FARGO-MOORHEAD METROPOLITAN AREA FLOOD RISK MANAGEMENT FEASIBILITY REPORT AND ENVIRONMENTAL IMPACT STATEMENT

REPORT SUMMARY FOR CIVIL WORKS REVIEW BOARD 23 SEP 2011

Feasibility Scoping Meeting:	19 MAY 2009
Alternative Formulation Briefing:	26 APR 2010
AFB Guidance Memorandum:	24 MAY 2010
In-Progress Review	13 APR 2011
In-Progress Review	09 JUN 2011
Division Engineer Transmittal:	07 AUG 2011
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CWRB Briefing:	23 SEP 2011
30-Day S&A Review start:	30 SEP 2011
30-Day S&A Review end:	31 OCT 2011

STUDY INFORMATION

Study Authority. The *Fargo-Moorhead Metropolitan Area Flood Risk Management Feasibility Report and Environmental Impact Statement* (the 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.*

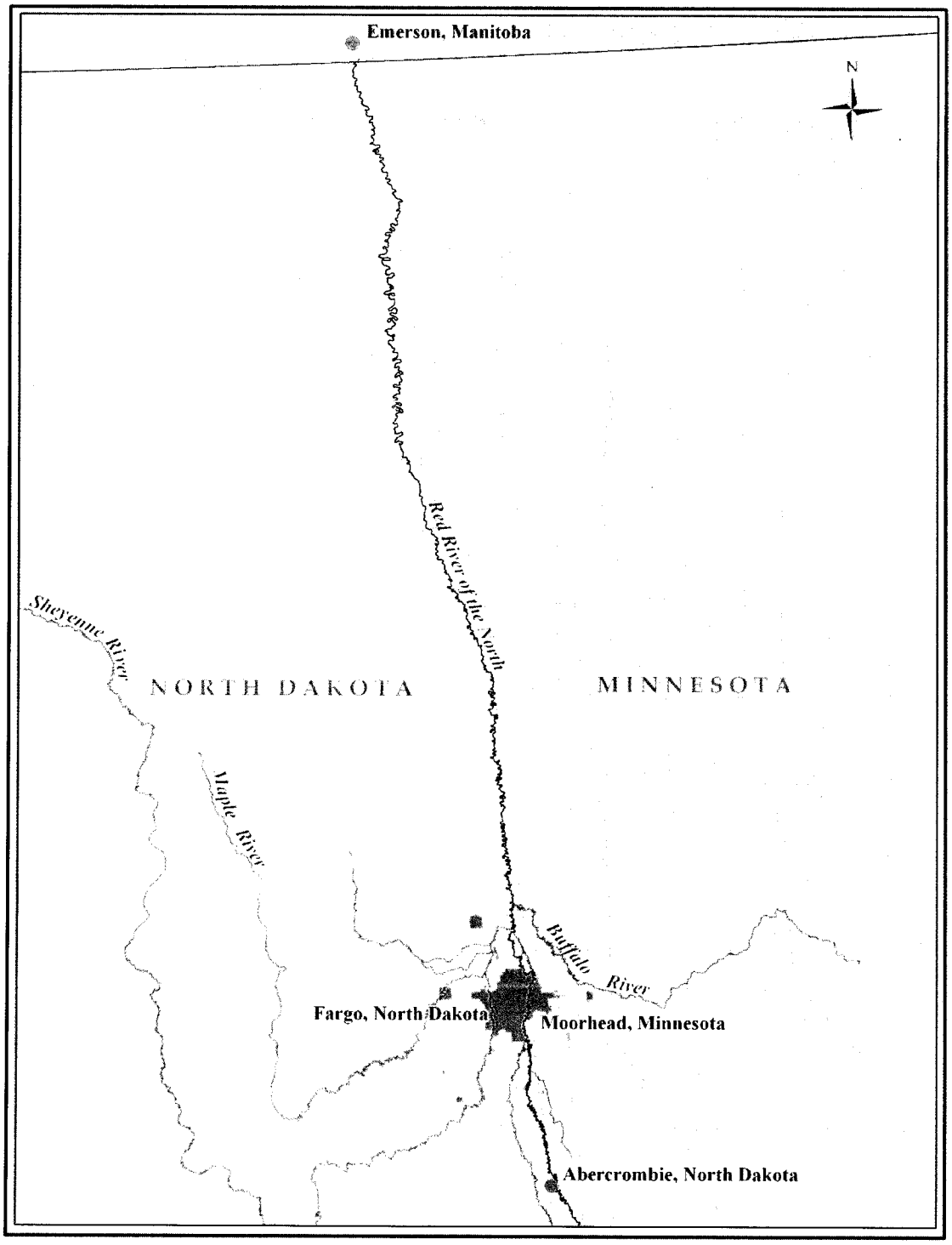
Study Sponsor. The cities of Fargo, North Dakota and Moorhead, Minnesota are the non-federal sponsors for this study.

Study Purpose and Scope. The purpose of this feasibility study is to identify measures to manage 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.

Project Location/Congressional District. The geographic scope of analysis for the environmental impacts of the selected plan and alternatives encompasses the Fargo-Moorhead Metropolitan area plus areas in the floodplain of the Red River from approximately 300 river miles north of Fargo near Emerson, Manitoba to approximately 30 miles south of Fargo near Abercrombie, ND. The Fargo-Moorhead Metropolitan area is 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.

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

Figure 1 – Fargo-Moorhead Location



Prior Reports and Studies. 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:

- 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, and several other features less relevant to this feasibility study.

- 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.

- Fargo-Moorhead and Upstream Feasibility Study, Corps of Engineers. The study began in August 2004 and is in progress (July 2011). Phase 1 analyses, completed in June 2005, showed that distributed flood storage upstream of Fargo-Moorhead could provide significant economic benefits, but additional study of environmental benefits is needed to justify a Federal project. Phase 1 also showed that distributed flood storage would provide less than two feet of stage reduction at Fargo for floods larger than a 1-percent chance event.

Existing Water Projects. There are several existing water projects that have been constructed within or have effects within the study area. The selected plan would modify three existing federal projects: the Sheyenne River project, Rush River Channel Improvement project, and Lower Rush River Channel Improvement project. The following projects are the most relevant for the current effort:

- The Lake Traverse project, including White Rock Dam and Reservation Dam, provides flood storage at the headwaters of the Bois de Sioux River 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.

- The Orwell Dam provides water storage for flood control and water supply on the Otter Tail 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 flood storage. The project is operated by the Corps of Engineers, St. Paul District.

- Sheyenne River projects: The Baldhill Dam and Lake Ashtabula project was authorized by the 1944 Flood Control Act and construction was originally completed in 1951 to provide water storage for flood control and water supply on the Sheyenne River. 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 on the Maple River to provide approximately 35,000 acre-feet of storage; 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 diversion projects were substantially completed in 1993 and 1994. The Maple River dam was de-authorized in 2002 for federal participation, and the Southeast Cass Water Resource District completed the project without federal assistance in 2007. The Maple River dam has a storage capacity of 60,000 acre-feet. Although these features reduce the risk associated with Sheyenne River flooding, the cities of Horace and West Fargo

and the west side of Fargo are still potentially affected by floods on the Wild Rice and Red Rivers that are larger than approximately a 0.5-percent chance event. The selected plan would incorporate the existing Horace to West Fargo diversion and reduce expected flood flows in the West Fargo diversion, resulting in reduced future flood risk from the Sheyenne River, as well as the Wild Rice and Red rivers.

- 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 selected plan would intercept this existing project, and the downstream portion of the channel improvement would be abandoned.

- 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 selected plan would intercept this existing project, and the downstream portion of the channel improvement would be abandoned.

- 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.)

- The Fargo-Ridgewood Section 205 (1948 Flood Control Act) project is located on the north side of Fargo and was completed in 2010. 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 reduces risk to the Department of Veterans Affairs (VA) hospital and the Ridgewood neighborhood of Fargo between 15th Avenue North and 22nd Avenue North. High ground at the ends of the project is at elevation 899.5 feet. However, the top elevation of the levees is at elevation 902.6 feet.

- Non-federal levee systems: Several communities within the study area have existing engineered levee systems, including Oakport, Halstad, and portions of Moorhead in Minnesota and Oxbow and Harwood in North Dakota. Several other communities in the area have emergency levees and are planning to build permanent levee systems in response to the 2009 flood event.

Federal Interest. There is a federal interest in managing flood risk and economic flood damage and in providing additional recreational opportunities in the Fargo-Moorhead Metropolitan area. 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 48 of the past 109 years, and every year from 1993 through 2011. The flood of record at Fargo-Moorhead was the 2009 spring flood with a stage of 40.8 feet on the Fargo gage. With an estimated peak flow of 29,200 cubic feet per second (cfs), the 2009 flood was approximately a 2-percent chance (50-year) event.

Equivalent expected annual flood damages in the Fargo-Moorhead metropolitan area are estimated to be more than $194.8 million in the future without project condition. The

population of the study area is approximately 200,000, and the population at risk in the 1-percent chance floodplain is estimated at approximately 25,000.

The selected plan provides $77.4 million net annual economic benefits and has an overall benefit-cost ratio of 1.76. Recreation features alone have a 2.71 benefit-cost ratio. The project would provide in excess of 1-percent chance level of flood risk reduction for the Fargo-Moorhead Metropolitan Area and would enable the metropolitan area to withstand floods up to a 0.2-percent chance event using additional emergency flood-fighting measures.

STUDY OBJECTIVES

Problems and Opportunities. 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 $194.8 million. 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.

Planning Objectives. The following planning objectives reflect the problems and opportunities in the Study area.

- 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.

Planning Constraints. 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.

ALTERNATIVES

Plan Formulation Rationale. Through several iterations of the Corps planning process, the study formulated, evaluated, and compared a wide array of structural and nonstructural flood risk management features, measures, and alternative plans to address one or more of the planning objectives.

Management Measures and Alternative Plans. 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. For planning purposes, the No Action Alternative forms the basis against which all other alternatives are measured.

Action alternatives were developed in four separate planning phases. Phase 1 was an extension of the reconnaissance effort. During Phase 1, hydraulic models and economic data were developed in order to assess basic conceptual plans. One diversion alternative and one levee/floodwall alternative were considered. The results verified that further study was warranted. This conclusion was reinforced by the occurrence of the flood of record in March 2009, which greatly increased public interest in the study.

Phase 2 included two screening iterations. During the first iteration potential features were formulated, based on the identified problems and opportunities, project goals, and objectives. Measures included nonstructural measures as well as structural measures including flood storage, flood barriers (levees and floodwalls), and increased conveyance (cutoff channels, tunnels, and diversions). The array of conceptual plans included 2-percent and 1-percent chance event levee alternatives and diversion channels with capacities ranging from 25,000 to 45,000 cubic feet per second (cfs) along four different alignments (two in Minnesota and two in North Dakota). Preliminary analysis of project performance, costs and benefits were prepared, and the measures were screened using the following criteria, which are based on the 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:

- Effectiveness
- Environmental effects
- Social effects
- Acceptability
- Implementability
- Cost
- Risk
- Separable mitigation
- Cost effectiveness

As a result of this screening, no action and diversion channels were identified to be carried forward for more analysis as stand-alone conceptual plans. Non-structural measures, flood storage, wetland and grassland restoration, bridge replacement, cut-off channels and levees

were retained for possible inclusion as features where they could be incrementally economically justified.

During the second iteration in Phase 2, the Study team developed an array of diversion plans with capacities ranging from 10,000 to 35,000 (cfs) along two different alignments (one in North Dakota and one in Minnesota). The North Dakota alignment was 36 miles long and crossed five tributary streams. The Minnesota alignment was 25 miles long and did not cross any tributaries to the Red River. The array included non-structural measures in addition to the diversions where economically justified. The Phase 2 Screening #2 results are shown in Table 1.

Table 1 – 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 proejct were $77.1 million.

On the basis of these results, the sponsors 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, the MN20K, MN25K, MN30K and MN35K plans were retained as possible NED plans to be considered in Phase 3.

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. Hydrologic assumptions were revised based on input from an Expert Opinion Elicitation panel and to include the 2009 flood event, and the hydraulic model was calibrated to the 2009 event. These changes increased estimated flood stages for the larger flood events. The analysis was completed on the MN20, 25, 30, 35, 40 and 45K alternatives and the ND35K alternative (the LPP at that time). Table 2 shows the estimated flood stages at the Fargo gage for the various diversion alternatives.

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 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 3.

Table 3 – 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 were $195.9 million.

Selection of the ND35K plan as the LPP made further consideration of the NED plan (MN40K) unnecessary. Federal cost sharing for the ND35K plan could not be based on the NED plan, because the ND35K plan 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 ND35K plan.

Table 3 shows that the MN35K plan and the ND35K plan 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 ND35K plan for cost-sharing purposes. The MN35K plan was therefore identified as the Federally Comparable Plan (FCP).

Throughout Phases 1-3 of the study, the diversion alternatives were designed to cause only downstream stage increases, and it was expected that any downstream stage increases would be relatively small and dissipate relatively quickly. Hydraulic models completed at the end of Phase 3 (during public review of the Draft Feasibility Report and Environmental Impact Statement) showed stage increases of nearly 16 inches 101 river miles downstream of the diversion outlet with the ND35K diversion (the LPP at that time). The maximum stage increases were more than 25 inches for a 1-percent chance event. Based on these results, it was determined that additional modeling was required to identify a point downstream with minimal to no impacts and that consideration would need to be given to other options such as upstream staging.

Final Array of Alternatives. Phase 4 focused on extending and refining the hydraulic models and using the models to assess several strategies to minimize project impacts. The strategies that were considered included shifting the diversion further north (to near the MN35K plan's inlet), staging water upstream on the Red and Wild Rice rivers, passing additional water through the protected area in the Maple River's natural channel, and using off-channel storage areas along the diversion channel. The study team assessed several different channel sizes and slopes in combination with various amounts of upstream staging and temporary storage within the protected area to achieve a definable impacted area. The control structures in the design were operated as necessary to achieve the desired hydraulic conditions in the Red River channel through Fargo-Moorhead.

The resulting final array of alternatives included the following four plans:

- No Action
- The FCP as defined in Phase 3 (MN35K),
- The ND35K as defined in Phase 3 (the LPP in the May 2010 Draft Environmental Impact Statement), and
- The redefined LPP (a 20,000 cfs capacity North Dakota diversion with upstream storage and staging).

Comparison of Alternatives. All three of the action alternatives are effective in meeting the primary planning objectives to reduce flood damages, increase wetland habitat and provide

recreational opportunities; none of them restore riverine habitat. Each diversion alternative could pass a 1-percent chance flood with minor emergency measures and a 0.2-percent chance flood with emergency measures similar to those used successfully in the 2009 flood. They all provide nearly the same level of flood damage reduction economic benefits and residual damages (total average annual economic benefits in excess of $172 million), but their net benefits are different due to differences in total project cost. A breakdown of the net benefits and residual damages associated with each of the diversion alternatives is provided in Table 4.

Table 4 – Efficiency of plans – Net Benefits (all dollar values are in thousands)

	NO Action	LPP	FCP	ND35k
Net Benefits of Plan (NED)	$0	$74,219	$100,433	$87,565
Residual Damages	$194,800	$32,000	$30,000	$32,000

The LPP and ND35K plans reduce flood risk from the Red and Wild Rice rivers plus four tributaries, while the FCP (along a Minnesota alignment) addresses only the Red and Wild Rice rivers. This was a key tradeoff for the non-federal sponsors that led to their request for the LPP on the North Dakota alignment.

All three of the action alternatives satisfy most of the planning constraints; they comply with international agreements, have no impacts on the Buffalo Aquifer in Minnesota, and comply with Executive Order 11988, Floodplain Management. However, none of the action alternatives avoided increasing peak Red River flood stages at all locations. The location and magnitude of stage increases are two significant tradeoffs between the alternatives.

The LPP causes upstream stage increases of up to 8.25 feet in the storage and staging areas and maximum downstream increases of less than four inches for a 1-percent chance event. Non-structural measures including buyouts, relocations, ring levees and easements will be used to mitigate for the upstream impacts to landowners. The ND35K plan and FCP cause much smaller stage increases (up to 2.1 feet) over a much larger downstream area along 250 river miles. The economic costs of these impacts and mitigation measures are reflected in the net benefits presented in Table 4. Although the Corps would not require mitigation for minor stage increases that did not rise to the level of a taking under the Fifth Amendment to the U.S. Constitution, the sponsors determined that downstream impacts of the ND35K plan were unacceptable, and they preferred to mitigate for upstream impacts in the smaller defined storage and staging areas included in the LPP.

The LPP is the most robust of the three action alternatives. The project features could withstand floods larger than a 0.2-percent chance event without overtopping into the benefitted area. The ND35K plan and the FCP would be overwhelmed by events larger than the 0.2-percent chance event.

Key Assumptions. Two key assumptions underlie the economic analysis.

- Emergency levees received no credit in the future without project condition
- Hydrologic probability is based on a non-standard approach to reflect non-stationarity in the hydrologic record at Fargo

Emergency Levees: The communities in the study area have been largely successful in using emergency measures to prevent widespread damage in recent flood events. The 2009 flood of record was approximately a 2-percent chance event (50-year recurrence). However, due to the nature of floodfighting and the significant uncertainty in performance of emergency measures, the Corps Vertical Team agreed that no credit should be given to emergency measures in the future without-project condition.

The hydrologic record for the USGS gage at Fargo shows an increasing trend in flood frequency and magnitude since the early 1940's. The Corps convened an Expert Opinion Elicitation (EOE) panel to consider an appropriate approach to address the non-stationarity evident in the record. The EOE panel recommended breaking the historic record into a "wet" period and a "dry" period and then combining them in a weighted fashion to reflect future probabilities. The study team worked with the Corps Hydrologic Engineering Center to apply the panel's recommendation.

Selected Plan. The selected plan is the redefined LPP: a 20,000 cfs capacity North Dakota diversion with upstream storage and staging. The ASA(CW) approved identifying the LPP as the tentatively selected plan on April 28, 2011. The LPP 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 and ultimately re-enters the Red River of the North at the confluence of the Red and Sheyenne Rivers near the city of Georgetown, MN. The alignment is approximately 36 miles long and incorporates the existing Horace to West Fargo Sheyenne River diversion channel. The LPP includes 19 highway bridges and 4 railroad bridges that cross the diversion channel. Interstate Highway 29, U.S. Highway 75 and a BNSF railroad line would be raised within the staging area to maintain transportation during flood events.

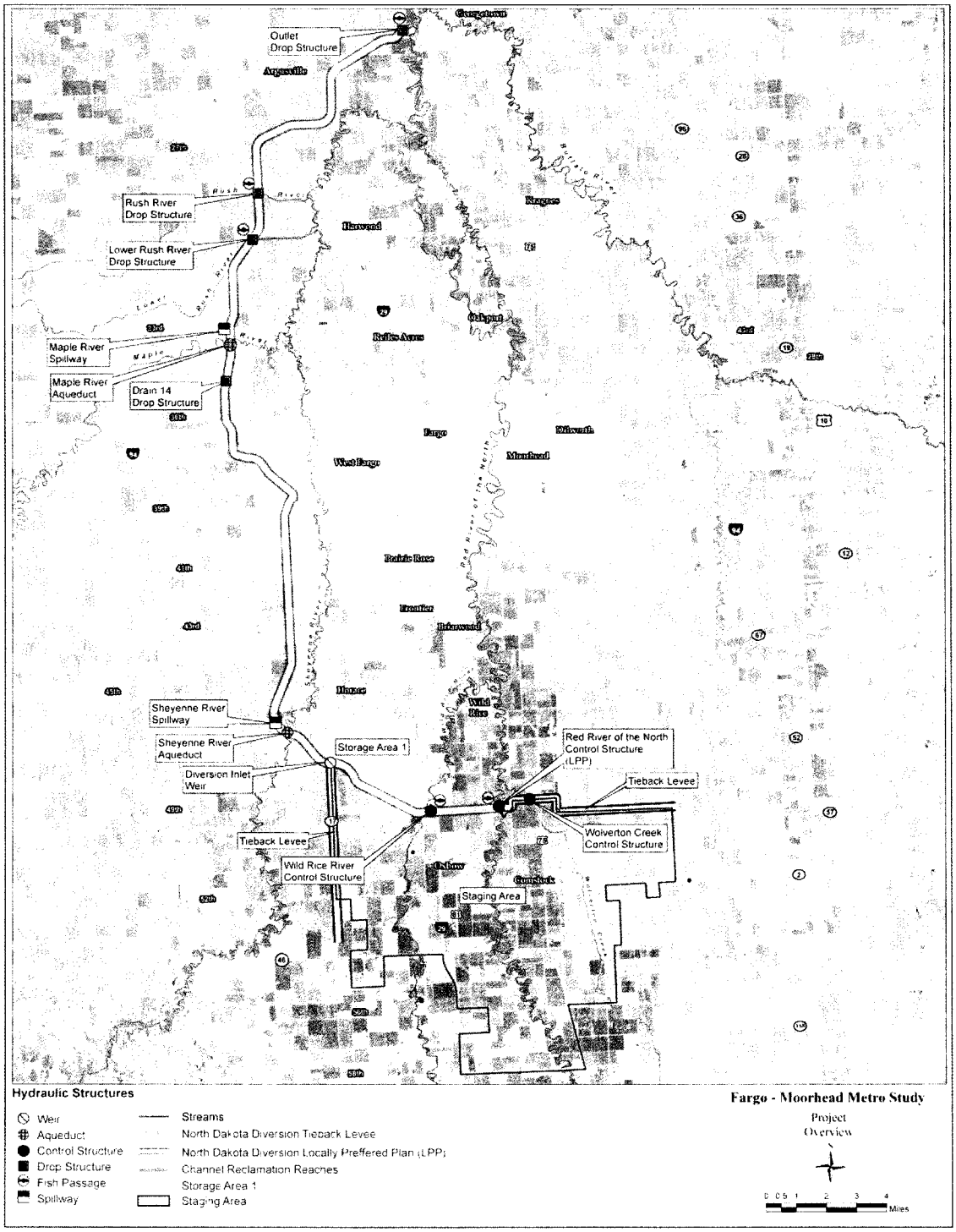
The plan consists of the following primary features:

- Red River gated control structure (with fish passage)
- Connecting channel (Red River to Wild Rice River)
- Wild Rice River gated control structure (with fish passage)
- Diversion inlet weir (at Cass County Road 17)
- Storage Area 1 (levees and flowage area)
- Upstream staging area (with non-structural mitigation)
- Main diversion channel
- Sheyenne River aqueduct and spillway structures
- Maple River aqueduct and spillway structures
- Lower Rush River drop structure (with fish passage)

- Rush River drop structure (with fish passage)
- Outlet drop structure (with adjacent fish passage)
- Wolverton Creek control structure
- Tie-back levees
- Side ditch inlet structures
- Highway bridges
- Railroad bridges
- I-29, US75 road raises and BNSF railroad raise in staging area
- Recreation features, including to multipurpose trails, benches and parking facilities
- Environmental mitigation features

Figure 2 shows the alignment of the major features.

Figure 2 – LPP Diversion Alignment and features



Systems / Watershed Context. The selected plan (LPP) substantially reduces flood risk in the largest urban area in North Dakota and western Minnesota. It greatly enhances the stability of the governmental, economic, educational, medical and social infrastructure for the entire Red River Basin region, which contributes to the national economy. The LPP addresses flooding from the Red River of the North and five of its tributaries in the study area. Significant portions of two counties in two states receive benefits from the project. The plan was developed in partnership with the cities of Fargo, North Dakota and Moorhead, Minnesota. Cass County and the Cass County Joint Water Resource District in North Dakota and Clay County and the Buffalo-Red River Watershed District in Minnesota participated heavily in the project development process.

The Corps invited the following agencies to be formal Cooperating Agencies:

- U.S. Environmental Protection Agency
- Federal Emergency Management Agency
- U.S. Fish and Wildlife Service
- North Dakota State Water Commission
- North Dakota Department of Game and Fish
- North Dakota Department of Health
- North Dakota State Historic Preservation Office
- Minnesota Department of Natural Resources
- Minnesota Pollution Control Agency
- Minnesota State Historic Preservation Office

Although some of these agencies expressed initial interest in serving as Cooperating Agencies, no formal agreements were executed. In discussing the opportunity with these agencies, it was generally determined that there were insufficient agency resources to take on tasks beyond each agency's official mission. Despite the absence of a formal agreement, all of the agencies participated in the planning process at appropriate times and provided the necessary input to ensure that issues were raised and addressed as soon as possible in the process.

Environmental Operating Principles (EOP). The seven Environmental Operating Principles were followed during the entire planning process. The 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.

Peer Review.

District Quality Control (DQC). The Product Delivery Team (PDT) was primarily composed of Corps staff from St. Paul District, staff of the non-federal sponsors, and contractors working for the Corps or the non-federal sponsors. The PDT received assistance from Rock Island District, St. Louis District, Vicksburg District, the Institute for Water Resources and the Hydrologic Engineering Center. The non-structural measures and alternatives were developed by the Corps' Non-Structural Flood Proofing Committee staff in Omaha District. Cost Engineering staff in Walla Walla District assisted with the cost and schedule risk analysis. DQC was performed by Corps staff throughout the study as products were developed.

Agency Technical Review (ATR). The ATR team included Corps staff primarily from Omaha District, the Hydrologic Engineering Center and the Cost Engineering Directory of Expertise who were not directly involved in preparation of the study products. The ATR review prior to the Feasibility Scoping Meeting in May, 2009 generated 106 comments. The ATR prior to the Alternative Formulation Briefing in April, 2010 generated 203 comments, of which eight were critical. The final ATR was conducted prior to the April 13, 2011 In-Progress Review prior to release of the Supplemental Draft Feasibility Report and EIS. The final ATR generated 308 comments, of which two were critical.

All but two ATR comments were resolved and closed prior to completion of the Final Feasibility Report and EIS. One comment that was unresolved was that the Supplemental Draft Feasibility Report did not identify and communicate as true a characterization of flood risk as is reasonably possible to community leaders and the public. The basis of the concern was that different hydraulic models and frequency analyses were used for different reaches. Additional language was added to the report to address the concern, and the comment was closed on August 10, 2011. The comment that remains unresolved is the question of whether

to treat the embankment surrounding Storage Area 1 as a levee or a dam. This will be resolved in consultation with Corps Headquarters.

Independent External Peer Review (IEPR). IEPR was initiated in April, 2010 to review the same document submitted to the vertical team for the Alternative Formulation Briefing. IEPR of the draft report was completed on July 6, 2010. A total of 23 comments were generated; all were resolved to the satisfaction of the IEPR panel. A second IEPR review began on April 21, 2011 to assess the Supplemental Draft Feasibility Report and EIS and supporting analyses. Final IEPR comments will be addressed after completion of the Final EIS in accordance with Corps review policy.

ASA(CW) Coordination. The non-federal sponsors provided a letter dated March 29, 2010 that formally identified the North Dakota 35,000 cfs diversion as the LPP. St. Paul District forwarded the non-federal sponsors' request for a LPP to the vertical team on April 8, 2010 for coordination with the Office of the ASA(CW). The ASA(CW) visited the study area on April 25, 2010 and approved the necessary exception from policy on April 28, 2010. The exception allowed St. Paul District to prepare the draft feasibility report and environmental impact statement tentatively recommending the ND35K plan as a LPP. In Phase 4 of the study, the LPP was revised to minimize downstream impacts by incorporating upstream storage and staging. The non-federal sponsors provided a letter on April 6, 2011 endorsing the revised LPP and requesting that it be identified as the tentatively selected plan. The ASA(CW) provided a letter dated April 28, 2011 allowing the LPP to be identified as the tentatively selected plan in the Supplemental Draft EIS.

Value Engineering (VE). A VE study was completed in December 2009 which looked at the preliminary levee and diversion alternatives. Results of the VE study were considered and incorporated into the feasibility study design efforts. A more detailed VE study will be performed on the final recommended plan early in the preconstruction engineering and design (PED) phase, prior to the 35 percent PED level.

EXPECTED PROJECT PERFORMANCE

Project Costs. Table 5 summarizes the selected plan costs.

TABLE 5
Cost Summary
Fargo-Moorhead Metropolitan Area Feasibility Study
(October 2011 Price Levels, $1,000s)

Construction Item	Selected Plan
Lands & Damages	$278,372
Elements	
Relocations	$154,290
Fish and Wildlife Facilities	61,987
Roads, Relocations and Bridges	60,045
Channels and Canals	783,778
Levees and Floodwalls	143,435
Recreation Facilities	29,799
Subtotal*	$1,233,335
Preconstruction Engineering & Design	$183,850
Construction Management (E&D, S&A)	$ 85,790
Total First Cost	**$1,781,348**

*An overall project contingency of 26-percent is included. This contingency is based on the Cost and Schedule Risk Assessment conducted with assistance of the Cost Directory of Expertise (Cost DX), Walla Walla.

Equivalent Annual Costs and Benefits. Table 6 summarizes the economic performance of the selected plan.

TABLE 6
Equivalent Annual Benefits and Costs
Fargo-Moorhead Metropolitan Area Feasibility Study
(October 2011 Price Level, 50-year Period of Analysis, 4.125 % Discount Rate, $1,000s)

Item	Flood Risk Management	Recreation	Total
Investment Costs			
Total Project Construction Cost	$ 1,745,033	$ 36,315	$1,781,348
Interest During Construction	296,914	791	297,705
Total Investment Cost	$ 2,041,947	$ 37,106	$2,079,053
Average Annual Costs			
Annualized Project Costs	97,097	1,764	98,861
Annual OMRR&R Cost	3,501	130	3,631
Total Annual Costs	$ 100,598	$ 1,894	$ 102,492
Average Annual Benefits			
Flood Risk Management	162,800	0	162,800
Flood Proofing Cost Savings	10,430	0	10,430
Flood Insurance Administrative Costs	960	0	960
Non Structural Flood Risk Benefit	627	0	627
Recreation	-	5,130	5,130
Total Annual Benefits	$ 174,817	$ 5,130	$ 179,947
Net Annual Benefits	$ 74,219	$ 3,236	$ 77,455
Benefit-Cost Ratio (4.125% interest)	1.74	2.71	1.76
Benefit-Cost Ratio (7% interest)[1]	1.06	1.88	1.07

[1] Per Executive Order 12893

Cost Sharing. Table 7 indicates the allocation of funds between the non-Federal sponsors and the Federal government.

TABLE 7
Project Cost Apportionment - October 2010 Price Level

Fargo-Moorhead Metro Feasibility - Cost Sharing (October 2011 Price Level, $1000s)			
Item	Federal	Non-Federal	Total
Flood Risk Management			
Lands and Damages		278,372	278,372
Relocations	60,045	154,291	214,336
Fish and Wildlife Facilities	61,987		61,987
Channels and Canals	783,778	0	783,778
Levees and Floodwalls	143,435	0	143,435
Planning, Engineering, & Design	156,408	23,000	179,408
Construction Management	72,985	10,732	83,717
Cash Contribution	-495,253	495,253	0
Total FRM [1]	783,384	961,649	1,745,033
Recreation			
Lands and Damages	0	0	0
Relocations	0	0	0
Recreation Facilities	29,800	0	29,800
anning, Engineering, & Design	4,442	0	4,442
Construction Management	2,073	0	2,073
Cash Contribution	-18,158	18,158	0
Total Recreation	18,158	18,158	36,315
Total Project	801,542	979,806	1,781,348

[1] Federal FRM cost for the LPP is capped at the Federal share of the FCP.

Project Implementation. The cities of Fargo, North Dakota and Moorhead, Minnesota are the non-federal sponsors for this project. The preconstruction engineering and design (PED) phase can begin once the Division Commander has transmitted the FEIS to HQUSACE, the Design Agreement has been signed by the non-federal sponsors, and funds are available. The schedule for project implementation assumes authorization in the proposed Water Resources Development Act (WRDA) of 2011, if enacted, or a future WRDA. A continuous funding stream is needed to complete this project within the anticipated time line, and this will require continuing appropriations from Congress and the non-federal sponsors in order to fund the design phase and to fully fund the construction. 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 contracts 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 2011
Receive construction funds	October 2012
Initiate construction	April 2013
Complete Construction	October 2021

At the completion of construction, the entire FRM system will be turned over to the cities of Fargo and Moorhead; the cities will then be fully responsible for the OMRR&R of the system. As sponsors, the cities would be required to obtain all appropriate permits. The contractors would be responsible for acquiring all local licenses/permits required to comply with state and municipal laws, codes and regulations.

The project includes pre- and post-construction monitoring and adaptive management to ensure the effectiveness of environmental mitigation.

Operation, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R). The non-federal sponsors will be responsible for all operations, maintenance, repair, rehabilitation and replacement (OMRR&R) of project features. The cost share agreement between the Corps and the non-federal sponsors requires the sponsors to operate the project in accordance with the OMRR&R manual provided by the Corps. This will include annual maintenance of the diversion channel and associated structures including the Red River control structure, any additional structures required for the alternative, bridges and recreation facilities. Annual OMRR&R Costs are estimated at $3,631,000, including routine maintenance like mowing, vegetation management, and maintenance of all structural and mechanical features. The non-Federal sponsors' responsibility for maintenance of all FRM components continues in perpetuity.

Key Social and Environmental Factors. The Other Social Effects (OSE) analysis shows the beneficial and adverse effects of the selected plan on the social well-being of the Fargo-Moorhead Metropolitan Area and the surrounding area. These effects are overwhelmingly positive for the majority of residents in the area. The primary social issue is displacement of residents from the upstream storage and staging areas and the loss of farmland within the footprint of the diversion channel. The selected plan includes measures to compensate landowners where appropriate or as required by law. The primary environmental issue is the potential of the project to affect fish passage on the rivers affected by the project. Impacts to fish passage have been minimized through design of the control structures, aqueducts and

other structures where the diversion crosses existing rivers. Fish passage structures have been included where necessary to maintain an adequate level of connectivity for continued biological success of the fishery. In addition, fish passage will be improved at other locations within the Red River Basin in order to improve the overall fishery.

Stakeholder Perspectives and Differences. The city of Fargo and city of Moorhead have expressed the desire to implement the project and sponsor project construction. The non-federal sponsors have completed the necessary financial self-certifications to complete the feasibility report and enter into a Design Agreement. These certifications indicate that they are financially capable of moving forward with the selected plan.

The feasibility study included extensive public involvement efforts. Between September 2008 and June 2011, these efforts included five public scoping meetings, 21 public meetings, 1 formal hearing, and 27 meetings of the non-federal sponsors' flood work group that were open to the public. In addition, all documents released to the public were posted on a project Website and remained available for public inspection. More than 20 meetings were held with local, state and federal resource agencies that participated on a resource agency team; the team included USFWS, USEPA, FEMA, Minnesota Department of Natural Resources, Minnesota Pollution Control Agency, North Dakota Game and Fish Department, North Dakota Department of Health, North Dakota State Water Commission, as well as numerous local agencies. Because these meetings were held throughout the feasibility study, the study team was able to modify the project design to address issues and concerns early in the process.

Primary issues of concern during public meetings and in the NEPA reviews were related to potential environmental effects on fish passage, a strong desire to avoid stage increases either upstream or downstream, and opposing views from local and federal agencies regarding removal of land from the floodplain. The selected plan attempts to balance these issues by including appropriate mitigation for all impacts that could not be avoided through design. There was also a desire among several stakeholders to include wetland restoration and flood water storage features in the selected plan; although these measures were investigated, they were not found to be economically justified as increments of the project. Other Corps and non-Corps planning efforts currently under way will continue to evaluate potential federal participation in such projects in the future.

Environmental Compliance. The Fargo-Moorhead Metropolitan Area Flood Risk Management Feasibility Report and Environmental Impact Statement has undergone all required review under the National Environmental Policy Act. The Final report includes responses to all resource agency and interested party comments on the Draft and Supplemental Draft reports. An indication of Section 401 Water Quality Certification was requested from both the Minnesota Pollution Control Agency (MPCA) and the North Dakota Department of Health. The MPCA indicated Section 401 WQ Certification for this report should be submitted to the MPCA after the plans and specifications are prepared and the 401 WQ Certification would be considered at that time. The North Dakota Department of Health

indicated that there are no identified major issues at this time that would preclude 401 WQ Certification as the project proceeds.

A Programmatic Agreement has been 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, are concurring parties to the Programmatic Agreement. The Cass County (North Dakota) and Clay County (Minnesota) Boards of Commissioners also signed as concurring parties. Sixteen Indian tribes were also invited to be concurring parties to the Programmatic Agreement.

The final U.S. Fish & Wildlife Service Coordination Act Report was received on July 14, 2011, and the selected plan would result in no significant impacts on federally-listed species or habitats. The Findings of Compliance for Clean Water Act Section 404(b)(1) Evaluation was signed on July 15, 2011. The Clean Water Act Section 402 NPDES permits will be obtained from the appropriate state agencies in Minnesota and North Dakota by the construction contractor before the start of construction.

State and Agency Review. To be completed by HQUSACE after completion of review.

Certification of Peer and Legal Review

District's Quality Control (DQC) assessment included PDT review and comment, including the Real Estate and Cost Estimates. Legal Certification was completed on July 15, 2011, by St. Paul District Counsel, with the Final Feasibility Report and Environmental Impact Statement document considered to be legally sufficient.

Agency Technical Review (ATR) of the subject document prepared by the District was managed by the FRM-PCX in SPD. The ATR was performed by a team composed of staff of the Omaha District, with some assistance from other Districts and the USACE Hydrologic Engineering Center. Review of the SDEIS document resulted in a total of 308 comments consisting of 16 comments regarding hydrology, 77 comments regarding hydraulics, 98 comments regarding economics, 31 other social effects comments, 4 environmental comments, 5 structural engineering comments, 67 cost engineering comments, 1 nonstructural comment and 9 risk and uncertainty comments. All but two comments were resolved prior to ATR and cost estimate certification on June 21, 2011. One of the outstanding ATR comments was resolved on August 10, 2011; the other will be resolved with HQUSACE early in the PED phase.

Final Independent External Peer Review (IEPR) of the subject document prepared by the District was managed by the FRM-PCX, in accordance with *Civil Works Review Policy*, ER 1165-2-209, dated January 31, 2010. The IEPR was contracted through the Army Research Office and administered by Battelle Memorial Institute, an independent consultant. Since the IEPR purpose is to "assess the adequacy and acceptability of the economic, engineering, and

environmental methods, models, and analyses used," the IEPR is limited to technical review, and does not involve policy review. The IEPR was conducted by four subject matter experts (i.e., IEPR Panel members) with extensive experience in economic, engineering, environmental resources, and plan formulation relevant to the project. The IEPR Panel was charged with responding to eighty five specific technical questions as well as providing a broad technical evaluation of the overall project. A total of sixteen IEPR Panel final comments were provided to the USACE on July 7, 2011. The one the Panel rated most significant regarded gate operation and the success of project operation. Fourteen comments rated "medium" were about hydraulics, hydrology, environmental, cost, plan formulation, and spoil areas. One comment rated "low" addressed costs for individual project features not being provided in the Total Project Cost Summary. All comments from this review have been addressed and incorporated into the final project documents and recommendation as appropriate.

Policy Compliance Review. The AFB Policy Compliance Review is documented in the Policy Guidance Memorandum dated May 20, 2010, which contains District responses and actions on all 61 comments – 1 general; 2 problems and opportunities; 4 without project conditions; 6 formulation of alternative plans; 7 evaluation and comparison of plans; 7 mitigation; 6 environmental and environmental compliance; 5 legal; 8 cost engineering; 7 real estate and 8 miscellaneous. All responses have been incorporated into the final report, Environmental Impact Statement, and appendices as appropriate.

The final policy review findings will be documented herein when completed by HQUSACE.