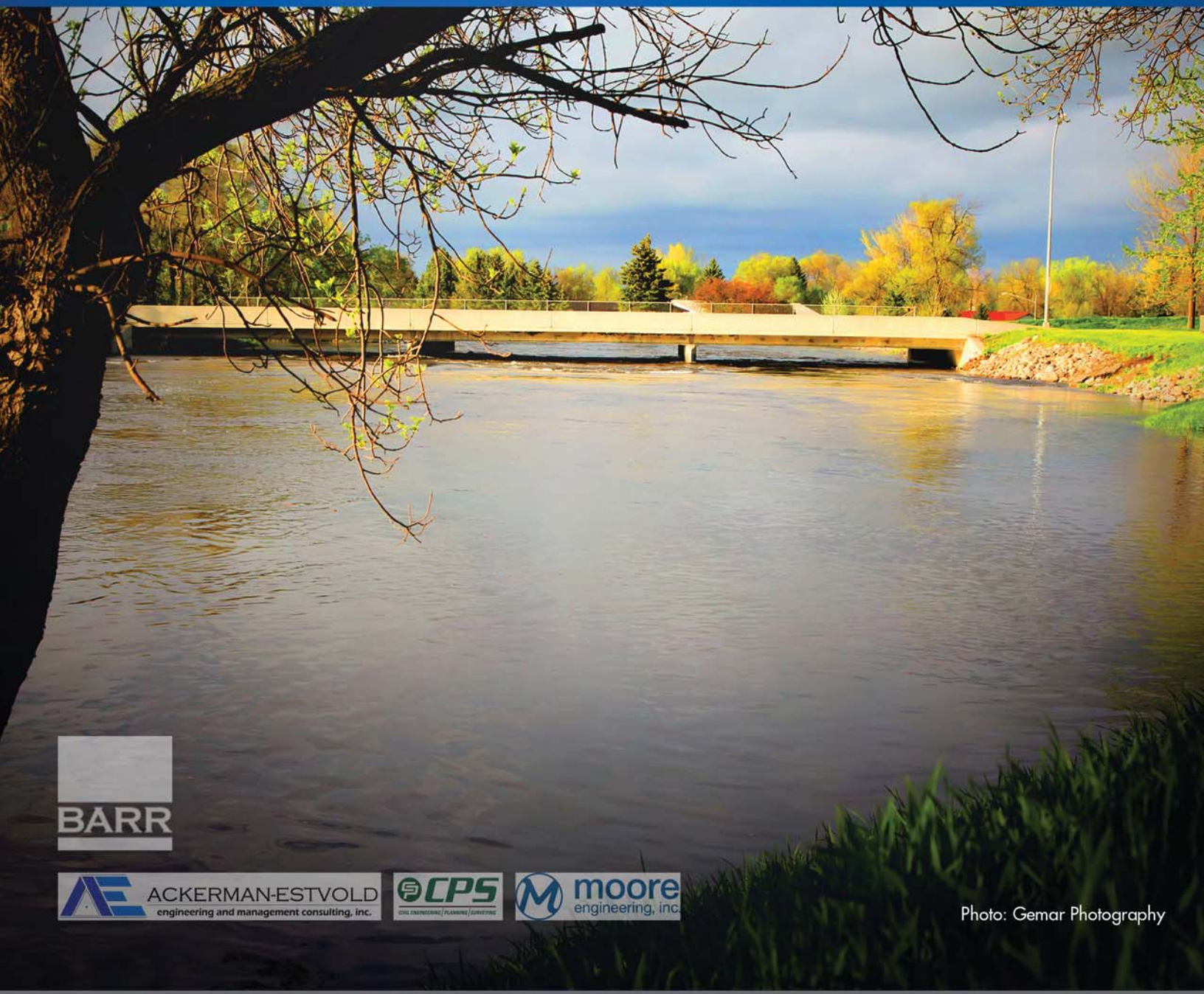
APPENDIX B

Mouse River Enhanced Flood Protection
Preliminary Engineering Report

Prepared for North Dakota State Water Commission



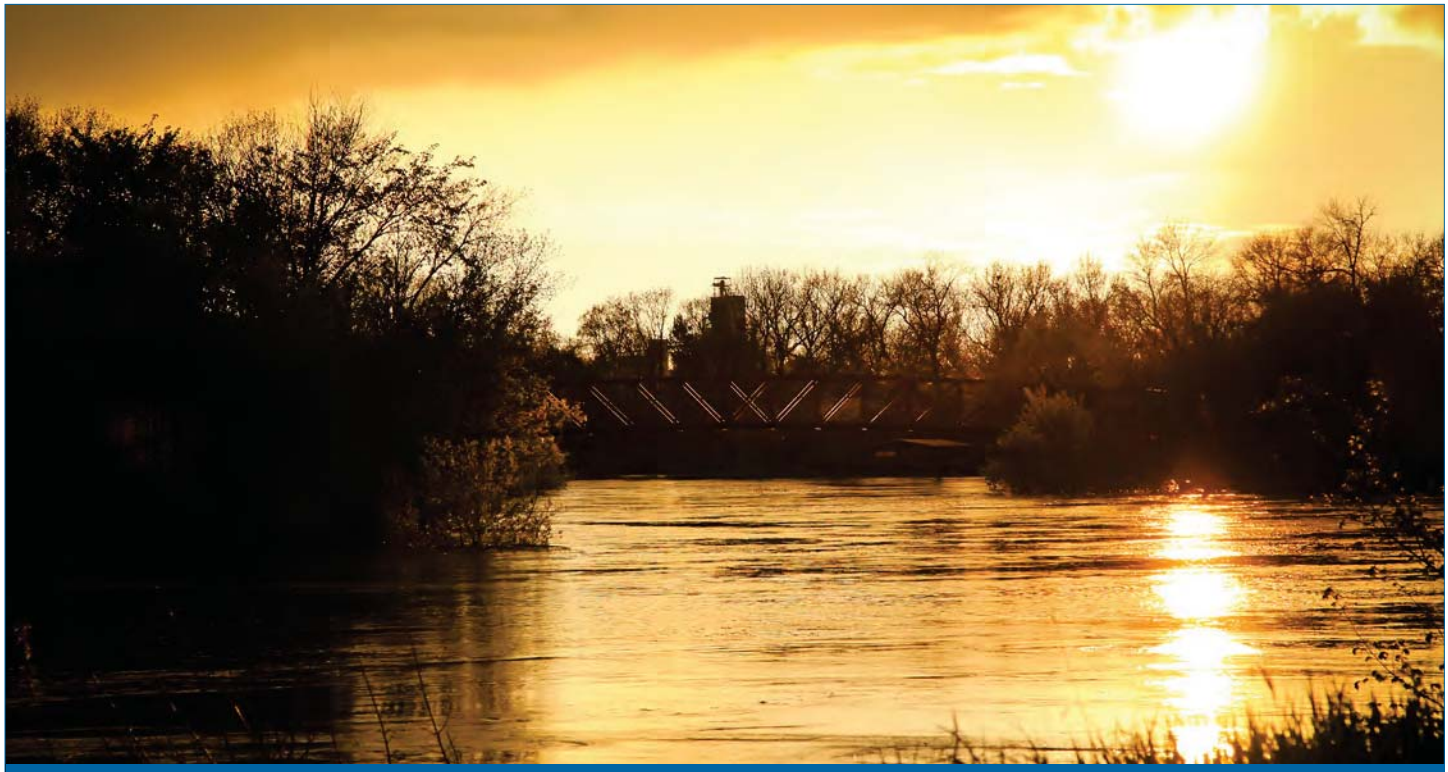
BARR

ACKERMAN-ESTVOLD engineering and management consulting, inc.

CPS

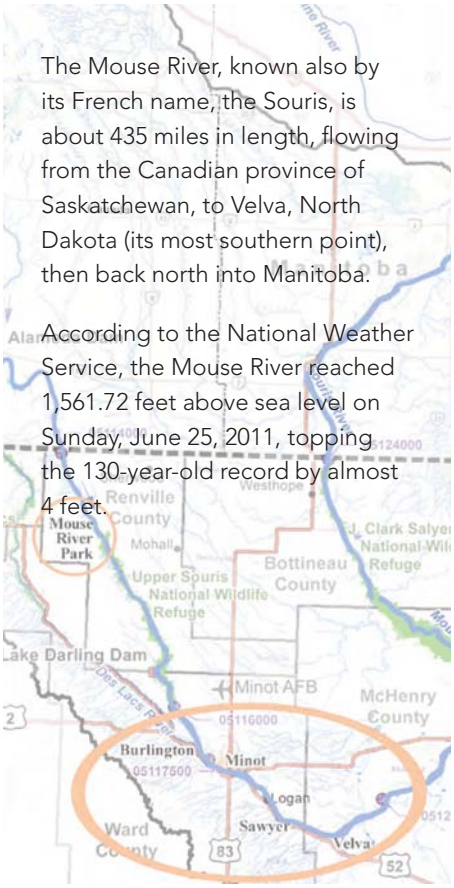
moore engineering, inc.

Photo: Gemar Photography



Executive Summary

The sun sets over the Mouse River and Zoo Bridge in Minot. (Photo: Gemar Photography, Minot)



The Mouse River, known also by its French name, the Souris, is about 435 miles in length, flowing from the Canadian province of Saskatchewan, to Velva, North Dakota (its most southern point), then back north into Manitoba.

According to the National Weather Service, the Mouse River reached 1,561.72 feet above sea level on Sunday, June 25, 2011, topping the 130-year-old record by almost 4 feet.

On June 25, 2011, the Mouse River flowed under Minot's Broadway Bridge at a record rate of 27,400 cubic feet per second (cfs)—more than five times the rate that existing channels and levees had been designed to handle and close to nine times the rate of any flood documented since construction of four upstream storage reservoirs. Not since 1882, a time when commercial production of automobiles was just beginning, had flows in excess of 20,000 cfs been seen. For days, during the 2011 flood, water levels were too high for cars to safely cross numerous area bridges.

The record-breaking flow overwhelmed most flood fighting efforts along the entire reach of the Mouse River through North Dakota, causing extensive damage to homes, businesses, public facilities, infrastructure, and rural areas. According to the U.S. Army Corps of Engineers (USACE), 4,700 commercial, public, and residential structures in Ward and McHenry counties sustained building and content damage totaling more than $690 million.

If no emergency flood fighting measures had been implemented, potential building and content damages would total roughly $900 million. This includes the 1,500 structures protected by the emergency levees but still considered at risk. This estimate does not reflect the cost of rebuilding in areas outside of the flood zone, where real estate values are particularly high.

The heroic efforts of residents, volunteers, local officials, and state and federal agencies prevented significant damages. Still, more than 11,000 residents were displaced by the 2011 flood. A preliminary alignment plan was a high priority so that affected residents and business owners could make decisions on whether to rebuild or relocate. (Photo, above left, courtesy of FEMA)

Rural Considerations

The rural areas of the Mouse River Valley, upstream of Burlington and downstream of Velva, were also devastated by the 2011 flood. Damage came in the form of flooded homes and farmsteads, erosion, sedimentation and debris deposition, lost crop production, and road and bridge washouts. These areas will be the focus of further study to address the circumstances and constraints specific to agriculture. A workshop was held on February 16, 2012, to gather stakeholder input for the engineering evaluation of rural areas.

In the aftermath of the flood, local government recognized the need to develop a plan that could provide direction during recovery and better protect the Mouse River community from similar future events. The Souris River Joint Board issued a request to the North Dakota State Water Commission to retain an engineering team to develop a "Mouse River Enhanced Flood Protection Project," including preliminary alignments for levees and floodwalls. The Preliminary Engineering Report provides a summary of the efforts undertaken to develop a preliminary alignment, as well as engineering, environmental, and cost considerations for plan implementation.

Project Objectives and Scope

The primary objective for the Mouse River Enhanced Flood Protection Project (Project) is to develop a preliminary plan that can be used as a guiding document to help reduce the risk of damages from river flows comparable to those seen during the June 2011 flood. The scope of this study is the Mouse River Valley from Burlington to Velva and Mouse River Park.

There are a wide range of flood risk reduction alternatives available, ranging from restoration and maintenance of the existing channel modifications, levees, and upstream flood storage system, to complete removal of at-risk properties within the 2011 flooded area. Previous reports and studies were reviewed to determine the range of options that have been considered for the Mouse River Valley. A more comprehensive review and analysis of potential alternatives to the preliminary alignment plan presented here will be required to comply with the regulatory review process for implementing any major flood risk reduction plan.

A series of workshops and public meetings were held to get stakeholder input and feedback used in the development of the preliminary alignment plan. Community members were also able to stay informed and offer feedback through the Project website (www.mouseriverplan.com), Facebook, and Twitter. Over the course of the Project over 1,200 public comments were received.

Preliminary Alignment Development Process

The development of a preliminary alignment, including measures such as levees and floodwalls, is a complex process that requires both significant technical analysis and substantial stakeholder input. Rapid identification of an alignment corridor is a key first step because it allows affected property owners to make informed decisions about rebuilding or relocating.

The preliminary alignment described in this report was developed through an iterative process consisting of: (1) obtaining stakeholder input, (2) alignment development, (3) performing detailed hydraulic modeling of the alignment, and (4) performing engineering analysis and design.

Initial input was gathered at an October 2011 workshop. The primary objective for this workshop, which consisted of presentations, dialog, and work sessions, was to engage participants in a discussion of priorities and strategies for flood risk reduction. The resulting consensus priorities and alignments were used to complete hydraulic modeling and plan refinements.

A draft preliminary plan was published on November 3, 2011, for public review and comment. Three additional cycles of input, alignment, and modeling revision (as well as dozens of intermediate iterations) occurred between November 3, 2011, and January 31, 2012. Plan revisions were posted to the Project website (www.mouseriverplan.com).

Project Objectives and Constraints

(1) Reduce the risk of flood damage to as many homes as reasonably possible

(2) Minimize the Project footprint and number of residential acquisitions required

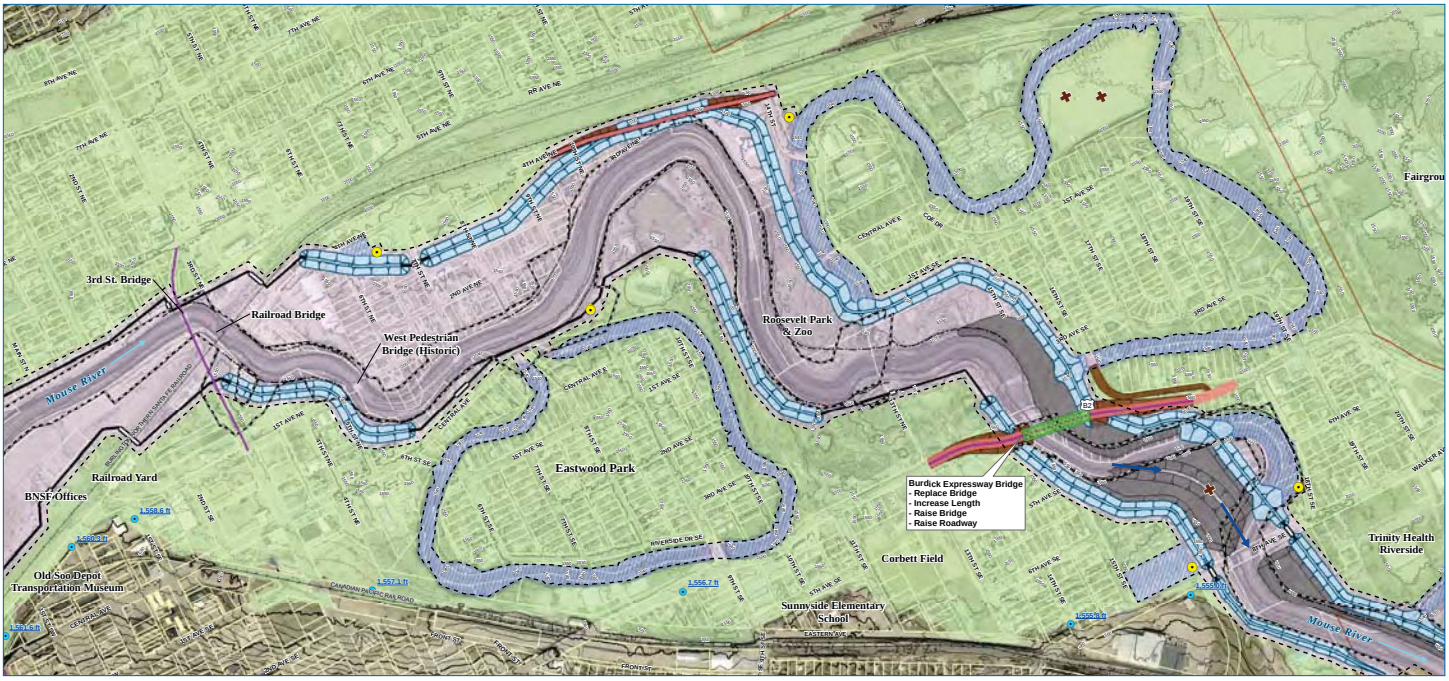
(3) Minimize increases in flood level water surface, flow rates, and duration

(4) Develop a Project that can be implemented at the lowest practical cost

(5) Establish key transportation corridors that can remain open during flood events

(6) Minimize environmental impacts to facilitate necessary regulatory approvals

(7) Design a Project that is consistent with the long-range objectives of the affected communities



The preliminary alignment plan includes levees, floodwalls, and river diversions and closure features to reduce the risk of flooding in populated areas along the Mouse River.

Primary Features

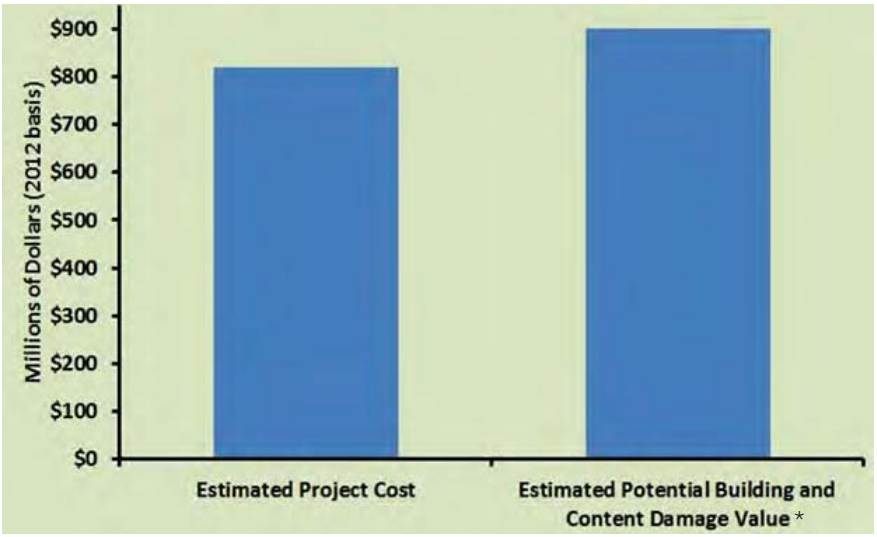
- 21.6 Miles — Levees
- 2.8 Miles — Floodwalls
- 30 — Transportation Closure Structures
- 33 — Stormwater Pump Stations

Description of the Preliminary Alignment

The preliminary alignment plan consists of levees, floodwalls, river diversions and closure features, transportation closure structures, interior pump stations, and 2011 floodplain buyouts. Levees comprise almost 90 percent of the alignment, totaling 21.6 miles. The remainder of the alignment consists of 2.8 miles of floodwalls, and 30 transportation closure structures (19 roadway and 11 railroad). In addition, the Project would require 33 stormwater pump stations.

The estimated total Project cost is $820 million, based on the current level of design and Project understanding. This Project cost is a point estimate, in current dollars, and does not consider the likelihood of cost escalation over the period of implementation. Of the estimated cost, $565 million is related to construction, $154 million is related to property acquisition, and the remaining $101 million covers planning, engineering, and program management costs.

Estimated Project Cost Compared to Potential Damages from Flood Similar to 2011



* *Project costs shown exclude the substantial costs related to emergency flood fighting, evacuations, damages to public infrastructure, lost commerce—and the incalculable human costs.*


Photo: courtesy of FEMA

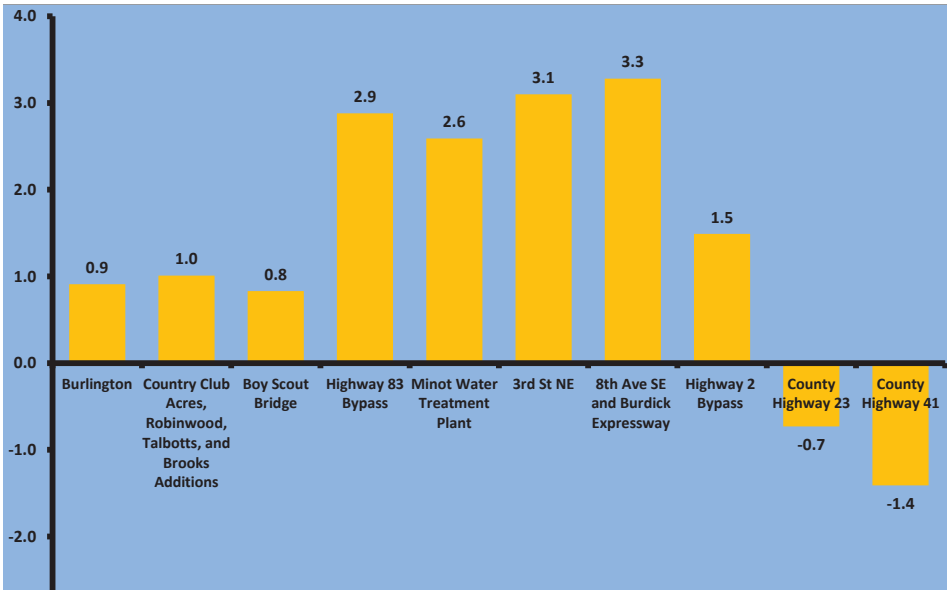
Impacts of Preliminary Alignment

Flood Level Impacts

One of the most critical design constraints of a flood risk reduction system is the estimation of the design water surface elevation. This defines the required height for constructed features such as levees and floodwalls. Potential hydraulic effects of the proposed alignment on upstream and downstream water surface elevations also need to be considered.

The Project will change the flood profile for the design flow (27,400 cfs) at most locations (see chart below). In the majority of cases, this is the result of efforts to narrow the floodplain—minimizing the Project footprint and the number of property acquisitions required.

Summary of Project Effect on 2011 Flood Profile (feet)



Property Impacts

Construction of levees, floodwalls, road raises, road realignments, etc., will require acquisition of property. The table below provides a summary of the estimated number of residential properties that would need to be accquired to implement the Project. This estimate is limited by information available in the Project area.

Summary of Residential Properties to be Acquired for the Preliminary Alignment Project

	Up-stream	Minot	Down-stream	Total
Number of Residential Properties[1]	90	278	15	383

[1] Residential properties includes parcels classified as single family, two-family, and multi-family with a dwelling unit. Data is not readily available for estimating the number of housing units represented by this property count.

Implementation of an Enhanced Flood Risk Reduction Project

Implementation of an enhanced flood risk reduction plan is a multi-step process. Phased implementation may provide desirable flexibility for funding and construction of high-priority elements. Steps that must be completed prior to construction are listed in the table shown at left.

The estimated time frame for planning, engineering, environmental, and regulatory steps for the entire Project could be 5 years—or longer. Select components or individual levee system modifications, which have minimal environmental impacts, could potentially proceed on a separate path and at a faster pace. Construction of a project similar to the preliminary alignment plan described in this report is likely to take a minimum of 5 years, and could be phased over an extended period if necessary.

Pre-Construction Implementation Steps

✓	Identifying funding mechanisms (local, state, federal)
✓	Extending the Project to consider rural areas downstream of Velva
✓	Investigating additional Project alternatives (e.g., lesser design events, reservoir modification, combinations, etc.)
✓	Adopting a final plan
✓	Performing the necessary field investigations (e.g., geotechnical investigations, wetlands, surveys, etc.)
✓	Completing engineering and environmental studies (e.g., hydrologic, hydraulic, geotechnical, socio-economic, biological resources, etc.)
✓	Developing detailed design
✓	Obtaining permitting and regulatory approvals (e.g., NEPA compliance; USACE Section 10, 404, and 408 approvals; Section 401 water quality certification; FEMA certification, etc.)
✓	Acquiring Project properties
✓	Preparing the corridor
✓	Continuing stakeholder and agency coordination

Rendering of the Maple Diversion area, part of the Enhanced Flood Risk Reduction Project