury and kill individuals. Sediment deposition may also occur downstream of the Red River control structure. Water that remains within the river channel will continue to carry the bulk of the sediment load, however the quantity and flow of water will be diminished. These areas of additional sediment deposition could bury and kill mussels if significant mussel beds are present.

Mussel species dispersal may be restricted during the operational phases of this project. Mussels infest host fish with glychodia, larval stage of mussel, which results in the host fish potentially transporting the glychodia to new suitable aquatic habitat. If fish passage is restricted during large flood events potentially infested fish will not be able to disperse the glychodia. Infested fish may also move up the diversion channel and become stranded, or the glychodia could drop off in the diversion channel in unsuitable permanent habitat. Infested fish moving in the diversion channel could result in the loss of larval stage mussels, and reduce the reproductive success and dispersion of various mussel species.

PROPOSED MITIGATION ACTIVITIES

1. A constructed fish ramp, 50 feet wide, is proposed to improve fish passage around the Red River control structure during large flow events when the gates will be closed. (Both Alternatives)
2. A natural substrate will be maintained under the Red River control structure and the structures on the Sheyenne and Maple Rivers to allow for complex flow regimes, which will allow for better fish passage through the structures. (Both Alternatives)
3. Maintain a base flow channel within the diversion channel to assist in minimizing fish stranding. (Both Alternatives)
4. Allow the bottom of the diversion channel function as aquatic and seasonal wetland habitats to provide habitat to local wildlife. (Both Alternatives)
5. The abandoned Lower Rush and Rush River channels to function as seasonal wetlands and aquatic habitats to benefit local wildlife species. (ND 35K Alternative Only)
6. All wetland impacts will be replaced at a ratio to meet or exceed the Compensatory Mitigation Standards of the Clean Water Act, Section 404 Permit Program. State wetland laws will also be satisfied. (Both Alternatives)
7. Impacted forested areas will replaced at a 1:1 ratio. (Both Alternatives)
8. Grassland habitat impacts will be offset by the reconstruction of native prairie on the inside slope of the diversion channel following construction. (Both Alternatives)

RECOMMENDATIONS

1. Determine wetland acreage to be impacted directly or indirectly by the proposed project, and assess the functions and values of individual wetlands with an established method of assessment, such as the Minnesota Rapid Assessment Method (MnRAM).
2. Provide compensatory mitigation for all wetland impacts in accordance with the standards specified for a Section 404 Permit under the Clean Water Act. A final

wetland mitigation plan should be coordinated with the Service and Corps Regulatory Project Manager.

3. Wetlands within the currently active floodplains of the Red, Wild Rice (ND), Sheyenne, Lower Rush, and Rush Rivers, downstream of the proposed structures and the diversion channel crossings or channel abandonments should be monitored for a 10 year period following the beginning of project flood reduction operations. This monitoring should focus on hydrologic impacts to the wetlands, wetland type conversions, and loss of wetlands. (ND 35K Alternative Only)
4. Biotic surveys within the potentially affected reaches of Red, Wild Rice (ND), Sheyenne, Maple, Lower Rush, and Rush Rivers should be conducted to determine species presences and potential suitable habitat areas (i.e. mussel beds, spawning habitats, etc)
5. Utilize native plant species in all aspects of mitigation, reconstruction, and replanting involved with the project.
6. Avoid impacts to migratory bird nesting habitats (woodlands, grasslands, and wetlands) during the primary nesting season, April 1st to August 31st, to the greatest extent that is feasible.
7. Provide equal mitigation (1:1) for lands currently enrolled in state or federally funded restoration or conservation programs that will be impacted by the proposed project.
8. Raptor nest surveys should be conducted every spring to determine the presence of existing or new nests that may be affected by the project construction and excavation activities. Surveys should be completed annually prior to “leaf out” until the project construction is complete.
9. Follow the Service’s National Bald Eagle Management Guidelines to minimize the likely-hood that the proposed project will affected any bald eagles nesting in the Fargo/Moorhead Project Area.

SUMMARY

River channel morphology is largely defined by the frequency and intensity of floods. Flood events and the intensity of their environmental effects are naturally unpredictable. The ND 35K Alternative and the MN 35K Alternative involve the construction and operation of a control structure within the Red River. Operation of the Red River control structure and the associated diversion channel would reduce the occurrence of flood flows, exceeding the 5 year storm event, into the Fargo – Moorhead Metro Area. This reduction in flood events could affect sediment loads and deposition within the Red River. The ND 35K Alternative also includes a second control structure within the Wild Rice (ND) River, diversion channel crossing structures on the Sheyenne and Maple Rivers, and the abandonment of portions of the Lower Rush and Rush Rivers.

Both diversion channel alternatives will result in direct and indirect wetland impacts. The ND 35K Alternative could potentially impact approximately 120 more acres then the MN 35K Alternative. There will be some wetland loss through direct excavation and/or fill of wetlands during channel, levee, and structure construction. Riparian wetlands along the river corridors are likely to incur some indirect impacts as the change in flood elevations may result in changes to the hydrologic inputs to some of these wetlands. The exact extent of wetland impacts cannot be quantified at this time as the footprint and design of the project have not been finalized. Wetland mitigation needed to address these issues should be carried out concurrent with project construction.

Both alternatives may potentially impact fish passage, fish spawning areas, mussel beds, and terrestrial wildlife habitat during construction, excavation, operation, and maintenance of the proposed Fargo-Moorhead Flood Reduction Project. The ND 35K Alternative as proposed will result in greater ecological impacts, then the MN 35K Alternative, see Table 2 below. Alternative impacts are greater due to the higher number of rivers affected by the diversion channel and wildlife habitat disturbance. Outside of work within the Red River and the adjacent riparian habitat the MN 35K Alternative primarily affects agricultural lands.

The Service is authorized under the Fish and Wildlife Coordination Act (16 U.S.C. 661 et seq.) to provide recommendations to the Corps on federally funded water development projects. Therefore, based on data available at this time, and the Impact Analysis outlined within this report the Service recommends, should the Corps and the Local Project Sponsors move forward with the Fargo-Moorhead Metropolitan Flood Risk Reduction Project, the MN 35K Diversion Channel Alternative should be the selected Alternative. Although ecological impacts will occur with either of the Diversion Channel Alternatives, the MN 35K Alternative would result in less ecological impact when compared to the ND 35K Diversion Channel Alternative.

	ND 35K Diversion	**MN 35K Diversion**
Direct Wetland Impacts	33 acres	17 acres
Indirect Wetland Impacts	157 acres	85 acres
Total Wetland Impacts	190 acres	102 acres
Forest Impacts	137 acres	75 acres
Aquatic Riverine Impacts	39 acres	10 acres
Red River Fish Passage Impacts	Yes	Yes
Red River Tributary Fish Passage Impacts	Yes	No
# of Rivers Impacted	6	1
Federal Threatened and Endangered Species Impacted	No	No
Bald Eagles Impacted	No	No
Red River Sedimentation Impacts	Yes	Yes
Red River Tributary Sedimentation Impacts	Yes	No

Table 2. Impact Analysis Comparison of ND 35K and MN 35K Alternatives.

Literature Cited

Aadland, L.P., T.M. Koel, W.G. Franzin, K.W. Stewart, and P. Nelson. 2005. Changes in fish assemblage structure of the Red River of the North. American Fisheries Society Symposium 45:293-321.

Minnesota Climatology Working Group. Summaries and publications. General statistics, normals, and summaries. Normals, means, and extremes – Fargo, North Dakota. http://climate.umn.edu/pdf/normals_means_and_extremes/2005_Annual_LCD_FAR_page_3.pdf.

Minnesota Department of Natural Resources. Breeding bird Animap: an interactive mapping tool. Clay County, Minnesota. http://www.dnr.state.mn.us/maps/animap/index.html.

Minnesota Department of Natural Resources. Nature snapshots. http://www.dnr.state.mn.us/snapshots/index.html.

Minnesota Department of Natural Resources. Rare species guide: filtered search. Clay County, Minnesota. http://www.dnr.state.mn.us/rsg/filter_search.html.

Minnesota Pollution Control Agency. Red River of the North basin. Last updated August 10, 2009. Accessed March 24, 2010. http://www.pca.state.mn.us/water/basins/redriver/.

Oldfield, B. and J.J. Moriarty. Amphibians and reptiles native to Minnesota. University of Minnesota Press. Minneapolis/London.

Schwert, D.P. A brief overview of the geology of the Fargo-Moorhead region. North Dakota State University. Accessed on March 24, 2010. http://www.ndsu.edu/fargo_geology/briefhistory.htm.

Sietman, B. Minnesota Department of Natural Resources. Mussel Survey Data. 2008.

Stoner, J.D., D.L. Lorenz, G.J. Wiche, and R.M. Goldstein. 1993. Water Resources Bulletin 29(4):575-615. American Water Resources Association.

U.S. Army Corps of Engineers. December 2009. Alternatives screening document Fargo-Moorhead metropolitan area flood risk management. St. Paul, Minnesota.

United States Geolgic Survey. Gage Data USGS 05054000 Red River of the North. Fargo, North Dakota. http://waterdata.usgs.gov/nwis/uv?05054000.

APPENDIX 1

FISH AND WILDLIFE RESOURCES OF THE RED RIVER

Table 1. Fish species present in the Red River drainage. (Aadland et al. 2005)

Common Name	Scientific Name
Chestnut lamprey	*Ichthyomyzon castaneus*
Silver lamprey	*Ichthyomyzon unicuspis*
White sucker	*Catostomus commersoni*
Silver redhorse	*Moxostoma anisurum*
Golden redhorse	*Moxostoma erythrurum*
Shorthead redhorse	*Moxostoma macrolepidotum*
Greater redhorse	*Moxostoma valenciennesi*
Spotfin shiner	*Cyprinella spiloptera*
Carp	*Cyprinus carpio*
Brassy Minnow*	*Hybognathus hankinsoni*
Common shiner	*Luxilus cornutus*
Bowfin	*Amia calva*
Emerald shiner	*Notropis atherinoides*
Bigmouth shiner	*Notropis dorsalis*
Blackchin shiner*	*Notropis heterodon*
Blacknose shiner*	*Notropis heterolepis*
Sand shiner	*Notropis stramineus*
River shiner	*Notropis blennius*
Spottail shiner	*Notropis hudsonius*
Carmine shiner*	*Notropis percobromus*
Northern redbelly dace*	*Phoxinus eos*
Fathead minnow	*Pimephales promelas*
Western blacknose dace*	*Rhinichthys obtusus*
Longnose dace	*Rhinichthys cataractae*
Creek chub	*Semotilus atromaculatus*
Black bullhead	*Ameiurus melas*
Yellow bullhead	*Ameiurus natalis*
Brown bullhead	*Ameiurus nebulosus*
Channel catfish	*Ictalurus punctatus*
Tadpole madtom	*Noturus gyrinus*
Central Mudminnow	*Umbra limi*
Northern pike	*Esox lucius*
Trout-perch	*Percopsis omiscomaycus*
Rock bass	*Ambloplites rupestris*
Pumpkinseed*	*Lepomis gibbosus*
Bluegill	*Lepomis macrochirus*
Largemouth bass*	*Micropterus salmoides*
Black crappie	*Pomoxis nigromaculatus*
White Crappie	*Pomoxis annularis*
Johnny darter	*Etheostoma nigrum*
Yellow perch	*Perca flavescens*
Blackside darter	*Percina maculata*
Logperch	*Percina caprodes*
Sauger	*Stizostedion canadense*
Walleye	*Stizostedion vitreum*
Freshwater drum	*Aplodinotus grunniens*

Table 1 cont'd. Fish species present in the Red River drainage. (Aadland et al. 2005)

Common Name	**Scientific Name**
Goldeye	*Hiodon alosoides*
Mooneye	*Hiodon tergisus*
Rainbow trout*	*Oncorhynchus mykiss*
Quillback	*Carpiodes cyprinus*
Bigmouth Buffalo	*Ictiobus cyprinellus*
Goldfish	*Carassius auratus*
Silver chub	*Macrhybopsis margarita*
Hornyhead chub	*Nocomis biguttatus*
Golden shiner	*Notemigonus chrysoleucas*
Bluntnose minnow	*Pimephales notatus*
Flathead chub	*Platygobio gracilis*
Stonecat	*Noturus flavus*
Muskellunge	*Esox masquinongy*
Rainbow smelt	*Osmerus mordax*
Banded killifish	*Fundulus diaphanous*
Burbot	*Lota lota*
White bass	*Morone chrysops*
Green sunfish	*Lepomis cyanellus*
Orangespotted sunfish	*Lepomis humilis*
Smallmouth bass	*Micropterus dolomieu*
Iowa Darter	*Etheostoma caeruleum*
Lake Sturgeon	*Acipenser fulvescens*

*Found in the tributaries to the Red River, but not in the main stem of the Red River.

Table 2. Mammals of the Fargo-Moorhead Project Area.

Common Name	Common Name
Grey fox	Fox squirrel
Red fox	Red squirrel
Raccoon	Northern flying squirrel
Striped skunk	Beaver
Coyote	Muskrat
Masked shrew	Deer mouse
Pygmy shrew	White-footed mouse
Short-tailed shrew	Southern red-backed vole
Star-nosed mole	Meadow vole
Little brown myotis	Prairie vole
Big brown bat	Norway rat
Red bat	House mouse
Eastern Cottontail Rabbit	Meadow jumping mouse
White-tailed jackrabbit	Plains pocket mouse
Eastern chipmunk	Ermine
Least chipmunk	Long-tailed weasel
Woodchuck	Least weasel
Thirteen-lied ground squirrel	Gray wolf
Franklin's ground squirrel	River otter
Eastern gray squirrel	Mink
White-tailed deer	Badger
Opossum	

Table 3. Amphibians and Reptiles of Clay County, Minnesota.

Common Name (Amphibians)	Common Name (Reptiles)
Northern leopard frog	Common garter snake
Wood frog	Redbelly snake
Gray treefrog	Plains hog nosed snake
Western chorus frog	Plains garter snake
Boreal chorus frog	Smooth green snake
American toad	Snapping turtle
Canadian toad	Painted turtle
Great plains toad	Prairie skink
Tiger salamander	

Table 4. Mussels in the Fargo-Moorhead Area. (Sietman 2008)

Common Name	Scientific Name
Fatmucket	*Lampsilis siliquoidea*
Threeridge	*Amblema plicata*
Giant floater	*Pyganodon grandis*
Black Sandshell	*Ligumia recta*

Table 5. Breeding Birds of Clay County, Minnesota. (MN DNR)

Common Name	**Common Name**
Canada goose	Sedge wren
Wood duck	Eastern bluebird
Mallard	Veery
Blue winged teal	American robin
Ring necked duck	Gray catbird
Pied billed grebe	Brown thrasher
Red necked grebe	European starling
Double crested cormorant	Cedar waxwing
Great blue heron	Yellow warbler
Northern harrier	Chestnut sided warbler
Red tailed hawk	American redstart
Killdeer	Ovenbird
Upland sandpiper	Common yellowthroat
Wilson’s snipe	Scarlet tanager
Black tern	Chipping sparrow
Rock pigeon	Clay colored sparrow
Mourning dove	Field sparrow
Great horned owl	Vesper sparrow
Chimney swift	Savannah sparrow
Ruby throated hummingbird	Grasshopper sparrow
Red bellied Woodpecker	Le Conte’s sparrow
Yellow bellied sapsucker	Song sparrow
Downy woodpecker	Swamp sparrow
Hairy woodpecker	Rose breasted grosbeak
Northern flicker	Indigo bunting
Eastern wood-pewee	Bobolink
Alder flycatcher	Red winged blackbird
Willow flycatcher	Western meadowlark
Least flycatcher	Yellow headed blackbird
Eastern phoebe	Brewer’s blackbird
Great crested flycatcher	Common grackle
Western kingbird	Brown headed cowbird
Eastern kingbird	Baltimore oriole
Yellow throated vireo	American goldfinch
Warbling vireo	Baird’s sparrow
Red eyed vireo	Bald eagle
Blue jay	Burrowing owl
American crow	Chestnut collared longspur
Horned lark	Greater prairie chicken
Tree swallow	Henslow’s sparrow
Bank swallow	Loggerhead shrike
Barn swallow	Marbled godwit
Black capped chickadee	Nelson’s sharp tailed sparrow
White breasted nuthatch	Sprague’s pipit
House wren	Trumpeter swan
Wilson’s phalarope	Yellow rail
Northern cardinal	

Attachment 3

Fargo Moorhead Metro

Draft

Feasibility Report

and

Environmental Impact Statement

Cultural Resources Programmatic Agreement

PROGRAMMATIC AGREEMENT AMONG THE U.S. ARMY CORPS OF ENGINEERS, ST. PAUL DISTRICT, THE NORTH DAKOTA STATE HISTORIC PRESERVATION OFFICER, AND THE MINNESOTA STATE HISTORIC PRESERVATION OFFICER REGARDING THE FARGO-MOORHEAD METRO FLOOD RISK MANAGEMENT PROJECT, CASS COUNTY, NORTH DAKOTA AND CLAY COUNTY, MINNESOTA

Draft – May 2010

WHEREAS, the St. Paul District, U.S. Army Corps of Engineers (Corps) is conducting a feasibility study of flood risk management measures for the cities of Fargo, Cass County, North Dakota and Moorhead, Clay County, Minnesota; and

WHEREAS, the Corps is considering the following flood risk management measures for the Fargo Moorhead metropolitan area and adjacent county areas (Figures 1 and 2): (1) Diversion channel on the east (Minnesota) side of the Red River of the North capable of passing 20,000 cfs [tentative National Economic Development (NED) Plan alternative] and (2) Diversion channel on the west (North Dakota) side of the Red River of the North capable of passing 35,000 cfs [Locally Preferred Plan alternative].

WHEREAS, the necessary cultural resources investigations, evaluations, and coordination for compliance with Section 106 of the National Historic Preservation Act of 1966, as amended, cannot be completed by the Corps or its agent prior to starting the design stage of the Fargo-Moorhead Metropolitan Flood Risk Management Project (Project); and

WHEREAS, the Corps has established the Project's Area of Potential Effects (APE), as required by 36 CFR § 800.4(a)(1) and defined in section 800.16(d), as consisting of the footprint of the selected diversion plan including the diversion channel alignment, its associated tieback levee, and associated Red River and Wild Rice River breakout channels (Minnesota diversion alternative only), plus associated construction work areas, staging areas, borrow areas, and disposal areas, and the viewshed to one-half mile from the diversion channel's, breakout channels', and tieback levee's centerlines; and

WHEREAS, the Corps has determined that the Project may have effects on historic properties within the APE and has consulted with the Advisory Council on Historic Preservation (Advisory Council) pursuant to section 800.2(b) of the regulations (36 CFR Part 800) implementing Section 106 of the National Historic Preservation Act (16 U.S.C. § 470f), and the Advisory Council has declined to participate in the Programmatic Agreement for this Project; and

WHEREAS, the City of Fargo, North Dakota, and the City of Moorhead, Minnesota (Cities), as the non-Federal sponsors for the Project, have participated in consultation on the Project's flood risk management measures and have been invited to concur in this Programmatic Agreement as consulting parties; and

WHEREAS, Cass County in North Dakota and Clay County in Minnesota are also interested parties and have been invited to participate in consultation on the Project's flood risk management measures and to concur in this Programmatic Agreement as consulting parties; and

WHEREAS, the Corps' St. Paul District Engineer initially contacted the chairman or chairwoman of the Sisseton-Wahpeton Oyate, the White Earth Band of Minnesota Chippewa, the Leech Lake Band of Ojibwe, the Turtle Mountain Band of Chippewa, the Upper Sioux Community of Minnesota, the Lower Sioux Indian Community, the Spirit Lake Tribe, and the Red Lake Band of Chippewa Indians, by letter dated April 8, 2009, to determine these tribes' interest in the Project, particularly regarding potential Project effects on properties important to their history, culture, or religion, including traditional cultural properties, and the Corps will continue consultation with any of these tribes interested in this Project; and

WHEREAS, the Leech Lake Band of Ojibwe's Tribal Historic Preservation Officer responded on May 1, 2009, that there were no sites of concern to the Leech Lake Band in the Project area, and no other tribes have responded to date; and

WHEREAS, the general public's opinions and comments on the Project and its alternative alignments have been and will be solicited through public meetings, including those held to comply with the National Environmental Policy Act (NEPA);

NOW THEREFORE, the Corps, the North Dakota State Historic Preservation Officer (SHPO), and the Minnesota State Historic Preservation Officer agree that upon filing this Programmatic Agreement (PA) with the Advisory Council on Historic Preservation, the Corps will implement the following stipulations in order to comply with Section 106 of the National Historic Preservation Act, as amended, with respect to the Project.

STIPULATIONS

The Corps will ensure that the following measures are carried out prior to the start of construction on Project flood risk management features at the cities of Fargo, North Dakota, and Moorhead, Minnesota:

A. The Corps will ensure that archeologists, historians, and architectural historians meeting the Secretary of the Interior's professional qualification standards (given in Appendix A of 36 CFR Part 61) will conduct or directly supervise all cultural resources identification, evaluation, and mitigation related to this Project, to include archeological surveys and testing, historic structure inventories and evaluation, and data recovery and documentation mitigation.

B. <u>Literature and Records Search</u> – Prior to conducting any fieldwork, the Corps or its contractors or the Cities' contractors shall at a minimum consult the site files, previous survey reports, and other documents at the Historic Preservation Division of the State Historical Society of North Dakota at Bismarck and at the State Historic Preservation Office at the Minnesota Historical Society in St. Paul, for information on previously recorded cultural resources sites, site leads, and previously surveyed areas in the Project's APE.

C. Phase I Cultural Resources Investigation – The Corps or its contractors or the Cities' contractors will conduct a pedestrian survey of all previously uninventoried project areas in order to locate any cultural resources (prehistoric, historic, and architectural) within the Project's APE. The cultural resources investigation will be an intensive, on-the-ground study of the area sufficient to determine the number and extent of the resources present and their relationships to Project features.

D. Phase II Testing and Evaluation – The Corps or its contractors or the Cities' contractors will evaluate the National Register of Historic Places eligibility of all cultural resources sites or structures over 50 years old located within the APE. Evaluation shall include intensive testing to determine the information potential of prehistoric and historic archeological sites and archival research for historic archeological and architectural sites. The Corps will request the concurrence of the North Dakota SHPO or Minnesota SHPO, whichever is applicable, in determining each such site or structure's eligibility or non-eligibility to the National Register.

E. Phase III Mitigation – The Corps will avoid or minimize Project-related adverse effects to historic properties (National Register of Historic Places-listed or eligible sites, structures, buildings, districts, or objects) to the extent practicable. Where adverse effects due to the Project are not avoidable, the Corps will coordinate a data recovery or mitigation plan with the North Dakota and/or Minnesota SHPO and the other consulting parties, any affected Indian tribes, and other interested parties, as applicable, to mitigate the adverse effects. The Corps or its contractor or the Cities' contractor will then implement the data recovery or mitigation plan, which will be completed prior to the start of Project construction in that area. Mitigation will specifically address Project-related adverse effects on the integrity and characteristics of a historic property which make it eligible to the National Register.

F. Burials – If any human burials are encountered during the cultural resources field work or Project construction, the Corps and its contractors and the Cities' contractors will comply with the Native American Graves Protection and Repatriation Act (NAGPRA) for federal or tribal lands, or with North Dakota Century Code Section 23-06-27, "Protection of Human Burial Sites, Human Remains, and Burial Goods," and North Dakota Administrative Code Chapter 40-02-03, "Protection of Prehistoric and Historic Human Burial Sites, Human Remains, and Burial Goods," for all other lands in North Dakota, or with Minnesota Statutes Section 307.08, Minnesota Private Cemeteries Act, for all other lands in Minnesota, whichever is applicable.

G. Traditional Cultural Properties – The Corps will consult and coordinate with the Sisseton-Wahpeton Oyate, the White Earth Band of Minnesota Chippewa, the Turtle Mountain Band of Chippewa, the Upper Sioux Community of Minnesota, the Lower Sioux Indian Community, the Spirit Lake Tribe, and the Red Lake Band of Chippewa Indians to identify sites of traditional religious or cultural importance to the tribe or their members within the Project area. Such sites shall be avoided or adverse effects to them minimized to the extent practicable and the remaining effects mitigated per a plan developed between the Corps, the applicable SHPO, and the affected tribe(s).

H. Curation – The Corps or its contractors or the Cities' contractors shall ensure that all materials and records resulting from the survey, evaluation, and data recovery or mitigation conducted for the Project will be curated in accordance with 36 CFR Part 79, "Curation of Federally-Owned and Administered Archeological Collections" at a facility within the state of North Dakota or the state of Minnesota, depending upon the location of the cultural resources fieldwork or site(s) being investigated, unless the private landowner wishes to retain ownership of artifacts recovered from his/her land.

ADMINISTRATIVE PROCEDURES

I. Dispute Resolution – Should the North Dakota SHPO, the Minnesota SHPO, an Indian tribe, or other consulting party object to any plans, documents, or reports prepared under the terms of this PA within 30 days after receipt, the Corps shall consult with the party to resolve the objection. If the Corps determines that the objection cannot be resolved, the Corps shall forward all documentation relevant to the dispute to the Advisory Council. Any recommendation or comment provided by the Advisory Council will be understood to pertain only to the subject of the dispute. The Corps' responsibility to carry out all actions under this PA that are not the subject of the dispute will remain unchanged.

J. Amendments – Any party to this PA may request that it be amended, whereupon the parties will consult to consider such amendment. The PA may only be amended with the written concurrence of all parties who have signed the PA.

K. Termination – Any signatory party to this PA may terminate it by providing thirty (30) days notice to the other parties, provided that the parties will consult during the period prior to termination to seek agreement on amendments or other actions that would avoid termination. In the event of termination, the Corps will coordinate with the Advisory Council in order to fulfill its compliance obligation under the National Historic Preservation Act.

L. Anti-Deficiency Provision – All obligations on the part of the Corps under this PA shall be subject to and dependent upon the appropriation and allocation of funds to the St. Paul District for such purposes.

M. Sunset Clause – This PA will continue in full force and effect for ten (10) years and all terms of the PA are met, unless the Project is terminated or authorization is rescinded.

Execution and implementation of this Programmatic Agreement evidences that the Corps has satisfied its Section 106 responsibilities for all aspects of this undertaking.

ST. PAUL DISTRICT, U.S. ARMY CORPS OF ENGINEERS

BY: ______________________________ Date: __________________

COL. Jon L. Christensen, District Engineer

NORTH DAKOTA STATE HISTORIC PRESERVATION OFFICER

BY: ______________________________ Date: ______________
Merlan E. Paaverud, Jr., State Historic Preservation Officer

MINNESOTA STATE HISTORIC PRESERVATION OFFICER

BY: ______________________________ Date: ______________
Nina Archabal, Director, Minnesota Historical Society

Concur:

CITY OF FARGO

BY: ______________________________ Date: ______________
Dennis Walaker, Mayor

CITY OF MOORHEAD

BY: ______________________________ Date: ______________
Mark Voxland, Mayor

CASS COUNTY BOARD OF COMMISSIONERS

BY: ______________________________ Date: ______________
Darrell Vanyo, Chairman

CLAY COUNTY BOARD OF COMMISSIONERS

BY: ______________________________ Date: ______________
Kevin Campbell, Chairman

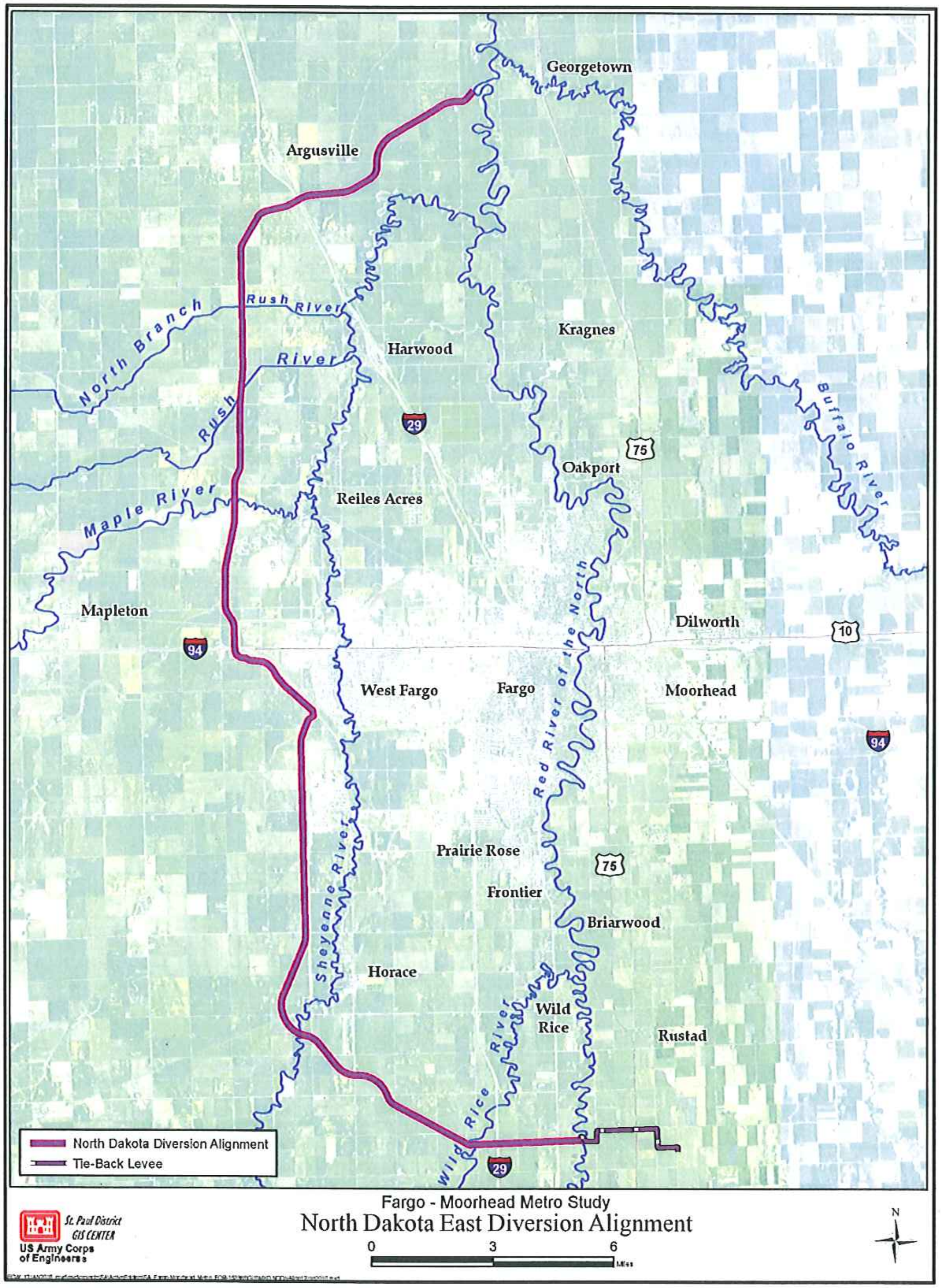


Figure 1. North Dakota diversion alignment.

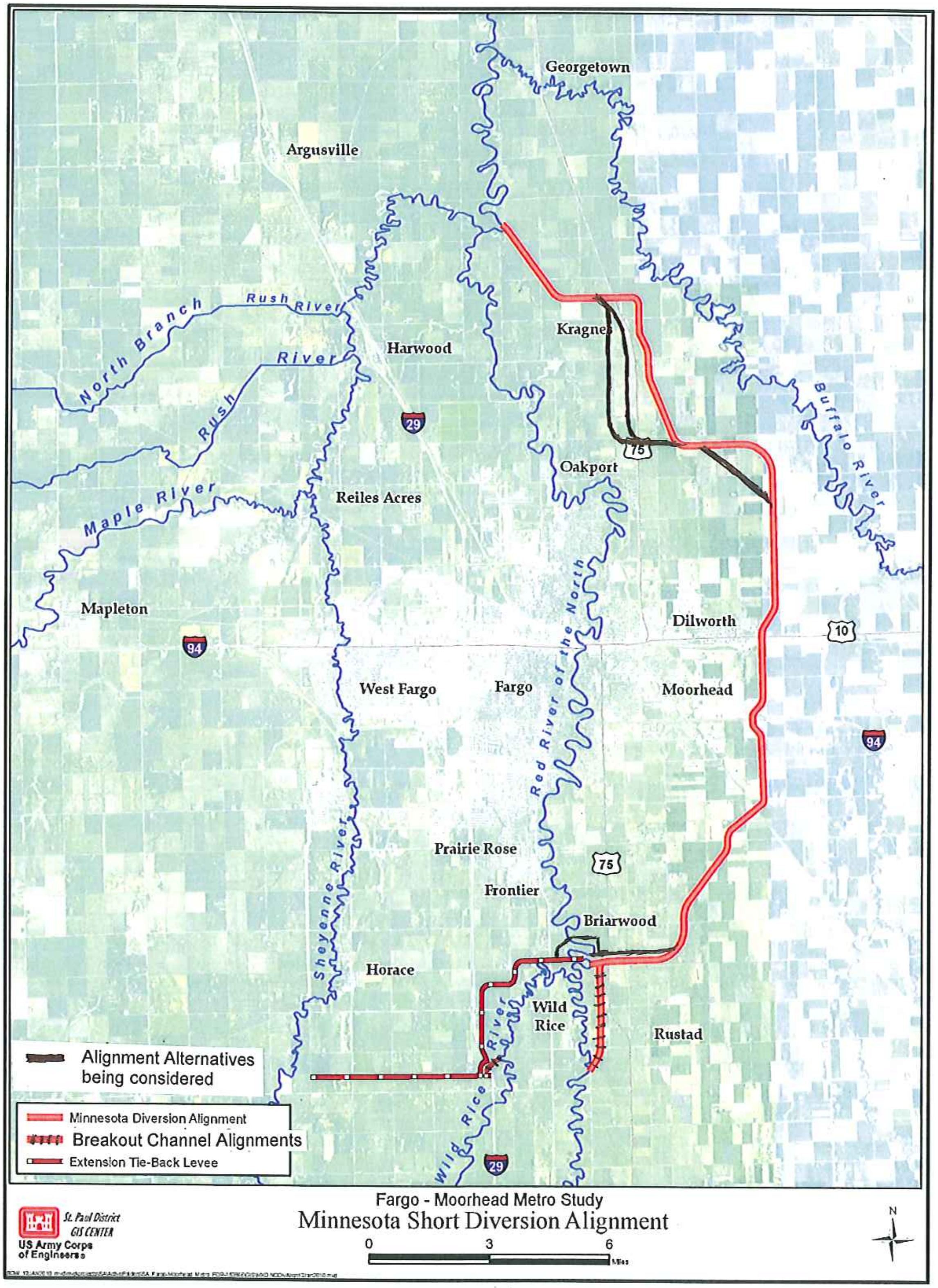


Figure 2. Minnesota diversion alignment.

File copy
Sent 5-18-10

May 17, 2010

Regional Planning and Environment Division North
Environmental and GIS Branch

SUBJECT: Fargo-Moorhead Metropolitan Flood Risk Management Feasibility Study, Cass County, North Dakota and Clay County, Minnesota, Draft Cultural Resources Programmatic Agreement

Ms. Susan Quinnell
Review and Compliance Coordinator
Historic Preservation Division
State Historical Society of North Dakota
612 East Boulevard Avenue
Bismarck, North Dakota 58505-0830

Dear Ms. Quinnell:

The enclosed draft Programmatic Agreement covers the St. Paul District, U.S. Army Corps of Engineers' responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended, for the Fargo-Moorhead Metropolitan Flood Risk Management Project in Cass County, North Dakota and Clay County, Minnesota. Two alternatives are still being considered under the ongoing feasibility study. The National Economic Development (NED) Plan alternative consists of a 26¼-mile-long diversion channel alignment, a Red River breakout channel, and 1.3 miles of tieback levee on the Minnesota side of the Red River, and 9.9 miles of tieback levee and a Wild Rice River breakout channel on the North Dakota side of the Red River (Figure 1). The tentatively selected Locally Preferred Plan (LPP) alternative consists of a 36-mile-long diversion channel alignment on the North Dakota side of the Red River and its associated 3.3-mile-long tieback levee on the Minnesota side of the Red River (Figure 2).

The project's Area of Potential Effect (APE) consists of the footprint of the selected diversion plan including the diversion channel alignment, its tieback levee, associated breakout channels (Minnesota diversion alternative only), and associated construction work areas, staging areas, borrow areas, and disposal areas. Indirect visual effects to historic properties are possible within one-half mile from the diversion channel's, tieback levee's, and breakout channels' centerlines. The enclosed Programmatic Agreement stipulates that the Corps or its contractors or the Cities of Fargo and Moorhead's contractors will complete the cultural resources inventory of the selected project area, evaluate the National Register of Historic Places eligibility of all cultural resources sites therein, and mitigate project-related adverse effects to National Register listed or eligible properties prior to the start of construction.

Please review the draft Programmatic Agreement and provide any comments to the Corps by June 21, 2010. If you have any questions on either the feasibility study or the Programmatic Agreement, please contact Corps archeologist Virginia Gnabasik at (651) 290-5262 or by email at virginia.r.gnabasik@usace.army.mil.

The St. Paul District Corps is moving to a new building. Our new address starting on June 14, 2010, will be: U.S. Army Corps of Engineers, St. Paul District, 180 Fifth Street East, Suite 700, St. Paul, MN 55101-1678.

Sincerely,

Terry J. Birkenstock
Chief, Environmental and GIS Branch

Enclosures
Draft PA
2 figures

PD-E, Gnabasik VG
PD-E, Devendorf
PM-A, A. Snyder
PD-E, Birkenstock

May 17, 2010

Regional Planning and Environment Division North
Environmental and GIS Branch

SUBJECT: Fargo-Moorhead Metropolitan Flood Risk Management Feasibility Study, Cass County, North Dakota and Clay County, Minnesota, Draft Cultural Resources Programmatic Agreement

Ms. Mary Ann Heidemann
Manager, Government Programs and Compliance
State Historic Preservation Office
Minnesota Historical Society
345 Kellogg Boulevard West
St. Paul, Minnesota 55102-1906

Dear Ms. Heidemann:

The enclosed draft Programmatic Agreement covers the St. Paul District, U.S. Army Corps of Engineers' responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended, for the Fargo-Moorhead Metropolitan Flood Risk Management Project in Clay County, Minnesota and Cass County, North Dakota. Two alternatives are still being considered under the ongoing feasibility study. The National Economic Development (NED) Plan alternative consists of a 26¼-mile-long diversion channel alignment, a Red River breakout channel, and 1.3 miles of tieback levee on the Minnesota side of the Red River, and 9.9 miles of tieback levee and a Wild Rice River breakout channel on the North Dakota side of the Red River (Figure 1). The tentatively selected Locally Preferred Plan (LPP) alternative consists of a 36-mile-long diversion channel alignment on the North Dakota side of the Red River and its associated 3.3-mile-long tieback levee on the Minnesota side of the Red River (Figure 2).

The project's Area of Potential Effect (APE) consists of the footprint of the selected diversion plan including the diversion channel alignment, its tieback levee, associated breakout channels (Minnesota diversion alternative only), and associated construction work areas, staging areas, borrow areas, and disposal areas. Indirect visual effects are possible within one-half mile from the diversion channel's, tieback levee's, and breakout channels' centerlines. The enclosed Programmatic Agreement stipulates that the Corps or its contractors or the Cities of Fargo and Moorhead's contractors will complete the cultural resources inventory of the selected project area, evaluate the National Register of Historic Places eligibility of all cultural resources sites therein, and mitigate project-related adverse effects to National Register listed or eligible properties prior to the start of construction.

Please review the draft Programmatic Agreement and provide any comments to the Corps by June 21, 2010. If you have any questions on either the feasibility study or the Programmatic Agreement, please contact Corps archeologist Virginia Gnabasik at (651) 290-5262 or by email at virginia.r.gnabasik@usace.army.mil.

The St. Paul District Corps is moving to a new building. Our new address starting on June 14, 2010, will be: U.S. Army Corps of Engineers, St. Paul District, 180 Fifth Street East, Suite 700, St. Paul, MN 55101-1678.

Sincerely,

Terry J. Birkenstock
Chief, Environmental and GIS Branch

Enclosures
Draft PA
2 figures

May 17, 2010

Regional Planning and Environment Division North
Environmental and GIS Branch

SUBJECT: Fargo-Moorhead Metropolitan Flood Risk Management Feasibility Study, Cass County, North Dakota and Clay County, Minnesota, Draft Cultural Resources Programmatic Agreement

Mr. Mark Bittner
City Engineer
Fargo Engineering Department
200 3rd Street North
Fargo, North Dakota 58102

Dear Mr. Bittner:

The enclosed draft Programmatic Agreement covers the St. Paul District, U.S. Army Corps of Engineers' responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended, for the Fargo-Moorhead Metropolitan Flood Risk Management Project in Cass County, North Dakota and Clay County, Minnesota. Two alternatives are still being considered under the feasibility study. The National Economic Development (NED) Plan alternative consists of a 26¼-mile-long diversion channel alignment, a Red River breakout channel, and 1.3 miles of tieback levee on the Minnesota side of the Red River, and 9.9 miles of tieback levee and a Wild Rice River breakout channel on the North Dakota side of the Red River (Figure 1). The tentatively selected Locally Preferred Plan (LPP) alternative consists of a 36-mile-long diversion channel alignment on the North Dakota side of the Red River and its associated 3.3-mile-long tieback levee on the Minnesota side of the Red River (Figure 2).

The project's Area of Potential Effect (APE) consists of the footprint of the selected diversion plan including the diversion channel alignment, its tieback levee, associated breakout channels (Minnesota diversion alternative only), and associated construction work areas, staging areas, borrow areas, and disposal areas. Indirect visual effects to historic properties are possible within one-half mile from the diversion channel's, tieback levee's, and breakout channels' centerlines. The enclosed Programmatic Agreement stipulates that the Corps or its contractors or the Cities of Fargo and Moorhead's contractors will complete the cultural resources inventory of the selected project area, evaluate the National Register of Historic Places eligibility of all cultural resources sites therein, and mitigate project-related adverse effects to National Register listed or eligible properties prior to the start of construction.

Please review the draft Programmatic Agreement and provide any comments to the Corps by June 21, 2010. If you have any questions on either the feasibility study or the Programmatic

Agreement, please contact Corps archeologist Virginia Gnabasik at (651) 290-5262 or by email at virginia.r.gnabasik@usace.army.mil.

The St. Paul District Corps is moving to a new building. Our new address starting on June 14, 2010, will be: U.S. Army Corps of Engineers, St. Paul District, 180 Fifth Street East, Suite 700, St. Paul, MN 55101-1678.

Sincerely,

Terry J. Birkenstock
Chief, Environmental and GIS Branch

Enclosures
Draft PA
2 figures

May 17, 2010

Regional Planning and Environment Division North
Environmental and GIS Branch

SUBJECT: Fargo-Moorhead Metropolitan Flood Risk Management Feasibility Study, Cass County, North Dakota and Clay County, Minnesota, Draft Cultural Resources Programmatic Agreement

Mr. Bob Zimmerman
City Engineer
City of Moorhead Engineering Department
500 Center Avenue, 4th Floor
Moorhead, Minnesota 56560

Dear Mr. Zimmerman:

The enclosed draft Programmatic Agreement covers the St. Paul District, U.S. Army Corps of Engineers' responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended, for the Fargo-Moorhead Metropolitan Flood Risk Management Project in Clay County, Minnesota and Cass County, North Dakota. Two alternatives are still being considered under the feasibility study. The National Economic Development (NED) Plan alternative consists of a 26¼-mile-long diversion channel alignment, a Red River breakout channel, and 1.3 miles of tieback levee on the Minnesota side of the Red River, and 9.9 miles of tieback levee and a Wild Rice River breakout channel on the North Dakota side of the Red River (Figure 1). The tentatively selected Locally Preferred Plan (LPP) alternative consists of a 36-mile-long diversion channel alignment on the North Dakota side of the Red River and its associated 3.3-mile-long tieback levee on the Minnesota side of the Red River (Figure 2).

The project's Area of Potential Effect (APE) consists of the footprint of the selected diversion plan including the diversion channel alignment, its tieback levee, associated breakout channels (Minnesota diversion alternative only), and associated construction work areas, staging areas, borrow areas, and disposal areas. Indirect visual effects to historic properties are possible within one-half mile from the diversion channel's, tieback levee's, and breakout channels' centerlines. The enclosed Programmatic Agreement stipulates that the Corps or its contractors or the Cities of Fargo and Moorhead's contractors will complete the cultural resources inventory of the selected project area, evaluate the National Register of Historic Places eligibility of all cultural resources sites therein, and mitigate project-related adverse effects to National Register listed or eligible properties prior to the start of construction.

Please review the draft Programmatic Agreement and provide any comments to the Corps by June 21, 2010. If you have any questions on either the feasibility study or the Programmatic

Agreement, please contact Corps archeologist Virginia Gnabasik at (651) 290-5262 or by email at virginia.r.gnabasik@usace.army.mil.

The St. Paul District Corps is moving to a new building. Our new address starting on June 14, 2010, will be: U.S. Army Corps of Engineers, St. Paul District, 180 Fifth Street East, Suite 700, St. Paul, MN 55101-1678.

Sincerely,

Terry J. Birkenstock
Chief, Environmental and GIS Branch

Enclosures
Draft PA
2 figures

May 17, 2010

Regional Planning and Environment Division North
Environmental and GIS Branch

SUBJECT: Fargo-Moorhead Metropolitan Flood Risk Management Feasibility Study, Cass County, North Dakota and Clay County, Minnesota, Draft Cultural Resources Programmatic Agreement

Mr. Darrell Vanyo
Chairman
Cass County Board of Commissioners
P.O. Box 2806
Fargo, North Dakota 58108-2806

Dear Mr. Vanyo:

The enclosed draft Programmatic Agreement covers the St. Paul District, U.S. Army Corps of Engineers' responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended, for the Fargo-Moorhead Metropolitan Flood Risk Management Project in Cass County, North Dakota and Clay County, Minnesota. Two alternatives are still being considered under the feasibility study. The National Economic Development (NED) Plan alternative consists of a 26¼-mile-long diversion channel alignment, a Red River breakout channel, and 1.3 miles of tieback levee on the Minnesota side of the Red River, and 9.9 miles of tieback levee and a Wild Rice River breakout channel on the North Dakota side of the Red River (Figure 1). The tentatively selected Locally Preferred Plan (LPP) alternative consists of a 36-mile-long diversion channel alignment on the North Dakota side of the Red River and its associated 3.3-mile-long tieback levee on the Minnesota side of the Red River (Figure 2).

The project's Area of Potential Effect (APE) consists of the footprint of the selected diversion plan including the diversion channel alignment, its tieback levee, associated breakout channels (Minnesota diversion alternative only), and associated construction work areas, staging areas, borrow areas, and disposal areas. Indirect visual effects to historic properties are possible within one-half mile from the diversion channel's, tieback levee's, and breakout channels' centerlines. The enclosed Programmatic Agreement stipulates that the Corps or its contractors or the Cities of Fargo and Moorhead's contractors will complete the cultural resources inventory of the selected project area, evaluate the National Register of Historic Places eligibility of all cultural resources sites therein, and mitigate project-related adverse effects to National Register listed or eligible properties prior to the start of construction.

Please have the Cass County Board of Commissioners review the draft Programmatic Agreement and provide any comments to the Corps by June 21, 2010. If you have any questions on either the feasibility study or the Programmatic Agreement, please contact Corps archeologist Virginia Gnabasik at (651) 290-5262 or by email at virginia.r.gnabasik@usace.army.mil.

The St. Paul District Corps is moving to a new building. Our new address starting on June 14, 2010, will be: U.S. Army Corps of Engineers, St. Paul District, 180 Fifth Street East, Suite 700, St. Paul, MN 55101-1678.

Sincerely,

Terry J. Birkenstock
Chief, Environmental and GIS Branch

Enclosures
Draft PA
2 figures

May 17, 2010

Regional Planning and Environment Division North
Environmental and GIS Branch

SUBJECT: Fargo-Moorhead Metropolitan Flood Risk Management Feasibility Study, Cass County, North Dakota and Clay County, Minnesota, Draft Cultural Resources Programmatic Agreement

Mr. Kevin Campbell
Chairman
Clay County Board of Commissioners
Clay County Courthouse
807 11th Street North
Moorhead, Minnesota 56560

Dear Mr. Campbell:

The enclosed draft Programmatic Agreement covers the St. Paul District, U.S. Army Corps of Engineers' responsibilities under Section 106 of the National Historic Preservation Act of 1966, as amended, for the Fargo-Moorhead Metropolitan Flood Risk Management Project in Clay County, Minnesota and Cass County, North Dakota. Two alternatives are still being considered under the feasibility study. The National Economic Development (NED) Plan alternative consists of a 26¼-mile-long diversion channel alignment, a Red River breakout channel, and 1.3 miles of tieback levee on the Minnesota side of the Red River, and 9.9 miles of tieback levee and a Wild Rice River breakout channel on the North Dakota side of the Red River (Figure 1). The tentatively selected Locally Preferred Plan (LPP) alternative consists of a 36-mile-long diversion channel alignment on the North Dakota side of the Red River and its associated 3.3-mile-long tieback levee on the Minnesota side of the Red River (Figure 2).

The project's Area of Potential Effect (APE) consists of the footprint of the selected diversion plan including the diversion channel alignment, its tieback levee, associated breakout channels (Minnesota diversion alternative only), and associated construction work areas, staging areas, borrow areas, and disposal areas. Indirect visual effects to historic properties are possible within one-half mile from the diversion channel's, tieback levee's, and breakout channels' centerlines. The enclosed Programmatic Agreement stipulates that the Corps or its contractors or the Cities of Fargo and Moorhead's contractors will complete the cultural resources inventory of the selected project area, evaluate the National Register of Historic Places eligibility of all cultural resources sites therein, and mitigate project-related adverse effects to National Register listed or eligible properties prior to the start of construction.

Please have the Clay County Board of Commissioners review the draft Programmatic Agreement and provide any comments to the Corps by June 21, 2010. If you have any questions on either the feasibility study or the Programmatic Agreement, please contact Corps archeologist Virginia Gnabasik at (651) 290-5262 or by email at virginia.r.gnabasik@usace.army.mil.

The St. Paul District Corps is moving to a new building. Our new address starting on June 14, 2010, will be: U.S. Army Corps of Engineers, St. Paul District, 180 Fifth Street East, Suite 700, St. Paul, MN 55101-1678.

Sincerely,

Terry J. Birkenstock
Chief, Environmental and GIS Branch

Enclosures
Draft PA
2 figures

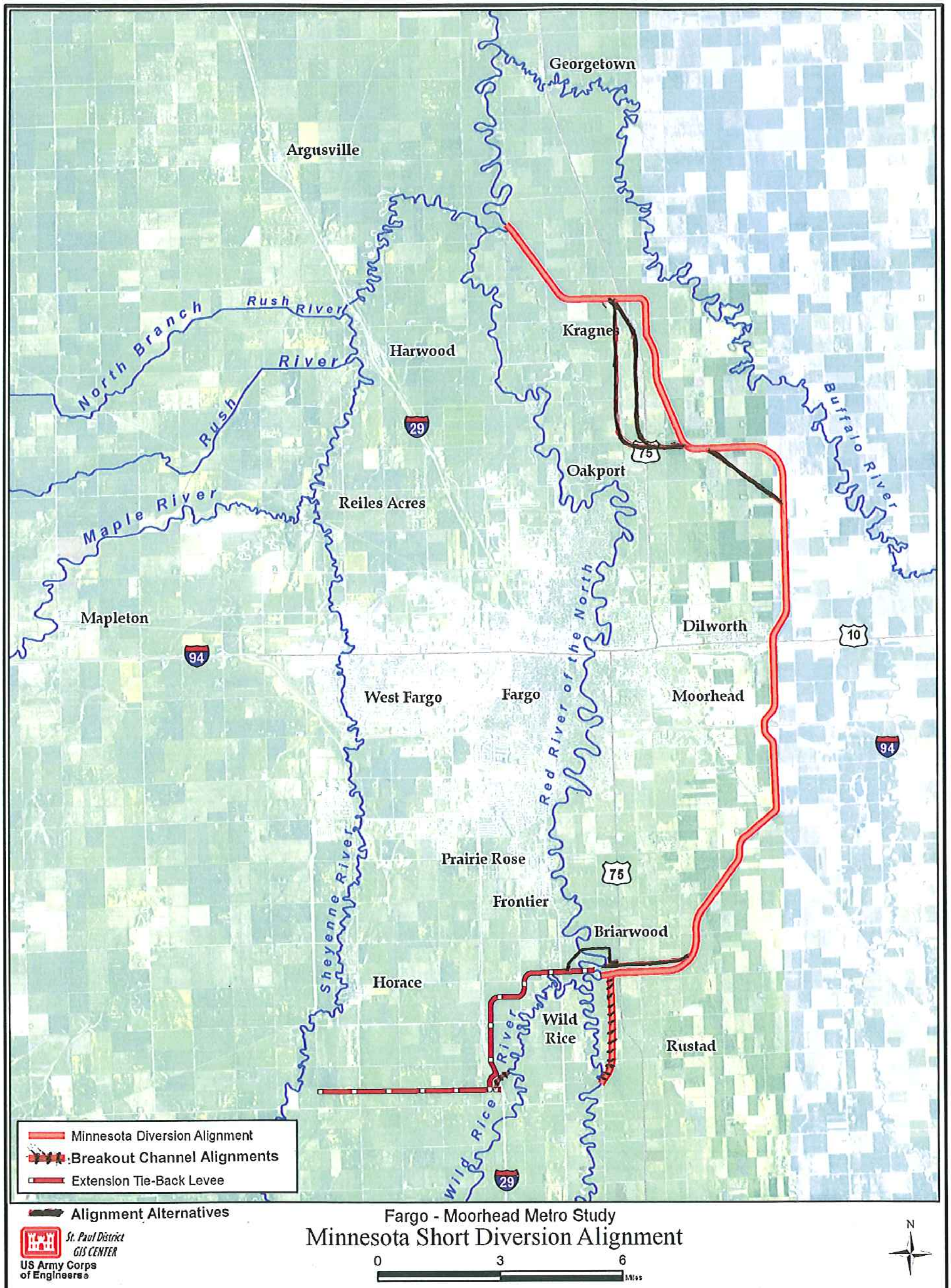


Figure 1. Minnesota Diversion Alignment and associated features.

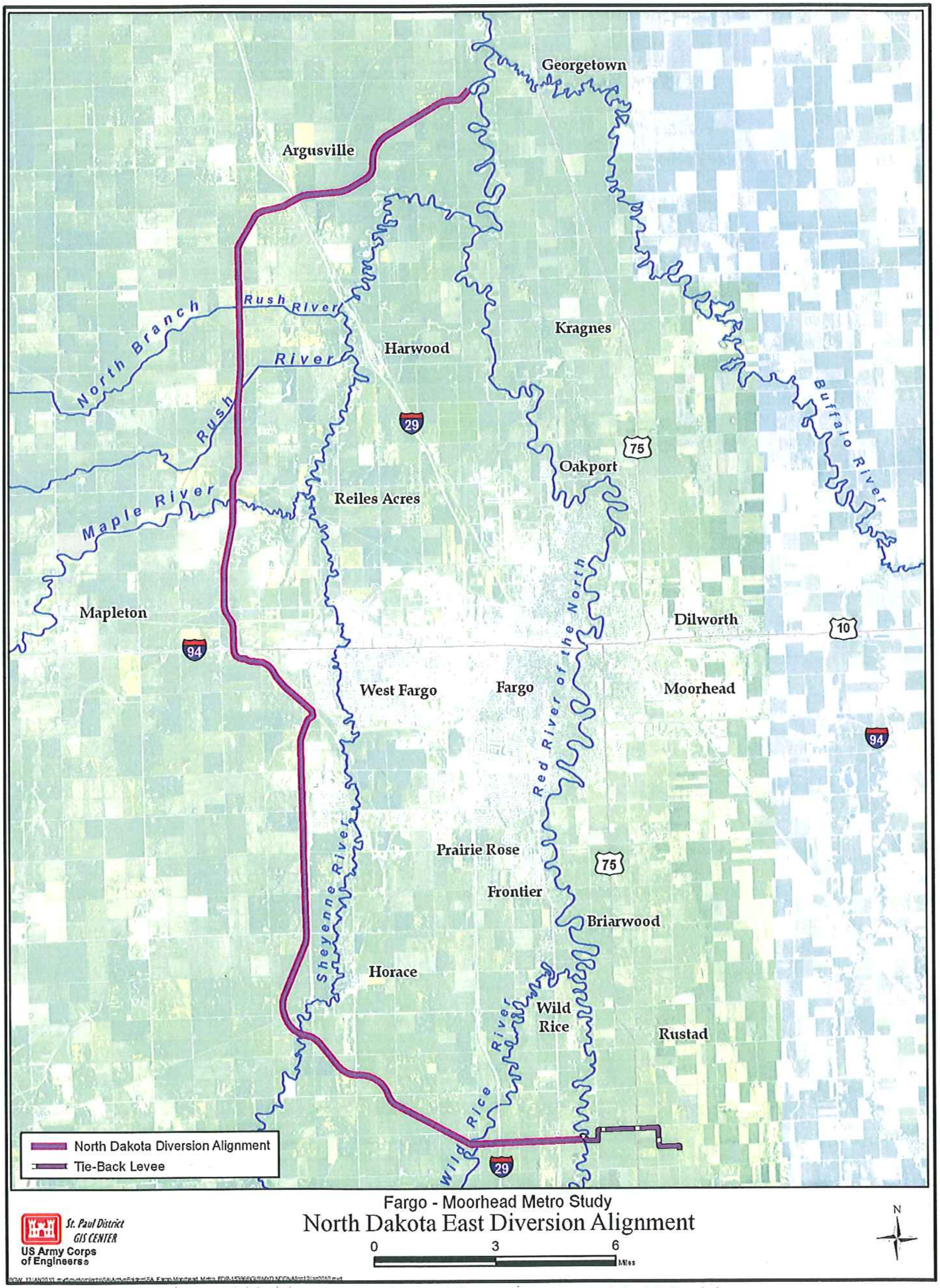


Figure 2. North Dakota Diversion Alignment and associated tieback levee.

Attachment 4

Fargo Moorhead Metro

Draft

Feasibility Report

and

Environmental Impact Statement

Mailing List

	Number of Copies			
	DEIS/CD + tech app	DEIS/Paper no app	DEIS/Paper + tech app	Final EIS
FEDERAL AGENCIES				
Advisory Council on Historic Preservation				
Mr. John M. Fowler Executive Director Advisory Council on Historic Preservation 1100 Pennsylvania Avenue NW, Suite 803 Washington, DC 20004 Phone: 202.606.8503	1		1	1
Eastern Office of Project Review Advisory Council on Historic Preservation 1100 Pennsylvania Avenue NW, Suite 803 Washington, D.C. 20004	1		1	1
Department of Agriculture				
State Director ND State Farm Service Agency Office 1025 28th Street South Fargo, ND 58103	2	2		2
Regional Forester, Northern Region 1 USDA Forest Service Federal Building P.O. Box 7669 Missoula, MT 59807 Phone: 406.329.3315	2	2		2
U.S. Forest Service Eastern Region-9 626 East Wisconsin Avenue Milwaukee, WI 53202 Phone: 414.297.3600	2	2		2
North Dakota State Conservationist , Paul Sweeny Natural Resources Conservation Service Federal Building 220 E. Rosser Ave. Room 270 Bismarck, ND 58502-1458 Phone: 701.530.2003	2	2		2
Minnesota State Conservationist, Don A. Baloun United States Department of Agriculture Natural Resources Conservation Service 375 Jackson Street, Suite 600 Saint Paul, Minnesota 55101 Phone: 651. 602.7900	2	2		2

Department of Commerce				
Director, Office of Ecology and Conservation National Oceanic and Atmospheric Administration Department of Commerce, Room 6117 1401Constitution Ave., NW Washington, DC 20230	3		2	2
Environmental Protection Agency				
USEPA, Office of Federal Activities EIS Filing Section Room 7220, Mail Code 2252A South Ariel Rios Building 1200 Pennsylvania Avenue, NW. Washington, DC 20460 **(EIS Filing)** **FOR COURIER SERVICE USE THE FOLLOWING:** USEPA, Office of Federal Activities EIS Filing Section Room 7220 (202) 564-2400 South Ariel Rios Building 1200 Pennsylvania Avenue, NW. Washington, DC 20460	3		2	5
Chief, NEPA Unit USEPA, Region 8 (8EPR-N) 1595 Winkoop Street Denver, Colorado 80202-1129 Phone: 303.312.6870	1		2	5
Ken Westlake (E-19J) NEPA Implementation Section USEPA Region 5 77 West Jackson Blvd. Chicago, IL 60604-3590 Phone: 800.621.8431	1		2	1
Department of Energy				
Office of NEPA Policy and Compliance Department of Energy GC-54 1000 Independence Ave., SW Washington, DC 20585 Phone: 202.586.4600	4	1		5
Federal Emergency Management Agency				
Federal Emergency Management Agency Federal Center Plaza Room 713 500 C Street, SW Washington, DC 20472 Phone: 202.646.2500	1	1		1

Cathy Brock Federal Emergency Management Agency Region 8 Denver Federal Center Building 710, Box 25267 Denver, CO 80225-0267 Phone: 303.235.4800	1	1		1
Federal Emergency Management Agency Region 5 536 South Clark Street 6th Floor Chicago, IL 60605 Phone: 312.408.5500	1	1		1
Department of Interior				
Director Office of Environmental Policy and Compliance Department of the Interior Main Interior Building MS-2462 1849 and C Street, NW Washington, DC 20240 Phone: 202.208.3100	2		1	1
Mr. Tony Sullins U.S. Fish and Wildlife Service Twin cities Field Office 4101 East 80th Street Bloomington, MN 55425 Phone: 612.725.3548	1	1		1
Mr. Jeffrey Towner U.S. Fish and Wildlife Service 3425 Miriam Avenue Bismarck, MD 58501	1	1		1
U.S. Geological Survey District Chief- Gregg Wiche 821 East Interstate Avenue Bismarck, ND 58501- 1199 Phone: 701.250.7401	1	1		1
U.S. Geological Survey District Chief- Jim Stark 2280 Woodale Drive Mounds View, MN 55112 Phone: 763.783.3100	1	1		1
Bureau of Indian Affairs Aberdeen Area Office 115-4th Avenue SE Aberdeen, SD 57401 Phone: 605.226.7343	1	2		1
Bureau of Reclamation Dakota Areas Office PO Box 1017 Bismarck, ND 58502 Phone: 701.250.4242	1	1		1

Department of State				
Office of Environmental Policy Main Department Building 2201 C Street, NW Washington, DC 20520	4		1	5
Department of Transportation				
North Dakota Division 1471 Interstate Loop Bismarck, ND 58503-0567 Phone: 701.250.4204		3		3
Regional Director, Region 8 Federal Railroad Administration 500 East Broadway Murdock Executive Building Suite 240 Vancouver WA 98660 Phone: 360.696.7536		2		2
Regional Director, Region 4 Federal Railroad Administration 200 West Adams Street, Suite 310 Chicago, IL 60606 Phone: 312.353.6203	1			1
Federal Aviation Administration 800 Independence Avenue, SW Washington, DC 20591 Phone: 1-866-835-5322	1	1		1
CORPS OFFICES				
Corps of Engineers Mississippi Valley Division 1400 Walnut Street Vicksburg, MS 39181-0080			5	5
Corps of Engineers 441 G Street NW Washington, DC 20314			5	5
Congressional				
Honorable Kent Conrad U.S. Senate 530 Hart Senate Office Bldg. Washington, DC 20510 Phone: 202.224.2043			1	1
Honorable Byron Dorgan U.S. Senate 322 Hart Senate Office Bldg. Washington, DC 20510 Phone: 202.224.2551			1	1
Honorable Al Franken U.S. Senate 320 Hart Senate Office Bldg. Washington, DC 20510 Phone: 202.224.5641			1	1

Honorable Amy Klobuchar U.S. Senate 302 Hart Senate Office Bldg. Washington, DC 20510 Phone: 202.224.3244			1	1
Honorable Collin Peterson U.S. House of Representatives 2211 Rayburn HOB Washington, DC 20515			1	1
Honorable Earl Pomeroy U.S. House of Representatives 1501 Longworth HOB Washington, DC 20515-3401			1	1
TRIBES				
*Honorable Erma Vizenor Chairwoman *Mr. Tom McCauley Tribal Historic Preservation Officer White Earth Reservation Business Committee P.O. Box 418 White Earth, MN 56591			2	2
* Honorable Richard Marcellais Chairman * Mr. Brady Grant Tribal Historic Preservation Officer Turtle Mountain Band of Chippewa P.O. Box 900 Belcourt, North Dakota 58316			2	2
*Honorable Kevin Jensvold Chairman *Mr. Scott Larson Member-At-Large Upper Sioux Community of Minnesota P.O. Box 147 Granite Falls, Minnesota 56241-0147			2	2
*Honorable Shannon Blue President *Ms. Pamela Halverson Tribal Historic Preservation Officer Lower Sioux Indian Community P.O. Box 308 Morton, Minnesota 56270			2	2

*Honorable Myra Pearson Chairwoman Spirit Lake Tribal Council P.O. Box 359 Fort Totten, North Dakota 58335			2	2
*Honorable Floyd Jourdain Chairman Red Lake Band of Chippewa Indians P.O. Box 550 Red Lake, Minnesota 56671			2	2
*Mr. Les Peterson Archeologist/Environmental Specialist Red Lake Band of Chippewa Indians Tribal Engineering P.O. Box 274 Red Lake, Minnesota 56671			2	2
STATE OF MINNESOTA				
Honorable Tim Pawlenty 130 Capitol Bldg. 75 Rev. Dr. Martin Luther King Jr. Blvd St. Paul, MN 55155	1	1		1
Steve Coven Environmental Review Unit MN Dept. of Natural Resources 500 Lafayette Road - Box 37 St. Paul, MN 55155-4010 Phone: 651.296.6157	3		1	4
Commissioner, Mr. Gene Hugoson MN Department of Agriculture 625 Robert Street N. St. Paul, MN 55155 Phone: 651.201.6000		1		1
Commissioner, Dr. Sanne Magnan MN Department of Health 625 Robert Street N. St. Paul, MN 55155-2538 Phone: 651.201.5810		1		1
Executive Director, John Jaschke MN Board of Water and Soil Resources 520 Lafayette Road N. St. Paul, MN 55155 Phone: 651.296.3767		1		1
Mr. Jeff Lewis Minnesota Pollution Control Agency Lake Avenue Plaza 714 Lake Ave. Suite 220 Detroit Lakes, MN 56501 Phone: 218.847.1519		1		1

Mr. Craig Affeldt Environmental Review Minnesota Pollution Control Agency 520 Lafayette Road St. Paul, MN 55155-4194 Phone: 651.296.6300	1	1		1
MN Department of Transportation Waterways Section Transportation Building 395 John Ireland Blvd. St. Paul, MN 55155		1		1
Ms. Britta Bloomberg Minnesota Historical Society Deputy State Historic Preservation Officer 345 Kellogg Boulevard West St. Paul, MN 55102-1906 Phone: 651-259-3466		1		1
Dr. Mark Dudzik Office of the State Archaeologist Fort Snelling History Center St. Paul, MN 55111	1	1		1
Clay County, Minnesota Courthouse 807 11th Street North Moorhead, MN 56560 Phone: 218.299.5002	1	1		1
Norman County, Minnesota 16 3rd Ave. E. Ada, MN 56510 Phone: 218.784.5473	1	1		1
MN/DOT Office of Aeronautics Mail Stop 410 222 E. Plato Blvd. St. Paul, MN 55107-1618 Phone: 651.234.7245	1	1		1
Buffalo Red River Watershed District 123 Front St S, PO Box 341 Barnesville, MN 56514 Phone: 218.354.7710	1	1		1
Ms. Loretta Johnson Wild Rice River Watershed District 11 East 5th Street Ada, Minnesota 56510 Phone: 218.784.5501	1			1
Mayor Mark Voxland City of Moorhead 500 Center Ave. Moorhead, MN 56561 Phone: 218.299.5307	1			1

Mayor, Kurt Johannsen City of Hendrum PO Box 100 Hendrum, MN 56550	1			1
Mayor Anne Manley City of Perley PO Box 437 Perley, MN 56574	1			1
Mayor, Glen Brookshire City of Halstad 520 5th Ave. E. Halstad, MN 56548	1			1
Mayor Traci Goble City of Georgetown PO Box 176 Georgetown, MN 56546	1			1
Mayor Chad Olson City of Dilworth 607 3rd St. NE Dilworth, MN 56529	1			1
Chairman Brian Thomas Kragnes Township 2218 130 Ave. N. Moorhead, MN 56560	1			1
Mayor Cecil Johnson City of Glyndon 36 3rd St. SE Glyndon, MN 56547	1			1
STATE OF NORTH DAKOTA				
Honorable John Hoeven State Capitol 600 East Boulevard Avenue Bismarck, ND 58505	1	1		1
Director, Terry Stienwand North Dakota Department of Game and Fish 100 North Bismarck Expressway Bismarck, ND 58501-5095 Phone: 701.328.6305	1	1		2
Michael Sauer Division of Water Quality North Dakota Department of Health 918 East Divide Ave. Bismarck, ND 58501-1947 Phone: 701.328.2372	1	2		1
David Galtt Chief of Environmental North Dakota Department of Health 918 East Divide Ave. Bismarck, ND 58501-1947 Phone: 701.328.2372		1		1

Mr. Dale Frink North Dakota State Water Commission 900 East Boulevard Bismarck, ND 58505 Phone: 701.328.2750	1	1		1
North Dakota State Water Commission North Dakota Red River Joint Water Resource District 900 East Boulevard Bismarck, ND 58505	1			1
State Historic Preservation Officer State Historical Society of North Dakota North Dakota Heritage Center 612 East Boulevard Avenue Bismarck, ND 58505-0830 Phone: 701.328.2666		1		1
Director, Greg Wills Division of Emergency Management PO Box 5511 Bismarck, ND 58506-5511 Phone: 701.328.8100	1	1		1
Agriculture Commissioner, Doug Goehring North Dakota Department of Agriculture 600 East Boulevard Avenue Bismarck, ND 58505 Phone: 701.328.2231		1		1
Director, Francis Ziegler North Dakota Department of Transportation 608 East Boulevard Avenue Bismarck, ND 58505-0020 Phone: 701.328.2500	1	1		1
State Forester: Larry Kotchman North Dakota Forest Service Molber Forestry Center 307 First Street East Bottineau, ND 58318-1100 Phone: 701.228.5422		1		1
Cass County, North Dakota P.O. Box 2806 Fargo, North Dakota 58108-2806	1			1
Southeast Cass Water Resources District P.O. Box 2806 Fargo, North Dakota 58108-2806	1			1
North Dakota Wildlife Federation ATTN: Julie Ellingson 1605 East Capitol Avenue Bismarck, ND 58501-2102 Phone: 701.222.2557	1			1

Fargo-Moorhead Metropolitan Council of Governments Case Plaza, Suite 232 One Second Street North Fargo, ND 58102-4807 Phone: 701.232.3242	1			1
Mayor Dennis Walaker City of Fargo 200 3rd St. N. Fargo, ND 58102	1			1
Mayor Bill Rohrich City of Harwood PO Box 65 108 Main St. Harwood, ND 58042	1			1
Mayor Shane Waloch City of Horace 215 Park Dr. E. Horace, ND 58047	1			1
Mayor Jim Nyhof City of Oxbow 708 Riverbend Rd. Oxbow, ND 58047	1			1
Mayor Mark Anderson City of Mapleton PO Box 94 Mapleton, ND 58059-0094	1			1
Mayor Darren Wentzel City of Arguville 201 N Hwy 81 Arguville, ND 58005-4108	1			1
Mayor Rich Mattern City of West Fargo 800 4th Ave. W. West Fargo, ND 58078	1			1
Mayor Jefferson Bay City of Reiles Acres 4515 35th Ave. N. Reiles Acres, ND 58102-5413	1			1
Mayor David Susag City of North River 5302 River Dr. Fargo, ND 58102-7002	1			1
Mayor Penny Kianian City of Prairie Rose 3308 40th Ave. S. Fargo, ND 58104-6626	1			1
Mayo, Barry Wegner City of Frontier 5301 33rd St. S. Fargo, ND 58104-6775	1			1

Mayor John Adams City of Briarwood 8 Briarwood Place Briarwood, ND 58104-7308	1			1
LIBRARIES				
Fargo Public Library 102 N. 3rd Street Fargo, ND 58102-4899			2	2
Moorhead Public Library 118 South 5th Street Moorhead, ND 56560-0076			2	2
West Fargo Public Library 401 7th St. E West Fargo, ND 58078-2809			2	2
Halstad Public Library 441 U.S. 75 Halstad, MN 56542			2	2
OTHERS				
Minnesota Center for Environmental Advocacy ATTN: Mary Marrow 26 East Exchange Street Suite 206 St. Paul, MN 55101-1667 Phone: 651.223.5969	1	1		1
Kit Fisher Outreach Coordinator National Wildlife Federation 240 N. Higgins, Suite 2 Missoula, MT 59802	1			
National Wildlife Federation 11100 Wildlife Center Drive Reston, VA 20190-5362 Phone: 800.822.9919	1			1
Mr. Charles A. Lawson Secretary, U.S. Section International Joint Commission 2000 L Street, N.W., Suite 615 Washington, D.C. 20036	1			1
Dr. Murray Clamen Secretary, Canadian Section International Joint Commission 234 Laurier Avenue West 22th Floor Ottawa, ON K1P 6K6	1	1		1
International Red River Board Secretary, Craig Evans 190 East Fifth Street St. Paul, MN Girma Sahlu	2			1

Red River Basin Commission 206-309 Hargrave Street. Winnipeg, MB R3B 2J8 Phone: 204.982.7255	1	1		1
Red River Basin Commission 119 South Fifth Street P.O. Box 66 Moorhead, MN 56560 Phone: 218.291.0422	1	1		1
Red River Watershed Management Board P.O. Box 763 Detroit Lakes, MN 56502-0763 Phone: 218.844.6166	1	1		1
PUBLIC				
Mr. R.C. Axlund 4014 15th Avenue NW Fargo, ND 58102		1		