Fargo-Moorhead Flood Risk Management Project
Preliminary-Draft EIS

June 12, 2015

Prepared by:

MINNESOTA DEPARTMENT OF NATURAL RESOURCES

500 Lafayette Road, Box 25
St. Paul, MN 55155

Table of Contents

Table of Contents (cont.)

Table of Contents (cont.)

Table of Contents (cont.)

Table of Contents (cont.)

Table of Contents (cont.)

Table of Contents (cont.)

Table of Contents (cont.)

Table of Contents (cont.)

Table of Contents (cont.)

Table of Contents (cont.)

Table of Contents (cont.)

LIST OF TABLES

Table of Contents (cont.)

Table of Contents (cont.)

Table of Contents (cont.)

LIST OF FIGURES

Table of Contents (cont.)

List of Illustrations

Table of Contents (cont.)

List of Graphs

LIST OF APPENDICES

Acronyms

(°)degrees
(ABA) Architectural Barriers Act
(ACMs) Potential Asbestos Containing Materials
(ADA) Americans with Disabilities Act
(AIS) Aquatic Invasive Species
(AMP) Adaptive Management Plan
(AMMP) Adaptive Management and Monitoring Plan
(AMT) Adaptive Management Team
(APE) Area of Potential Effect
(APHIS) USDA Animal and Plant Health Inspection Service
(ASTs) Aboveground Storage Tanks
(ATV) All-terrain Vehicles
(AUAR) Alternative Urban Areawide Review
(Avg) Average
(BFEs) Base Flood Elevations
(BMPs) Best Management Practices
(BNSF) Burlington Northern Santa Fe Rail Lines
(BRRWD) Buffalo-Red River Watershed District
(Btu) British thermal unit
(BWSR) Minnesota Board of Water and Soil Resources
(CCJWD) Cass County Joint Watershed District
(CEQ) Council on Environmental Quality
(cfs) cubic feet per second
(CLOMR) Conditional Letter of Map Revision
(CRREL) United States' Army Corps of Engineers' Engineer Research and Development Center Cold Regions Research and Engineering Laboratory
(CUP) conditional use permits
(CWA) Clean Water Act
(DELT) Deformities, Eroded Fins, Lesions, or Tumors
(DFIRM) Digital Flood Insurance Rate Maps
(DSA)Distributed Storage Alternative
(DSC) Downstream Control
(DU) Ducks Unlimited
(EA) Environmental Assessment
(ECS) Ecological Classification System
(EDDMS) Early Detection & Distribution Mapping System
(EIS) Environmental Impact Statement
(EMB) Excavated Material Berm
(EMTs) Emergency Medical Technicians
(EOEP) Expert Opinion Elicitation Panel
(ESA) Environmental Site Assessment
(EQB) Environmental Quality Board
(F) Fahrenheit
(FCC) No Action p. 4
(FDR) Flood Damage Reduction
(FEMA) Federal Emegency Management Agency
(FIRMs) Flood Insurance Rate Maps
(FIS) Flood Insurance Study
(FFREIS) Final Feasibility Report and Environmental Impact Statement
(F-M) Fargo-Moorhead
(FRP) Federally Recommended Plan
(ft) feet
(ft^2) foot squared
(ft/sec) feet per second
(ft/yr) feet per year
(GIS) Geographic Information System
(GPS) Global Positioning System
(H and H) hydrologic and hydraulic
(HEC-FDA) Hydrologic Engineering CenterFlood Damage Reduction Analysis
(HEC-HMS) Hydrologic Engineering Center Hydrologic Modeling System
(HEC-RAS) Hydrologic Engineering Centers River Analysis System
(hr) hour
(HUR) Halstad Upstream Retention Study
(Hwy) Highway
(HTRW) Hazardous, Toxic, and Radioactive Wastes
(I-29) Interstate 29
(I-94) Interstate 94
(IBI) Index of Biotic Integrity
(IMPLAN) IMpact Analysis for PLANning Model
(I-O) input-output analysis
(IRT) Interagency Review Team
(lb/ft^2) pounds per square foot
(LBP) Lead Based Paint
(LGU) Local Government Unit
(LiDAR) Light Detection and Ranging
(LOL) Loss of Life
(LOMR) Letter of Map Revision
(LPP) Locally Preferred Plan
(MDA) Minnesota Department of Agriculture

(MEPA) Minnesota Environmental Policy Act
(MN) Minnesota
(MNDNR) Minnesota Department of Natural Resources
(MNRAM) Minnesota Routine Assessment Methodology for Evaluation of Wetland Functions
(MPCA) Minnesota Pollution Control Agency
(NAA) Northern Alternative Alignment
(NAVD) North American Vertical Datum
(ND) North Dakota
(NDDA) North Dakota Department of Agriculture
(NDDH) North Dakota Department of Health
(NDGF) North Dakota Game and Fish Department
(NDNHI) North Dakota Natural Heritage Inventory
(NEPA) National Environmental Policy Act
(NFIP) National Flood Insurance Program
(NHIS) Minnesota Natural Heritage Information System
(NHPA) National Historic Preservation Act
(NLCD) National Land Cover Dataset
(NRCS) Natural Resources Conservation Service
(NRHP) National Register of Historic Places
(NWI) National Wetlands Inventory
(O & M) Operations & Maintenance
(OHB) Oxbow, Hickson, and Bakke
(OHV) Off-Highway Vehicle
(OHWL) Ordinary High Water Level
(OMRR&R) Operations, Maintenance, Repair, Rehabilitation, and Replacement
(OSE) Other Social Effects
(PAHs) Poly Aromatic Hydrocarbons
(PCBs) Polychlorinated Biphenyls
(PED) Preliminary Engineering Design
(PFSAA) *FM Diversion Post-Feasibility Southern Alignment Analysis* (HMG, 2012)
(PMF) Probably Maximum Flood
(PWI) Public Waters Inventory
(QA) Quality Assurance
(QC) Quality Control
(QHEI) Qualitative Habitat Evaluation Index
(RECs) Recognized Environmental Conditions
(RGU) Responsible Government Unit
(ROD) Record of Decision
(ROW) Right-of-Way
(RRJWD) Red River Joint Water Resource District
(RRWMB) Red River Watershed Management Board
(RS) River Stage
(SEAW) Scoping Environmental Assessment Worksheet
(SFHAs) Special Flood Hazard Areas
(SGCN) Species of Greatest Conservation Need
(SHPO) State Historic Preservation Office
(SIAM) Sediment Impact Analysis Model
(SoCP) Species of Conservation Priority
(SOW) Scope of Work
(SSTS) Subsurface Sewage Treatment Systems
(STS) Storm Sewer
(LS) Lift Station
(SWAPS) State Wildlife Action Plans
(T138 R48) Unnamed Tributary to the Red River
(TCPs) Traditional Cultural Properties
(URS) URS, Corporation
(US) United States
(USACE) United States' Army Corps of Engineers
(USC) United States' Code
(USDA) United States' Department of Agriculture
(USEPA) United States' Environmental Protection Agency
(USFWS) United States' Fish and Wildlife Service
(USGS) United States' Geological Survey
(USPS) United States' Postal Service
(USTs) Underground Storage Tanks
(WCA) Wetland Conservation Act
(WRAPS) Minnesota Pollution Control Agency Watershed Restoration and Protection Strategy

Definitions

0.2-percent chance event: A flood event that has the statistical average of occurring once every 500 years. See also 500-year flood.

1-percent chance event: A flood event that has the statistical average of occurring once every 100 years. See also 100-year flood.

10-percent chance event: A flood event that has the statistical average of occurring once every 10 years. 10-percent chance event. This would result in an approximate flow of 17,000 cfs at the Fargo gage.

10- year flood: A flood event that has the statistical average of occurring once every 10 years. See also 10-percent chance event.

100-year flood: A flood event that has the statistical average of occurring once every 100 years. See also 100-year flood. See also 1-percent chance event.

500-year Event: A flood event that has the statistical average of occurring once every 500 years. See also 0.2 percent chance event.

Accessibility: refers to the ability to access a property from an adjacent roadway.

Accreditation: An accredited levee system is a system that FEMA has determined can be shown on a FIRM as providing a 100-year flood event or greater level of flood protection.

This determination is based on the submittal of data and documentation required by 44 CFR Section 65.10 which must be certified by a Professional Engineer. The area landward of an accredited levee system is shown as a moderate-risk area, labeled Zone X (shaded), on the DFIRM except for areas of residual flooding, such as ponding areas, which will be shown as high-risk areas, called Special Flood Hazard Areas (SFHAs). Flood insurance is not mandatory in Zone X (shaded) areas, but is mandatory in SFHAs. SOURCE: http://www.fema.gov/media-library-data/20130726-1600-20490-4180/lv_accredit_checklist_nov08.pdf

Action Threshold: The point at which data and information indicate identified criteria have been met requiring steps to address impacts or potential impacts.

Activity Hubs: Key locations along the proposed trail system offering recreational amenities, such as trail access or interpretive signs.

Activity Nodes: Similar to activity hubs but provide less intensive site-specific activities and could serve as secondary access points to the trails.

Adaptive Management: A process wherein management actions can be changed in response to a monitored result or impact. An adaptive management plan proposes pre-construction and post-construction studies of biota and physical habitat for both impact sites and mitigation sites, including a framework for evaluation and response actions.

Adaptive Management Team: A decision-making body for the Adaptive Management Plan composed of local, state, and federal agency personnel working collaboratively to address adaptive management needs.

Adverse Effect: A harmful or undesired effect from the Proposed Project on the environment.

Anthropogenic: Relating to or resulting from the influence of human beings on nature.

Associated Facilities: Components of the Project that are not primary, but are necessary for Project construction and operation. Primary components include the diversion channel, tieback embankment, and control structures.

Aqueduct: a structure that looks like a bridge and that will be used to carry the Sheyenne River over the Diversion Channel.

Bankfull: The elevation of the floodplain adjacent to the active channel.

Bankfull Flow: The discharge at channel capacity or the flow at which water just fills the channel without over-topping the banks.

Base Flood Elevation: The elevation of surface water resulting from a flood that has a one percent (1%) chance of equaling or exceeding that level in any given year. The BFE is shown on the Flood Insurance Rate Map (FIRM) for zones AE, AH, A1–A30, AR, AR/A, AR/AE, AR/A1– A30, AR/AH, AR/AO, V1–V30 and VE. (source: https://www.fema.gov/national-flood-insurance-program/definitions)

Base Flow (Q_{Base}): The component of streamflow not directly attributed to stormwater runoff. Base flow defines low flow conditions for maintaining viable habitat for stream organisms. While base flow does not transport large amounts of sediment it can be important in maintaining a low-flow channel needed by stream organisms when water levels drop in the summer and fall.

Base No Action Alternative: includes the potential flood risk reduction impact of already completed and currently funded projects such as levee construction and property buyouts.

Benthic Biodiversity: The many different kinds of organisms living on the bottom of a body of water, such as mussels or other bottom-dwelling species.

Berms: a hill or wall of dirt or sand.

Best Management Practices: Methods or techniques found to be the most effective and practical means in achieving an objective (such as preventing or minimizing pollution) while making use of resources.

Bioassessment (Biological Assessment): Biological assessments are evaluations of the condition of waterbodies using surveys and other direct measurements of resident biological organisms (macroinvertebrates, fish, and plants). Biological assessment results are used to answer the question of whether waterbodies support survival and reproduction of desirable fish, shellfish, and other aquatic species -- in other words, if the waterbodies meet their designated aquatic life uses.

Biological Community: All the interacting organisms living together in a specific habitat of varying sizes, larger biological communities may contain smaller communities.

Biota: flora (plants) and fauna (animals) of a particular location

Biotic: of, relating to, or caused by living organisms

Biotic Community: A group of interdependent organisms inhabiting the same region and interacting with each other.

Biotic Connectivity: The quality, state or capability of the flora and fauna (i.e., organisms) or biotic processes of a region being connected or being able to move unimpeded.

Best Management Practices (BMPs): The schedule of activities, prohibition of practices, maintenance procedures, and other management practices to avoid or minimize pollution or habitat destruction to the environment. BMPs can also include treatment requirements, operating procedures and practices to control runoff, spillage or leaks, sludge or waste disposal, or drainage from raw material storage.

Blue Books: US Fish and Wildlife Service habitat assessment models.

Brush/Grassland: grassland areas dominated by graminoid or herbaceous vegetation and shrub/scrub areas dominated by shrubs less than five meters tall with shrub canopy typically greater than 20 percent of total vegetation, including true shrubs, young trees in an early successional stage, or trees stunted due to harsh environmental conditions. Includes those areas in the Eastern United States that commonly are called brush lands (Anderson et al., 1976).

Buffalo-Red River Watershed District: Located in northwest Minnesota, the district covers approximately 1,785 square miles and is one of the ten major watersheds in the Red River Basin. (http://www.brrwd.org/) 2.2, 2-22, 1

Class I Dam: A dam (defined in Minnesota Rules 6115) whose failure, misoperation, or other occurrences or conditions would probably result in any loss of life or serious hazard, or damage to health, main highways, high-value industrial or commercial properties, major public utilities, or serious direct or indirect, economic loss to the public. (https://www.revisor.mn.gov/rules/?id=6115.0340)

Class I Hazard: Presents the greatest hazard, with potential loss of life or damage to health, main highways, high-value industrial or commercial properties, or major public utilities, or potential major economic loss.

Class II Hazard: Poses a possible health hazard or probable loss of property or damage to secondary highways, railroads or other public utilities.

Class II Hazard: The least serious condition; property losses would be restricted primarily to rural buildings and local county and township roads.

Collector Roadway: Provides a less highly developed level of service at a lower speed for shorter distances by collecting traffic from local raods and connecting them with arterials. (http://www.fhwa.dot.gov/environment/publications/flexibility/ch03.cfm)

Comstock ring levee: A ring levee that would be constructed around the city of Comstock, Minnesota, which is currently located outside of the 100-year floodplain.

Concrete Baffle: A concrete structure containing a series of sediment settling chambers separated by baffles. The primary function of baffle boxes is to remove sediment, suspended particles, and associated pollutants from storm water. (http://water.epa.gov/scitech/wastetech/upload/2002_12_13_mtb_baffle_boxes.pdf)

Conditional Use Permit: A conditional use permit is a document a regulatory agency issues to grant a conditional use when the general and specific ordinance standards have been met by the applicant. The use is allowed by the permit only if the special concerns are addressed as set forth in the zoning ordinance. Conditional use permits are authorized under state law. (http://www.lmc.org/media/document/1/conditionalusepermits.pdf?inline=true)

Connecting Channel: The 6-mile long connecting channel between the Red River and the diversion inlet control structure.

Construction Footprint: Portions of the Project that would result in a direct impact from disturbance during Project construction, such as excavation, piling of earthen material, and equipment movement. In general these areas include the diversion channel, connecting channel, excavated material berms, and embankments.

Control Structure: A structure in a water management system that conveys water, controls the direction or rate of flow, maintains a desired water surface elevation or measures water.

Cover Type: A general term referring to the specific land cover of an area.

Cropland: Land used for growing crops, which are typically associated with cultivated, agricultural crops, such as corn and soybeans.

Cubic Feet Per Second (cfs): the rate of flow representing a volume of one (1) cubic foot passing a given point in one (1) second.

Cumulative Potential Effects: Means the effect on the environment that results from incremental effects of the project in addition to other projects in the environmentally relevant area that might be reasonably expected to affect the same environmental resources including future projects actually planned or for which a basis of expectation has been laid, regardless of what person undertakes the other projects or what jurisdictions have authority over the projects.

Cyprinids: Any of numerous, often small, freshwater fishes of the family Cyprinidae, which includes the minnows, carps, and shiners.

Dam: an artificial barrier that may impound water, which includes the embankments and control structures.

Dam Owner: the owner or lessee of the property to which the dam is attached, unless the dam is sponsored by a governmental agency which will be responsible for operation and maintenance of the dam, in which case that sponsoring agency shall be considered the owner. (https://www.revisor.mn.gov/rules/?id=6115.0320)

Detritivorous: of an organism (as an earthworm or a fungus) that feeds on dead and decomposing organic matter.

Direct Mortality: Death as a result of construction or operation of the Project.

Drain 14: A drainage ditch which runs generally south to north from Davenport to the Maple River.

Drayton Dam: A dam on the Red River located near Drayton, North Dakota, approximately 125 miles downstream of the project area.

Easement: an interest in land owned by another that entitles its holder to a specific limited use.

Ecological Classification System (ECS): Developed by the MNDNR and U.S. Forest Service, ecological land classifications are used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features, including climate, geology, topography, soils, hydrology, and vegetation.

Electronic Data Access (EDA): The MPCA's database system that allows users to view and download environmental data that is collected and stored by the agency and its partner organizations.

Embankment: A mound or earthen material, typically created from placement and compaction of soil, sand, clay and/or rock, to form a barrier to water seepage. Embankments can be used to form dams or created to form walls on the outside of man-made water channels. The Project would include the overflow embankment along Cass County Highway 17, the tieback embankment to form the staging area, and the diversion channel embankment on the outside banks of the channel.

Endangered Species: A species that is threatened with extinction throughout all or a significant portion of its range in Minnesota.

Energy Dissipation Chambers: A device constructed in a waterway to reduce the kinetic energy of fast flowing water. (Technical Manual: Outlet Works Energy Dissipators: Best Practices for Design, Construction, Problem Identification and Evaluation, Inspection, Maintenance, Renovation, and Repair. FEMA P-679/June 2010.)

Environmental Assessment Worksheet (EAW): Provides information about a project that may have the potential for significant environmental effects. The EAW is prepared by the Responsible Governmental Unit or its agents to determine whether an Environmental Impact Statement should be prepared.

Excavated Material Berms: a small hill or mound of dirt or sand created from earthen material that was excavated for creation of the Diversion Channel.

Exceptional Use Threshold: High quality waters with fish and invertebrate communities at or near undisturbed conditions.

Fargo Gage: U.S. Geological Survey gage in Fargo

Fargo-Moorhead area (F-M area): the general area in and surrounding the Fargo-Moorhead urban area. The F-M area includes the rural and urban areas of municipalities, townships, and counties adjacent to the cities of Fargo and Moorhead.

Fargo-Moorhead urban area (F-M urban area): the urbanized area within the cities of Fargo and Moorhead, and the adjacent cities.

Fee acquisition: Purchase of land or of an interest of land for a monetary amount.

FEMA Region V: FEMA Region V is comprised of Illinois, Indiana, Michigan, Minnesota, Ohio, and Wisconsin. *(https://www.fema.gov/region-v-il-mi-mn-oh-wi)*

FEMA Region VIII: FEMA Region VIIO is comprised of Colorado, Montana, North Dakota, South Dakota, Utah, and Wyoming. (http://www.fema.gov/region-viii-co-mt-nd-sd-ut-wy)

Final Scoping Decision Document (FSDD): A companion to the Scoping EAW prepared for the project. The purpose of a Scoping Decision Document is to identify those project alternatives and environmental impact issues that will be addressed in the EIS. A Scoping Decision Document also presents a tentative schedule of the environmental review process.

Flap Gates: Gates that prevent water from backing up out of the diversion channel after the local peaks have passed.

Flood: A general and temporary condition of partial or complete inundation of two or more acres of normally dry land area or of two or more properties (at least one of which is the policyholder's property) from:
--Overflow of inland or tidal waters; or
--Unusual and rapid accumulation or runoff of surface waters from any source; or
--Mudflow; (https://www.fema.gov/national-flood-insurance-program/definitions)

Flood Crest Elevation: The highest stage or level of a flood as it passes a particular location. Gages along a river record the level of water, and the highest level record at each gauge is the crest for that gauge.

Flood Risk: The chance of an area to flood.

Flood Stage: An established gage height for a given location above which a rise in water surface level begins to create a hazard to lives, property, or commerce. The issuance of flood advisories or warnings is linked to flood stage. Not necessarily the same as bankfull stage.

Floodplain: Any land area susceptible to being inundated by floodwaters from any source.

Floodplain Forest: A lowland forest deciduous habitat, included as a separate Type 1 wetland cover type.

Floodproofing: Any combination of structural and nonstructural additions, changes or adjustments to structures, which reduce or eliminate risk of flood damage to real estate or improved real property, water and sanitation facilities or structures with their contents.

Floodwalls: A wall built along a shore or bank to protect an area from floods.

Flowage Easement: A flowage easement provides the legal ability to inundate property as part of the operation of the Project. Value of a flowage easement on an individual property would follow Federal/USACE process and would be determined by appraisal. Factors that would be considered are depth, duration, and frequency of additional flooding, and the highest and best use of the property.

USACE policy defines a flowage easement as a one-time payment made at the time that the easement is acquired.

Fluvial Geomorphology: the study of steam channels, substrate, bank stability, flow characteristics and features or events influential in altering the river and its floodplain.

Formal Section 7 Consultation: The Endangered Species Act directs all federal agencies to work to conserve endangered and threatened species and to use their authorities to further the purposes of the Act. Section 7 of the Act, called "Interagency Cooperation," is the mechanism by which Federal agencies ensure the actions they take, including those they fund or authorize, do not jeopardize the existence of any listed species. **(**http://www.fws.gov/midwest/endangered/section7/section7.html**)**

Freeboard: An additional amount of height above the Base Flood Elevation used as a factor of safety (e.g., 2 feet above the Base Flood) in determining the level at which a structure's lowest floor must be elevated or floodproofed to be in accordance with state or community floodplain management regulations.

General Use Threshold: Waters with good fish and invertebrate communities that meet or should meet minimum goals.

Glochidia: Larvae expelled from a female mussel, which find a host fish where they attach to fish gills or fins.

Headcutting: the process of a stream to create an erosional feature where an abrupt vertical drop occurs, which typically resembles a very short cliff or bluff. If left to natural processes, the headcut will likely migrate upstream.

Historic Building: Any building that is:

- Listed individually in the National Register of Historic places (a listing maintained by the Department of the Interior) or preliminarily determined by the Secretary of the Interior as meeting the requirements for individual listing on the National Register; or
- Certified or preliminarily determined by the Secretary of the Interior as contributing to the historical significance of a registered historic district or a district preliminarily determined by the Secretary of the Interior to qualify as a registered historic district; or
- Individually listed in a state inventory of historic places in states with preservation programs that have been approved by the Secretary of the Interior; or
- Individually listed on a local inventory of historic places in communities with historic preservation programs that have been certified either:
  --By an approved state program as determined by the Secretary of the Interior; or
  --Directly by the Secretary of the Interior in states without approved programs.

Hydraulic Aqueduct Structure: A bridge-like structure that carries a water conduit or canal across a valley or over a river. In the case of this Project, the aqueducts convey river channels over the diversion channel.

Hydraulic Structure: Anything that can be used to divert, restrict, stop, or otherwise manage the natural flow of water.

Hydrology: The science dealing with the origin, distribution, and circulation of waters of the earth such as rainfall, streamflow, infiltration, evaporation, and groundwater storage.

Impact: Any change to the environment, whether adverse or beneficial, resulting from a facility's activities, products, or services.

Impacted Areas: A location that would experience change to the environment, whether adverse or beneficial, resulting from the Project.

Impervious Surfaces: mainly artificial structures—such as pavements (roads, sidewalks, driveways and parking lots) that are covered by impenetrable materials such as asphalt, concrete, brick, and stone--and rooftops. (http://encyclopedia.thefreedictionary.com/Impervious+surface) 3.6.1, 3-4, 2

In-Town Levees: floodwalls and levees in Fargo and Moorhead.

Index of Biotic Integrity (IBI): The stream IBI integrates information from individual, population, community, and ecosystem levels into a single ecologically based index of water resource quality (Karr, 1981). The IBI is a numerical index that is comprised of various measures of the biological community (called metrics) that are assigned a score (typically 0-10) based on their deviation from reference and summed to provide an integrative expression of site condition. It has been used to express the condition of fish, macroinvertebrate, algal, and terrestrial assemblages throughout the United States and in each of five major continents.

Infrastructure: the basic equipment and structures (such as roads and bridges) that are needed for a country, region, or organization to function properly.

Inundation: To flood, cover, or overspread with water.

Inundation area: Applies to any flooded area, regardless of depth, under existing, Project or NAA conditions within the project area.

Invasive Species: a broad term used to define a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112, Appendix 1, 1999) and encompasses all species, including plants and animals, terrestrial or aquatic.

Junk Vehicles: an abandoned, non-functional vehicle.

Jurisdictional: The identification and location of jurisdictional Waters of the United States, which includes wetlands, is a Jurisdiction Determination (JD). The USACE determines jurisdiction by documenting: connections of waters and wetlands to downstream navigable waters; interstate commerce connections; and adjacency of wetlands to other waters.

Key Habitat: those habitats that are most important to Minnesota's Species of Greatest Conservation Need (SGCN) and are identified with discrete ecological boundaries. Specifically, those habitats 1) used by the greatest number of SGCN, 2) changed the most over the past 100 years, 3) having a high percentage of habitat specialist SGCN, or 4) having been identified as important stream segments by The Nature Conservancy. Key Habitats are equivalent to Landscape Components in North Dakota.

Keystone Species: a species that has a disproportionately large effect on its environment relative to its abundance. Such species are described as playing a critical role in maintaining the structure of an ecological community, affecting many other organisms in an ecosystem and helping to determine the types and numbers of various other species in the community.

Lands and Damages, and Construction Costs: Expenses related to land acquisitions, damage compensation, and construction of the Project.

Landscape Component: areas in North Dakota that historically support Species of Conservation Priority and are identified with discrete ecological boundaries. Landscape Components are equivalent to Key Habitats in Minnesota.

Left-Bank: left side of stream channel when facing downstream

Less Than Significant Effect: An effect that is predicted to be below an identified threshold and/or an effect that was determined by the lead agencies to not have a magnitude that is great based on the context and intensity of that effect.

Letter of Map Revision (LOMR)--An official amendment to the currently effective FEMA map. It is issued by FEMA and changes flood zones, delineations and elevations. (FEMA)

Levee: an embankment or structure for preventing flooding

Levee Construction: building of the embankment to prevent flooding **(**i.e., structural measures)

Level I species: Species having a high level of conservation priority because of declining status either in North Dakota or across their range; or a high rate of occurrence in North Dakota constituting the core of the species' breeding range, but are at-risk range wide, and funding other than State Wildlife Grants is not readily available to them. (http://gf.nd.gov/magazines/north-dakota-species-conservation-priority/level-1)

LiDAR: Light Detection and Ranging (LiDAR) is a remote sensing technology that collects 3-dimensional point clouds of the Earth's surface. The technology is used for a wide range of applications including high-resolution topographic mapping and 3-dimensional surface modeling as well as infrastructure and biomass studies. (https://lta.cr.usgs.gov/LIDAR)

Lithophile: micro-organisms that can live within the pore interstices of sedimentary and even fractured igneous rocks to depths of several kilometers.

Littoral Zone: The portion of a lake that is less than 15 feet in depth (MNDNR/MPCA); extends from the shoreline of a lake and continues to depth where sufficient light for plant growth reaches the sediments and lake bottom (U of M Extension).

Local Sponsor: synonymous with "non-Federal sponsor" or "non-Federal interest", the preferred term being "non-Federal sponsor" by the USACE. The USACE defines the "non-Federal sponsor" as a 1) a legally constituted public body (including a federally recognized Indian tribe); or 2) a nonprofit entity with the consent of the affected local government that has full authority and capability to perform the terms of its agreement and to pay damages, if necessary, in the event of failure to perform. The "non-Federal sponsor" for the Project has evolved over time and will likely continue to evolve as Project designs are finalized and if the Project is implemented. As of the production of the EIS, the "non-Federal sponsors" are the City of Moorhead, City of Fargo, and Flood Diversion Board of Authority.

Lower Rush River Spillway: structure used to provide the controlled release of flows from the diversion channel back into the Lower Rush River.

Macroinvertebrate: An animal without a backbone living in one stage of its life cycle, usually the nymph or larval stage, that can be seen with the naked eye.

Map Revision: A change in the Flood Hazard Boundary Map (FHBM) or Flood Insurance Rate Map (FIRM) for a community which reflects revised zone, base flood or other information. (FEMA)

Meander: turn or winding of a stream

Mobility: refers to the efficient movement of people and goods**.**

MPCA IBI Metric: multiple measures of a biological community which reflect aspects of the structure, function, or some other measurable characteristic of the biotic community that responds in a predictable manner to stressors (Fausch et al. 1990) **(**http://www.pca.state.mn.us/index.php/view-document.html?gid=6882**) (Fausch, K.D., J. Lyons, J.R. Karr, and P.L. Angermeier. 1990. Fish communities as indicators of environmental degradation. American Fisheries Society Symposium 8:123-144) 3.8.1.4, 3-25, 3**

National Flood Insurance Program (NFIP): The program of flood insurance coverage and floodplain management administered under the Act and applicable federal regulations promulgated in Title 44 of the Code of Federal Regulations, Subchapter B. (FEMA)

National Geodetic Vertical Datum (NGVD) of 1929: National standard reference datum for elevations, formerly referred to as Mean Sea Level (MSL) of 1929. NGVD 1929 may be used as the reference datum on some Flood Insurance Rate Maps (FIRMs). (FEMA)

National Heritage Data: database containing information on rare plants, animals, native plant communities, and other rare features. (http://www.dnr.state.mn.us/nhnrp/nhis.html) 3.10.2, 3-70, 2

Natural Levees: a deposit of sand or mud built up along, and sloping away from, either side of the floodplain of a river or stream. (http://dictionary.reference.com/browse/natural+levee) 2.1, 2-6, 4

Newly Inundated: Applies to areas that do not flood under existing conditions, but are predicted to flood under Project or NAA conditions.

No Action Alternative with Emergency Measures: ***Needs work yet, but a start:*** similar to the Base No Action Alternative, but also assumes that emergency measures currently being pursued in the project area would continue to be implemented as necessary due to flooding. *No actions, p. 1*

Non-Federal sponsor: The USACE defines the "non-Federal sponsor" as a 1) a legally constituted public body (including a federally recognized Indian tribe); or 2) a nonprofit entity with the consent of the affected local government that has full authority and capability to perform the terms of its agreement and to pay damages, if necessary, in the event of failure to perform. The "non-Federal sponsor" for the Project has evolved over time and will likely continue to evolve as Project designs are finalized and if the Project is implemented. As of the production of the EIS, the "non-Federal sponsors" are the City of Moorhead, City of Fargo, and Flood Diversion Board of Authority.

Non-Residential Building (including hotel/motel): This is a commercial or non-habitational building or a mixed-use building that does not qualify as a residential building. This category includes but is not limited to: small businesses, churches, schools, farm buildings (including grain bins and silos), garages, poolhouses, clubhouses, recreational buildings, mercantile buildings, agricultural and industrial buildings, warehouses, nursing homes, licensed bed and breakfasts and hotels and motels with normal room rentals for less than 6 months. (FEMA)

Non-Structural Features: features or measures used to reduce flood risk or provide mitigation, such as buyout, relocation, or raising individual structures.

Nondegradation standards: Minnesota water quality standards (Minnesota Rules Chapter 7050) include four general components: beneficial uses; numeric standards; narrative standards; and nondegradation. The nondegradation standards provide extra protection for high quality or unique waters and outstanding resource value waters (ORVW) to keep them from being degraded.

Noxious weed: a specific regulatory definition applied to invasive plant species. Noxious weeds refer to invasive/non-native terrestrial plant species regulated by noxious weed laws.

NPDES/SDS Permit: An NPDES/SDS Permit is a document that establishes the terms and conditions that must be met when a facility discharges wastewater to surface or groundwater of the state. The permit is jointly issued under two programs. The National Pollutant Discharge Elimination System (NPDES) is a federal program established under the Clean Water Act, aimed at protecting the nation’s waterways from point and nonpoint sources. In Minnesota, it is administered by the MPCA under a delegation from the USEPA. The State Disposal System (SDS) is a state program established under Minn. Stat. § 115. In Minnesota, when both permits are required they are combined into one NPDES/SDS Permit administered by the state. The permits are issued to permittees discharging to a surface water of the state.

OHB ring levee: See Oxbow/Hickson/Bakke (OHB) Levee.

Old Diversion Node: the area that would be abandoned by the relocation of the Sheyenne River Diversion.

Operation and Maintenance Plan: A plan providing specific standards and requirements for operation of the Project will be developed by the USACE. This plan would be followed by the local sponsor for the life of the Project.

Orifice: an opening in a wall or dam through which flow occurs. Orifices may be used to measure or control rates of flow.

Outfall: The discharge point of a waste stream into a body of water; alternatively it may be the outlet of a river, drain or a sewer where it discharges into a lake or other body of water.

Overflow Embankment: the structure to be constructed south of the diversion inlet control structure along Cass County Highway 17 at an elevation lower than the east/west portion of the dam. This portion of the dam would act as an emergency spillway for extreme events that exceed the 0.2-percent chance (i.e., 500-year flood) event design capacity of the Project.

Oxbow: a place where a river curves in the shape of a U

Oxbow Basin: a place where a river curved in the shape of a U and then was cut off from the current river channel, forming a U-shaped depression.

Oxbow/Hickson/Bakke (OHB) Ring Levee: a ring levee encompasses the communities of Oxbow, Hickson, and the Bakke Subdivision.

Passage: The ability to migrate upstream or downstream, on rivers and tributaries.

Phase I Cultural Resources Survey: An archaeological survey conducted to locate and identify all archaeological sites within a survey area, estimate size and boundaries of identified sites, evaluate potential site significance and recommend treatment of identified sites.

Phase II Cultural Resources Survey: Further investigates a specific site identified in the Phase I survey, including site-specific archival research, intensive surface survey, site mapping and possibly excavation of a test unit.

Phase III Cultural Resources Survey: Typically involves data recovery of a NRHP eligible site or other archaeologically important site that would be adversely impacted by a project.

Phase I Environmental Site Assessment (ESA): An investigation of a parcel of land and its associated structures for potential environmental issues.

Phase II ESA: Provides a more detailed investigation, which involves chemical analysis of soil and groundwater to detect the presence of hazardous substances and/or petroleum hydrocarbons.

Piscivorous: feeding on fishes.

Planform: the outline of an object when viewed from above.

Pool-Riffle System: a stretch of a stream that develops as a stream's hydrological flow structure alternates from areas of relatively shallow to deeper water. This sequence is present only in streams carrying gravel or coarser sediments. Riffles are formed in shallow areas by coarser materials such as gravel deposits over which water flows. Pools are deeper and calmer areas whose bed load (in general) is made up of finer material such as silt. (Lisle, Thomas (July 1979).

Preferred Alternative: The agencies' desired project that meets the purpose and need, is feasible, and gives consideration of the effects to the environment.

Project: The Fargo-Moorhead Metropolitan Area Flood Risk Management Project, as currently designed at the time of State EIS publication, includes the Project footprint and associated components, and the staging area.

Project Footprint: Comprised of the diversion channel, connecting channel, excavated material berms, shallow drainage ditches outside of the berms, tieback embankments, control structures in the Red and Wild Rice Rivers, and hydraulic structures in the Maple and Sheyenne Rivers.

Propagules: a vegetative structure (e.g., a bud, sucker, or spore) that can become detached from a plant and give rise to a new plant (i.e., reproductive material).

Protected Area: The within which flood risk is reduced, such as downstream of the tieback embankment or within the OHB ring levee.

Recognized Environmental Condition: the presence or likely presence of any hazardous substances or petroleum products in, on, or at a property that have the potential to release into the environment, and therefore, pose a threat due to the potential for contamination of soil, groundwater, or surface water. (ASTM 2013)

Red River Basin Commission: the mission of the Red River Basin Commission (RRBC) is to develop a Red River Basin integrated natural resources framework plan; to achieve commitment to implement the framework plan; and to work toward a unified voice for the Red River Basin. The RRBC has offices in Moorhead, Minnesota, and Winnipeg, Manitoba. The RRBC is not a local government unit. *(http://www.redriverbasincommission.org/index.html)*

Residual Risk: the amount of risk **after structural or non-structural flood management measures** have been applied.

Return Period: the average number of years between floods of a certain size is the recurrence interval or return period. The actual number of years between floods of any given size varies a lot because of the naturally changing climate. (https://water.usgs.gov/edu/100yearflood.html)

Right Bank: right side of stream channel when facing downstream

Ring levee: an embankment for preventing flooding in the shape of a circle to protect a given area.

Riparian Floodplain: a bottomland, deciduous or deciduous-conifer forest community occupying low-lying areas adjacent to streams and rivers of third order or greater, and subject to periodic over-the-bank flooding and cycles of erosion and deposition (i.e., floodplain forest).

Rock-ramp Spillways: a passage for surplus water to run over or around an obstruction (as a dam) created with rocks.

Rosgen Level II: a classification described as a morphological description of Stream types A1-A6 to G1-G6. (http://www.fgmorph.com/fg_4_21.php)

Rosgen Level III: a classification described as a Stream state or condition for Stream types earlier characterized in Level 2 (http://www.fgmorph.com/fg_4_22.php)

Schumm Stream Classification: nine subclasses of river channels defined on the basis of channel stability and the dominant mode of sediment transport. (http://pubs.usgs.gov/circ/1963/0477/report.pdf)

Sensitive Species: those species which are often the first to decline in environments that experience anthropogenic disturbance and associated environmental stressors (Sandberg, 2014).

Shear Stress: the force applied by flowing water parallel to the stream bed (or bank).

Sheyenne River Diversion: a diversion channel, constructed between 1990 and 1992 that channels the waters of the Sheyenne River and is designed to discharge 4,600 cubic feet per second. (http://www.westfargond.gov/Home/Departments/PublicWorks/FloodInformation/SheyenneDiversion.aspx)

Significant effect: An effect that is predicted to be above an identified threshold and/or an effect that was determined by the lead agencies to have a magnitude that is great based on the context and intensity of that effect.

Significant Nexus: a connection affecting the biological integrity of an adjacent federal navigable water

Sinuous: a stream pattern that appears to meander back and forth along its corridor in a wavy form.

Southern Alignment Alternative: the locally preferred plan (LPP), as evaluated in the FFREIS 2011

Special Flood Hazard Area (SFHA): An area having special flood, mudflow or flood-related erosion hazards and shown on a Flood Hazard Boundary Map (FHBM) or a Flood Insurance Rate Map (FIRM) Zone A, AO, A1-A30, AE, A99, AH, AR, AR/A, AR/AE, AR/AH, AR/AO, AR/A1-A30, V1-V30, VE or V. For the purpose of determining Community Rating System (CRS) premium discounts, all AR and A99 zones are treated as non-SFHAs. (FEMA)

Species of Special Concern: Although the species is not endangered or threatened, it is extremely uncommon in Minnesota, or has unique or highly specific habitat requirements and deserves careful monitoring of its status. May include species that were once threatened or endangered but now have increasing or protected, stable populations.

Spoil Piles: excavated materials consisting of topsoil or subsoils that have been removed and

temporarily stored during the construction activity.

Staging Area: a defined area immediately upstream of the tieback embankment. When the Project is operated, water would be temporarily detained in the staging area to minimize impacts downstream. The staging area encompasses the area where the Project increases the 100-year flood water surface elevation by approximately one foot or more over existing conditions and encroachment must be prevented to preserve operability of the Project. The staging area is a Project component that is being used as a management tool for land use/development and application of mitigation by the USACE, such as property acquisition, easements, and programmatic agreements, and it does not constitute the total area affected by Project operation.

Taxa: Species

Temporal Loss: the time it takes to re-establish vegetation, such as floodplain, that was lost due to disturbance. Temporal loss is greater the longer it takes to re-establish previously established vegetation.

Threatened Species: Those likely to become endangered in the foreseeable future throughout all or a significant portion of its range within Minnesota.

Tolerant: Species that can withstand a broader range of diversity conditions in comparison to a sensitive species. (http://www.epa.gov/caddis/pecbo_intro4.html) 3.8.1.4.2, 3-30. 3

Turbidity: the measure of the relative clarity of a liquid. (https://water.usgs.gov/edu/turbidity.html)

Uncontrolled Inlets: Inlets without flap gates

Wadeable Stream: streams, creeks and small rivers that are shallow enough to be sampled using methods that involve wading into the water. They typically include waters classified as 1st through 4th order (and sometimes 5th) in the Strahler Stream Order classification system (based on the number of tributaries upstream). (http://water.epa.gov/type/rsl/monitoring/streamsurvey/web_qa_06.cfm#1)

Waters of the State: Water bodies, including wetlands, identified through a jurisdictional determination and regulated by the USACE under Section 404 of the Clean Water Act. Waters of the State for Minnesota regulatory agencies are defined in statute 115.01, subd. 22 as *all streams, lakes, ponds, marshes, watercourses, …and all other bodies or accumulations of water…which are within…the state or any portion thereof.*

Watershed: A geographic area from which water is drained by a river and its tributaries to a common outlet. A ridge or drainage divide separates a watershed from adjacent watersheds.

Weir: a low wall or dam built across a stream or river to raise the level of the water or to change the direction of its flow.

Wetlands: Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water.

Executive Summary

See Separate Document

1.0 Introduction

1.1 ABOUT THE PROJECT PROPOSER

The Project Proposer is the Flood Diversion Board of Authority (Diversion Authority). The Diversion Authority was created by a joint powers agreement between the Cities of Fargo, North Dakota (ND) and Moorhead, Minnesota (MN), along with Cass County, ND, Clay County, MN, the Cass County Joint Water Resources District, and the Buffalo-Red River Watershed District effective July 11, 2011. The Diversion Authority is led by nine board members from the stakeholder entities. The purpose of the Diversion Authority is to build and operate a flood diversion channel along the Red River of the North (Red River) to reduce the flood risk of the stakeholder communities and counties. Additional information on the Diversion Authority is available on their website, www.fmdiversion.com.

1.1.1 Other parties involved

The USACE has partnered with the Diversion Authority to plan, secure funding for, and construct the Project. Operation and future maintenance of the Project would be the responsibility of the Diversion Authority and/or non-Federal sponsors.

Prior to formation of the Diversion Authority, the U.S. Army Corps of Engineers (USACE) was brought in by the Cities of Fargo and Moorhead to help them determine what could be done to reduce flood risk in the metropolitan area. Together, they worked to create the Fargo-Moorhead Metro Flood Risk Management Feasibility Study (Feasibility Study) to develop the flood diversion channel project. In order to further advance the diversion channel concept, the Cities officially partnered with USACE as a non-Federal sponsor and proceeded with federal Environmental Review.

The Diversion Authority should not be confused with "local sponsor," which is synonymous with "non-Federal sponsor" or "non-Federal interest," the preferred term being "non-Federal sponsor" by the USACE. The USACE defines the non-Federal sponsor as a 1) a legally constituted public body (including a federally recognized Indian tribe); or 2) a nonprofit entity with the consent of the affected local government that has full authority and capability to perform the terms of its agreement and to pay damages, if necessary, in the event of failure to perform. Fargo and Moorhead were the two non-Federal sponsors during the Project feasibility study and for the original Design Agreement (executed September 12, 2011). A Design Agreement Amendment #1 was executed on December 19, 2013 which added the Diversion Authority as a non-Federal sponsor. Thus, as of the production of the EIS, the non-Federal sponsors are considered the City of Moorhead, City of Fargo, and the Diversion Authority. Note that even though Fargo and Moorhead are stakeholder entities of the Diversion Authority, legally and for the purposes of the Design Agreement they are three different entities and thus are currently all considered as non-Federal sponsors. The non-Federal sponsors have changed over time and likely will likely continue to change as Project designs are finalized and if the Project is implemented.

1.2 NEED FOR A STATE OF MINNESOTA ENVIRONMENTAL IMPACT STATEMENT

The proposed project (Project) includes a water control structure on the Red River that would meet the definition of a Class I Dam under Minnesota's Dam Safety program rules (Minnesota Rules, part 6115.0340). Any embankment upstream of the control structure that is at or below the elevation of the top of the dam and impounds water due to the presence of the control structure would be considered to be part of the dam. Minnesota Rules part 4410.4400, subpart 18 requires a mandatory EIS for projects that involve construction of a Class I dam. The Minnesota Department of Natural Resources (MNDNR), as the Responsible Governmental Unit (RGU), prepared this EIS, which evaluated the Project in accordance with the Minnesota Environmental Policy Act (MEPA) (Minnesota Statutes Chapter 116D). This EIS was developed to meet applicable requirements of Minnesota Rules Chapter 4410 (Environmental Quality Board; Environmental Review Program) that govern Environmental Review in Minnesota.

1.2.1 Federal Environmental Review

In accordance with the National Environmental Policy Act (NEPA) process, per Council on Environmental Quality (CEQ) regulations 40 Code of Federal Regulations (CFR) 1500-1508, and guidance for implementation of NEPA for the Civil Works Program of the USACE provided in 33 CFR 230, and Engineer Regulation 220-2-2; the USACE with cooperation from the Diversion Authority, issued a Final Feasibility Report and Environmental Impact Statement (FFREIS) for the Project in July 2011. The USACE's Record of Decision (ROD) was issued in April 2012 in accordance with 40 CFT 1505.2. The USACE designated the Locally Preferred Plan (LPP) as its Selected Plan in the FFREIS or as the Federally Recommended Plan (FRP) for evaluation in the Supplemental EA.

Following the issuance of the ROD, on October 11, 2012 the Diversion Authority endorsed two design changes proposed by the USACE to reduce potential impacts of the LLP. These changes add adjustable gates on the diversion inlet channel and increase the Red River flows through the Fargo-Moorhead downtowns to a Fargo stage of 35 feet by constructing new levees and floodwalls and improving existing levees. This change reduces the need for operation of the LPP by limiting its operation to flood flows in the Red River in excess of 17,000 cubic feet per second (cfs). A third USACE-proposed change was endorsed by the Diversion Authority on November 8, 2012. This change revised the diversion channel alignment and associated features, including the addition of the Oxbow-Hickson-Bakke ring levee, to achieve cost savings and reduce the number of impacted residential structures. Due to substantial Project design changes, the USACE prepared a Supplemental EA for the Project in September 2013. The MNDNR submitted comments on the federal Draft EIS, federal Supplemental Draft EIS, FFREIS, and Supplemental EA.

MNDNR comments submitted during the federal review process have been used to inform the scope of this EIS. Design changes evaluated within the Supplemental EA have also been considered as part of the Project for study in this EIS. In accordance with Minnesota Rules part 4410.0300, subpart 4(E) and 4410.3900, subpart 1; the MNDNR relied on the federal documents to the extent that they adequately addresses the scoped issues and complies with the content requirements of a Minnesota State EIS.

1.3 PROJECT PURPOSE AND NEED

The Project is located in the Red River Valley, which forms the state border of Minnesota and North Dakota, flowing through the Fargo-Moorhead area (F-M area). The project area is located within the area from approximately 12 miles west to six miles east of the Red River and from 20 miles north to 20 miles south of Interstate Highway 94 (I-94) (Figure 1) and consists of a central urban area (i.e., F-M urban area), surrounded by smaller outlying communities, interspersed with rural residences and agricultural operations.

The Red River basin in eastern North Dakota and along the western Minnesota border has a long history of flooding due to the unique hydrology of the area. Three large rivers, the Red River, the Wild Rice River (ND), and the Sheyenne River, converge in the F-M area and contribute to extensive flooding. This prompted studies, analysis, and engineering design to develop a plan to manage the flood risk in the F-M area, known as the Fargo-Moorhead Flood Risk Management Project (Project).

The Red River, Wild Rice River (North Dakota), Sheyenne River, Maple River, Lower Rush River, and the Rush River all contribute to the flood risk. Average annual national economic flood damages in the F-M area are estimated to be more than $194.8 million (FFREIS, Section 2.3, History and Future Without Project Conditions), and a failure of emergency flood measures could result in loss of life. Flooding in the F-M area typically occurs in late March and early April as a result of spring snowmelt. Flooding poses a significant risk of damage to urban and rural infrastructure and disrupts transportation throughout the F-M area. The Fargo-Moorhead urban area (F-M urban area) is a regional center for healthcare, education, government, and commerce. Infrastructure at risk in the F-M urban area includes several regional medical centers, three college campuses, and city and county government headquarters offices.

The Red River has exceeded the National Weather Service flood stage of 18 feet at the United States Geological Survey (USGS) gage in Fargo (the Fargo gage) in 49 of the past 114 years (1902 through 2015), and recently every year from 1993 through 2015. Flood stage is defined as “an established gage height for a given location above which a rise in water surface level begins to create a hazard to lives, property, or commerce” (www.noaa.gov). The record-setting Red River flood stage in 2009 at Fargo was 40.82 feet on the Fargo gage. The hydrologic record of the Red River shows a trend of increasing magnitude and frequency of flooding in recent decades.

Official estimates vary for the 1-percent chance event flow (100-year flood) and flood stage. The current base flood elevation (100-year flood) established by the Federal Emergency Management Agency (FEMA) corresponds to a flood stage of 38.3 feet on the Fargo gage. FEMA is proposing a revised 100-year flood stage of 39.3 feet.

During preparation of the FFREIS, a panel of experts (Expert Opinion Elicitation Panel) in hydrology and climate change was convened to elicit opinions on how to appropriately reflect this trend (FFREIS Appendix A, Hydrology). The panel concluded that the hydrologic record showed a “dry” period in the early decades of the 20th century and a “wet” period in later years continuing to the present and recommended developing revised flow frequency curves separately for the dry and wet periods. The revised flow frequency curves showed the 100-year flood flow to be approximately 34,700 cubic feet per second (cfs) at present; 32,900 cfs in 2035; and 31,300 cfs in 2060. The hydraulic modeling developed for the FFREIS 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 (FFREIS Appendix B, Hydraulic Engineering). The analyses described in the FFREIS were based upon the Expert Opinion Elicitation Panel’s hydrologic recommendations, which result in significantly higher stages for the 100-year flood than what FEMA has adopted in Minnesota and is proposing to use in North Dakota for the National Flood Insurance Program. The MNDNR concurs with this approach and will use the recommendations of the Expert Opinion Elicitation Panel in the EIS.

When assessing the viability of various alternatives, the MNDNR considered the fundamental need for the Project in addition to the environmental and socioeconomic merits of each alternative. The purpose and need statements have been developed by the Diversion Authority to meet the needs of the state environmental review process and are not the same as those used in the FFREIS.

The purpose of the Project is to reduce flood risk, flood damages, and flood protection costs related to flooding in the F-M urban area. To the extent technically and fiscally feasible, the Project will:

- Reduce flood risk potential associated with a long history of frequent flooding on local streams including the Red River, Sheyenne, Wild Rice (North Dakota), Maple, Rush and Lower Rush Rivers passing through or into the F-M urban area,
- Qualify substantial portions of the F-M urban area for 100-year flood accreditation (i.e., meets the standard to be shown on a Flood Insurance Rate Maps as providing protection) by the FEMA under the National Flood Insurance Program; and
- Reduce flood risk for floods exceeding the 100-year flood or greater, given the importance of the F-M urban area to the region and recent frequencies of potentially catastrophic flood events.

1.4 GOVERNMENT AGENCIES AND APPROVALS

The EIS provides information and evaluation on potential environmental impacts resulting from the Project, as well as identifies possible need for additional mitigation measures. The EIS is not a decision-making document, but is to be used by governmental units as information and a guide for the permitting process (Minnesota Administrative Rule 4410.0300: Authority, Scope, Purpose, and Objectives). All local and state government bodies identified in an environmental impact statement with permitting authority shall consider the report in making any decision to authorize the project according to Minnesota Rule 4410.7055. No permits, approvals, nor can a project begin until environmental review is completed, including an EIS Determination of Adequacy by the MNDNR, according to Minnesota Rule 4410.3100. Minnesota Statute 116D.04 subdivision 6, states:

> *No state action significantly affecting the quality of the environment shall be allowed, nor shall any permit for natural resources management and development be granted, where such action or permit has caused or is likely to cause pollution, impairment, or destruction of the air, water, land or other natural resources located within the state, so long as there is a feasible and prudent alternative consistent with the reasonable requirements of the public health, safety, and welfare and the state's paramount concern for the protection of its air, water, land and other natural resources from pollution, impairment, or destruction. Economic considerations alone shall not justify such conduct.*

Although the EIS provides information for use in permit issuance or denial, it is not required to gather or present all necessary permit-related information. Additional information may be required as part of the various permitting processes depending on the permit and the permitting authority. A Determination of Adequacy does not mean a permit will be granted.

The permits and approvals required or potentially required for the Project are listed in Table 1.1 and explained further in the sections that follow. As further addressed in Section 3.14 Land Use Plans and Regulations, in implementing a federal project, the USACE is required to comply with State and local laws, regulations and ordinances only to the extent specifically required by federal law.

Table 1.1 Summary of Permits and Approvals Related to the Project

Permit/Approval	Governing Agency	Responsibility
Federal Agencies		
Clean Water Act – Section 404	United States Army Corps of Engineers (USACE)	Non-Federal Sponsor *if* constructed by Non-Federal Sponsor[1]
Section 7 of the Endangered Species Act Coordination	United States Fish and Wildlife Service (USFWS)	USACE
Rivers and Harbors Act of 1899 – Sections 9 and 10	USACE	Non-Federal Sponsor *if* constructed by Non-Federal Sponsors
Section 106 Consultation	North Dakota State Historical Society and Minnesota State Preservation Office	USACE
Conditional Letter of Map Revision (CLOMR)	Federal Emergency Management Agency (FEMA)	Non-Federal Sponsors
Letter of Map Revision (LOMR)	FEMA	Non-Federal Sponsors
Prime and Unique Farmlands	Natural Resources Conservation Service	USACE
State Agencies: North Dakota		
Clean Water Act – Section 401 Certification, Water Quality - ND	North Dakota Department of Health (NDDH)	USACE
Dewatering Permit	NDDH	Contractor
NPDES Storm Water Permit	NDDH	Contractor/Owner
Aquatic Nuisance Species Rule	North Dakota Game and Fish Dept.	Contractor
Memorandum of Understanding	North Dakota Department of Transportation (NDDOT)	Non-Federal Sponsors
Section 106 Consultation	North Dakota State Historical Society	USACE
Waters Drain Permit	North Dakota State Water Commission (ND State Water Commission)	Non-Federal Sponsors
Construction Permit	ND State Water Commission	Non-Federal Sponsors
Sovereign Lands Permit	ND State Water Commission	Non-Federal Sponsors
State Agencies: Minnesota		
Dam Safety Permit	Minnesota Department of Natural Resources (MNDNR)	Non-Federal Sponsors
Water Appropriations Permit	MNDNR	Non-Federal Sponsors
Public Waters Work Permit	MNDNR	Non-Federal Sponsors
Burning Permit	MNDNR	Non-Federal Sponsors
Invasive Species Prohibition and Regulation	MNDNR	Non-Federal Sponsors
Cooperative Construction Agreement	Minnesota Department of Transportation (MNDOT)	Non-Federal Sponsors
Clean Water Act (CWA) – Section 401 Certification, Water Quality – MN	Minnesota Pollution Control Agency (MPCA)	USACE

Permit/Approval	Governing Agency	Responsibility
NPDES Storm Water Construction Permit	MPCA	Contractor/Owner
Section 106 Consultation	Minnesota State Preservation Historic Office	USACE
Counties: Minnesota		
Floodplain	Clay County, Minnesota	Non-Federal Sponsors
MN Wetland Conservation Act	Clay Soil and Water Conservation District	Non-Federal Sponsors
MN Wetland Conservation Act	Wilkin County, Minnesota	Non-Federal Sponsors
Townships: North Dakota		
Building Permit	Harwood Township, North Dakota	Non-Federal Sponsors
Floodplain Permit	Harwood Township, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	Mapleton Township, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	Pleasant Township, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	Warren Township, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	City of Argusville, North Dakota	Non-Federal Sponsors
Municipalities: North Dakota		
Floodplain Permit	City of Fargo, North Dakota	Non-Federal Sponsors
Storm Water Permit	City of Fargo, North Dakota	Non-Federal Sponsors
Conditional Use Permit -Site Approval for General Ground Excavation	City of Horace, North Dakota	Non-Federal Sponsors
Conditional Use Permit	City of West Fargo, North Dakota	Non-Federal Sponsors
Municipalities: Minnesota		
Floodplain Permit	City of Moorhead, Minnesota	Non-Federal Sponsors
Storm water Permit	City of Moorhead, Minnesota	Non-Federal Sponsors
Other Jurisdictions		
Application to Drain	Cass County Joint Water Resource District, North Dakota (Cass County Joint WRD)	Non-Federal Sponsors
Construction/Floodplain Approval	Buffalo-Red River Watershed District, Minnesota (BRRWD)	Non-Federal Sponsors
Two Rivers WD Application	Two Rivers WD, Minnesota	Non-Federal Sponsors

[1]A section 404 permit would be required for construction of the Project if construction is completed by an entity other than the USACE as they are the governing agency. However, the USACE is required to adhere to Section 404 requirements for construction.

1.4.1 United States Army Corps of Engineers

The USACE regulatory programs include Section 404 of the Clean Water Act (CWA) (33 USC § 1344) and Sections 9 and 10 of the Rivers and Harbors Act of 1899. The USACE St. Paul District's regulatory jurisdiction covers the state of Minnesota and the USACE Omaha District covers the state of North Dakota.

1.4.1.1 Section 404 Clean Water Act

Under Section 404, the USACE has regulatory authority over waters of the U.S., which includes jurisdictional lakes, rivers, streams, and wetlands. A Section 404 permit would be required for discharges of dredged or fill material in jurisdictional waters for any construction performed by the non-Federal sponsor. A Section 404 permit would not be required for construction completed by the USACE; however, the USACE would be required to comply with Section 404 requirements.

The USACE generally requires compensatory mitigation for adverse effects to aquatic resources. Standards and criteria for any compensatory mitigation would be included in the Section 404 permit. Specifically 33 CFR 332.3(n)(1) addresses financial assurance stating, "The district engineer shall require sufficient financial assurances to ensure a high level of confidence that the compensatory mitigation project will be successfully completed, in accordance with applicable performance standards. In cases where an alternate mechanism is available to ensure a high level of confidence that the compensatory mitigation will be provided and maintained (e.g., a formal, documented commitment from a government agency or public authority) the district engineer may determine that financial assurances are not necessary for that compensatory mitigation project." Financial assurance requirements for aquatic resource impacts would be based on the size and complexity of the mitigation project, the likelihood of success, past performance of the Diversion Authority, all costs related to mitigation of project development, and the form of financial assurance (e.g., performance bond, letters of credit, or escrow accounts).

1.4.1.2 Section 7 Endangered Species Act Consultation with U.S. Fish and Wildlife Service

Section 7 of the Endangered Species Act [16 USC 1531 *et seq.*] requires federal agencies to consult with the USFWS to ensure that actions they authorize, permit or carry out would not jeopardize the continued existence of any listed species or adversely modify designated critical habitats. Section 7(a)(2) defines the consultation process, which is further developed in regulations promulgated at 50 CFR § 402. The USACE coordinated with the USFWS to fulfill the requirements of Section 7 as part of the NEPA process.

1.4.1.3 Section 106 National Historic Preservation Act Determination for Historic Properties

Section 106 of the National Historic Preservation Act as implemented by the Advisory Council on Historic Preservation's regulations found at 36 CFR Part 800 is applicable to the proposed project. The USACE executed a Programmatic Agreement pursuant to 36 CFR § 800.14(b) during the feasibility study (see Attachment 3 to the FFREIS). As project design and implementation proceeds, the USACE will complete their Section 106 consultation in accordance with the Programmatic Agreement and in coordination with the state historic preservation offices: North Dakota State Historical Society and Minnesota State Historic Preservation Office.

1.4.1.4 Rivers and Harbors Act of 1899 – Sections 9 and 10

Under Section 9 the USACE has regulatory authority over navigable waters for the construction of dikes and dams in navigable waters of the U.S. Under Section 10 the USACE has regulatory jurisdiction over structures or work in or affecting navigable waters. A Section 9 and/or 10 permit would be required for any construction performed by the non-Federal sponsor in navigable waters. A Section 9 or 10 permit is not required for construction by the USACE.

1.4.2 Federal Emergency Management Agency

FEMA requires submittal of data for projects that change a Flood Insurance Rate Maps (FIRM), including changes to the Base Flood Elevations (BFE), Special Flood Hazard Areas (SFHA) or the regulatory floodway. Data is submitted through the Letter of Map Revision (LOMR) process. Proposed projects use the Conditional Letter of Map Revision (CLOMR) process. Completed projects use the LOMR process. Both processes review technical engineering data to determine that approved engineering methods, required by 44 CFR Section 65.10, were applied and that the project is in compliance with the local government ordinance and FEMA's standards. This includes FEMA levee system accreditation, which allows the levee system to be shown on a FIRM as providing a 100-year flood event or greater level of flood protection. The CLOMR process and LOMR process for the Project is further discussed in Section 3.2 – FEMA Regulations and the CLOMR Process.

1.4.2.1 Conditional Letter of Map Review

The CLOMR is required if the proposed project causes an increase in excess of 0.00 feet in a regulatory floodway or a SFHA with existing structures. In floodplain areas without regulatory floodways, if no existing structures are affected, a floodway analysis is required to determine that the proposed project does not cause an increase above the allowable surcharge in the local government ordinance. CLOMRs are not required if the project is compliant with the local ordinance. Certification that no insurable structures are impacted is required.

CLOMRs require certification from a Professional Engineer that the elevation, hydrologic and hydraulic data is accurate and in compliance with 44 CFR 65.2. It also requires acknowledgement by the local community official that the proposed project is in compliance with the community floodplain management requirements and the Endangered Species Act (7 U.S.C. § 136, 16 U.S.C. § 1531 et seq). Another requirement is that affected individuals and organizations affected by the project are aware of the changes and have had a chance to comment. This usually requires documented individual notices to the impacted property owners.

FEMA's review is usually completed within ninety days from submittal of all necessary data, but it is rare that the first submittal has all necessary data. CLOMRs do not change the FIRM. Their purpose is to review project floodplain impacts before construction.

1.4.2.2 Letter of Map Review

LOMRs revise the maps based on better data or analysis or completed projects. The CLOMR requirements for the Professional Engineers and local community officials are also required for LOMRs. As-built drawings of the project are needed for the review. The same technical review process is followed. If the project is built as presented for the CLOMR and the engineering analyses have not changed, a LOMR can reference an approved CLOMR instead of resubmitting all of the data.

FEMA's review timelines are the same as for the CLOMR, but there are changes after the LOMR is issued. There is a 90-day appeal period from the LOMR approval date. If no valid appeals are made, the local government must adopt the LOMR mapping as the official community floodplain map.

1.4.3 Natural Resources Conservation Service

The Natural Resources Conservation Service (NRCS) is a branch of the United States Department of Agriculture. The NRCS assists with the conservation of soil, water, air, and other natural resources.

1.4.3.1 Prime and Unique Farmlands

The NRCS regulatory programs include the Farmland Protection Policy Act (FPPA) of 1981, which requires potential impacts to prime farmlands to be identified and avoided as possible for federally funded projects. Farmlands identified are recorded and given a farmland conversion impact rating through completion of Form NRCS-CPA-106**.** The impact rating is determined by the NRCS. This is used to work with a project proposer to determine avoidance actions as needed to minimize the conversion of farmland into nonagricultural lands. The NRCS evaluated the Project footprint during the FFREIS process and made prime farmland determinations. Because over 90-percent of all farmland in the project area is considered prime and unique, the Project impact is considered to be less than significant. The USACE would continue to coordinate with the NRCS as the Project develops.

1.4.4 North Dakota Game and Fish Department

The North Dakota Game and Fish Department (NDGF) regulates activities that affect the state's fish and game. These regulatory programs may require certain permits depending on the proposed activity and its magnitude.

1.4.4.1 Aquatic Nuisance Species Rule

Pursuant to North Dakota Century Code Chapter 20.1-17, the NDGF has authority to prohibit the spread of aquatic invasive species. This would be enforced to assure that nuisance species are not spread via any equipment used for the construction of the Project.

1.4.5 North Dakota Department of Health

The North Dakota Department of Health (NDDH) focuses on protection of health and enhancement of the safety and environment for North Dakota.

1.4.5.1 Section 401 Water Quality Certification

The NDDH is responsible for Section 401 water quality certification, required for Section 404 permits issued by the USACE and for projects implemented by USACE. Section 401 of the CWA (33 United States Code (USC) § 1341) requires activities that may result in discharges to navigable waters and require a federal license or permit to construct, modify, or operate (i.e., Section 404 permits), to be conducted in compliance with Sections 301, 302, 303, 306, and 307 of the CWA. These portions of the CWA are the basis of state water quality standards. In order to ensure these activities comply with the CWA and the state water quality standards, a determination is made by the state agency with primary water quality regulatory responsibilities under the CWA. Such a determination is known as a 401 Water Quality Certification.

In North Dakota, the NDDH is the delegated agency responsible for making certification determinations on federal permits and federal projects that affect waters of the state. The NDDH would evaluate whether to issue Section 401 certification for this Project.

1.4.5.2 National Pollutant Discharge Elimination System (NPDES) Permits

The NPDES permitting authority, delegated to the NDDH by the U.S. Environmental Protection Agency (USEPA), regulates wastewater and storm water discharges to lakes, streams, wetlands, and other surface waters in North Dakota. The NPDES permit establishes specific limits and requirements to protect North Dakota's surface and groundwater quality.

1.4.5.3 NPDES/SDS General Storm Water Discharge Permit for Construction Activity

Construction projects in North Dakota that disturb one acre or more of land must obtain coverage under North Dakota's NPDES general storm water discharge permit for construction activity. The permit application certifies that temporary and/or permanent erosion and sediment control plans have been prepared and implemented to prevent soil particles from being transported off-site both during and after construction. The permit requires the applicant to prepare a Storm Water Pollution Prevention Plan (SWPPP) that applies best management practices for controlling and managing stormwater runoff during and after construction.

1.4.6 North Dakota State Water Commission

The North Dakota Office of the State Engineer (OSE) regulates activities that affect the state's water resources. Regulatory programs may require certain permits depending on the proposed activity and its magnitude. As outlined in North Dakota Century Code (N.D.C.C) ch. 61-03, the state engineer is responsible for review of permit applications for construction permits, surface drain permits, and sovereign lands permits.

1.4.6.1 OSE Construction Permit

Pursuant to N.D.C.C § 61-16.1-38 and North Dakota Administrative Code (N.D.A.C) art. 89-08, permit(s) to construct or modify a dam, dike, or other device would be required for this Project. Applications would need to be submitted to the state engineer for consideration, after which the engineer would forward the application to the water resource board of the appropriate water resource district. The board then has 45 days to review the application and suggest any changes, conditions, or modifications, and then return the application to the state engineer for the final review and decision. The state engineer also notifies the North Dakota Department of Health and the USACE—North Dakota regulatory office that a construction permit application was submitted.

1.4.6.2 North Dakota Waters Drain Permit

Pursuant to N.D.C.C. ch. 61-32 and N.D.A.C ch. 89-02-01, permit(s) to drain surface waters would be required if drainage of any pond, slough, lake, sheetwater, or series thereof, with a watershed of 80 acres or more would occur. Applications would need to be submitted to the state engineer who would then make a determination if the proposed project involves drainage of statewide or interdistrict significance. The state engineer, for all applications, will forward the application on to the appropriate water resource district for review and approval. The state engineer also notifies the NRCS local and state offices and the USACE—North Dakota regulatory office that a surface drain permit application was submitted. For applications of statewide or interdistrict significance, the board must return the application to the state engineer for final approval.

If subsurface drainage is to be used as part of the project, N.D.C.C § 61-32-03.1 states that construction of a subsurface drainage system greater than 80 acres would require a subsurface drain permit. Applications would need to be submitted to the appropriate water resource board for review and approval.

1.4.6.3 OSE Sovereign Lands Permit

Pursuant to N.D.C.C. ch. 61-33 and N.D.A.C ch 89-10-01, a sovereign lands permit(s) would be required for this Project. Sovereign lands are defined as those areas within the ordinary high water mark of state-identified navigable lakes and streams. Applications would need to be submitted to the state engineer. The state engineer will solicit comments during a 30-day comment and review period from the NDGF, North Dakota Parks and Recreation Department, NDDH, State Historical Society of North Dakota, North Dakota Department of Trust Lands, Water Resource Board of the appropriate Water Resource District, USACE, and United States Fish and Wildlife Service.

1.4.7 Minnesota Department of Natural Resources

The MNDNR regulates activities that affect the state's natural resources, including those related to wetlands, water, and threatened and endangered species. These regulatory programs may require certain permits depending on the proposed activity and its magnitude. Additionally, the MNDNR is responsible for determining EIS adequacy pursuant to MEPA, which is required for the permitting process to move forward.

1.4.7.1 Invasive Species

Pursuant to Minnesota Statutes Chapter 84D and Minnesota Rules Chapter 6216, the MNDNR has authority to prohibit the spread of aquatic invasive species. This would be enforced to assure the spread of nuisance species from the construction and operation of the Project is avoided and minimized as feasible.

1.4.7.2 Dam Safety Permit

Minnesota Rules, parts 6115.0300 through 6115.0520 for Public Water Resources describe the requirements pertaining to dam safety permits for new construction, repair, alteration, removal, and transfer of property containing a dam. A dam safety permit would generally be needed from the MNDNR for construction, operation, and maintenance of the tieback embankment and control structures, which collectively fall within the definition of a Class I dam under Minnesota Rules part 6115.0340.

1.4.7.3 Public Waters Work Permit

Pursuant to Minnesota Statutes § 103G and Minnesota Rules Chapter 6115, a Public Waters Work Permit is required for proposed projects constructed below the ordinary high water (OHW) mark which alter the course, current, or cross section of public waters or public waters wetlands. The permit program applies to those lakes, wetlands, and streams identified on MNDNR Public Water Inventory (PWI) maps. The MNDNR would be responsible for defining special provisions of the permit and implementing the permit approval.

A public waters work permit would generally be required from the MNDNR for Project construction. The public waters work permit and dam safety permit would likely be applied for under one application and would be authorized under one permit.

1.4.7.4 Burning Permit

Per Minnesota Statute 88.17, an open burning permit may be required from the MNDNR if trees, brush, and other vegetative materials are burned on-site as part of any land clearing activities conducted for the Project.

1.4.7.5 Water Appropriations Permit

Per Minnesota Rules Chapter 6115, a water appropriations permit is required for any project withdrawing more than 10,000 gallons of water per day or 1 million gallons of water per year. Dewatering activities associated with dam construction would be included within the provisions of the dam safety permit as discussed above. A separate water appropriations permit would be required for dewatering activities not associated with dam construction.

1.4.8 Minnesota Pollution Control Agency

The Minnesota Pollution Control Agency (MPCA) monitors environmental quality and administers a number of regulatory programs focused on protecting water resources, including the Section 401 of the Clean Water Act. Many of the MPCA regulatory programs require a permit from the agency.

1.4.8.1 Section 401 Water Quality Certification

The MPCA is responsible for Section 401 water quality certification required for Section 404 permits issued by the USACE and for projects implemented by the USACE. Section 401 of the CWA (33 USC § 1341) requires that activities that may result in discharges to navigable waters and require a federal license or permit to construct, modify, or operate (i.e., Section 404 permits), must be conducted in compliance with Sections 301, 302, 303, 306, and 307 of the CWA. These portions of the CWA are directives for the development of state water quality standards. In order to ensure these activities comply with the CWA and the state water quality standards, a determination is made by the state agency with primary water quality regulatory responsibilities under the CWA. Such a determination is known as a 401 Water Quality Certification.

In Minnesota, the MPCA is the delegated agency responsible under Minnesota Statute 115.03 Powers and Duties for making certification determinations on federal permits and federal projects that affect waters of the state. MPCA would evaluate whether to issue Section 401 certification for the Project.

1.4.8.2 NPDES/SDS General Storm Water Discharge Permit for Construction Activity

Construction projects in Minnesota that disturb one acre or more of land must obtain coverage under Minnesota's NPDES general storm water discharge permit for construction activity. The permit application certifies that temporary and/or permanent erosion and sediment control plans have been prepared and implemented to prevent soil particles from being transported off-site both during and after construction. The permit requires the applicant to prepare a SWPPP that applies best management practices for controlling and managing storm water runoff during and after construction. An NPDES permit would be required in Minnesota for construction of the tieback embankment and control structures.

1.4.9 Local Government Approvals

There are local governments in North Dakota and Minnesota that potentially have jurisdiction over portions of the Project. Table 1.1 (above) provides a summary of the local government units (LGUs) with potential permitting and approval authority in the project area. The planning, zoning, and permits required or potentially required for the Project are discussed in greater detail in EIS Section 3.14 - Land Use Plans and Regulations.

The following provides a general description of the primary local government approvals that could be required for construction and operation of the Project, which include a wetlands permit, shoreland permit, conditional use permit, floodplain permit, and storm water permit. Issuance of approval or a permit is at the discretion of the LGU and may require an application, environmental commitments, site plans, public hearings or other conditions.

1.4.9.1 Zoning Variance, Conditional Use Permit

Variances may be granted when compliance with a local ordinance cannot be achieved. Conditional Use Permits (CUPs) may be issued for certain land uses or development that would not be appropriate or without restriction in a particular zoning district, but may be allowed with conditions. These applications require a public hearing process and review by the individual local government.

1.4.9.2 Zoning Amendment

A zoning amendment may be required in some of the local governments once the Project is in operation, and it can be observed for potential impacts. If impacts are observed, a zoning amendment may be needed. A zoning amendment may include rezoning of areas of a community to accurately reflect changes due to the Project, including amending the zoning map for zoning district changes. This could include, for example, water retention in the staging area or land use that is no longer agricultural. Each local government would have specific steps for their approval process. The individual local governments would be consulted as to the appropriate approval or permit needed and the application process for that approval.

1.4.9.3 Wetland Conservation Act

The Minnesota WCA would apply to wetland impacts from the Project. Wetland impacts resulting from construction in Clay County or Wilkin County would require WCA approval for unavoidable wetland impacts associated with the Project. As currently proposed, no direct impacts to wetlands from the Project would occur in Wilkin County. For additional information regarding wetland impacts from the Project, see Section 3.4 – Wetlands.

The USACE, MNDNR, MPCA, and local governments in Minnesota have jurisdiction over wetland impacts for the Project and would review and approve the proposed wetland mitigation plan to satisfy replacement requirements for unavoidable wetland impacts. In Minnesota, wetland impact would be replaced under WCA and CWA standards. In Minnesota, local governments, typically counties, administer WCA. Wetland impacts occurring in Minnesota would require mitigation to occur in Minnesota. The USACE Omaha District is the primary agency that determines the adequacy of wetland replacement for the CWA wetland impacts in North Dakota. Mitigation for wetland impacts in North Dakota would not qualify as wetland mitigation credit for wetland impacts in Minnesota.

Minnesota Rules 8420.0522 outlines the replacement standards for wetlands as regulated under WCA. Minnesota Rules 8420.0522, subp. 9(A) and (B) discuss financial assurance requirements for compensatory wetland mitigation stating, "(A) For wetland replacement that is not in advance, a financial assurance acceptable to the local government unit must be submitted to, and approved by, the local government unit to ensure successful replacement. The local government unit may waive this requirement if it determines the financial assurance is not necessary to ensure successful replacement. The local government unit may incorporate this requirement into any financial assurance required by the local government unit for other aspects of the project. (B) The financial assurance may be used to cover costs of actions necessary to bring the project into compliance with the approved replacement plan specifications and monitoring requirements." The financial assurance requirements would be part of the WCA permitting process for the Project.

1.4.9.4 Floodplain Permit

Minnesota Statutes Chapter 103F and 394.21 delegate responsibility to LGUs to adopt regulations designed to minimize flood losses. The Flood Insurance Rate Map (FIRM), developed by the Federal Emergency Management Agency (FEMA), is typically used by LGUs as their official floodplain zoning district map in order to establish floodway, flood fringe, and general floodplain (unnumbered A zones on the FIRM) zoning districts. The Regulatory Flood Protection Elevation is also used and defined as an elevation no lower than one foot above the elevation of the regional flood plus any increases in flood elevation caused by encroachments on the floodplain that result from designation of a floodway.

A floodplain permit is required for construction within one of the three flood-related zoning districts. The permit requires structures to be constructed to meet certain criteria for elevation and flood proofing, for example. A LGU permit application process would be used and may be tied to a local CUP depending on the LGU. The MNDNR will be available for assistance and review for issuance and administration of permits.

1.4.9.5 Shoreland Permit

Minnesota Rules, part 6120 provides standards for shoreland management. A shoreland permit is typically required from a township or municipality for any grading/filling or excavation within the Shoreland Overlay District established under the LGU zoning ordinance. The Shoreland Overlay District is defined as the area surrounding a designated water body, extending out 1,000 feet from the ordinary high water level (OHW) of lakes/wetlands and 300 feet from streams. Conditions of this permit may be covered under the floodplain permit or CUP depending on the LGU. The MNDNR will be available for assistance and review for issuance and administration of permits.

1.4.10 Other Jurisdictions

There are two watershed districts, the Buffalo-Red River Watershed District and the Two Rivers Watershed District, within the project area that may require permits for the Project. The Buffalo-Red River Watershed District (BRRWD) Rules Section 8 require a permit for alteration of natural drainage-ways, lakes, and wetlands. Project construction would occur on the Red River, and therefore, the BRRWD should be consulted for permit requirements. The Two Rivers Watershed District may require a permit for modification of the Drayton Dam as part of proposed mitigation for the Project. The Cass County Joint Water Resource District also requires an application to drain permit, and should be consulted for potential permits needed for the Project.

1.5 EIS ORGANIZATION

This EIS analyzes potential impacts from the Project for various topics as identified in the Final Scoping Decision Document (FSDD). Organization of this section generally follows the standard format as set forth in Minnesota Rules 4410.2300. The EIS is organized by the following components:

- **Chapter 1** – **Introduction** provides a Project overview, describes the purpose and need for the Project, and the government approvals that would be needed for construction and operation of the Project, including the various permits and agencies that would review the Project prior to construction and operation.
- **Chapter 2** – **Proposed Project and Project Alternatives** provides detailed information on the Project and the alternatives evaluated in the EIS, including the Base No Action Alternative, No Action with Emergency Measures, and the Northern Alignment Alternative (NAA). This chapter also provides an alternatives evaluation with information on alternatives considered, but not carried forward for further evaluation in this EIS.
- **Chapter 3** – **Affected Environment and Environmental Consequences** describes the potentially affected environment in which the Base No Action Alternative, Proposed Project, No Action with Emergency Measures, and the NAA would occur. Environmental consequences of the Project and alternatives are analyzed and a discussion of potential impacts is presented for each topic area, considering short-term, long-term, beneficial, and adverse effects, and the significance of each of those potential effects.
- **Chapter 4 – Cumulative Effects** presents the results of the analysis that identified the potential for cumulative effects within a local and regional context.
- **Chapter 5** – **Comparison of Alternatives** provides a summary of each of the alternatives relevant to the Project purpose and potential impacts.
- **Chapter 6** –**Mitigation and Monitoring Measures** describes mitigation measures that could reasonably eliminate or minimize adverse environmental, economic, or sociological effects of the Project. Identifying these measures is required per Minnesota Rules part 4410.2300. To meet this requirement, the EIS evaluates and discusses mitigation measures to address adverse effects identified as a result of analyses proposed in Chapter 3 of the EIS.
- **Chapter 7** – **Consultation and Coordination** describes how the MNDNR and USACE developed the FEIS in coordination with other state and federal agencies, tribal entities, and the public. This chapter also includes a distribution list of the individuals and organizations that will receive the EIS.
- **Chapter 8** – **List of Preparers** provides a list of preparers and document reviewers, their qualifications, and areas of responsibility.
- **Chapter 9 – References** provides a list of references that were used during the evaluation and analysis for the EIS and are cited in the EIS text.
- **Figures and Appendices** are also included in the EIS, and the reader is directed to these sources of information as needed throughout the EIS.

2.0 Proposed Project and Alternatives

The Project would primarily serve the F-M area as previously described in Chapter 1. This section provides descriptions and discussion on the Project and alternatives. EIS Alternatives include: the Base No Action Alternative, No Action Alternative (with Emergency Measures), and the Northern Alignment Alternative. A Distributed Storage Alternative was reviewed but not carried forward for further analysis. Section 2.2.1 provides an Alternatives Evaluation Summary to describe the alternatives and the criteria used to determine if EIS analysis was warranted.

2.1 PROPOSED PROJECT

The Project would be located in the F-M area, within an area approximately 12 miles west to six miles east of the Red River and from 20 miles north to 20 miles south of I-94 (Figures 1 and 2). The Project consists of a dam and diversion channel system including, but not limited to: a tieback embankment (i.e., dam); excavated channels; a channel inlet control structure; hydraulic control structures on the Red and Wild Rice (ND) Rivers; an upstream floodwater staging area (staging area); hydraulic structures on tributaries; levees and floodwalls in the Fargo-Moorhead urban area (F-M urban); non-structural features (such as buyout, relocation, or raising individual structures); and recreation features (such as multipurpose trails and pedestrian bridges). The Project also consists of environmental mitigation projects, which would be located inside and outside the project area.

Direct disturbance of approximately 8,000 acres would occur with construction of Project components listed above. Project operation would increase the depth and duration of the 100-year flood in portions of the project area. It is estimated that 20,000 acres of land that does not currently receive floodwaters would be newly inundated within and beyond the boundaries of the staging area. Any land that becomes flooded, regardless of depth, is referred to as inundation area(s) for this EIS (Figure 3). A 100-year flood, with construction and operation of the Project, has the potential to create an inundation area of greater than 100,000 acres.

The tieback embankment would extend from high ground in Minnesota to high ground in North Dakota and would be constructed to connect the Red River, Wild Rice River, and diversion inlet control structures. The tieback embankment and control structures would impound water in the inundation areas and would be designed to meet USACE dam safety standards. Also, the tieback embankment and control structures collectively fall within the definition of a Class I dam under Minnesota Rules 6115.0340.

The Project would be federally-sponsored and would be designed and constructed to federal standards. The Project would be owned and operated by a local government unit or group of local government units anticipated to be under a joint powers agreement, such as the Diversion Authority. Once constructed, Project operation, maintenance, and monitoring would be the responsibility of the Diversion Authority. With continual, sufficient funding construction is expected to take a minimum of 8.5 years.

As proposed, the Project would create a 30-mile long diversion channel on the North Dakota side of the F-M area. There would be a 6-mile long connecting channel between the Red River and the diversion inlet control structure. When operated, the Project would divert a portion of the Red River flow upstream of the F-M urban area, intercept flow at the Wild Rice, Sheyenne, Maple, Lower Rush and Rush Rivers, and return it to the Red River downstream of the F-M urban area. Operation of the Project would occur when it becomes known that a stage of 35.0 feet would be exceeded at the U.S. Geological Survey (USGS) gage in Fargo (Fargo gage). At this stage, the flow through Fargo would be approximately 17,000 cfs. A flow of 17,000 cfs at the Fargo gage is approximately a 10-percent chance flood (i.e., 10-percent chance flood). Operation begins by partially closing the gates at the Red River and Wild Rice River hydraulic control structures. Once the gates are partially closed, water would begin to accumulate in the inundation areas.

The Project would reduce flood damages and flood risk in the F-M urban area, but it would not completely eliminate flood risk. The Project would reduce flood stages on the Red River in the cities of Fargo and Moorhead and would also reduce stages on the Wild Rice, Sheyenne, Maple, Rush and Lower Rush Rivers between the Red River and the diversion channel. With the Project operational, the stage from a 100-year flood event on the Red River would be reduced from approximately 42.1 feet (assuming emergency levees confine the flow) to 35.0 feet at the Fargo gage.

2.1.1 Detailed Project Description

The following provides details on the Project components. These include the staging area and dam, Red River and Wild Rice River hydraulic control structures, connecting channel, diversion inlet control structure, diversion channel, Maple River and Sheyenne River aqueducts, Lower Rush River and Rush River spillways, and the diversion channel inlets, control structures, and hydraulic structures. Within the staging area are the OHB ring levee and the Comstock ring levee. The Project also includes floodwalls and in-town levees, non-structural features, and recreation features. Details about Project operation are provided below (Figure 2).

2.1.1.1 Dam

A “dam” is an artificial barrier that may impound water, so the “dam” includes the control structures and embankments, and collectively fall within the definition of a Class I dam under Minnesota Rules 6115.0340. The control structures are gated structures that span the river and control the flow of water downstream and include the Red River control structure, the Wild Rice River control structure, and the Diversion Inlet control structure. The embankments are raised structures constructed of soil and include the tieback embankment and the overflow embankment.

The length of dam between high ground in Minnesota to the diversion inlet control structure would be approximately 12 miles (six miles in Minnesota and six miles in North Dakota) and would be generally in an east/west direction. The expected elevation of this portion of the dam is between 927.5 and 930.1. A four-mile long overflow embankment would be built south of the diversion inlet control structure along Cass County Highway 17 at an elevation lower than the east/west portion of the dam. This portion of the dam would act as an emergency spillway for extreme events that exceed the 0.2-percent chance (i.e., 500-year flood) event design capacity of the Project.

2.1.1.2 Red River and Wild Rice River Hydraulic Structures

A gated control structure would be constructed adjacent to the Red River in Holy Cross Township (Clay County), Minnesota. A similar control structure would be constructed adjacent to the Wild Rice River in Pleasant Township (Cass County), North Dakota. The structures would be constructed adjacent to the existing channels in order to keep the sites dry during construction.

Once the control structures are built, the Red River and Wild Rice River would be rerouted through the control structures. When operated during flood events, these structures would limit flows downstream in the natural channels and cause the water to accumulate in the inundation areas.

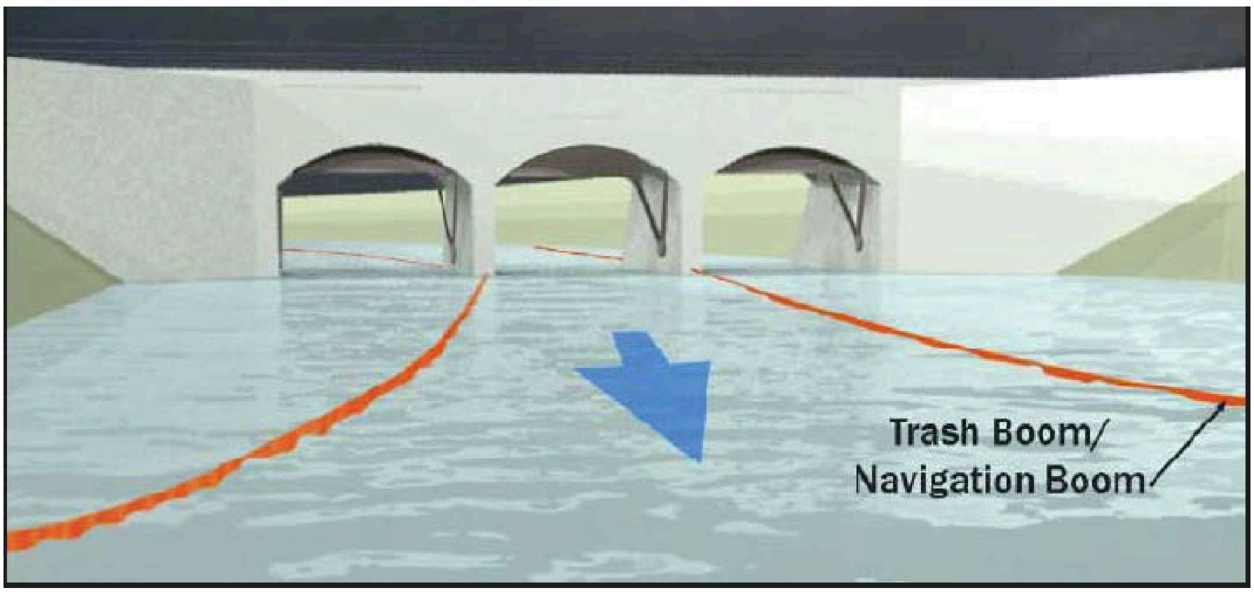


Illustration 2.1 Hydraulic Control Structure.

2.1.1.3 Connecting Channel

The Project would include a six mile long connecting channel between the Red River and the diversion channel inlet control structure. The connecting channel is smaller than, and separate from, the diversion channel. The proposed design of the connecting channel is lower than ground level, so it would be the first area inundated when the Project operates. The connecting channel bottom width is approximately 100 feet and would slope toward the Wild Rice and Red Rivers to drain the inundation areas when flood flows have receded.

At the Wild Rice River crossing, there would be two weirs (a low wall or dam built across a stream or river to raise the level of the water or to change the direction of its flow) across the connecting channel to maintain flow in the Wild Rice River during non-flood conditions.

2.1.1.4 Diversion Inlet Control Structure

The diversion inlet control structure would be located where the diversion channel alignment crosses Cass County Highway 17 in the southeast quarter of Section 31, Stanley Township (Cass

County), North Dakota. The diversion inlet control structure would consist of a 135-foot wide spillway with operable gates to control flows going into the diversion channel. Conditions on the Red, Wild Rice, Sheyenne, and Maple Rivers would be monitored to determine gate operation need and minimize downstream impacts.

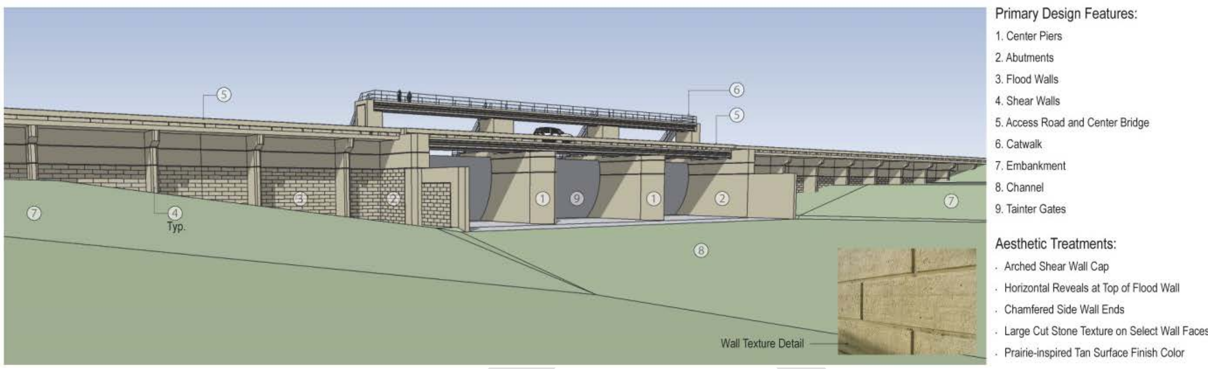


Illustration 2.2 Diversion Inlet Control Structure.

2.1.1.5 Staging Area

When the Red and Wild Rice River control structure gates are partially closed to limit flows through the F-M urban area, water would begin to pool and inundate behind the dam. Red River and Wild Rice River control structures would be operated to raise water surface elevations to approximately 922.2 feet (North American Vertical Datum (NAVD) 88) at the diversion inlet for all events up to a 500-year flood (0.2-percent chance) event. Based on the estimated depth and duration of a 500-year flood, approximately 150,000 acre-feet of undisturbed, unfilled, and regulated land is required to stage the water before it can be redirected into the connecting channel and diversion channel. This required area is generally referred to as the staging area.

The USACE describes the staging area as:

> *"…a defined area immediately upstream of the tieback embankment. When the project is operated, water will be temporarily detained in the staging area to minimize impacts downstream of the diversion outlet. The staging area encompasses the area where the Project increases the 100-year flood water surface elevation by 1 foot or more over existing conditions and encroachment must be prevented to preserve operability of the project. The staging area is a Project component that is being used as a management tool for land use/development and application of mitigation by the USACE, such as property acquisition, easements, and programmatic agreements, and it does not constitute the total area affected by Project operation."*

There are many areas within the staging area that stay dry, and therefore have zero feet of additional flood depth. All of the fringes of the inundated area within the staging area would experience additional flood depths of zero to one foot, while the majority of the land within the staging area would see additional depths greater than one foot. There are a few areas that are located outside of the designated staging area would experience over one foot change in surface water elevation for a 100-year flood. These areas in total make up 2,116 acres; the larger of these areas located east of the staging area (would be 311 acres of new inundation) and east of Mapleton (ND) (increased flood inundation over 1,167 acres).However, the majority of the inundated areas outside the staging area boundary would experience less than one foot of additional flood depth. Inundated areas outside the staging area boundary would likely require less land use restrictions and less intensive mitigation than locations within the staging area. More information on the staging area can be found below under the *Non-Structural Features Description.*

2.1.1.6 Diversion Channel

The diversion channel would start from the diversion inlet control structure near Cass County Road 17, just southeast of Horace, North Dakota. From the inlet control structure, the diversion channel would extend approximately 30 miles downstream to its outlet north of the confluence of the Red and Sheyenne Rivers near Georgetown, Minnesota. The diversion channel would route west of Horace, West Fargo, and Harwood and cross the Sheyenne, Maple, Lower Rush and Rush rivers. The diversion channel would continue west of and separate from the existing “Horace to West Fargo” and “West Fargo” diversion channels.

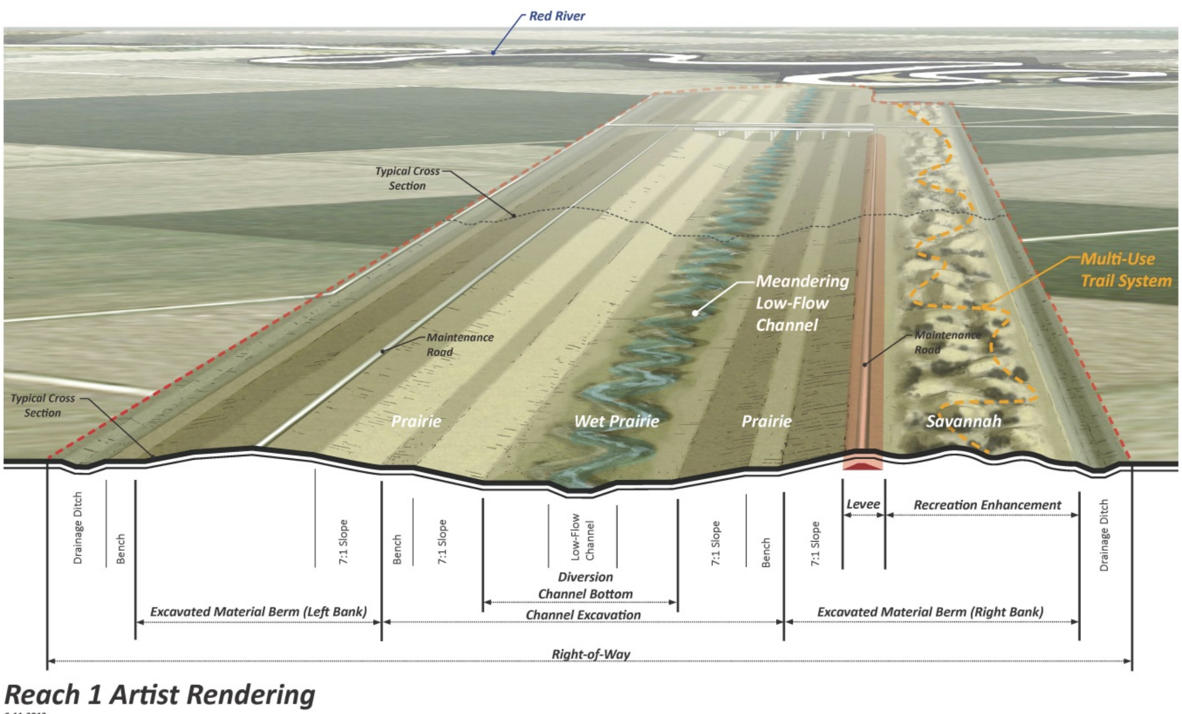


Illustration 2.3 Diversion Channel Design.

The diversion channel outlet, located where the diversion channel returns to the Red River in Wiser Township (Cass County), North Dakota, would consist of a rock ramp spillway with a crest width of 300 feet designed to allow fish passage.

	Location	Feature	Description	Peak Velocities			
				100 cfs	1000 cfs	7000 cfs	20000 cfs
1	Center	Weir	High velocity area at the center of the channel through the boulder weirs which can accommodate passage for fish with stronger ***maximum burst speeds***	5.5 ft/s	8.5 ft/s	10.8 ft/s	3.6 ft/s
2	Fringe	Weir	Fringe area through boulder weirs with moderate velocity to accommodate fish passage for ***a full range of burst speeds***	4 ft/s	5 ft/s	6.4 ft/s	2.4 ft/s
3	Center	Pool	Pool area at the center of the channel with velocities in the range of ***sustained swim speeds*** for most flows	0.4 ft/s	2.2 ft/s	6.3 ft/s	3.3 ft/s
4	Fringe	Pool	Fringe areas of the pools with low velocities for ***resting***	0.3 ft/s	1 ft/s	2.7 ft/s	2.3 ft/s

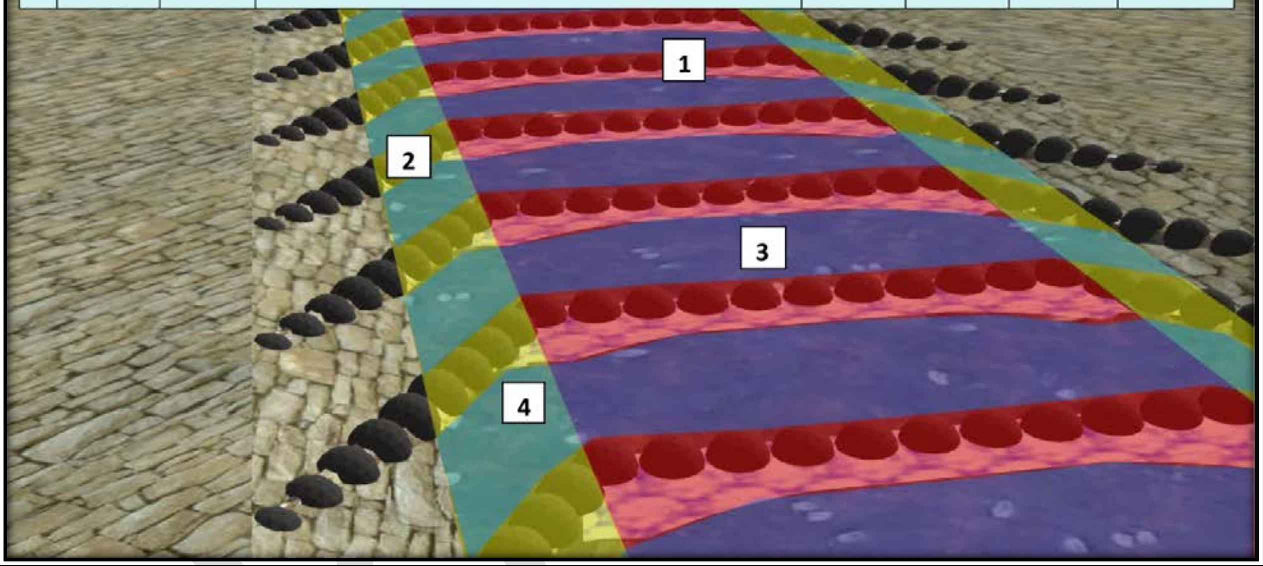


Illustration 2.4 Diversion Channel Outlet Spillway.

The diversion channel is designed to receive 20,000 cfs at its inlet and additional water from drainages intersected downstream. The diversion is designed to keep the 100-year flood flows below existing ground elevations as much as practicable to limit impacts to drainage outside the channel. The diversion channel would have a bottom width of 300 feet and a variable-width, low-flow channel that has been sized based on sediment transport considerations (Illustration ###). The low-flow channel would meander within a 200-foot belt width within the 300-foot bottom width from just upstream of the diversion outlet to just downstream of the Maple River aqueduct. The meandering portion of the low-flow would also serve as a way of substituting for lost aquatic habitat in the Lower Rush and Rush River channels between the diversion channel and the Sheyenne River.

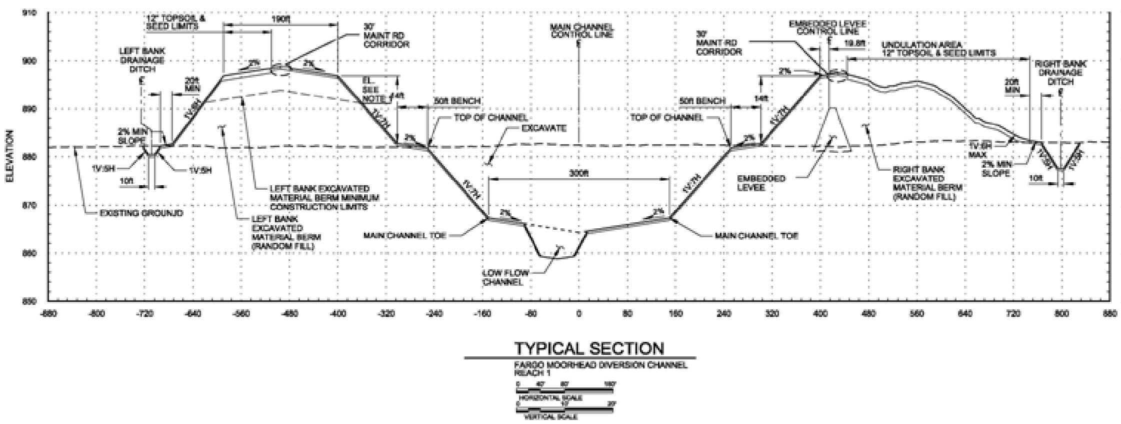


Illustration 2.5 Diversion Channel Cross Section.

The depth of the diversion channel would range from 15 to 25 feet deep excluding the low-flow channel and 20 to 30 feet deep including the low-flow channel. The general longitudinal slope of the diversion would be 0.9 ft/mile, with the low-flow channel having slightly less slope due to the meandering pattern. The side slopes outward from the 300-foot bottom width would be one vertical to seven horizontal and include geotechnical "benches" of 0 to 30 feet wide, as needed, to provide additional stability to meet the required factors of safety. Surfaces such as the bottom width and the geotechnical stability benches would be sloped at two percent toward the center of the channel to provide adequate drainage. The low-flow channel increases in size and capacity as the diversion channel moves downstream to accommodate drainage inflows; its bottom width increases from 10 feet to 52 feet, and its depth below the main channel increases from 2.5 feet to 6.5 feet in four increments along the 30-mile channel alignment. Additional details are described in Appendix D of the Supplemental EA, September 2013.

Soil excavated from the diversion channel would be placed into excavated material berms adjacent to the channel to a typical height of 16 feet. The excavated material berms would be as wide as necessary to contain the excavated material. Portions of the berms on the east side of the channel would be constructed to serve as levees when the water surface in the channel is higher than the natural grade. The maximum width of the footprint along the diversion channel would be approximately one half mile including the diversion channel and excavated material berms.

Drainage ditches adjacent to the berms would be necessary to intercept local drainage and direct it to the nearest downstream diversion inlet structure. The drainage ditches would run along the exterior excavated material berm toe on both sides of the diversion channel. The left-bank (looking downstream) ditch would direct flow to the diversion inlets (e.g., Drain 30, Rush River, Reach 4 inlet). The right-bank ditch would direct flow into existing drainage features that would direct flow away from the diversion channel.

2.1.1.7 Maple River and Sheyenne River Aqueducts

Hydraulic aqueduct structures (bridge-like structures that carry water across the diversion channel) would be located along the diversion channel at each tributary crossing. At the Maple

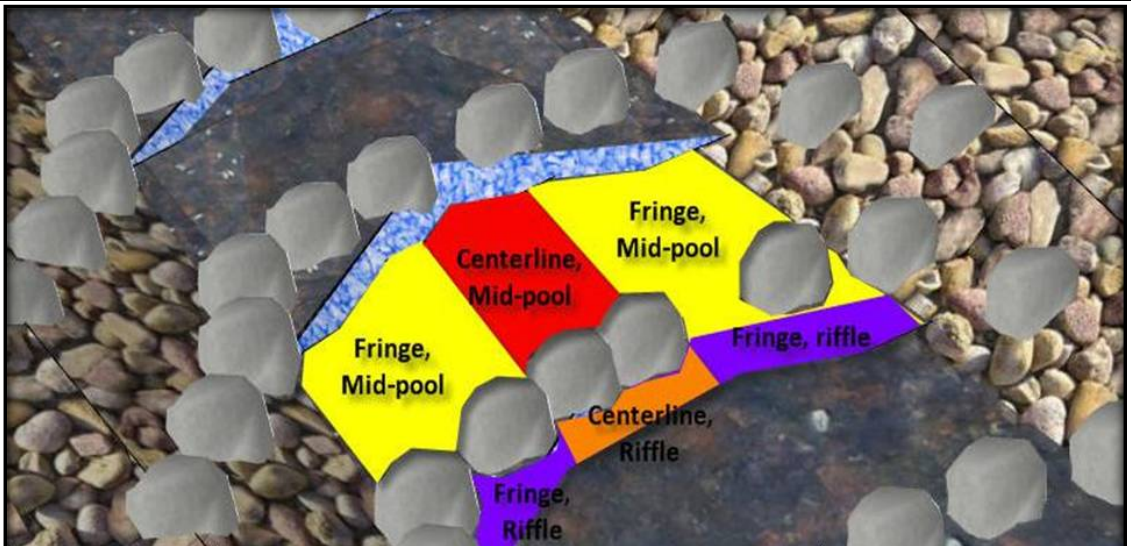
River and Sheyenne River crossings, there would be open aqueducts that cross over the top of the diversion channel to allow continuous connectivity of these two rivers and fixed-crest weir spillways that would direct flood flows into the diversion channel (Illustration 2-6). These structures would be constructed off-channel with the river diverted across the structure upon completion.

Illustration 2.6 Maple and Sheyenne Rivers Aqueduct Design.

The aqueducts would allow for flows in the diversion channel to pass underneath the existing river channels, while allowing bank-full flows to continue down the rivers. Once bank-full flows are exceeded in the river channels, excess water would be diverted into the diversion channel. The purpose of maintaining bank-full flows in the rivers is to maintain existing geomorphologic processes and existing habitat conditions in the natural channels. The intent of the Sheyenne and Maple River structures, as planned and operated, would be to maintain biological connectivity and fish passage in the rivers. The two crossing structure systems are similar in concept; each includes a grade control structure to prevent headcutting on the tributary, a spillway weir to control diversion of tributary flows, and a hydraulic structure (the aqueduct) to pass a limited flow over the diversion channel to maintain the desired downstream flow.

2.1.1.8 Lower Rush River and Rush River Spillways

At the Lower Rush River and Rush River, rock ramp spillways (i.e., drop structures) would be used to continuously divert the entire flow into the diversion channel. The Lower Rush River and Rush River would be diverted into the diversion channel and no longer would flow into the Sheyenne River downstream.



Discharge	Peak "Fringe Riffle" Velocity	Peak "Fringe Mid-pool" Velocity	Peak "Center Riffle" Velocity
	"Burst Speed"	"Resting Speed"	"Maximum Speed"
(cfs)	(cfs)	(cfs)	(cfs)
500	1.4	1.0	5
1000	2.1	1.6	6.4
1500	2.7	2.1	7.7
2000	3.2	2.5	8.3
2500	3.8	2.9	8.5
3230	4.4	1.2	8.9
3490	4.6	0.8	9

Illustration 2.7 Rush and Lower Rush Rivers Spillway Design.

2.1.1.9 Inlets, Ditches, and Smaller Hydraulic Structures

Ditches and smaller hydraulic structures would be required to accept existing drainages intersected by the diversion channel. Ditches running outside and parallel to the diversion channel would direct local drainage to a reasonable number of diversion inlet locations. Existing ditches, field swales, and drain tile would be directed into these parallel ditches. The larger inlets, such as Drain 14 (a drainage ditch which runs generally south to north from Davenport to the Maple River near its mouth), would be open inlets like the Lower Rush River and Rush River. These larger inlets would be either concrete drop structures or rock ramps. The smaller inlets would be culvert structures with flap gates and energy dissipation chambers at the outlet. The culvert flap gates would prevent backflow from the diversion channel after peak flows.

Uncontrolled inlets (inlets without backflow prevention) would be placed at drainages that have either natural or manmade levees which would prevent widespread flooding from diversion channel backflow for events up through the 100 year flood. The project design is to maintain the existing 100-year flood floodplain in adjacent upstream drainages.

2.1.1.10 Oxbow/Hickson/Bakke Ring Levee

The communities of Oxbow, Hickson, and Bakke Addition in North Dakota are located within the inundation area and would be impacted during Project operation. The Diversion Authority has begun building a ring levee around these communities to address existing flood threats. The ring levee is intended to eliminate the need to relocate these communities and prevent inundation.

The full Oxbow, Hickson, and Bakke Levee alignment (OHB ring levee) would surround Hickson, Bakke, and a portion of Oxbow (Figure 4). Oxbow is located along the banks of the Red River and generally consists of residential lots surrounding the Oxbow Country Club. A number of residential lots as well as the country club would be impacted by the levee alignment. Approximately 40 residential structures would be removed. The alignment would generally parallel the Red River through residential areas in both the north and south portions of Oxbow and would cross directly through the Oxbow Country Club. The alignment would parallel the north edge of Bakke and continue south along the west edge of Bakke and Hickson. From the southeast edge of Oxbow and the southwest edge of Hickson, the levee would encompass agricultural areas, new residential lots, and portions of the golf course.

The levee would be constructed to maintain a freeboard, the height above the recorded high-water mark, of 4.0 feet above the 100-year flood floodplain elevation, the higher elevation being on the upstream end of the levee. The 100-year flood elevation at Oxbow, Hickson and Bakke, North Dakota, based on modeling information, is an elevation of approximately 922.3, and the 500-year flood elevation is approximately 922.5. The 100-year and 500-year flood elevations are similar since all three communities are located in the inundation area. The top of OHB ring levee elevation is designed to 927.50. The five foot elevation difference accounts for: four feet of freeboard, 0.5 feet of overbuild to account for settlement, and 0.5 feet of aggregate roadway. The OHB ring levee includes a 2,300 foot overflow section on the west side of the levee that is one foot lower than the levee designed elevation. During a flood event greater than the 500-year flood, which could potentially overtop the OHB ring levee, this overflow section would allow flood water to enter (breach) the levee, but in a controlled location. This design could potentially prevent an uncontrolled breach of the levee elsewhere along the alignment.

The levee embankment would be located a sufficient distance, approximately 150 feet, from residential lots to allow for levee maintenance access, drainage features, and a vegetative buffer. The levee would be located a sufficient distance from the Red River to ensure geotechnical stability.

OHB ring levee construction requires the raising of Cass County Highways 81, 18, and 25and Interstate 29 (I-29)to allow continued access during inundation. An additional area of Oxbow would be created within the benefitted area that would include new roads, residential lots, golf course holes, and a new clubhouse to replace structures and features lost due to construction. The existing sanitary sewer system, water main, and storm sewer system would be modified to accommodate the ring levee and new residential areas. Internal drainage features would be included, such as: open channels, storm sewers, storm water ponds, and a storm sewer pump station.

2.1.1.11 Comstock Ring Levee

A levee would be also constructed around the city of Comstock, Minnesota, which is currently located outside of the 100-year floodplain. Operation of the Project would cause new inundation in this community during the 100-year flood. The levee would be constructed to prevent flooding by maintaining a freeboard of 3 to 3.5 feet above the 100-year flood elevation, the higher elevation being on the upstream end of the levee (Figure 5). The 100-year flood elevation at Comstock, based on modeling information, is an elevation of approximately 922.30, and the 500-year flood elevation is approximately 922.30. The 100-year flood and 500-year flood elevations are the same since the city of Comstock is located in the staging area. The proposed levee elevations for Comstock would be set at 926.50 on the north end of the city to provide four feet of freeboard. The top elevation of the proposed levee on the south side of town is 927.00.

The Comstock ring levee would require Clay County Hwy 2, west of Comstock, to be raised to an elevation of 926.67. This elevation is adequate at that location as it is above the 100-year flood elevation. Where the levee crosses Hwy 2 east of Comstock, an earthen levee would be constructed to protect against waters above the 100-year flood elevation. The railroad on the north and south side would require protection measures above a 100-year flood event.

The alignment on the north and east side of Comstock would have an internal ditch constructed along the levee. South of Hwy 2 and east of the Burlington Northern/Santa Fe (BNSF) railroad, an area for future development would be protected by the levee. West of the railroad tracks on the south side, the alignment of the levee was designed to include future commercial expansion. Existing flow from the southeast would be diverted by an external ditch installed around the outside of the levee. This ditch would carry the storm/flood water to the east and then north around town.

Interior drainage east of the railroad would continue to drain to the north; however, instead of exiting town through an existing ditch on the east side of the railroad, the water would enter an internal ditch, which would carry the water to a new lift station to be installed in an interior storm water pond. A pump station would be installed to drain the pond. Another pond located in the southwest corner would be used for interior storm water storage. The two ponds would be connected through a surface ditch.

2.1.1.12 Transportation and Utility Features

Interstate 29, U.S. Highway 75, and the railroad near U.S. Highway 75 would be raised slightly above the 100-year flood elevation to maintain access during flood inundation. Other roads within the inundation areas would be allowed to flood when the Project operating. Utilities located in the inundation area would be evaluated during final Project design. Known utilities include, but are not limited to, electric power lines, rural water supply, and sewer facilities. Utilities that cannot withstand occasional flooding would be abandoned, modified or relocated, depending on the situation in accordance with applicable regulations.

Along the length of the diversion channel, 19 road crossings and highway relocations would occur at approximately three mile intervals, primarily for county roads. Other roads may be terminated at the diversion channel or rerouted to the local road network, which would be determined during final Project design. Four new railroad bridges would be needed where existing railroads intersect the diversion channel.

2.1.1.13 Project Operation

Project operation would occur when predictions at the Fargo gage exceed 35.0 feet. Predictions are accomplished by adding the observed discharge at the Red River gage at Enloe, North

Dakota to the observed discharge at the Wild Rice River gage at Abercrombie, North Dakota and making a reasonable allowance for local inflow. At a stage of 35.0 feet, the flow through Fargo would be approximately 17,000 cfs, which is approximately a 10-year flood event. Operation begins with partially closing the gates at the Red River and Wild Rice River hydraulic control structures. Once the gates are partially closed (i.e., partially lowered), water would begin to accumulate in the inundation areas. Water would not be released through the diversion inlet control structure gates until after the Red River and Wild Rice River control structures begin operating. Opening the diversion inlet control structure gates would depend on the flow conditions of the Red, Wild Rice, Sheyenne, and Maple Rivers, which would be dependent on timing of peak flows of the tributary streams in order to limit the elevation and duration of upstream flooding. Staging may occur without operating the diversion inlet control structure gates. Once the initial tributary stream flow peaks have passed, the diversion inlet control structure gates would be opened.

A maximum stage of 35.0 feet would be maintained at the Fargo gage until the upstream staging elevation reaches 922.2 (the staging elevation would just reach elevation 922.2 for the 100-year flood). Once the upstream staging elevation reaches 922.2, the Red River and Wild Rice River hydraulic control structure gates would be opened as necessary to maintain the upstream staging elevation of 922.2 while not exceeding a stage of 40.0 feet at the Fargo gage (a stage of 40.0 feet would occur for the expected 500-year flood). A stage of 40.0 feet would be maintained by first allowing more flow down the diversion channel and then allowing flow to exit the staging area over the overflow embankment at elevation 923.0 along the west side. Flow exiting the staging area via the overflow embankment would flow overland into the Sheyenne River basin.

Floods larger than the 100-year flood event would require emergency flood fighting measures. With the Project operational, the stage for a 500-year flood would be approximately 40.0 feet at the Fargo gage, which is comparable to the 2009 flood. Emergency measures would be employed within the F-M urban area to reduce flood damages when the stage is between 35.0 and 40.0 feet. If the upstream water surface elevation is forecasted to reach the point of minimum acceptable freeboard, four to five feet below the top of the dam, an evacuation order would be issued for the F-M urban area. Once water is flowing over the overflow embankment and the upstream staging elevation reaches the point of minimum acceptable freeboard, the Red River and Wild Rice River control structure gates would be opened further to maintain the minimum freeboard, and stages would rise above 40.0 feet at the Fargo gage.

The non-federal local sponsors would be responsible for all operations, maintenance, repair, rehabilitation and replacement (OMRR&R) of the Project. The cost share agreement between the USACE and the non-federal local sponsors requires the sponsors to operate the Project in accordance with the OMRR&R manual provided by the USACE.

2.1.1.14 Floodwalls and In-Town Levees

The Project would include floodwalls and levees in Fargo and Moorhead, which would allow more flows to pass through town and reduce Project operation frequency. The in-town levees would be such that FEMA would be able to accredit the levees for the 100-year flood once the Project is complete.

The in-town levees would include the following features:

- Certification of the existing Ridgewood/VA levee (Fargo)
- Certification of the existing project area F1 levee (Moorhead)
- Construction and certification of the El Zagal Area levee (Fargo)
    - The El Zagal Area levee consists of an approximately 3,000-foot long levee connecting an existing floodwall near 15th Avenue North and Elm Street North west and around El Zagal Park to high ground near Treefoil Park Road and Elm Street North. Eight (8) residential structures would require removal for this feature.
- Construction and Certification of the Mickelson Field levee (Fargo)
    - Certification of recently completed levee paralleling Oak Street from 11th Avenue North to the south line of Mickelson Field.
    - Construction and certification of the final segment of the Mickelson Field levee consisting of an approximate 150-foot long levee connecting the existing levee to high ground at North Terrace and North River Road. Five (5) structures would require removal for this feature as they are less than the 150-ft connecting levee footprint.
- Construction and certification of the 2nd Street North floodwall and Levee (Fargo)
    - The levee/floodwall would extend the line of protection from NP Avenue to the BNSF Railroad Grade, maintain traffic on 2nd Street North, and provide the opportunity for additional flood protection on the Park East Apartment property. The 2nd Street North floodwall includes realigning 2nd Street to the west to accommodate construction of a floodwall between the river and the roadway. Because of the frequency of potential risk in this area and the anticipated timing of other components of the Project, the floodwall would be completed to a higher level of protection in order to provide interim protection until the entire Project is complete. As a result, the level of protection has been established to be consistent with other on-going interim flood risk reduction projects within Fargo. Consequently, all proposed floodwalls are designed to have a protection elevation of 44-feet (39.5-feet plus 5.5-feet for appropriate freeboard similar to other on-going risk reduction projects). This would help provide flood protection for events larger than a 100-year flood before and after the Project is complete.
    - Includes the acquisition of property north of 1st Avenue North including the Feder Realty Company building and the Fargo Board of Public Education building, and partial acquisition of the Northland Hospitality (Howard Johnson) structure. In order to provide minimum protection to 39.5 feet, this feature would extend protection through the Case Plaza parking lot using a removable floodwall constructed throughout the parking lot.
    - Includes the acquisition of the Park East Apartments to remove that property from the floodplain at a river stage of 35.0 feet and higher and to allow for the construction of a levee across the property. An additional floodwall would then also be constructed to connect this levee to the north end of the existing 4th Street levee.
- Acquisition of the isolated urban property near Wood Lawn Park (Moorhead)
- Certification of the existing Woodlawn Area levee (Moorhead)
- Certification of the Belmont Area through acquisitions (Fargo)
    - Two structures would require removal.
- Certification of the existing Horn Park Area levee (Moorhead)

2.1.1.15 Non-structural Project Features

There are several non-structural mitigation measures included in the Project to address impacts of increased flooding within the inundation area. These consist of fee acquisitions, construction of ring levees and the acquisition of flowage easements. Within the staging area, Impacted homes, structures, and businesses that have greater than three feet of flooding for the 100-year flood with the Project would be purchased, those with one to three feet of flooding would be considered for ring levees or purchase (a risk and safety analysis would be conducted for determination of viability of a ring levee), and other insurable structures with any surcharges would be mitigated. Section 3.16.3 – Socioeconomics Proposed Mitigation and Monitoring provides details on proposed mitigation for structures.

Farmsteads would be given additional consideration based on the depth of flooding, duration of flooding, and access. Acquisition of farmsteads would generally follow the mitigation plan listed above, however under some circumstances it may be viable to construct a ring levee or raise the farmstead. In any case, where farmsteads would have greater than 3 feet of flooding a buyout would be offered to the owner prior to consideration of other options. Impacts to agricultural lands in the staging area would be mitigated through the acquisition of flowage easements. Agricultural lands would be impacted by the Project primarily in the spring, and it is anticipated that in most areas farming could continue without significant impacts. A property-by-property analysis would be conducted throughout the inundation area to ensure that the specifics of each parcel are taken into account when determining the appropriate mitigation. Alternative mitigation options would be considered when application of the general rule does not result in adequate mitigation for a particular parcel.

In areas with greater than one foot of flooding for the 100-year flood, no residential development would be allowed. In areas with less than one foot of flooding for the 100-year flood, future residential development must be raised above the 500-year flood elevation.

Areas outside the staging area such as those along the Red River, Wild Rice River and connected drainages may also be affected by Project operation. Inundation outside of the designated staging area is estimated to be less than one foot of additional flood depth for a 100-year flood. A legal analysis would be conducted to determine if the impacts in these areas rise to the level of a taking under the Fifth Amendment of the U.S. Constitution[1]. This analysis would include evaluation of property impacts such as land value, water supply, and septic systems. Outside of the designated staging area, landowners would be compensated appropriately for any takings. Minnesota Rules 6120.5700(A) requires mitigation for existing structures in Minnesota with any impact.

[1] The 5th Amendment of the US Constitution requires just compensation when private property is taken for public use. CFR 49 Part 24 - Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended, details benefits to the property owner and/or displaced residential renters for Federal and Federally Assisted Programs.

2.1.1.16 Recreation Features

The conceptual recreation plan for the Project includes one concrete multi-purpose trail and one aggregate equestrian trail loop with a combined length of approximately 47-miles. These trails are in addition to the aggregate maintenance road that is included in the Project. The multi-purpose trails would be 10-foot wide concrete, while the equestrian trail would be 12-foot wide compacted gravel. Both trails would be situated within an undulating landscape on top of the right bank excavated material berm (EMB) of the diversion channel, and designed to be a trail system that would provide varying distances and aesthetic experiences to the users. The trails would start at the Red River outlet and go upstream. While there are no separate pedestrian crossings across the diversion channel, the proposed County and local road bridge designs allow for shared-use. At each proposed bridge location, including railroad and interstate bridges, the trails would merge and be constructed down the side slopes of the main diversion channel so that the trail can pass underneath the bridge structures. Along the trails, benches, trash receptacles, and interpretive signage would be located approximately every mile to provide the trail users information about the wildlife, history, culture, and ecology of the area as well as respite.

Recreation use along the left bank EMB would be limited to a winter snowmobile trail, which could be located along the base of the outside slope. The maintenance road on both the left and right bank EMB could serve as a bird watching trail or for other passive recreation opportunities. This access road would be closed to motorized vehicles, but public non-motorized use may be allowed.

In addition to the proposed trail system, other activities have been identified and planned for in key locations. These locations are known as Activity Hubs. There are four hubs identified for the Project; Red River Hub, Maple River Hub, Sheyenne River Hub, and Diversion Structure Hub. These Activity Hubs would function as primary trail access locations as well as recreation destinations. While the individual hubs would vary in character, recreation features would include parking, restrooms, trail way-finding signage, picnic facilities, drinking water, interpretative signage, fishing, and boat access.

Also included in the conceptual recreation plan are Activity Nodes. Nodes are similar to hubs but provide less intensive site-specific activities and could serve as secondary access points to the trails. Proposed activity nodes include the following:

- Two Off-Highway Vehicle (OHV) nodes are proposed for adjacent parcels along the diversion and would be designed to accommodate four-wheel vehicles, ATVs, off-road motorcycles and mountain biking. The OHV node would also include a trailhead facility with restrooms, and concessions.
- Rush River Node would accommodate fishing access and a small trailhead.
- I-94 Node would provide a small trailhead off of I-94 and provide access to the Diversion trail system.
- Rendezvous Node would enlarge the existing Rendezvous Park and provide a dog park as well as parking and portable restroom facilities.
- Old Diversion Node is planned for the area that would be abandoned by the relocation of the Sheyenne River Diversion. This site would provide an opportunity for a park that

- includes a sledding hill, community amphitheater and other desired community amenities.
- Wild Rice River Node would provide fishing access to the Wild Rice River and a small trailhead to access the Diversion trails.

Landscaping of trees and shrubs at the trailheads, Activity Hubs and Nodes are proposed along with trees, native prairie grasses and forbs along the trail. All proposed recreation facilities would meet the guidelines for Americans with Disabilities Act (ADA) and the Architectural Barriers Act (ABA) as well as the final draft of the ADA-ABA Accessibility Guidelines for Outdoor Developed Areas.

2.2 ALTERNATIVES

The alternatives section describes the process that was used to develop, evaluate, and eliminate potential alternatives based on the Project Purpose and Need described in Chapter 1. The discussion includes how alternatives were selected for detailed study, the reasons why some alternatives were eliminated from consideration and describes how the alternatives meet the need for the Project.

2.2.1 Alternatives Evaluation Summary

Projects that require the preparation of an EIS focus on key environmental, social and economic issues that are likely to result from the Project, and the detailed analysis of those issues. The EIS – as required by law - also examines whether there are alternative Project designs or locations that are reasonable, would result in fewer environmental impacts, and achieve the Project Purpose and Need. The goal is to identify if other alternatives could improve environmental and/or socioeconomic benefits while reducing environmental impacts. Alternatives offer decision makers and the public options to the Project. A no action alternative is always included in this evaluation and considers the effects that would occur if the Project is not constructed.

2.2.1.1 Process Overview

The Minnesota Environmental Policy Act of 1973 (MEPA) established a formal process for investigating the environmental impacts of major development projects. This formal process operates according to rules adopted by the Environmental Quality Board (EQB). Under MEPA, the EQB statutes and rules (Minnesota Statutes, chapter 116D, sections 04 and 045; and Minnesota Rules, parts 4410.0200 to 4410.6500) require that an EIS consider at least one alternative from each of the following categories or provide a concise explanation of why no alternative of a particular type is included in the EIS:

- Alternative sites;
- Alternative technologies;
- Modified designs or layouts;
- Modified scale or magnitude, and
- Alternatives incorporating reasonable mitigation measures identified through comments received during the public comment period during EIS scoping.

Alternatives may be identified at any time throughout the EIS process. Alternatives may also be identified by the Project Proposer, the Responsible Governmental Unit (RGU), other agencies, local government units, or members of the public.

According to Minnesota Rules, part 4410.2300(G), an alternative may be excluded from analysis if it would not meet the underlying need for or purpose of the Project, it would not likely have an significant environmental benefit compared to the Project as proposed, or another alternative, of any type, that will be analyzed in the EIS would likely have similar environmental benefits but substantially less adverse economic, employment, or sociological impacts.

2.2.1.2 Screening Analysis

Based on the alternatives categories in Minnesota Rules for environmental review, reasonable alternatives were considered for their relevance to meet the Project purpose and need, as well as their feasibility to improve environmental and/or socioeconomic benefits, while reducing potential environmental impacts that may result. This section evaluates alternative sites and alternative technologies. Other alternatives considered, but dismissed from further evaluation in the EIS include modified designs and layouts, and modified scale and magnitude. Alternatives incorporating reasonable mitigation measures were also evaluated in the EIS for each topic area as it related to the mitigation. Additional discussion on mitigation is provided in Chapter 6.

2.2.1.2.1 Alternative Sites

Minnesota Rules allow the RGU to exclude alternative sites if other sites do not have any significant environmental benefit compared to the project as proposed or if other sites do not meet the underlying need for and purpose of the project. The Minnesota Environmental Quality Board's (EQB) Guide to Minnesota Environmental Review Rules (2010) lists a number of factors for the RGU to consider when deciding whether alternative sites would meet the underlying need for or purpose of the Project.

The MNDNR conducted an independent assessment of alternative sites for a diversion, considering the alternatives discussed in the FFREIS and combining other measures with those alternatives. As part of the scoping, the MNDNR prepared the Alternatives Screening Report: Fargo-Moorhead Metropolitan Area Flood Risk Management Project (Wenck, 2012) (Alternatives Screening Report). This report determined that the reasonably available alternate diversion sites in Minnesota and/or North Dakota do not produce benefits for environmental resources or socioeconomic factors, and therefore the EIS will not evaluate alternative sites.

2.2.1.2.2 Alternative Technologies

Six potential technology alternatives were studied in the Alternatives Screening Report. Two of these alternatives, tunneling and I-29 Viaduct, had a similar effectiveness to the Project but did not present a significant environmental benefit. In addition, they are expected to transfer potential impacts of the Project downstream, and they have excessive capital costs, and therefore will not be evaluated in the EIS.

The remaining alternative technologies (non-structural measures; flood barriers; flood storage; and flood storage combined with a control structure) did not effectively meet the Project purpose by themselves. However, it was initially thought that a combination of these alternatives could potentially meet the Project purpose and present increased environmental benefit. Therefore the Distributed Storage Alternative, which is principally a modified design alternative that incorporates these alternative technology aspects, was further evaluated as part of the alternatives evaluation. As part of the alternatives evaluation it was eventually determined that the Distributed Storage Alternative could not meet the purpose and need for the Project on its own, and therefore, was not evaluated further in the EIS for potential impacts. Additional discussion on the Distributed Storage Alternative is provided in Section 2.2.1.3.1.

2.2.1.2.3 Modified Design or Layouts

The Northern Alignment Alternative (NAA) is a modified version of the Project design and layout. The NAA was conceptualized during the public comment and alternatives screening process. The Alternatives Screening Report has details on the alternatives considered and the screening criteria used to select alternatives that could meet Project purpose while providing other potential benefits. The NAA was one of two additional alternatives recommended for further study through the EIS process. The NAA was selected for further evaluation in this EIS.

The NAA would move the tieback embankment of the Project north approximately 1.5 miles (Figure 6). The remaining design features of the NAA would remain the same as the Project. The NAA consists of a dam and diversion channel system including, but not limited to: a tieback embankment, excavated channels; a channel inlet control structure; river control structures on the Red and Wild Rice (ND) Rivers; a floodwater staging area (staging area); hydraulic structures on tributaries; levees and floodwalls in the F-M urban area; non-structural features (such as buyout, relocation, or raising individual structures); and recreation features (such as multipurpose trails and pedestrian bridges). The NAA also includes environmental mitigation projects located inside and outside the project area.

Because the Project impact footprint is different than the NAA, some studies or investigations providing environmental effects may not have been completed, or may not have been completed to the same extent as for the Project. According to Minnesota Rules 4410.2500, if information about potentially significant environmental effects of an alternative is not available or is incomplete, the EIS shall include a statement of the information that is incomplete or unavailable, a brief explanation of why it is not available, and an explanation of the information's importance. Incomplete NAA impact information will be addressed within each EIS topic section. If the NAA is pursued beyond the EIS, additional site specific studies would need to be conducted and considered in the final design and construction plans.

Additionally, the design details or construction plans for the structures might need to be modified for reasons such as different topography, soil types, or land use. These potential differences or modifications are not anticipated to be significant; therefore, for the purposes of the EIS, the NAA design features are described as being similar or the same to the Project as applicable. To the extent that studies or investigations have been completed within the NAA project area, these have been included in the EIS and discussed in the appropriate sections. A more detailed description of the NAA is provided in Section 2.2.2.2.

2.2.1.2.4 Modified Scale or Magnitude

The MNDNR will not evaluate a scale or magnitude alternative in the EIS. While an alternative with reduced staging and increased reliance on flood fighting could offer significant flood protection, this alternative would have similar environmental impacts to the Project while also transferring additional impacts to downstream structures.

2.2.1.2.5 Alternatives Incorporating Reasonable Mitigation Measures

The MNDNR has considered alternatives and mitigation measures identified during the comment period on the draft scoping documents. These suggested mitigation measures were considered against the exclusionary criteria identified in *Minnesota Rules* part 4410.2300(G). Mitigation measures identified through public comments include:

- Monitoring diversion channel and flood water drawdown to reduce fish stranding in the diversion channel and inundation areas;
- incorporate invasive species monitoring and mitigation strategies into the Project operation plan (Appendix A);
- review existing Indexes of Biological Integrity (IBIs) for their potential to inform future monitoring of the aqueducts on the Maple River and Sheyenne River for freezing during low-flow and no-flow conditions; and
- assess the need for groundwater monitoring as part of the Adaptive Management and Monitoring Plan (AMMP) (Appendix B).

These mitigation and monitoring measures, along with proposed and additional recommended mitigation and monitoring measures, were considered and evaluated in the EIS. Measures specific to a certain topic area, such as fish passage and mortality, are discussed in the relevant sections of this EIS. Chapter 6 further evaluates the proposed mitigation and monitoring measures and provides additional recommended measures where needed. Additionally, the Adaptive Management Plan concept presented in the FFREIS was further refined during this EIS process which resulted in a comprehensive Draft AMMP that provides background information, proposed and recommended mitigation and monitoring measures, and outlines draft monitoring protocols. The AMMP is provided as Appendix B.

2.2.1.3 Alternatives Considered But Dismissed From Further Evaluation

2.2.1.3.1 Distributed Storage Alternative

The Distributed Storage Alternative (DSA) was conceptualized during the public comment and alternative screening process as part of the State of Minnesota environmental review for the Project. During the EIS scoping process, many public comments received suggested that distributed storage, or a similar approach, or in combination with other measures, might provide greater environmental benefits than the proposed Project. As a result, the MNDNR included the DSA alternative in the Final Scoping Decision Document (FSDD) for further evaluation in the EIS. An alternative may subsequently be excluded from analysis in the EIS if it is determined that the alternative would not meet the underlying purpose of the project, would not have significant environmental benefit, or would have similar environmental benefits but substantially less adverse economic, employment or social impacts. If a scoped alternative is excluded from the EIS analysis, it must be discussed briefly and the reasons for its elimination shall be stated (Minnesota Rules 4410.2300).

DSA Description

The DSA is a combination of distributed Red River basin storage sites upstream of Halstad (MN) and an in-town levee for flood protection of the F-M urban area. The distributed storage component of the DSA relies on the recent Halstad Upstream Retention Study (HUR) completed by the Red River Basin Commission in December 2013. The HUR identified 96 specific retention sites throughout the basin to achieve a 20-percent flow reduction on the Red River. The in-town levee component of the DSA relies on a maximum levee protection plan that was developed by the USACE. The levee plan includes over 50 miles of levee construction and ties into high ground. As part of analyzing the DSA, the MNDNR considered other measures, including the Sheyenne diversion and wetland/grassland restoration that could be combined with the DSA to improve flood risk reduction in the F-M area.

DSA Evaluation

MNDNR first evaluated the conceptualized DSA by seeing if it would meet the project purpose as defined by the Diversion Authority. Second, MNDNR evaluated the following two variations to the DSA to see whether they could provide additional benefits to meet the project purpose: 1) the DSA in combination with a new Sheyenne River Diversion, and 2) the DSA in combination with other non-structural measures (e.g., wetland and grassland restoration).

The project purpose is defined as:

1) Qualify substantial portions of the F-M urban area for 100-year flood accreditation by the Federal Emergency Management Agency (FEMA) under the National Flood Insurance Program (NFIP);
2) Reduce flood risk potential associated with a long history of frequent flooding on local streams including the Red River, Sheyenne, Wild Rice (in North Dakota) Maple, Rush and Lower Rush Rivers, passing through or into the F-M urban area; and
3) Reduce flood risk for floods exceeding the 100-year flood, given the importance of the F-M urban area to the region and recent frequencies of potentially catastrophic flood events.

Evaluation in the screening analysis is based on the following information:

- Water flow models included in the Final DSA Report (Wenck, 2014).
- Relevant literature examining the potential for using upstream storage areas (e.g., wetlands and reservoirs) in major subwatersheds to reduce downstream flows through the F-M urban area. These storage areas referenced were often built with other structural and non-structural measures for flood risk reduction.

Reasons for Elimination

As described in the DSA Screening Analysis (Appendix C), it appears that the DSA by itself would not meet the Project purpose as defined by the Diversion Authority.

One of the project purpose components is to qualify substantial portions of the F-M urban area for 100-year flood FEMA accreditation. While the DSA does provide some protection, it faces challenges to meeting freeboard requirement for 100-year flood FEMA accreditation. Additionally, FEMA accreditation would require that all 96 sites identified in the HUR study be constructed. Compounding these challenges are the factors of time, funding, land acquisition, and regulatory issues. While it is possible that this component could be met, the feasibility of getting FEMA accreditation is questionable.

The second component of the project purpose is to reduce flood risk from the North Dakota tributaries. The DSA does provide some flood risk reduction, but it does not protect from break out flows on the Sheyenne River. Large portions of the F-M area will continue to have flood risk from the Sheyenne, particularly the north and west. Therefore, the DSA does not meet this component of the Project purpose.

Protection from floods greater than the 100-year flood is the third component of the Project purpose. The HUR study limited the evaluation to a 100-year flood; while there is potential for storage to protect above this event, it is likely limited. The levee system will contain flows greater than the 100-year flood, but it would do so without the additional freeboard that would typically be required for a larger event. Flood events greater than the 100-year flood significantly increase the probability of overtopping the levee, which would result in catastrophic flood damages. Thus, the DSA does not present a reasonable or prudent alternative from flood events greater than the 100-year flood.

Consideration was given as to whether the cumulative benefit of additional flood reduction measures could help the DSA meet the project purpose. The MNDNR revisited an alternative (i.e., DSA with Sheyenne Diversion, or Northwestern Diversion) that was suggested in the Alternatives Screening Report to see if there was a modification that would increase the alternative's ability to meet the project purpose. While this addition does provide additional protection from the North Dakota tributaries and removes the need for a dam on the Red River, there are still problems with getting 100-year flood FEMA accreditation and with flood flows greater than the 100-year flood event. Similarly, adding wetland restoration to storage already considered in the DSA would have minimal impact on reducing flow rate and volume for the F-M urban area. It was, therefore, determined that these additions do not present a feasible and prudent alternative, and still is not likely to meet the project purpose.

The screening analysis of this alternative indicates that the DSA:

1) is limited in meeting the project purpose;
    a. The DSA provides the communities on the Red River mainstem with limited protection from catastrophic events or from peak tributary flows;
2) is not a feasible or practical alternative to the proposed project; and
    a. Roughly 96 impoundment sites would be required to achieve the desired 20 percent flow reduction basin-wide. Since 1997, only 3 impoundment projects have been completed upstream of Halstad.
    b. It would be very challenging for the Diversion Authority or the USACE to work with all interested parties across the basin to implement this number of storage sites within a reasonable time period.
3) in combination with other measures, does not substantially improve the performance of the alternative toward meeting the project purpose.
    a. Sheyenne Diversion: The addition of the Sheyenne Diversion has the potential to increase flood flows downstream of the F-M urban Area; and the cost of adding the Sheyenne Diversion, while not a prime consideration, would decrease the feasibility of DSA.
    b. Wetland/Grassland Restoration: it is unlikely that adding wetland/grassland restoration to the DSA measures would have a sufficient impact to allow the DSA to meet the Project purpose as it relates to catastrophic flood events.

Distributed Storage is a positive basin-wide approach to provide local flood protection and should be pursued wherever feasible. Additional upstream storage would greatly benefit many downstream communities in the Red River Basin, including Fargo and Moorhead, but individual communities will still need additional flood protection for large or catastrophic flood events.

The analysis of this alternative determines that the DSA: 1) does not fully meet the project purpose; and 2) is not a feasible or practical alternative to the proposed project. Minnesota Rules 4410.2300 subpart G allows for alternatives that were included in the scope of the EIS to be eliminated from further consideration based on information developed as part of the EIS. The full DSA screening analysis (Appendix D) is included in this Draft EIS to briefly describe why this alternative is not being carried forward for full analysis in the Draft EIS. Public comments on the DSA screening analysis will be considered during preparation of the Final EIS.

2.2.1.3.2 More Flows Through Town Alternative

Alternatives may be identified at any time throughout the State of Minnesota environmental review process. Alternatives may also be identified by the Project Proposer, the Responsible Governmental Unit, other agencies or local government units, as well as by members of the public. The More Flows Through Town Alternative was first conceptualized in 2011 by the USACE as part of the FFREIS as a potential fish mitigation measure. Since then, the concept of sending more flows through town has been discussed many times between the USACE and MNDNR—three 2012 interagency meetings (May 30, July 18, and November 8, 2012) and again during development of the State of Minnesota's Draft EIS. MNDNR technical staff suggested that the concept of sending more flows through town during Project operation might provide greater environmental and social benefits than the proposed Project. The non-Federal sponsor evaluated more flow through town in 2012, resulting in a project change that increased the river stage through the protected area from RS 31 to RS 35. Subsequently, the MNDNR screened the concept to see if additional flow through town should be included as an alternative suitable for further evaluation in the EIS. An alternative, whether scoped in the FSDD or not, may subsequently be excluded from analysis in the EIS if it is determined that the alternative would not meet the underlying purpose, would not have significant environmental benefit, or would have similar environmental benefits but substantially less adverse economic, employment or social impacts. If a scoped alternative is excluded from the EIS analysis, it must be discussed briefly and the reasons for its elimination shall be stated (Minnesota Rules 4410.2300).

More Flows Through Town Alternative Description

As currently proposed, during operation, the Project would allow the Red River and residual staged water to flow through town (i.e., protected area, or flood damage reduction area) at a rate of approximately 17,000 cubic feet per second (cfs). This flow is equivalent to River Stage (RS) 35 feet, or about the 10-year flood. MNDNR suggested that allowing river stages through town in excess of RS 35 could potentially reduce environmental and social impacts of the Project. The potential benefits of sending more flows through town would be decreasing the duration that flood water is stored in the staging area and decreasing the frequency of Project operation. Sending more flows through town would still require upstream staging to offset downstream stage impacts and would have the same staging area footprint.

More Flows Through Town Evaluation

MNDNR first evaluated the More Flows Through Town concept to see if it would meet the Project purpose as defined by the Diversion Authority. Second, the alternative was evaluated for significant environmental benefit and substantially less adverse economic, employment or social impacts compared to the proposed project.

In order for this alternative to meet the Project purpose, the existing and proposed levees would need to be as high as possible (i.e., maximum levee height). As explained in the Appendix O (Plan Formulation) of the USACE Supplemental EA, the top elevation of flood barrier alternatives is limited to the highest natural ground available to begin and end the levee.

The Project purpose has been defined as:

1) Qualify substantial portions of the F-M urban area for 100-year flood accreditation by the Federal Emergency Management Agency (FEMA) under the National Flood Insurance Program (NFIP);
2) Reduce flood risk potential associated with a long history of frequent flooding on local streams including the Red River, Sheyenne, Wild Rice (in North Dakota) Maple, Rush and Lower Rush Rivers, passing through or into the F-M urban area; and
3) Reduce flood risk for floods exceeding the 1-percent event (100-year flood or greater), given the importance of the F-M urban area to the region and recent frequencies of potentially catastrophic flood events.

Evaluation in the screening analysis was based on the following information:

- Appendix A-1 (Hydrology) from USACE FFREIS
- Appendix B (In-Town Levees) from the USACE EA
- Final Technical Memo AWD-00002 – Flows Through Flood Damage Reduction Area (Table 11 updated August 25, 2014)
- Diversion Authority RS 35 Decision Document (January 13, 2015)

MNDNR worked with USACE during Draft EIS development to update the Phase 2 levee results to match the most recent models. The results of the updates are in Table 2.1.

Table 2.1. Residual Peak 100-yr Flood Stage, Discharge, and Approximate Existing Frequency Conditions.

Residual 100-yr Flood Stage	Residual 100-yr Peak Discharge (cfs)	Approximate Existing Condition Frequency (yr)
RS30	10,700	4.1
RS31	11,900	4.8
RS32	13,300	5.9
RS33	14,600	7.0
RS34	15,900	8.3
RS35	17,500	10.5
RS36	19,200	13.3
RS37	21,000	17.2

Source: USACE and HMG 2015.

Reasons for Elimination

The Project has three components to the project purpose; in order for the alternative to be considered for full analysis in the EIS, it must meet all three components. Additionally, it must offer significantly less environmental or social impacts.

One of the three project purpose components is to qualify substantial portions of the F-M urban area for 100-year flood FEMA accreditation. FEMA requires a minimum of three feet freeboard to qualify a levee for 100-year flood accreditation. This translates to a maximum levee height at RS 37 feet, which is equivalent to 21,000 cfs, or about the 17-year flood. At that river stage, there would be a small area in the southern portion of the protected area that would still need to implement emergency measures. On the whole, at RS 37, substantial portions of the F-M urban area could quality for FEMA accreditation, so this component of the Project purpose could be met.

The second component of the Project purpose is to reduce flood risk from the North Dakota tributaries. The More Flows Through Town Alternative does provide some flood risk reduction, but it would provide less opportunity to mitigate downstream impacts from tributary flows on the Sheyenne, Maple, Rush, and Lower Rush Rivers. Nevertheless, this component of the Project purpose could be met.

Protection from floods greater than the 100-year flood is the third component of the Project purpose. As explained in the 1/13/15 decision document, “it is expected that the in-town levee segments will meet USACE Risk and Uncertainty requirements for RS 37.” That said, there would be additional flood risks from floods greater than the 100-year event throughout the metro area that inhibit, but do not prevent, this alternative from fully meeting this project component. These additional risks include:

- RS37 would require mitigation for an additional 10 homes inside the protected area;
- RS37 would inundate an additional 4,797 acres (approximately 7.5 square miles) of land within the protected area;
- RS37 would add an additional 9,399 basements below the water surface profile;
- RS37 would inundate an additional 22,597 feet of roadway (approximately 4.3 miles);
- RS37 would have an additional 29,864 feet of levee that would have floodwater against the base of the levee (approximately 5.7 miles); and,
- RS37 would require the modification or relocation of City of Moorhead Sanitary Lift Station #2.

Since the More Flows Through Town Alternative marginally meets the Project purpose, it could be included for full analysis in the EIS provided it has similar environmental benefits but substantially less adverse economic, employment or sociological impacts (Minnesota Rules 4410.2300, subpart G.). Moderate environmental benefits would be realized for fish passage and wetlands (reduced sedimentation occurrences and accumulation). Further reduction in frequency of operation would provide only minor geomorphic benefits. While this alternative would provide incremental environmental benefits, the social benefits are not substantial enough—the staging area footprint is projected to be the same, and mitigation (i.e., buyouts) would still be required. Therefore, it was determined that this alternative offers similar environmental benefits (an incremental benefit) but fails to provide substantially less social impacts. Therefore, the More Flows Through Town Alternative does not present a feasible and prudent alternative.

The analysis of this alternative determines that More Flows Through Town: 1) marginally meets the project purpose; and 2) is not a feasible or practical alternative to the proposed project. Minnesota Rules 4410.2300 subpart G allows for alternatives considered during EIS development to be eliminated from further consideration. Despite the fact that the More Flows Through Town Alternative will not receive full evaluation in the Draft EIS, increasing flows does offer incremental environmental benefits and will be included as a mitigation measure (see Chapter 6—Mitigation and Monitoring). Public comments on the More Flows Through Town screening analysis will be considered during preparation of the Final EIS.

2.2.2 Project Alternatives Analyzed in the EIS

As a result of the screening analysis, three alternatives have been included in this EIS. These include two No Action Alternatives: the Base No Action Alternative and the No Action Alternative (with Emergency Measures), and the Northern Alignment Alternative. The two No Action Alternatives are required to be evaluated by State rules, and therefore, carried forward to the EIS analysis. The NAA would meet the purpose and need for the Project. These three alternatives are discussed in greater detail below.

2.2.2.1 No Action Alternatives

The No Action Alternatives provide the context for the potential environmental and socioeconomic effects that would occur if the Project is not developed. There are two No Action alternatives considered for the Project: 1) Base No Action Alternative; and 2) No Action Alternative (with Emergency Measures). The Base No Action Alternative includes the potential flood risk reduction impact of already completed and currently funded projects such as levee construction and property buyouts and does not include the utilization of emergency measures. The No Action Alternative (with Emergency Measures) is similar to the Base No Action Alternative, but also acknowledges the emergency measures currently being pursued in the project area and assumes that those would continue to be implemented as necessary due to flooding. Emergency measures have lower reliability, higher risk for loss of life than permanent flood risk reduction features and cannot be certified or accredited by the USACE or FEMA, respectively; and so they are being discussed under a second No Action Alternative option.

2.2.2.1.1 Existing Conditions

The FFREIS provided a discussion on the existing infrastructure in the F-M area, including references to flood stage in Fargo and Moorhead. During the preparation of the FFREIS, a panel of experts (Expert Opinion Elicitation Panel (EOEP)) in hydrology and climate change was convened to discuss flooding trends in the Red River basin. Analyses completed for the FFREIS and Supplemental EA (Appendix D, Table 4) were based on the EOEP hydrologic recommendations, which result in significantly higher stages for the 100-year flood than what FEMA has defined in Clay County, Minnesota and Cass County, North Dakota as part of the National Flood Insurance Program (NFIP). This means that the FEMA 100-year hydrology is different than the EOEP hydrology used for modeling in the FFREIS and in this EIS. The following from the FFREIS provides a summary of the EOEP anticipated flood stages, implementation of emergency measures, and general overview of Flood Damage Reduction (FDR) projects.

As summarized in the FFREIS:

> 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. Many places along the line of protection rely on private sandbag levees which begin to be needed at a stage of about 33 feet. Newer developments in the southern part of the F-M urban area have been elevated above the base flood elevation, but city infrastructure (e.g., roads and sewers) 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 significant 2009 flood of record, 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. Private sandbag levees and emergency clay levees constructed by the USACE protected many areas, but the areas closest to the rivers [had significant damage].
>
> 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 100-year flood 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 FEMA 100-year flood stage, but the 500-year flood floodplain south of I-94 extends east almost to 20th Street South. North of I-94, the 500-year flood floodplain generally extends to east of 14th Street. During flood events larger than a 100-year flood, 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. (FFREIS 2011)

2.2.2.1.2 Flood Damage Reduction Projects

Permanent FDR projects are a key component to both the Base No Action Alternative and the No Action Alternative (with Emergency Measures). Since the 1997 flood, the cities of Fargo and Moorhead have implemented flood risk reduction measures, including acquisition of floodplain houses, constructing levees and floodwalls, raising and stabilizing existing levees, installing permanent pump stations and improving storm sewer lift stations and the sanitary sewer system. Both Fargo and Moorhead have lists of potential properties along the Red River and in the floodplain that have been identified for purchase and removal from the floodplain. Fargo also has a flood risk management incentive program that provides for a City cost share of up to 75-percent for improvements made by the individual homeowners to reduce their level of flood risk.

Since the historic 2009 flood on the Red River, both the City of Fargo, North Dakota and City of Moorhead, Minnesota have implemented a number of flood damage reduction measures, including buyouts of flood-prone properties, construction of permanent levees and floodwalls, and improvements to storm water facilities. These measures are on-going. When several adjacent properties have been acquired, levees and/or floodwalls are constructed on the properties with the balance of the property typically converted to open space or public park land. Clay County and Cass County have also identified properties for acquisition, removal and remediation that would result in similar land use as Fargo and Moorhead.

In general, floodwalls are being constructed to an elevation of River Stage (RS) 39.5 feet plus 5.5 feet of freeboard. Earthen levees are designed to have a top of protection elevation of RS 39.5 feet plus four feet of freeboard. The proposed levees and floodwalls tie into natural ground at approximately RS 39.5 feet. RS 39.5 feet equates to approximately the FEMA 100-year flood levels as defined in the preliminary Digital Flood Insurance Rate Maps (DFIRM) for eastern Cass County, North Dakota dated July 31, 2012, which will become effective on January 16, 2015, and the effective DFIRM for Clay County, MN dated April 17, 2012.

FDR projects have been designed for protection at the current, effective FEMA 100-year flood event. Because of the difference between the FEMA hydrology and the EOEP hydrology, some of the FDR projects are at elevations above the EOEP 100-year flood elevation, but do not have sufficient free board and/or tie-in elevations for FEMA accreditation under the EOEP hydrology. This means there could be actual protection, but not accredited protection under the EOEP hydrology. For the purposes of EIS analysis, non-accredited structures are shown as flooded for the Base No Action Alternative.

FDR projects, such as permanent levees and floodwalls, are being constructed for a number of purposes, including:

- Protection of critical infrastructure.
- Reduction of emergency measures that need to be implemented during flood events.
- Protection that can be certified and accredited by FEMA to remove properties from the current, effective FEMA regulatory 100-year flood floodplain. Both FEMA Regions V and VIII have recently indicated they may require the levees and floodwalls to tie into natural ground at approximately RS 39.5 feet plus three feet of freeboard, which may not allow the existing levees and floodwalls to be accredited by FEMA for either hydrology.
- Interim flood protection until construction of the Fargo-Moorhead Diversion Project (i.e., Project) is complete.
- USACE certifiable flood protection for the 100-year flood following construction of the Project.
- Make emergency measures for flood events greater than the 100-year flood following completion of the Project more feasible.

Fargo FDR Projects

Total projected cost for implementing FDR projects (completed, in-progress, and funded for future construction) in the city of Fargo is $187,274,000.

- Table 2.2 provides a summary of completed FDR projects in Fargo and shown on Figures 7 and 8.
- Table 2.3 provides a summary of Fargo FDR projects currently in progress and shown on Figure 9.
- Table 2.4 provides a summary of 2014 Under Design and To Be Constructed FDR Projects.
- Table 2.5 provides a summary of planned FDR projects that are planned for 2015 implementation in Fargo and shown on Figure 10.

Table 2.2. Fargo - Completed FDR Projects.

Project	Location	Levee RG Height (ft)	Permanent Levee Length (ft)
5229-04	Ridgewood Addition	45	2,825
5601	University Drive South	44	3,750
5747-24	Demolition-Oak Grove, South River Rd, and River Drive South	44	2,200
5747-25	Demolition-Southwood	42.5	1,100
5747-26	Demolition - Oak St, North Terrace, Lindenwood, Southwood	44	350
5747-27	Demolition-Sterling Rose Lane, Rose Creek Parkway, River Vili	N/A	N/A
5747-28	Demolition-Mickelson Field, Southwood, 64th Avenue	N/A	N/A
5747-29	Demolition - Harwood, 64th Ave	43.5	665
5902	Mickelson Field	43.5	1,000
5903	Drain 27 (South of 52nd Ave S)	43.5	13,648
5904	Drain 53 (South of 52nd Ave S)	43	11,364
5906	South Acres Addition	44	2,400
5909	4th Street Levee Raise	43	3,000
5944	Meadow Creek	44	5,400
5944-03	Meadow Creek Tree Planting	N/A	N/A
5946-02	North Oaks	43-44	2,000
5949	Timberline Phase I	44	2,500
5949-03	Timberline Phase II	44	1,850

Project	Location	Levee RG Height (ft)	Permanent Levee Length (ft)
5951-02	Rose Creek Storm Sewer Lift Station, Earth Levee & Incidentals	44	550
5958-02	Rose Creek Phase 1	43	1,550
6002-02	FCC/Southwood	43.5	3,200
6024	Lindenwood Park	44	1,900
6030	Lemke Park	44	900
6031	Riverview Place, Oakcreek & Coulees Crossing	44	900
6031	Additional Site - Coulees Crossing Extension	44	500
6032	Various Locations - Drain 27	44	6,450
6042	Ulteig/Fleet Farm Area - Drain 27	44	2,900
6043-02	River Vili - Phase I	43.5	1,850
6058	El Zagal STS LS	N/A	N/A
6172-01	Oakcreek & Harwood Demos	N/A	N/A
6172-02	Oakcreek Demos/Temporary Levee	N/A	N/A
	Total Levee Length		**74,752**

Source: City of Fargo, June 2014

Table 2.3. Fargo – Construction-In-Progress FDR Projects.

Project	Location	Levee RG Height (ft)	Permanent Levee Length (ft)
5958-03	Rose Creek - Phase 2	45	2,050
5902-02	Mickelson Field	44	1,550
6172-03	Home Demos (Harwood, Hackberry, Woodcrest, Oak Grove, Belmont)	Structure Removal	N/A
6234	Drain 53 (South of 64th Ave) & 64th Ave Borrow Pit	44	4,200

Project	Location	Levee RG Height (ft)	Permanent Levee Length (ft)
FM-14-01	4th Street Levee (Misc Encroachments, NSP Gatewells)	43	Existing
FM-14-02	4th Street Levee (Earth Levee Relocation, Floodwall construction)	44	510
FM-14-21	River Vili (Earth Levee, STS Lift Station Relocation)	44	500
HD-14-01	Woodcrest, South River Rd, Copperfield, Rosewood (Home Demos)	Structure Removal	N/A
HD-14-11	Hackberry & River Drive (Home Demos)	Structure Removal	N/A
HD-14-21	River Drive (Home Demos)	Structure Removal	N/A
	Total Levee Length		**8,810**

Source: City of Fargo, June 2014

Table 2.4. Fargo - 2014 Under Design and To Be Constructed FDR Projects.

Project	Location	Levee RG Height (ft)	Permanent Levee Length (ft)
6260	4th Street Pump Station and 2nd Street S. Wall (Main Ave. to 4th St. S.) & STS #18 & #19 Reconstruction – Phase 1	45	430
FM-14-11	Coulees Crossing, Oakcreek, Copperfield (Earth Levee Construction)	44	2,000
FM-14-31	2nd Street N (NP Ave to 6th Ave N) - Floodwall, Street Relocation, and Pump Station	45	2,000
FM-14-41	Harwood, Hackberry, River Dr (Earth Levee, STS Lift Station Construction)	44	3,600
FM-14-51	El Zagal Bowl (Earth Levee, Floodwall, Utility Relocations, Property Buyouts)	44	3,200
FM-14-61	Drain 27 (40th Ave to I-29) - Earth Levee, Floodwall	44	1,000

Project	Location	Levee RG Height (ft)	Permanent Levee Length (ft)
FM-14-71	Drain 27 (I-29 to 42nd St) - Earth Levee, Floodwall	44	1,900
HD-14-31	Prairie Rose, Rosewood	Structure Removal	N/A
HD-14-41	Rosewood, Oakcreek, Hackberry, Southwood	Structure Removal	N/A
	Total Levee Length		**11,230**

Source: City of Fargo, June 2014

Table 2.5. Fargo - Planned FDR Projects for 2015.

Project	Location	Levee RG Height (ft)	Proposed Levee Length (ft)
6260	2nd Street S (Main Ave to 4th St. S) & STS #18 & #19 Reconstruction – Phase 2	44	900
FM-14-03	4th Street Levee Phase 3	44	900
FM-14-12	Oakcreek & Copperfield – Phase 2	44	1,700
FM-14-32	2nd Street N (NP Ave to 6th Ave N)	45	2,000
FM-14-52	El Zagal Bowl – Phase 2	44	700
FM-14-62	Drain 27 (40th Ave to I-29) – Phase 2	44	3,700
FM-14-72	Drain 27 (I-29 to 42nd St) – Phase 2	44	650
	Total Levee Length (ft)		**10,550**

Source: City of Fargo, June 2014

Moorhead FDR Projects

Total projected cost for implementing FDR projects (completed, in-progress, and funded for future construction) in the city of Moorhead, including the town of Oakport, is $137,281,000.

- Table 2.6 provides a summary of completed FDR projects in Moorhead, which are shown on Figure 11.
- Table 2.7 provides a summary of Moorhead FDR projects currently in progress and shown on Figure 11.
- Table 2.8 provides a summary of planned FDR projects that are funded for future implementation in Moorhead and shown on Figure 11.

Table 2.6. Moorhead – Completed FDR Projects.

Project	Project Name	Levee Height (ft)	Permanent Levee, Floodwall, and/or Road Raise Length (ft)
09-A13-02A Phase 1	27th Ave N Levee - Phase 1	44	450
09-A13-02A Phase 1	Voll Park Contingency Levee	44	415
09-A13-02A Phase 2	27th Ave N Levee - Phase 2	44	1,430
09-A13-02B Phase 1	River Haven Road: 46th - 50th Ave S (Contingency Levee)	44	2,475
09-A13-02B Phase 2	River Haven Road: 40th - 43rd Ave S Road Raise & Floodwall	44/45	1,970
09-A13-02C	Horn Park Levee	44	2,380
09-A13-02D	Woodlawn Park South Levee	44	375
09-A13-02D	Woodlawn Park Levee & Road Raise	44	1,350
09-A13-02E	Caddy/18th Ave N Area Levee: 900 Block of 18th Ave Circle N	44	390
09-A13-02E	Caddy/18th Ave N Area Levee: 18th Ave N & Cart Path (Contingency Levee)	44	1,990
09-A13-02G	Hjemkomst Area: Hjemkomst & Parkview Terrace Levees & 1st Ave N Road Closure Structure	44/45	1,305
09-A13-02I Phase 1	Horn Park Floodwall & Road Closure Structure	45	380
09-A13-02I Phase 2	Brookdale Levee: 4th St S & Rivershore Dr Levee & 22nd Ave S road raise	44	3,470
09-A5-01H&I	I-94 ROW Floodwall & Levee	44/45	237
09-A5-02B Phase 1	Public Works Yard Levee: 700 15th Ave N	44	790
09-A5-02B Phase 4	The Saddle - Phase 1	44	280
09-A5-02B Phase 4	2900 Block of Rivershore Dr Levee	44	180
09-A5-02B Phase 4	Davy Park Levee: 1st Ave & 8th St N	44	600
09-A5-02B Phase 4	Public Housing High Rise - Middle Levee	44	380
09-A5-02B Phase 4	7th St Levee	44	360
09-A5-02B Phase 4	Bridgeview Levee - Phase 1	44	460
09-A5-02B Phase 4	15th Ave North/St Francis De Sales Levee	44	760
09-A6-02A	Woodlawn Lift Station	43.5	280
11-13-02	Bluestem Levee	44	3,700
11-13-03	Rivers Edge Levee	44	1,000
11-A13-02B	Rivershore Drive Floodwall & Road Closure Structure	44.5	204
11-A13-02B	Public Housing High Rise - South Levee	44	200
11-A13-02B	Public Housing High Rise - North Levee	44	230

Project	Project Name	Levee Height (ft)	Permanent Levee, Floodwall, and/or Road Raise Length (ft)
11-A13-02D	River Haven Road Levee: 43rd - 46th Ave S	44	1,600
11-A13-02E	River Oak Circle	44	450
11-A13-02I	43rd Ave N Road Raise	44	1,400
11-A13-03A	Project A Levee	44	4,830
11-A13-03B	Project B	44/45	1,800
11-A13-03C Phase 1	Project C	44	650
11-A13-03C Phase 1	Project C	44	1,200
11-A13-03C Phase 2	Project C - Phase 2	45	575
11-A13-03F1	Project F1	44	3,560

Source: City Moorhead, June 2014

Table 2.7. Moorhead – In-Progress FDR Projects.

Project	Project Name	Levee Height (ft)	Permanent Levee, Floodwall, and/or Road Raise Length (ft)
11-A13-02H	50th Ave S Levee - South Levee	44	8,300
11-A13-02H	50th Ave S Levee - NW & NE Levee	44	4,100

Source: City Moorhead, June 2014

Table 2.8. Moorhead – Funded Future FDR Projects (Proposed).

Project	Project Name	Levee Height (ft)	Permanent Levee, Floodwall, and/or Road Raise Length (ft)
TBD	Tessa Terrace	44	930
TBD	The Saddle - Phase 2	44	200
11-A13-03D&E	Project D & E	44	3,137
TBD	Elm Street: 600 block	44/45	270
TBD	4th St Levee: 3rd to 5th Ave S	44	481
TBD	2nd Ave S Road Closure	44/45	206
11-A13-05	7th St N Cul-de-sac Road Raise	44	218
11-A13-05	15th Ave Road Raise	44	50
N/A	Crystal Creek Levee	42.5	3,079
N/A	Oakport Protection - Phase 3A - Brentwood Levee north	44	1,200
N/A	Oakport Protection - Phase 3B - Brentwood Levee, west, east & south	44	7,000
N/A	Oakport Protection - Phase 3C - Wall St & Oakport St road raises	44	4,100
N/A	Oakport Protection - Phase 1A -	44	5,000

Project	Project Name	Levee Height (ft)	Permanent Levee, Floodwall, and/or Road Raise Length (ft)
	South Levee (west of coulee)		
N/A	Oakport Protection - Phase 1B - East Levee (west side of coulee)	44	5,400
N/A	Oakport Projection - Phase 2 - 70th Ave N/CR 93 Road Raise	44	4,500
N/A	Oakport Protection Phase 4 - Broadway St NW road raise/levee*	44	8,900

Source: City of Moorhead, June 2014

2.2.2.1.3 Base No Action Alternative

The Base No Action Alternative includes the potential flood risk reduction impact of already completed and currently funded permanent projects such as levee construction (i.e., structural measures) and property buyouts (i.e., non-structural measures). The FDR projects presented in the tables above for Fargo and Moorhead are the specific projects included in this alternative. This alternative does not include emergency measures currently pursued in the project area as necessary due to flooding, and therefore, the Base No Action Alternative would have flooding where the water level exceeds the tie-in of levees to natural ground.

Figure 12 illustrates the current areas of flooding in the F-M area during the 100-year flood. The 100-year flood causes approximately 170,000 acres of inundation. The extent of flooding illustrated on the figure represents currently constructed FDR projects as well as currently funded permanent projects. As shown on Figure 12, flooding during the 100-year flood would flow around the levees where the water level exceeds the tie-in elevations to natural ground.

2.2.2.1.4 No Action Alternative (With Emergency Measures)

The No Action Alternative (with Emergency Measures) includes the potential flood risk reduction impact of already completed and currently funded FDR projects presented in the Tables 2.2 through 2.8 for Fargo and Moorhead. This alternative also assumes that emergency measures similar to those that have been historically implemented in the project area would continue to be implemented as necessary due to flooding.

Winter snowfall and precipitation can be monitored to predict potential levels of spring runoff that influence flooding and flood levels. Flood crest elevations are predicted in the F-M area by the National Weather Service in order to provide as much time as possible to implement emergency measures. The higher the flood crest elevation, the more time and effort it would take to construct emergency measures. Both Fargo and Moorhead, as well as Cass County have flood emergency plans in place outlining the implementation steps, emergency measures, and the locations for each of the measures. These emergency measures may include temporarily raising permanent levees, constructing temporary levees and other temporary flood barriers in various areas, and sandbagging.

Emergency measures are intended to temporarily protect specific areas from flooding that do not have permanent FDR projects in place or enhance existing FDR projects, where there are gaps in levee protection between each of the individual FDR projects, for example. Where gaps in FDR project protection exist, a temporary levee may be constructed to tie into existing levees to reduce flood risk from occurring behind the levee or overtopping an existing levee. Implementation of emergency measures could result in upstream stage increases larger than those under full levee protection for the Base No Action Alternative. Figure 13 shows the extent of flooding in the project area under the No Action Alternative (with Emergency Measures). This alternative would reduce flood risk in some areas not protected under the Base No Action Alternative, while increasing flooding in other areas upstream, as shown on Figure 13.

The locations of each type of emergency measure are mapped with instructions for implementation at various times and stages of flooding. Emergency measures in the F-M urban area require significant financial and human resources. During past large flood events, such as the 2009 flood, 80 miles of temporary emergency levees were constructed, requiring more than three million sandbags and thousands of volunteers.

Several factors have made the probability of having consistently successful emergency efforts in the future low, especially for flooding events larger than the 100-year flood. These factors include variable and extreme temperatures and weather conditions during March and April when flooding typically occurs. These conditions also complicate flood crest predictions and emergency measures implementation. Construction of emergency measures typically occurs on frozen ground using frozen materials, which adds to greater difficulty and risk to implement. Additionally, due to successful emergency measures in the past, there is a perceived sense of security that may not reflect the true flood risk in the area. This has led to people staying to fight the flood rather than evacuate, which puts a greater number of people at risk if the emergency measures suddenly fail, especially during the 100-year flood.

2.2.2.2 Northern Alignment Alternative

The following provides details on the NAA that differ from the Project. Components of the NAA and the Project that are the same should be reviewed in the description for the Project. From upstream to downstream, the NAA includes a staging area, including the OHB ring levee, dam, Red River and Wild Rice River hydraulic control structures, connecting channel, diversion inlet control structure, diversion channel, Maple River and Sheyenne River aqueducts, Lower Rush River and Rush River spillways, and the diversion channel inlets, control structures, and hydraulic structures. Direct land impact from the NAA components would be similar in scale to the Project. NAA operation would be similar; therefore the depth and duration of flooding of the current 100-year flood within the project area would increase. It is estimated that 15,000 acres of land that does not currently receive floodwaters would be newly inundated within and beyond the boundaries of the staging area. The NAA also includes floodwalls and in-town levees, non-structural features, and recreation features.

2.2.2.2.1 Dam

The NAA dam would be similar to the features described for the Project.

2.2.2.2.2 Red River and Wild Rice River Hydraulic Structures

A gated control structure would be constructed adjacent to the Red River in Kurtz Township (Clay County), Minnesota. A similar control structure would be constructed adjacent to the Wild Rice River in Stanley Township, Cass County, North Dakota. The structures would be constructed adjacent to the existing channels in order to keep the sites dry during construction. The remaining features of the Red River and Wild Rice River hydraulic control structures would be the same as those described for the Project.

2.2.2.2.3 Connecting Channel

The connecting channel would be designed the same as described for the Project.

2.2.2.2.4 Diversion Inlet Control Structure

The diversion inlet control structure for the NAA would be designed the same as described for the Project.

2.2.2.2.5 Staging Area

In order to nearly eliminate downstream impacts, approximately 150,000 acre-feet of storage is required upstream of the dam and diversion channel inlet. The Red River and Wild Rice River control structures would be operated to raise water surface elevations to approximately 919.3 feet at the diversion inlet for all events up to a 500-year flood. The remaining features of the staging area would be the same as those described for the Project.

2.2.2.2.6 Diversion Channel

The diversion channel features for the NAA are the same as those described for the Project.

2.2.2.2.7 Maple River and Sheyenne River Aqueducts

The Maple River and Sheyenne River aqueducts for the NAA are the same as those described for the Project.

2.2.2.2.8 Lower Rush River and Rush River Spillways

The Lower Rush River and Rush River spillways for the NAA are the same as those described for the Project.

2.2.2.2.9 Inlets, Ditches, and Smaller Hydraulic Structures

The inlets, ditches and smaller hydraulic structures for the NAA are the same as those described for the Project.

2.2.2.2.10 Oxbow/Hickson/Bakke Levee

The OHB ring levee for the NAA is the same as described for the Project.

2.2.2.2.11 Comstock ring levee

The community of Comstock, Minnesota is located near the NAA inundation area; however, the community would not be impacted directly so a ring levee is not included as part of the NAA. The lagoons for the community are located in the NAA inundation area and may require mitigation.

2.2.2.2.12 NAA Operation

Operation of the NAA would be similar to the Project with the exception of the upstream staging elevation. A maximum stage of 35.0 feet would be maintained at the Fargo gage until the upstream staging elevation reaches 919.3, which is anticipated to occur with the 100-year flood event. The remaining NAA operational details would be the same as those described for the Project.

2.2.2.2.13 Floodwalls and In-Town Levees

The floodwalls and in-town levees for the NAA would the same as those described for the Project.

2.2.2.2.14 Non-structural Features

The non-structural features associated with the NAA are the same as those described for the Project.

2.2.2.2.15 Recreation Features

The conceptual recreation plan for the NAA is the same as described for the Project.

3.0 Affected Environment and Environmental Consequences

3.1 PROJECT HYDROLOGY AND HYDRAULICS

Due to the nature of the Project, hydrologic and hydraulic (H and H) analysis is a key component for evaluation as it forms a basis for Project design. Hydrology refers to the rainfall and resulting runoff as it applies to flood events. It is used to estimate flood flow rates, typically through stream gage analysis, rainfall-runoff models, or a combination of the two. Hydraulics is the study of water flow. In floodplain management, hydraulics refers to determination of the flood depth and area flooded. Hydraulics also encompasses the flow characteristics around and through hydraulic structures such as bridges, culverts, and weirs (IDNR 2002).

This section discusses the hydrologic and hydraulic analyses completed to date for the Project. The United States' Army Corps of Engineers (USACE), along with the Diversion Authority and its consultants have completed comprehensive H and H modeling.

3.1.1 Affected Environment

The cities of Fargo and Moorhead are located along the Red River (Red River) that flows north, discharging into Lake Winnipeg in Manitoba, Canada. Figure 1 shows the location and general layout of the (Fargo-Moorhead) F-M urban area. There are six primary rivers and tributaries that connect in the vicinity of the F-M urban area. This includes the Wild Rice River, which flows into the Red River upstream of the F-M urban area. Flowing into the Sheyenne River on the west side of the project area, the Maple, Lower Rush, and Rush Rivers connect with each other downstream of the F-M urban area, where the Sheyenne River eventually flows into the Red River (Figure 1).

The F-M area has a long history of flooding due to the unique hydrology of the area. The geographic characteristics of the area and the large watershed draining through the Red River contribute to the higher flood risk for the F-M area. A major portion of the upper watershed of the Red River lies within the former bed of Glacial Lake Agassiz. As a result, the watershed and rivers have little slope with shallow meandering channels. As the Red River flows north, timing of the spring melt has an impact on flooding as the upstream watersheds start melting earlier in the spring and flow downstream into portions of the river that can remain frozen later into the season. This causes water to back up a long distance upstream due to the shallow slope of the Red River. Three large rivers, the Red River, the Wild Rice River (ND), and the Sheyenne River, converge in the F-M area and contribute to extensive flooding. Contributing to this flooding are the three tributaries of the Sheyenne River, the Maple, Rush and Lower Rush Rivers, which converge with the Sheyenne River immediately west of Fargo. Flood flows and associated stages along these rivers through the F-M area would be affected by the Project.

The Red River has exceeded flood stage approximately half of the years during the past century. The recent past has seen a higher frequency of large flood events with 2009 being a record setting year with a flood stage of 40.8 feet at the United States' Geological Survey (USGS) Fargo stream gage.

3.1.1.1 Hydrologic and Hydraulic Evaluation for Project Design

Numerous studies, modeling, and other analyses have been completed that examine hydrology and hydraulics of the Project. The Diversion Authority and their consultant team, along with the USACE, have developed and refined H and H models for the Project for over five years.

The hydrologic record of the Red River at Fargo shows a trend of increasing magnitude and frequency of flooding in recent decades. During preparation of the Final Feasibility Report and Environmental Impact Statement (FFREIS), a panel of experts (Expert Opinion Elicitation Panel (EOEP)) in hydrology and climate change was convened to elicit opinions on how to appropriately reflect this trend. The panel concluded that the hydrologic record showed a "dry" period in the early decades of the 20th century and a "wet" period in later years continuing to the present and recommended developing revised flow frequency curves separately for the dry and wet periods. The analyses described in the FFREIS were based upon the EOEP's hydrologic recommendations, which result in significantly higher stages for the 100-year flood (1-percent chance flood) than what Federal Emergency Management Agency (FEMA) has adopted in Minnesota and is proposing to use in North Dakota for the National Flood Insurance Program. The Minnesota Department of Natural Resources (MNDNR) concurs with this approach and will utilize the recommendations of the EOEP in this Environmental Impact Statement (EIS).

Table 3.1 below shows the results of the studies in comparison to past records and FEMA information. This section provides a brief summary and adequacy review of the H and H modeling analyses as currently completed for the Project. It does not constitute a detailed review or quality assurance of the H and H models. As the models are very complex, it is not practical to conduct an independent review of all associated elements. A discussion on review of information provided by the H and H models and other methods of analysis is also included.

Table 3.1 Summary of Red River Peak Flow and Stage data at the USGS Gage

Event	Discharge (cubic feet per second (cfs)) at USGS Gage at Fargo, ND	Stage (feet (ft)) at USGS Gage at Fargo, ND*
10-year FEMA	10,300	29.5
10-year USACE EOEP (Wet)	17,000	35.0
50-year FEMA	22,300	36.6
50-year USACE EOEP (Wet)	29,300	40.4
100-year FEMA	29,300	39.3
100-year USACE EOEP (Wet)	34,700	42.1
500-year FEMA	50,000	43.5
500-year USACE EOEP (Wet)	61,700	46.3

***** Stages are dependent: 1) FEMA data are from the Clay County Flood Insurance Study, April 17, 2012; 2) USACE stages are from the current existing-condition-with-full-protection unsteady Hydrologic Engineering Center River Analysis System (HEC-RAS) model – Phase 7.0 Environmental Assessemnt (EA) results (2013); 3) Flood stage is 18 feet when minor flooding begins (National Weather Service).

Table 3.2 Summary of Historic Flood Events in the F-M Urban Area

Event	Discharge (cfs) at USGS Gage at Fargo, ND	Stage (ft) at USGS Gage at Fargo, ND
1997 Historic	28,000	39.7
2006 Historic	19,900	37.1
2009 Historic	29,500	40.8
2010 Historic	21,200	37.0
2011 Historic	27,200	38.8

Source: USGS recorded data

The hydrologic analyses also made use of watershed-wide gage data and detailed Hydrologic Engineering Center Hydrologic Modeling System (HEC-HMS) models that were created for each of the contributing watersheds. These models include all of the major rivers and local drains that are tributaries to the Red River starting from the upper end at Lake Traverse, to the city of Drayton, North Dakota, at the downstream end.

The hydraulic analysis was a HEC-RAS unsteady flow model calibrated to the 2009 Flood, and verified by comparing the results to the 1997, 2006, and 2010 events using discharge and stage hydrographs and high water marks. The models were built by a team of consultants and USACE staff to allow for continual checks and balances during model development and refinement.

The models are subjected to continual refinement as additional information is obtained. For example, the domain of the HEC-RAS model was extended downstream after initial results suggested more significant adverse downstream impacts that could not be fully defined from a diversion than initially anticipated. The latest updates, referred to as the Phase 7 model updates, reflect the alignment alternative selected based on the Value Engineering Option 13 A (HMG, 2012) (PFSAA Report) and include gates at the inlet control structures to the diversion channel as well as in-town protection to the 35-foot stage.

The Document Summary Memorandum which is included in Appendix E (Wenck, 2014) includes a summary of all the updates that have been done to the models since the Phase 4 updates, which is the earliest published modeling results. Appendix B of the Project Study Phase 4 Report (HMG, 2011) includes detailed descriptions of the model development at Phase 4 including changes made to incorporate floodplain storage, upstream staging, and downstream impacts using the unsteady state HEC-RAS models. A list of the current documents that were reviewed to evaluate the hydrology and hydraulics of the Project are provided in Appendix E (Wenck, 2014).

Along with the above summary of modeling completed, the following are the considerations regarding the adequacy of H and H modeling as it relates to the EIS and the appropriate level of review of available data:

- The level of detail and extent of the models completed for the Project.
- The types of models used are appropriate for the purpose of the analysis and use of results generated.

- The use of area specific H and H models by Diversion Authority and local watershed districts for various localized analysis projects, indicates independent review of the models.
- The calibration of the model to different datasets and different runoff conditions, suggests that the level of detail and underlying assumptions are adequate and appropriate.

3.1.1.1.1 Accuracy of Modeling Results and Available Information

This analysis is dependent on available information provided by others such as the Diversion Authority, USACE, and Red River Basin Commission (RRBC). The first step of the Quality Assurance/Quality Control (QA/QC) process begins with the Diversion Authority or USACE as they are the source of the technical data and information. As this information is being provided by professional engineers and scientists, it is reasonable to assume that the information that is transmitted and available has gone through a Quality Assurance (QA)/Quality Control (QC) process specific to the Project and meets the standard of care appropriate for this Project. The USACE QC guidelines for civil projects along with the project specific QC guide are included in Appendix E (Wenck, 2014).

The following list of documents found in the FFREIS (located at http://www.fmdiversion.com/eis.php) lists the QA/QC steps that have been followed during the development and refinement of the model:

- Appendix B, Section B.3.0
- Attachment 5 (Consultant's Report), Appendix B (Section B6.0 and Exhibit H).
- Attachment 5 (Consultant's Report), Appendix C (Section 2.15 and Exhibit 5).

The model is based on a number of modeling decisions and assumptions; these assumptions can have a measurable impact on the results. To better understand the key assumptions as they relate to the various scenarios being considered (i.e., the Project, Base No Action Alternative, No Action Alternative (with Emergency Measures), and Northern Alignment Alternative), an additional layer of review of the model was completed as part of the this EIS process. The focus of this review is on the Red River HEC-RAS unsteady flow model(s). This model extends from Abercrombie, North Dakota to Grand Forks, North Dakota and includes the main stem, major and minor tributaries, lateral inflow, and hundreds of interconnected storage areas. This complex model was developed, calibrated, and refined over a period of several years.

An overall review of the model structure was completed for components that define the Project and two No Action alternatives. Only the portion of the model in the immediate vicinity of the F-M urban area was reviewed. A detailed examination of the HEC-RAS model was not completed (e.g., checking specific cross sections or the stage-volume curves for individual storage areas).

Overall Model Review

The model output was compared against a spreadsheet provided by Houston-Moore Group, the design consultant for the Diversion Authority – “MNEIS HEC-RAS Profiles_201-40307” and the plotted water surface profiles. An exact match was found that indicated the tabulated results were generated by the provided models.

Due to the complexity and magnitude of the model, selected data and locations were verified rather than verifying the entire model. A cursory review of selected boundary conditions (inflow hydrographs) was completed and no issues were identified. Several stream confluences were checked to verify the computed downstream flows were found to be reasonably consistent with the flows upstream of the confluence.

While reviewing the overall model structure, numerous cross sections and computed water surface profiles were plotted. No potential coding errors with the model setup or results were identified.

Floodplain Modeling Using Storage Areas

The Red River HEC-RAS model makes extensive use of lateral structures. This model component in large part defines how the various versions of this model represent the Project and the No Action Alternatives.

Along the rivers and smaller waterways, the HEC-RAS cross sections reflect the main flow path of the channel and immediate overbank area. The connection between the channel and the broader floodplain is generally defined in this Red River HEC-RAS model by lateral structures. Lateral structures are typically represented by a combination of weirs and culverts. Placement of the lateral structures is a modeling decision; typically they are placed on top of roads or along the ground near the extent of the assumed effective flow area. While the top elevation of a lateral structure in HEC-RAS is defined by a feature called a weir/embankment, it does not necessarily mean the actual feature on the landscape is a road, levee, or floodwall; sometimes the weir/embankment simply defines the highest controlling ground along that reach of the river.

If, at a given point in time during a simulation, the computed river stage at a given cross section is higher than the associated lateral structure's weir/embankment, flow is computed across that lateral structure into the adjacent storage area (assuming the water surface elevation in that storage area is also lower than the level in the river). Once the flood peak has passed, water can drain back into the river across that same lateral structure. Flow between and/or among the adjacent storage areas is also controlled by weirs and/or culverts in a similar manner. This use of channels, lateral structures, and storage areas provides a reasonably realistic depiction of the very complex flow dynamics of the Red River and its broad floodplain. The model should accurately account for a given volume of water leaving the channel and entering an adjacent storage area; that volume of water may then traverse several more storage areas before re-entering the river many miles downstream.

These lateral structures were used along the entire reach of the Red and Sheyenne Rivers as well as the smaller waterways within the F-M urban area for the No Action Alternative model runs. Two No Action Alternative models were developed for this EIS: the Base No Action Alternative and the No Action Alternative (with Emergency Measures), which incorporate the actual height of existing and planned flood control measures, providing for an improved estimate of flood inundation areas and depths for the no action alternatives. The Base No Action Alternative includes existing and planned (currently funded) levees in the city of Fargo and the city of Moorhead. The gaps in the levees are left open and are modeled as lateral structures to account for flow passing between the levee segments during larger flood events. The No Action (with Emergency Measures) alternative includes the existing and planned (currently funded) levees, along with emergency measures that follow the 2009 flood protection filling the gaps between the permanent levees.

Project HEC-RAS Model Review

The key elements of the Project were incorporated into the HEC-RAS model, including the control structures on the Red River and Wild Rice River, the diversion channel and its inlet control structure, the aqueducts on the Sheyenne and Maple Rivers, and the connections with the North Dakota tributaries.

The three control structures have operable features, but designs for the control structures have not been finalized, which would better define how the three control structures would operate over a wide range of possible flood scenarios. For this modeling exercise, the operation appears to match the general description of how the Project would function.

Distributed Upstream Storage Alternative HEC-RAS Model Review

The Distributed Storage Alternative (DSA) is a combination of distributed Red River basin storage sites upstream of Halstad, Minnesota, and an in-town levee plan for flood protection of the F-M urban area. The distributed storage component of the DSA relies on the recent Halstad Upstream Retention Study (HUR) completed by the Red River Basin Commission in December 2013. The HUR identified 96 specific retention sites throughout the basin to achieve a 20-percent flow reduction on the Red River. The in-town levee component of the DSA relies on a maximum levee protection plan that was developed by the USACE.

The HUR study made extensive use of the existing HEC-HMS hydrologic models for the major river tributaries and the HEC-RAS unsteady flow model for the Red River. Further refinements were made to the models – methodology documented in the RRBC's final report.

Northern Aligment Alternative HEC-RAS Model Review

A separate model – based on the Project model – was developed for the Northern Alignment Alternative. The Red River control structure and tieback embankment were moved downstream in the model approximately 1.5 miles. The associated connecting channel and its control structure were also added to this model. As with the Project model, the top elevation of the lateral structures along the Red River are based on a 44 foot gage height water surface profile.

Accuracy Assessment

Based on the USACE QA/QC procedure used for development and analysis of information for the Project, there is a reasonable level of confidence that the information included in this EIS is valid and accurate. Overall, the extent and completeness of the H and H information available and provided for the Project is significant. Project elements have changed since some of the reports and information were developed and have continued to change during the environmental review process, creating the need to review the data for relevancy and apply the relevant information to the current Project design or to answer questions that come up during environmental review. Appropriate QA/QC procedures are followed and documented as new data and information is generated to further ensure data quality as the Project design changes or is further refined.

Therefore, it is reasonable to conclude that the H and H models developed for the Project are adequate and appropriate to evaluate the Project. It is important to note this assessment is based on a general, high-level review of the HEC-RAS models and their boundary conditions, along with review of available reports about the Project.

3.1.2 Environmental Consequences

The Project would affect flood flows and river stages on the Red River and its tributaries throughout the F-M area. Table 3.3 provides a summary of the overall H and H impacts in the F-M area associated with the Project, Base No Action Alternative, No Action Alternative (with Emergency Measures), and Northern Alternative Alignment (NAA). Detailed discussions of H and H impacts from Project operation, the Base No Action Alternative, the No Action Alternative (with Emergency Measures), and NAA are provide below.

Table 3.3 Summary of Hydrologic and Hydraulic Impacts in the Project Area

Alternative	Hydrologic and Hydraulic Impact
Proposed Project	The Project diverts peak flow around the F-M urban area causing hydraulic impacts along the river reaches in the project area. The main hydraulic impacts are: 1) the reduction of flood stage through the main stem of the Red River, 2) an increase in the depth and extent of flooding immediately upstream of the tieback embankment in the inundation area, 3) a diversion of high flows from the Sheyenne and Maple Rivers, and 4) rerouted lower portions of the Rush and Lower Rush Rivers.
Base No Action Alternative	The Base No Action Alternative has minor impact on hydrology or hydraulics in the project area. The levees alone do not provide protection from flooding during low frequency flood events.
No Action Alternative (with Emergency Measures)	The No Action Alternative (with Emergency Measures) incorporates emergency measures to fill the gaps between the levees in order to protect flooding during low frequency events. There are hydraulic impacts that cause an increase in flood extents immediately upstream of the F-M urban area from these measures. This upstream staging reduces peak flow rates through the F-M urban area.
Northern Alignment Alternative	In general, the NAA results in similar impacts as those summarized above for the Project. These H&H impacts would occur in some of the same areas as the Project, but to different degrees. Flood elevations, depth, and duration would differ with the NAA compared to the Project depending on a particular location.

3.1.2.1 Proposed Project

Operation of the Project would occur when it becomes known that a stage of 35.0 feet would be exceeded at the USGS gage in Fargo (the Fargo gage). At this stage, the flow through Fargo would be approximately 17,000 cfs. A flow of 17,000 cfs at the Fargo gage is approximately a 10-year flood event (10-percent chance flood). Operation begins by partially closing the gates at the Red River and Wild Rice River hydraulic control structures. Once the gates are partially closed, water would begin to inundate the area upstream of the tieback embankment. A maximum stage of 35.0 feet would be maintained at the Fargo gage until the inundation area elevation reaches 922.2 North American Vertical Datum 1988 (NAVD 88), at which point the Red and Wild Rice River control structures would be opened as necessary to maintain a staged elevation of 922.2 while not exceeding a stage of 40.0 feet at the Fargo gage. Once a stage of 40.0 feet is achieved at the Fargo gage, a stage of 40.0 feet would be maintained by first allowing more flow into the diversion channel through the diversion inlet gates and eventually allowing flow to exit the inundation area over the overflow embankment (elevation 923.0) until the staged water surface rises to an elevation that provides a minimum acceptable height of freeboard for the tieback embankment. If the staged water surface elevation is forecasted to reach the point of minimum acceptable freeboard, an evacuation order would be issued for the F-M urban area. Once the inundation area elevation reaches the point of minimum acceptable freeboard, the Red and Wild Rice River control structures would be opened further to maintain the minimum freeboard and stages would rise above 40.0 feet at the Fargo gage.

3.1.2.1.1 Diversion Channel

The main focus of the Project, as mentioned previously, is reduction of flood risk potential for the F-M urban area. This would be accomplished by diverting a major portion of the peak flow rates during low frequency events through the F-M urban area along the main stem of the Red River and its tributaries through a diversion channel that bypasses the F-M urban area. The connecting and diversion channels intersect with the Wild Rice, Sheyenne, Maple, Lower Rush, and Rush Rivers, subsequently re-connecting with the Red River downstream of the F-M urban area. The Project would cause a hydraulic impact of flood stage reduction along the main stem of the Red River through the F-M urban area. This hydraulic impact would result in reduced flood risk for the F-M urban area downstream of the tieback embankment.

The diversion channel changes the way the Sheyenne, Maple, Lower Rush, and Rush Rivers connect with the Red River. Project features maintain channel forming flows through the F-M urban area for the Sheyenne and Maple River channels, but divert the entire flow from the Lower Rush and Rush Rivers into the diversion channel and eventually flow into the Red River near Georgetown, Minnesota. This would change the system dynamics (e.g., geomorphology, runoff, base flows, peak flows) of the abandoned channels for the Lower Rush and Rush Rivers. The abandoned channel areas east of the diversion channel are anticipated to convert to a more wetland type land cover, as discussed in Section 3.4.

Flow controls for the Sheyenne and Maple River connections with the diversion channel allow bank-full flows to continue along the existing channel reaches. The Project would divert a portion of the excess flow rates in the Sheyenne and Maple Rivers to the diversion channel. This would change the hydrology to those river reaches between the diversion channel and the Red River, such as the Sheyenne River reach east of the diversion channel. This reach would behave similarly to a low flow stream fed by flows up to the bank-full flow from the upper watershed and local runoff from areas in Horace and West Fargo, for example. The risk of sedimentation in the streambed and potential impacts to geomorphology are further discussed in Section 3.3 –

Stream Stability. Lack of higher peak flow rates can have an impact on geomorphology and land cover.

3.1.2.1.2 Staging Area

The staging area provides approximately 150,000 acre-feet of required water storage. The staging area is the significant change that occurred during the Phase 4 modeling updates and revisions that were required to mitigate downstream impacts from the Project. Further details on this analysis are available in Section 3.3 of the Phase 4 General Report, dated April 2011. Unsteady state modeling showed that water storage is required to mitigate the adverse impacts that would occur along the Red River, downstream of the project area. As shown in Figure 3, the change in flood extents from existing conditions in the staging area is significant. Project operation would cause the depth and extent of flooding to increase and cause flooding in currently non-flooded areas. Table 3.4 shows the flooding duration from existing conditions to Project operation conditions for the 10-, 25-, and 100-year events for select upstream, center, and downstream locations of the staging area for reference (see Illustration 3.1 below). Example flood hydrograph and flood elevation data (Graph 3-1) that were used to determine the flood durations are shown in Table 3.4. These data were obtained from the USACE Phase 7.0 HEC-RAS unsteady flood models.

Graph 3.1 Flood Hydrograph and Flood Elevation Data

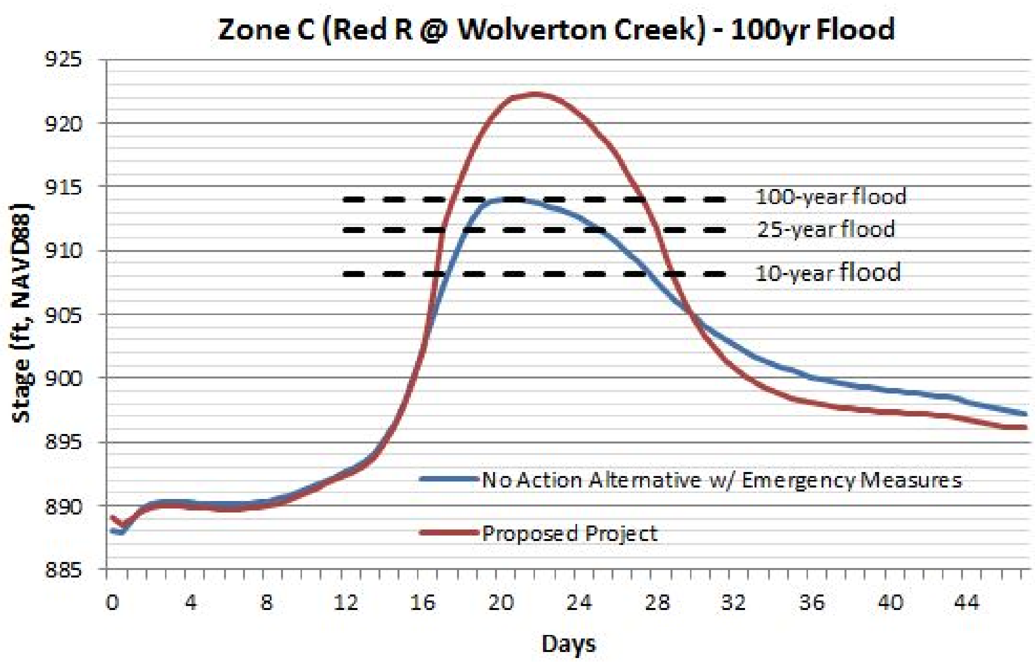
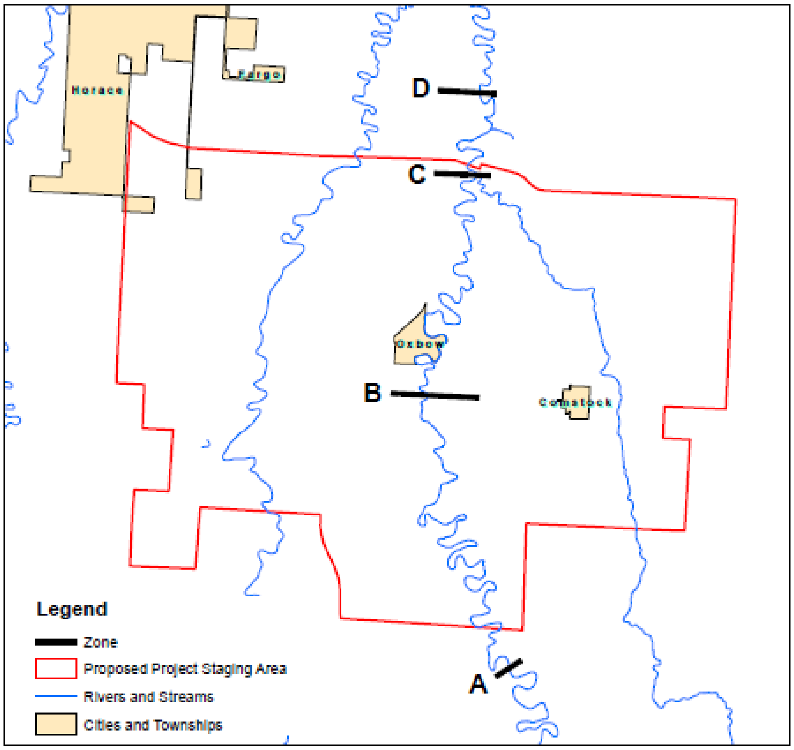


Table 3.4 Project and No Action w/Emergency Measures

			Duration of the 100-year event at or above the peak stage of the No Action Alternative with Emergency Measures (days)	
	Flood Return Period (Years)	**Peak Stage: No Action Alternative w. Emerg. Measures**	**No Action Alternative w. Emergency Measures**	**Proposed Project**
Zone D			Peak Stage: 912.7	908.1
	10-year	907.0	11	5
	25-year	910.4	7	0
	100-year	912.7	1.5	0
Zone C			Peak Stage: 914.0	922.2
	10-year	908.1	10.5	12
	25-year	911.6	7	11
	100-year	914.0	1.5	10
Zone B			Peak Stage: 917.5	922.4
	10-year	910.8	10	12
	25-year	914.5	6	10
	100-year	917.5	0.5	8
Zone A			Peak Stage: 923.5	924.2
	10-year	914.8	9.5	12
	25-year	919.1	5	9
	100-year	923.5	0.5	4

Illustration 3.1 Proposed Project Zone Location Map



> Inundation is contained upstream of the tieback embankment that runs along the connecting channel from the Red River control structure. The tieback embankment also extends east and connects to high ground on the Minnesota side of the inundation area. During Project operation for low frequency flooding events (more intense flood events), the tieback embankment would be designed to hold back water more than six feet deep (which is a threshold for a designation of a dam). Therefore, the embankment would be designed to meet USACE Dam Safety Criteria. The tieback embankment and control structures meet the definition of a Class I Dam under Minnesota Rules and may require a Minnesota Dam Safety Permit.

3.1.2.2 Base No Action Alternative

Detailed discussion of the Base No Action Alternative is presented in Chapter 2.0. Figure 12, shown below, shows the flood extents that are associated with the Base No Action Alternative. The flood extents of the Base No Action Alternative are similar to the existing conditions, as this alternative essentially represents the existing condition when all the planned levee systems, as listed in Chapter 2.0, are constructed. As depicted on the map, flooding occurs behind current and planned levees for the Base No Action Alternative during the 100-year flood event. There are gaps between the levee tie in points and the top of levee elevations that allow the 100-year flood event to continue to flood the F-M urban area. While the current and planned levees would cause some stage increase resulting in additional floodplain storage upstream of the levee system, the non-continuous Base No Action Alternative levee system has only minor hydrologic or hydraulic impacts within the project area.

3.1.2.3 No Action Alternative (with Emergency Measures)

A detailed discussion of the No Action Alternative (with Emergency Measures) is presented in Chapter 2.0, including a list of current and planned levees. Emergency measures, such as sandbags and other flood fighting measures, are used to fill in the gaps between the levees that are constructed and are planned for construction and provide flood risk reduction to the F-M urban area during low frequency events. The No Action Alternative (with Emergency Measures) essentially represents the conditions that are needed currently to protect the F-M urban area from flooding during a 100-year flood. Figure 13 below shows the extent of emergency protection measures used to prevent flooding from the Red River and Wild Rice River in the F-M urban area. This figure also shows the flood extent under this alternative. As shown in Figure 13 below, the flow for the 100-year flood is maintained within the channel sections between the levees through the main stem of the Red River through the F-M urban area. Compared to the Base No Action Alternative the No Action Alternative (with Emergency Measures) increases the flood depth and flood extent immediately upstream of the F-M urban area. The increased flood extents immediately upstream of the protected area are due to the surcharge in water surface elevation caused by the constriction of flow between the levees and emergency measures through the F-M urban area. This surcharge provides storage upstream of the levee which decreases peak flow rates through the F-M urban area. The permanent levees of this alternative would not have sufficient freeboard to meet FEMA's accreditation standards for 100-year flood protection with higher EOEP discharge.

3.1.2.4 Northern Alignment Alternative

The NAA is a modified version of the Project, which would move the southern tieback embankment of the Project north approximately 1.5 miles. As with the Project previously discussed above, the NAA would not change the hydrology downstream of the diversion. The extent and elevation of the inundation area would slightly differ from the Project as described below for the 100-year flood (Figure 14). Flood inundation associated with the NAA would not directly impact the community of Comstock, which would eliminate the need for a proposed ring levee, but the Comstock wastewater lagoons would need protection. The Red River and Wild Rice River control structures would be operated to raise water surface elevations to approximately 919.3 feet at the diversion inlet for all events up to a 0.2-percent chance event. Operation of the NAA would be similar to the Project with the exception of the upstream inundation area elevation. Portions of the diversion channel would also be slightly modified for the NAA compared to the Project.

3.1.2.4.1 Diversion Channel

The diversion channel would remain similar to that described for the Project. The main differences between the Project and the NAA diversion channels are the length of the channel and the inlet structure location. The length of diversion channel alignment between the Sheyenne River aqueduct and the inlet structure is slightly longer for the NAA (8,000 linear feet) compared to the Project (7,700 linear feet). The alignment of the diversion channel east of the Sheyenne River is modified for the NAA, as it would curve south to avoid the subdivision located in Section 30 south of Horace. This portion of the NAA diversion channel alignment would cross County Road 17, the approximate location of the overflow embankment, and then curve northwest, eventually joining the Project diversion channel alignment just east of the Sheyenne River aqueduct, where the remainder of the diversion channel alignment would be the same as described for the Project.

3.1.2.4.2 Staging Area

For the NAA, approximately 150,000 acre-feet of storage is required immediately upstream of the dam and diversion channel inlet. As previously described, the staging area was added as a necessary element of the Project design to mitigate for downstream impacts on the Red River. NAA staging area design would be similar to what was previously described for the Project.

Operation of the NAA would occur when it becomes known that a stage of 35.0 feet would be exceeded at the Fargo gage. At this stage, the flow through the F-M urban area would be approximately 17,000 cfs. A flow of 17,000 cfs at the Fargo gage is approximately a 10 percent chance or 10-year flood event. Operation begins by partially closing the gates at the Red River and Wild Rice River hydraulic control structures. Once the gates are partially closed, water would begin to inundate the area upstream of the tieback embankment. A maximum stage of 35.0 feet would be maintained at the Fargo gage until the inundation area elevation reaches 919.3 NAVD 88, at which point the Red and Wild Rice River control structures would be opened as necessary to maintain a staged elevation of 919.3 while not exceeding a stage of 40.0 feet at the Fargo gage. Once a stage of 40.0 feet is achieved at the Fargo gage, a stage of 40.0 feet would be maintained by first allowing more flow into the diversion channel through the diversion inlet gates and eventually allowing flow to exit the inundation area over the overflow embankment (elevation 920.0) until the staged water surface rises to an elevation that provides a minimum acceptable height of freeboard for the tieback embankment. If the staged water surface elevation is forecasted to reach the point of minimum acceptable freeboard, an evacuation order would be issued for the F-M urban area. Once the inundation area elevation reaches the point of minimum acceptable freeboard, the Red and Wild Rice River control structures would be opened further to maintain the minimum freeboard and stages would rise above 40.0 feet at the Fargo gage.

In general, the NAA inundation area is anticipated to result in similar flood durations for the 100-year flood as described for the Project. Flooding related to NAA operation would differ in the inundation area compared to the Project in the extent and geographic areas that would be affected. The greatest flooding from NAA operation would be moved north from the Project location. This would shift flood inundation to the north and would change the extent of flooding based on topography and other features that have the potential to affect the hydraulic impact compared to the Project. As shown in Figure 14, the change in flood extents from existing conditions in the inundated area is significant. NAA operation would cause the depth and extent of flooding to increase and cause flooding in currently non-flooded areas during the 100-year flood compared to existing conditions. Table 3.5 shows the flooding duration from existing conditions to NAA operation conditions for the 10-, 25-, and 100-year flood events for select upstream, center, and downstream locations of the staging area for reference (see Illustration 3.2 below).

Table 3.5 NAA and No Action with Emergency Measures

			Duration of the 100-year event at or above the peak stage of the No Action Alternative with Emergency Measures (days)	
	Flood Return Period (Years)	**Peak Stage: No Action Alternative w. Emergency Measures**	**No Action Alternative w. Emergency Measures**	**Northern Alignment Alternative**
Zone D			Peak Stage: 912.7	919.3
	10-year	907.0	11	12
	25-year	910.4	7	10.5
	100-year	912.7	1.5	9
Zone C			Peak Stage: 914.0	919.3
	10-year	908.1	10.5	12
	25-year	911.6	7	10.5
	100-year	914.0	1.5	8.5
Zone B			Peak Stage: 917.5	919.8
	10-year	910.8	10	11.5
	25-year	914.5	6	9.5
	100-year	917.5	0.5	6.5
Zone A			Peak Stage: 923.5	923.8
	10-year	914.8	9.5	11.5
	25-year	919.1	5	7.5
	100-year	923.5	0.5	1

Source: MNDNR, 2015

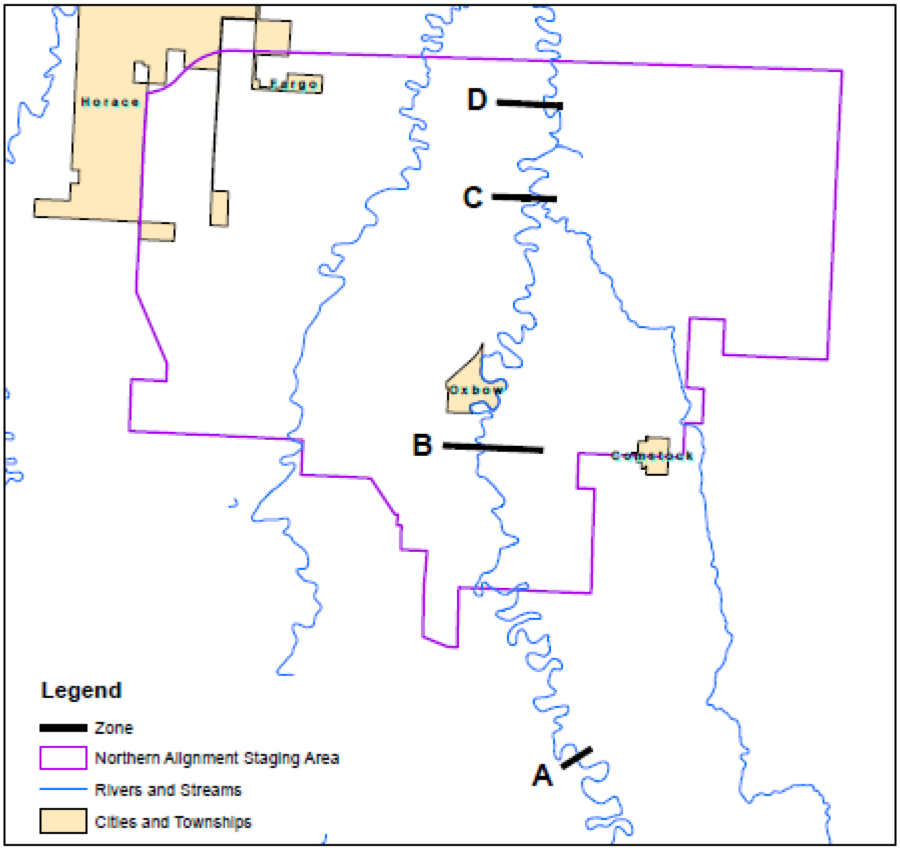


Illustration 3.2: Northern Alignment Alternative Zone Location Map

Inundation is contained upstream of the tieback embankment that runs along the connecting channel from the Red River control structure. The tieback embankment also extends east and connects to high ground on the Minnesota side of the inundation area. During Project operation for low frequency flooding events (more intense flood events), the tieback embankment would be designed to hold back water more than six feet deep (which is a threshold for a designation of a dam). Therefore, the tieback embankment would be designed to meet USACE Dam Safety Criteria. The tieback embankment and control structures meet the definition of a Class I Dam under Minnesota Rules and may require a Minnesota Dam Safety Permit.

3.1.3 Proposed Mitigation and Monitoring Measures

The Phase 7 EA unsteady HEC-RAS model was used during the evaluation of mitigation measures for the Project. Specific mitigation measures proposed for the Project are discussed in other sections of Chapter 3.0 for each resource topic. Evaluation of the proposed mitigation and monitoring is discussed in Chapter 6.0 for each resource topic, along with any additional recommended mitigation. Chapter 6.0 also includes a discussion on the Adaptive Management and Monitoring Plan.

3.2 FEMA REGULATIONS AND THE CLOMR PROCESS

The National Flood Insurance Program (NFIP), created by Congress in 1968 and governed by the FEMA, is intended to mitigate future flood losses nationwide through community enforced building and zoning ordinances and to provide access to federally-backed flood insurance protection for property owners.

The FEMA reviews projects where construction would result in the modification of existing Flood Insurance Study mapping because of changes to regulatory floodways, Base Flood Elevations (BFEs) or extent of Special Flood Hazard Areas (SFHAs). FEMA reviews map modifications through the Letter of Map Revision (LOMR) process which includes the Conditional Letter of Map Revision (CLOMR) for revisions from proposed projects and the LOMR for completed projects or improved data.

This section discusses how the Project would meet FEMA regulations, such as those codified in 44 Code of Federal Regulations (CFR) 65.12, which includes the CLOMR requirement to mitigate the impact to any existing insurable structure if the proposed Project is expected to cause a flood stage increase greater than 0.00 feet. The exact manner that the Fargo-Moorhead Flood Risk Management Project complies with FEMA regulations is subject to ongoing discussion between FEMA and the USACE. The Diversion Authority, the USACE, and FEMA are currently determining what actions the Project should include to meet FEMA's CLOMR requirements. This section identifies measures needed or planned to address any compliance issues that are identified in the CLOMR process.

3.2.1 Affected Environment

The NFIP participating communities with Flood Insurance Rate Maps (FIRMs) affected by the Project are listed in Table 3.6. Effective Flood Insurance Study (FIS) Reports and FIRMs for all communities impacted by the Project are available at the FEMA Map Service Center site at: http://www.msc.fema.gov/. FEMA has updated or is updating the FIRMs for the four affected counties and associated incorporated areas into their digital format. The final digital maps are effective for Clay and Wilkin County, Minnesota and incorporated areas and Richland County and Cass County, North Dakota and incorporated areas. The hydraulic information from the USACE 2003 Regional Red River Flood Assessment Report was the basis for the Cass, Clay, and Wilkin maps. Local project sponsors have access to the FIS and FIRMs both effective and issued preliminary for their jurisdictions. The hydrology for the proposed project discussed in Section 3.1 determines increases in the peak discharges at Fargo. The updated hydrology data would be used for future NFIP Map Revisions.

The updated mapping shows no SFHA in Comstock or Christine. Comstock does not participate in the NFIP. Both of these communities are in the Project staging area.

Table 3.6 NFIP Communities With FIRMs

Community	Community ID	State	Community	Community ID	State
Cass County	38017	ND	Raymond Township	380261	ND
Wilkin County	270519	MN	Fargo City	385364	ND
Richland County	380098	ND	Barnes Township	380256	ND
Clay County	275235	MN	West Fargo City	380024	ND
Pleasant Township	380263	ND	Riverside City	380316	ND
Normanna Township	380264	ND	Reiles Acres City	380324	ND
Stanley Township	380258	ND	Reed Township	380257	ND
Warren Township	380265	ND	Harwood City	380338	ND
Harwood Township	380259	ND	Comstock	270079	MN
Moorhead	275244	MN	Wolverton	270524	MN
Christine	380291	ND			

Source: FEMA 2014

3.2.1.1 Flood Hazard Areas

The NFIP requires FEMA to identify and map flood hazard areas as high, medium and low flood risk. The SFHA is the high risk area defined as any land that would be inundated by a flood having a one percent chance of occurring in a given year. The SFHA is also commonly referred to as the “base flood” or the 100-year flood. The 100-year flood is labeled on the FIRM as Zone-A (A, A1-30, AE, AO, AH, A99, and AR). The medium risk areas are labeled on the FIRM as Zone-B (older maps) or shaded Zone-X (newer maps). The areas identified as medium risk on the FIRM are protected by a FEMA accredited levee, have less than one square mile drainage area, are inundated by less than one-foot of sheet flow or are inundated by the 0.2 percent annual chance flood, also known as the 500-year flood. Other areas on the maps are considered low risk.

The regulatory floodway is an important designation on the FIRM. A floodway is the portion of the floodplain where development and filling is very restricted. The restrictions maintain a flow conveyance area that limits increases in flood stage to allowable tolerances. Typically the floodway is the portion of the floodplain where the water is the deepest and fastest. Projects in the floodway must show there is no-rise in the BFE. The floodplain outside of the floodway is considered the flood fringe. Filling in the flood fringe is allowed. The allowable tolerance in North Dakota is one foot, which is the national standard. In Minnesota, it is 0.5 feet. Since the Red River falls on the border between the states of North Dakota and Minnesota, the allowable floodway surcharge for the Red River has been set at 0.75 feet (9 inches).

3.2.1.2 NFIP Map Revisions

NFIP map revisions are made through the FEMA LOMR process. The effective maps cannot be revised for proposed projects or future conditions. Therefore, the current maps, and after adoption the preliminary maps, will be in effect until a LOMR is approved after a project is completed. Proposed conditions are reviewed with a CLOMR. A CLOMR is the formal review and comment FEMA uses to determine whether a proposed project complies with minimum NFIP standards. Upon approval, a CLOMR also describes eventual changes to the NFIP maps within the affected community if the project is completed as designed. CLOMRs are required for any project causing any increase in flood stage based on hydrologic and hydraulic analyses. (44CFR 60.3(d)4). CLOMRs require that the community provide written assurance that they comply with the requirements in 44CFR65.6(a)14.

3.2.1.3 Floodplain Management Requirements

In order to obtain a CLOMR approval from FEMA, the H and H modeling and other supporting information would need to meet NFIP regulations codified in the CFR for the NFIP, parts 60.3, 65.3, 65.6, 65.8, and 65.12. General and specific requirements of the Project are discussed in the FEMA/USACE Coordination Plan (Appendix F), currently in draft form, and the Joint Memorandum titled: *Federal Emergency Management Agency / U.S. Army Corps of Engineers Joint Actions on Planning for Flood Risk Management Projects*.

3.2.2 Environmental Consequences

3.2.2.1 Proposed Project

Results of the H and H modeling indicate there would be increases in the BFE as well as other flood hazards, such as the 500-year flood at specific locations within the F-M urban area and the surrounding region. As a result of the increased flood risk within the SFHA and floodway, there are projected increases to insurable structures greater than 0.00 feet. Potential impacts and changes to hydrology and hydraulics from the Project are discussed in Section 3.1 and supporting documents to the EIS. Because the Project causes an increase in the SFHA and BFEs, a FEMA approved CLOMR is required.

After completion of the project, the Diversion Authority, or local sponsors, submits a LOMR request for the Project based on the Project as-built and supporting technical data including updated hydrologic and hydraulic analysis and delineation of new floodplain boundaries and floodways. The Project purpose of removing structures in the F-M urban area from the FEMA SFHA would not occur until the LOMR request is approved by FEMA.

3.2.2.1.1 100-year Flood

Increases are anticipated in the SFHA (flood inundation from the 100-year flood) upstream of County Road 16 (Figure 15). In contrast, the Project would remove large portions of existing areas from the SFHA downstream of County Road 16 and within the F-M area (Figure 15).

3.2.2.1.2 500-year Flood

Increases are anticipated in the SFHA from the 500-year flood upstream of County Road 16 (Figure 16). Similarly, the Project would remove large portions of existing areas from the SFHA downstream of County Road 16 and within the F-M area (Figure 16).

3.2.2.2 Base No Action Alternatives

The Base No Action Alternative includes the potential flood risk reduction impact of already completed and currently funded permanent projects such as levee construction (i.e., structural measures) and property buyouts (i.e., non-structural measures). The Flood Damage Reduction (FDR) projects presented in the tables in Section 2.2 for Fargo and Moorhead are the specific projects included in this alternative. This alternative does not include emergency measures currently pursued in the project area as necessary due to flooding, and therefore, the Base No Action Alternative would have flooding where the water level exceeds the tie-in of levees to natural ground.

Any alterations to the flood hazard risk due to currently funded and completed projects will need a LOMR to officially update the effective FIRMs. These projects are eligible for LOMRs before completion of the Project if they meet the criteria outlined in Section 3.2.1.

3.2.2.3 No Action Alternatives (with Emergency Measures)

The No Action Alternative (with Emergency Measures) includes the potential flood risk reduction impact of already completed and currently funded permanent projects such as levee construction and property buyouts. The FDR projects presented in the tables in Section 2.2 for Fargo and Moorhead are the specific projects included in this alternative. This alternative also assumes that emergency measures similar to those that have been historically implemented in the project area would continue to be implemented as necessary due to flooding.

Future flood damage reduction projects should be evaluated to determine if a CLOMR is required as outlined in Section 3.2.1 above. Any official change to the flood hazard risks shown on the FIRM will need a LOMR, but if the project functions independently of the Project, a smaller scale CLOMR could be obtained.

3.2.3 Mitigation and Monitoring Measures

Section 65.12 of the CFR requires communities to apply to FEMA for conditional approval (see 44 CFR Part 72 of the NFIP regulations) of actions which will cause increases in BFEs in excess of the limits. Prior to permitting the encroachments, communities must:

- complete a request using the MT-2 application forms,
- provide an evaluation of alternatives,
- document individual legal notice to impacted property owners,
- obtain concurrence of Chief Executive Officers of communities impacted by the proposed actions, and
- provide a certification that no structures are impacted by increased BFEs or a description of the proposed mitigation measures for all impacted structures.

In accordance with the NFIP, mitigation would be required for the Project for structures that are subject to increases in BFE greater than the tolerances set in the FIS floodway tables for the affected communities. The Diversion Authority has developed guidance for mitigation of parcels impacted by flood stage increases. The current mitigation guidance identifies flood level thresholds at the 0-1, 1-3, and 3+ foot levels for mitigation decision-making. These guides are subject to further evaluation and potential revisions as the Project is finalized. Based on the requirements in the NFIP regulations, appropriate mitigation would be determined through the CLOMR process. Because of the magnitude of the Project, FEMA has discussed interpreting standards so that the CLOMR includes a list of properties that will be mitigated before Project completion but that the mitigation of those properties can be delayed until the Project affects the property flood risk.

3.3 STREAM STABILITY

Fluvial geomorphology is the study of stream channels and their associated valley types, substrate, bank stability, flow and sediment characteristics (driving variables) and features or events influential in altering or maintaining stability (controlling variables) in the river and its floodplain. Evaluation of the stability of a particular river or tributary can provide information about the cause and effect of processes such as erosion, bank failure, and sediment transport and deposition. This is accomplished in part by analyzing short and long-term changes in channel width, depth and slope, pattern, degradation or aggradation, water depth, velocity, shear stress and riparian condition. All of which affect the shape and condition of a stream. This information can be used to understand and predict potential impacts resulting from constant conditions and isolated events, such as floods.

Stream stability is defined as a river or stream's ability in the present climate to transport the stream flows and sediment of its watershed over time in such a manner that the channel maintains its dimension, pattern and profile without either aggrading or degrading (Rosgen 1996, 2001c, 2006b). As a result, stream stability departure can be quantified and characterized by monitoring aspects of the channel dimension, pattern and profile.

The proposed diversion channel with associated hydraulic control structures, embankments and flood storage (staging area) would be used to modify and control water flow, and change the existing floodplain for certain flooding events (flood elevations) in the project area. Specific geomorphologic processes of concern include stream stability in the inundation area, channel bed scour at the water control structures, and susceptibility for geomorphological changes in the stream and river channels and at the confluence of the diversion channel with the natural river channel at the Red River due to hydrology and hydraulic Project modifications.

This section provides a discussion on the existing conditions of rivers and streams in the project area, potential impacts to stream stability in those stream and river channels due to construction and operation of the Project, and proposed mitigation and monitoring measures. An evaluation of the proposed mitigation and monitoring measures discussed herein as well as any additional recommended mitigation and/or monitoring measures for stream stability are discussed in Section 6.2.3 and within the EIS Draft Adaptive Management and Monitoring Plan (AMMP) (Appendix B).

Several resources were used in the preparation of this section. These include correspondence between the USACE, Diversion Authority and the MNDNR. In addition, the USACE and Diversion Authority have conducted and/or partnered with agencies on several studies that characterize the historical and current stream stability and geomorphologic patterns observed in the project area and estimate potential Project impacts to these processes. Some of studies include LiDAR data collected for the Red River basin during 2008 and 2009; bathymetric data collected in 2010 for the Red River from Abercrombie, North Dakota to Perley, Minnesota; and sediment transport data for the Red River and select tributaries during the spring floods of 2010 and 2011 (USGS 2010, USGS 2011) and summer and fall flow conditions in 2011 (USGS 2012). Several of these studies, and others, have been discussed and/or included in previous USACE documents that precede this EIS. The studies have also been used in the ongoing design of Project features as well as in the continued development of proposed mitigation and monitoring measures.

One study in particular, the *Geomorphology Study of Fargo, North Dakota and Moorhead, Minnesota Flood Risk Management Project* (WEST, 2012) (Geomorphology Report) served as a primary resource for this section. Because of the relevance of this study to the stream stability discussion, a summary of the Geomorphology Report is provided below.

Geomorphology Report

The Scope of Work (SOW) for performing the geomorphic assessment was developed as part of the FFREIS and included as part of the adaptive management monitoring plan (Attachment 6: Discussion of Habitat Loss, Mitigation Needs and Adaptive Management (FFREIS, 2011)). The Geomorphology Report included analysis of hydrology, bank stability, sediment transport and morphological classification that will be used to provide key pre-Project construction and operation observations to form the basis for future comparison. Work under this SOW was initiated in 2010.

The geomorphic study area included the following locations in the project area:

- Red River from Abercrombie to Perley, Minnesota
- Wild Rice River from Abercrombie, North Dakota to the Red River

- Sheyenne River from Kindred, North Dakota to the Red River
- Sheyenne River Diversion Channel from Horace to West Fargo, North Dakota
- Rush River from Prosper, North Dakota to the Sheyenne River
- Lower Branch Rush River from Prosper, North Dakota to the Sheyenne River
- Maple River from Mapleton, North Dakota to the Sheyenne River
- Buffalo River from 1 mile upstream of Georgetown, Minnesota to the Red River
- Wolverton Creek for 3 miles upstream of the Red River

A total of 30 detailed study reaches were defined within these general study reaches and physical conditions within each detailed reach were evaluated and documented. Results obtained from each detailed study reach are considered applicable to the entire general study reach in which it is located. The data collected for this effort was applied to various study analyses.

The preparation of this report included an extensive literature review and data compilation effort. In total, forty-eight documents from a variety of sources were utilized. These documents included peer-reviewed and agency literature and data, including USACE, USGS, FEMA, U.S. Department of Agriculture (USDA), U.S. Bureau of Reclamation, and the University of Minnesota. Data analysis included a combination of fluvial geomorphic, hydrologic, and hydraulic engineering approaches that were applied to define historical and current conditions and to predict potential future condition effects.

3.3.1 Affected Environment

The project area is located within the Red River drainage basin. The surficial topography and geologic features of the Red River basin are primarily the result of deposition and erosion associated with continental glaciation. Glacial Lake Agassiz left clay-rich sediments in a flat lake plane along the Red River axis (Stoner et al., 1993). The streams within the project area flow through the extremely flat clay deposits. These cohesive soils are up to 95 feet thick in some locations (Stoner et al., 1993). Lake Agassiz also deposited large quantities of sand along its shoreline. The Sheyenne River flows through the sand deposits upstream of the project area, supplying sand to the downstream study reaches.

The Red River, Wild Rice, Sheyenne, Maple, Lower Rush, Rush and Buffalo rivers, Wolverton Creek and their associated floodplains flow through the project area as shown on Figure 1. Geomorphologic changes naturally occur on each of these rivers and can be influenced by specific changes in water flow. The project area currently experiences flooding associated with spring snowmelt and summer runoff events. Flood flows from these events are prone to exceed the natural banks of the reaches for extended durations, as the flood levels rise much faster than they recede. This results in extended durations of saturated bank conditions and inundation of riparian vegetation. These flood flows also result in sediment deposition along the banks of the reaches.

The reaches of the Red River, Wild Rice River and Wolverton Creek within the inundation area are currently prone to and commonly exhibit bank slumping as a result of the flood flows described above, especially on the outside bends. Bank instability from riparian vegetation removal, either resulting from flood flows, as described above or through local land use practices, is also another factor in bank slumping. However, in general the streams show a resistance to significant channel migration with sufficient capacity to transport nearly all of the sediment, which is primarily composed of silt and clay-sized material. Cohesive clay in the channel substrate of both the bed and banks provides resistance against significant channel migration. Stability in the bed keeps the bed from degrading and the channel incising, stability in the banks resists bank erosion, and subsequent lateral migration.

3.3.1.1 Geomorphic Stream Classification

There are a number of reasons for classifying a stream; Rosgen (Rosgen method) listed four: 1) To be able to predict the behavior of the river in regard to its physical aesthetics; 2) To develop relationships for given stream types in regard to hydraulics and sediment; 3) To extrapolate data specific to the site and apply them to similar rivers; and 4) To classify a river is to be able to provide a consistent reference for describing the river's morphology for those working in various disciplines (Rosgen, 1994). Currently, there are several acceptable stream classification methods in use. To help define streams within the project area, their current conditions, and attempt to predict potential changes that may occur within these systems from Project operation; the Geomorphology Report considered three geomorphic stream classification systems; Rosgen Level II, Rosgen Level III, and the Schumm Stream Classification. The results of the stream classification study are discussed below.

Rosgen Level II provides a detailed morphological description of stream types from field-determined reference reach information. This level breaks the channel into discreet slope ranges and introduces particle sizes of channel material. Other variables include entrenchment, width/depth, and sinuosity. Results indicated that the majority of the channel types within the project area are stable; however, the detailed study reaches completed on the Red River were found to be potentially unstable both laterally and vertically due to changes in flow and sediment supply. It is noted that the Red River instability finding was not consistent with other analysis completed as part of the study.

Rosgen Level III describes the state of streams and helps measure existing conditions in response to channel change. This method is often used to aid in restoration efforts as it provides a qualitative rating with regard to vertical and lateral stability and assesses the potential for a channel to change types. Variables studied include riparian vegetation, depositional patterns, meander patterns, confinement features, fish habitat indices, flow regime, river size category, debris occurrence, channel stability index, and bank erodibility (Rosgen, 1994). The riparian vegetation analysis is discussed further below. Analysis indicated that all of the reaches are classified as being either stable or only moderately unstable laterally. Detailed study reaches are predicted by the Level III method to experience no or only slight degradation over time.

The Schumm Method is a process-based stream classification system that uses the type and amount of material transported as its defining criterion for classification that identifies the processes causing the channel to be either stable or unstable. There are three types of material transport methods considered, suspended load, mixed load, and bedload. The three types of alluvial channels considered are stable, depositing, and eroding. The results indicated that streams within the study area are considered to be stable suspended load channels.

3.3.1.2 Riparian Vegetation Analysis

The Geomorphology Report included two riparian vegetation analyses that were completed; one, through a desktop review of historical aerial photographs and the second that was also conducted as part of the Rosgen Level III analysis discussed above. These analyses were completed to provide a qualitative description of riparian vegetation types and how bank vegetation, or lack of bank vegetation, may be influencing bank stability within the project area. Along with hydraulic forces and bank material, riparian vegetation is one of the primary influences on bank stabilization (Thorne, 1982). The root structure of bank vegetation can increase the shear strength of soil, while above ground vegetation can reduce stream velocities and act as a protective layer, decreasing the influence of surface erosion processes.

For the aerial photography analysis, bank vegetation was classified in order to identify historical trends in bank vegetation types and to determine if a relationship exists between vegetation type and the rate of channel migration (WEST 2012). Estimates of the dominant category of bank vegetation along each general study reach were based on a desktop review of the available aerial imagery for Years 1, 2, and 3 (Table 3.7). The review determined what percentage of the total length of each reach is dominated by what category of vegetation. Bank vegetation was classified into one of four categories: canopy (trees), mixed vegetation (consisting of a combination of trees, grass, and shrubs), non-canopy (grass and shrubs), and bare earth (no vegetation).

Table 3.7 Aerial Imagery Source Dates

Stream	Year 1	Year 2	Year 3
Buffalo River	2010	1965	1939
Lower Rush River	2010	1997	1962
Maple River	2010	1997	1962
Red River	2010	1978	1939
Rush River	2010	1997	1962
Sheyenne River	2010	1997	1962
Wild Rice River	2010	1997	1941
Wolverton Creek	2010	1965	1939

The aerial photograph analyses can be used as a tool to assess potential stream stability trends related to vegetation presence and type within the project area from the past 70 years. It is important to note that the aerial images had differing quality and are subject to higher error rates than field investigation studies based on photo interpretation subjectivity and canopy cover. Canopy cover on aerial photographs blocks the view of understory and groundcover vegetation, which results in less accurate determinations of bank vegetation, and therefore, the Rosgen Level III vegetation analysis provides a more accurate assessment of actual vegetation conditions.

The riparian vegetation analysis completed during field investigations in 2010/2011 as part of the Rosgen Level III investigation looked at the percent of site covered by canopy, shrub, herbaceous, leaf or needle litter, and bare ground within each study reach. Observations of the vegetative conditions for each detailed study reach are shown in Table 3.8.

The average value of the percent of bare earth on all of the reaches in the study was about 55 percent. While Rosgen indicates that riparian vegetation has a marked influence on the stability of streams (Rosgen, 1996), observations and other analyses completed and discussed in this report indicates that vegetation coverage does not influence stream stability in this river system as much as the cohesive clay soils that form the stream banks. However, it is important to note that root mass bank investigations were not part of this study. Vegetation roots can span large areas and provide support to banks even in the absence of surface vegetation. Typical benefits from vegetation, including surface protection and increased strength from root penetration, are important contributing factors to stream stability, and vegetation plays an important role in soil moisture conditions.

Table 3.8 Rosgen Level III Riparian Vegetation Summary

Detailed Study Reach	Percent Canopy	Percent Shrub Layer	Percent Herbaceous	Percent Litter Layer	Percent Bare Earth
Buffalo River-1-1.19	10	2	3	0	85
Lower Rush River-1-1.10	0	20	48	2	30
Lower Rush River-2-6.03	0	15	85	0	0
Maple River-1-0.78	1	58	36	0	5
Maple River-2-11.39	1	48	49	0	2
Red River-1-410.65	5	20	10	0	65
Red River-2-419.14	10	15	10	0	65
Red River-3-440.57	1	2	2	0	95
Red River-4-452.52	1	2	5	1	91
Red River-5-463.56	1	3	5	0	91
Red River-6-470.23	2	1	1	0	96
Red River-7-492.47	15	40	20	5	20
Red River-8-521.18	10	35	15	5	35
Rush River-1-0.08	0	10	10	0	80
Rush River-2-6.15	0	0	94	1	5
Sheyenne River-1-4.20	2	10	22	6	60
Sheyenne River-2-11.56	2	3	10	10	75
Sheyenne River-3-18.15	1	0	5	0	94
Sheyenne River-4-22.27	3	10	7	20	60
Sheyenne River-5-26.47	3	40	27	10	20
Sheyenne River-6-35.82	2	40	43	10	5
Sheyenne River-7-43.27	1	5	2	1	91
Sheyenne River-8-55.75	3	38	7	2	50
Wild Rice River-1-3.01	3	3	5	10	79
Wild Rice River-2-4.23	5	10	10	5	70
Wild Rice River-3-17.52	10	25	5	5	55
Wild Rice River-4-22.94	15	5	15	5	60
Wild Rice River-5-38.49	15	10	5	10	60
Wild Rice River-6-42.36	20	20	5	5	50
Wolverton Creek-1-0.64	1	27	27	15	30
Wolverton Creek-2-2.02	0	13	15	2	70

Source: WEST 2012

3.3.1.3 Hydrologic Assessment

The Geomorphology Report completed a hydrologic assessment to help characterize the channel-forming discharges for current and historical conditions. The analysis also looked at the discharge-duration and elevation-duration curves for current, historical and future (with Project) conditions as well as completed a specific gage record analysis to check the accuracy of the rating tables. The revised flow frequency curves developed by the EOEP were applied for this analysis (see Chapter 1 and 2 for more information on the EOEP).

Channel-forming discharges are a single steady discharge that in theory will produce the same bankfull channel dimensions as a natural sequence of discharge events. Within the project area, current channel-forming discharge recurrence intervals averaged approximately 1.28 years, ranging from 1.05 years to 1.67 years, which is consistent with other studies in the Upper Midwest. The channel-forming discharge for historical conditions resulted in a 2.4-recurrance interval compared to a 1.26-year recurrence interval in the current years. This was determined using a recurrence interval method due to limited historical stream gage information. While this is based on one data point, qualitatively it can be assumed that the historical channel-forming discharges across the entire study area were likely less than the current channel-forming discharges.

A discharge-duration curve show the percent of time a given discharge is equaled or exceeded under a certain hydrologic regime. Discharge-duration curves indicated that the current discharge-duration curves have greater discharges than the historical conditions curves. Elevation-duration curves also indicated that water surface elevations have increased from historical to current conditions. These results suggest that the magnitude and frequency of flood events have increased from historical to current conditions.

Specific gage analysis indicated that the water surface elevations at the USGS gages within the project area have remained relatively stable or have exhibited a slight decrease in water surface elevation which generally coincides with historical cross section comparisons made during this study and as discussed below.

3.3.1.4 Stability Analysis

The Geomorphology Report completed a stability analysis by comparing historical and current aerial photography and cross section data. Parameters investigated for both the aerial photography and the cross sections help to assess if the changes observed indicate whether the channels are stable (i.e., in a state of natural evolution or migration) or if they are unstable and trending away from channel geometry.

3.3.1.4.1 Aerial Photography

Current and historical aerial imagery was studied to provide information related to channel planform including sinuosity, channel migration rates, meander amplitudes and frequencies, trends in sedimentation features, bank erosion rates, and changes in riparian vegetation over time. Riparian vegetation was previously discussed in subsection 3.3.1.2 above.

This analysis indicated that channels in the project area are relatively stable or in dynamic equilibrium showing little changes between subsequent years. Trends in migration, bank erosion, planform, and other indicators of geomorphic stability are predominantly controlled by flow rates and sediment loads. This river system may be transitioning to a non-stationary system (discharges and durations increasing over time – subsection 3.3.1.3 above). The Geomorphology Report suggests that stream migration may be occurring at a slow rate with significant changes occurring over larger time scales than what could be analyzed in the study, which examined available historical records from approximately 1940 to 2012. Accelerated erosion rates and meander migration, if they occur, would be evident with aerial photography over a shorter timeframe, such as within a 20-year period.

3.3.1.4.2 Cross Section Comparison

To further evaluate the stability of the channels, current and historical cross sectional comparison was completed for 30 cross sections to provide information related to changes in top width, average depth, and channel area over time. Comparing current to historical channel cross sections is a way to study stream stability since overall dimensions of stable streams tend to stay similar with little movement horizontally or laterally. If the dimensions become noticeably wider, straighter, more entrenched or accumulate sediment, the stream may become unstable.

Table 3.9 provides a summary of the data sources used by year and stream for the cross section comparison completed for the Geomorphology Report. Available data for the cross section comparison may be too short of a time period (approximately 67 years of data was studied, less in most cases) to identify trends in migration or width changes. Significant migration or changes to these channels may occur over timescales of hundreds or thousands of years. Current cross section survey data was obtained in 2010 and 2011 as part of the Geomorphology Report study. Historical cross section information was obtained from the USACE St. Paul District.

Table 3.9 Cross Section Geometry Source Dates

Stream	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6
Buffalo River	2010	2004	1967			
Lower Rush River	2010	1964				
Maple River	2010	2003	1947			
Red River	2010	1999	1983	1978	1960	1943
Rush River	2010	1966				
Sheyenne River	2010	1940				
Wild Rice River	2010	1988				
Wolverton Creek	2010	2000				

Source: WEST, 2012.

Table 3.10 below shows the results of the historical cross section comparison. The cross section comparison of top width found that 13 channels were narrowing, 10 were widening and seven had no discernable trend (WEST 2012). Review of hydraulic depth for the 30 cross sections, 18 appear to be degrading/deepening, two appear to be aggrading, and 10 had no discernable trend in changes to hydraulic depth. The Geomorphology Report used the thresholds of top width of at least 0.5 feet per year and hydraulic depth of at least 0.1 feet per year to individually evaluate cross section changes and investigate apparent causes of the changes. Twelve of the 30 cross sections were above the thresholds (bold text).

Table 3.10 Cross Section Geometric Change Rates

Stream	Station	**XS ID**	**Top Width Rate of Change (feet/year)**	**Hydraulic Depth Rate of Change (feet/year)**
Buffalo River	1305	B1	-0.1	0.0
Buffalo River	7224	B2	0.2	**0.2**
Maple River	2437	M1	-0.4	**0.2**
Maple River	6343	M2	0.2	0.0
Maple River	36198	M3	**-0.6**	0.0
Red River	2219762	R1	**1.6**	**0.1**
Red River	2254328	R2	0.1	0.0
Red River	2288183	R3	**1.3**	**0.1**
Red River	2359548	R4	-0.3	0.0
Red River	2380772	R5	-0.2	0.0
Red River	2400488	R6	**-3.2**	**0.2**
Red River	2437441	R7	**1.5**	**0.1**
Red River	2448951	R8	0.3	**0.1**
Red River	2515596	R9	0.4	**0.1**
Red River	2537700	R10	**-0.6**	**0.1**
Red River	2562789	R11	-0.3	0.0
Red River	2672724	R12	-0.4	0.0
Red River	2762274	R13	0.2	0.0
Rush River	394	Ru1	-0.1	0.0
Sheyenne River	63841	S1	-0.1	0.0
Sheyenne River	115599	S2	0.1	0.0
Sheyenne River	117965	S3	-0.1	0.0
Sheyenne River	158429	S4	-0.2	0.0
Sheyenne River	189121	S5	-0.2	0.0
Sheyenne River	230797	S6	0.1	0.0
Sheyenne River	255972	S7	-0.3	0.0
Sheyenne River	316964	S8	0.2	0.0
Sheyenne River	337323	S9	0.0	0.0
Wolverton Creek	3106	W1	0.2	**0.3**
Wolverton Creek	11329	W2	**0.9**	0.0

Source: WEST, 2012.

Of the 12 cross sections that showed change above the thresholds, in Table 3.10 (bold), some of the apparent causes of why the stream reach appeared to be above thresholds or unstable include:

- Potential bank failures that raised the elevation of the channel bottom (Buffalo River – B2, Wolverton Creek – W2).

- Potential anthropogenic impacts from the installation, modification or removal of structures (Maple River – M1, Maple River – M3, Red River – R6, Red River – R7, Wolverton Creek – W1 and Wolverton Creek – W2).
- Erroneous historical data. The historical 1978 cross section for the Red River was determined to be erroneous due to a coordinate system mismatch (Red River – R1, R3, R8, and R9). There was no way to align the datasets to a common system. It does not mean the data is wrong, there was just no direct correlation, and therefore, it would not be able to be included in the analysis.

This indicates that the 30 reaches exhibited variable rates of erosion, as detected using the data available, and ranging from -3.2 and 1.6 feet.

3.3.1.5 Sediment Transport and Channel Bed Stability

To help evaluate sedimentation patterns currently observed in the project area, the Geomorphology Report looked at averaged channel velocity and shear stress for bankfull conditions for general study reaches and compared them to published threshold values for soils types typically found to make up sediment and channel beds in the project area. Several studies have been completed that identify the suspended sediment load of the project area to consist primarily of silt and fine clay (USGS 2010, USACE 2012). The Feasibility Study, Phase 4, Appendix F -Hydraulic Structures, Exhibit I "Sediment Transport" (HMG, 2011) found that all of the waterways within the project area, with the exception of the Sheyenne River, are dominated by the transport of fine suspended material. The fine clay and silt lake plain sediments are known to be easily suspended, and tend to stay in suspension even during relatively low-flow conditions (MPCA 2006). The Sheyenne River system has coarser bed material and more course suspended sediment than the other affected rivers; however, studies completed do not indicate that it is transported in large quantities through the system (HMG, 2011). Colloidal sand is typical of the fine sands that make up the sediment from the surrounding watersheds. Streambanks in the area are found to typically consist of stiff clays.

The reach averaged bankfull, or channel forming velocities and shear stresses, are summarized in Table 3.11; the threshold values of soils provided in Table 3.12. The reach averaged values were found to be below the soil threshold value for stiff clay; however, almost all of the study reaches, with the exception of the Lower Rush Reach 2, were found to exceed averaged channel velocities and/or shear stresses for fine colloidal sand. This suggests that for flows equal to or less than bankfull flow, shear stress has enough force to mobilize fine sands in the channel but not enough force to erode the channel bed itself. For the flows higher than bankfull (flood flows) when the water has access to the floodplain, channel velocities and shear stresses do not significantly increase higher than at bankfull flow.

Table 3.11 Reach Averaged Channel Velocity and Shear Stress for Bankfull Conditions

General Study Reach	Q (cfs)	Average Channel Velocity (feet/second)	Average Shear Stress (pound/foot^2)
Buffalo 1	420	1.14	0.03
Lower Rush 1	65	1.01	0.07
Lower Rush 2	60	0.53	0.02
Maple 1	650	1.64	0.04

General Study Reach	Q (cfs)	Average Channel Velocity (feet/second)	Average Shear Stress (pound/foot^2)
Maple 2	650	1.44	0.04
Red River 1	4700	2.30	0.04
Red River 2	4280	2.68	0.06
Red River 3	2380	1.98	0.06
Red River 4	2380	1.82	0.07
Red River 5	2380	1.42	0.03
Red River 6	1780	1.39	0.05
Red River 7	1650	1.53	0.04
Red River 8	1650	1.74	0.06
Rush 1	150	1.35*	0.08*
Rush 2	150	1.48	0.08
Sheyenne 1	1900	2.49	0.17
Sheyenne 2	1750	1.84	0.11
Sheyenne 3	1680	1.78	0.11
Sheyenne 4	1030	1.80	0.14
Sheyenne 5	580	1.59	0.09
Sheyenne 6	860	1.65	0.09
Sheyenne 7	1200	1.72	0.11
Sheyenne 8	1000	1.48	0.10
Wild Rice 1	6000	1.06	0.04
Wild Rice 2	6000	1.29	0.06
Wild Rice 3	517	1.08	0.02
Wild Rice 4	517	1.28	0.05
Wild Rice 5	517	0.98	0.03
Wild Rice 6	517	1.21	0.05
Wolverton 1	130	1.72	0.14
Wolverton 2	130	1.79	0.10

* Does not include velocity and shear stress from XS 11119 (weir) due to significant skewing

Source: WEST, 2012.

Table 3.12 Threshold Values for Shear and Velocity

Boundary Type	Permissible Velocity (feet/second)	Permissible Shear Stress (pound/foot^2)
Fine Colloidal Sand	1.5	0.02-0.03
Stiff Clay	3-4.5	0.26

Source: WEST, 2012.

Results of the Geomorphology Report indicated the channels that would be affected by the Project are not prone to significant changes, mainly because of the erosion resistant nature of the cohesive glacial lake bed clay soils and the very flat gradient of the channels that prevents significant changes in channel cross section geometry. The channels appear to have sufficient capacity to transport nearly all of the sediment supplied from upstream and the surrounding landscape since it is generally composed of silt and clay-sized material with only minor amounts of sand-sized material. The clays and silts that form the bed of the streams originated from the buildup of successive layers of fine sediments that were deposited within glacial Lake Agassiz (Stoner et al., 1993). These layers of fine sediments have compacted over time, resulting in the formation of a “hardpan” channel bottom (WEST, 2012).

3.3.2 Environmental Consequences

Stream stability of the Red River and its tributaries are influenced by flood flows and changes in river stages. Stream stability can be influenced by the hydrology of the watershed as it impacts channel hydraulics, stream bank vegetation, and sediment transport. These impacts can lead to channel migration, bank sloughing, and changes in stream bed elevation, for example.

3.3.3 Proposed Project

The Project would create a diversion channel, river-crossing aqueducts, and staging area, including new inundation area, which would limit the magnitude of high flow events for most of the river and stream channels, altering the natural hydrology of the project area. The extent of hydrology modification would be dependent on the location in the project area. Hydrology upstream of the tieback embankment would be modified by increased depth and duration of flooding in many areas and new inundation in other areas. Hydrology downstream of the tieback embankment would be more limited to less frequent flood flows within the protected area.

Project operation is anticipated to occur primarily during the spring melt months of March and April. Floods have been recorded in the project area in the months of May and June, but they have typically been shorter in duration and not as frequent (FFREIS 2011). Project operation would reduce flows to the 100-year flood or 17,000 cfs at the Fargo gage; the river reaches would still experience normal range of flows including flows which exceed the bankfull or channel forming flows.

3.3.4 Project Area

Using the evaluation methods previously described in Section 3.3.1, the Geomorphology Report evaluated susceptibility of the river reaches with hydrology modified by the Project and the confluence of the diversion channel with the Red River for historical geomorphological changes. The Geomorphology Report indicated that in general, except for two reaches (Rush River 1 and Lower Rush River 1) there would be no expected major changes to geomorphology as a result of the Project. The Rush River 1 and Lower Rush River 1 reaches are going to be completely diverted into the diversion channel with the natural channel downstream of the diversion channel abandoned. It is predicted that these stream segments would only receive local inflows downstream of the diversion channel and may become aggraded from sediment deposited by the Sheyenne River and flood events, if those reaches no longer have the stream power to transport the accumulated sediment.

Expected changes to the geomorphology of each channel reach studied in the Geomorphology Report are summarized in Table 3.13. Additional details and discussions on these findings are provided in the sections that follow the table.

Table 3.13 Predicted Geomorphology Impacts Resulting from LPP Diversion Channel Alternative1

General Study Reach	Bank Stability	Channel Migration Rate	Bankfull Depth	Bankfull Width	Riparian Vegetation Density	Predicted Discernible Changes to Geomorphology
Buffalo River 1	0	0	0	0	0	No
Lower Rush River 1	0	0	-	-	+	Yes
Lower Rush River 2	0	0	0	0	0	No
Maple River 1	+	0	0	0	+	Minor
Maple River 2	0	0	0	0	0	No
Red River 1	0	0	0	0	0	No
Red River 2	+	0	0	0	+	Minor
Red River 3	+	0	0	0	+	Minor
Red River 4	+	0	0	0	+	Minor
Red River 5	+	0	0	0	+	Minor
Red River 6 downstream of diversion	+	0	0	0	+	Minor
Red River 6 upstream of diversion	-	0	0	0	-	Minor
Red River 7	-	0	0	0	-	Minor
Red River 8	0	0	0	0	0	No
Rush River 1	0	0	-	-	+	Yes
Rush River 2	0	0	0	0	0	No
Sheyenne River 1	+	0	0	0	+	Minor
Sheyenne River 2	+	0	0	0	+	Minor
Sheyenne River 3	+	0	0	0	+	Minor
Sheyenne River 4	+	0	0	0	+	Minor
Sheyenne River 5	0	0	0	0	0	No
Sheyenne River 6	0	0	0	0	0	No
Sheyenne River 7	0	0	0	0	0	No
Sheyenne River 8	0	0	0	0	0	No
Wild Rice	+	0	0	0	+	Minor

General Study Reach	Bank Stability	Channel Migration Rate	Bankfull Depth	Bankfull Width	Riparian Vegetation Density	Predicted Discernible Changes to Geomorphology
River 1						
Wild Rice River 2	+	0	0	0	+	Minor
Wild Rice River 3	-	0	0	0	-	Minor
Wild Rice River 4	-	0	0	0	-	Minor
Wild Rice River 5	0	0	0	0	0	No
Wild Rice River 6	0	0	0	0	0	No
Wolverton Creek 1	+	0	0	0	+	Minor
Wolverton Creek 2	-	0	0	0	-	Minor

(0) No Change, (+) increasing, (-) decreasing

Source: WEST, 2012.

[1]LPP Diversion Channel Alternative for the purposes of this EIS is considered the Project.

3.3.4.1 Protected Area Stream Stability (Downstream of the Tieback Embankment)

For areas with modified hydrology due to the diversion channel, riparian vegetation would not experience extended periods of inundation by floodwaters nor significant burial by overbank sediment deposits. Additionally, damage to riparian vegetation from ice flows is expected to be reduced because of the reduced probability of flooding. The trees and shrubs would be expected to encroach on the channel compared with current conditions which may result in less bank slumping. An example of the riparian conditions that may be expected to occur along reaches protected by the diversion channel is Sheyenne River Reach 5 which is currently protected from flooding by the West Fargo Diversion (WEST 2012).

3.3.4.2 Inundation Area Stream Stability (Upstream of the Tieback Embankment)

The inundation area would be created through the construction of a tieback embankment which would receive diverted floodwaters from the Red and Wild Rice Rivers through hydraulic control structures on these rivers. It is anticipated that the area that would experience the majority of the inundation (both in depth, duration, and new inundation) would be within the defined staging area. The frequency of Project operation would be tied to a flow threshold (e.g., 17,000 cfs in the Red River at Fargo), which is equal to or larger than the bankfull discharge of the Red River or a 10-year flood event (10-percent chance flood).

The Project modeled water elevations immediately upstream of the Red River control structure for a 10-year flood which would exceed 906 feet (an elevation a few feet above bankfull) approximately seven days longer than existing conditions (USACE FFREIS, July 2011). A longer duration of inundation associated with the Project could potentially reduce soil strength in bankline areas. The risk would be greatest at the outer face, or outside bend of the bank. Results from the Geomorphology Report suggested that while the duration of flood events could vary, the incremental differences in durations (with Project versus existing conditions) generally under consideration are not expected to substantially change soil strength conditions; therefore, changes in the stability of the outer face of the lower bank due to Project operation would be expected to be small if they occurred. In addition, the Geomorphology Report concluded the stability of a larger portion of the lower bank, as well as the upper bank, would not likely be substantially affected by a small increase in duration of bankfull conditions. However, an important factor to consider is that bank failures currently occur within this system (project area) and extended inundation durations could exacerbate the issue.

Bank failures are often triggered or exacerbated by receding water levels, with failures most influenced under the following conditions: 1) drought conditions, where water elevations are reduced to levels below those that have occurred for many previous weeks, months or even years; and 2) receding water levels associated with the diminishing limb of a flood hydrograph (FFREIS 2011). Bank failures can also be caused by other factors that increase the weight or pressure on the soil of the bank including undercutting of the bank, sediment deposition, soil moisture, or loss of bank vegetation, or other characteristics.

The floodplain forest occurs within the narrow riparian zone in the inundation area that is typically associated with potential stream stability impacts and currently experiences flooding events. Compared to the existing 100-year flood, the Project would result in deeper water surface elevation and longer duration of flood inundation of the banks in the staging area during flood events in the inundated area. Riparian vegetation along the bank is beneficial in removing water weight and pressure from the clayey soils of the banks. This may result in impacts to riparian vegetation, which may increase the risk of bank instability. Without the water removal assistance of the vegetation, the clayey banks could be more prone to collapse.

An example where an increase in bank failures may occur is along the Red River Segment 7 (Table 3.13 above). Although the Geomorphology Report results indicate that the Red River Segment 7 is anticipated to minor changes in geomorphology due to the Project, slumping increases would be expected in this reach (impoundment area) due to increased duration of high water, increased bank saturation, and increased deposition and bank height. Rotational bank failures in the area upstream of the F-M urban area occur more frequently where the forest has been removed from the corridor. Increased moisture in the soils due to reduced evapotranspiration rates from loss of trees and root structure are a likely cause of rotational bank failures in this area, usually occurring after receding high water events.

Pertaining to sedimentation, Project operation would likely increase the amount of sedimentation that occurs within the inundation area as a result of the impoundment. This would be expected to occur primarily within the defined staging area and nearest to the water control structures; however, all inundated areas, particularly those with lower elevations, would likely experience some level of sedimentation.

Sedimentation would be anticipated to occur incrementally over several decades (occurring during all flow events within the channel and throughout the floodplain and newly inundated areas during flood events) and therefore, is not anticipated to result in significant immediate effects to areas within the inundated area. Flood events that occur more frequently, such as the 10-year food event, would be expected to contribute more to the accumulated sediment over time than large, more infrequent flood events such as the 500-year flood (0.02-percent flood). Long-term effects from sedimentation over several decades could lead to or contribute wetland-type changes, bank slumping, and changes in riparian vegetation composition and density for example.

The majority of the floodplain species are adapted to inundation by floodwaters and partial burial by sediment during the dormant season (USACE 2012). However, riparian vegetation occurring in reaches within the inundation area would be subject to longer durations of inundation and greater burial by overbank sediment deposits. Flood events are more likely to occur in the months of March and April when the vegetation is dormant and less susceptible to die off; however, if the inundation by floodwaters extends into the growing season, plants are likely to be stressed, which could make them susceptible to disease and insect infestations. Additionally, there could be greater damage from ice flows. As a result, trees and shrubs may tend to retreat from the stream channel. If this occurs, seasonal grasses or other vegetation types better suited to such conditions would become more prominent in these areas. Reduced tree and shrub density could contribute to an increased rate of bank slumping as discussed previously. An example of the riparian vegetation conditions that might be expected within the riparian corridors is shown in Illustration 3-3 (Figure 9-7 from the Geomorphology Report), which is a photo that was taken along Sheyenne River Reach 1 following the spring and summer flood of 2011 (WEST 2012).

Illustration 3.3: Riparian Vegetation Conditions along Sheyenne River – 1

Based on the available information, impacts on channel morphology as a result of changes in the riparian vegetation conditions are anticipated to be minimal as the average value of the percent bare earth on all of the reaches observed in the Geomorphology Report is about 55 percent (see Table 3.12: Rosgen Level III Riparian Vegetation Survey). Instead, it is concluded that bank saturation and possible buildup of sediments on the banks may likely be a greater factor in causing possible bank instability than vegetation conditions. However, there are some considerations for the Geomorphology Report conclusions. These analyses were based on aerial photograph (historical and current) interpretations and a riparian vegetation survey as noted above. Observations for aerial photographs are limited to the top-most community present. It is not possible, for example, to determine understory density or composition if a tree is present. For both the aerial and field vegetation survey analyses, root density or root depth could not be verified or was not collected, respectively.

Roots, particularly for tree species, can spread far and help reduce soil moisture through evapotranspiration thus providing support to the bank. As mentioned above, sedimentation within the inundation is anticipated to increase, although incrementally over decades. Further studies would need to be completed to determine how much of a role vegetation plays in bank stability within this system.

Potential impacts from additional flooding due to Project operation could occur to vegetation communities, such as floodplain forest, outside the riparian zone that are not adapted to periodic flooding. A discussion of these impacts is provided in Section 3.4 – Wetlands and Section 3.6 – Cover Types.

3.3.4.3 Bed Scour at Water Control Structures

Final design detail of the hydraulic structures and the operating plan were not available for inclusion in the EIS analysis. The potential for bed and channel scour at the water control structures would primarily be a result of outlet shear stress and velocity from the control structures. To counteract the potentially high shear stresses and velocities, energy dissipation technologies would be incorporated into the structure designs. Estimates of permissible shear stress and velocity for soils (channel bed substrate is cohesive clay) adjacent to water control structures are provided in Tables 3.11 and 3.12.

3.3.4.4 Base No Action Alternative

The Base No Action Alternative does not interrupt the historical or current function and condition of the geomorphic processes. The Base No Action Alternative would result in the continued threat of flood damage to the cities and infrastructure in the project area during high water events. This would cause no significant change in the current geomorphic processes observed.

3.3.4.5 No Action Alternative (With Emergency Measures)

The No Action Alternative (with Emergency Measures) would be the same as the Base No Action Alternative but would provide additional protection for adjacent floodplain areas within the urbanized area of Fargo and Moorhead by utilizing emergency measures such as sandbagging and temporary levees. Implementation of emergency measures during significant flood events may cause some increases in upstream flood elevations. Implementation of these measures is not anticipated to significantly change the depth, rate or duration of flow in the project area, resulting in no significant change in the current geomorphic processes.

3.3.4.6 Northern Alignment Alternative

The NAA would shift the control structure and tieback embankment on the Red River and Wild Rice River to the north approximately 1.5 miles. Similar to the Project, the NAA tieback embankment would cross Reach 2 of the Wild Rice River and Reach 6 of the Red River, but at points further downstream within the same reaches as the Project. The NAA tieback embankment would move further downstream from the confluence of the Red River and Wolverton Creek compared to the Project, as shown in Figure 6.

The assessment of stream stability (WEST, 2012) used several methods to evaluate the historic and current stream conditions in the project area. The Geomorphology Report found that stream reaches in the project area are stable, showing little significant change over time. Construction and operation of the NAA are expected to result in potential impacts similar in magnitude to those previously described for the Project. In general, construction and operation are not expected to significantly impact the stability of the affected reaches within the project area.

The NAA would alter the inundation area and relative depths of inundation for the reaches within the staging area, as well as the extent and location of the overall flood inundation area. Portions of Reach 2 of the Wild Rice River and Reach 3 of the Red River would be inundated as part of the NAA staging area that would have been protected under the Project. Compared to the Project, the NAA would remove portions of some reaches that are further upstream from new inundation caused by operation. As discussed in 3.3.2.2 Inundation Area Stream Stability (Upstream of Tieback Embankment), potential impacts from the Project to stream stability could result from several factors that increase the weight or pressure on the soil of the bank including undercutting of the bank, rapid drawdown of water elevation (i.e., receding water levels) in the stream channel after saturation of the bank soil, sediment deposition, soil moisture, or loss of bank vegetation, and other characteristics. Operation of the NAA could result in similar impacts to stream stability to affected reaches in the inundation area.

Mitigation and monitoring measures for the NAA would be similar to those identified and described for the Project. Similar to the Project, NAA mitigation and monitoring would include implementation of the EIS Draft AMMP included as Appendix B. The EIS Draft AMMP includes monitoring to assess potential impacts to stream stability, pre-construction and post-Project operation. These potential monitoring activities as well as others are discussed further in Section 3.3.5 – Proposed Mitigation and Monitoring.

3.3.5 Proposed Mitigation and Monitoring Measures

The Geomorphology Report and other supporting data collected (e.g., sediment transport studies) suggests that based on the information collected so far, the Project is not likely to have a significant effect on stream stability and geomorphology throughout the potentially impacted/affected environment. However, because of the magnitude and variation of changes (impoundment, diversion channel, cutoff channels, mainstem) and the extent of stream and riparian area potentially affected (+80 miles of river channel) by a project of this size, and the uncertainty that exists within the associated fields of science (climate, hydrology, sediment erosion and transport), monitoring and adaptive management are essential for tracking and validating assumptions and adjusting management of the project according to significant findings.

Monitoring plans and potential mitigation measures for the Project were identified in Attachment 6 of the FFREIS. Pertaining to potential impacts to geomorphic processes, the USACE proposed completing geomorphic assessments that would be used to determine whether or not the Project impacted physical aquatic habitat and river processes and to what extent. These would be completed through an adaptive management approach. Pre- and post-Project construction and operation monitoring for stream stability through geomorphic assessments would be completed with results evaluated to determine if Project operation has an impact on stream stability, which may require mitigation or other measures, such as altered operation of the Project or stream stability mitigation.

As discussed above, the Geomorphology Report and additional data to support the geomorphic assessments such as Light Detection and Ranging (LiDAR) (2008 and 2009), bathymetry (2010) and sediment transport studies (2010 and 2011) used in the preparation of this section, were conducted in part, to fulfill the pre-Project monitoring identified in Attachment 6.

According to the Attachment 6, Monitoring Plan for Geomorphology, geomorphic surveys would be performed once prior to construction, which was already completed as part of the Geomorphology Report, and at least twice following construction. The timing of post-construction monitoring is still being identified. Geomorphic changes are often triggered by flood events, and therefore, changes may not occur until one or more 10-year floods have occurred in the project area, making scheduling specific years for post-construction geomorphic surveys difficult. However, the first post-construction assessment would potentially be five to ten years following Project completion. The second assessment would potentially be twenty years following Project completion. Additional future geomorphic surveys could be warranted, the need for which would be collaboratively discussed by the Adaptive Management Team (AMT).

Since the FFREIS, the USACE and Diversion Authority have continued working with the MNDNR as well as other agencies and local governments on developing and revising approaches outlined in Attachment 6 for pre- and post-Project construction and operation monitoring. The EIS Draft AMMP included as Appendix B, which includes additional and more detailed pre- and post-Project construction and operation monitoring plan, is an example of this collaborative effort. The EIS Draft AMMP is built off of the Attachment 6 proposed survey monitoring plan, ongoing communications, and studies completed to date, such as the Geomorphology Report, as discussed above.

Further evaluation of the Attachment 6 Monitoring Plan, subsequent studies findings and additional recommendations are discussed in Chapter 6 and within the EIS Draft AMMP included as Appendix B. It is important to note however, that although the EIS Draft AMMP was a collaborative agency and local government effort, the Draft AMMP was prepared for use in this EIS and therefore also includes MNDNR recommendations for the AMMP approach, specific protocol, and additional studies different to or above that which the USACE and Diversion Authority have proposed. The USACE Adaptive Management Plan (AMP) and the EIS Draft AMMP will continue to be revised through ongoing cooperation efforts, as pre-Project construction and operation monitoring results are assessed, Project designs are finalized, and as Project permitting requires.

3.4 WETLANDS

Wetland is a general term that refers to land where saturation with water is the dominant factor determining the nature of soil development and the types of plant and animal communities living in the soil and on its surface (Cowardin, December 1979). The Clean Water Act defines the term wetland as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas." Differences in soil, topography, climate, hydrology, and human disturbance, along with other factors influence wetlands.

The FFREIS and Supplemental EA evaluated the potential impacts the Project would have on the wetlands in the project area. The FFREIS included a wetland assessment of the project area that provided a baseline for existing conditions. Additional wetland evaluation was completed for the Supplemental EA and updated in the Scoping Environmental Assessment Worksheet (SEAW) to identify Project impacts. The FFREIS and Supplemental EA addressed specific wetland resources for the proposed diversion channel, tieback embankment, and associated facilities (i.e., Project footprint). Other direct or indirect potential wetland impacts from the inundation area have been estimated using the National Wetlands Inventory (NWI) as described in this section.

This section provides updated and additional detail beyond the information provided in the previously completed environmental review documents. Conditions under the Project, Base No Action Alternative, the No Action Alternative (with Emergency Measures), and the NAA are described below. Proposed mitigation and monitoring measures for wetland replacement are also described below.

3.4.1 Affected Environment

3.4.1.1 Existing Conditions

The project area is largely a flat plain which at one time was the lake bed of ancient glacial Lake Agassiz. The lakebed contains fertile silty and clayey soils, which when drained, provide land suitable for agriculture. Historically this area was comprised of tall grass and wet prairies. According to the 1997 Minnesota Wetlands Conservation Plan (MNDNR 1997) less than 20 percent of the native wetlands in the Moorhead area and upstream sub-basins remain.

3.4.1.1.1 Wetland Acreage and Type

Existing wetland resources within the Project footprint and new inundation area were previously inventoried and assessed for direct impacts as part of the FFREIS. Inventoried wetlands were then classified using off-site review methodology with field verification/determinations. Off-site review utilized remote sensing of NWI mapping, soil survey mapping, USGS topographic maps, LiDAR imagery, and multiple years of aerial photography. Wetland functional assessment was also completed and results included in the FFREIS.

The 8,727 acre project footprint (i.e., diversion channel, embankment and associated facilities), is categorized by six main cover types (see EIS Section 3.6 – Cover Types for further details) which include wetlands. Of the six different cover types in the project footprint, wetlands represent approximately 20 percent or approximately 1,780 acres.

To assist with overall impact assessment the somewhat generic "wetland" cover type has been further broken down or classified using the Circular 39 system (Shaw and Fredine, 1971) and Eggers and Reed (Wetland Plants and Plant Communities of Minnesota and Wisconsin, USACE, St. Paul District, 1997). The Circular 39 wetland classification system was created for Minnesota wetlands. Table 3.14 provides a description of the wetland types and acreages in the Project footprint as described by Eggers and Reed classification and Circular 39 classification systems.

Table 3.14 Wetland Types, using the Eggers & Reed and Circular 39 Classification Systems, Present in the Project Footprint

Eggers and Reed	Circular 39	Current (acres)
Seasonally Flooded Basin: poorly drained, shallow depressions that may have standing water for a few weeks each year, but are usually dry for much of the growing season; frequently cultivated; when not cultivated, wetland vegetation can become established.	Type 1	1,483
Fresh (Wet) Meadow: grasses and forbs growing on saturated soils; may represent younger communities that indicate recent disturbances of other inland fresh	Type 2	127

Eggers and Reed	Circular 39	Current (acres)
meadows by drainage, siltation, cultivation, pasturing, peat fires and/or temporary flooding. Once established, the forbs and grasses of the fresh (wet) meadow community may persist for extended periods of time.		
Shallow Marsh: soils are saturated to inundated by standing water up to 6 inches in depth, throughout most of the growing season (Shaw and Fredine 1971). Herbaceous emergent vegetation characterizes this community.	Type 3	108.5
Floodplain Forest: Dominated by mature, deciduous hardwood trees growing on alluvial soils associated with riverine systems. Soils are inundated during flood events, but are usually somewhat well-drained for much of the growing season (Shaw and Fredine 1971). Floodplain forests typically include the northern and southern wet- mesic hardwood forest associations described by Curtis (1971). The shrub layer is typically sparse to lacking because of frequent flooding.	Type 1	62
Shallow Open Water Communities: general water depths of less than 6.6 feet (2 meters). Submergent, floating and floating-leaved aquatic vegetation.	Type 5	1
Shrub-Carr: tall, deciduous shrubs growing on saturated to seasonally flooded soils; ground layer species diversity dependent on degree of shrub canopy cover, degree of disturbance, and water source. Relatively undisturbed shrub-carrs may have a ground layer with a rich diversity of species.	Type 6	1.5

Source: Eggers & Reed, Circular 39, FFREIS, Supplemental EA, and SEAW

There are wetlands located outside of the Project footprint that currently become inundated with floodwater during high flow events as well as wetlands that would become newly inundated with the Project. Some of these wetlands are identified on the NWI and could be classified using Eggers and Reed and Circular 39. Wetlands outside of the Project footprint within new inundation areas have not been field verified to quantify and accurately classify. Additional discussion on wetland impacts from the Project, including an analysis of potential wetland impacts in new inundation areas, are discussed in Section 3.4.2.

3.4.1.1.2 Wetland Function

Wetlands provide a variety of functions such as flood water storage, nutrient and sediment removal, fish and wildlife habitat, and recreational opportunities. The MnRAM, Version 3.3 was used by the USACE for the FFREIS to determine the functional assessment of wetlands in the Project area. Field data gathering and MnRAM was completed on approximately 25 representative wetlands of all types and classifications as presented in Appendix F of the FFREIS. MnRAM was created by the Minnesota Board of Water and Soil Resources (BWSR, 2009) to assess wetland functions. The USACE also recognizes the MnRAM methodology to assess existing wetland functions (USACE, 2009). The MnRAM assessment tool is a qualitative rating based on a field assessment of a variety of wetland features including plant community, water regime, flood and storm water storage, water quality, fish and wildlife habitat, and aesthetics and recreational value. The MnRAM assessment produces a functional value rating for an assessed wetland, with a rating at one of four levels. The four MnRAM functional value ratings are described in Table 3.15.

Table 3.15 MnRAM Functional Assessment Ratings

Functional Rating	Description
Exceptional	Highly diverse native plant community; rare/unique habitat or features related to wildlife, fish; aesthesis, groundwater, or water quality.
High	Limited disturbance to wetland; diverse native plant community; provides some combination of high quality wildlife and aquatic habitat, flood storage, water quality protection, and/or aesthetics and recreational opportunities.
Medium	Low to moderate amount of disturbance; mixture of native and invasive species; mixture of low quality wildlife and aquatic habitat, flood storage, water quality protection, and/or aesthetics and recreational opportunities.
Low	High level of disturbance; dominated by non-native or invasive species; provides limited to no wildlife or aquatic habitat, flood storage, water quality protection, and/or aesthetics and recreational opportunities.

Source: Minnesota Routine Assessment Methodology for Evaluation Wetland Functions, Version 3.3

As indicated in Table 3.14, the vast majority of wetlands are seasonally flooded basins (potholes) that are located on agricultural land. Based on the representative functional assessments completed, wetlands found within the active agricultural lands provide limited levels of function due to the extensive drainage and overall alteration that has taken place. Due to extensive drainage systems, seasonally flooded wetlands generally provide low function for Maintenance of Hydrologic Regime and Maintenance of Wetland Water Quality.

Depressional wetlands within agricultural fields can, however, generally provide moderate to high function for Flood/Storm Water Attenuation and also for Downstream Water Quality. Those wetlands that have been shaped into shallow field ditches provide a moderate level of flood/storm water attenuation because they are able to hold some of the water on the landscape for at least a short period of time. All field wetlands provide a moderate level of function for protection of downstream water quality because they are able to filter at least some of the nutrients from the agricultural runoff before the water enters nearby waterways.

3.4.1.2 Regulatory Framework

Wetlands are protected in Minnesota under state and federal laws, including the Minnesota Wetland Conservation Act (WCA) (Minnesota Rules Chapter 8420), and the Clean Water Act (CWA) Section 404. In addition, some wetlands are also designated as Minnesota Public Waters and subject to Minnesota Rules Chapter 6115. North Dakota does not have a state wetland law; however CWA Section 404 does apply.

Both the state and federal wetland regulations require that a permit, approval, and/or certification be issued by the regulatory agency for wetland impacts as defined by the respective regulations (hereafter referred to as “permitted”). For the Project, both the St. Paul and Omaha USACE Districts are working together as the permitting authority for federal CWA Section 404 permits. The Minnesota Pollution Control Agency (MPCA) has authority in Minnesota to issue a CWA Section 401 water quality certification on the CWA Section 404 permit. In North Dakota, the North Dakota Department of Health (NDDH) has authority to issue a 401 water quality certificate.

Regulatory processes require documentation of existing wetland boundaries, proposed wetland impacts (sometimes including functional assessment analyses), and documentation of project sequencing. Project sequencing includes wetland impact avoidance and minimization efforts, as well as proposed mitigation for unavoidable impacts. State and federal regulatory processes differ with respect to the definition of wetlands/waters that are regulated in each process and can also differ in determination of mitigation requirements.

CWA applies to Waters of the U.S., which include jurisdictional wetlands and lakes. However, isolated wetlands and other water bodies, such as those that do not have a surface water connection to a navigable water of the U.S., a sufficient connection to interstate commerce other than their use by migratory birds, or a “significant nexus” (a connection affecting the biological integrity of an adjacent federal navigable water) are not regulated under Section 404 of the CWA (SWANCC decision of 2001; Rapanos decision of 2006).

In contrast, WCA regulates isolated wetlands, but does not regulate wetlands created for a purpose other than to create the wetland, i.e., incidental wetlands (Minnesota Rules, part 8420.0105, subp. 2D). Therefore, most, if not all, of the wetlands and other water bodies within the Project footprint would be regulated through either CWA or WCA (or both for Minnesota wetlands). Regardless, all wetlands in Minnesota are regulated by MPCA under nondegradation rules; Minnesota Rules, part 7050.0185.

The Public Waters Inventory (PWI) described in Minnesota Statute 103G.005 identifies waters and wetlands under the jurisdiction of the MNDNR Division of Waters (now Division of Ecological and Water Resources). Public Waters within the project area in Minnesota include the Red River, Wolverton Creek, Unnamed Tributary to the Red River (T138 R48), and Unnamed Tributary to the Red River (T140 R48). North Dakota does not have a PWI classification system or a similar system; however, the rivers within the project area in North Dakota are the Wild Rice, Sheyenne, Maple, Lower Rush, and Rush Rivers, along with numerous wetlands.

The USACE can also claim regulatory authority over a water body, such as a wetland, through a jurisdictional determination. Once determined jurisdictional by the USACE, impacts to a water body would be regulated under Section 404 of the CWA.

3.4.2 Environmental Consequences

The location of rivers, existing structures, and Project functionality influence the Project route, and therefore route design options to completely avoid wetland impacts are not practicable at the scale necessary to meet the purpose of the Project. Design constraints include natural river channels, transportation infrastructure, safety, economics, and property ownership issues. For these reasons, no complete wetland avoidance alternatives are practicable for the Project.

The sections that follow describe the anticipated direct wetland impacts, potential indirect wetland impacts, and proposed mitigation for unavoidable wetland impacts.

3.4.2.1 Proposed Project

3.4.2.1.1 Direct Impacts

Project components that would impact wetlands include: the diversion channel, connecting channel, excavated material berms, shallow drainage ditches outside the berms, tieback embankment, roads, control structures in the Red and Wild Rice Rivers, and hydraulic structures in the Maple and Sheyenne Rivers. The Oxbow, Hickson, and Bakke (OHB) ring levee and Comstock ring levee construction would also directly impact wetlands, but Comstock ring levee impacts have yet to be quantified. Direct impacts could include dredging, draining, filling and the excavation of wetlands. Direct wetland impacts are not anticipated for the inundation areas. These areas would be temporarily inundated with flood water, which currently occurs in some areas, but would not include Project construction associated with permanent alteration of wetland.

Other project features that were calculated as direct wetland impacts include: wetlands within the footprint of the shallow drainage ditches on the outside of the berms (Jonathon Sobiech, USACE St. Paul District, April 7, 2014 meeting), a construction road planned along the outside edge of these drainage ditches, and wetlands within the right-of-ways for shallow drainage ditches and construction road which vary between 50 and 100 feet in width.

As mentioned above, construction of the Comstock ring levee would result in direct impacts to wetlands that are not included in the Project footprint impacts shown in Table 3.16. Exact wetland acreage impacts are currently unknown and it is the responsibility of the Diversion Authority to follow WCA and Section 404 requirements for delineating wetlands during project development. An aerial photograph review of the general area of the Comstock ring levee indicates that the current land use is predominantly agricultural row crops. These fields include existing surface ditches and subsurface drain tiles that have effectively drained the majority of pre-settlement wetlands. Therefore, it is estimated that less than five acres of wetland could be impacted by the Comstock ring levee construction. The wetland impacts from the construction of the Comstock ring levee, once quantified, would require permitting through WCA and Section 404, including implementation of applicable mitigation.

The Drayton Dam Mitigation Project would include work in the Red River and its floodplain. The majority of project work would occur directly in the river. This habitat is primarily riverine and not wetland. However, the project site does include small areas of adjacent floodplain, and these low lying floodplain areas could be considered wetlands, which would be determined through the WCA process administered by Kittson County.

The United States' Fish and Wildlife Service (USFWS) National Wetland Inventory data was reviewed to identify and confirm the presence of wetlands outside the project footprint (as described above). Prior to construction, additional wetland delineation would be completed as part of the WCA process. Most of the wetland areas within the Drayton Dam project footprint are along the Minnesota bank. The 0.5-acre area along the Minnesota bank where erosion protection and weir placement would occur would likely be considered wetland. This footprint area would be permanently changed. The grading area on the Minnesota bank just upstream of the proposed structure also may include wetland. This area would be disturbed through grading but would be revegetated. Its form may change slightly; however, it is small (approximately 0.2 acres) and would remain as river floodplain.

The total direct impact to wetlands (forested and non-forested) from the Project footprint and the OHB ring levee is estimated to be 1,820 acres (Table 3.16). Table 3.16 compares and summarizes the total wetland impacts in the Project footprint and OHB ring levee by Eggers and Reed Classification. Table 3.16 indicates that 99 percent of the wetlands existing within the Project footprint are likely to be impacted. Small remnant wetlands may remain adjacent to the Project footprint but would likely be considered an indirect impact by changing the type and would require applicable mitigation. It should be noted that direct wetland impacts for the Comstock ring levee and Drayton Dam project are not included in the table below as impacts have not been determined as previously discussed above.

Table 3.16 Estimated Direct Wetland Impacts by Wetland Type

Wetland Type (Eggers and Reed)	Diversion/Embankments (acres)	Control/Hydraulic Structures in Red, Wild Rice, Maple and Sheyenne Rivers (acres)	OHB ring levee (acres)
Shallow Open Water Communities	1	0	0
Seasonally Flooded Basin	1,477	0	44
Shallow Marsh	106	0	4
Shrub-Carr	1	0	0
Fresh (Wet) Meadow	120	0	5
Floodplain Forest	31	31	0
Total Acres	**1,736**	**31**	**53**

The majority of the impacted wetland acreage in the Project footprint and OHB ring levee is farmed Seasonally Flooded Basins (1,477 and 44 acres respectively). As noted above, the remaining function of these basins is generally low since they are farmed, temporarily wet basins usually devoid of emergent vegetation. However, the basins meet the wetland definition since the “Atypical” section of the 1987 USACE Wetlands Delineation Manual allows the vegetation parameter to be assumed if, in the best professional judgment of the wetland delineator, hydrophytic vegetation would be present in the absence of farming. Therefore, these farmed basins meet jurisdictional wetland criteria, but are considered to be of low function.

In total, the USACE estimated that 124 acres of forest would be impacted by the Project. For this EIS, additional review of the Project footprint on aerial photographs was completed to evaluate floodplain forest, upland shelterbelts, and other wooded non-wetland areas. Based on this review, it is estimated that approximately half of the 124 acres of forest impacts would be to floodplain forest wetlands. This would equate to a total estimated floodplain forest wetland impact of 62 acres as shown on Table 3.16.

3.4.2.1.2 Indirect Impacts

Indirect wetland impacts are considered those impacts that result from the Project, but are not caused by the direct impact from construction of the Project footprint. Indirect impacts from the Project include changes in hydrology of wetlands, sedimentation occurring over time in the inundation area, and temporary flood inundation occurring due to Project operation.

Indirect wetland impacts could occur from: changes in hydrology of wetlands as a result of drainage patterns being cut off by the diversion channel or the OHB ring levee construction; the diversion channel creating a lower potential drainage gradient toward which subsurface water might flow; and/or drainages being created that would drain wetlands toward the channel or into the shallow drainage ditches that have been designed along the outside of the berms.

Most of the wetlands in the project area are underlain with fine-textured soils, and therefore, wetland loss that might occur from cutting off drainage to wetlands is expected to be minor since most wetlands outside the Project footprint rely on surface water runoff and have relatively small catchment areas. Potential drainage impacts on wetlands outside the Project footprint are unlikely since any such wetlands would be far enough away from the diversion channel that a hydrologic connection would not exist (Illustration 3-4 below).

Indirect wetland impacts by changing the wetland type could occur from the diversion channel bisecting the Rush and Lower Rush Rivers. Where the diversion channel intersects these rivers, the two rivers would be diverted into the diversion channel and the lower 2.5 miles of each would be abandoned and no longer receive water from the historic upstream catchment area. After Project construction, the contributing watershed to these channels would be limited to local runoff, which is not anticipated to cause wetland loss, but a change in function to the remaining wetlands. Acreages associated with the change of wetland function for the Lower Rush River and Rush River would be offset by the channel design within the diversion channel, which would be considered mitigation for the change in wetland function from river channel abandonment.

The NWI dataset was reviewed to approximate the potential indirect wetland impact caused by new inundation within the project area (Table 3.17). NWI classifications were interpolated to Eggers and Reed classifications, and Circular 39 types for comparison. Field verification would be necessary to more accurately reflect existing acreages and types as well as confirm potential impacts. The majority of potential impacts would be to Type 5 shallow open water and shallow open water communities.

Table 3.17 Estimate of Indirect Wetland Impacts from New Inundation During the 100-year Flood

Wetland Type	Current (acres)
Open Water	0
Type 1 (farmed)	18
Type 1 (floodplain forest)	0.2
Type 2 (fresh (wet) meadows)	0
Type 3 (Shallow Marsh)	13
Type 4 (deep marshes)	2
Type 5 (shallow open water and shallow open water communities)	116
Type 6 (shrub swamp)	1
TOTAL ACRES	**151**

Additionally, Project operation may increase inundation of some wetlands in the project area compared to flood events occurring under existing conditions. The additional inundation from the Project could result in changes to the existing vegetation communities; however, length of inundation is anticipated to be temporary and cause seasonal flooding similar to existing conditions. Flood duration, depth, and associated drainage or infiltration rate changes within the wetland basins could cause changes in wetland type over time.

Portions of the inundation area have a history of row-cropping wetlands made feasible through the use of field tiling. Existing agricultural activities result in a high potential for sediment transport due to loose fine-textured surface soils exposed through plowing. The greatest potential for sediment to cumulatively fill shallow wetlands over time would be near the tieback embankment, where flood inundation would be greatest and more frequent. The 10-year flood would inundate wetlands within the floodplains of Wolverton Creek, Red River, and Wild Rice River. Wetland types could change over time in the inundation area due to sediment deposition during Project operation. Sedimentation in the wetlands adjacent to waterways is not expected to be accelerated because of the Project and is anticipated to maintain similar rates of sedimentation to the existing condition.

Coarse textured soils have a tendency to fall out of suspension sooner, likely closer to the tieback embankment and terraces of adjacent stream beds. Wetlands in closer proximity to the tieback embankment or stream bed terraces would therefore be more likely to be impacted by potential sedimentation. In general, sediment would fall out of suspension as the inundation area slowly progresses away from the tieback embankment. Other factors that affect the potential impact of sedimentation include: changes in frequency of inundation, duration of inundation, and inundation of new area compared to existing areas that are more adapted to inundation. Each of these factors would affect the rate and occurrence of sedimentation. Wetland impacts in the inundation area are not anticipated to be significant. However, monitoring of impacts would be a part of the AMP for the Project as further discussed in Section 3.4.3 – Mitigation and Monitoring Measures.

3.4.2.2 Base No Action Alternative

Under the Base No Action Alternative, wetland impacts from flood events would remain the same. Flooding that could occur would be temporary, and wetland impacts would occur slowly over a long period of time as part of flood dynamics and from other system influences.

The Cities of Fargo and Moorhead each have ongoing and planned flood risk reduction projects that reduce flooding for the cities and properties located along the Red River within the F-M urban area. These projects may reduce the risk of impacts during future floods by reducing or eliminating flood water impact on certain lands, which includes wetlands.

Direct and indirect impacts could occur with the natural expansion of the F-M area as wetlands become developed, however mitigation would be required.

3.4.2.3 No Action Alternative (with Emergency Measures)

Under the No Action Alternative (with Emergency Measures), wetland impacts from flood events would remain the same. Emergency measures would be used to reduce flooding in certain areas, which could alter the flow causing flooding or changes in other areas. Flooding that could occur would be temporary, and wetland impacts would occur slowly over a long period of time as part of flood dynamics and from other system influences.

As discussed for the Base No Action Alternative, the Cities of Fargo and Moorhead have planned flood risk reduction projects that reduce flooding potential for properties along the Red River within the F-M urban area. Additionally, the No Action Alternative (with Emergency Measures) would use emergency measures, such as sandbagging and temporary levees, to protect certain areas that may require additional protection. These actions could reduce impacts to the protected areas, but potentially increase impacts to other areas.

Direct and indirect impacts could occur with the natural expansion of the F-M area as wetlands become developed, however mitigation would be required.

3.4.2.4 Northern Alignment Alternative

Direct and indirect impacts from operation of the NAA are anticipated to be similar to those previously described for the Project. It is estimated that the NAA diversion channel construction footprint and OHB ring levee direct wetland impact acreage would remain equal to the wetland acreage impacts for the Project, totaling approximately 1,820 acres. The type and quality of these wetlands are anticipated to be similar as described in Section 3.4.1. The NAA has the potential to eliminate the need for the Comstock ring levee and any associated direct wetland impacts.

Wetlands located between the Project and NAA control structures and tieback embankment have not been field verified. Based on NWI data, NAA operation during the 100-year flood event would cause approximately 148 acres of indirect wetland impacts from new inundation. Similar to the Project, indirect impacts from NAA operation include: changes in temporary flood inundation, increased hydrology of existing wetlands, and sedimentation occurring over time. Some wetlands currently experience flood inundation during high flow events. Some of these wetlands may experience an increased inundation and/or duration during operation of the NAA compared to existing conditions during flood events. Similar to the Project, the additional inundation from the Project could result in changes to the existing vegetation communities; however, length of inundation is anticipated to be temporary and cause seasonal flooding similar to existing conditions. Flood duration, depth, and associated drainage or infiltration rate changes within the wetland basins could cause changes in wetland type over time. If long-term inundation would occur, there would be a greater potential for impacts to vegetation communities.

Table 3.18 expresses the estimated indirect wetland impacts caused by new inundation within the NAA area.

Table 3.18 Estimate of Indirect Wetland Impacts from New Inundation during the 100-year Event

Wetland Type	Current (acres)
Open Water	0
Type 1 (farmed)	18
Type 1 (floodplain forest)	0.2
Type 2(fresh (wet) meadows)	0
Type 3 (Shallow Marsh)	8
Type 4 (deep marshes)	2
Type 5 (shallow open water and shallow open water communities)	117
Type 6 (shrub swamp)	1
Type 7 (wooded swamp)	2
TOTAL ACRES	**148**

Source: NWI, Eggers and Reed, and Circular 39

Direct and indirect impacts to wetlands from the NAA would be further evaluated and field verified if and when a final design is completed. A wetland mitigation plan would also be developed based on final design and estimated wetland impacts, which is further discussed in Section 3.4.3.

3.4.3 Proposed Mitigation and Monitoring Measures

The wetland mitigation plan would be used during the federal and state permitting/approval processes to assess wetland impacts and determine appropriate replacement of those impacts. USACE compensatory wetland mitigation is regulated by 33 CFR 332.3(n)(1) which describes the use of financial assurances. The USACE district engineer has the ability in the CWA Section 404 permit to require financial assurance mechanisms to ensure successful completion of the Project mitigation.

In the state permitting process for WCA, Minnesota Rules, part 8420.0552 subp. 9(A) would require financial assurance if project specific mitigation is proposed. Mitigation completed through wetland bank credit purchase in advance of the impact would not require financial assurance.

The USACE, MNDNR, MPCA, and local governments in Minnesota have jurisdiction over wetland impacts for the Project and would review and approve the proposed wetland mitigation plan to satisfy replacement requirements for unavoidable wetland impacts. In Minnesota, wetland impact would be replaced under WCA and CWA standards. The MPCA would have permitting jurisdiction in Minnesota through CWA Section 401 Water Quality Certification. The MNDNR would have permitting jurisdiction for structures and fills below the Ordinary High Water Level (OHWL) of any Protected Wetlands or Waters. In Minnesota, local governments, typically counties, administer WCA. The USACE Omaha District is the primary agency that determines the adequacy of wetland replacement for the CWA wetland impacts in North Dakota.

Under current WCA rules, mitigation would need to be located within a defined area in Minnesota and possibly of a defined type depending on whether mitigation banking is used or a project-specific mitigation plan is developed. Currently, there are no wetland bank options in Minnesota that would provide the necessary credits for Project impacts occurring in Minnesota. Therefore a site or sites would need to be identified, acquired, restored, and protected through a deed restriction or perpetual easement in order to provide the necessary mitigation credit for the Minnesota impacts. Mitigation sites located in Minnesota require a conservation easement is established per WCA.

USACE guidance requires a protective covenant over the North Dakota mitigation areas. *The U.S. Army Corps of Engineers' Guidance for Compensatory Mitigation and Mitigation Banking in the Omaha District* states, on page 8, states that *"[a]ll mitigation will need site protection. This can be in the form of an easement, deed restriction or similar legal instrument."*

The Project would use an AMP for mitigation and monitoring of impacts, which includes the diversion channel conceptual wetland mitigation plan (wetland mitigation plan).
The wetland mitigation plan is habitat-based with a goal of replacing impacted wetland habitat and certain functions rather than designing the plan purely on wetland design criteria. The AMP would also be in place for mitigation and monitoring of floodplain forest impacts. MnRAM would be used to evaluate the mitigation wetlands at the end of the monitoring period.

A habitat-based approach was proposed instead of quantifying mitigation acreage in order to provide suitable replacement habitat, rather than a certain acreage. It is assumed the entire 36-mile diversion channel bottom and some areas of the side slopes would be designed and managed as wetland replacement, resulting in approximately 1,597 acres of wetland credit. This would equate to a replacement ratio of 0.94:1. If the remaining inside upland slopes of the berms were assumed to generate 25 percent credit as upland buffer, this would add approximately 438 acres of credit for mitigation acreage totaling 2,035, a 1.19:1 ratio. The revegetation plan would use native species to seed and manage the inside upland slopes.

Additionally, Ducks Unlimited (DU) in North Dakota has launched an in-lieu fee mitigation program that has been coordinated and approved through the Interagency Review Team (IRT) consisting of North Dakota Game and Fish Department (NDGF), Federal Highway Administration, Natural Resources Conservation Service, USACE, United States' Environmental Protection Agency (USEPA), and USFWS. In summary, the DU program would locate, purchase, construct and monitor wetland restoration/creation sites for a per-acre fee. Although it may not be feasible to do all of the wetland mitigation in this manner, there would be options to provide additional mitigation in North Dakota if needed. As a coordinating agency with the DU program, the USACE is proposing to use the DU program for some of the wetland mitigation for the Project.

The AMMP, developed for this EIS, includes specific recommendations for monitoring measures and outlines monitoring protocols. Monitoring is recommended in the AMMP to include potential indirect wetland impacts in the inundation area. The AMMP is provided as Appendix B.

3.4.3.1 Forested Wetlands

An estimated 62 acres of forested wetland impacts (diversion channel and hydraulic structure impacts) would be replaced at a 2:1 ratio by restoring farmed Seasonally Flooded Basin wetlands along rivers, including the Red and Wild Rice Rivers as forested floodplain wetlands (FFREIS 2011). The USACE St. Paul and Omaha Districts as well as the USFWS have used "Blue Books" (USFWS habitat assessment models) to determine adequate replacement for the forested wetland impacts. Some mitigation sites have been preliminarily identified by the USACE.

Forested wetland impacts, all within North Dakota, associated with the Red River control structure would be replaced per CWA Section 404 standards. Forested wetland impacts in Minnesota would require mitigation to comply with WCA. WCA requires 2:1 replacement for the impacts in Minnesota which would equate to an estimated six acres of mitigation.

Whether in Minnesota or North Dakota, temporal loss of wetland function and value while the mitigation sites mature should be considered, which means timing of mitigation establishment is an important factor. Restoration of the mitigation sites should be completed in advance or at least concurrently with the proposed impacts to minimize temporal loss of wetland functional. Replacement ratios that exceed 1:1 compensation that is completed concurrently helps minimize temporal loss.

3.4.3.2 Non-Forested Wetlands

3.4.3.2.1 Diversion Channel

This section discusses proposed mitigation occuring in the diversion channel. Illustration 3-4 (below) provides an illustration showing the typical diversion channel cross-section, including low-flow channel and side slopes.

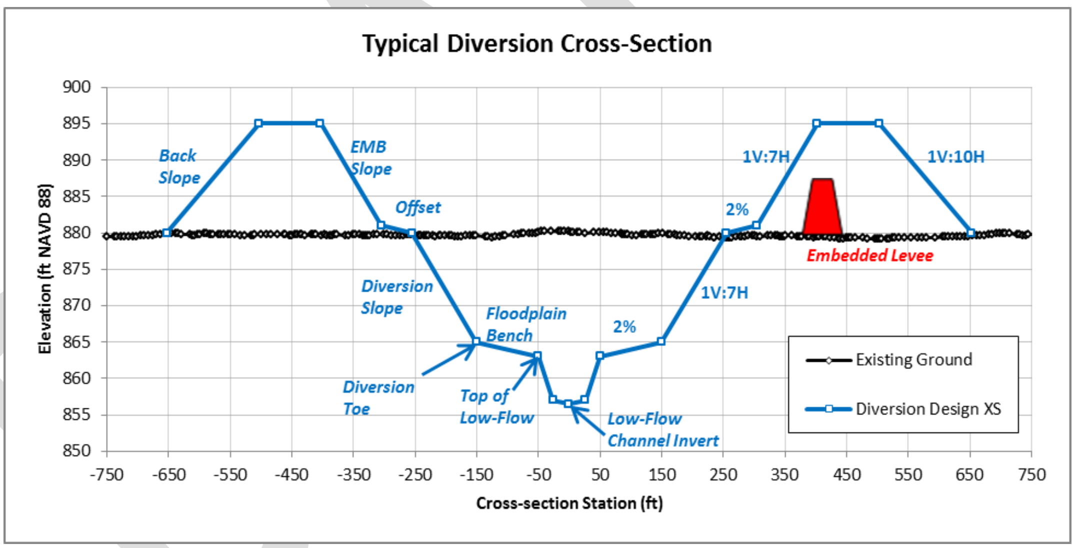


Illustration 3.4: Typical Diversion Channel Cross Section

Bottom of Diversion Channel

The conceptual mitigation plan, as a habitat-based approach for impacts to non-forested wetlands, would be to create wetlands on the floodplain bench in the bottom of the diversion channel. The wetland created would be used to compensate for wetland impacts in North Dakota; however, no compensatory wetland mitigation credit is assumed for the low-flow channel. The mitigation in the diversion channel bottom would not qualify as adequate replacement per WCA, because the mitigation would take place outside Minnesota.

Two Percent Side Slopes

The proposed mitigation plan assumes 100 percent credit for the two percent sloped areas on either side of the low-flow channel. Existing wetlands within the two percent slope areas would be lowered topographically, and therefore, the mitigation plan is self-mitigating in those areas. Hydrology for the two percent slope areas would come from the low-flow channel when it overtops its banks and also from runoff from the inside diversion channel embankment slopes. There would be periods before the growing season in March and April when the Project is in operation during the 10-year or greater event, which would cause several feet of water to be present in these areas. Hydrology would be expected in the early part of the growing season which is typical of a Seasonally Flooded Basin. This mitigation approach is different than the impacts from the shallow drainage ditches outside of the diversion channel berms, in that those impacts are not self-mitigating and require other mitigation.

There may be times when the side slope mitigation area has deep water flowing downstream instead of shallow standing water. This zone would experience highly disruptive hydrologic events when water elevations are higher. Without intensive management, this zone could establish a mudflat environment characterized by frequent changes in the mix and extent of dominant species, many of which would be expected to be weedy annuals such as flat sedge (*Cyperus)* and knotweed (*Persicaria)*. In areas where standing water persists for longer periods, non-native invasive species such as bulrushes/cattails (*Typha)* could establish, and canary grass (*Phalaris)* could establish in drier areas without intensive management.

Variable hydrologic events could be a limiting factor for establishing mitigation sites within the diversion channel. If the Project normally operates in the non-growing season, hydrology for the mitigation area in the diversion channel would be reliant on bank overtopping of the low-flow channel as well as runoff from interior slopes of the channel and channel embankment berms. If the Project operates during the growing season, the hydrology depth and duration in the mitigation areas would be dependent upon the individual event. While the focus for these mitigation areas is the replacement of lost function and value, due to fluctuating water levels the mitigation area would not be tied to a specific performance standard for hydrology.

In addition to variable hydrologic events, sedimentation may also become a limiting factor to the success of the plantings in the two percent slope zones. Sediment loads would be expected to be highest near the Wild Rice and Red River tieback embankment toward the south end of the diversion channel. As sediment falls out of suspension, accumulation may impede the growth of or kill the plantings. Areas of accumulated sediments would likely be patchy and the impact of this disturbance is unknown. Monitoring and adaptive management would be used to mitigate for observed impacts.

7:1 Slope Zones of the Diversion Channel

The proposed mitigation plan assumes the lower 50 feet of the 7:1 slope zone would be given 100 percent mitigation credit which infers that portion of the slope would normally have wetland hydrology at least in the early part of the growing season. The proposed species mix for the 7:1 slope zone is typical of sedge meadow/wet meadow environments where soils are commonly saturated for a significant portion of the growing season. Hydrology would not be expected for long periods during the growing season, even in the lower 50 feet of the slope, making it challenging to establish the hydrophytes proposed in the seed mix. Some of the grasses proposed in the seed mix would be tolerant to hydrologic variability. The remaining upper part of the 7:1 slope zones is assumed to generate 25 percent credit.

3.4.3.2.2 Tieback Embankment

Tieback embankment impacts that occur in Minnesota east of the Red River would be approximately 19 acres, as summarized in Table 3.19, and would be replaced per WCA.

Table 3.19 Estimated Direct Wetland Impacts Associated with Tieback Embankment in Minnesota

Wetland Type	Embankment Impact (acres)
Seasonally Flooded Basin	17
Shallow Marsh	1
Fresh (Wet) Meadow	1
Total Acres	**19**

The WCA requires 2:1 replacement for these impacts which is an estimated 38 acres of mitigation in Minnesota.

3.4.3.2.3 OHB Ring Levee

The USACE Omaha District determined adequate wetland replacement for the OHB ring levee through its permit process which requires that a proposed project be in the public interest and that acceptable wetland mitigation is provided. Mitigation sites for OHB ring levee impacts are stated in the OHB ring levee USACE permit, issued June 20, 2014. The OHB ring levee permit requires 30.11 acres of compensatory wetland mitigation. Of the required wetland mitigation acreage, 2.92 acres will be of onsite and in-kind mitigation for existing roadside wetland ditch segments, 9.92 acres will be of high functioning wetland mitigation sites and 17.27 acres of wetland mitigation will be secured through the DU North Dakota Aquatic Resource In-Lieu Fee Program. Mitigation sites for OHB ring levee impacts would be managed to comply with mitigation plans and permit conditions. A habitat-based mitigation plan will be used that includes performance standards. The OHB ring levee permit indicates the MnRAM will be used to evaluate the mitigation wetlands at the end of the monitoring period.

The OHB Wetland Mitigation Plan includes several mitigation sites including the Forest River site which has already been constructed. Other sites proposed include the Oxbow Country Club site and the remaining sites will be developed through the DU In-Lieu Fee Program. The Forest River site has had earthwork and native grass seeding completed. Tree plantings will be completed once the native grasses are established. The Oxbow Country Club site is currently part of an existing golf course. Following completion of the OHB ring levee, new wetland areas will be constructed as an extension of an existing oxbow, and native grasses and floodplain forest species will be planted.

Maintenance of the local mitigation sites will be carried out by the Local Sponsors and other properties owned by the corresponding Local Government Units (LGUs). Monitoring reports will be submitted to the North Dakota Regulatory Office at the end of each growing season for the first three growing seasons, and a final report will be due at the end of the fifth growing season.

Reports must include logs of the wetland development, photographs and a narrative summary of the site's development, wetland delineation, and MnRAM scores of the site for years 3, 4, and 5. Onsite monitoring will be required from June 15 to the end of the growing season. The monitoring requirements may be waived, extended, or modified depending on the success of the wetland development.

3.5 COLD WEATHER IMPACTS ON AQUEDUCT FUNCTION AND BIOTICS

The Project includes two open-air aqueducts for the Sheyenne and Maple Rivers to cross over the diversion channel, maintaining connectivity to the natural river channels on either side. Portions of the natural river channels would be removed as the proposed diversion channel cuts through them, while other portions of the river channels would be abandoned as a new alignment is followed to carry the river flows through the aqueducts over the diversion channel.

The aqueducts are designed to maintain connectivity for fish upstream and downstream of the aqueducts in the Sheyenne and Maple Rivers. However, water flows are naturally less in the winter which results in shallower water depths. Shallow water within the aqueducts is more likely to freeze than within the natural river channel. Freezing water within an aqueduct could result in negative impacts to fish and other water-dependent resources as a result of temporary blocking of species passage. Ice build up within an aqueduct could also alter channel flows and result in increases in the upstream water levels up to the 2-year flow event. This section describes the potential impacts to the channel flows and water-dependent resources in aqueducts during cold weather conditions.

Aqueducts in cold regions are rare; and none are currently operated by the USACE. To help quantify the amount of ice that could form in the Maple River aqueduct during the winter months, the USACE Engineer Research and Development Center Cold Regions Research and Engineering Laboratory (CRREL) completed a report, *Development of Conceptual Designs for the Prevention of Ice Formation in the Proposed Maple River Aqueduct* (USACE, 2014a) (CRREL Report). The report included the analysis of different operating scenarios for the Maple River utilizing existing condition data and applying predicted results from computer modeling and analysis. The Sheyenne River aqueduct was not included in the CRREL Report analysis referenced above. The Maple River is a smaller river and serves as a tributary of the Sheyenne River. It is assumed that if there were cold weather impacts observed during aqueduct operation, that they would be likely be observed within the Maple River aqueduct first. Also, the Sheyenne River aqueduct has not been fully designed yet. When the Sheyenne River aqueduct design commences, it will be further evaluated by the USACE for potential cold weather impacts. For the purposes of this EIS and to the extent practical, cold weather impacts to aqueduct function and biotics for the Sheyenne River aqueduct have been extrapolated from the Maple River information reviewed and discussed below.

The CRREL report was the primary document referenced for technical information provided in the summary below that addresses ice formation and flow conditions for various aqueduct heating and insulation design scenarios. To help assess potential impacts of aqueduct function during freezing weather on biotics, Indexes of Biological Integrity (IBI) developed for the Project can be used to inform future monitoring efforts. IBI scores are a useful tool for assessing impacts from habitat fragmentation and connectivity barriers. IBI scores provide indicators of species tolerance; tolerant species generally have low sensitivity to barriers, while intolerant species are often extirpated upstream of barriers. Other habitat evaluation assessments were also reviewed for this discussion including the Qualitative Habitat Evaluation Index (QHEI). For this section, this information is only briefly discussed as it relates to current conditions and for mitigation and monitoring purposes. IBIs and other additional information about fish and aquatic biota and habitats are more thoroughly discussed in Section 3.8 – Fish Passage and Biological Connectivity.

3.5.1 Affected Environment

Currently the reaches of the Sheyenne and Maple Rivers within the project area are flowing in their present channels. Both rivers are subject to seasonal conditions and variations in flow. The Maple River is smaller than the Sheyenne River and is a tributary to the Sheyenne River.

3.5.1.1 CRREL Report Maple River Hydrology and Meteorology

Hydrology (flow) data was collected from two USGS gages to establish existing conditions for the Maple River. Gage 05060000 MAPLE RIVER NR MAPLETON, ND is located about 14 river miles upstream of the proposed Maple River Aqueduct, and Gage 05060100 MAPLE RIVER BL MAPLETON, ND is located about seven river miles upstream of the proposed Maple River Aqueduct. Gage 05060000 has data recorded from April 1944 to September 1958. Gage 05060100 has data recorded from October 1958 through September 1975. This gage was restarted in March 1995 and had recorded through the present (USGS 2015). Combining the data from the two gages, data for the Maple River is available for two periods of time, 1944 through 1975, and 1995 through 2013 (timeframe reflective of data available through the CRREL Report study period), with a twenty-year data gap in between, as summarized in Table 3.20 below.

Table 3.20 Summary of Gage Data Records

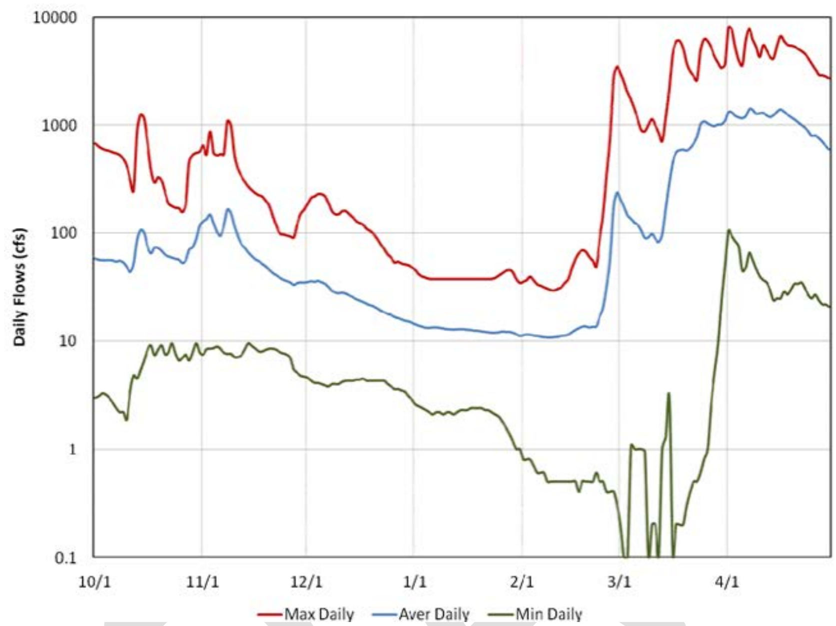
Gage 05060000	Gage 05060100
April 1944 through September 1958	
	October 1958 through September 1975
	March 1995 through 2013

Source: USACE, 2014a

There is a notable difference in the magnitudes of the low winter flows between the two time periods of data (1944–1975 and 1995–2013). For the period 1944–1975, both gages display consistent and lower winter discharges compared to data from Gage 05060100 recorded after 1995. The cause of these changes was determined to be due to changes in the data collection procedures or other factors, such as modifications to upstream drainage systems, land use changes, sedimentation, and climatic variation (USACE, 2014a).

The Aqueduct Flow and Ice Simulation Model was applied over the most recent 18 winters, Water Year 1996 through the present. This period begins with the reestablishment of the USGS gage on the Maple River (USACE, 2014a). Flow data indicates that flows in the Maple River typically decline throughout the fall and winter (Graph 3-2). The wintertime discharge shows some variation, but often the river is in recession. Discharge is monotonically decreasing when ice is likely to form. The average daily discharge typically drops from 50 cfs at the beginning of December to about 10 cfs in late January to mid-February. During this time, the air temperatures remain below freezing (32 degrees Fahrenheit). There is little to no liquid precipitation or snowmelt available for runoff, and the flow in the river derives from water draining from unfrozen soil and ground-water layers. The historical extreme lows of daily discharges are in early to mid-March when the daily discharge can drop to near zero. On average, the flow typically increases near the beginning to middle of March. In some years, the increase in flow can be rapid (USACE, 2014a).

Graph 3.2: Range of daily winter flows in the Maple River for 1995–2012.



Temperature and precipitation data was collected from the Fargo Hector International Airport (GHCND: USW00014914 and WMO: 727530), which is located about six miles east-southeast of the proposed Maple River aqueduct. Data is available for January 1948 through May 2013 (USACE, 2014a).

An analysis of winter temperatures near the Maple River aqueduct indicates that the lowest temperatures occur in the end of January, with a typical range of zero degrees (°) Fahrenheit (F) to 20°F and extremes ranging from −35°F to just above 40°F (USACE, 2014a). The average temperature generally remains below freezing from mid-November to mid-March. Daily average highs are typically below freezing from early December to early March. The most ice is expected to grow during periods of intense cold. These periods were analyzed in lengths of one, three, five, 10 and 30 days.

Table 3.21 Most Severe Periods of Intense Cold

Number of days in the Period	Water Year	Date	Average Temperature (°F)	Average Flow (cfs)	Accumulated Freezing Degree Days (°F-days)
1	1996	2/1	−29.5	1.0	1612
3	1996	2/1–2/3	−27.7	1.0	1730

Number of days in the Period	Water Year	Date	Average Temperature (°F)	Average Flow (cfs)	Accumulated Freezing Degree Days (°F-days)
5	1996	1/30–2/3	−24.5	1.2	1730
10	1996	1/25–2/3	−18.8	1.6	1730
30	1982	1/7–2/5	−7.7	-	1617

Source: USACE, 2014a

3.5.1.2 Sheyenne River Hydrology and Meteorology

As noted above, a cold weather impact report has not been completed for the Sheyenne River aqueduct. Meteorology for the Sheyenne River would be expected to be relatively similar to that described above for the Maple River. Hydrology would be expected to be different from the Maple River as the Sheyenne River has approximately twice the contributing watershed size as the Maple River. When the Sheyenne River aqueduct design commences, potential cold weather impacts to the aqueduct and biotics will be assessed by the USACE. Information provided in the Maple River CRREL Report will be considered in determining what level of cold weather impact analysis is necessary for this larger river.

3.5.1.3 Maple and Sheyenne Rivers Habitat Assessments- Current Conditions

The health of the biological communities in the Sheyenne and Maple Rivers are dependent on a number of factors, including, but not limited to, water quality, habitat, and the specific needs of a certain species. Monitoring has been completed to identify the species within the system, and ranking the potential health of the system using the QHE) for macroinvertebrates and IBI for fish communities (see Section 3.8 – Fish Passage and Biological Connectivity for more details).

3.5.2 Environmental Consequences

Aqueducts have the potential to alter channel flows and impact water-dependent resources during cold weather low-flow and no-flow conditions. Freeze out can occur in a natural channel if flows, depth of water and temperatures decrease too much; blocking species passage. Aqueducts have the potential to increase the likelihood of ice formation due to the elevated structure and accelerated cooling (like a roadway bridge) compared to the surrounding ground temperatures, because an aqueduct is exposed to cold air on all sides. Freeze out of an aqueduct has the potential to reduce connectivity in an affected river, as well as connectivity to the upstream tributaries.

The design dimensions of the Maple and Sheyenne River aqueducts could be different, but current plans for both river crossings are for fifty foot wide aqueducts. A larger aqueduct would likely respond differently to icing because of potentially larger volumes of water, differences in cross sections, and different water velocities. The CRREL Report provided analysis for the Maple River aqueduct. However, once frozen to the same degree, the impact of freezing on aqueduct function would be similar between the two aqueducts, but the rate at which ice develops in each aqueduct would likely be different.

Fish passage, or connectivity impacts are likely to be less critical during the winter than in spring. Most fish species will make overwintering migrations well before the aqueducts could freeze; however specific species studies are limited and therefore connectivity impacts to individual species are difficult

to predict. Spring connectivity is more of a concern as many fish species initiate pre-spawning migrations well before spawning commences.
Freezing within the aqueducts could possibly be less of a concern for the Sheyenne River than for the Maple River. The Sheyenne River likely has a more stable winter flow than the Maple River as the Sheyenne has a much larger watershed and a large dam regulating flows. Therefore, low-flow or no-flow conditions that would increase the likelihood of freezing conditions in the normal channel are less likely to occur or at a minimum, would likely occur at less duration than what is observed in the Maple River.

There are other influences to fish passage within the aqueducts that may need to be considered in addition to freeze out. Influences within the aqueduct such as Project flow velocities and bed materials may also influence the effectiveness of fish passage within the aqueducts. To assess for impacts, flow variations and other location conditions such as temperature and precipitation would need to be observed over several years following construction and during Project operation.

As discussed in the Section 3.8 – Fish Passage and Biological Connectivity, it is not known how the quality of habitat provided by the new project features (e.g., aqueducts) would compare to the quality of existing habitat that would be lost. In addition, the aqueducts “habitat” created would not be considered aquatic habitat that could be used to offset the potential impacts. As a result, aquatic habitat in the Sheyenne and Maple Rivers disturbed or altered by aqueduct construction would be lost and considered an impact.

3.5.2.1 Proposed Project

3.5.2.1.1 Potential Alteration of Channel Flow

Installation and operation of the proposed aqueducts in the cold weather climate of the project area has the potential to alter existing channel flow especially during the winter months. Icing in the aqueduct would potentially occur at different rates (i.e., faster) compared to the rest of the natural Maple and Sheyenne River channels. Ice development in the aqueduct has the potential to cause upstream stage increases (up to the fixed crest elevation of the upstream spillway) by reducing flow and potentially blocking the aqueduct with ice, preventing water flow downstream.

To quantify the volume of ice that may form in the aqueduct, it was necessary to determine the flow conditions in the aqueduct throughout the winter. Bed ice and surface ice form only in the areas of the aqueduct covered by flow. As the ice grows, it modifies the channel geometry, changes the water surface elevation throughout the aqueduct and controls the areas of the aqueduct where ice forms. All of these parameters are interrelated and together determine the amount of ice that forms. Hydraulic and ice modeling was used to account for this multi-variable interaction. The Aqueduct Flow and Ice Simulation Model used to estimate ice formation includes five parameters: flow, water temperature, surface ice growth, bed ice growth, and ice interaction (if surface and bed ice converge).

There are five conceptual ice control approaches for aqueduct operation in winter (USACE, 2014a). These include:

1) *Uninsulated and no heat applied*. Water flow through the proposed aqueduct would lose heat to the frigid atmosphere directly through the air and through the concrete

mass of the aqueduct. The heat loss would cause surface ice to form and bed ice to form everywhere that the aqueduct is inundated. The area where ice is formed would be limited by the area inundated by the flow. This means that the flow can have a strong impact on ice production. The formation of ice in the proposed aqueduct would block the cross section flow area of the aqueduct, reduce the available flow area, and raise upstream water levels.

2) *Insulation applied to the aqueduct structure and no heat applied*. Insulating the aqueduct reduces the heat transfer through the aqueduct structure itself to the frigid air and would reduce the amount of bed ice formed. Insulation would not affect the formation of surface ice, which is formed by heat transfer from the top surface of the ice to the frigid air.
3) *Downstream control with no heat applied*. Downstream control would maintain aqueduct flow by increasing the downstage stage through the use of a hydraulic control structure, such as an inflatable dam. Surface ice and bed ice would form, but the flow area would be maintained beneath the surface of the ice. The control structure would result in a stage increase upstream and throughout the aqueduct to the level of the downstream control structure.
4) *Application of heat to the aqueduct with and without insulation*. The installation of heaters in the bed of the aqueduct low-flow channel would prevent the formation of bed ice in the low-flow channel and would reduce the thickness of surface ice. Eliminating the formation of bed ice in the low-flow channel would maintain a channel for the flow, which would most closely mimic a natural/existing channel process of forming ice. Surface ice would form in the low-flow channel even with bed heaters, but the ice thickness would be reduced compared to unheated scenarios. A benefit to maintaining the flow area in the low-flow channel is that flow would be confined to the low-flow channel and would not spread out across the width of the aqueduct. Minimizing the width covered by flow would minimize ice production.
5) *Additional Options*. Alternative approaches to heating the aqueducts included active and passive solar heating, and the application of retractable and permanent roofs. It is assumed that the behavior of these types of heating would likely be similar to heat application or insulation approaches; however, parameters were not included in modeling scenarios.

The CRREL Report simulated five basic scenarios:

1) The aqueduct with no applied heating or downstream control (Base scenario).
2) The aqueduct with downstream control and no applied heating (Base scenario with downstream control). Downstream elevation was maintained to keep a depth of about 11.5 ft in the aqueduct throughout the winter.
3) The aqueduct with applied heating of 5 British thermal units (Btus) per hour (hr) per foot squared (ft^2) ($Btu/hr/ ft^2$) in the low-flow channel and no downstream control.
4) The aqueduct with applied heating of 30 $Btu/hr/ft^2$ in the low-flow channel and no downstream control.
5) The aqueduct with applied heating of 60 $Btu/hr/ft^2$ in the low-flow channel and no downstream control.

Each of these five basic scenarios was modeled for three different options of insulation: no insulation, three inches of insulation, and six inches of insulation. Table 3.22 summarizes the 15 simulations plus a model run that did not allow ice formation. This allowed a comparison of the open water surface elevations with the scenarios in which ice formed.

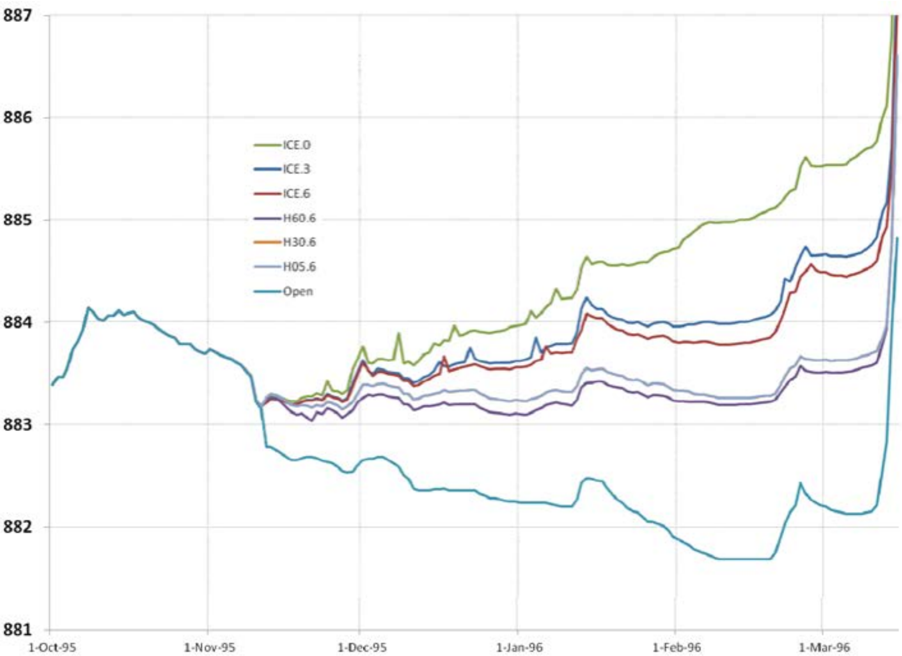
Table 3.22 Summary of Simulations

Insulation	Scenario Title	Description
No insulation on the aqueduct	ICE.0	No heat. No downstream control.
	DSC.0	No heat. Downstream elevation maintained at 892.5.
	H05.0	5 Btu/ hr/ft^2 heat in the low-flow channel. No downstream control.
	H30.0	30 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
	H60.0	60 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
3 in. of insulation on the aqueduct	ICE.3	No heat. No downstream control.
	DSC.3	No heat. Downstream elevation maintained at 892.5.
	H05.3	5 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
	H30.3	30 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
	H60.3	60 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
6 in. of insulation on the aqueduct	ICE.6	No heat. No downstream control.
	DSC.6	No heat. Downstream elevation maintained at 892.5.
	H05.6	5 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
	H30.6	30 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
	H60.6	60 Btu/hr/ft^2 heat in the low-flow channel. No downstream control.
No insulation on the aqueduct	Open	Open water comparison. No ice formation.

Source: USACE, 2014a

An additional scenario, number 16, was run for the aqueduct with no heat and no insulation and assuming no ice formation. This scenario provides an open water comparison or a baseline approximation to the existing gage depth of the Maple River in the wintertime for the Water Year 1996.

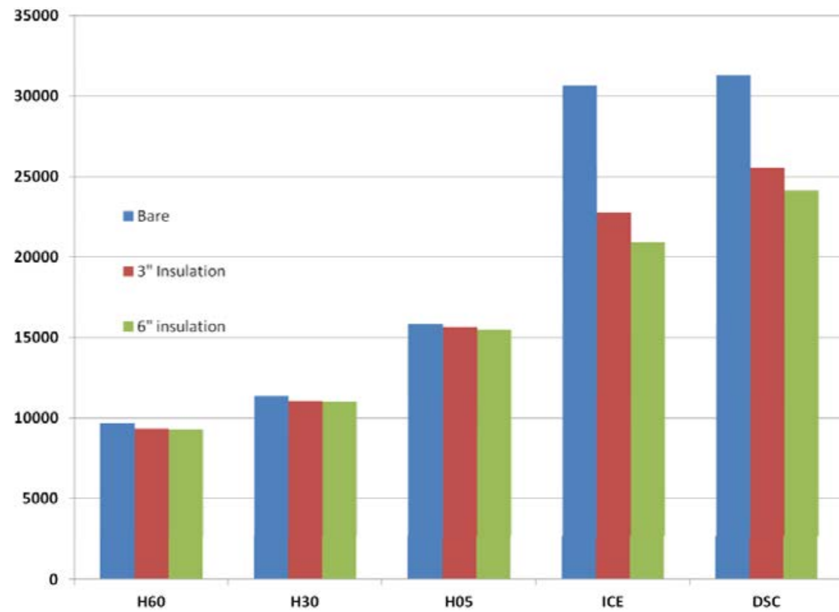
Graph 3.3: Upstream Water Levels for Water Year 1996 for Different Scenarios and for Open Water



Graph 3-3 shows that select scenarios are identical prior to November 11 when ice formation commenced and compares the quantitative difference in upstream elevation based on ice thickness. In all cases the formation of ice in the aqueduct raises the upstream water level compared to the open water scenario. The largest increase in the upstream water level results for the scenario of no applied heat and no insulation (ICE.0). The scenarios with three inches (ICE.3) and six inches (ICE.6) of insulation resulted in smaller upstream water level rises over the course of the winter. The scenarios using heat application resulted in smaller increases in upstream stage. Most of the increase in the upstream stage for these scenarios results from the increase of the downstream stage boundary condition due to surface ice formation (USACE, 2014a).

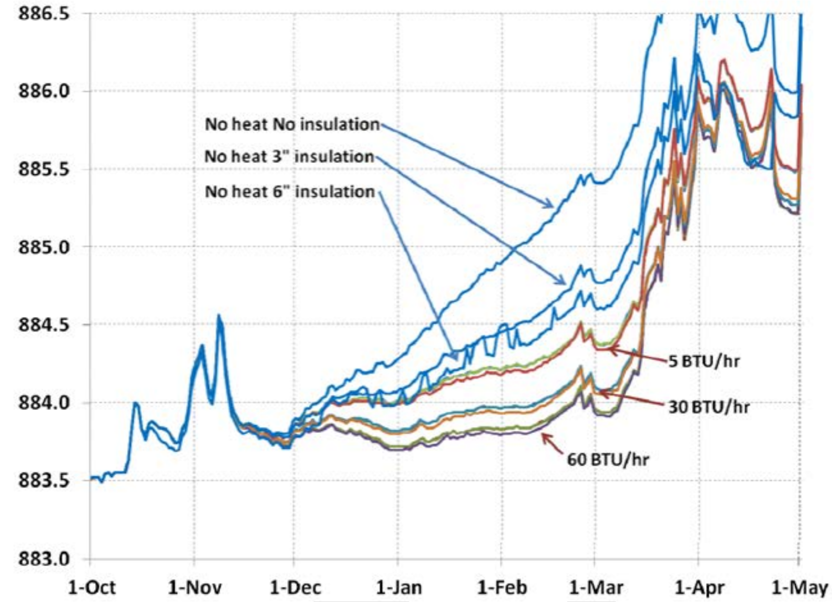
Chart 3-1 below displays the ice volume averaged over all 18 winters of the simulation periods for each scenario and for the three insulation levels. Under Downstream Control (DSC), the downstream stage was set at 892.5, which essentially created a pool about 11.5 feet deep above the center of the low-flow channel throughout the aqueduct. This scenario generated large volumes of ice but could maintain a large flow area, if required. Insulation caused the largest reduction in ice volume for these two scenarios.

Chart 3-1. The average ice volume (ft^3) formed under each scenario.



The formation of ice in the aqueduct under all the scenarios averaged over all 18 winters of the simulation periods reduced the conveyance of the aqueduct and caused the upstream stages to rise. Graph 3-4 displays the stage upstream of the aqueduct for each scenario. The unheated scenarios saw the largest stage rise. The use of insulation in the unheated scenarios resulted in the greatest impact. Applying heat to the aqueduct reduced stages compared to the unheated scenarios. However, when the aqueduct was heated, the overall impact of the insulation was greatly reduced. In the heated cases, the decrease in the upstream stages was determined almost entirely by the amount of heat applied; and the thickness of the insulation had little impact.

Graph 3.4: The average stage at the spillway weir location for each day of the winter season under each scenario. The heated scenarios include no insulation, three inches of insulation, and six inches of insulation.



The use of insulation and/or heat influenced ice volume, which in turn influenced potential for upstream stage increases. Table 3.23 summarizes how insulation thickness impacted ice volume in the basic aqueduct.

Table 3.23 Insulation Impacts on Ice Volume

Aqueduct Type	Insulation Thickness (inches)	Percent Reduction in Ice Volume (%)
Basic Aqueduct	3	25.8
	6	31.8
Basic Aqueduct with Downstream Control	3	18.3
	6	22.9

Table 3.24 summarizes how the application of heat reduced the volume of ice formation in the uninsulated aqueduct. Application of heat significantly reduced the volume of ice formed compared to the ice volume of the basic aqueduct without heat.

Table 3.24 Heat Impacts on Ice Volume

Aqueduct Type	Application of Heat (Btu/hr/ft^2)	Percent of Ice Volume Compared to Non-heated Aqueduct (%)
Uninsulated Basic Aqueduct	60	31.6
	30	37.0
	5	51.6

The use of insulation on the outside of the aqueduct did little to improve the ice reduction performance of the heated aqueduct. Table 3.25 provides a summary of results associate with the use of both insulation and heat on the aqueduct.

Table 3.25 Comparison of Heat Application and Insulation

Aqueduct Type	Application of Heat ($Btu/hr/ft^2$)	Insulation Thickness	Percent Reduction in Ice Volume (%)
Insulated Aqueduct with heat	60	3	3.5
		6	4.1
	30	3	2.8
		6	3.2
	5	3	1.3
		6	2.2

Under all the scenarios, the formation of ice in the aqueduct reduced the conveyance of the aqueduct and caused the upstream stages to rise. The average upstream stage varied between three feet (above datum) for the heat scenario and 3.4 to 3.9 feet (above datum) for the unheated scenarios.

Surface ice would typically form in the low-flow channel even with the bed heaters, but the ice thickness would be reduced compared to the unheated scenario. Historically the Maple River typically does not freeze through, sustaining an average around 10 cfs flow.

Additionally, there is potential for ice flows and other debris to accumulate in the aqueduct structure, which could cause debris jamming and blocking of the aqueduct. Debris dams could block the aqueduct and cause upstream stage increases up to the fixed crest elevation of the upstream spillway, which is separate from the aqueduct structure and would allow flow into the diversion channel, before flooding would occur to areas upstream. The spillway is intended to direct flow into the diversion channel at about a 50 percent chance event (2-year flow event). This would likely prevent upstream flooding from debris or ice jams at the aqueduct.

3.5.2.1.2 Potential Impacts to Aquatic Habitat and Biological Connectivity

Fish Passage and Connectivity Impacts

Section 3.8.2 discusses fish passage and biotic connectivity on the Maple and Sheyenne Rivers. If the aqueducts are properly designed and constructed to convey flows from the Maple and Sheyenne Rivers under all flow conditions, impacts to fish migration and/or habitat connectivity would likely be minimal. However, as previously discussed, cold weather conditions (i.e., potential freezing of the aqueduct), along with typically low river flows during a particular season, regardless of design considerations, have the potential to impact fish passage and biotic connectivity within the aqueduct. Aqueduct design would be important to minimize potential impacts to aquatic habitat and biotic connectivity. Consideration should be given to materials used, such as concrete and aluminum, as well as consideration for aqueduct operation using electrical currents and heating elements, and how materials and operation could potentially affect aquatic biota in the aqueduct.

Alteration of Channel Bed Substrate (Habitat)

Installation and operation of the proposed aqueducts in the cold weather climate of the project area would alter the channel bed from natural elements (i.e., cohesive clays and sediments) to unnatural man-made elements, primarily concrete and aluminum. Although this was not addressed in the CRREL Report, which focused on potential cold weather impacts on the aqueduct function on the Maple River, consideration on how the aqueducts materials potentially affect aquatic biota and habitat should be considered. As discussed in Section 3.8 – Fish Passage and Biological Connectivity, concrete baffles have been observed to be less effective in slowing velocities and providing for fish movement as compared to using natural material, including variable size boulders. Natural materials are known to provide more complex flow patterns as well as variation in flow velocities, as compared to concrete baffles (Aadland, 2010), which allows for a wider variety of species (i.e., fish body types and sizes) to pass through a feature.

3.5.2.2 Base No Action Alternative

The Base No Action Alternative would not interrupt the historic or current function and condition of the Maple and Sheyenne Rivers. The Base No Action Alternative would result in the continued threat of flood damage to the F-M area and infrastructure in the area during high water events. The Sheyenne Diversion and West Fargo Diversion were constructed to reduce flood risk to the F-M urban area and its infrastructure during flood events.

3.5.2.3 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) would be similar to the Base No Action Alternative in that the historic and current function of the Maple and Sheyenne Rivers would not be interrupted. Emergency measures are not currently used or anticipated around the Maple and Sheyenne Rivers. If sandbagging and temporary levees are used in this area to protect adjacent floodplain areas, more flow would remain in the river channels and could increase flow velocities.

3.5.2.4 Northern Alignment Alternative

The NAA would not change the location or anticipated design of the aqueducts on the Maple and Sheyenne Rivers, and therefore, potential impacts from these aqueducts would be the same as those described for the Project.

3.5.3 Proposed Mitigation and Monitoring Measures

Based on the CRREL Report modeling results and summary, different design options and operation of an aqueduct would result in various thicknesses of ice formed in the aqueduct, the amount of flow allowed through the aqueduct, and the additional level of upstream stage rise due to flow constriction (up to the 2-year event). These could have varying effects on fish passage and biological connectivity within these river systems. Due to the complex, dynamic nature of river systems, it is difficult to predict actual impacts of the aqueducts or the true functionality and value of the proposed mitigation projects until the actual conditions can be observed. As a result, post-construction and Project operation monitoring efforts would be a key component in determining aqueduct impacts to the riverine systems and any adaptive management response.

Most of the mitigation and monitoring measures proposed are related to fish passage and biological connectivity. The aqueducts on the Maple and Sheyenne Rivers are intended to provide connectivity needed for fish passage and aquatic biota. The design of the aqueducts would need to ensure that fish and aquatic biota connectivity is maintained. Although connectivity is less a concern in the winter as fish will likely have made overwintering migrations in advance of aqueduct freezing, connectivity impairments could affect pre-spawning migrations. Therefore monitoring for changes in fish and aquatic biota distribution as well as diversity would be useful in determining if the aqueducts are functioning as designed.

The following provides a brief summary of proposed mitigation and monitoring measures for fish and biotic connectivity, and habitat loss. Additional discussion on proposed mitigation and monitoring measures for the Maple River and Sheyenne River is provided in Section 3.8.3 – Fish Passage and Biological Connectivity. Section 6.2.8 Mitigation and Monitoring and the Fargo-Moorhead Flood Risk Management Project Draft AMMP included as Appendix B provide further details of proposed mitigations, the evaluation of proposed mitigation and monitoring along with additional recommendations if necessary.

3.5.3.1 Fish and Biological Connectivity

Monitoring to assess potential impacts to fish migration on the Maple and Sheyenne Rivers would occur once Project features are in place and the Project is put into operation. An Aquatic Biological Monitoring Team in coordination with the Adaptive Management and Monitoring Team would collaborate on how best to identify and define fish passage effectiveness. This could include assessing the number of species observed to pass through a structure; and the relative percentage of a population that accumulates below a structure that is able to migrate around or through a structure (FFREIS 2011).

3.5.3.2 Habitat Loss

The FFREIS discusses proposed mitigation and adaptive management that includes monitoring for fish, macroinvertebrates and physical habitat. Impacts to aquatic habitat on the Maple and Sheyenne Rivers would be verified through the comparison of IBI scores developed before and after construction. Impacts would also be quantified by calculating a “Habitat Unit” as Impact Area multiplied by Habitat Quality (as identified from one or more of the above metrics). Existing conditions for IBI and QHEI are discussed in Section 3.8 – Fish Passage and Biological Connectivity. Mitigation would be considered effective if Habitat Units lost through impact are less than Habitat Units gained through mitigation. This would also take into account the Habitat Units that are present within any newly constructed river channels to facilitate routing flow through Project features (e.g., water control structures and aqueducts) (FFREIS 2011).

3.6 COVER TYPES

Cover type is a general term that refers to the specific land cover of an area. Six general cover types occur in the affected area: cropland, wetlands, lawn/landscaping, wooded/forest, impervious surfaces, and brush/grassland. This section describes current cover types in the project area, potential changes during project construction and operation, and mitigation measures to avoid or minimize impacts. Cover type information was obtained from the USACE FFREIS, Supplemental EA, and SEAW.

3.6.1 Affected Environment

The project area is large, and therefore, cover types were narrowed down to areas that would be impacted by the Project: the Project footprint (i.e., direct impacts), comprised of the diversion channel, tieback embankment, associated facilities; and the inundation area (i.e., indirect impacts). Collectively the Project footprint and the inundation area are referred to as the Project.

A total of six cover type are represented in the project area and would be directly impacted. Of these, cropland is the primary cover type comprising over 75 percent of the Project footprint. The second greatest cover type is wetlands, covering over 20 percent of the Project footprint. Other cover types present within the Project footprint and project area: brush/grassland, wooded/forest, lawn/landscaping, and impervious surfaces. Table 3.26 provides a summary of the cover types present in the Project footprint.

Table 3.26 Cover Types Present in the Project Footprint

Land Cover Type	Current Project Footprint (acres)
Wetlands	1,780
Lawn/Landscaping[C]	<100
Wooded/Forest	70
Impervious Surface[D]	50 (approx.)
Brush/Grassland[E]	100
Cropland[F]	6,500
TOTAL (approximate)	**8,600**

Sources: FFREIS, Supplemental EA, SEAW, USGS 2001 National Land Cover Dataset (NLCD)
[A] The USGS 2001 NLCD was used to estimate cover types. This data was not field verified, and is intended to provide rough estimates.
[B] NWI, using Eggers & Reed classification and Circular 39, was used to estimate newly inundated wetland. This data was not field verified, and is intended to provide rough estimates.
[C] Lawn/landscaping correlates to Developed-Open Space in the USGS 2001 NLCD.
[D] Impervious surface correlates to Developed: High, Medium and Low Intensity in the USGS 2001 NLCD.
[E] Brush/grassland includes USGS 2001 NLCD pasture and hayland classification.
[F] Cropland correlates to the USGS 2001 NLCD cultivated crops classification.

Indirect impacts were also evaluated for areas outside of the Project footprint in portions of the project area that currently become inundated during flood events and have the potential to become inundated during Project operation. The project area includes the same cover types as those identified for the Project footprint with ratios of cover types anticipated to be similar to those within the Project footprint. Field verification has not been completed on cover types and wetlands located outside of the Project footprint. Wetlands are classified into six types using the Circular 39 system (Shaw and Fredine, 1971). The majority of wetlands are Type 1 wetland (farmed), which have previously been converted from their natural condition to an agricultural use. Other wetland types comprise a much smaller component of the overall cover (see EIS Section 3.4 – Wetlands for further details). The Brush/Grassland cover type is primarily tame grassland or hayland; native grassland is not present in the Project. Wooded/Forest cover type is primarily shelterbelts and planted windbreaks. The natural woodland in the project area, the floodplain forest (discussed in detail in Section 3.9 – Wildlife Resources and Section 3.4 – Wetlands). Lawn/landscaping and impervious surfaces were associated with developed, urban areas.

3.6.2 Environmental Consequences

Cover type impacts have implications for numerous resources, such as wildlife, state-listed species, and wetlands. Potential impacts on other resources in the project area as a result of changes in cover types are discussed in their respective sections of the EIS. The focus of this assessment is on permanent changes in cover type (i.e., footprint of the diversion channel, tieback embankment, and associated facilities). Operation of the Project would cause indirect impacts during the 10-year or greater flood events.

3.6.2.1 Proposed Project

Areas that would be permanently converted to a different cover type after construction of the Project include the footprint of the diversion channel, tieback embankment, and the Comstock and OHB ring levees. Other permanent structures such as in-town levees and floodwalls would be constructed in already urbanized areas and would not result in a substantial change in cover type. River control structures would not permanently change cover type since it would regulate water flow within existing channels.

Project operation would result in indirect impacts to cover types due to inundation during flood events and would not cause a permanent conversion of existing cover types from individual flood events. Some current cropland would be purchased as part of the Project and would no longer be farmed. These areas may be reseeded with native plant species, and therefore, converted to grassland or other appropriate cover type. It is also anticipated that sedimentation would occur incrementally over time in portions of the inundation area nearest the tieback embankment. This could result in cover type conversion in areas that are not actively used for agriculture. Most impacts from new inundation would occur to cropland. Table 3.27 provides a summary of both indirect and direct Project impacts.

Table 3.27 Cover Types: After Construction and Operation of the Project

Land Cover Type	Direct Impacts: Project Footprint After Construction (acres)	Indirect Impacts: Inundation Area Additional 100-year Flood Area With Project Operation (acres)[A]
Wetlands[B]	1,780	151
Lawn/Landscaping[C]	0	1,305
Wooded/Forest	0	112
Impervious Surface[D]	50 (approx.)	1
Brush/Grassland[E]	4,000-4,700[H]	1
Cropland[F]	2,100[I] (approx.)	18,630
TOTAL[A,B] (approximate)	**8,000**	**20,200**

Sources: FFREIS, Supplemental EA, SEAW, USGS 2001 NLCD

[A] The USGS 2001 NLCD was used to estimate cover types. This data was not field verified, and is intended to provide rough estimates.

[B] NWI, using Eggers & Reed classification and Circular 39, was used to estimate newly inundated wetland. This data was not field verified, and is intended to provide rough estimates.

[C] Lawn/landscaping correlates to Developed-Open Space in the USGS 2001 NLCD.

[D] Impervious surface correlates to Developed: High, Medium and Low Intensity in the USGS 2001 NLCD.

[E] Brush/grassland includes USGS 2001 NLCD pasture and hayland classification.

[F] Cropland correlates to the USGS 2001 NLCD cultivated crops classification.

[G] The current wetland mitigation plan uses the bottom of the diversion channel for wetland creation. The wetland type in the diversion channel bottom may be a combination of Type 2 and Type 1 emergent wetland, but the entire acreage has been included as Type 2 since differentiating based on available information is not possible.
[H] There is uncertainty as to how much of the diversion channel would be considered wetland, upland, and cropland. Operation of the channel would dictate the difference between wetland and upland cover types. Therefore, Grassland has considerable uncertainty.
[I] Acreage for cropland is the area on the outside of the diversion channel.

3.6.2.1.1 Cropland

Construction of the diversion channel would result in the greatest cover type change by converting approximately 4,500 acres of cropland to grassland and wetland. The change in cover type from cropland to grassland or wetland would span a long distance (greater than 30 miles), minimizing potential direct impacts to individual areas of cropland. There is some uncertainty as to how much of the diversion channel embankment would become grassland cover, as Project construction would require specific wetland mitigation based on impacts (see EIS Section 3.4 – Wetlands for details).

Additionally, it is anticipated that agricultural production on the cropland would continue outside of the tieback embankment area further reducing direct impacts to cropland. Total potential cropland impacts are estimated to be approximately 4,500 acres, which is less than one-half percent of the total cropland in Cass and Clay Counties (FFREIS 2011). Relative to the larger project area and the Red River Valley region, this permanent loss of cropland would not be substantial. Project operation would result in approximately 18,630 acres of indirect cropland impacts in the inundation area during the 100-year flood event.

3.6.2.1.2 Brush/Grassland

The current estimated brush/grassland (i.e., grassland) in the Project footprint is approximately 100 acres. Grassland would increase between 3,900 and 4,600 acres as a result of Project construction. This increase is mainly a result of seeding the diversion channel side slopes with grass species to aid in soil stabilization post-construction. This grassland would transition to wetland at the bottom of the diversion channel and on some of the side slope areas. Project operation would result in approximately one acre of indirect impacts to grasslands in the inundation area during the 100-year flood event.

3.6.2.1.3 Wetlands

Direct impacts to wetlands in the Project footprint are estimated to result in a total of approximately 1,780 acres. Type 1 Wetlands (farmed) would be the primary wetland cover type impacted in the Project footprint, with impacts totaling approximately 1,200 acres. Impacts to these wetlands would be mitigated by creation of approximately 1,379 acres of Type 2 Wetlands within the diversion channel. Additional detail about specific wetland types and potential acreage impacts to those types is discussed in Section 3.4 – Wetlands.

The floodplain forest is the only natural forest habitat in the project area, with impacts totaling approximately 62 acres. Impacts to this habitat type would be mitigated at a 2:1 ratio by creation of 124 acres of floodplain forest habitat in existing floodplain and agricultural land. For additional information, see EIS Section 3.4 – Wetlands and EIS Section 3.9 – Wildlife Resources.

Project operation would result in approximately 151 acres of indirect impacts to wetlands in the inundation area during the 100-year flood event. The majority of these wetlands have been identified as floodplain forest (0.2 acres) and anticipated to occur along the Red River and Wild Rice River corridors. The estimated indirect wetland impacts are based on NWI, Eggers and Reed classification, and Circular 39 and have not been field verified.

3.6.2.1.4 Wooded/Forest

Shelterbelts and windbreaks are grouped under the Wooded/Forest cover type. After construction, 70 acres of this cover type would be converted to grassland or wetland cover in the diversion channel. In general, this cover type has been planted and would not represent a natural forest condition. Conversion of this cover type is not anticipated to result in substantial impacts.

Project operation would result in approximately 112 acres of indirect impacts to wooded/forest cover type in the inundation area during the 100-year flood event. Based on the USGS 2001 National Land Cover Dataset (NLCD), the majority of these impacts would occur to shelterbelts and windbreaks.

3.6.2.1.5 Lawn/Landscaping

Lawn/Landscaping impacts would occur primarily around urban or residential areas, where natural cover has already been converted to human uses. Less than 100 acres of this cover type would be converted to grassland or wetland cover in the diversion channel.

Based on the USGS 2001 NLCD, operation of Project would result in approximately 1,305 acres of indirect impacts to lawn/landscaping cover type in the inundation area during the 100-year flood event.

3.6.2.1.6 Impervious Surface

Impervious surface cover would not change as a result of the Project. Operation of Project would result in approximately one acre of indirect impacts to lawn/landscaping cover type in the inundation area during the 100-year flood event. Based on the USGS 2001 NLCD, the majority of these impacts would be to roadways in the staging area. The Project would raise or alter some of these roads (Section 3.13-Infrastructure).

3.6.2.2 Base No Action Alternative

Under the Base No Action, flooding would continue in the project area. Cover types are expected to stay relatively similar, with natural changes in vegetation communities occurring over time after flooding or other natural disturbance events. Additional wetlands may be converted to agricultural use at the discretion of individual landowners and permitting authorities. This area of North Dakota and Minnesota has been developing at a fairly consistent rate. As the Metropolitan Area grows, various cover types would likely be converted to lawn/landscaping and impervious surfaces with the development. This development and conversion of cover types would also occur under the No Action Alternative.

3.6.2.3 No Action Alternative (with Emergency Measures)

Flooding would continue throughout the project area, with temporary changes in cover during flood events. Overall, cover types would be anticipated to remain similar to their current condition, with natural changes in vegetation communities occur over time. Emergency measures are not anticipated to cause substantial changes in cover types. Localized, indirect impacts to cover types may occur where sandbagging and temporary levees are constructed for the duration of a flood event. Direct impacts are not anticipated.

3.6.2.4 Northern Alignment Alternative

Direct and indirect impacts from operation of the NAA are anticipated to be similar to those previously described for the Project with the exception of the overall cover type acreage affected by new inundation. Cover types were not field verified for the NAA and the design of the NAA has not been completed. It is anticipated that the NAA construction footprint impacts (i.e., direct impacts) would be similar to the total cover type acreage impacts for the Project, totaling approximately 8,000 acres. During NAA operation, new inundation (i.e., indirect impacts) is anticipated to occur to approximately 15,450 acres for the 100-year flood event.

The 2001 USGS NLCD and NWI, using Eggers and Reed classification and Circular 39, were used to evaluate the cover types and wetlands occurring in areas that would be newly inundated by the NAA. Table 3.28 provides a summary of cover types that would be impacted by new inundation during NAA operation.

Table 3.28 Cover Types Impacted by New Inundation During NAA Operation For the 100-year Flood Event

Land Cover Type	Indirect Impacts: New Inundation Area for the 100-year Flood During NAA Operation (acres)[A]
Wetlands[B]	148
Lawn/Landscaping[C]	970
Wooded/Forest	60
Impervious Surface[D]	1
Brush/Grassland[E]	1
Cropland[F]	14,270
TOTAL	**15,450**

Sources: FFREIS, Supplemental EA, SEAW, USGS 2001 NLCD

[A] The USGS 2001 NLCD was used to estimate newly inundated cover types. This data was not field verified, and is intended to provide rough estimates.

[B] NWI, using Eggers & Reed classification and Circular 39, was used to estimate newly inundated wetland. This data was not field verified, and is intended to provide rough estimates.

[C] Lawn/landscaping correlates to Developed-Open Space in the USGS 2001 NLCD.

[D] Impervious surface correlates to Developed: High, Medium and Low Intensity in the USGS 2001 NLCD.

[E] Brush/grassland includes USGS 2001 NLCD pasture and hayland classification.

[F] Cropland correlates to the USGS 2001 NLCD cultivated crops classification.

Indirect impacts to cover types from flood inundation are not anticipated to result in changes to vegetation communities or cover types for individual flood events. Sedimentation has the potential to occur incrementally over time in portions of the inundation area nearest the tieback embankment. Sedimentation may occur slowly over time and could lead to changes in vegetation communities and cover types in some areas, particularly areas where sediment may accumulate or areas that are not actively used for agriculture. Additional information on potential impacts to wetlands and specific wetland types is provided in Section 3.4 – Wetlands.

Some areas currently used as cultivated cropland may be purchased and potentially converted to grassland or another cover type as part of mitigation for the Project. Additional discussion on mitigation is provided in Section 3.6.3.

3.6.3 Proposed Mitigation and Monitoring Measures

Cover type impacts would occur primarily to croplands and wetlands. Cropland impacts would be mitigated by compensation to landowners for direct cropland impacts, such as land purchase for Project construction. Owners of croplands that are purchased for the Project would be compensated at fair market value (FFREIS 2011). Where agricultural use is not feasible in certain areas of the tieback embankment, that area would be seeded and revegetated with native plant species and managed as grassland. Flowage easements have also been proposed for mitigation of cropland, which would allow agricultural use to continue on the land.

Preliminary North Dakota mitigation plans call for wetland impacts to be replaced on a functional level and not by specific wetland type. This could result in a specific wetland type having an overall acreage loss within the project area. The vast majority of the impacted wetland acreage is Type 1 Wetland (farmed) and would be mitigated by creation of wetlands within the diversion channel on the bottom and some side slope areas. Mitigation for non-forested wetland impacts associated with the diversion channel is revegetation at the bottom of the diversion channel and management of upland inside slopes.

All direct impacts to the floodplain forest would be mitigated at a 2:1 ratio. The USACE St. Paul and Omaha Districts, as well as the USFWS, have used “Blue Books” (USFWS habitat assessment models) to determine adequate replacement for the forested impacts. Some of these sites have been preliminarily identified by the USACE. Additional wetland mitigation discussion is provided in EIS Section 3.4 – Wetlands.

Uncertainty associated with both the level and type of impacts and the effectiveness of mitigation would be addressed as part of an AMP, developed by the AMT lead by the USACE. This plan requires pre-construction and post-construction studies of biota and physical habitat for both impact sites and mitigation sites. This would allow impacts to be verified and mitigation effectiveness to be evaluated. A key component of the AMP is a thorough monitoring program with performance measures, action thresholds, and response actions. Monitoring activities, including review of results, would be performed by an AMT.

The effectiveness of the AMP would be dependent on the ability to implement monitoring and mitigation through available sources of funding. Without funding, implementation of the AMP would not be feasible. The FFREIS (Section 5.5.4 on page 375) states: “If significant project modifications are needed, or if further construction actions are needed, the non-federal sponsors will work with the USACE 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 USACE to secure potential funds under the USACE Continuing Authorities Program (CAP) to modify an existing project. It also could include seeking congressional action to secure additional federal funds."

3.7 POTENTIAL ENVIRONMENTAL HAZARDS BASED ON PRIOR SITE USE

The project area has numerous parcels of land and associated structures that may have potential hazardous, toxic, and radioactive wastes (HTRWs) issues. The HTRWs have the potential to contaminate soil and groundwater resources. To identify the potential extent of HTRW issues that may be present in an area or specific parcel of land, Phase I Environmental Site Assessments (ESAs) are typically conducted. A Phase I ESA is an investigation of a parcel of land and its associated structures for potential environmental issues. During a Phase I ESA survey, potential issues are identified by site visits to document current uses and features; searching current and historical records; or interviewing current users, owners, and city/county offices. The goal of Phase I ESAs is to identify the potential for recognized environmental conditions (RECs) that exist at a site. RECs are defined as: the presence or likely presence of any hazardous substances or petroleum products in, on, or at a property that have the potential to release into the environment, and therefore, pose a threat due to the potential for contamination of soil, groundwater, or surface water (ASTM 2013).

If Phase I ESAs identify RECs and consider a site to be potentially contaminated with hazardous substances or petroleum products, Phase II ESAs are recommended to provide a more detailed investigation, which involves chemical analysis of soil and groundwater to detect the presence of hazardous substances and/or petroleum hydrocarbons. The additional details gathered would provide information necessary to determine what types of RECs may be present, if any, and if avoidance, mitigation or monitoring measures necessary.

This section discusses the Phase I ESAs that have been completed in the project area and the results and recommendations of those assessments. In addition, this section also discusses proposed and potential mitigation and monitoring actions and what could result if HTRWs are not handled properly. A more detailed discussion and evaluation of the proposed mitigation and monitoring as well as any additional recommendations for mitigation and monitoring is included in Chapter 6, Section 6.2.7.

3.7.1 Affected Environment

Several Phase I ESAs have been conducted within the project area; however, these were completed along the alignments where Project features were proposed to be constructed as described in the FFREIS. Therefore, investigations have not been completed for the current Project design, in consideration of the NAA, or for those areas outside the staging area that would be affected during Project and or NAA operation, except where the earlier Project design included a constructed feature. Those areas where investigations have not been conducted include the western alignment shift, southern alignment shift, Comstock ring levee, parts of the staging area or proposed mitigation sites, and parts of the inundation areas outside of the staging area. The USACE has stated that additional Phase I ESAs would be completed for properties identified for acquisition as Project designs are refined and as the areas that will be impacted are more clearly defined.

The Phase I ESAs included recommendations for Phase II ESAs to be completed for those sites in which it was determined that further investigation was necessary. These recommended Phase II ESAs were not completed at the time of EIS publication. As Project designs have changed and continue to be revised, the need for the recommended Phase II ESAs will be reevaluated. Any necessary previously recommended Phase II ESAs and newly recommended Phase II ESA needs will be completed as needed as Project designs are refined.

The following Phase I ESAs were reviewed for this EIS.

- *Phase I Environmental Site Assessment, Moorhead Metro Feasibility Study HTRW, Clay County, Minnesota,* prepared for the USACE by Stanley Consultants, Inc. and dated November 2010 (2010 Moorhead ESA) (Stanley Consultants, 2010b).

- *Phase I Environmental Site Assessment, Fargo Metro Feasibility Study HTRW,* prepared for the USACE by Stanley Consultants, Inc. and dated November 2010 (2010 Fargo ESA) (Stanley Consultants, 2010a).

- *Fargo-Moorhead Metropolitan Area Flood Risk Management Project, Phase I Environmental Site Assessment (ESA) 2012 Supplement*, prepared for the USACE St. Paul District, by the USACE St. Louis District and dated September 2012 (2012 Supplemental ESA) (USACE, 2012b).

- *In-Town Levees Project Phase I Environmental Site Assessments* (a number of specific properties were assessed), prepared for the Fargo-Moorhead Diversion Authority by HDR Engineering Inc. and dated July 2013 (2013 In-Town Levee ESAs) (HDR Engineering, Inc., 2013a-f).

- *Phase-I Environmental Site Assessment Report, Oxbow-Hickson-Bakke, North Dakota, Flood Risk Reduction Project*, prepared for the USACE St. Paul District, by the USACE St. Paul District and dated August 15, 2014 (2014 OHB ESA) (USACE, 2014b).

A summary of each completed Phase I ESA and the associated REC(s) is provided below.

3.7.1.1 2010 Moorhead ESA

The 2010 Moorhead ESA evaluated parcels that would be directly affected by the construction footprint of an approximately 26-mile proposed diversion channel and associated tieback levee for three alternative alignments located in the Moorhead, Minnesota area.

The 2010 Moorhead ESA identified ten RECs, consisting of hazardous substances and release of hazardous substances. However, since the completion of the 2010 Moorhead ESA, this alternative diversion channel alignment and structures were not included in the Project, and therefore, RECs identified in the 2010 Moorhead ESA no longer pertain and will not be discussed further.

3.7.1.2 2010 Fargo ESA

The 2010 Fargo ESA evaluated parcels that would be directly affected by the construction footprint of the approximate 35-mile proposed diversion channel and associated tieback embankment for three alternative alignments.

The 2010 Fargo ESA identified four RECs containing hazardous substances. One of the four RECs included 13 parcels adjacent to railroads at four intersections with the Project in North Dakota. The RECs are summarized in Table 3.29.

Table 3.29 Summary of RECs Identified in the 2010 Fargo ESA

REC Number	Affected Parcel(s)	Description of REC
1	70000013646010	Junk vehicles and large storage building that may potentially store petroleum and/or other hazardous substances
2	4400000012820	Junk vehicles with visual staining
3	150091001	Junk vehicles, hobby shop with stored petroleum and/or hazardous substances
4	09020011902000, 59000010866000, 590000108687000, 530000009023000, 530000009023010, 02300001455000, 530000008024000, 67000012709000, 67000012714020, 67000012714010, 15000050, 150092500, 150091000	13 parcels (4 Railroad crossings in ND). Contaminants may include: arsenic, chromates, coal, creosote, and lead

3.7.1.3 2012 Supplemental ESA

The 2012 Supplemental ESA covers the Project design evaluated for the FFREIS, which has changed since 2012. The Project design evaluated in the 2012 Supplemental ESA consists of a North Dakota diversion channel, upstream staging and storage areas, and associated structures. This ESA includes areas that were not previously included in the 2010 Fargo ESA, including an alignment shift along the northern portion of the diversion channel, extensions on the tieback embankment in Minnesota, tieback embankment along Highway 17, staging area, and storage area. The 2012 Supplemental ESA also revisited RECs noted in the 2010 Fargo ESA to identify any potential changes. The 2012 Supplemental ESA did not provide specific details about RECs for each property, but rather general information about where possible RECs may occur in the staging area.

The 2012 Supplemental ESA identified the following potential RECs generally occurring in the project area:

- Aboveground storage tanks (ASTs) – Propane, Diesel, Gasoline, Heating Oil
- Underground storage tanks (USTs) – Heating Oil
- Potential Asbestos Containing Materials (ACMs)
- Polychlorinated Biphenyls (PCBs) – Transformers
- Underground Gas Lines
- Underground Utilities – Wells, Communication, Power
- Railroad Crossings – Poly Aromatic Hydrocarbons (PAHs), Metals

The above RECs are in addition to the RECs identified in the 2010 Fargo ESA.

3.7.1.4 2013 In-Town Levee ESAs

The 2013 In-Town Levee ESAs cover properties that would be affected by the construction of six in-town levees, which include:

- City Hall Parking Lot Property
- Fargo Public Schools Property
- Feder Realty Property
- Howard Johnson Property
- Park East Apartments Property
- Case Plaza Property

Of the six properties that would be affected by in-town levees, potential RECs were identified on three of the properties: City Hall Parking Lot, Howard Johnson, and Casa Plaza. The 2013 In-Town Levee ESAs did not identify any RECs on the Fargo Public Schools, Feder Realty, or the Park East Apartments properties. A summary of identified RECs is provided in Table 3.30.

Table 3.30 Summary of RECs Identified in 2013 In-town Levee ESAs

REC Number	Property	Description of RECs
1	City Hall Parking Lot Property	Soil/Groundwater contamination from adjacent sites, which historically included a tannery, foundry, and machine & welding services
2		At least three feet of fill below surface, which may be contaminated
3	Howard Johnson Property	One unmaintained underground storage tank
4	Case Plaza Property	Soil/Groundwater contamination from adjacent sites, which historically included a lumber yard and farm equipment manufacturer
5		Soil/Groundwater contamination from adjacent site, which historically included a gas station with underground storage tanks

3.7.1.5 2014 OHB ESA

The 2014 OHB ESA covers properties that would be affected by the construction of a ring levee around the communities of Oxbow, Hickson, and Bakke, North Dakota, which include residential properties and tilled farmland.

A search performed by Environmental Data Resources identified one potential REC, an UST listed on the North Dakota UST database. Follow-up research for the potential REC was completed by contacting the North Dakota Department of Health Hazardous Waste Program, who had no record of the UST. Additional follow-up was conducted by contacting the company listed (Petro-Serve USA) who also stated they have never had a station or UST in the vicinity. The UST is considered likely to be an error in the database. Also, a listing on the North Dakota UST database does not necessarily mean the site is a REC. Other possible RECs visually identified in the area included:

- Aboveground Storage Tanks (propane);
- Below ground utilities (water, power, communications);

- Potential asbestos shingles; and,
- Aboveground utilities (power, communications).

The visually identified sites are not necessarily RECs, but could affect construction if not given consideration and further evaluation prior to construction.

3.7.2 Environmental Consequences

3.7.2.1 Proposed Project

Project construction of the diversion channel, tieback embankment, and in-town levees would directly impact parcels with identified RECs as summarized in Table 3.31 and Table 3.32. These RECs include junk vehicles, petroleum products, and railroad crossings that may contain contaminants or may have contaminated soil or groundwater. One REC identified in the 2010 Fargo ESA (Table 3.31, REC Number 2) is no longer included in the Project due an alignment shift in the Project design. Additional Phase I ESAs would be needed to address Project design changes that have occurred since the Phase I ESAs, reviewed for this EIS, were completed. These design changes include, for example, the western alignment shift, southern alignment shift, Comstock ring levee, parts of the staging area, and areas outside the staging area that would be affected during Project operation, as well as proposed mitigation sites. Construction has the potential to impact identified RECs, which has the potential to spread contaminants in soil and groundwater. This could result in potentially adverse impacts to human health and water quality. Operation of the staging area also has the potential to spread contaminants of identified RECs if not handled properly.

Of the four RECs identified, the railroad crossings and associated contaminants have the greatest potential for contamination and subsequent remediation. Subsequent Phase I ESAs conducted in the project area, as a result of design changes, may result in additional identified RECs. A general discussion of the potential impact each of the possible contaminants could have on the environment is provided in Table 3.31.

Operation of the staging area would periodically impact parcels that may have RECs. Phase I ESA information indicates possible RECs generally exist in the staging area, as summarized in Section 3.7.1.3, including ASTs, USTs, ACMs, and PCBs. Flooding of the staging area could cause damage to structures and spread contaminants in soil and groundwater. These flooding consequences could result in adverse impacts to human health, soil conditions, groundwater quality, agricultural crops, and fish and wildlife populations. General discussion of the potential impact each of the possible contaminants could have on the environment is provided in Table 3.31.

Table 3.31 Summary of Potential Environmental Consequences from Identified RECs

Identified Possible RECs	Potential Environmental Consequences
Junk Vehicles and Visible Soil Staining	Junk vehicles stored on properties could be releasing various petroleum (gasoline/motor oil) or other hazardous materials (antifreeze) into the soils and groundwater if the holding vessels have corroded or deteriorated over the years from weathering.

Identified Possible RECs	Potential Environmental Consequences
	Existing soil or groundwater contamination could be spread when flood waters inundate an area, which could further contaminate soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Flood waters could cause further corrosion of a vehicle and associated tanks and reservoirs, leading to leaking of petroleum and hazardous materials, which could impact soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Flood waters could cause direct release of petroleum and hazardous materials if water entered directly into tanks and vessels releasing petroleum and hazardous materials into the flood waters, which could contaminate soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Depending on the levels of petroleum and hazardous material contamination, human or animal consumption of crops could be limited; and have negative impacts on fish and wildlife.
Stored Petroleum and Hazardous Materials	Existing soil or groundwater contamination could be spread when flood waters inundate an area, which could further contaminate soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Flood waters could cause the corrosion of the holding vessels, resulting in leakage which could impact soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Petroleum and hazardous materials could be released if flood water entered directly into tanks and vessels, which could contaminate soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Depending on the levels of petroleum and hazardous material contamination, it could prevent the use of crops for human or animal consumption; have negative impacts on fish, wildlife, and wetlands.
Railroad Crossings	Railroad ties are often times treated with chemicals such as: arsenic, chromates, coal, creosote, PAHS, lead, and other metals to prevent/slow deterioration of the wood. The above mentioned chemicals can leach over time into adjacent soils and groundwater.
	Flooding could lead to the migration of these items to impact adjacent soils, ground water, surface water, and potentially wells used for irrigation or drinking water.
	Depending on the levels of contamination, it could prevent the use of crops for human or animal consumption; have negative impacts on fish, wildlife, and wetlands.
USTs/ASTs	Existing soil or groundwater contamination could be spread when flood waters inundate the area, which could further contaminate soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.

Identified Possible RECs	Potential Environmental Consequences
	Flood waters could cause the corrosion of the tanks, leading to leaks which could impact soil, groundwater, and potentially wells used for irrigation or drinking water.
	Depending on the levels of petroleum contamination, human or animal consumption of crops could be limited; and have negative impacts on fish and wildlife.
ACMs	ACMs may be present in houses, barns, and farmstead buildings. Flood waters could cause damage directly to ACMs or structures containing ACM to collapse causing asbestos to potentially contaminate the air and surrounding soils.
	ACMs located in structures to be demolished or relocated require ACM to be removed prior to demolition activities. If not removed, asbestos can contaminate the air and surrounding soils.
	ACMs may be present on underground pipelines. Flood water could cause damage to the ACMs causing soil contamination.
	ACMs located on underground pipelines to be removed or relocated may require ACM to be removed prior to those activities. If not removed, asbestos could contaminate the air and surrounding soils.
	Asbestos is a known carcinogen and a threat to human health.
PCBs	Leaking transformers contain PCBs that can potentially cause soil contamination.
	Flood waters could cause pole mounted transformers to become damaged if the pole were to collapse or cause pad mounted transformers to corrode causing leaking of PCBs. This could result in impacts to soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
Underground Gas/Petroleum Lines	Existing soil or groundwater contamination could be spread when flood waters inundate the area, which could further contaminate soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Flood waters could cause the corrosion of the pipes, leading to leaks which could impact soil, groundwater, surface water, and potentially wells used for irrigation or drinking water.
	Depending on the levels of petroleum contamination, negative impacts on fish and wildlife could occur, and human or animal consumption of crops could need to be limited.
Underground Utilities (wells, septic systems, communication, power)	Drinking water and irrigation wells could become contaminated with migration of chemicals or contaminated flood waters.
	Flood waters could inundate septic systems, causing sewage to be released; flooding could lead to the migration of wastes and could potentially affect drinking water wells.
Soil/Groundwater Contamination from Adjacent Sites	Flooding could lead to the migration chemicals, petroleum products, creosote, green treat chemicals, or lead resulting in impacts to soils, groundwater, surface water, and potentially wells used for irrigation or drinking water.

Identified Possible RECs	Potential Environmental Consequences
	Depending on the levels of contamination, negative impacts could occur to fish, wildlife, and wetlands.
Contaminated Fill	Flooding could lead to the migration chemicals, petroleum products, asbestos, and heavy metals
	Depending on the levels of contamination, negative impacts could occur to fish, wildlife, and wetlands.

Once specific properties in the inundated areas are identified for acquisition, additional assessments, such as a Phase I ESA or subsequent Phase II ESA, would be conducted to provide details on the extent of potential contamination and specific removal and remediation measures that may be required to avoid impacts. The Diversion Authority would acquire a flowage easement from the property owner on properties not purchased for the Project but anticipated to be impacted in the staging area. Completion of Phase I ESAs or remediation is not anticipated for properties that are not acquired for the Project.

A possible REC that was not identified in the Phase I ESAs, but could be of potential concern is lead based paint (LBP), which is discussed in Table 3.32.

Table 3.32 Summary of Environmental Consequences from Potential Additional RECs

Potential RECs	Potential Environmental Consequences
LBP	Flood waters could cause the deterioration of the LBP causing it to lift from its substrate, leading to the migration of lead that could impact soils, groundwater, or potentially wells used for irrigation or drinking water.
	Existing soil contamination from deteriorated LBP from past floods and weathering may already be present; flooding could lead to lead migration into adjacent soils, ground water supplies, such as drinking water and irrigation wells.

3.7.2.2 Base No Action Alternative

Under the Base No Action Alternative, all parcels with identified RECs would remain as-is, which would maintain the possibility of contamination of soil and groundwater during each flood event unless the RECs are removed or the potential for flooding no longer exists.

The Cities of Fargo and Moorhead each have ongoing and planned flood risk reduction projects that reduce flooding for the cities and properties located along the Red River. These projects may reduce the risk of contamination from identified RECs during future floods by reducing or eliminating flood water impact on parcels with identified RECs.

3.7.2.3 No Action Alternative (with Emergency Measures)

Under the No Action Alternative (with Emergency Measures), all parcels with identified RECs would remain as-is, which would maintain the possibility of contamination of soil and groundwater during each flood event unless the RECs are removed or the potential for flooding no longer exists. Emergency measures would be used to reduce flooding in certain areas, and reduce the risk for contamination from RECs. As discussed for the Base No Action Alternative, the Cities of Fargo and Moorhead have planned flood risk reduction projects that reduce flooding potential for properties along the Red River. Additionally, the No Action Alternative could use emergency measures, such as sandbagging and temporary levees, to target any identified RECs to protect certain areas, further reducing the risk of potential contamination.

3.7.2.4 Northern Alignment Alternative

The NAA diversion channel design and its location is similar to the Project. The NAA tieback embankment and control structure design are anticipated to be similar to the Project, but would be located approximately 1.5 miles downstream. This would result in a different flood inundation and staging area.

Phase 1 ESAs for the Project were completed for the majority of the diversion channel, the in-town levees, OHB ring levee, and parts of the staging area, but not for the latest Project design or for inundation areas located outside of the staging area. Portions of the NAA that are in the same locations as the Project that have completed Phase I ESAs include parcels with previously identified RECs. Potential RECs were identified in the 2010 Fargo ESA, 2012 Supplemental ESA, 2013 In-Town Levee ESAs, and 2014 OHB ESA as discussed above under Proposed Project. It is anticipated that all of these identified RECs would also be impacted as part of the NAA with the exception of possibly some identified within the 2012 Supplemental ESA, as that report does not provide specific locations for RECs, but rather a general discussion on the presence of certain types of RECs primarily in the staging area. The areas that have not been surveyed for the Project that also apply to the NAA would still need Phase I ESA completion, as well as additional areas for the NAA, such as the tieback embankment, control structures, staging area, and possibly inundated areas outside of the staging area that are specific to the NAA design.

The possibility of contamination of soil and groundwater during each flood event exists where RECs have been identified for the NAA, unless the RECs are remediated or the potential for flooding no longer exists. Areas within the NAA which have not had ESAs completed would need to be evaluated and a Phase I ESA completed. Types of potential RECs in the vicinity of the NAA are anticipated to be similar to those identified for the Project as these areas have similar land uses. RECs and their potential impacts are discussed in Table 3.31 above.

Mitigation and monitoring would be dependent on the type and location of identified RECs. The USACE would conduct Phase I ESAs and any necessary subsequent Phase II ESAs after a property has been identified for acquisition. Remedial actions and mitigation would occur as needed prior to construction. Mitigation for RECs associated with the NAA are anticipated to be similar to what was described for the Project in Section 3.7.3 – Proposed Mitigation and Monitoring Measures.

3.7.3 Proposed Mitigation and Monitoring Measures

Results from the previously completed Phase I ESAs indicated that Project construction and operation would directly impact parcels with identified and possible RECs. Phase II ESAs have been recommended where additional investigations were warranted. As Project designs have continued to evolve since the Phase I ESAs were complete, both the Phase I ESAs and the recommended Phase II ESAs will be further evaluated for applicability due to Project design changes that have occurred since they were completed.

This primarily applies to the findings of the 2010 Fargo ESA, 2012 Supplemental ESA findings, and 2013 In-Town Levee ESAs.

Once Project designs are more refined, acquisition of the properties necessary for Project construction and operation would be determined. The USACE would then conduct additional Phase I ESAs and subsequent Phase II ESAs, as necessary that were not previously covered by or were inaccessible at the time of the original ESAs completed in 2010, 2012, and 2013. Subsequent Phase II ESAs would be conducted, as recommended by the Phase I ESAs. Based on the identified contamination levels, a response action plan, detailing remediation plans and additional testing requirements may be generated. Impacts associated with the RECs could then be mitigated through soil and groundwater remediation projects or other measures as identified during the Phase II ESA.

It should be noted that further investigations would be conducted to include properties that may be affected if the Project design is altered prior to or during construction.

The Diversion Authority would be responsible for property acquisition. The Diversion Authority would also be responsible for any required remedial actions or mitigation for the property prior to Project construction as identified in the Phase II ESAs, including asbestos/lead and regulated materials building surveys. Any identified regulated materials would be mitigated according to existing rules and regulations by a licensed remediation contractor, such as removal and proper disposal of all hazardous substances, contaminated soils, relocation of utilities, and potentially the removal of various structures that may contain asbestos, lead, or other hazardous materials. Potential mitigation measures would reduce or eliminate the potential for impacts from HTRW.
In addition to RECs, numerous residential homes, agricultural structures and commercial businesses would also be impacted during the construction of the diversion channel and in-town levees. Structures that are located within the construction footprint of the diversion channel or in-town levees would require demolition or relocation to allow for the construction of the diversion channel and levees. Prior to the demolition or relocation of these structures, a building survey is required by Minnesota Rules 7035.0805. A building survey would identify ACMs, LBP, and any regulated/hazardous materials that require special handling and/or recycling or disposal. Any regulated materials would be mitigated according to local, state, and federal laws by a licensed hazardous waste remediation contractor or licensed asbestos abatement contractor, and disposed of properly.

Inundation impacts to structures within and adjacent to the staging area may require mitigation and additional investigations such as Phase I ESAs to determine potential RECs. The need for these investigations would be determined once Project designs are more refined. Impacts to structures and proposed mitigation for impacts to structures due to inundation is further discussed in the Socioeconomics Section 3.16.

Table 3.33 provides a summary of the potential remedial actions and mitigation measures typically associated with each type of REC that may be implemented or may be required depending on the REC, HTRW and/or level of potential contamination. The Diversion Authority would be required to comply with all applicable laws and regulations related to potential HTRW.

Table 3.33 Summary of Potential Mitigation Measures for Potential RECs

Identified Possible RECs	Potential Mitigation Measures
Junk Vehicles and Visible Soil Staining	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal of contaminated soils
	Removal and disposal of junk vehicles
	Remediation of any contaminated groundwater or wells
Stored Petroleum and Hazardous Materials	Conduct additional site visits to identify the materials present
	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal of stored petroleum and hazardous materials
	Relocation of stored petroleum and hazardous materials, above flood stage and in a secondary containment
	Removal and disposal of contaminated soils
	Remediation of any contaminated groundwater or wells
Railroad Crossings	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal of railroad ties, relocation, or elevating railroad tracks
	Removal and disposal of contaminated soils
	Remediation of any contaminated groundwater or wells
USTs/ASTs	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal of tanks and associated piping
	Construct secondary leak containment systems around ASTs
	Replace USTs with ASTs that include secondary containment systems
	Removal and disposal of contaminated soils
	Remediation of any contaminated groundwater or wells
ACMs	Conduct a building survey to test for asbestos in and on structures
	Test any materials found in soil excavations for asbestos
	Removal and disposal of soils contaminated with ACM
	Removal and disposal of asbestos containing materials, especially damaged or friable
	Relocation or elevation of structures containing ACM
PCBs	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal or relocation of transformers
	Removal and disposal of contaminated soils
	Replace with mineral oil transformers
Underground Gas/Petroleum Lines	Conduct a Phase II ESA to test for soil and groundwater
	Relocation of utilities
	Removal and disposal of contaminated soils

Identified Possible RECs	Potential Mitigation Measures
	Remediation of any contaminated groundwater or wells
Underground Utilities	Conduct a Phase II ESA to test for soil and groundwater contamination
	Sealing of wells and septic systems
	Relocation of utilities
	Removal and disposal of contaminated soils
	Remediation of any contaminated groundwater or wells
Soil/Groundwater Contamination from Adjacent Sites	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal of contaminated soils
	Remediation of any contaminated groundwater or wells
Contaminated Fill	Conduct a Phase II ESA to test for soil and groundwater contamination
	Removal and disposal of contaminated soils
	Remediation of any contaminated groundwater or wells
LBP	Conduct a building survey to test for LBP in/on structures
	Stabilization or removal of LBP
	Relocation of structures with LBP

3.8 FISH PASSAGE AND BIOLOGICAL CONNECTIVITY

Passage, or the ability to migrate upstream or downstream, on rivers and tributaries is important to the overall health of an aquatic community, which includes both macroinvertebrate and fish species. Various factors can affect fish passage, which can be naturally occurring, such as flow velocity or changes in geomorphology; and human-caused, such as river impoundments, or dams. The Project has the potential to disrupt fish passage through the construction of the diversion channel, associated hydraulic control structures, tieback embankment, and a flood storage area (staging area), as well as Project operation through modification of the natural hydrology of the project area by controlling water flow during flood events. Section 3.3 – Stream Stability describes potential impacts to fluvial geomorphology.

This section describes the potential environmental impacts to macroinvertebrates and fish species within the Red River, as well as several tributary streams in the project area in both Minnesota and North Dakota, including Wolverton Creek, Wild Rice River, Sheyenne River, Maple River, Lower Rush River, and Rush River. Existing conditions for each stream were established using available data from the QHEI for macroinvertebrates and theIBI for fish communities. Sensitive and significant species, including the lake sturgeon, were also identified for the project area for the purposes of potential impact evaluation. For each stream, potential impacts to aquatic habitat, fish passage and biological connectivity, and fish standing and mortality were evaluated. This evaluation assessed the potential for interruption to fish migration and movement; and impacts on fish and macroinvertebrate communities. This section also discusses proposed mitigation and monitoring measures, which include stream channel restorations; fish migration and connectivity, such as dam modifications; construction avoidance periods; and monitoring measures and adaptive management. An assessment of proposed mitigation and monitoring and additional recommendations discussion is included in subsection 6.2.8. More details on proposed mitigation and monitoring can be found in the Draft AMMP included as Appendix B.

3.8.1 Affected Environment

The primary rivers and streams in the project area include the Red River, Wild Rice River, Sheyenne River, Maple River, Lower Rush River, Rush River, and Wolverton Creek. There are also a number of smaller tributary streams that are part of the larger Red River basin. A summary of historical fish surveys compiled for the Red River basin (Aadland et al, 2005) revealed there were 57 fish species identified in the Red River from surveys conducted between 1962 and 2000. This is a conservative estimate since most Red River surveys are completed with boat electrofishing which is ineffective for small-bodied species. Most species found in tributaries (roughly 80 native fish species in total) likely use the Red River main stem seasonally for habitat and as a migration route.

There is a world class trophy catfish fishery present within the Red River as well as numerous other important game fish species including northern pike, walleye, and sauger. Lake sturgeon, a species once common throughout the Red River basin, have recently been reintroduced into the Red River basin. Fish surveys on the Sheyenne River resulted in a similar number of fish species as the Red River, 56, while surveys on the Wild Rice, Maple, and Rush rivers indicated that each had approximately half as many fish species as the Red River. Recent surveys on Wolverton Creek revealed there are roughly one-third as many fish species as in the Red River.

The health of a biological community is dependent on a number of factors, including, but not limited to, water quality, habitat, and the specific needs of a certain species. Other factors, such as exposure to periodic flood events naturally occur under existing conditions and may be necessary as part of life cycle events (such as annual spring melt off) or may be detrimental to biological communities such as the case with large, less frequent flood events that could result in fish stranding in isolated pools or in the floodplain where water eventually recedes, causing mortality. These factors are typically measured through monitoring to identify the species within the system, and ranking the potential health of the system using the QHEI for macroinvertebrates and IBI for fish communities. The following sections provide information on the current river and stream conditions within the project area where data was available.

3.8.1.1 Habitat Assessment

The QHEI is a tool that is used to assess physical habitat quality of a stream reach and the ability for that reach to potentially support a biological community. The QHEI uses a variety of metrics to calculate a score for the assessed stream reach. The metrics include: substrate; in-stream cover; channel morphology; riparian zone; pool/riffle quality; and map gradient. The QHEI value ratings and rankings for an assessed reach are shown in Table 3.34.

Table 3.34 Qualitative Habitat Evaluation Index

Rank (maximum value 100)	Headwaters (less than or equal to 20 square mile drainage area)	Large Stream
Excellent	≥70	≥75
Good	55 – 69	60 – 74
Fair	43 – 54	45 – 59

Rank (maximum value 100)	Headwaters (less than or equal to 20 square mile drainage area)	Large Stream
Poor	30 – 42	30 – 44
Very Poor	< 30	< 30

A QHEI assessment was completed by the Diversion Authority (URS, 2013) as part of the fisheries and macroinvertebrate inventory and assessment of streams in the project area. QHEI assessments were conducted at 21 reaches on the primary rivers and streams in the project area including: Red River, Wild Rice River Sheyenne River, Maple River, Rush River, and Wolverton Creek. Sampling of the Lower Rush River was planned, however, the Lower Rush River did not meet the requirements of a sampleable stream when reconnaissance was performed and therefore, assessment data is not available for this river. Analysis of the assessment data found that the average QHEI rank for the assess reaches was poor. The QHEI data is summarized below in Table 3.35.

Table 3.35 Summary of QHEI Data

River/Stream	Reaches Sampled	QHEI Ranking Range	QHEI Average Ranking
Red River	6	30.5% – 45% Poor – fair	38.5% Poor
Wild Rice River	4	35% – 42.5% Poor	40% Poor
Sheyenne River	5	36.5% – 45% Poor – fair	36% Poor
Maple River	3	33% – 39.5% Poor	36% Poor
Rush River	2	16% – 35.5% Very Poor - Poor	26% Very Poor
Wolverton Creek	1	41.5% Poor	41.5% Poor

Source: Fargo Fisheries Assessment Final Report (2-20-2013). URS, Corporation

3.8.1.2 Macroinvertebrates

The Diversion Authority conducted macroinvertebrate assessments of the rivers and streams in the project area including: Red River, Wild Rice River Sheyenne River, Maple River, Rush River, Lower Rush River and Wolverton Creek (URS, 2013). Samples were sent to Valley City State University for analysis. The macroinvertebrate data was used to calculate several indices used to assess the stream community, population and quality. The Simpson Diversity Index, which quantifies the diversity of species present within a sampled population and how evenly individuals are distributed among species, was calculated for the aquatic macroinvertebrates collected from each reach. For a given study reach, n(n-1) was calculated, where n is the numbers of individuals within a species, and summed for all species present. The summation was then divided by N(N-1), where N is the total numbers of individuals for the study reach.

$$D = \frac{\Sigma\, n(n-1)}{N(N-1)}$$

Where:
n = total number of individuals in a particular species, and
N = total number of individuals of all species

The value of D ranges between 0 and 1. A dataset with a high diversity presents a D value of 0, whereas a low diversity presents a D value of 1. The Maple River had the greatest diversity according to Simpson’s Index and the Red River had the least. The macroinvertebrate data is summarized below in Table 3.36.

Table 3.36 Summary of Macroinvertebrate Data

River/Stream	Reaches Sampled	D Value	Number of Different Species	Most Common Species and % of Abundance
Red River	6	0.675	17 – 26	Water boatman (Corixidae family) 70.4% - 90.6%
Wild Rice River	4	0.462	21 – 27	Water boatman (Corixidae family) 50% - 80%
Sheyenne River	5	0.225	23 – 43	Water boatman (Corixidae family) 26.2% - 51.9%
Maple River	3	0.132	33 – 35	*The species with the highest relative abundance varied at each reach.*
Rush River	2	0.194	27-35	*The species with the highest relative abundance varied at each reach.*
Wolverton Creek	1	0.413	26	*Caenis, (*Order Ephemeroptera) 63.2%

Source: Fargo Fisheries Assessment Final Report (2-20-2013). URS, Corporation

3.8.1.3 Sensitive and Significant Species

Sensitive species are defined as those which are often the first to decline in environments that experience anthropogenic disturbance and associated environmental stressors (Sandberg, 2014). While many species decline under severe stress, sensitive species are responsive to low and moderate degrees of stress, and would decline or disappear before other, more tolerant species. Sensitive species may possess specialized ecological traits and life history attributes that require specific environmental conditions be met for continued survival. These conditions can be degraded or eliminated by anthropogenic disturbance, inhibiting sensitive species’ survival and reproduction.

The MPCA developed a Fish IBI in 2011 (with an update in 2014) to assess fish communities in streams and rivers across the entire state of Minnesota (Sandberg, 2014). Sensitive species within Minnesota Streams have been identified within the MPCA Fish IBI. Fish community data compiled from the MPCA, NDDH, MNDNR, and USACE compared to the MPCA Fish IBI sensitive species list reveals that there are nine sensitive species that have been recently documented in the Red River and tributaries (Table 3.37). There are likely additional sensitive species beyond those listed in Table 3.37 in the Red River and its tributaries within the project area, but those species, discussed further below, are not typically collected by standard IBI electrofishing methods.

Table 3.37 MPCA Fish IBI Sensitive Species Collected in the Project Area

Species	Waterbody	Agency
Carmine Shiner	Red River	MPCA
Iowa Darter	Rush River, Wild Rice River	NDDH
Lake Sturgeon	Red River	MNDNR[1]
Mooneye	Red River	MPCA
Rock Bass	Red River, Maple River, Wild Rice River, Sheyenne River	USACE, MPCA
Smallmouth Bass	Red River, Sheyenne River	USACE, MPCA
Spottail Shiner	Red River	USACE
Stonecat	Red River, Wild Rice River	USACE

[1]Lake Sturgeon were identified within the project area from angler hook and line records.

Connectivity of aquatic habitat is an important factor for river fishes. Many of the 57 species documented in the Red River make significant migrations. Potential impacts to a separate group of sensitive species, outside of those defined within the MPCA IBI metric, include significant species that are sensitive to the loss of channel connectedness and subsequent loss of access to various associated habitats. Significant species known to migrate within the Red River include lake sturgeon, channel catfish, freshwater drum, walleye, sauger, goldeye, and greater redhorse (Aadland, 2010). While only the lake sturgeon is included in the MPCA sensitive species metric, these other important species of the Red River are considered sensitive to the construction and operation of the Project if their ability to migrate throughout the watershed is disturbed or blocked. Freshwater drum and channel catfish are especially vulnerable to extirpation by barriers and are known to be reproductive hosts for 11 and 13 freshwater mussel species respectively. Mussels are keystone species that serve critical roles in water quality (by filtering water), channel stability (by stabilizing substrates), and benthic biodiversity (by maintaining interstitial spaces in sediments and through the release of pseudofeces.

3.8.1.3.1 Lake Sturgeon

Lake Sturgeon are a benthic species that are not routinely collected using standard fish community monitoring methods such as electrofishing used by the MPCA for IBI assessments. The recent USACE fish monitoring assessment of the project area (URS, 2013) did not collect Lake Sturgeon from the 23 monitoring sites on the Red River and associated tributaries. Because Lake Sturgeon are not collected by traditional IBI monitoring gear, recent IBI efforts by the MPCA, NDDH or USACE are not good data sources for the presence of Lake Sturgeon within the Red River watershed.

As mentioned above, the Lake Sturgeon is included in the MPCA sensitive species metric and is also considered a Minnesota state-listed species of Special Concern (Section 3.10 – State-listed Species). It is a native species to the Red River watershed that is particularly sensitive to the

potential impacts of the Project due to its life history strategy and large migration patterns so tracking the status of this species is important and provides key information regarding the health and quality of the system.
A variety of factors have led to the decline of the species in the Red River watershed, including dam construction limiting migration, siltation, channel modifications, and loss of necessary in-stream habitat. Significant efforts have been undertaken to re-establish a self-sustaining Lake Sturgeon population within the Red River through stocking, removal of fish passage barriers, and habitat improvements. Multiple tribal, state, and international agencies are involved in Lake Sturgeon reintroduction efforts. Details of the Lake Sturgeon restoration plan and activities are provided in "Restoration of Extirpated Lake Sturgeon (*Aciperser fulvescens*) in the Red River Watershed" MNDNR, 2002, revised 2013.

Barriers to fish passage are thought to be the most significant obstacle to the restoration of Lake Sturgeon populations. Efforts have been made over the last decade by the MNDNR and other groups to remove or bypass migration barriers (such as low-head dams) on the Red River as well as tributaries throughout the watershed. These continued efforts to remove barriers to migration are an integral part of the program to reestablish a spawning population of lake sturgeon within the Red River watershed.

The MNDNR has been tracking angler hook and line catches of Lake Sturgeon since the stocking program began in 1997, including both tagged and untagged fish. MNDNR records indicate there have been 50 records of Lake Sturgeon caught by anglers within United States, including 13 in the F-M area between 1998 through 2013 (111 total records).

3.8.1.4 Index of Biotic Integrity

Fisheries biologists have developed a protocol for assessing and measuring stream community health called an IBI. An IBI is a tool that uses a component of a biological community, such as fish, to determine the health of a system. Health is assessed by using a variety of individual metrics related to the biological community to calculate a score for the stream or river. The metrics compare the mix of taxa (i.e., species) and individuals present at a monitoring site to a reference condition that would be expected for that stream type. Typically higher IBI scores indicate better community health, closer to reference conditions, while lower scores indicate alteration of the biological community and/or water body. IBI scores are also affected by fragmentation since tolerant species generally have low sensitivity to barriers while intolerant species are often extirpated upstream of barriers. An IBI scoring protocol and individual metrics are normally specific to a watershed or ecological region. This is to ensure the criteria being used to assess the community are applicable and relevant to that particular monitoring reach or system.

In the project area, IBIs were reviewed to assess the current condition of the rivers and streams. This information, along with evaluation of potential Project impacts, presented in Section 3.8.2, would be used to develop a monitoring plan to measure Project impacts and the effectiveness of mitigation.

3.8.1.4.1 Red River

The Red River begins in Wahpeton, North Dakota at the confluence of the Otter Tail River and the Bois De Sioux River. The Red River flows north and forms the border of North Dakota and Minnesota from Wahpeton, North Dakota to Pembina, North Dakota, where the river then continues north into Canada. The USEPA completed an IBI for the fish communities of the Red River and selected tributaries in 1998. The USEPA IBI for the Red River reported a classification of fish community health from fair to good at five sites on the Red River within or near the project area (Figure 17 in the FFREIS, 2011).

Since the initial USEPA IBI, there have been fish community assessments conducted by several entities from Minnesota and North Dakota on the Red River near the project area over the last 20 years. The MPCA has conducted fish community sampling events at eight stations along the Red River within or in close proximity (15 miles upstream or downstream) to the project area. Another assessment was completed by the USACE at six stations on the Red River in 2012 (URS, 2013).

Within the MPCA Fish IBI there were nine identified stream categories with a unique set of scoring metrics and impairment thresholds (Table 3.38). The MPCA Fish IBI divides Minnesota into northern and southern groups with four categories each and then a separate low gradient category. The Red River and its tributaries fall within the southern group of the IBI categories. This MPCA Fish IBI is the most up-to-date protocol for the Red River used by the MPCA to assess fish community health and determine fish community impairment. The NDDH also uses the MPCA Fish IBI protocol to assess monitoring on the Red River.

Table 3.38 MPCA Fish IBI Categories for the Red River in Minnesota

MPCA IBI Category	Impairment Threshold	General Use Threshold	Exceptional Use Threshold
Southern Rivers	≤ 48	≥ 49	≥ 71
Southern Streams	≤ 49	≥ 50	≥ 66

The fish community monitoring sites along the Red River are all scored within the Southern Rivers category of the Fish IBI, which includes rivers of the Glacial Lake Agassiz Basin ecoregion with drainage areas greater than 300 miles. For monitoring sites in the Southern Rivers category, IBI scores of 49 or higher are considered to meet the general use threshold and be above the impairment standard (Sandberg, 2014). IBI scores below 49 are not considered to be fully supporting of the general use criteria of the fish community and considered impaired. The MPCA identified an IBI score of 71 for the Southern Rivers category as meeting the exceptional use threshold. The Southern Rivers Fish IBI includes the following 12 individual scoring metrics:

- Relative abundance (%) of taxa that are detritivorous
- Relative abundance (%) of individuals that are generalist feeders
- Relative abundance (%) of individuals that are insectivore species (excludes tolerant species)
- Taxa richness of piscivorous species
- Relative abundance (%) of individuals that are short-lived
- Relative abundance (%) of taxa that are serial spawners (multiple times per year)

- Relative abundance (%) of individuals that are tolerant
- Relative abundance (%) of taxa that are very tolerant
- Relative abundance (%) of taxa that are sensitive (scoring adjusted for gradient)
- Taxa richness of simple lithophilic spawning species (scoring adjusted for gradient)
- Combined relative abundance of two most abundant taxa
- Relative abundance (%) of individuals with Deformities, Eroded fins, Lesions, or Tumors (DELT)

Positive points are awarded for 11 of 12 metrics, with only the last metric, the relative abundance of DELT anomalies, resulting in negative points. For this metric, the IBI score is zero points unless DELT anomalies are found on collected fish. The total possible maximum IBI score is 100. The 11 remaining metrics with positive points contributes a maximum score of up to 9.1 points per metric.

Fish IBI scores are available for eight MPCA stations near the project area. These sites were established as part of the MPCA watershed wide assessment which occurs once every ten years. Fish community monitoring data from the six monitoring sites in the USACE assessment (URS, 2013) were also used by the MPCA to calculate IBI scores. Fish IBI scores for the Red River using the Southern Rivers scoring category are provided in Table 3.39. The sites are listed from upstream (near Breckenridge, Minnesota) to downstream (near Halstad, MN). There are two sites where the MPCA and the USACE monitored in the same location (Figure 18).

Table 3.39 Red River Fish IBI Scores Using the MPCA Southern Rivers Scoring Protocol[1]

MPCA Site ID	Monitoring Year	IBI Score	USACE Site ID	Monitoring Year	IBI Score[(1)]
06RD001	2006	76	-	-	-
06RD002	2006	77	-	-	-
05RD010	2006	71	Site 1	2012	24
-	-	-	Site 2	2012	46
-	-	-	Site 3	2012	53
06RD003	2006	71	-	-	-
-	-	-	Site 4	2012	58
05RD030	2006	31	Site 5	2012	43
-	-	-	Site 6	2012	43
06RD004	2006	35	-	-	-
05RD047	2006	52	-	-	-
10EM032	2010	67	-	-	-

[1]USACE monitoring did not include IBI scores. The IBI scores were calculated by the MPCA for the purpose of this EIS.

IBI scores on the Red River, have a range from 24 to 77. Six of the eight MPCA sites exceed the general use threshold, while only two of six USACE sites exceed the general use threshold.

There are two instances where the MPCA and USACE monitored at the same location (Table 3.39). The first is at MPCA site 05RD010 (USACE Site 1) and the second was at MPCA site 05RD030 (USACE Site 5). Comparisons of IBI scores from the same site revealed that site 05RD010 had very different scores. The score from the MPCA was above the exceptional use threshold and the score from the USACE was below the impairment threshold. Site 05RD030

(MPCA) and Site 5 (USACE) had similar scores, with both falling below the impairment threshold (Table 3.38).

IBI scores for the Red River below the impairment threshold of 49 were driven by low to very low metric scores for:

- taxa richness of piscivorous species
- relative abundance (%) of taxa that are very tolerant
- relative abundance (%) of taxa that are sensitive
- relative abundance (%) of taxa that are serial spawners (i.e., can spawn multiple times per year)
- taxa richness of simple lithophilic spawning species
- negative points for the presence of DELT anomalies

The Red River sites that had IBI scores above the impairment threshold or approach exceptional use had good to very good metric scores for:

- relative abundance (%) of individuals that are generalist feeders
- taxa richness of piscivorous species
- relative abundance (%) of individuals that are short-lived
- relative abundance (%) of individuals that are tolerant

3.8.1.4.2 Minnesota Tributary

There is one primary tributary to the Red River located in Minnesota within the project area, Wolverton Creek. The creek is approximately 23 miles long and flows into the Red River approximately five miles downstream of Oxbow, North Dakota. The total drainage area for the Wolverton Creek watershed is approximately 100 miles. There are two records of fish monitoring conducted by the MPCA on Wolverton Creek, both in 2008. The MPCA stations for the Wolverton Creek monitoring sites are 08RD063 and 08RD051. The USACE assessment of streams also included one fish monitoring site on Wolverton Creek (URS, 2013). The USACE monitoring Site 23 was located near MPCA site 08RD051 (Figure 18). There were nine species collected from station 08RD063, while at 08RD051/Site 23 there were 11 species collected by the MPCA and 12 species collected by the USACE.

Wolverton Creek falls within the Southern Stream category of the MPCA IBI scoring protocol. This category includes large streams and small rivers in the Glacial Lake Agassiz Basin ecoregion where watershed area is between 30 and 300 square miles. There are nine metrics in the Southern Streams category of the MPCA Fish IBI (Sandberg, 2014):

- Relative abundance (%) of taxa Benthic Insectivores (excludes tolerant)
- Relative abundance (%) of taxa that are Detritivores
- Relative abundance (%) of individuals with a female mature age <=2
- Relative abundance (%) of individuals with DELT Anomalies
- Relative abundance (%) of taxa that are Sensitive
- Taxa richness of short-lived species
- Relative abundance (%) of taxa that are Tolerant
- Relative abundance (%) of individuals that are Tolerant
- Relative abundance (%) of individuals the dominant 2 species

The total maximum IBI score is 100 points. The Southern Streams category uses the metric Abundance of DELT Anomalies, which has a score of zero unless anomalies are present, in which case negative points are given. The other eight metrics add up to a total of 100, which equates to a maximum metric score of 12.5. The Fish IBI scores for the Wolverton Creek monitoring data are presented in Table 3.40. Site 08RD063 scored above the MPCA general use threshold of 50 for fish communities in the Southern Streams category, while both scores from site 08RD051/Site 23 fell below this threshold. The two different monitoring years at Site 08RD051/Site 23, while only separated by three years, produced similar IBI scores.

Table 3.40 Wolverton Creek Monitoring Data

MPCA Station ID	Monitoring Year	Total Species	IBI Score	USACE Site ID	Monitoring Year	IBI Score[1]
08RD063	2008	9	54			
08RD051	2008	11	43	Site 23	2011	48

[1]USACE monitoring did not include IBI scores. The IBI scores were calculated by the MPCA for the purpose of this EIS.

Wolverton Creek scored well on several individual metrics including:

- Taxa richness of short-lived species
- Relative abundance of individuals that are tolerant
- Relative abundance of taxa that are tolerant metrics

The Wolverton Creek sites scored poorly on:

- Relative abundance of sensitive taxa
- Relative abundance of the two dominant species metrics

3.8.1.4.3 North Dakota Tributaries

There are five tributaries to the Red River in North Dakota that would be directly impacted by the construction or operation of the Project. These are the Wild Rice River, Sheyenne River, Maple River, Lower Rush River, and Rush River. The Wild Rice River flows directly into the Red River south of the F-M urban area. The Sheyenne River is located west of the Red and Wild Rice Rivers, and flows north through West Fargo, eventually flowing into the Red River downstream of the F-M urban area. The Maple River, Lower Rush River, and Rush River are all located west of the F-M urban area. These three rivers flow into the Sheyenne River downstream of West Fargo.

A bioassessment of wadeable streams in the Red River basin was developed by the NDDH, and was used to develop a Fish IBI of streams in the Lake Agassiz Plain ecoregion (Larsen, 2013). The North Dakota Fish IBI uses seven individual metrics to assess fish community health of a stream, including:

- Fish per minute (number of individual fish collected / total minutes spent fishing)
- Percent of taxa that a lithophilis
- Percent of individuals that are lithophilis
- Percent individuals that are insectivorous cyprinids
- Percent dominant taxa
- Percent abundance of tolerant individuals
- Total Taxa (i.e., number of species)

The total IBI score is out of 100. Based on the evaluation of all monitoring reaches and reference sites within the assessment, the NDDH established thresholds for fish community quality. Scores over 62 indicate the least amount of community disturbance, scores from 62 to 47 indicating a moderate amount of disturbance, and scores below 47 indicate the most disturbance. Fish IBI scores from NDDH monitoring within the project area are available for the Wild Rice, Sheyenne, Maple, and Rush Rivers. There are one or two sites on each river and were monitored from one to three years. There is no previous monitoring on the Lower Rush River in the project area. Fish IBI scores from NDDH are presented in Table 3.41.

Table 3.41 Fish IBI Scores From NDDH Monitoring

System	Approximate Location	Monitoring Year	IBI Score	Health Condition
Wild Rice River	2.5 Miles South of St. Benedict, ND	1994	28	Most Disturbed
Wild Rice River	2.5 Miles South of St. Benedict	1995	19	Most Disturbed
Wild Rice River	2.5 Miles South of St. Benedict	1997	34	Most Disturbed
Sheyenne River	1.5 Miles South of Kindred	1996	31	Most Disturbed
Maple River	1 Mile South of Mapleton	1994	28	Most Disturbed
Maple River	1 Mile South of Mapleton	1995	29	Most Disturbed
Rush River	4 Miles North of Mapleton	1994	40	Most Disturbed
Rush River	4 Miles North of Mapleton	1995	15	Most Disturbed
Rush River	4 Miles North of Mapleton	2010	72	Least Disturbed
Rush River	2 Miles East of Amenia	2010	69	Least Disturbed

The majority of the sites scored in the most disturbed category having IBI scores of 46 or below. These low IBI scores were monitored from 1994 through 1997 for four of the rivers. The low IBI scores were driven by low metric scores for:

- Fish collected per minute
- Percent individuals that are insectivorous cyprinid
- Percent individuals that are lithophilis
- Total taxa

Two IBI scores from 2010 monitoring on the Rush River scored in the least disturbed category. The Rush River site near Mapleton had the highest IBI score of 72 in 2010. This is in contrast to the 1995 results when this same site had the lowest IBI score of 15. The two Rush River sites in 2010 also scored poorly on the fish per minute metric, which is similar to the low IBI scores from the monitoring in the mid-1990s. However, the high IBI from the two Rush River sites in 2010 are driven by high individual metric scores for the majority of the other metrics including:

- Percent of individuals that are lithophilis
- Percent of dominant taxa
- Percent abundance of tolerant individuals
- Total taxa

Monitoring of fish communities was completed by the USACE (URS, 2013). The USACE assessment included 14 stations on the five North Dakota tributaries including four sites on the Wild Rice River, five sites on the Sheyenne River, three sites on the Maple River and two sites on the Rush River (Figure 18). The sites on the Wild Rice, Sheyenne, and Maple Rivers were assessed in 2012, while the sites on the Rush River were assessed in 2011. The USACE monitoring did not include calculation of IBI scores from the collections. NDDH assessed the data from the USACE to calculate IBI scores using the Fish IBI for Wadeable Streams of the Red River (Larsen, 2013). Fish IBI scores from the fourteen USACE monitoring sites are presented in Table 3.42.

Table 3.42 Fish IBI Scores from USACE Monitoring Efforts in the Project Area

USACE Site ID	System	Location Compared to Project Features	Monitoring Year	IBI Score[1]	Health Condition
7	Wild Rice River	Upstream Location	2012	61	Moderately Disturbed
8	Wild Rice River	Upstream Location	2012	45	Most Disturbed
9	Wild Rice River	Footprint Site	2012	44	Most Disturbed
10	Wild Rice River	Protected Area	2012	51	Moderately Disturbed
11	Sheyenne River	Upstream Location	2012	61	Moderately Disturbed
12	Sheyenne River	Footprint Site	2012	67	Least Disturbed
13	Sheyenne River	Protected Area	2012	64	Least Disturbed
14	Sheyenne River	Protected Area	2012	65	Least Disturbed
15	Sheyenne River	Protected Area	2012	60	Moderately Disturbed
16	Maple River	Upstream Location	2012	44	Most Disturbed
17	Maple River	Footprint Site	2012	49	Moderately Disturbed
18	Maple River	Protected Area	2012	47	Moderately Disturbed
21	Rush River	Upstream Location	2011	66	Least Disturbed
22	Rush River	Downstream location (control structure)	2011	48	Moderately Disturbed

[1]USACE monitoring did not include IBI scores. The IBI scores were calculated by the NDDH for the purpose of this EIS.

The 14 sites on North Dakota rivers had scores within all three Health Condition categories (least, moderate, and most disturbed). However, the range of IBI scores in 2012 (44 to 67) was less than past monitoring (15 to 72). Almost all 14 sites scored well on the following metrics:

- Percent of dominant taxa
- Percent abundance of tolerant individuals
- Total taxa

Most sites scored poorly on the following metrics:

- Fish collected per minute
- Percent of individuals that are lithophilis

3.8.2 Environmental Consequences

Changes to the riverine systems within the project area, including the floodplain, through direct or indirect ways can have effects on aquatic habitat, macroinvertebrates, fish passage and biological connectivity, and fish mortality. Construction of aqueducts, channels, and levees for example, alter the natural bed and bank and affect the quality and availability of aquatic habitat. Changes in hydrology and hydraulics as well as floodplain extents could have effects on aquatic habitat, fish and macroinvertebrate populations and life cycles (e.g., migrations and spawning). The extent of changes or effects of changes are dependent on whether or not they are temporary or permanent; when they occur; the frequency of occurrence; and for flood events, the depth and duration the inundation is experienced.

3.8.2.1 Proposed Project

Construction and operation of the Project would alter rivers in the project area, including potential impacts to aquatic habitat, macroinvertebrates, fish passage and biological connectivity, and fish mortality. Loss or alteration of aquatic habitat can lead to changes in the species composition of a river as specific habitats become less abundant or unavailable. Creation of the diversion channel could lead to new habitat for macroinvertebrates. Direct impacts to macroinvertebrates could occur in areas that experience increased sedimentation from bank erosion and flood events, which could lead to mortality from burial and eventually suffocation. Habitat alteration from sedimentation can also have an impact. Potential impacts from bank erosion and sedimentation are further discussed in other sections of the EIS, including Section 3.3 – Stream Stability, Section 3.9 – Wildlife and Wildlife Habitat, Section 3.10 – State-listed Species, and Section 3.4 – Wetlands.

Interruptions or blocking of fish migrations could result in a reduction of spawning success which impacts population sustainability. Stranding of fish in upland areas outside of the river channels could result from receding water after Project operation, resulting in direct mortality of fish. Significance of potential impacts on fish populations is dependent on features or Project operation specific to a river.

3.8.2.1.1 Red River

Project construction has the potential to directly impact macroinvertebrates and fish. Project operation would interrupt and redirect flows on the Red River into the staging area and diversion channel. This has the potential to impact macroinvertebrate and fish populations within the Red River by altering aquatic habitat and fish migration. In addition, there is potential for fish stranding.

3.8.2.1.2 Aquatic Habitat

Aquatic habitat would be directly impacted by Project construction, which could lead to impacts to macroinvertebrates and fish. The Project includes construction of two features on the Red River, a control structure at the upstream end of the Project and a connecting weir at the outlet of the diversion channel. The construction would be sequenced. Initially, the control structure and connecting weir would be constructed on lands adjacent to the existing river channel. When construction of a structure is complete, a new channel would then be excavated to connect the existing river to the new Project feature.

Project construction and excavation could result in direct mortality to macroinvertebrate species from crushing, excavation, or other disturbance. This would occur in the immediate construction area. It is anticipated that new constructed channels and Project features would be repopulated by macroinvertebrates once aquatic habitat is re-established. Fish are anticipated to temporarily relocate to other areas of the water body to avoid Project construction activities occurring to aquatic habitat. Some fish mortalities may occur due to construction, but this is expected to be minor. These impacts could occur within the Project footprint during construction of the river control structures and connecting weir. After completion of Project construction, fish would move back into the areas where aquatic habitat has been re-established. Although the impacts to aquatic habitat are small compared to the amount of available habitat in the Red River, mitigation would still be provided.

The original stream channel would be abandoned, by cutting it off from the new channel and structure. The abandoned section of channel would not be filled and would be left as open channel similar to an oxbow basin or wetland. The abandoned area is anticipated to convert from flowing river habitat to some form of wetland habitat.

The designs of the control structures and connecting weir have not been finalized. It is possible that final design may determine that the abandoned channel needs to be filled for engineering purposes in order to maintain the integrity and design of the new structure. If the final design requires filling of the abandoned river channel, impacts for aquatic habitat/wetlands would be assessed, and additional mitigation would be included with the Project to offset habitat loss. This sequence of construction minimizes the amount of work within the active river channel thereby minimizing the potential for direct macroinvertebrate and fish mortality. Impacts to the channel and habitat on the Red River are summarized in Table 3.43.

Table 3.43 Impacts to Aquatic Habitat on the Red River From Construction of the Project

Water Body	Project Feature	Channel Length Impact	Habitat Impact[1]
Red River	Control Structure	0.8 miles	14 acres
Red River	Diversion Channel Connecting Weir	0.2 miles	3 acres

[1]Habitat impacts summary taken from FFREIS

The impacts to aquatic habitat listed in Table 3.43 are relatively small compared to length of the river channel and the amount of available habitat within the river system. The Red River channel is hundreds of miles long and the individual footprint impacts of each feature would not result in significant loss of habitat that would cause population level impacts to individual macroinvertebrate and fish species, such as sensitive species (e.g., lake sturgeon) or the macroinvertebrate and fish communities in the Red River. While some features of the new channel, control structure, and connecting weir could provide aquatic habitat for macroinvertebrates and fish, it is not known how the quality of habitat provided by the new features would compare to the quality of the existing habitat that would be lost. As a result, all aquatic habitat disturbed or altered on the Red River would be assumed lost and considered an impact. The existing habitat in the Red River channel near Project features was rated as moderate to poor quality (URS, 2013), meaning Project impacts would occur to lower quality aquatic habitat.

Project operation has the potential to alter velocities and depth on the Red River. This could lead to impacts on aquatic habitat, such as changes to the prevalence and location of deep or shallow pools. Sedimentation could occur in the inundation areas, which could result in impacts to aquatic habitat over time. A draft Project operation plan was provided for the EIS, but has not been finalized, and therefore, the level of potential impacts to aquatic habitat are currently not quantified. Proposed mitigation for loss of aquatic habitat would minimize Project impacts. Details on proposed mitigation are discussed in Section 3.8.3.

3.8.2.1.3 Fish Passage and Biological Connectivity

The Project would include the construction of a control structure on both the Red River. Preliminary designs of the flood control structures were described in the FFREIS (Section 3.7) and discussed below. Final designs were not available during EIS production. The structures would include gates across the channels which would be utilized to divert flood flows. Preliminary designs provide a combination of rocks and possibly concrete baffles within the control structures to provide flow complexity along the bottom of the channels. Concrete baffles have been observed to be less effective in slowing velocities and providing for fish movement as compared to using natural material, including variable size boulders. Natural materials are known to provide more complex flow patterns as well as variation in flow velocities, as compared to concrete baffles (Aadland, 2010), which allows for a wider variety of species (i.e., fish body types and sizes) to pass through a feature. As mentioned above, design of the structures has not been finalized and the specific elements to be included in the structures to facilitate fish movement are not known. Incorporation of multiple design elements addressing specific flow conditions within the channels would be required to ensure impacts to fish movement are minimized. When the Project is not in operation the gates would be open, flow would pass through the control structures, and there would not be impacts to fish passage.

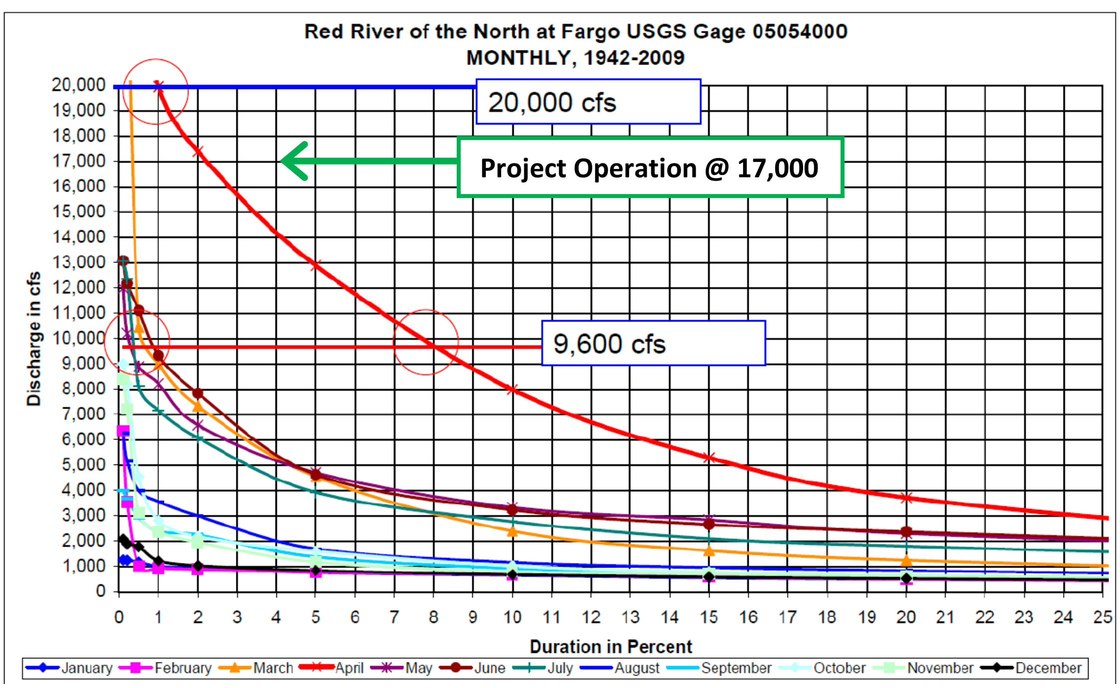
Operation of the Project would begin when it becomes known that a stage of 35.0 feet would be exceeded at the USGS gage in Fargo (the Fargo gage). At this stage, the Red River at the Fargo gage would be 17,000 cfs, equivalent to the 10-year return frequency flood event. This would be determined when the measured flows at the upstream end of the Project (Red River at Enloe and Wild Rice River at Abercrombie) reach a sum of 17,000 cfs unless the hydrographs indicate that the flow may be close to peaking at which point the flows at the structures would be monitored to be sure 17,000 cfs would occur at Fargo before Project operation would begin. This is a change compared to the originally proposed operation which referenced a discharge of 9,600 cfs (see FFREIS Section 5.2.1.7.2). The operation of the Project would be dependent on actual weather and flood conditions and could occur at variable frequencies, not necessarily once every ten years. Over time weather and flooding patterns have and would likely continue to change, such that a flow of 17,000 cfs may no longer represent the 10-year return frequency flood event. Under the current proposed operation scenario, the gates of the control structure would be open and not in operation when river stages are below 35.0 feet, with limited impacts anticipated to fish passage and biological connectivity. As described above, the design of the structures have not been finalized, and therefore, Project design may include elements to minimize impacts to fish passage during Project operation. When the control structures are in operation, the gates would be partially closed to force flows into the diversion channel and staging area. This would result in increased flow velocities through the control structures.

The FFREIS did not model flows within the control structure at the current operation of 17,000 cfs, but estimated that flows could exceed eight to ten feet per second within the partially closed structure gates, which would be impassable to fish. Flood conditions reached approximately 17,000 cfs in the Fargo area in 1978, 1979, and 1989, with flows exceeding 17,000 cfs several times in recent years including 2006, 2009, 2010 and 2011. The number of days the Project would be operated would depend of the magnitude of flood flows. The latest modeling information provides that for a flood exceeding 17,000 cfs, the Project would be in operation for 10 days. Flow velocities would produce impassable conditions for fish during this period of operation, with lower velocities leading up to operation and following operation, which would be a potential barrier to fish migration. More substantial flood events above 17,000 cfs would result in longer operation, and an associated longer period of impassable conditions for fish. For example, based on the latest modeling, the 100-year flood operation extends 12 days and the 500-year flood operation lasts approximately 14 days.

An analysis of the flow recorded for the wet period of record in the Red River from 1942 through 2009 was included within the FFREIS to determine how often flows of certain levels would be exceeded and which months the flows would occur. The analysis focused on flows of 9,600 cfs which was tied to the operation of the Project at the time of the analysis. The same analysis can be used to evaluate the likelihood of flows for proposed operation of the Project at 17,000 cfs. Graph 3-2 (FFREIS 2011) shows the duration percentage of Red River flows from January through December, with each month represented by a specific flow curve on the graph. This analysis covers a significant period of record (67 years) and past flood events. Based on the past flow record, the Project would begin to operate in March or April, as these are the only months when a flow of 17,000 cfs has been exceeded (Graph 3-2).

Graph 3.5: Comparison of Flow Exceedance at the Fargo Gage on the Red River by Month

Flow exceedence probability, by month, based on “wet” period of record (1942-2009)



Source: FFREIS, 2011

Depending on the timing of flood events, an operation period of 12-14 days (based on modeling) would result in impassable flow velocities for a portion of fish migration periods, but would be unlikely to completely block all fish migrations that year. As described above, historically the Project would have only operated in March or April. Depending on the species, fish migrations within the Red River have been approximated to be 30 to 60 days in length (Aadland, 2010). The fish migration periods for sensitive species of the Red River and major tributaries such as the Otter Tail River vary across the spring and early summer (Illustration 3-5). Earliest northern pike and walleye migrations within the Red River begin from mid-March into early April. Species such as catfish and lake sturgeon begin later in the spring and extend into summer, from early May through June, sometimes extending into early July. While these are general times that spawning runs and migrations occur for these species, migrations during a given year can vary and could occur later or earlier than the typically observed period depending on specific conditions triggering migrations that season.

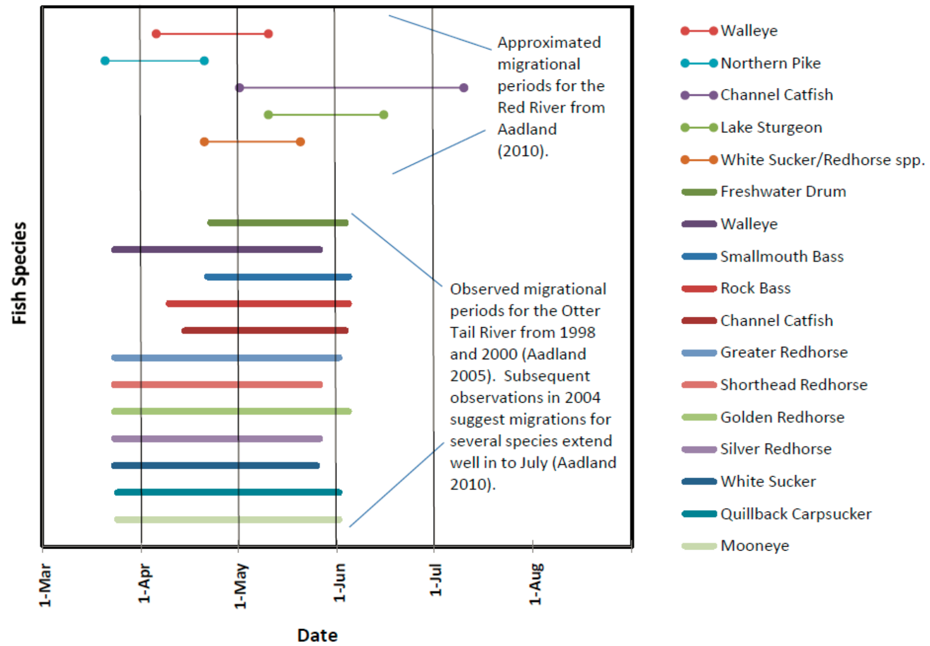
Based on the fish species migration periods and the likely operation of Project in either March or April, portions of the migrations of walleye, northern pike, and possibly redhorse/white sucker are most likely to be interrupted. It is unlikely that Project operation (12-14 days based on modeling) would completely block the migration of these species, because the migration period of these species is generally longer (more than 30 days). However, there are several factors that could influence the level of impacts to migration including the actual operation of the Project, final design of the control structure, and specific timing of Project operation compared to migration triggers and species movements in a given year. Based on modeling, larger flood events may require longer Project operation for the 50-year, 100-year, and 500-year floods. Longer Project operation has the potential to lengthen the time when velocities through the control structure would be impassable and increase the chances that Project operation overlaps with and/or disrupts migration of a species.

An additional factor is the timing of peak migrations of a given species. While migrations for a given species vary in length from 30 to 60 days, the timing of peak migration within the overall migratory period may be much shorter, on the order of several days. If flooding events and timing of Project operation occurred at the same time as the peak migration for a species, the impacts to migrations and spawning would likely be greater than impacts when Project operation coincides with the beginning or end of a species migration. The exact timing of Project operation compared to specific migration period impacts would not be known until actual flooding events resulting in operation occur.

The location of the structure in relation to species movements throughout the watershed could also be an influencing factor on impacts to species migrations from Project operation. For example, in order for peak migrations of a species such as lake sturgeon to occur in May in the Otter Tail River upstream of the project area, the peak migration within the Red River would have to occur at an earlier time in April. As a result, the timing of the species migration within the overall watershed compared to the location and operation of the structure would influence the level Project impacts on fish movements.

The design of the control structures and associated channel have not yet been finalized. If not properly designed to convey river flows and channel roughness elements, such as variable size boulders or concrete baffles, the control structure and associated channel could potentially impede fish passage during flow conditions when the Project is not in operation.

Illustration 3.5: Fish Species Migration Periods on the Red River and Otter Tail River



Source: FFREIS, 2011

Based on these factors it is likely some impacts to migration would occur on years the Project is operated. Under the proposed operation (10-year flood) impacts to fish migration within the Red River would potentially occur during operation of the control structure. When the Project is in operation, it is unlikely that it would completely disrupt the entire migration period of an individual fish species or the fish community for that year. However the timing of Project operation compared to specific species migration during a given year, including the timing of the peak migration period, has the potential to occasionally cause disruption of species migration.

3.8.2.1.4 Fish Stranding and Mortality

Fish stranding is dependent upon the timing of receding water after a flood. If water recedes too quickly, fish may become stranded in remaining pools or eventually on land that dries. This process naturally occurs during flood events in the project area along river floodplains. The Project has two potential locations where stranding may occur after Project operation: the upstream inundation area and the diversion channel.

Stranding in the Inundation Area

When in operation the gates on the control structures would be partially closed. This would begin to divert flood waters into the upstream inundation area. Fish may leave the Red River channel and access the adjacent floodplain. The FFREIS analyzed the potential for fish to become stranded within the adjacent floodplain or in the staging area after operation has ended. The important factor to consider when examining fish stranding in the floodplain is the timing and rate of receding flood waters. The analysis determined that when flood waters are outside the banks of the Red River, they would recede at an estimated 0.2 to 0.6 feet per day. At these rates, fish should have sufficient time to follow the receding waters back into the channel of the Red River. However, some fish could become isolated or stranded, but the magnitude is not expected to be significant. Sensitive species are not likely to be more or less prone to stranding or mortality than other fish species.

The analysis also found that rates of receding flood waters that could result in stranding of fish (from 2.0 to 3.5 feet per day) would be present at certain times. Review of the water elevations in the models showed that flood waters would no longer be spread out over the adjacent floodplain and instead would be back within the channel of the Red River. Therefore these high rates of receding flood water would not result in stranding. The exact timing and rate of receding flood waters would not be known until the Project is constructed and operated. As stated, based on modeling, fish stranding or mortality is not expected to be significant. However, monitoring of Project operation and observations of incidents of fish stranding would need to be conducted before it can be fully determined if fish stranding is a significant impact of the Project.

Stranding in the Diversion Channel

Operation would result in fish entering the connecting channel and the diversion channel under certain flow conditions. Fish could enter into the diversion channel swimming downstream from the Red River or Wild Rice River into the connecting channel and then into the diversion channel under high flow conditions. Fish may also swim downstream from the Rush and Lower Rush Rivers with normal or flood level flows that would be directed into the diversion channel. Fish may also access the diversion channel by swimming upstream from the Red River through the connecting weir at the downstream end of the Project.

Within the diversion channel some water is expected to be present under all flow conditions, as water from seepage, tile lines, and ditches would be directed into the diversion channel. Additionally the flows from the Rush and Lower Rush Rivers would be directed into the diversion channel. The diversion channel would include a low flow channel for the entire length. The low flow channel is expected to have flow conditions similar to the surrounding tributary flow conditions (i.e., continuous year round flow under average flow conditions in the Red River basin). The Proposed Project includes a larger low flow channel, with a cross section approximately 84 feet wide and five feet deep (Illustration 3-6). These are general preliminary design elements and a final detailed design has not been completed for the diversion channel or the connecting channel. The final design elements and specific habitat features of the low flow channel would be important factors in minimizing the potential for fish stranding.

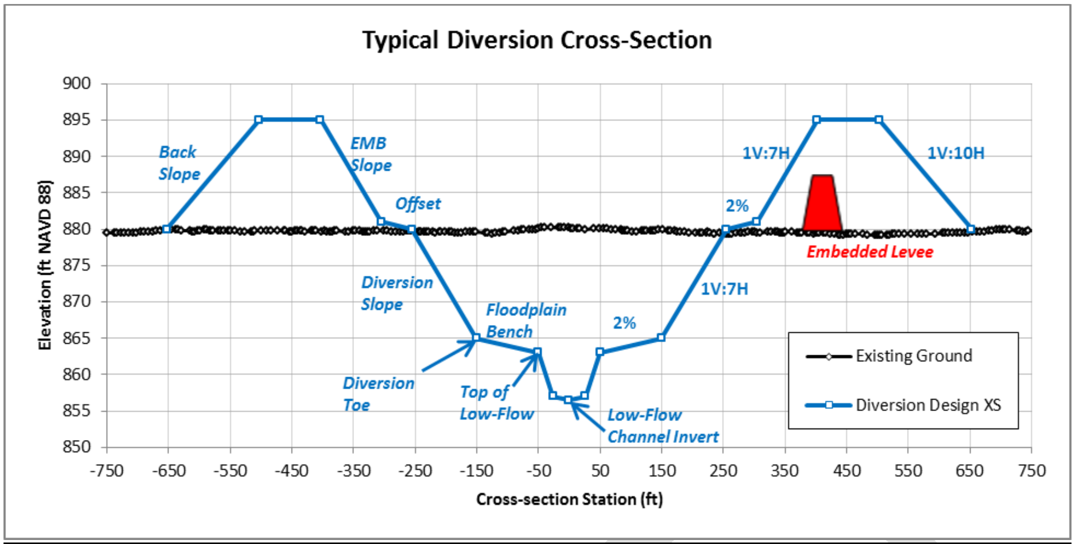


Illustration 3.6: Typical Diversion Channel Cross Section

When operation is stopped, flows within the diversion channel would begin to recede. The USACE modeled the rate of flow recession within the diversion channel for the 10-percent chance event (10-year flood) (17,000 cfs). The models indicate that waters within the diversion channel would drop from 1.0 to 2.5 feet per day depending on the water depth. A gated control structure would be installed at the diversion channel inlet to slowly reduce flows into the diversion channel after Project operation. This was a design change from the FFREIS and was evaluated in the Supplemental EA as a measure to minimize or eliminate fish stranding. Operation of the gated control structure would allow some flow into the diversion channel after Project operation, which would allow flow to gradually decrease. The design of the diversion inlet control structure has not been finalized, and therefore, the amount and rate of water flowing into the diversion channel through the gated control structure is not known. Proper operation of the gated control structure has the potential to minimize fish stranding within the diversion channel. However, the potential impact cannot be fully assessed until design elements and operation plans for the Project are finalized.

As water recedes, fish would be expected to follow the receding waters downstream. There is the potential for fish stranding if isolated pools exist, similar to conditions on the Maple, Rush and Lower Rush Rivers. The increased size and depth of the low flow channel is anticipated to minimize the potential for stranding, and is not expected to be significant or result in population level impacts to individual fish species, sensitive fish species, or the fish community. Tributaries would continue to flow into the diversion channel after Project operation, which would provide flow and further minimize the potential for fish stranding. The potential for fish stranding within the diversion channel or low flow channel is not anticipated to be a significant impact.

3.8.2.1.5 Minnesota Tributaries

Wolverton Creek is the only Minnesota tributary to the Red River that has the potential to be impacted by the Project due to additional inundation occurring from Project operation. Potential impacts to aquatic habitat, macroinvertebrates, fish passage, and fish stranding and mortality were reviewed and assessed.

Aquatic Habitat

There is no Project construction proposed for Wolverton Creek, and therefore, construction impacts to aquatic habitat are not anticipated. Project operation has the potential to disrupt aquatic habitat within Wolverton Creek. Waters from the inundation area would backup into Wolverton Creek and the adjacent floodplain, which could potentially result in increases to water depths and velocities. This could alter the amount of available habitat such as reducing the amount of shallow pools and increasing the amount of deep pools. Fish species utilize different habitats from one another, while also utilizing different habitats through stages of their life cycle (Aadland, 1993). Sedimentation could occur in the inundation areas, which could result in impacts to aquatic habitat over time such has to habitat quality or a change in the type of habitat available. A draft Project operation plan was provided for the EIS (Appendix A), but has not been finalized, and therefore, the level of potential impacts to Wolverton Creek are currently not quantified. Monitoring of Wolverton Creek during and after Project operation would be needed to assess impacts on aquatic habitat and determine adaptive management strategies to lessen or offset impacts. Potential fish stranding impacts to Wolverton Creek from the Project are discussed in Section 3.8.2.2.3.

Fish Passage and Biological Connectivity

The confluence of Wolverton Creek with the Red River is upstream of the control structure on the Red River. The Project does not include control structures or other features that would be a barrier to fish migrations on Wolverton Creek and fish would be able to move freely into and out of the Red River similar to existing conditions. During operation, fish on the Red River would not be able to pass through the control structure and access Wolverton Creek. The Red River serves as the main travel corridor and pathway for fish migrations and spawning runs throughout the overall watershed. As a result, it is likely that fish from Wolverton Creek access the Red River at different times depending on flow conditions and life cycle requirements. Project operation, including the closure of the gates on the Red River control structure and increase of water backing up into Wolverton Creek, could result in disruptions to fish migration within the creek. The length and level of disruption to fish migration would be dependent on the length of Project operation for a specific flood event, as well as the timing of Project operation compared to the timing of fish migration that season. Fish within the Red River above the control structure would be able to access the Wolverton Creek channel.

Fish Stranding and Mortality

When operation begins, the gates on the control structures in the Red River and Wild Rice River would be partially closed diverting water into the staging area. Wolverton Creek is located within the inundation area above the Red River control structure. Project operation would cause water levels in Wolverton Creek to increase outside of the channel and into the adjacent floodplain to a greater extent than what currently occurs during the 100-year flood. This would result in fish potentially leaving the channel of Wolverton Creek into a larger inundation area than what occurs under the existing flood conditions.

An analysis was conducted to examine the rate of receding flood waters following Project operation (see FFREIS, Section 5.2.1.7.4). The analysis indicated that when flood waters are outside the banks of the river channels, the rate that waters would recede were estimated to be

0.2 to 0.6 feet per day. At these rates, fish should have sufficient time to follow the receding waters back to the channel of Wolverton Creek. Project impacts to fish in Wolverton Creek due to stranding and mortality is not expected to be significant.

The final operation plan for the Project has not been developed, including the rate at which flood waters would recede. However, the Draft Operation Plan states that the diversion inlet gates would be operated such that inflows are gradually decreased, further supporting a gradual reduction in diversion flow that would allow fish to sense that they need to swim downstream to the diversion outlet (USACE, 2014c). Depending on the level of Project-related flooding outside of the current floodplain and the topography of the land in the area, it is possible that some fish could potentially become isolated or stranded. Based on model analysis for the Project, fish stranding due to the Project is not expected to be significant. Sensitive species are not likely to be more prone to stranding or mortality than other fish species. The current models are preliminary and so there is uncertainty associated with estimating impacts from the Project. The exact timing and rate of receding flood waters would not be known until the Project operated. Monitoring of Project operation and observations of incidents of fish stranding would need to be conducted before it can be fully determined if fish stranding is a significant Project impact.

3.8.2.1.6 North Dakota Tributaries

There are five tributaries (i.e., Wild Rice, Sheyenne, Maple, Lower Rush, and Rush Rivers) to the Red River in North Dakota that would be altered by the Project, including construction of a control structure, aqueducts, new river channels, and rock-ramp spillways. Project operation would interrupt and redirect flows from the North Dakota tributary rivers into the diversion channel and staging area. This has the potential to impact fish populations, aquatic habitat and fish populations, migration and stranding.

Aquatic Habitat

The Project includes constructing a control structure on the Wild Rice River. The diversion channel would cross the Sheyenne and Maple Rivers and aqueducts would be constructed to transport flows of these rivers over the diversion channel. For the Rush River and Lower Rush River, several miles of river channel on each river would be abandoned from Project construction, as the flows from each river would be directed into the diversion channel. The Rush and Lower Rush Rivers would be connected to the diversion channel via rock-ramp spillways. Impacts to the channels and habitats caused by the construction of Project components of the North Dakota tributaries are summarized in Table 3.44. Rivers and streams are dynamic systems and impacts from the Project to aquatic habitat beyond the direct physical impacts, listed in Table 3.44, have the potential to extend beyond the Project construction footprint. The actual impact of the Project would not be fully known until the Project has been operated and likely for multiple flood events, and observations made.

The control structure on the Wild Rice River and aqueducts on the Sheyenne and Maple Rivers would be constructed on lands adjacent to the existing river channel. When construction of a structure is complete, a new channel would then be excavated to connect the existing river to the new project feature. The old channel would then be abandoned. This sequence of construction minimizes the amount of work within the active river channel, thereby limiting the potential for direct fish mortality.

Table 3.44 Impacts to Aquatic Habitat on North Dakota Tributaries From Construction of the Project

Water Body	Project Feature	Channel Length Impact	Habitat Impact
Wild Rice River	Control Structure	0.9 miles	12 acres
Sheyenne River	Aqueduct over Diversion Channel	0.9 miles	8.4 acres
Maple River	Aqueduct over Diversion Channel	1.1 miles	11 acres
Rush River	Flows directed into Diversion Channel	2.3 miles	-
Lower Rush River	Flows directed into Diversion Channel	2.7 miles	-

Fish are anticipated to temporary relocate to other areas of the water body to avoid Project construction activities. Some crushing of fish may occur due to construction, but this is expected to be minor. The impacts to habitat listed in Table 3.44 are relatively small compared to the length of the river channels and the amount of available habitat. The loss of aquatic habitat would not specifically impact sensitive fish species such as lake sturgeon. The channels of the Wild Rice, Sheyenne, and Maple River are hundreds of miles long, and the individual footprint impacts of each Project feature would not result in significant loss of habitat that would cause population level impacts to individual fish species or the fish community in these rivers. After Project construction is complete, fish would move back into the areas that were avoided during construction.

While some features of the new channel, control structure, and aqueducts could provide aquatic habitat for fish, it is not known how the quality of habitat provided by the new features would compare to the quality of the existing habitat that would be lost. The new features created by the Project are not considered aquatic habitat that would be used to offset the potential impacts. As a result, all aquatic habitat in the Wild Rice, Sheyenne and Maple Rivers disturbed or altered by Project construction would be lost and considered an impact.

The quality of the habitat was assessed in the channel of the rivers near where the Project features would be constructed (URS, 2013). The existing habitat in the Wild Rice, Sheyenne, and Maple River channels rated as moderate to poor quality, which lessens the potential for adverse impacts on aquatic habitat. However, even though the impacts to aquatic habitat on these rivers are likely to be small, proposed mitigation for loss of aquatic habitat would minimize Project impacts.

The Rush and Lower Rush Rivers would lose river channel (2.3 and 2.7 miles, respectively), starting at the diversion channel to the confluence with the Sheyenne River. Flows form the Rush and Lower Rush Rivers would be directed into the low flow channel within the diversion channel. This would result in the loss of habitat within both the Rush River and Lower Rush Rivers. The low flow channel would provide some habitat for fish, but it is not known what quality of habitat the new channel would provide.

The Rush and Lower Rush River are channelized rivers that flow intermittently and are considered to have low quality habitat, and therefore, habitat loss in these river channels are not considered significant. For the Rush River, the Project would result in impacts to aquatic habitat that would be offset through habitat provided in the low flow channel of the project diversion. Although Project impacts to habitat on the Rush and Lower Rush Rivers are not anticipated to be significant, based on existing IBI scores, the Rush River currently has a healthy fish community (Figure 17). The rock ramp spillway on the Rush River into the diversion channel has been designed to facilitate fish passage to ensure watershed connectivity of this river is maintained. Continued monitoring of the fish community and IBI scores on the Rush River (as well as other impacted streams) would help determine if additional adaptive management measures need to be implemented. Details on proposed mitigation are discussed in Section 3.8.3.

Fish Passage and Biological Connectivity

The Project would include the construction of a control structure on the Wild Rice River. Preliminary designs of the flood control structures were described in the FFREIS (Section 3.7) and are discussed below. Final designs were not available during EIS production. The structure would include gates across the channel which would be utilized to divert flood flows. A combination of rocks, and possibly concrete baffles, would be added within the control structure to provide flow complexity along the bottom of the new channel. As stated in Section 3.8.2.1.3, concrete baffles have been observed to be less effective in slowing velocities and providing for fish movement as compared to using natural material, including variable size boulders. Natural materials are known to provide more complex flow patterns as well as variation in flow velocities, as compared to concrete baffles (Aadland, 2010), which allows for a wider variety of species (i.e., fish body types and sizes) to pass through a feature. As mentioned above, the design of the structure and fish passage have not been finalized. Design details would determine the effectiveness of fish passage. When the Project is not in operation the gates would be open, flow would pass through the control structure, and there would be no impacts to fish passage compared to existing conditions on the Wild Rice River.

The control structure on the Wild Rice River would be operated in conjunction with the control structure on the Red River. The gates of the control structure would be open and not in operation most years, with no impacts to fish movement within the Wild Rice River. The current operation plan indicates the control structure on the Wild Rice River would begin operation when the measured flows at the upstream end of the Project (Red River at Enloe and Wild Rice River at Abercrombie) reach a sum of 17,000 cfs (35.0 feet) at the Fargo gage unless the hydrographs indicate that the flow may be close to peaking at which point the flows at the structures would be monitored to be sure 17,000 cfs (10-year flood) would occur at Fargo before Project operations would begin. Project operation would be dependent on actual weather and flood conditions and could occur at variable frequencies, not necessarily once every ten years. When the control structures are in operation, the gates would be partially closed to force flows into the diversion channel and staging area. This would result in increased flow velocities through the control structure on the Wild Rice River. The exact flows through the Wild Rice River control structure are not known as the design of the new channel and control structure have not been finalized but are estimated to increase to eight to ten feet per second (similar to what is expected at the Red River control structure) which would be impassable to fish. The USACE plans to include roughness elements into the design of the control structure, however during Project operation it is unlikely the roughness elements would be sufficient enough to allow for fish passage when velocities reach ten feet per second.

The Wild Rice River would be expected to experience similar impacts to fish migrations and biotitic connectivity as are described for the Red River in Section 3.8.2.1.3. Based on the fish species migration periods and the likely operation in either March or April, portions of the migrations of walleye, northern pike, and redhorse/white sucker are most likely to be interrupted. Migration of channel catfish typically occurs in May and June, and therefore, is less likely to be impacted by Project operation. It is unlikely that operation would completely block the migration of these species because the migration period of these species is generally longer (more than 30 days) than operation of the Project. For larger flood events the Project would be operated for longer periods of time, which increases the potential that operation would overlap with the peak migration of a species, and therefore, disrupt fish movement.

As described in section 3.8.2.1.3, there are several factors that influence the level of impacts on fish migration. These include the final operational plan for the Project; frequency the Project is operated; the duration the Project is operated for a specific flood event; and species timing of the peak migration compared to Project operation. These potential impacts would not be known or fully understood until after the Project is constructed and operated several times. Through the combination of these factors, it is likely some impacts to migration would occur during years the Project is operated.

The Project is less likely to impact fish migration on the Maple and Sheyenne Rivers. The Maple and Sheyenne Rivers would have their river channels and flows transported over the diversion channel via an aqueduct. As a result, the channel flows from the Maple and Sheyenne Rivers are independent of flows within the diversion channel. The final designs of the aqueducts are currently in progress. If the aqueducts are properly designed and constructed to convey flows from the Maple and Sheyenne Rivers under all flow conditions, there would not be a barrier to fish migration or habitat connectivity. However, the design of the aqueducts has not been finalized. Final design features, Project flow velocities, and bed materials would determine the effectiveness of fish passage. Additionally, during cold, winter conditions, which is also the time when river flows are typically lowest, cold air would pass below the aqueduct channel, potentially causing freezing of the river channels within the aqueduct. More detailed discussion on the aqueducts and the potential impacts from cold weather is provided in Section 3.5 – Cold Weather Impacts on Aqueduct Function.

Existing structures on the Maple River, the Sheyenne Diversion, and the West Fargo Diversion have resulted in previous impacts to fish passage and biological connectivity. The Project would construct of aqueducts on the Maple or Sheyenne Rivers that could further contribute to impacts or barriers to fish migration and habitat connectivity. The potential for impacts from the Project to fish migrations on the Sheyenne and Maple Rivers is not expected to be significant.

Lower portions of both the Rush River and Lower Rush River channels (2.3 and 2.7 miles, respectively) would be abandoned and would no longer provide habitat for river fish. This could have an impact on fish from the Red and Sheyenne Rivers that currently migrate upstream into either the Rush or Lower Rush Rivers. It is not known to what extent fish from the Sheyenne

River use the Rush or Lower Rush Rivers for seasonal migrations, and it is possible that some impacts could occur as a result channel abandonment and complete disconnection of the Rush River from migrations from the Red and Sheyenne Rivers.
The inclusion of the low flow channel within the diversion channel may allow fish to migrate up the low flow channel within the diversion under certain flow conditions and levels. The Rush and Lower Rush Rivers would empty into the diversion channel via means of rock-ramp spillways. The spillway on the Rush River has been designed to accommodate fish passage using a series of stepped drops totaling 13.2 feet along a general slope of one vertical to 50 horizontal from the Rush River to the invert of the low-flow channel. The stepped drops would be created with riprap and boulders to create a pool-riffle system to accommodate fish passage for all types of flow conditions. For the Lower Rush River, due to the elevation changes across the rock-ramp spillways into the low flow channel, it would be difficult for fish to migrate out of the diversion channel or low flow channel upstream into the Lower Rush River. The Rush and Lower Rush Rivers would flow into the Red River via the diversion channel.

The Rush and Lower Rush Rivers would be disconnected from the Sheyenne River by the diversion channel. The interaction of fish from the Rush and Lower Rush Rivers with the fish community of the Sheyenne River is not known. Therefore, potential impacts to fish migrating within these individual rivers and collective river system is unknown. Any future restoration projects on the Rush and Lower Rush Rivers would no longer have potential to occur in the abandoned channel area of these two rivers. The extent of adherence to natural channel design techniques (dimension, pattern, and profile) within the diversion channel would determine effects on habitat and fish passage.

Fish Stranding and Mortality

Fish stranding is dependent upon the timing of receding water after a flood. If water recedes too quickly, fish may become stranded in remaining pools or eventually on land that dries. The Project has two potential locations where stranding may occur after Project operation: the upstream inundation area and the diversion channel. Potential impacts from the construction and operation of the control structure on the Wild Rice River would be similar to those described for the control structure on the Red River.

Stranding in the Inundation Area

During operation the gates on the control structure in the Wild Rice River would be partially closed, diverting water into the staging area. Fish may leave the Wild Rice River channel and access the adjacent floodplain within the inundation area. An analysis was conducted to examine the rate of receding flood waters after Project operation (see FFREIS Section 5.2.1.7.4). The analysis determined that when flood waters are outside the banks of the Wild Rice River channel, the rate that waters would recede were estimated to be 0.2 to 0.6 feet per day. At these rates, fish should have sufficient time to follow the receding waters back into the channel of the Wild Rice River. Some fish would potentially become isolated or stranded, but it is not expected to be significant. Sensitive species are not likely to be more prone to stranding or mortality than other fish species. Based on model analysis, fish stranding is not expected to be significant.

Stranding in the Diversion Channel

Fish in the Sheyenne and Maple Rivers are unlikely to access the diversion channel or low flow channel as the flows of these rivers would pass over the diversion channel via aqueducts. Fish in the Rush and Lower Rush Rivers would travel downstream over the rock-ramp spillways into the diversion channel and low flow channels. The Sheyenne, Maple, Rush, and Lower Rush Rivers are located downstream of and outside the upstream inundation area. The aqueducts on the Sheyenne Rivers would convey flows up to bankfull conditions, with higher flows being directed into the diversion channel to avoid impacts to the downstream protected area of the Project. As a result, Project operation would ensure flood flows leave the banks of these rivers less often than what occurs under existing conditions. Project operation is not likely to result in an increase in fish stranding or mortality for fish communities on the Sheyenne, Maple, Rush, and Lower Rush Rivers. Cessation of Project operations at the control structure would cause dewatering of the diversion channel and potential stranding unless low flows are maintained. The length of the diversion channel and large numbers of fish that could congregate in the diversion channel could result in mortality unless all phases of Project operation provide adequate flow or flow ramping to allow out-migration.

3.8.2.2 Base No Action Alternative

Under the Base No Action Alternative, aquatic habitat, fish migration and fish mortality would remain similar to the existing conditions, including variable flow rates and other factors that influence aquatic habitat, fish passage and mortality in the Red River, Wild Rice River, Sheyenne River, Maple River, Rush River, Lower Rush River, and Wolverton Creek. Habitat within these rivers would continue to be influenced by the flooding patterns that currently occur and potentially contribute to channel scouring and/or siltation of aquatic habitat.

Fish migration within the Red River watershed, including all tributaries to the Red River, would remain the same as under current conditions. There are existing structures present in the Red River basin that currently impede fish passage including the Drayton Dam on the Red River and the Wild Rice Dam on the Wild Rice River. Under this alternative there would be no changes to these existing structures. There have been significant efforts in the last ten to twenty years by the MNDNR to remove barriers to fish passage and improve overall connectedness and fish migration within the Red River Watershed. Under the Base No Action Alternative, the DNR would continue these efforts to improve fish passage within the Red River Watershed. This would include pursuing funding sources to complete fish passage improvement projects currently identified by the MNDNR, such as the Drayton Dam removal and reconstruction project.

Fish mortality in the form of fish stranding within floodplain areas adjacent to rivers would be expected to continue in to a similar magnitude as currently occurs, which is dependent on the frequency of current flood patterns on the Red River and its tributaries.

The Cities of Fargo and Moorhead have planned flood risk reduction projects that would target reducing flood risk within the cities and properties along the Red River. Depending on the nature of the projects (such as levee construction), there could be some localized impacts to aquatic habitat associated with the flood reduction projects. These flood control projects are not anticipated to create barriers to fish migration in the watershed or contribute to fish stranding and mortality in adjacent floodplain areas in the watershed.

3.8.2.3 No Action Alternative (with Emergency Measures)

Under the No Action Alternative (with Emergency Measures), impacts to aquatic habitat would be similar to the Base No Action Alternative, with the exception that there may be some localized impacts from the implementation of flood control measures. In most cases emergency measures would include adding height to existing levees or adding temporary levees to protect additional areas. However, these actions are unlikely to be conducted directly within river channels and result in aquatic habitat impacts beyond those described for the Base No Action Alternative.

The utilization of emergency measures would result in less inundated areas in the immediate F-M urban area compared to the Base No Action Alternative, specifically in the City of Fargo south of Highway 10 and in areas near the towns of Frontier and Briarwood. The loss of access to the floodplain from the increased levee heights is unlikely to impact fish feeding or spawning activities as the levee protected areas are generally urban and offer limited suitable habitat adjacent to the Red River channel. By reducing access through increased levee heights to these areas urban areas with low habitat value there is less chance that fish would become stranded behind levees in unsuitable urban areas.

As with the Base No Action Alternative, the No Action Alternative (with Emergency Measures) would not add or remove barriers to fish passage within the Red River and its tributaries, and therefore, fish passage and migration within the watershed would not change from existing conditions. The MNDNR would continue efforts to remove fish barriers and improve fish passage within the Red River watershed, by pursing improvement projects they have identified, including finding a funding source for the Drayton Dam project.

3.8.2.4 Northern Alignment Alternative

The NAA would shift the control structure and tieback embankment on the Red River and Wild Rice River to the north approximately 1.5 miles. The assessment of stream habitat (URS, 2013) included a survey location near the NAA that was found to have habitat conditions similar to those evaluated at the Project location as the river channel and associated floodplain are similar for the Red River and Wild Rice Rivers. The assessment of in-stream habitat was rated poor to moderate quality with little diversity in substrate or habitat type at all reaches. Fish IBI scores from near the NAA location were slightly higher in both the Red and Wild Rice Rivers as compared to the Project control structure location. Table 3.39 above presents the IBI data for the Red River in surveyed locations. Site 3 is located on the Red River downstream from the NAA and had an IBI score of 53, which is considered in fair condition. The NAA is not anticipated to result in impacts to the overall fish community, habitat, or migration and connectivity different than those that were previously described for the Project along these four rivers.

The impacts to aquatic habitat from construction of the NAA control structures would include the abandonment and loss of approximately one mile of river channel to connect the new structure to the existing channel on both the Red River and the Wild Rice River. Impacts to aquatic habitat from construction of the NAA control structures are anticipated to be of a similar magnitude to those described for the Project approximately 14 acres on the Red River (Table 3.43) and approximately 12 acres on the Wild Rice River (Table 3.44)**.**

The NAA may lessen some impacts to fish and biological habitat and connectivity on Wolverton Creek. By moving the control structure to the north, the construction zone within the Red River would be over one mile further away from the confluence of Wolverton Creek with the Red River. This could lessen the potential for disturbance to Wolverton Creek during construction but also lessen the likelihood that operation of the Red River control structure would impact fish passage into Wolverton Creek. Additionally, the NAA movement of the control structure and the staging area to the north would lessen the total river miles of Wolverton Creek channel.

Operation of the NAA control structures would be similar to those described for the Project. This is anticipated to result in impacts to fish migration and connectivity within the watershed similar to those described for the Project. Operation of the control structures on the Red and Wild Rice Rivers has the potential to interrupt fish migration during the years when flow conditions cause the structures to be operated (i.e., anticipated operation at the 10-year flood and greater flow event) as described for the Project. The mitigation measures for impacts to connectivity and fish passage for the NAA, as with the Project, would be the reconstruction of the Drayton Dam to include fish passage and the removal of the Wild Rice River Dam.

The remaining portions of the NAA (i.e., diversion channel and aqueducts) would remain the same as what is described for the Project. This includes construction of aqueducts over the Sheyenne and Maple Rivers, which is anticipated to result in 8.4 and 11 acres of impacts to aquatic habitat, respectively (Table 3.44), and abandonment of approximately one mile of channel on each of these rivers. The Rush and Lower Rush Rivers would also result in over two miles of channel abandonment on each river and have drop structures installed at the confluence into the diversion channel. Impacts on the fish and aquatic community from construction and operation of the current Project design were previously described and are anticipated to be the same for the NAA.

Additional mitigation and monitoring measures, beyond those identified for the Project, are not anticipated to be required to address potential impacts from the NAA. Stream restoration within the Red River basin would be completed for impacts to aquatic habitat from the NAA, which was previously discussed for the Project.

3.8.3 Proposed Mitigation and Monitoring Measures

The Project would result in a variety of impacts to the Red River and tributary systems in Minnesota and North Dakota, including loss of aquatic habitat and disruption of fish migrations. Mitigation actions have been proposed with the intent of offsetting Project impacts. This section includes a discussion of the proposed mitigation, as presented by the USACE in the FFREIS and Supplemental EA. Proposed mitigation effectiveness and recommended additional monitoring is discussed in Section 6.2.8 – Fish Passage and Biological Connectivity.

3.8.3.1 Proposed Mitigation

3.8.3.1.1 Stream Channel Restorations

The construction of the control structures, aqueducts, rock spillways and the diversion channel would impact aquatic habitat on the Red, Wild Rice, Sheyenne, Maple, Rush, and Lower Rush Rivers. The Project proposes to locate all features in upland areas adjacent to the existing river channels. Upon completion, connection would be made to the existing river channels. As it is not known what extent the new channels would replace the loss of the existing habitat, the use of habitat features of the new channels and structures is not proposed as mitigation for fish habitat impacts. Mitigation has been proposed in the form of stream restoration projects.

Stream restoration projects would be anticipated to offset the direct impacts to aquatic habitat in the Red, Wild Rice, Sheyenne, and Maple Rivers. The mitigation plan discussed in the FFREIS and Supplemental EA described funding for the stream restoration projects, totaling approximately $10.9 million. The breakdown of funding allocated toward offsetting impacts to aquatic habitat in each river is shown in Table 3.45.

Table 3.45 Stream Restoration Projects to Serve as Mitigation for Impacts to Aquatic Habitat

Water Body	Proposed Mitigation Project	Funds Allocated Toward Project
Red River	Stream Channel Restoration	$5 Million
Wild Rice River	Stream Channel Restoration	$790,000
Sheyenne River	Stream Channel Restoration	$3.1 Million
Maple River	Stream Channel Restoration	$2.1 Million
Rush River[1]	Sinuous Low Flow Channel	-
Lower Rush River[1]	Sinuous Low Flow Channel	-

[1]Construction of the sinuous low flow channel is part of the cost of the diversion channel construction and not listed as a separate mitigation cost in the FFREIS.

Stream restoration projects have not yet been identified. One of the limiting factors in planning a stream restoration project is landowner consent. The non-Federal sponsor would need to find willing landowner partners who are interested in allowing a stream restoration project to be constructed on their property. The stream restoration project would then need to have the land enrolled into an easement or deed restriction. As it is unknown where the stream restoration projects would occur at this time, it may be necessary to construct stream restorations on a river that is not impacted by the Project or that may be located outside of the project area.

The Project would impact aquatic habitat on the Rush and Lower Rush Rivers. The quality of habitat within the Rush and Lower Rush Rivers is considered to be of low quality and therefore, stream restorations are not proposed as mitigation for aquatic habitat impacts to the Rush and Lower Rush River. From the Maple River downstream to the outlet of the diversion into the Red River, the low flow channel would be constructed in a sinuous, meandering nature. This would be done to provide habitat within the low flow channel, mimicking a more natural stream channel. The current design for the low flow channel has dimensions of approximately 84 feet wide by five feet deep for habitat creation.

3.8.3.1.2 Fish Migration and Connectivity

One of the impacts that would potentially result from the Project would be the interruption of fish migration and loss of biological connectivity during Project operation. When the control structures on the Red and Wild Rice Rivers are in operation, velocities through the structures are likely to increase to levels impassable to fish. Depending on the timing of the flooding events, required operation, and seasonal fish migrations that year, spawning migrations could be partially blocked or interrupted by the Project. There are two projects that have been identified to offset impacts to fish passage and biotic connectivity of habitats; these include the Drayton Dam fish passage project and the Wild Rice Dam removal project. Fish passage channels at the Red River and Wild Rice River control structures, originally proposed as mitigation, were eliminated from current Project design due to anticipated reduced operation (from a discharge of 9,600 cfs [see FFREIS Section 5.2.1.7.2] to a 10-year flood at 17,000 cfs).

Drayton Dam Project

The Drayton Dam is located within the city of Drayton, approximately 125 miles downstream of the project area on the Red River. A separate EA has been completed by the USACE for the Drayton Dam fish passage project (USACE, 2012a). The EA evaluated a variety of factors and potential environmental impacts associated with the proposed passage project. The EA states that of the eight dams on the Red River within the United States that pose a barrier to fish migrations and habitat connectivity, the Drayton Dam is the last structure that has not been reconstructed or modified to facilitate fish passage. Information in the EA stated that the Drayton Dam may be passable by fish up to 70 percent of the time in April but likely passable less than 50 percent of the time in all other months, which makes providing fish passage at the Drayton Dam a potential mitigation measure for impacts associated with the Project pertaining to fish passage.

A design of the Drayton Dam fish passage project was presented in the EA modeled after other USACE dam reconstruction efforts on the Red River. An example of a similar rock-ramp spillway with fish passage is the Riverside Dam in Grand Forks displayed in Illustration 3-7 below. The Drayton Dam fish passage project would construct a new rock-ramp spillway and removal of portions of the existing dam. The rock-ramp spillway would consist of rip-rap, boulders and sheet pile and start 300 feet upstream of the existing dam and end at the existing dam.

Illustration 3.7: Example of a fish passage dam project on the Red River at the Riverside Dam, Grand Forks, North Dakota.

Source: Drayton Dam EA, 2012

The new spillway would be sloped at the sides to maintain flows within the center of the channel, directing them away from the banks to reduce erosion, while also allowing fish passage through the center of structure. A variety of factors were considered and incorporated into the Drayton Dam fish passage project design including:

- Maintaining the intake area for reliable water supply for the city of Drayton, North Dakota,
- Ensuring the current water level elevation maintained by the existing dam was not lowered significantly, which could lead to upstream channel erosion and bank failures,
- Maintaining the public use and access point on the Red River located on the North Dakota bank, and
- Minimize construction downstream of the existing dam, which would avoid filling the downstream scour hole that currently provides habitat for the local fishery.

Wild Rice Dam Project

The Wild Rice Dam removal project is proposed as mitigation for Project impacts to fish passage and biological connectivity on the Wild Rice River. This low-head dam is located downstream of the proposed control structure location, near the town of Horace, North Dakota. The Wild Rice Dam fragments habitat and interrupts fish passage on the Wild Rice River under most normal and low flow conditions, and is likely only passable at high flows.

3.8.3.2 Proposed Monitoring

The FFREIS described monitoring efforts that would be conducted, including pre-construction and post-construction fish, macroinvertebrates, and aquatic habitat surveys. Pre-construction surveys were proposed to be performed at least twice prior to construction. Survey locations were to include areas near the footprint of the Project structures (i.e., control structures, aqueducts, rock-ramps), as well as sites above or below the features. These pre-construction efforts would be used to established baseline conditions and a point for monitoring future changes potentially associated with the Project. Post-construction included a minimum of two surveys over the first 20 years following Project construction completion. Surveys would be completed in the same locations as those for the pre-construction surveys to identify any changes to habitat quality.

The FFREIS Attachment 6 also included monitoring for aquatic connectivity and fish passage to assess the effects of Project features on fish migration. Monitoring would be completed once Project features were in place and Project operation had occurred (post-construction). No pre-construction monitoring was proposed to assess fish movements. However, pre-construction monitoring was proposed to assess potential connectivity impacts specific to Wolverton Creek. Details of the proposed monitoring were not available at the time of the FFREIS.

Monitoring was proposed to observe for stranded fish that included cursory visual assessments, following Project operation. Pre-identified problem areas such as low areas in topography such as near the river channel upstream of the Red River and Wild Rice River control structures as well as within the diversion channel would be the areas of focus. Observations would include notes on numbers, species, and size of fish. These results would be discussed with the USACE AMT. At a minimum, observations would be made following the first two or three times the Project is operated.

Since the completion of the FFREIS a pre-construction assessment of the aquatic habitat and fish and macroinvertebrate communities within the Red River and associated tributaries was completed for the project area (URS, 2013). This assessment, completed in 2011 and 2012, was conducted on 23 sites across the project area (Figure 18), including all rivers that would be impacted by the Project. The results from these surveys were included in the discussions above.

Since the FFREIS, the USACE and Diversion Authority have continued working with the MNDNR as well as other agencies and local governments on developing and revising approaches outlined in the FFREIS Attachment 6 for pre- and post-Project construction and operation monitoring. The Draft AMMP included as Appendix B, includes additional and more detailed pre- and post-Project construction and operation monitoring plan, is an example of this collaborative effort. The Draft AMMP is built off of the Attachment 6 proposed survey monitoring plan, ongoing communications, and studies completed to date, such as the macroinvertebrate, habitat, and fish communities surveys completed by URS in 2011 and 2012, as discussed above.

Further evaluation of the Attachment 6 Monitoring Plan, subsequent studies findings and additional recommendations are discussed in Chapter 6 and within the Draft AMMP included as Appendix B. It is important to note however, that although the Draft AMMP was a collaborative agency and local government effort, the Draft AMMP was prepared for use in this EIS and therefore also includes MNDNR recommendations for the AMMP approach, specific protocol, and additional studies different to or above that which the USACE and Diversion Authority have proposed. The USACE AMP and the Draft AMMP will continue to be revised through ongoing cooperation efforts, as pre-Project construction and operation monitoring results are assessed, Project designs are finalized, and as Project permitting requires.

3.9 WILDLIFE AND WILDLIFE HABITAT

This section describes wildlife and wildlife habitat within the project area, potential environmental impacts related to Project construction and operation, and measures proposed to avoid, minimize or mitigate impacts. Key habitats and associated sensitive species are the focus as they represent those species and habitats that are in need of protection and that would be the most sensitive to any disturbances. Detailed discussions on fish and aquatic habitat; state-listed species and special status species; and invasive species are discussed within Sections 3.8, 3.10, and 3.11, respectively. The Wetlands (Section 3.4) and Cover Types (Section 3.6) are referred to frequently as more detail about habitat types and acreage amounts are included within those sections. The FFREIS and Supplemental EA were reviewed for information on wildlife and wildlife habitat within the project area. The Minnesota and North Dakota Comprehensive Wildlife Conservation Plans or Strategies (i.e., State Wildlife Action Plans, or SWAPs) were reviewed for specific key habitats and associated species that could be located within the project area.

3.9.1 Affected Environment

In general, the project area can be viewed as consisting of both an urban and rural environment. The urban center (i.e., the F-M urban area) consists largely of manicured lawns and landscaped areas and provides only limited habitat for wildlife species. Therefore species observed includes those that would be considered more as generalist species such as some species of songbirds, reptiles, amphibians, and small mammals. The rural area provides a variety of habitat for both generalist and specialist species. Primarily consisting of cropland, generalist species include beaver, muskrats, striped skunks, fox squirrels, white-tailed deer, red fox, raccoons, raptors, waterfowl, and pheasant for example (FFREIS 2011). The specialist species are those associated with key habitats (focus areas) and are further described below. The riparian areas (floodplain forests) associated with the Red, Wild Rice, and Sheyenne Rivers provide the majority of the terrestrial habitat that exists within the project area. Other than the floodplain forests, wildlife resources are limited to those that can acclimate to drainage ways, shelterbelts, agricultural fields, road right-of-ways or within remnant key habitats that may be present.

Both Minnesota and North Dakota have developed SWAPs (funded through federal grants and programs) that identify key habitats and their associated Species of Greatest Conservation Need (SGCN) (MNDNR, 2006) as well as conservation plans and strategies for the key habitats. The term SGCN is used in Minnesota, while North Dakota uses the term Species of Conservation Priority (SoCP). For the purposes of this EIS, the term SGCN will be used when discussing species in the context for both Minnesota and North Dakota.

SGCN are wildlife species that are “rare, declining, or vulnerable to decline and are below levels desirable to ensure their long term health and stability” (MNDNR, 2006). These species are often considered as indicators to the overall health of wildlife communities (Hagen et al., 2005). Key habitats are those habitats that are identified as being the most important for SGCN and have been identified as those habitats that: are used by the greatest number of SGCN; experienced the most alteration over the past 100 years; contain high percentages of SGCNs that are habitat specialists; or are designated by The Nature Conservancy as important stream segments (MNDNR 2006). The following discussion is focused on habitats where SGCN could be present within the project area. More specific SGCN details are discussed in EIS Section 3.10 – State-Listed Species.

Key habitats are identified within discrete ecological boundaries. This allows conservation actions to be focused on specific interrelated ecological areas. Since key habitats exist in relationship to each other, understanding the relationships between them will allow management within their broader ecological context.

Minnesota and North Dakota use different methods to divide the states into ecological boundaries in their respective SWAPs. In Minnesota, the specific ecological classification system (ECS) divides areas into broad provinces, which are further divided into sections, and finally into subsections. In Minnesota, the project area is in the Prairie Parkland ecological province, within the Red River Valley section, within the Red River Prairie subsection (MNDNR, 2006). Key habitats that can be found in the Red River Prairie subsection include: prairie, wetland-nonforest, river-headwater to large, river-very large, and forest-lowland deciduous.

In North Dakota, ecological areas are divided into landscape components, which are sub-divided into focus areas. Under North Dakota terminology, the project area would contain three landscape components: Tallgrass Prairie (Red River Valley); Rivers, Streams, and Riparian; and Wetlands and Lakes. Specific focus areas in these landscape components include: Saline Area; Sand Deltas and Beach Ridges; and the Red River and Tributaries.

Although Minnesota and North Dakota use different methods to identify ecological regions, the purpose is the same: to define discrete ecological boundaries where conservation efforts can focus on protection of key habitats, and in turn preserve and protect SGCN. For the purposes of this EIS, the Minnesota classification system will be used to define key habitats and SGCNs within the project area. A comparison of the two systems providing each state's habitat classification system and its equivalent for the other state is shown in Table 3.46.

Table 3.46 Comparison of Minnesota and North Dakota Habitat Classification Systems

Key Habitat (MN)	Landscape Component (ND)
Prairie	Tallgrass Prairie (Red River Valley)
Wetland-Nonforest	Wetlands or Lakes
River-Headwater to Large	Rivers, Streams, and Riparian
River-Very Large	Rivers, Streams, and Riparian
Forest-Lowland Deciduous	Rivers Streams and Riparian

Source: MNDNR 2006; Hagen et al. 2005.

Using the names associated with the Minnesota classification system, each key habitat in Table 3.46 is described further below, including the occurrence of SGCNs. Each of the habitats is within the Red River Prairie subsection of Minnesota's Ecological Classification System and is further described in a subsection profile (MNDNR, 2006).

3.9.1.1 Prairie

Prairie habitats are dominated by grasses and forb species. Woody species, such as trees and shrubs, were historically absent from these habitats due to natural fire regimes. Within the Prairie Parkland ecological province, tallgrass prairies were the dominant land cover prior to European settlement and supported a variety of upland wildlife species.

Land use practices over the last century, including urban development and widespread agriculture, have significantly reduced the amount of native prairie habitat across Minnesota and North Dakota, including within the project area. While the prevalence of prairies has been reduced compared to pre-settlement levels, grassland and surrogate upland habitats are present. These include hayland, pasture, and planted shelterbelts (FFREIS 2011). Shelterbelts, planted near farmsteads and homes or along field edges, are composed mostly of small shrubs and fast growing tree species, but can also include some coniferous trees, as well as grassy understory. These habitats support wildlife species at varying levels depending on the size of habitat tracts and their proximity to existing human developments or activities. Pasture and hayland also support a variety of migratory birds for foraging and nesting. The type of agricultural activities, as well as the timing of weather conditions and migratory activity during a given year, influence the extent to which birds and other wildlife are able to use these habitats.

Remnant prairie within the Red River Prairie subsection provides habitat for several insect and bird SGCNs, including examples such as those below (MNDNR, 2006). Each of these species is sustained by one or more specific components of prairie habitat. In the case of insects, these include plants that provide nectar or serve as hosts for egg laying. For birds, specific habitat types, such as dry prairie with native short grasses, are important. Some of these species are considered to be declining in number within their ranges, their habitat is the core of the species breeding range, and/or the species is at risk throughout its range (Hagen et al., 2005).

- Regal fritillary (*Speyeria idalia*)
- Arogos skipper (*Atrytone arogos)*
- Uncas skipper (*Hesperia uncas)*
- Red-tailed leafhopper (*Aflexia rubranura)*
- Dakota skipper (*Hesperia dacotae)*
- Chestnut-collared longspur (*Calcarius omatus*)
- Sprague's pipit (*Anthus spragueii)*
- Baird's sparrow (*Ammodramus bairdii)*
- American bittern (*Botaurus lentiginosus*)
- Upland sandpiper (*Bartramia longicauda)*
- Wilson's phalarope (*Phalaropus tricolor*)
- Canadian toad (*Bufo hemiophrys*)

There are no known prairie remnants located within the project area. Other surrogate habitats are present, as described above, that may provide some habitat for these species. However, it is presumed that there is a low potential for these SGCNs to be present.

3.9.1.2 Wetland-Nonforest

Wetland-Nonforest (non-forested wetlands) habitats are dominated by herbaceous plants adapted to saturated soils for all or most of the growing season. These habitats occur in several major types across Minnesota, including marshes, wetland meadows, fens, and bogs, each with a characteristic plant community and period of inundation. Non-forested wetlands have declined in many subsections of Minnesota's ecological classification system, especially in the Prairie Parkland province, which includes the Red River Prairie subsection (MNDNR, 2006). As previously mentioned, wetlands present in the project area, and associated impacts, are discussed in detail in EIS Section 3.4 - Wetlands. Cover types are discussed in Section 3.6, which includes a summary of the total wetland acreages within the project area.

Due to the decline of non-forested wetlands, several species of birds are considered SGCN. Optimal habitat for these birds includes requirements for depth of water; height, density, and type of vegetation; and prevalence of open water. Also within this landscape are several species of mammals, reptiles, and amphibians. Examples are listed below (MNDNR, 2006; Appendix B of Hagen et al., 2005).

- Sedge wren (*Cistothorus platensis)*
- Yellow rail (*coturnicops noveboracensis)*
- Nelson's sharp-tailed sparrow (*Ammodramus nelson)*
- Two-spotted skipper (*Euphyes bimacula Illinois*)
- Least bittern (*Ixobrychus exilis*)
- American bittern (*Botaurus lentiginosus*)
- Marsh wren (*Cistothorus palustris*)
- Virginia rail (*Rallus limicola*)
- Forster's tern (*Sterna forsteri*)
- Wilson's phalarope (*Phalaropus tricolor*)
- Horned grebe (*Podiceps auritus*)
- American bittern (*Botaurus lentiginosus*)
- Yellow rail (*Coturnicoops noveboracensis*)
- Canadian toad (*Bufo hemiophrys*)

There are very few non-forested wetland areas located within the project area within North Dakota. Within Minnesota, the non-forested wetlands are primarily Seasonally Flooded Basins that are farmed, temporary wet basins, typically void of emergent vegetation and would not necessarily qualify as a key habitat. Therefore, it is presumed that the potential of these SGNC within the project area is low. Bird usage may occur during migration.

3.9.1.3 River Habitat

The Red River Prairie subsection has two key river habitats within the project area: river – headwater to large; and river – very large. Rivers and streams within the Red River Valley ecological section have been significantly altered since the time of settlement. The main stem of the Red River itself remains a sinuous stream. However, the watershed has been altered through intensive agriculture, wetland drainage, channelization of streams, and addition of dams (Aadland et al., 2005). Historically the pre-settlement vegetation of the Red River Prairie subsection was dominated by tall grass prairies and wet prairies but has been replaced by wide-spread agriculture (MNDNR, 2006). In order to facilitate crop production, the land has been extensively drained through tiling of wetlands, creation of ditches, and channelization of streams, including streams within the project area such as the Rush and Lower Rush Rivers. All of these land use alterations lead to changes in river habitat such as alteration of flow regimes and increased sedimentation that reduces pool depth or covers hard substrates.

One of the other most significant changes to river habitats with the Red River watershed is the creation of dams and flow control structures. The addition of these structures has altered the ability of fish to migrate within individual rivers and also through multiple rivers and streams across the overall watershed. This limitation of fish movement throughout the Red River watershed limits the access of fish to certain important habitat types such as native spawning areas or wetlands located in the upstream portions of the watershed. Reduced fish migrations can also impact other aquatic organisms, such as mussels which depend on fish hosts for reproduction and dispersal (Aadland, 2010).

An environmental assessment examining fish passage in the Red River of the North basin in Minnesota was completed by the USFWS in 2005. This assessment identified over 400 dams and control structures that have been constructed throughout the watershed on the Red River and its tributaries. Additionally there have been thousands of culverts installed at road crossings on ditches and streams, which in some cases have become barriers to fish movement. These collective land use changes have impacted the habitat within and adjacent to rivers and streams in the Red River Prairie subsection, which ultimately impacts the types and prevalence of wildlife species present. Despite the past alterations, river habitats within the Red River Prairie subsection support several significant fish and wildlife resources such as a world class catfish fishery within the Red River. Efforts undertaken to remove barriers to fish migrations have been successful, including the reintroduction of lake sturgeon to the watershed starting in 1997. A description of the two key river habitats within the project area and example SGCN supported by each habitat is provided.

3.9.1.3.1 River-Headwater to Large

Rivers in this category range in size from a few feet to more than 150 feet wide, and include cold and warm water types. The size of these rivers is dependent on the area of the watershed they drain. These river channels range from three to 23 feet wide for Headwaters and from 50 to 150 feet wide for a large river. Water temperature, velocity, and depth also vary with river size; typically, cold water is less likely, water velocity is slower, and pool depth increases as the size of the river increases. Human activities have affected all types of rivers in this habitat category. Water quality is affected by inputs of chemical and other pollutants. Typically, as river size increases, a greater variety of pollutants with a resulting greater decline in water quality is expected (MNDNR, 2006).

Within the project area, the Wild Rice River, Sheyenne River, Rush River and Lower Rush Rivers in North Dakota, and Buffalo River and Wolverton Creek in Minnesota would be classified as River-Headwater to Large. These systems predominantly support fish species, which are discussed in detail in Section 3.8 – Fish Passage and Biological Connectivity. Terrestrial species are typically supported by riparian habitat associated with these systems, and are discussed in Forest-Lowland Deciduous.

Several fish species are among the SGCNs found in River-Headwater to Large habitat. As with other SGCNs, these species have particular habitat requirements. Water temperature and quality, water velocity, substrate type, and vegetation type and density are important features for refuge and spawning (MNDNR, 2006).

- Redside dace (*Clinostomus elongates*)
- Plains topminnow (*Fundulus sciadicus*)
- Creek heelsplitter (*Lasmigona compressa*)
- Largescale stoneroller (*Campostoma oligolepis*)
- Black redhorse (*Moxostoma duquesnei*)
- Great redhorse (*Moxostoma valenciennesi*)
- Least darter (*Etheostoma microperca*)
- Crystal darter (*Ammocrypta asprella*)

Portions of the Sheyenne River, Wild Rice River, South Branch of the Wild Rice River are considered key habitat (focus area) rivers that provide unique or declining habitat for specialized species within the project area. Many of these species are known or likely to occur.

3.9.1.3.2 River-Very Large

Rivers in this category typically have a large drainage area and are the terminus for smaller tributaries. Within the project area, the Red River would be classified as River-Very Large. Typically, these rivers have lower gradients and slower current velocities than their smaller tributaries, which lead to the creation of oxbows, islands, and backwater systems. Significant flooding, which can occur periodically, helps maintain these river characteristics. Considered the most biologically diverse type of river system in Minnesota, water quality is a common concern, as these rivers have large watersheds that can receive higher loads of nutrients and sediments (MNDNR, 2006). Higher sediment loads increase turbidity and reduce sunlight to the streambed, limiting densities of rooted aquatic plants.

Historically, the Red River and its backwaters supported several species of animals. Land settlement has affected the river through conversion of prairie to agriculture, which has led to loading of sediment, nutrients, and pollutants into the Red River and its tributaries. Many SGCNs therefore have been extirpated from the Red River (MNDNR, 2006), but some species, such as the Prothonotary warbler (*Protonotaria citrea*), may persist. Presently, the Red River supports a distinct fish community compared to smaller tributaries. This is discussed in detail in Section 3.8 – Fish Passage and Biological Connectivity.

Habitat of the Red River, its tributaries, and backwater areas include many species of birds, mammals, reptiles, amphibians, fish and mussels (Hagen et al., 2005) such as:

- Horned grebe (Podiceps auritus)
- American bittern (Botaurus lentiginosus)
- Swainson's hawk (Buteo swainsoni)
- Yellow rail (Coturnicops noveboracensis)
- Willet (Cataptrophorus semiplamatus)
- Upland sandpiper (Bartramia longicauda)
- Baird's sparrow (Ammodramus bairdii)
- Canadian toad (Bufo hemiophrys)
- Smooth green snake (Liochlorophis vernalis)
- Pearl dace (Margariscus margarita)

The Red River is considered a key habitat (focus area) river within the project area. Some of these species are known or likely to occur within the project area, particularly where there is adjacent floodplain forest habitat or grassland/pasture land that provides additional habitat needs.

3.9.1.4 Forest-Lowland Deciduous

For the purposes of this EIS discussion, Forest-Lowland Deciduous is defined as the riparian floodplain forest (i.e., floodplain forest). This key habitat represents most of the natural terrestrial wildlife habitat that presently exists in the project area (FFREIS 2011). Frequent flooding after spring snowmelt or unusually heavy rains has resulted in distinctive vegetation adapted to saturated soils, prolonged inundation, frequent erosion, and sediment deposition. Wetlands are frequently present in these forests (see Section 3.4 for detailed description of wetlands within the project area). Vegetation less tolerant to frequent flooding may be found on terraces. Floodplain forests in the project area are dominated by deciduous tree species such as cottonwood and green ash. Areas of contiguous overstory coverage may have some openings, which support herbaceous ephemerals. Frequent flooding sometimes results in excessive vegetation scouring and sediment deposition, which produces areas of bare ground. The understory is typically open, with few shrubs or saplings (MNDNR, 2006). Floodplain forests can support a variety of aquatic and terrestrial wildlife due to the transitional nature of riparian to upland habitat.

Large areas of floodplain forests have been lost since European settlement within the project area (MNDNR, 2006). Floodplain forests were formerly dominant in the wide floodplains surrounding streams and rivers. However, conversion to agriculture and urbanization has reduced the floodplain forests to narrow margins along rivers and streams. Within the project area, floodplain forest is less prevalent than it is in other parts of Minnesota, such as along the Mississippi River. The remnant margins are essentially the only floodplain forest habitat remaining in the project area. Five to seven percent of the Red River Prairie subsection consisted of floodplain forest, but its occurrence is now less than one percent (MNDNR, 2006; Hagen et. al, 2005). Since the project area was historically prairie, forest was uncommon but served as important nesting, breeding, and overwintering habitat for a variety of terrestrial wildlife species (FFREIS 2011).

Floodplain forest supports SCGNs that include several birds, such as those listed below. Factors affecting the persistence of these species include the presence and size of lowland hardwood or mature deciduous forest, characteristics of waterways, topographic features, and suitable nesting opportunities (MNDNR, 2006).

- Prothonotary warbler (*Protonotaria citrea*)
- Cerulean warbler (*Dendroica cerulean*)
- Red-shouldered hawk (*Buteo lineatus*)

Few floodplain forests remain within the project area. Those that remain are small and lack corridors to other floodplain forest tracts. Remaining floodplain forests are located both upstream and downstream of the F-M urban area.

3.9.2 Environmental Consequences

This section describes both temporary and permanent impacts that are anticipated to occur to the previously described wildlife and habitats present within the project area for the Project and Project alternatives. Temporary and permanent impacts are described for both Project construction and operation.

3.9.2.1 Proposed Project

Environmental consequences to wildlife and wildlife habitat depend on their presence in the project area and the presence of remnant or specific habitat requirements, as discussed in Section 3.9.1. Studies of remnant habitat have not been completed specifically for the project area, however an analysis of cover types has been done for the footprint of the diversion channel construction and within the inundation area. The project area is cropland with a high-density population urban area located in the middle. Low-quality remnants of non-native grassland or hayland and remnant floodplain forest account for less than one percent of the Project footprint (Section 3.6 - Cover Types). There is no evidence that parcels of native prairie habitat remain in the area. Forest-lowland deciduous habitat (i.e., floodplain forest) has been identified as the primary terrestrial wildlife habitat that remains in the project area (FFREIS 2011). Wildlife using the project area are thus likely to be those adapted to human activity and agricultural environments, with a limited presence of SCGNs with specific habitat needs. The discussion of impacts to wildlife is therefore general with a more detailed discussion about floodplain forest. Impacts to wetland habitat types are discussed in EIS Section 3.4 - Wetlands.

3.9.2.1.1 Construction Impacts

Construction of the diversion channel, embankment systems, community ring levees, and aqueducts would primarily result in the conversion of cropland to grassland and wetland habitat (Section 3.6 – Cover Types). Most of the wildlife and wildlife habitat that would be disturbed are generalist species and the habitats they use. Few key habitats that contain SGCNs would be disturbed; however, small areas that contain forest-lowland deciduous, river habitat (i.e., aquatic habitat), and non-forested wetlands would be directly impacted. Direct impacts include dredging, draining, filling, and excavation.

Forest-Lowland Deciduous – Floodplain Forest

The majority of impacts to floodplain forests would occur along the Red River during the construction of the OHB ring levee, control structures, and diversion outlet. Other floodplain forest impacts may occur along the diversion channel near river and stream intersections and during mitigation work, such as the Drayton Dam Mitigation Project. Potential floodplain forest impacts were estimated in the Supplemental EA. Impacts were calculated using aerial photographs (Figures 19 and 20) showing impacted areas (i.e., footprint of the diversion channel, connecting channel, excavated material berms, and tieback embankments) on the Wild Rice and Red Rivers, as well as construction of control structures on the Red River and Wild Rice River, outlet structure on the Red River, and aqueducts on the Maple and Sheyenne Rivers. The Project footprint is currently approximately 20 percent wetlands, which includes approximately 0.007 percent floodplain forest or about 62 acres (Section 3.4 – Wetlands and Section 3.6 – Cover Types). (It should be noted that upland shelter belts and other non-riparian wooded areas were also included in the USACE floodplain forest calculation.) It is estimated that of the 62 acres of floodplain forest impacts from the Project, approximately three acres would occur in

Minnesota and approximately 59 acres would occur in North Dakota. Impacts to floodplain forest would require mitigation at a 2:1 ratio as described in Section 3.9.3 – Proposed Mitigation and Monitoring Measures.

River Habitat

Aquatic habitat with two key habitat (focus area) rivers would be impacted directly through local disturbance during construction activities and from the abandonment of several miles of river sections on the Rush River and Lower Rush River, i.e., river habitat, and through the construction of the control structures and aqueducts (Sections 3.5 – Cold Weather Impacts on Aqueduct Function and 3.8 – Fish Passage and Biological Connectivity). River habitat from the control structures and diversion channel would range from eight to 25 acres for the Red River, Wild Rice River, Sheyenne River and Maple River (FFREIS 2011). Compared to the amount of river habitat within these rivers, the amount of habitat impacted would be small but depending on the quality of habitat present could result in localized impacts to fish and other wildlife species. Impacts to riparian vegetation during construction may also cause stream bank destabilization.

Non-forested Wetlands

Twenty percent of the Project footprint would directly impact non-forested wetlands. The majority of direct impacts would occur to Seasonally Flooded Basins (approximately 85 percent). The remaining impacts would secondarily affect fresh (wet) meadows and shallow marshes (approximately seven and six percent, respectively).

The extent of construction impacts to wildlife and wildlife habitat impacts are dependent on a variety of factors such as construction timing, locations, actions (e.g. earth moving, dewatering, and etc.), and reestablishment of disturbed areas to desired outcome (i.e., mitigation approach). Federal, state, and/or local permits that may be required could include provisions such as date restrictions for when construction can occur for particular Project features or other requirements to help minimize effects on wildlife or wildlife habitat based on the factors involved. Project construction planning, such as the when certain Project features are constructed during this timeframe, are still in development and would be determined when Project plans are finalized and permits have been issued. Project construction is expected to occur over an 8.5-year timeframe or as funding becomes available.

Temporary Impacts

During construction of the Project features there could be potential for direct impacts to some wildlife and aquatic species in these areas. Impacts include potential for direct mortality, displacement or increased exposure of less mobile species (i.e., small mammals, amphibians, reptiles, ground-nesting birds, including some migratory birds) to predators. Increased human activity, increased noise, and visual disturbances may indirectly impact mobile species (i.e., medium to large mammals and birds, including migratory waterfowl and raptors), which may be displaced from their habitat or may disperse from the area. Vegetation may be disturbed through construction vehicle compaction, construction equipment storage, and construction material placement. Disturbed vegetation would be expected to recover or would be replanted to avoid the establishment of undesirable or invasive species. Due to the temporary nature of these impacts, they are not anticipated to cause long-term declines in populations. It would be anticipated that generally, wildlife would return to the area following construction activities.

Permanent Impacts

Permanent impacts would occur to wildlife habitat, specifically within and along stream channels, wetlands, and upland habitats (i.e., hayland/grassland) – floodplain forests and wetlands-nonforested key habitats. The duration of this impact would vary according to the length of time required for construction of each portion of the Project features and for the time required for a particular type of habitat to become re-established. Impacts to upland habitats would likely be short-term as the new grasslands associated with the Project would be created concurrently with the Project and would become established within a few growing seasons. Impacts to non-forested wetland habitat such as shallow marshes would likely take several growing seasons to become established as new habitat replacing the function of the habitat lost due to the Project. The impacts to floodplain forest would have the longest potential temporal loss of habitat function as the loss of habitat would be immediate, but the creation of new forests as mitigation would likely take more than a decade to replace the function of what was lost. Mitigation of the floodplain forest and other wetland habitats is discussed in Section 3.4 – Wetlands.

The construction of the diversion channel is anticipated to create habitat and result in positive impacts to wildlife in the project area in the long term once mitigation is achieved by providing a unique water feature in an otherwise primarily cropland cover type dominated landscape.

3.9.2.1.2 Operation Impacts

Based on historic flow records, Project operation is anticipated to occur primarily within the months of March and April and during flood events larger than the 10-percent chance flood (10-year flood). The number of days the Project would be in operation would be dependent on a number of factors, but it is estimated that it would be in operation from about 10-14 days (up to a 0.2-percent chance flood (i.e., a 500-year flood)). Receding water time would take longer following Project operation. Ultimately, the level of impacts would be dependent on the timing and duration of flood events and operation of the Project.

Indirect impacts would occur both downstream and upstream of the tieback embankment; and within Project features (e.g., diversion channel, aqueducts). Areas located downstream of the tieback embankment are those that would be protected by the Project, largely the F-M urban area. This area would no longer experience flood events larger than a 10-year flood (with the exception of a 500-year flood, in which emergency measures would also be used to reduce flood impacts). The river habitat would be impacted within this reach from flood damage reduction (FDR) projects and hydrologic and hydraulic changes as a result of Project operation. However, river habitat is already considered poor within this reach (Section 3.8 – Fish Passage and Biological Connectivity, Table 3.35) likely from manmade features such as dams and control structures, and land use conversion from prairie to agriculture or to developed communities.

The area upstream of the tieback embankment would experience the majority of impacts resulting from Project operation. The staging area would act as a storage area for flood waters; the depth and extent of flooding would increase within this area and some surrounding areas

(Figure 3) as well as flood durations (Section 3.1 – Hydrology, Table 3.4, Graph 3.1). This area consists primarily of cropland, drainage ways, and ROW-type habitat. Wildlife that is typically found in this area primarily includes generalist species. Key habitats (focus areas) and their respective SGCNs that may be indirectly impacted include floodplain forests, river habitats, and non-forested wetlands.

Constructed Project features (e.g., diversion channel and aqueducts), as currently designed, would create non-forested wetland and river/aquatic habitat. During Project operation, those areas would experience an influx of water and wildlife and wildlife habitat within those corridors would be impacted. As the quality of created habitat is unknown at this time, it is uncertain as to whether or not these features may include SGCNs. Generalist species are more likely anticipated at this time to populate these areas and be affected.

As the majority of impacts resulting from Project operation are likely to occur within the inundation area and to a lesser extent, within constructed Project features, the discussion below on temporary and permanent impacts is focused on those areas.

Temporary Impacts

As operation of the Project is anticipated to occur during early spring, temporary impacts to migratory species may occur. This includes generalist species as well as SGCN or other rare or listed species that may use the project area in route of breeding grounds. Migratory birds that may use undeveloped land as stop-overs would need to find other resting grounds. Flow velocities would produce impassible conditions for fish during Project operation which would be a barrier to fish migration. In addition, there is a chance for fish stranding and mortality to occur within the inundated areas and diversion channel when flood waters recede.

Resident terrestrial species would be temporarily displaced from habitats that would become inundated. Although much of this area has experienced flooding under existing conditions, the extent, depth, and duration of flooding specifically within the staging area would be increased. There are some areas within the staging area would not experience flooding, even with Project operation; however, the area available to displaced wildlife would be less which may result in higher mortality rates to those species that are unable to travel distances or get to higher ground. As Project operation would not occur that frequently, it is not expected that mortality, if it were to occur, would not have long-term effects on wildlife populations.

Wildlife in the floodplain forest corridors and associated floodplains are adapted to periodic flood events and would likely relocate to nearby areas until flood waters have receded. Periodic floods, particularly in the spring, are part of a natural disturbance regime necessary for the health of these systems. Silt deposition and development of microtopography during flood events creates suitable sites for tree germination and establishment, and floods also carry seeds and propagules of plant species. (Epstien et al., 2002). Interaction between terrestrial and aquatic ecosystems occurs in floodplain forests through the processes of over-the-bank flooding, bank cutting, and sedimentation. Over-the-bank flooding can directly cause treefall or indirectly lead to windthrow through increased soil saturation. Spring floodwaters often carry ice floes and debris that can scour trees, leading to the development of multiple-stemmed canopy trees. Woody debris from floodplain vegetation influences the development of channel morphology and provides necessary habitat for many aquatic organisms. Riparian vegetation within these corridors reduces overland water flow and sediment transport (Kost et al., 2007).

Permanent Impacts

Indirect impacts to the floodplain forest communities could occur over time within the inundation area from sediment deposition during Project operation. The greatest potential for sediment to accumulate would be near the embankment. This would coincide generally with a 10-year flood as these flood events occur much more frequently than larger-events. Less sediment deposition would be expected at the south side of the staging area during the 100- or 500-year floods. This is due to the anticipated infrequency of these events, and because sediment would tend to fall out of suspension as inundation slowly progresses from near the embankment to further upstream.

Sediment deposition is a naturally occurring phenomenon within the Red River floodplain; however, the tieback embankment acts as a large impoundment during flood events, distributing sediment to areas outside of the historical floodplain into areas (i.e., wildlife habitats) that would not normally receive it. Also, the rate of sedimentation may increase as a result of the altered hydrology and hydraulics. Increased flow velocities and the extended duration of flood events would increase soil saturation times that could lead to stream bank destabilization, potentially resulting in increased sedimentation or bank failure (Section 3.3 – Stream Stability). These effects are anticipated be greater near the tieback embankment where the depth of flooding would increase over current conditions by greater than eight feet with lesser inundation depth increases anticipated further upstream and away from the tieback embankment. Sedimentation would be expected to occur incrementally over several decades; however, inundation of these depths and duration of flooding may result in some permanent habitat impacts depending on the scale of the flood event and the amount of deposition that occurs.

3.9.2.2 Base No Action Alternatives

Under the Base No Action Alternative, flooding would be expected to continue in the project area. Wildlife and wildlife habitat would be expected to remain similar to existing conditions, with changes in habitat (e.g., vegetation communities) occurring over time after flooding or other disturbance or system-changing events. Increased pressure from agricultural practices, such as extensive drainage tile systems and/or irrigation usage, as well as hydrologic and hydraulic alteration changes caused by dams or other manmade features or development, would continue to have an influence wildlife and wildlife habitat in the project area.

3.9.2.3 No Action Alternative (with Emergency Measures)

Under the No Action Alternative (with Emergency Measures) could result in minor, temporary impacts to wildlife habitat along the Red River primarily within the cities of Moorhead and Fargo where levees and sandbags would be used to control flooding. During this time, wildlife may be temporarily displaced. These impacts would be minor as most emergency measures would occur in urban areas or communities, where wildlife habitat is already disturbed by human activities. Wildlife and wildlife habitat responses to flood events and other influences would be similar to those described under the Base No Action Alternative.

3.9.2.4 Northern Alignment Alternative

The NAA is similar to the Project in design, construction, and operation with the exception that the tieback embankment and control structures would be located approximately 1.5 miles north of the Project tieback embankment alignment. Habitat within the 1.5 mile area consists of agricultural lands with some development. No key habitats are known to be located within this 1.5 mile area with the exception of river habitat. This area would become part of the staging area and would be inundated during Project operation. Similar to the Project, areas nearest the tieback embankment would experience the greatest depth and duration of flooding (greater than eight feet). New areas upstream of the tieback embankment would be inundated that do not experience flooding under existing conditions.

Temporary and permanent impacts to wildlife would be similar to those described for both Project construction and operation. Wildlife transition between habitat areas for foraging and cover in the region, meaning impacts to wildlife species and populations can occur indirectly due to impacts to habitat. Localized, direct impacts may also occur depending on the species and its habitat relative to NAA construction and operation. Generally, wildlife using the project area is likely to be those adapted to human activity and agricultural environments, with a limited presence of SCGNs with specific habitat needs. Migrating birds that are not adapted to aquatic landscapes would need to find alternative resting grounds. During Project operation, flow velocities would become a barrier to fish movement. Receding flood waters could result in fish stranding. Sedimentation to floodplain forest may also occur from operation of the NAA that could result in permanent impacts to wildlife habitat and key habitats such as floodplain forests, river habitats, and non-forested wetlands.

Specific habitat acreages could vary between the Project and the NAA. Floodplain forest for example, provides a transition-type habitat for terrestrial and aquatic species, including birds, mammals, and reptiles. Due to extensive agricultural activities, floodplain forest is an important habitat in this region. Floodplain forest acreage was delineated and calculated for direct impacts from the Project construction footprint. A similar assessment of non-forested wetlands and floodplain forest has not been completed for the NAA, but is anticipated to result in a similar impact (Section 3.4 – Wetlands). Field studies would be needed prior to construction to determine the extent of impact to floodplain forest and other cover types.

Proposed mitigation and monitoring would also be similar to those described for the Project in Section 3.9.3 – Proposed Mitigation and Monitoring Measures.

3.9.3 Proposed Mitigation and Monitoring Measures

Mitigation in the form of habitat restoration or creation is proposed to minimize impacts to wildlife habitat and populations. This mitigation was outlined in an adaptive management plan (AMP) included in the FFREIS (Attachment 6 Monitoring Plan, USACE 2011). The AMP for the Project would be further refined by an Adaptive Management Team (AMT), composed of local, state, and federal agency personnel, once Project design is finalized and prior to construction. This plan requires pre-construction and post-construction studies of biota and physical habitat for both impact sites and mitigation sites. This would allow impacts to be verified and mitigation effectiveness to be evaluated. A key component of the AMP is a thorough monitoring program with performance measures. Monitoring activities, including review of results, would be performed by an AMT. In addition, it would provide a contingency process where corrective actions could be pursued should impacts prove greater than anticipated; and/or if mitigation proves less effective at offsetting impacts.

As outlined in the AMP, construction-related impacts would be mitigated by replacement of habitat in disturbed areas or at mitigation locations near the project area. The goal of mitigation would be to replace the lost functions and values of the impacted floodplain forest, which means several, larger mitigation sites would be selected as opposed to a patchwork of small sites. All direct impacts to the floodplain forest would be mitigated at a 2:1 ratio in farmed wetlands along the Red River. This would replace floodplain forest habitat directly impacted by construction of the Project. As previously discussed, there will likely be some temporal loss of habitat function during the period after habitats are impacted by the Project but before created mitigation habitats have matured and replaced the lost habitat function. The time for created floodplain forests to mature and replace lost habitat function could exceed ten years. The temporal loss could be minimized by beginning habitat mitigation projects prior to construction impacts occurring.

Some mitigation sites have been preliminarily identified by the USACE; however most sites have not been identified. For floodplain forests, sites that are likely to be successful for restoration would be historic floodplains along rivers that are currently used for intensive agriculture. The USACE is currently in the process of managing floodplain forest habitat creation as mitigation at other sites in the upper Midwest. One location is in Pierce County, Wisconsin where over 300 acres of floodplain forest has been created along the Rush and Trimble Rivers as mitigation for impacts due to navigation improvements near Mississippi River Lock and Dam No. 3. The floodplain forests were created in two seeding phases, which are currently within the third and sixth growing seasons. Species planted within the mitigation areas include several oak species, black walnut, hackberry, and green and black ash. Different species have matured to different levels depending on their growth rate and seeding phase.

The initial seeding phase (now in the sixth growing season) included oak species which have reached a height of six feet in some places and are beginning to form a canopy. The USACE is continuing to monitor progress of the floodplain forest, including managing understory species such as reed canary grass and thinning of trees that were not planted but have become established in the habitat such as box elder. The early progress and success of this program illustrates that floodplain forest habitat restoration is possible as a viable mitigation program. However, proper planning and management of the habitat is necessary and the time between impacts to forests and maturation of new habitats is likely several years, possibly more than ten years, before habitat function is restored. It will be crucial to plan and implement floodplain forest habitat creation for the Project in the manner that is currently being carried out by the USACE in Pierce County, Wisconsin to ensure impacts to this key habitat from the project are not detrimental to the overall habitat within the project area.

It is also proposed that all non-cropped upland habitat that would be disturbed by Project activities would be replanted with native species, particularly native grasses that are anticipated to have positive impacts on overall habitat value (FFREIS 2011). Detailed discussion about wetland mitigation, including the floodplain forest, is discussed in EIS Section 3.4 – Wetlands.

As part of this EIS process, the USACE and Diversion Authority have continued working with the MNDNR as well as other agencies and local governments on developing and revising approaches outlined in FFREIS Attachment 6 for pre- and post-Project construction and operation monitoring. The EIS Draft

AMMP included as Appendix B, includes additional and more detailed pre- and post-Project construction and operation monitoring plan, is an example of this collaborative effort. The EIS Draft AMMP is built off of the Attachment 6 proposed survey monitoring plan, ongoing communications, and studies completed to date. The Draft AMMP includes refined monitoring plans for fish and streams - Aquatic Biological Monitoring Plan and the Geomorphology Monitoring Plan. These plans include proposed monitoring measures for fish connectivity, fish stranding, stream stability, water quality, and sedimentation.

Further evaluation of the FFREIS Attachment 6 Monitoring Plan and additional recommendations are discussed in Chapter 6 and within the EIS Draft AMMP included as Appendix B.

3.10 STATE-LISTED SPECIES

Minnesota's Endangered Species Statute (Minnesota Statutes Section 84.0895) authorizes the MNDNR to designate species that are endangered, threatened, or species of special concern. The list is codified as Minnesota Rules Chapter 6134. Minnesota's Endangered Species Statute and the associated rules prohibit "taking, purchasing, importing, possessing, transporting, or selling endangered or threatened plant or animal including their parts or seeds without a permit" (MNDNR 2014a). Minnesota state regulations provide a separate level of regulation beyond that of the federal Endangered Species Act of 1973. In North Dakota, state laws have not been adopted to define a regulatory definition of rare or threatened species, but the federal Endangered Species Act applies.

Endangered species analyses were completed in 2009 for the FFREIS, which focused on federally-listed species, and formal Section 7 consultation was done with the USFWS to determine potential impacts. For the purposes of this EIS, the Minnesota Natural Heritage Information System (NHIS) and North Dakota Natural Heritage Inventory (NDNHI) were queried for information about state listed animal and plant species that are in the project area. The NHIS provided updated information on Minnesota state-listed species that may be affected by the Project. The NDNHI data was consistent with data previously presented in the FFREIS and no significant changes in potential species impacts were noted within the project area from previous analyses for the FFREIS.

To provide updated information to that which was presented in the FFREIS, this section focuses on state-listed species in Minnesota for compliance with Minnesota Endangered Species Statutes. It describes state-listed plant and animal species potentially found within the project area and potential impacts associated with Project construction and operation.

3.10.1 Affected Environment

The Minnesota Endangered Species Statute requires the MNDNR to adopt rules designating species meeting the statutory definitions of endangered, threatened or species of special concern. Under the law, a person may not take, import, transport or sell any portion of an endangered or threatened species. Special Concern Species are not protected by Minnesota's Endangered Species Statute or the associated Minnesota Rules. Endangered species are defined by the law as those that are threatened with extinction throughout all or a significant portion of its range in Minnesota. Threatened species are those likely to become endangered in the foreseeable future throughout all or a significant portion of its range within Minnesota. Finally, special concern species are those that are extremely uncommon in Minnesota, or have a unique or highly specific habitat requirement in need of careful monitoring. Species at the edge of their natural range may be included in the species of special concern category along with those that were once threatened or endangered, but now have increased or protected, stable populations (MNDNR, 2013e).

Degradation and destruction of habitat are the primary reasons for the listing of most state-listed species. In the project area in particular, the conversion of native prairie and floodplain forest habitats to agricultural land has resulted in the decline of many species. Analysis of cover types has been done for the footprint of the diversion channel construction and within the inundation area, which indicated the majority of the area is cropland (Section 3.6 – Cover Types). Low-quality remnants of non-native grassland or hayland and remnant floodplain forest account for less than one percent of the Project footprint. There is no evidence that parcels of native prairie habitat remain in the area. Forest-lowland deciduous habitat (i.e., floodplain forest) has been identified as the primary terrestrial wildlife habitat that remains in the project area (FFREIS 2011). Riverine habitats associated with the rivers and tributaries in the project area provide habitat for aquatic species, and have also been impacted over time by agricultural land use. Wildlife using the project area are thus likely to be those adapted to human activity and agricultural environments.

3.10.1.1 State-Listed Species in the Project Area

The NHIS query identified six state-listed species within the project area. Four of the six species are associated with riparian habitats along the Red River or its tributaries. The remaining two species are associated with native prairie habitats. Table 3.47 provides the status of each species and its potential habitat requirements. Additional discussion of habitat present in the project area is described in several other sections of the EIS (EIS Section 3.4 – Wetlands, EIS Section 3.8 Fish Passage and Mortality, EIS Section 3.9 – Wildlife and Wildlife Habitat and EIS Section 3.6 – Cover Types).

Table 3.47 Minnesota State-listed Species in the Project Area

Species	Type	State Rank/ Global Rank[1]	MN Status[2]	Preferred Habitat
Lake Sturgeon (*Acipenser fulvescens*)	Vertebrate Animal	S3 / G3G4	Special Concern	Red River and its tributaries. Recovery program has been implemented
Burrowing Owl (*Athene cunicularia*)	Vertebrate Animal	S1B, SNRM / G4	Endangered	Open, grazed pastures or native, mixed-grass prairies populated by burrowing mammals
Black Sandshell (*Ligumia recta*)	Invertebrate Animal	S3 / G4G5	Special Concern	Typically found in the riffle and run areas of medium to large rivers in areas dominated by sand or gravel
Garita Skipper (*Oarisma garita*)	Invertebrate Animal	S2 / G5	Threatened	Native prairie habitats
Short-beaked Arrowhead (*Sagittaria brevirostra*)	Plant	SH / G5	Endangered	Mud or shallow water of streams and lakes

Source: NHIS 2014; MNDNR 2014c

[1] The international network of Natural Heritage Programs employs a standardized ranking system to denote global (G) or state (S) status. Species are listed on a scale from 1-5, 1 being the highest risk of extinction or extirpation and 5 being common, widespread, and abundant. "B" and "N" modifier used for migratory animals that are breeding populations (B) or represent a non-breeding population (N). "H" denotes species that were historically known from records usually greater than 20 years old. "NRM" denotes that the rank is not yet assessed.
[2]MN Status refers to listing under the Minnesota Endangered Species Statute.

3.10.2 Environmental Consequences

Natural Heritage data from both Minnesota and North Dakota were used to determine the potential general distribution and location of state-listed species in the project area. Field surveys were not conducted to verify the data, and therefore, potential impacts to species were evaluated based on the potential habitat required for each species relative to the occurrence of that habitat or cover type in the project area (Section 3.6 – Cover Types). This evaluation approach provides a basis for determining potential impacts to state-listed species that may occur in the project area.

3.10.2.1 Proposed Project

The Project has the potential to impact state-listed species directly and indirectly. Direct impacts may include fatalities of individuals due to construction activities, such as excavation, crushing, or burial. Operation of the Project may also cause fatalities due to flooding of the diversion channel and inundation area. Indirect impacts from the Project include habitat disturbance, degradation, or loss that may result in species relocation or death of individuals.

Since most of the project area is in an agricultural setting, impacts to wildlife habitat are anticipated to be minimal. The Project is not anticipated to cause long-term decline in species populations.

3.10.2.1.1 Riverine / Wetland Species

Lake Sturgeon (Special Concern)

The lake sturgeon is a long-lived, slow growing migratory species that was once common throughout Minnesota and native to the Red River watershed including major tributary streams and lakes (MNDNR, 2014b). Between 1910 and 1950, the lake sturgeon was eliminated from this watershed due to a variety of factors including dam construction limiting migration, siltation, channel modifications, and loss of necessary in-stream habitat. In 1997, efforts were undertaken to re-establish a naturally reproducing lake sturgeon population within the Red River through a stocking program led by the MNDNR. From 1998-2013, there have been 85 tagged and 26 untagged lake sturgeon caught by anglers (111 total records), including 13 in the Fargo-Moorhead area.

No direct mortality is anticipated to lake sturgeon in the project area. Construction would temporarily displace lake sturgeon that may be present near the footprint of individual river control structures. The individual footprint impacts of each Project feature would total approximately 49 acres of potential aquatic habitat distributed among the Red, Wild Rice, Sheyenne, and Maple Rivers (EIS Section 3.8 – Fish Passage and Mortality). Project footprint impacts are relatively small compared to the length of the river channel and the amount of available habitat in the river system. These impacts are not anticipated to result in population level impacts to the lake sturgeon. After construction of the Project is complete, fish would move back into the areas that were avoided during construction. Mitigation is proposed for loss of aquatic habitat. Details on proposed mitigation are discussed in Section 3.8 – Fish Passage and Mortality.

Limitations to migration could occur during operation of the Project hydraulic structures at high flow velocities, but not during normal flow (Section 3.8 – Fish Passage and Mortality). Typically, the Project would operate in March or April. Flooding in May and June has typically been below the 17,000 cfs (10-year flood event) threshold when the Project would be operated. It is believed that the historic spawning period for lake sturgeon occurs from late April through the end of June with peak migration and spawning varying within that timeframe depending on annual conditions. The lake sturgeon population that was reintroduced into the Red River watershed has not yet reached maturity and begun spawning in the system. Project operation during the months of April through June could interrupt the migration period of this species once a mature population begins spawning.

During Project operations, gates at the hydraulic structure would be partially closed to direct flows into the diversion channel. Velocities through the partially closed gates would reach a point where fish would not be able to pass through. The modeling completed for the Project estimates the average period of operation during this scenario would be approximately 19 days. Lake sturgeon and other fish migrations usually occur over several weeks, typically 30 to 60 days, but the timing of peak migration within the overall migratory period may be much shorter, on the order of several days. If flooding events and timing of Project operation occurred at the same time as the peak migration for lake sturgeon, the impacts to migration and spawning would likely be greater than impacts when Project operation coincides with the beginning or end of species migration. The exact timing of Project operation compared to specific migration period impacts will not be known until actual flooding events resulting in operation occur. It will be necessary to monitor the impacts to migrations or spawning when the Project is operated to determine the level of impact and the mitigation measures that may be needed to offset impacts.

The Project is not anticipated to completely block fish passage, but may interrupt fish passage or completely block it during a given year depending on timing of Project operation, flood flow variables, and lake sturgeon peak migration that year. Section 3.8 – Fish Passage and Mortality provides additional discussion on potential impacts to fish passage.

Black Sandshell (Special Concern)

The black sandshell was documented in the Red River within the Project area during surveys conducted in 2008. This species was also documented in 2003 and 2004 in the Buffalo River within the project area. Mussels are long-lived animals that spend most of their lives buried in the bottom sediments of permanent water bodies and often live in multi-species communities called mussel beds (MNDNR 2014c). Mussels are generally sedentary, filtering organic matter from the water column. Their limited mobility makes them especially susceptible to habitat degradation, specifically from non-point source water pollution and sediment pollution. Dams, channelization, and dredging increase siltation, physically alter habitat conditions, and block the movement of fish hosts. Invasive zebra mussels can also impact native mussels by attaching to native mussel shells in large numbers, eventually causing suffocation.

Excavation of the Project could result in mussel fatalities due to crushing, excavation, or other disturbance. These impacts could occur within the Project footprint during construction of the river control structures. There are no known occurrences of state-protected (endangered or threatened) mussels in the project area. Mussel surveys on the Red River in the project area was dominated by threeridge, pocketbook and pink heelsplitter (MnDNR Data; Valley City State University Data) with relative abundance considered low to moderate (FFREIS 2011). Special status species observed included Wabash pigtoe (ND), black sandshell (ND and MN) and mapleleaf (ND). Mussel surveys on the Wild Rice and Sheyenne Rivers (Valley City State University Data) indicated the black sandshell was most abundant (FFREIS 2011). Pre-construction surveys in the Project footprint are proposed to quantify the presence of the black sandshell.

Indirect impacts to the black sandshell could occur in areas of increased sedimentation, which could lead to fatality from burial and eventually suffocation. Habitat alteration from sedimentation can also have an impact of less tolerant mussel species. The greatest potential for sediment to accumulate would be just below the tieback embankment for the Wild Rice River, Red River, and Wolverton Creek, with less sedimentation in the southern portions of the inundation area. Sediment is expected to accumulate incrementally over time. Sedimentation in locations with the black sandshell could have an impact on individuals depending on the degree of sedimentation, but is not expected to impact populations of the species.

Mussels are dependent on fish hosts for dispersal throughout a river system. Glochidia are larvae expelled from a female mussel, which find a host fish where they attach to fish gills or fins. The glochidia live as parasites on the host fish until they develop into juvenile mussels, at which point they detach from the fish and fall to the streambed as free-living mussels. Host fish for the glochidia of the black sandshell include the bluegill (Lepomis macrochirus), largemouth bass (Micropterus salmoides), sauger (Stizostedion canadense), and white crappie (Pomoxis annularis) (Watters 1994). Impacts to the dispersal of the black sandshell are possible if fish passage is inhibited on the river system due to Project operation, as the host fish would not be able to move freely within the system. This could limit glochidia dispersal during a given year. Additional discussion on fish passage is provided in Section 3.8 – Fish Passage and Mortality.

Impacts to native mussels from zebra mussel invasion are not anticipated as a result of the Project. Zebra mussels are anticipated to spread over time up the Red River whether the Project is implemented or not. Potential impacts from zebra mussels are discussed in EIS Section 3.11 – Invasive Species.

<u>Short-beaked Arrowhead (Endangered)</u>

The short-beaked arrowhead is a native wetland plant species present in the Midwest prairie region from South Dakota to Texas (USDA NRCS 2014). This species was documented in 1956 along the Red River in Moorhead, more than five miles downstream of the diversion channel.

Given the historical record and the distance from the proposed Project, impacts to this species are not anticipated.

3.10.2.1.2 Prairie Species

Burrowing Owl (Endangered)

Historically, burrowing owls were present in the western prairie margin of Minnesota. Core habitat for the burrowing owl is in mixed and shortgrass prairie habitats west of Minnesota. Burrowing owls nest in areas of grazed pasture or native, mixed grass prairies populated by burrowing animals. Areas of intensive agriculture are typically avoided, although studies in Minnesota have shown that burrowing owls sometimes nest in alfalfa fields, indicating this species may have some capacity to adapt to agricultural habitats (MNDNR 2014c). Nesting burrows are the limiting factor for breeding owls. Declining American badger and ground squirrel populations and their associated burrows, in which the owls often live, have contributed to burrowing owl population decline.

The NHIS record is a single observation from 2007 of an individual during the breeding season. It is unknown whether nesting occurred in the area. Most of the project area would be in an agricultural setting. No native prairie is present (Section 3.6 – Cover Types). Although studies have shown that burrowing owls can use agricultural land, natural or artificial burrows are required to create necessary nesting habitat. Based on the cover types analysis (Section 3.6 – Cover Types), approximately 15 acres of brush/grassland, which includes pasture and hayland, currently flood during the 100-year flood event. The Project would cause an additional estimated three acres of flooding to this cover types. Habitat for the burrowing owl is not likely to be affected by the Project. Operation of the Project would not limit conservation or reintroduction for this species.

Garita Skipper (Threatened)

The garita skipper is a grassland butterfly species found in native prairie habitats. In Minnesota, populations are primarily in aspen parkland in Kittson County. One record from the late 1960s in Clay County may represent a brief establishment from the Kittson County population, but likely did not establish a population (MNDNR 2014c). The garita skipper is dependent upon the persistence of its habitat, especially dry and moist native prairie with abundant forb (i.e., flower) species.

The Project would be in an agricultural setting. No native prairie is present in the project area (Section 3.6 – Cover Types). The agricultural setting would not support this species. Since no habitat is present, no Project impacts (direct or indirect) are anticipated.

3.10.2.2 Base No Action Alternative

Under the Base No Action Alternative, flooding would continue in the project area. Natural habitat would remain similar to existing conditions, with natural changes in vegetation communities occurring over time after flooding or other natural disturbance events. Connectively improvements through continued pursuit of opportunities for dam removal or modification projects would provide positive impacts on biological connectivity. Mussel species, such as the black sandshell, could be impacted by severe flood events. Continued spread of zebra mussels would also threaten the existing native mussel communities. No impacts to other state-listed species would be anticipated.

3.10.2.3 No Action Alternative (with Emergency Measures)

Under the No Action Alternative, emergency measures could result in minor, temporary impacts to wildlife habitat along the Red River within the cities of Moorhead and Fargo where temporary levees and sandbags are used to control flooding. Direct impacts to the black sandshell or other native mussels from crushing or other disturbance could occur if emergency measures are implemented in the river channel. Other habitat would generally remain similar to existing conditions, with natural changes in vegetation communities over time after flooding or other natural disturbance events. Connectively improvements through continued pursuit of opportunities for dam removal or modification projects would provide positive impacts on biological connectivity. Native mussel species could be impacted by sedimentation from severe flood events. Continued spread of zebra mussels would also threaten the existing native mussel communities. No impacts to other state-listed species are anticipated.

3.10.2.4 Northern Alignment Alternative

Natural Heritage data for Minnesota and North Dakota was reviewed to determine potential impacts to threatened and endangered species in the project area. The NAA is similar to the Project in design, construction, and operation. Under the NAA impacts to the state-listed species are not anticipated to be significantly different from those expected under Project conditions. Available data and information does not indicate a noticeable difference in potential impact to threatened and endangered species by moving the location of the NAA downstream approximately 1.5 miles from the Project location. The location of the NAA does not indicate a direct impact to known locations of threatened and endangered species. Impacts to the lake sturgeon, black sandshell, and short-beaked arrowhead are anticipated to be similar to those identified for the Project. Cover type impacts, affecting habitat for prairie species (i.e., burrowing owl and garita skipper) identified for the Project, are anticipated to be similar to those described for the Project under the NAA. Additional discussion on impacts to cover types is provided in Section 3.6 – Cover Types.

3.10.3 Mitigation and Monitoring Measures

Mitigation and monitoring measures are proposed that would avoid impacts to state-listed riverine species. An AMP has been proposed for the Project. This plan would be further refined by an AMT, composed of local, state, and federal agency personnel, once Project design is finalized and prior to construction. This plan proposes pre-construction and post-construction studies of biota and physical habitat for both impact sites and mitigation sites. This would allow impacts to be verified and mitigation effectiveness to be evaluated. A key component of the AMP is a thorough monitoring program with performance measures. Monitoring activities, including review of results, would be performed by an AMT.

Lake Sturgeon

Monitoring plans have been proposed to effectively measure potential impacts to this species. Fish passage structures could be constructed to mitigate impacts to migrating lake sturgeon populations if monitoring indicates impacts from the Project. These topics are discussed in detail in EIS Section 3.8 – Fish Passage and Mortality.

Black Sandshell

A mussel survey was completed by the USACE in October 2011 for the diversion channel footprint, biotic sample sites, and areas to be abandoned by the diversion channel. The results of this survey were published in January 2012. Mussel surveys would also be conducted after construction is complete on the Red River.

Prairie Species (Burrowing Owl and Garita Skipper)

Upland restoration is proposed, using a habitat-based approach, which would provide upland habitat in the project area that has historically converted its native prairie to agricultural land. This would provide new potential habitat for state-listed species, such as the burrowing owl and garita skipper, where it currently does not exist. Additional wildlife habitat mitigation measures are present in EIS Section 3.4 – Wetlands and EIS Section 3.9 – Wildlife and Wildlife Habitat.

3.11 INVASIVE SPECIES

This section describes invasive species within the project area, potential environmental impacts related to construction and operation of the Project, and specific mitigation measures to avoid and minimize the introduction and spread of invasive species. The USACE FFREIS and Supplemental EA were reviewed for information on terrestrial and aquatic invasive species (AIS). Aquatic invasive species distribution information was obtained from the USGS, MNDNR, and NDGF. The Minnesota Department of Agriculture (MDA) and North Dakota Department of Agriculture (NDDA) data provided terrestrial invasive species that could occur within the project area.

Invasive species is a broad term used to define a species that is non-native to the ecosystem under consideration and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order 13112, Appendix 1, 1999). The definition of invasive species encompasses all species, including plants and animals, terrestrial or aquatic. A noxious weed is a specific regulatory definition applied to invasive plant species. Within this section, invasive species refers to non-native animal species and non-native aquatic plants that have been found to be invasive under the federal definition or are regulated under invasive species laws. Noxious weeds refer to invasive/non-native terrestrial plant species regulated by noxious weed laws.

Invasive species are problematic because they are able to spread rapidly, out-compete native species, and can result in adverse ecological or economic impacts (MDA, 2014a). Recent estimates show the economic impact of terrestrial and aquatic invasive species cost the U.S. economy billions of dollars each year (Lovell and Stone, 2005; MDA, 2014a).

The potential environmental and economic impact of invasive species led to regulation at the federal, state, and county level. Minnesota and North Dakota both have regulations for terrestrial and aquatic invasive species and noxious weeds. Noxious weed laws give the authority to counties in Minnesota and North Dakota to list additional noxious weeds that are of particular concern to that county. Table 3.48

provides a summary of the federal and state regulations for preventing and controlling the spread of invasive species. The counties within the project area do not have noxious weed regulations that differ from state and federal laws.

Table 3.48 State and Federal Regulations Pertaining to Invasive Species

Government Entity	Regulation	Description
Federal		
USDA Animal and Plant Health Inspection Service (APHIS)	7 U.S.C. 7701 *et. seq*, Plant Protection	Provides specific regulations for transport, control, and suppression of noxious weed species
Executive Branch	Executive Order 13112	Created a Council of Departments to prevent the introduction of invasive species, control their spread, and minimize economic, ecological, and human health impacts
U.S. Fish and Wildlife Service	18 USC 42-43, 16 USC 3371-3378 Lacey Act and the Alien Species Prevention Enforcement Act of 1992.	Prohibits the importation or shipment of invasive animal species, including the zebra mussel and other invasive mollusks
U.S. Fish and Wildlife Service	16 U.S.C. 4701 Aquatic Nuisance Prevention and Control Act, as amended by the National Invasive Species Act of 1996	"to prevent unintentional introduction and dispersal of nonindigenous species into waters of the United States"
State		
Minnesota	MN Statutes Chapter 18: Pest Control	Department of Agriculture rules to protect the state from "injurious effect of noxious weeds on public health, the environment, public roads, crops, livestock, and other property"
	MN Statutes Chapter 18G Plant Protection and Export Certification; MN Statutes Chapter18J Inspection and Enforcement	Department of Agriculture regulates the introduction or establishment of plant pests that "threaten Minnesota's agricultural, forest, or horticultural interests or the general ecological quality of the state"
	MN Statutes Chapter 84D: Invasive Species; MN Administrative Rules Chapter 6216, Invasive Species	Department of Natural Resources regulates the spread and control of aquatic invasive species and wild animals
North Dakota	ND Century Code Chapter 4.1-	"Requires every person to do all

Government Entity	Regulation	Description
	47-02, Noxious Weeds	things necessary and proper to control the spread of noxious weeds and makes it illegal for any person to distribute, sell, or offer for sale within this state a noxious weed"
	ND Century Code 20.1-17, Aquatic Nuisance Species	Provides the Game and Fish Department with legal authority to prohibit the spread of aquatic invasive species

Source: USFWS 2012; MDA 2014b; NDDA 2013a

3.11.1 Affected Environment

3.11.1.1 Aquatic Invasive Species

There are several AIS of concern, including: zebra mussels (*Dreissena* spp.), bighead and silver carp (*Hypophthalmichthys* spp.), curlyleaf pondweed (*Potamogeton crispus*), Eurasian watermilfoil (*Myriphyllum spicatum*), flowering rush (*Butomus umbellatus*), and purple loosestrife (*Lythrum salicaria*), which is an emergent plant species. Of these species, zebra mussels, curlyleaf pondweed, and purple loosestrife are known to currently exist in the project area. However, Eurasian watermilfoil and flowering rush are currently found in several water bodies within the Red River drainage basin. The distribution of these species was identified by a query of the infested waters listing in Minnesota and North Dakota, and USGS Nonindigenous Aquatic Species database (MNDNR 2013b; NDGF 2012; USGS 2014 a-c).

As of July 2012, zebra mussels have been identified in the Red River in Richland County, North Dakota (NDGF 2012; USGS 2013c). In Minnesota, zebra mussels have been identified in Breckenridge Lake and the Otter Tail River from near the confluence of the Pelican River, downstream to the Bois De Sioux River (MNDNR 2013b). Bighead and silver carp are not present within the Red River drainage basin (USGS 2014a, 2014b).

Tributaries to the Red River have known populations of listed aquatic invasive plant species. However, the Red River itself does not have known populations of these species (NDGF 2012: MNDNR 2013b). In North Dakota, curlyleaf pondweed is present in the Wild Rice River in Richland County, and Eruasian watermilfoil is present in the Sheyenne River in Barnes and Ransom Counties (NDGF 2012). Aquatic invasive plants are also present within the Red River drainage basin of Minnesota (MNDNR 2013b). Eurasian watermilfoil is present in Union Lake in Polk County. Curlyleaf pondweed is common in many water bodies within the drainage basin, but is not included in the list of designated infested waters in Minnesota. Flowering rush has been documented in the Pelican River watershed. Purple loosestrife, an emergent plant species, is also present within the project area, and is managed and regulated by terrestrial noxious weed laws (Table 3.48) and MNDNR invasive species laws.

3.11.1.2 Terrestrial Invasive Species: Noxious Weeds

Minnesota and North Dakota maintain noxious weed lists to regulate activities that could cause spreading. Under these laws, counties have the authority to list additional noxious weeds that are problematic to that county. Noxious weeds that may occur within Minnesota and North Dakota, as well as specific weeds listed for Clay, Wilkin, Cass, and Richland Counties are presented in Table 3.49.

Table 3.49 Listed Noxious Weeds Potentially Present in the Project Area

Common Name	Scientific Name	State Listing
Absinthe wormwood	*Artemisia absinthium*	ND
Bull thistle	*Cirsium vulgare*	MN[1]
Canada thistle	*Cirsium arvense*	MN, ND
Common reed	*Phragmities australis ssp. australis*	MN
Common tansy	*Tanacetum vulgare*	MN
Dalmatian toadflax	*Linaria genistifolia*	MN, ND
Houndstongue	*Cynoglossum officinale*	ND[2]
Japanese hops	*Humulus japonicas*	MN
Kochia	*Bassia scoparia*	MN[1]
Leafy spurge	*Euphorbia esula*	MN, ND
Musk thistle	*Carduus nutans*	ND
Plumeless thistle	*Carduus acanthoides*	MN
Purple loosestrife	*Lythrum salicaria*	MN, ND
Russian knapweed	*Centaurea repens*	ND
Saltcedar	*Tamarix ramosissima*	ND
Spotted knapweed	*Centaurea maculosa*	MN, ND
Yellow toadflax	*Linaria vulgaris*	ND
Wild parsnip	*Pastinaca sativa*	MN

Source: MNDA 2014, NDDA 2013a, NDDA 2013b, EDDMS 2014

[1]Listed in Clay County, MN

[2]Listed in Richland County, ND

3.11.1.3 Existing Management Programs

Noxious weeds and invasive species are currently managed in the project area under County and State authority. Cass and Clay County require eradication of noxious weeds through lawful methods. County Agricultural Inspectors ensure compliance with Minnesota noxious weed statutes. The MNDNR maintains the AIS program with seasonal staff at public accesses on water bodies to inspect for AIS on boat trailers and in boat water or bait buckets. Terrestrial invasive species are currently managed on MNDNR-owned lands using chemical, mechanical, and biological methods.

3.11.2 Environmental Consequences

Terrestrial and aquatic invasive species have the potential to adversely affect the project area and surrounding environment by spreading and establishing greater populations, potentially resulting in significant impacts to agriculture and natural plant and animal communities. These impacts could result in poor crop harvest, loss of native plant communities, and loss of wildlife habitat.

3.11.2.1 Proposed Project

Construction has the potential to spread invasive species. Aquatic and terrestrial invasive species could be introduced to the project area by movement of equipment or materials from infested waters and lands. The diversion channel has the greatest potential for spreading invasive species. Terrestrial invasive species could spread by significant surface disturbance from construction. Aquatic invasive species could spread by creation of a new water pathway or from unclean construction equipment moving from infested areas into the project area. Most Project construction would occur on terrestrial land, and therefore, the use of marine construction equipment is not anticipated.

The focus of this section is on the construction and operation of the diversion channel due to the potential to affect the spread of invasive species. To a lesser degree, inundated areas have potential to affect the spread of invasive species and is also discussed.

3.11.2.1.1 Aquatic Invasive Species Impacts

The potential introduction and spread of AIS during construction and operation could result in environmental consequences to aquatic communities. Zebra mussels and bighead and silver carp could cause harm through direct impacts to the aquatic food chain and displacement of native species (MNDNR 2014b, MNDNR 2014d). Zebra mussels are already located within the Red River Basin, and are anticipated to spread downstream regardless of the Project. Zebra mussels could also result in increased maintenance costs to Project control structures by direct attachment and encumbering structure function. Bighead and silver carp are not currently located within the Red River drainage basin.

Construction

Transport of construction equipment from outside the project area has the potential to introduce aquatic invasive species that may not be present. There is also potential for construction equipment to spread existing populations already present within the project area. This could potentially result in invasive species establishing new populations in currently unaffected areas.

Operation

Project operation is not anticipated to affect the spread of zebra mussels nor bighead and silver carp. Current management of AIS in the project area and Red River drainage basin would continue. The diversion channel would provide a minor dispersal opportunity for zebra mussels during operation. Dispersal would occur from the upstream inundated areas on the Red River, through the diversion channel, and terminate downstream where the diversion channel re-enters the Red River. Essentially, the diversion channel would provide another route for the spread of AIS, but the destination on the Red River would remain the same. Therefore, operation of the Project would not provide a significant transportation opportunity into unaffected drainage systems, and is not anticipated to accelerate the spread of zebra mussels. Additionally, the upstream inundated area would not connect rivers or tributaries with known populations of bighead or silver carp to the Red River drainage basin, and therefore, is not anticipated to promote the spread of this species.

3.11.2.1.2 Terrestrial Invasive Species: Noxious Weed Impacts

Direct impacts to natural vegetation, such as clearing or excavating, could result in noxious weeds spreading into adjacent floodplain forest. Since most natural plant communities are limited to riparian areas in the project area, noxious weed spread into these areas is of particular concern for the Project.

The spread of noxious weeds during construction or operation could result in impacts to agricultural production. Noxious weed infestations have been shown to result in agricultural crop yield losses of 50 to 90 percent (MDA 2014a). A potential consequence of noxious weed spread could be increased herbicide use to control noxious weeds. Increased herbicide application can lead to more herbicide contained in runoff to nearby waterways. This results in water quality impacts, impacts to natural plant and wildlife communities, and could eventually lead to degradation of the quantity and quality of wildlife habitat in the project area.

Construction

Disturbance of soils in the footprint of the diversion channel and associated structures provide the potential for noxious weeds or invasive plants to spread and colonize the disturbed area. Most construction would occur in areas previously disturbed by agricultural activities, which comprise approximately 6,625 acres of the total approximately 8,725 acres in the Project footprint. The remaining undisturbed areas are primarily wetland (Section 3.6 – Cover Types). Spread of noxious weeds or invasive species could also occur if construction equipment is contaminated with soil containing noxious weed seeds or other plant material. Without mitigation and management, noxious weeds could spread into surrounding areas impacting agricultural operations and natural plant communities.

Operation

Water has long been recognized as a mechanism for the spread of invasive weeds (Zimdahl 1993; Pysek and Prach 1994). Floods provide an extreme example of the spread of plant species with water. During large flood events, as water velocities increase as a function of flow volumes, the erosive power of the water increases exponentially as a function of velocity, increasing sediment transport rates (Donaldson, 1997).

Periodic flooding provides disturbances and openings in vegetative cover (Pysek and Prach 1994). Species favored by disturbance and by newly mobilized dissolved nutrients will rapidly fill these niches. Flood flows likewise act to transport seeds and plant parts from existing infestations into previously weed-free areas (Donaldson 1997). Vegetative reproduction is a common trait of perennial weeds, and allows them to colonize readily in a wide range of disturbed habitats (Bhowmik, 1997). As flows recede, the plant matter is deposited on newly formed sandbars and in areas which have been stripped clear of riparian vegetation. For many weed species, invasion of riparian areas by seeds follows an exponential curve (Pysek and Prach, 1994).

Periodic inundation of the area upstream of the tieback embankment and floodplain benches of the diversion channel would likely result in deposition of sediment. Both the periodic inundation and depositions can cause soil disturbances, which could lead to the colonization of noxious weeds. Operation of the Project would occur when flow through Fargo is approximately 17,000 cfs, which is approximately the 10-percent chance or 10-year flood event. Without mitigation and management, aquatic and terrestrial invasive species that spread by water would likely colonize inundated areas or spread during diversion channel operation.

Mitigation Areas

Spread of noxious weeds is a concern to wetland mitigation areas along the diversion channel, as discussed in Section 3.4 – Wetlands. Noxious weeds likely out compete re-established native vegetation and become an established source of noxious weeds without mitigation through chemical and mechanical maintenance. Wetland mitigation areas are credited based on function and noxious weeds would reduce functionality of these mitigation wetlands.

3.11.2.2 Base No Action Alternative

Under the Base No Action Alternative, terrestrial and aquatic invasive species currently established in the project area are expected to spread. Existing populations provide a source for invasive species propagules (i.e., reproductive material) to spread into areas not yet colonized by invasive species. Periodic inundation of the floodplain would result in deposition of sediment, providing potential areas for noxious weed species to colonize. Existing aquatic invasive species, such as the zebra mussel, would be expected to increase in the Red River.

Existing management programs for AIS and terrestrial invasive species are assumed to continue. These efforts will help control the spread of invasive species as feasible. Program priorities will determine where funding and resources are targeted and implemented.

3.11.2.3 No Action Alternative (with Emergency Measures)

Under the No Action Alternative, the potential effects of invasive species in the project area would be the same as those anticipated for the Base No Action Alternative.

3.11.2.4 Northern Alignment Alternative

Under the NAA, design, construction methods, and operation would be similar to those previously described for the Project. As is true for the Project, NAA construction would primarily occur in areas previously disturbed by agricultural activities. Invasive species are a regional issue, and therefore, potential impacts associated with the NAA would not significantly change compared to the Project. Impacts from invasive species associated with construction and operation would also be similar to those previously discussed for the Project. Without mitigation and management for the NAA, aquatic and terrestrial invasive species that spread by water would likely colonize inundated areas or spread during diversion channel operation in the same manner described for the Project.

3.11.3 Proposed Mitigation and Monitoring Measures

The uncontrolled expansion of non-native, invasive species and noxious weeds would be reduced by the implementation of mitigation and the continued use of existing management methods for terrestrial and aquatic invasive species. Mitigation would reduce the potential introduction and spread of invasive species during Project construction and operation. A challenge to mitigation is that the management of invasive species through mechanical and chemical means can be expensive and ineffective once large populations are established.

An AMP has been proposed for the Project. This plan would be further refined by an AMT, composed of local, state, and federal agency personnel, once Project design is finalized and prior to construction. Pre-construction monitoring data previously collected by the USACE and post-construction monitoring of biota and physical habitat for both impact sites and mitigation sites would be included as part of AMP implementation. This would allow impacts to be verified and mitigation effectiveness to be evaluated. A key component of the AMP is a thorough monitoring program with performance measures. Monitoring to review effectiveness and follow through of proposed mitigation strategies would be overseen by the AMT. The Diversion Authority would be responsible for contingency mitigation. Additional detail on the AMP is provided in Attachment 6 of the FFREIS.

Construction

During construction, Best Management Practices (BMPs) would be followed to prevent the introduction and spread of aquatic or terrestrial invasive species (MNDNR 2013b). Prior to transporting equipment to the project area, all equipment would be cleaned and free of soil and vegetation to prevent the spread of invasive species, including removal of attached zebra mussels, plant material, and mud, which may contain plant seeds, propagating parts or other invasive species. When Project construction occurs in areas of known noxious weed infestations, equipment working in these areas would be cleaned prior to moving from the area. This would prevent migration of noxious weeds or invasive species within the project area during construction. The AMP would outline the inspection procedures and occurrences to ensure compliance with the proposed mitigation.

When construction activities are complete, disturbed areas would be seeded with native plant species or other plant species per Project plans and specifications. Native species are adapted to local climate and soil conditions, and after establishment, need little maintenance to thrive (MNDNR 2004). An established native plant community would reduce the amount of bare ground available for noxious weeds and invasive species to colonize, in addition to soil stabilization by deep spreading roots. Prior to planting, all source materials would be free of invasive plant seeds and other invasive species (e.g., emerald ash borer larvae, gypsy moth egg masses on woody plant material or zebra mussels on aquatic materials). After native species have been planted, the seeded areas would be monitored per the Project plans and specifications. The Diversion Authority would be responsible for noxious weed control on the whole Project perpetually as part of the Operations, Maintenance, Repair, Rehabilitation, and Replacement (OMRR&R).

Operation

Operation of the diversion channel and upstream inundation has the potential to spread terrestrial invasive species into areas not previously exposed during 500-year or greater flood event, and therefore, the Diversion Authority would maintain and control the spread of invasive species for the life of the Project as defined in the OMRR&R. A monitoring plan would include procedures on surveys for identifying noxious weed populations, treatment plans, and follow-up surveys to confirm that treatment measures are effective. Since there are sensitive areas in the project area (i.e., organic farms), specific maintenance activities would be identified based on the location of the noxious weed infestation. Monitoring, maintenance, and control efforts would be done on an annual basis in accordance with the OMRR&R.

The AMP would include measures to control invasive species, including mowing, burning, disking, mulching, biocontrol, and/or herbicide treatments. Monitoring for the spread of invasive and/or noxious weeds would be determined by the AMT. For more details on the wetland mitigation areas, refer to Section 3.4 - Wetlands.

3.12 CULTURAL RESOURCES

Cultural resources include a wide range of historic, archaeological and other resources related to past human activities, including sites with observable evidence of human activities, sites of religious or cultural significance that may have no observable evidence, historic structures and buildings, properties associated with the cultural practices or beliefs of a living community that are rooted in that community's history and are important in maintaining the community's cultural identity, as well as natural resources inexorably linked to cultural beliefs and practices.

Pertaining to cultural resource surveys, the USACE cultural resources studies include a Phase I survey and a Phase II evaluation. The purpose of a Phase I survey is to gain an understanding of what is present within the Area of Potential Effect (APE – defined further below) and whether any of the archaeological sites or historic buildings and structures may be potentially significant resources. For cultural resources, significant is defined as a cultural resource that is listed or eligible for listing in the National Register of Historic Places. A Phase I survey includes background research on what is already known and recorded about the historic properties in the project area. Research normally includes:

- examination of the state archaeological site and historic structure files at the State Historic Preservation Office (SHPO), which contain a list of previously recorded archaeological and historic sites;
- general background research on the prehistory, history, and environment of the project area to provide a context within which to evaluate any newly discovered sites or buildings;
- informal interviews with other archaeologists and historians who may have worked near the project area; and
- the Phase I survey may also include interviews with local experts and inhabitants who may know the locations of any undocumented sites that should be evaluated for significance.

If potentially eligible cultural resources are found in the project area, a Phase II evaluation may be conducted. A Phase II evaluation further investigates a specific site or property in detail to determine its eligibility for the National Register of Historic Places (NRHP), which is administered by the National Park Service. A property is eligible for listing based on its age (generally 50 years old or older), integrity (comparison of existing condition to original condition), and significance (associated with events, activities, or developments that were important in the past; associated with people who were important in the past; possesses significant architectural features, designed landscapes, and/or engineering achievements; and/or potential of the property to yield important information through archeological investigation about the past). Eligibility determinations are made by the federal agency conducting the undertaking and the appropriate SHPO. If a property is found to be eligible, effects on the property by the federal, federally licensed, or federally assisted project must then be considered and mitigated if they are adverse and cannot be avoided.

Cultural resource surveys are conducted within a defined Area of Potential Effect (APE). The APE is the area where historic properties may be impacted, directly or indirectly. Impacts in the APE are influenced by the size and type of the project (36 CFR Part 800.16(d)). For this Project, the APE for direct and indirect impacts has been defined in a programmatic agreement. A Programmatic Agreement for the Project was negotiated and signed per 36 CFR Part 800, Protection of Historic Properties, section 14(b), as a method for the St. Paul District, USACE to comply with Section 106 of the National Historic Preservation Act (NHPA), as amended. In the Programmatic Agreement, the APE is defined as consisting of the footprint of the selected diversion plan including the diversion channel alignment, its associated tieback levee(s), associated construction work areas, construction staging areas, borrow areas, and disposal areas, as well as associated upstream water storage and water staging areas, Project-related flood-proofing locations, Project-related environmental mitigation areas, Project-related in-town (Fargo and Moorhead) levees, and the viewshed to one-half mile from the diversion channel's centerline and all other above-ground project features. In addition, cemeteries upstream of the staging area where the Project or NAA would cause additional depth of floodwater above what is already experienced during a 100-year flood event would also be investigated.

Traditional Cultural Properties (TCPs) are cultural resource properties that are eligible for inclusion in the NRHP based on their associations with the cultural practices, traditions, beliefs, lifeways, arts, crafts, or social institutions of a living community. Investigations are most commonly identified through consultations with individuals or groups who may ascribe traditional culture significance to locations within the project area. The study includes background research and may involve varying levels fieldwork. For Indian tribes, knowledge of TCP locations and the important qualities associated with them are considered to be sensitive information and information may be retained and considered confidential during any identification and documentation process.

This section discusses the cultural resources that have been identified in the APE for the project area, additional cultural resource survey needs within the APE, the Project's and the Project alternative's potential impacts on cultural resources, and mitigation that may be required as a result of direct or indirect impacts to these resources.

3.12.1 Affected Environment

Cultural resource surveys were conducted beginning in 2010 and are continuing. During that timeframe, survey areas included portions of the diversion channel and associated structures alignment presented in the FFREIS (FFREIS alignment) and portions of the currently proposed Project alignment presented in the Supplemental EA (Project alignment), as shown on Figure 1.

Those portions within the APE for direct and indirect impacts by the Project or NAA that were not included in previous surveys would need to be surveyed in order to document unidentified NRHP, NRHP-eligible, or NRHP-recommended sites that may be impacted. This additional information is also needed to determine appropriate mitigation for impacts. The USACE has indicated that the necessary additional cultural resource surveys are underway or will be completed prior to construction, which is further discussed in Section 3.12.3. Based on the currently surveyed areas (Figure 21), additional surveys for the Project or the NAA would be needed in the following areas:

1) A portion of the Project alignment between the Maple River crossing and the Sheyenne River crossing;
2) Areas east of the Sheyenne River crossing for the Project alignment, including part of the diversion inlet control structure area, the Wild Rice River and Red River control structures, a portion of the connecting channel between the Red River and the diversion inlet control structure, and the tieback embankment in Minnesota.
3) For the NAA alignment, the Wild Rice and Red River control structures, a portion of the connecting channel between the Red River and the diversion inlet control structure, and the tieback embankment in Minnesota.
4) The majority of the staging area for the Project and the NAA.

Results from completed cultural resource surveys are summarized below within their appropriate sections as feasible. Details from some more recently completed surveys that are still under report development may not have been available for inclusion in the EIS. Where applicable, those surveys have been acknowledged in the text below. Information that is not able to be assessed and discussed within the EIS will be included and evaluated along with the additional surveys as discussed above.

In addition to cultural resource surveys, a TCP Inventory was conducted for the Project in Cass County, North Dakota and Clay County, Minnesota by the Turtle Mountain Band of Chippewa Indians Tribal Historic Preservation Office. Conclusions from this study are included in the discussion below as appropriate.

3.12.1.1 Existing Conditions

Diversion Channel

Phase I cultural resource surveys were conducted of the APE for direct effects for the northern portion of the diversion channel from the Maple River to the outlet and portions of the Project diversion channel overlapping the FFREIS alignment from the Maple River to the Sheyenne River crossing between 2010 and 2014 (Tucker et al. 2012 for 2010-2011 surveys; Meier et al. 2013 for 2012 surveys; McCarthy et al. 2014 for the 2013-2014 surveys). A Phase I cultural resources survey of the FFREIS alignment from the Sheyenne River crossing to the inlet at County Road 17 was conducted in 2010 to 2012 (Tucker et al. 2012; Meier et al. 2013).

A portion of the diversion channel between the Maple River and south to the Sheyenne River remains to be surveyed.

As of November 25, 2014, the following were recorded in the diversion channel alignment:

- 10 prehistoric archeological sites,
- 19 prehistoric isolated find spots,
- 9 historic archeological sites,
- 5 historic isolated find spots,
- 2 combination prehistoric/ historic archeological sites,

- 1 lead to a reported grave site,
- 7 farmsteads,
- 1 bridge, and
- 12 built-environment linear resource sites, including;
    - 5 railroad segments,
    - 1 highway segment, and
    - 6 drains/ditches/channelized river segments

Of these cultural resources listed above, prehistoric occupation site 32CS201 in the outlet reach of the diversion channel alignment and prehistoric cultural material scatter sites 32CS5127 and 32CS5146 near the Maple River crossing were determined eligible to the NRHP as a result of Phase II testing in 2012 and 2013 (Jones et al. 2013; Jones et al. 2014). A farmstead site, 32CS5153, between the Sheyenne River and the diversion inlet at County Road 17, is recommended eligible for the NRHP under Criteria A (association with significant events) and under Criteria C (distinctive architecture) (Tucker et al. 2012).
Prehistoric sites 32CS5138 and 32CS5141 and prehistoric archeological site 32CS5139, all near the Maple River crossing, will require additional testing to determine if there are significant archeological resources associated with the buried topsoil horizons at their locations. Prehistoric archeological site 32CS5135, near Drain No. 14 south of the Maple River also needs additional Phase II testing.

Testing where local lore had a "chief's grave" (site lead 32CSX362), located at the Sheyenne River crossing , was conducted in 2013 under North Dakota Administrative Code 40-02-03-06, Planned Disinterment—Notification, but no evidence of a burial was encountered (Jones and Shillinglaw 2013).

Connecting Channel, Diversion Inlet Control Structure, Wild Rice River Control Structure, Red River Control Structure, CR17 Overflow Embankment, and Tieback Embankment
A Phase I cultural resources survey was conducted of the direct area of potential effects (i.e., Project footprint) for portions of the Project's connecting channel from the diversion inlet structure to I-29 in 2010, 2011, and 2012 as part of the former Storage Area #1 (Tucker et al. 2012; Meier et al. 2013). The overflow embankment along County Road 17 was completely surveyed for cultural resources in 2012 (Meier et al. 2013).

The tieback embankment in Minnesota crosses the reported route of the Red River Trail, a historic oxcart trail along the east side of the Red River. Physical evidence of that trail within the Project alignment still requires field verification. Most of the remainder of the connecting channel alignment in North Dakota was surveyed for cultural resources in October and November 2014. Details from those surveys are not currently available but will be updated and included in the EIS as feasible. This information would include from the diversion inlet structure at County Road 17 eastward to the Red River and the structures at the Wild Rice River and Red River. The Minnesota portion of the Red River control structure and the tieback embankment in Minnesota still need a Phase I survey.

As of June 1, 2014, the following were recorded in these feature locations:
- 2 prehistoric isolated find spots

- 1 historic isolated find spot
- 1 rural residence
- 2 farmsteads
- 1 bridge
- Site leads including:
  - 1 historic oxcart trail.

Northern Alignment Alternative

Approximately 80 percent of the NAA connecting channel from County Road 17 to I-29 was surveyed for cultural resources in 2010, 2011, and 2012, as part of the former Storage Area #1 (Tucker et al. 2012; Meier et al. 2013). The overflow embankment along County Road 17 was surveyed for cultural resources in 2012 (Meier et al. 2013).

The NAA tieback embankment in Minnesota crosses the reported route of the Red River Trail, a historic oxcart trail along the east side of the Red River. Physical evidence of that trail in the alignment requires field verification.

A Phase I cultural resources survey will need to be conducted for most of the connecting channel from just west of I-29 eastward to the Red River, the structures at the Wild Rice River and Red River, and the tieback embankment in Minnesota.

As of June 1, 2014, the following were recorded in the NAA connecting channel, overflow embankment, and tieback embankment areas:

- 2 historic archaeological site
- 2 prehistoric isolated find spots
- 1 historic isolated find spot
- 1 rural residence
- Site leads including:
  - 1 historic oxcart trail.

Staging Area

A Phase I cultural resources survey will need to be conducted for most of the staging area (OHB surveys have been completed, see discussion on OHB ring levee below). Previously surveyed portions of the staging area are limited to the former Storage Area #1, the overflow embankment in North Dakota, and the original tieback embankment alignment in Minnesota (Tucker et al. 2012; Meier et al. 2013).

The following were recorded in the staging area:

- 5 prehistoric archeological sites,
- 3 prehistoric isolated find spots,
- 4 historic archeological sites,
- 6 farmsteads,
- 3 rural residences,

- 1 log cabin,
- 1 bridge,
- 1 public school
- 1 church
- 3 commercial buildings
- 4 built-environment linear resource sites, including
  - 1 railroad segment,
  - 2 highway segments, and
  - 1 drains/ditches/channelized river segments
- Site leads, including
  - 2 prehistoric archeological sites
  - 1 log cabin
  - 1 rural residence
  - 1 school
  - 1 historic oxcart trail
  - 7 cemeteries (Lower Wild Rice and Red River, North Pleasant, Hemnes, Hoff, Clara, Comstock, and Roen Family)

Two sites, CY-CSC-001 (Comstock Public School) and CY-HCR-001 (Bernard Bernhardson Log Cabin), were listed on the NHRP as of May 7, 1980. Known cultural resources sites in the staging area include two farmsteads (32CS5154 and 32CS5168). Buildings at site 32CS5168 are recommended as eligible to the NRHP under Criteria A (association with significant events) (Tucker et al. 2012). Other sites recommended eligible include:

- 1 historic archeological site
- 5 farmsteads
- 1 railroad site
- 1 drain/ditch site.

Sites with undetermined eligibility include:

- 6 prehistoric archeological sites
- 1 rural residence
- 1 church
- 3 commercial buildings
- 8 cemetery site leads

All site leads, other than the cemeteries, have unknown eligibility.

<u>*Northern Alignment Alternative (NAA) Staging Area*</u>

Phase I cultural resource surveys have been completed for a portion of the NAA staging area. Previously surveyed portions of the staging area are limited to the former FFREIS Storage Area #1, the overflow embankment in North Dakota, and the original tieback embankment alignment in Minnesota (Tucker et al. 2012; Meier et al. 2013).

The following were recorded in the NAA staging area:

- 6 prehistoric archeological sites

- 4 prehistoric isolated find spots
- 11 historic archeological sites
- 1 historic isolated find spots
- 19 farmsteads
- 1 granary
- 5 rural residences
- 1 log cabin
- 2 bridges
- 1 public school
- 1 church
- 5 commercial buildings
- 4 built-environment linear resource sites, including
    - 1 railroad segment,
    - 2 highway segments, and
    - 1 drains/ditches/channelized river segments
- Site leads, including
    - 2 prehistoric archeological sites
    - 2 historic archeological sites
    - 1 log cabin
    - 1 historic oxcart trail
    - 1 ghost town (Kurtz)
    - 5 cemeteries (St. Benedicts, Lower Wild Rice and Red River, Hoff, Clara, and Roen Family)

All site leads, other than the cemeteries, have unknown eligibility.

Oxbow-Hickson-Bakke Levee

This project feature is within the staging area. A Phase I cultural resources survey of the entire ring levee footprint and associated project areas was conducted in October and November 2013 (Meier et al. 2014). Cultural resources sites recorded in the OHB ring levee area include:

- 2 historic archeological sites
- 6 historic isolated finds
- 1 prehistoric isolated find
- 12 residences
- 1 garage
- 1 granary site
- 1 barn
- 1 church
- 1 dam
- 1 highway segment
- 1 railroad segment
- 2 railroad station site leads

Of these 30 sites, the Hickson Dam (32CS5096) and the Hickson Lutheran Church (32CS113) are both recommended as eligible to the NRHP. All the other sites are recommended as not eligible to the NRHP.

In addition, no archeological evidence was found at the two site lead locations to former railroad stations at Hickson.

Six farmsteads (two in North Dakota and four in Minnesota), which may contain historic buildings, are located in the one-half mile indirect APE outside the OHB ring levee. These farmsteads will be checked for visual effects to historic buildings at their locations once rights-of-entry for these parcels have been acquired.

In-Town Levees and Floodwalls – 2nd Street, Fargo

A Phase I cultural resources survey was conducted of the direct area of potential effects (i.e., Project footprint) for the proposed floodwall along 2nd Street North and for the proposed levee and floodwall along 2nd Street South in Fargo in 2013 (McCarthy et al. 2014). Three historic archeological sites were observed in the riverbank along 2nd Street North. All are recommended as not eligible to the NRHP. Three historic buildings were recorded; the Fargo Public School Warehouse (32CS5234), the Howard Johnson Hotel (32CS5233), and the 4th Street levee pump station (32CS773). All three are recommended as not eligible to the NRHP.

A survey of the area of indirect (visual) effects in both North Dakota and Minnesota recorded 11 historic properties in North Dakota and 2 historic properties in Minnesota which are recommended as eligible to or are listed on the NRHP, which are within the viewshed for the 2nd Street levee and floodwalls. One of these properties, the NP Avenue/Center Avenue Bridge over the Red River is shared by both states.

Drayton Dam Fish Passage Mitigation Project

A Phase I cultural resources survey of the project area and Phase II evaluation of the eligibility of Drayton Dam to the NRHP was conducted in July 2012 (USACE, 2012a). An additional Phase I cultural resources survey on the Minnesota side of the project area was conducted in November 2012. No prehistoric or historic archeological sites were found in the project area during either survey. Drayton Dam was recommended as not eligible to the NRHP as it is less than 50 years old. The Minnesota SHPO concurred with the non-eligibility of the dam. The North Dakota SHPO has requested that the dam be reevaluated once it reaches 50 years of age, which is in 2014.

Wild Rice Dam Fish Passage Mitigation Project

A Phase I cultural resources survey of the approximately four acre project area and Phase II evaluation of the eligibility of the Wild Rice Dam to the NRHP was conducted in May 2014. Two historic archeological sites, one prehistoric isolated find, and the Wild Rice Dam itself were recorded in the project area (Dolin et al., 2014). All four are recommended as not eligible to the NRHP. The Black Duck Battlefield traditional cultural property (Ferris, 2011) is located within one mile of the dam but would not be affected by construction or dam removal related to this mitigation project.

Cemeteries Within the Project Area

The USACE conducted a separate Cemetery Study (Study) (Appendix G), dated June 2014, for the project area. The Study identified 54 cemeteries within the project area, 28 located within the area enclosed by the Project, seven within the Staging Area, and 15 south of the staging area. The Study noted that although an extensive search was performed, additional cemeteries could be discovered during earth-moving or other construction activities. Following identification of the cemeteries, interviews were conducted with points of contact for the majority of the cemeteries. The interviews focused on current impacts to the cemetery, the level of effort to clean up and/or repair flood impacts, and possible flood impact mitigation. Impacts to cemeteries from current flood conditions include:

- Access issues during flooding
- Erosion in the cemetery affecting gravesites, driveways, parking lots, and/or roadways
- Gravestone displacement
- Inaccessibility to crematorium during flooding.
- Sediment deposition
- Vegetation die-off
- Debris scatter from receding flood waters

Current cleanup efforts include:

- Sediment removal
- Erosion repair
- Road, driveway, parking lot repair
- Repair of gravesites and gravestones
- Replanting of vegetation, where needed.

Phase I cultural resources surveys documenting the Hemnes Cemetery in Richland County and the Lower Wild Rice and Red River Cemetery in Cass County were conducted in October and November 2014 (no details are available yet). Surveys documenting the remaining cemeteries that are in the staging area for the Proposed Project alignment (North Pleasant, South Pleasant/Lium, South Pleasant Church, and Eagle Valley Evangelical in Cass County; Hoff, Clara, Comstock, and Roen Family in Clay County; and Wolverton/Salem Lutheran Church in Wilkin County) are waiting on rights of entry. For the NAA alignment, in addition to the above cemeteries, St. Benedict's Cemetery in Cass County would also need to be documented.

3.12.1.2 Regulatory Framework

Cultural Resources Management within federal and state agencies seeks to identify and consider cultural resources with the goal of balancing development with protection of cultural resources. Section 106 of the NHPA of 1966, as amended (16 U.S.C. 470), is a key component for Cultural Resources Management by federal agencies. A historic property is defined as any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in the NRHP. Section 106 of the NHPA requires federal agencies to take into account the effects of their undertakings on historic properties and afford the Advisory Council on Historic Preservation (Advisory Council) a reasonable opportunity to comment on such undertakings. The Section 106 process is outlined in 36 CFR Part 800 – Protection of Historic Properties, subpart B.

3.12.2 Environmental Consequences

Potential impacts from the Project could occur to NRHP properties and NRHP-eligible properties. The Section 106 process includes the assessment of adverse effects to historic properties (36 CFR, subpart B § 800.5). Adverse effects on historic properties include, but are not limited to: physical destruction of or damage to all or part of a property; alteration of a property; removal of a property from its historical location; change of character of a property's use or physical features; introduction of visual or audible elements that diminish the integrity of a property's significant historic features; neglect of a property which causes its deterioration; and transfer, lease, or sale of property out of federal ownership or control without adequate restrictions or conditions to ensure long-term preservation.

3.12.2.1 Proposed Project

Construction and operation of the Project has the potential to directly and indirectly impact NRHP and NRHP-eligible properties. Direct impacts include damage, destruction or physical alteration of a property, as well as removal of a property. Indirect impacts include those associated with visual and noise impact from the Project. Cultural resources surveys have been completed for portions of the Project and its staging area (Figure 21) as described above. Table 3.50 provides a summary of properties that have been identified within the project area that may be affected by the Project. The table does not include those sites, buildings and structures in the Project APE that have been determined not eligible to the NRHP. Additional areas of the Project footprint and staging area remain to be surveyed, which means additional NRHP-eligible sites could be found. A programmatic agreement is in place to avoid and minimize impacts to these properties and any unknown cultural resources in the project area. The *Programmatic Agreement (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* (Appendix H), was signed in June and July 2011 and was included in the FFREIS. Besides the primary signatory parties, the City of Fargo, the City of Moorhead, the Cass County Board of Commissioners, the Clay County Board of Commissioners, and the Tribal Historic Preservation Officer for the Leech Lake Band of Ojibwe signed the agreement as concurring parties. Fourteen other tribes were contacted and consulted with in preparing the agreement. The Agreement outlines avoidance, minimization, and consultation measures that would be taken during Project construction. This is discussed further in Section 3.12.3 – Mitigation and Monitoring Measures.

Table 3.50 Site Identification Results for Project

Cultural Resource Numbers	Site Type	National Register of Historic Places Eligibility
	Diversion Channel	
32CS201	Prehistoric archeological site	Eligible
32CS5127	Prehistoric archeological site	Eligible
32CS5146	Prehistoric archeological site	Eligible
32CS5135	Prehistoric archeological site	Undetermined eligibility
32CS5138	Prehistoric archeological site	Undetermined eligibility

Cultural Resource Numbers	Site Type	National Register of Historic Places Eligibility
32CS5141	Prehistoric archeological site	Undetermined eligibility
32CS5139	Combination prehistoric and historic archeological sites	Prehistoric -- undetermined eligibility; Historic -- not eligible
32CS5153	Farmstead	Recommended eligible
32CS5216	Infrastructure: Bridge	Recommended not eligible
32CS2657, feature 4	Infrastructure: Highway segment	Recommended not eligible
32CSX342	Prehistoric isolated find	Recommended not eligible
32CSX343	Prehistoric isolated find	Recommended not eligible
32CSX344	Prehistoric isolated find	Recommended not eligible
32CSX345	Prehistoric isolated find	Recommended not eligible
32CSX347	Prehistoric isolated find	Recommended not eligible
32CSX348	Prehistoric isolated find	Recommended not eligible
32CSX369	Prehistoric isolated find	Recommended not eligible
32CSX370	Prehistoric isolated find	Recommended not eligible
32CSX373	Prehistoric isolated find	Recommended not eligible
32CSX380	Prehistoric isolated find	Recommended not eligible
32CSX382	Prehistoric isolated find	Recommended not eligible
32CSX383	Prehistoric isolated find	Recommended not eligible
32CSX385	Prehistoric isolated find	Recommended not eligible
32CSX386	Prehistoric isolated find	Recommended not eligible
32CS47, feature 2	Infrastructure: Railroad segment	Recommended not eligible
32CS47, feature 4	Infrastructure: Railroad segment	Recommended not eligible
32CS47, feature 5	Infrastructure: Railroad segment	Recommended not eligible
32CS47, feature 7	Infrastructure: Railroad segment	Recommended not eligible
32CS47, feature 8	Infrastructure: Railroad segment	Recommended not eligible
Connecting Channel, CR17 Overflow Embankment, and Tieback Embankment		
*32CS5154**	*Farmstead*	*Recommended not eligible*

Cultural Resource Numbers	Site Type	National Register of Historic Places Eligibility
*32CS5168**	*Farmstead*	*Recommended eligible*
*32CS4678**	*Bridge over Wild Rice River*	*Recommended eligible*
32CS5163	*Rural residence*	*Recommended not eligible*
32CSX376	*Prehistoric isolated find spot*	*Recommended not eligible*
32CSX377	*Prehistoric isolated find spot*	*Recommended not eligible*
21Cyr	*Historic oxcart trail – site lead*	*Unknown*
	Staging Area	
CY-CSC-001	Comstock Public School	Listed 5/7/1980
CY-HCR-001	Log Cabin: Bernhardson	Listed 5/7/1980
32CS5098	Historic archeological site	Recommended eligible
32CS5109	Farmstead	Recommended eligible
32CS5169	Farmstead	Recommended eligible
CY-HCR-003	Drains, ditches	Recommended eligible
CY-MHC-108	Farmstead	Recommended not eligible
CY-MHC-109	Farmstead	Recommended not eligible
CY-MHC-110	Farmstead	Recommended not eligible
CY-MHC-111	Farmstead	Recommended eligible
21CY43	Prehistoric archeological site	Undetermined eligibility
21CY44	Prehistoric archeological site	Undetermined eligibility
21CY45	Prehistoric archeological site	Undetermined eligibility
21CY46	Prehistoric archeological site	Undetermined eligibility
21CY47	Prehistoric archeological site	Undetermined eligibility
32CS32	Prehistoric archeological site	Undetermined eligibility
Cemetery	Site lead: Lower Wild Rice and Red River Cemetery	Undetermined eligibility
Cemetery**	Site lead: North Pleasant Cemetery	Undetermined eligibility
CY-CSC-002	Building	Undetermined eligibility
CY-CSC-003	Building	Undetermined eligibility
CY-CSC-004	Building	Undetermined eligibility
CY-HCR-002	Residence	Undetermined eligibility
Cemetery**	Site lead: Hemnes Cemetery	Undetermined eligibility
Cemetery	Site lead: Hoff Cemetery	Undetermined eligibility
Cemetery	Site lead: Clara Cemetery	Undetermined eligibility

Cultural Resource Numbers	Site Type	National Register of Historic Places Eligibility
Cemetery**	Site lead: Comstock Cemetery	Undetermined eligibility
Cemetery	Site lead: Roen Family Cemetery	Undetermined eligibility
2011 NWRR	Site Lead: Prehistoric archeological site	Unknown
2011 RRE	Site Lead: Prehistoric archeological site	Unknown
21Cyr	Site lead: Historic trail	Unknown
32CSX248**	Site Lead: Residence	Unknown
32CSX5**	Site Lead: School	Unknown
Unknown	Site Lead: Cabin	Unknown
32CS2657, feature 3	Infrastructure: Highway segment	Recommended not eligible
32CS5079	Historic archeological site	Recommended not eligible
32CS5099	Historic archeological site	Recommended not eligible
32CS5103	Historic archeological site	Recommended not eligible
32CS5110	Infrastructure: Bridge	Recommended not eligible
32CS5111	Historic archeological site	Recommended not eligible
32CS5112	Residence	Recommended not eligible
32CS5155	Farmstead	Recommended not eligible
32CS5163	Residence	Recommended not eligible
32CS5167	Residence	Recommended not eligible
32CSX366	Prehistoric isolated find	Recommended not eligible
32CSX367	Prehistoric isolated find	Recommended not eligible
32CSX368	Prehistoric isolated find	Recommended not eligible
XX-HWY-001, segment 3	Infrastructure: Highway segment	Recommended not eligible
XX-RRD-004, segment 2	Infrastructure: Railroad segment	Recommended eligible
Oxbow-Hickson-Bakke Levee		
32CS113	Hickson Lutheran Church	Recommended eligible under Criteria A and C
32CS5096	Infrastructure: Hickson Dam	Recommended eligible under Criterion A
32CS2655	Infrastructure: Railroad segment	Recommended not eligible
32CS2657	Infrastructure: Highway segment	Recommended not eligible

Cultural Resource Numbers	Site Type	National Register of Historic Places Eligibility
32CS5197	Residence	Recommended not eligible
32CS5198	Residence	Recommended not eligible
32CS5199	Residence	Recommended not eligible
32CS5200	Residence	Recommended not eligible
32CS5201	Residence	Recommended not eligible
32CS5202	Residence	Recommended not eligible
32CS5203	Residence	Recommended not eligible
32CS5204	Residence	Recommended not eligible
32CS5205	Garage	Recommended not eligible
32CS5206	Residence	Recommended not eligible
32CS5207	Residence	Recommended not eligible
32CS5208 32CS5209	Granaries Residence	Recommended not eligible Recommended not eligible
32CS5210	Residence	Recommended not eligible
32CS5211	Barn	Recommended not eligible
32CS5215	Historic archeological site	Recommended not eligible
32CS5217	Historic archeological site	Recommended not eligible
32CSX391	Historic isolated find	Recommended not eligible
32CSX392	Historic isolated find	Recommended not eligible
32CSX393	Historic isolated find	Recommended not eligible
32CSX394	Historic isolated find	Recommended not eligible
32CSX395	Historic isolated find	Recommended not eligible
32CSX396	Historic isolated find	Recommended not eligible
32CSX397	Prehistoric isolated find	Recommended not eligible
In-town Levees and Floodwalls – 2nd Street, Fargo (Area of direct effects only)		
32CS5212	Historic archeological site	Recommended not eligible
32CS5213	Historic archeological site	Recommended not eligible
32CS5214	Historic archeological site	Recommended not eligible
32CS773	4th Street Pump Station	Recommended not eligible
32CS5233	Building	Recommended not eligible
32CS5234	Building	Recommended not eligible
In-town Levees and Floodwalls – 2nd Street, Fargo (Area of indirect effects—ND and MN)		
32CS1849	Case Plaza Building	Recommended eligible – major visual effects

Cultural Resource Numbers	Site Type	National Register of Historic Places Eligibility
32CS179	Pontoppidan Lutheran Church	Recommended eligible – moderate visual effects
32CS209	Donaldson Hotel	Recommended eligible – minor/no visual effects
32CS4474 (ND) CY-MHC-61 (MN)	NP Ave/Center Ave Bridge	Recommended eligible – minor/no visual effects

Source: USACE
* Along proposed Project connecting channel, but in NAA staging area.
** In proposed Project staging area but not in (south of) NAA staging area.

Diversion Channel, Connecting Channel and Tieback Embankment

Impacted sites were determined based on their proximity to the construction footprint and work limits. The work limits include primary areas where construction activity from trucks and temporary equipment or materials staging would occur. Table 3.50 provides a list of sites located, based on Phase I cultural resource surveys, within the construction footprint and work limits. These sites would be impacted by the Project. This includes the diversion channel and embankment areas. The overflow embankment along County Road 17 in North Dakota was surveyed. However, the Minnesota tieback embankment has not been surveyed and most of the connecting channel alignment from the diversion inlet east to the Red River has been surveyed but results are not yet available. All construction footprint and work limit areas will have a Phase I cultural resources survey completed prior to Project construction, which may result in additional identification of historic or archaeological sites. Subsequent Phase II investigations will follow as needed.

Of the areas currently surveyed, the diversion channel would directly impact three NRHP-listed properties and one NRHP-eligible site, which means the sites would be removed by the Project. Sites that are NRHP-listed or recommended eligible have concurrence between the USACE and SHPO, and require avoidance, minimization, and mitigation for impacts. Mitigation, as further described in Section 3.12.3, is required for both archaeological and historic sites prior to construction. Archaeological sites would require Phase III mitigation, which means data recovery in the form of archaeological excavation of a portion of the site. Mitigation for architectural properties (buildings, structures) would include thorough documentation using text, photographs, and scaled drawings as needed.

There are four undetermined NRHP-eligible sites within the construction footprint and work limits of the Project. Sites listed as undetermined eligibility would require a Phase II investigation to further evaluate the NRHP eligibility of the site. This evaluation would be completed prior to Project construction. If a site is determined NRHP-eligible, mitigation would be required for impacts. Sites recommended as not eligible for the NRHP listing would not require mitigation under Section 106 of the NHPA.

Staging Area

Only a small portion of the staging area has had a Phase I cultural resources survey completed. Previously surveyed areas include the former Storage Area #1, the previous location of the Minnesota tieback embankment, and the OHB ring levee. Of the areas surveyed in the staging area, there are two NRHP-listed sites, eight recommended NRHP eligible, and eight with undetermined NRHP eligibility. As discussed for the diversion channel, NRHP-listed or eligible sites would require avoidance, minimization or mitigation for impacts. Impacts would be determined at a particular site, building or structure by comparing existing conditions to conditions during Project construction and operation. Sites recommended as not eligible for the NRHP listing would not require mitigation under Section 106 of the NHPA. Mitigation, as further described in Section 3.12.3, is required for both archaeological and historic sites prior to construction.

The staging area would be surveyed prior to Project construction completion. The USACE, North Dakota SHPO, and Minnesota SHPO have agreed on an approach to completing Phase I cultural resources surveys in the staging area as follows:

- All buildings and cemeteries within the staging area would have a Phase I cultural resources survey completed. This would identify NRHP-listed and NRHP-eligible sites that may be impacted by the Project.
- Phase I surveys for archaeological sites would be based on a ranking system of low, moderate, and high potential for landscape features to contain such sites. Phase I surveys would be completed for high and moderate site potential areas. This approach is based on the MN/Model Statewide Archaeological Predictive Model used by the Minnesota Department of Transportation. High site potential areas are likely to be used as habitation sites near rivers, water sources, and other areas desirable by past cultures for home sites. Moderate site potential areas may include areas used for hunting and gathering or temporary home sites. Low site potential areas are located in the upland areas away from water sources and have likely been disturbed by existing land use practices, such as cultivation.

Oxbow-Hickson-Bakke Ring Levee

Sites 32CS5096 (Hickson Dam) and 32CS113 (Hickson Lutheran Church) would not be directly affected by the OHB ring levee and related construction. There should be no direct adverse effects to NRHP-eligible historic properties as a result of the proposed OHB ring levee construction. Additionally, six farmsteads (two in North Dakota and four in Minnesota) within one-half mile of the exterior of the ring levee will be checked for indirect (visual) effects to any historic buildings at their locations resulting from construction of the ring levee once rights-of-entry to these parcels have been acquired.

In-Town Levees and Floodwalls – 2nd Street, Fargo and El Zagal Golf Course, Fargo

No NRHP-eligible or listed historic properties will be directly affected by levee, floodwall, and pump station construction at 2nd Street and at the El Zagal golf course in Fargo. Indirect effects from the 2nd Street levee and floodwalls to historic properties includes major visual effects to the Case Plaza Building, moderate visual effects to the Pontoppidan Lutheran Church, minor to no visual effects to the Donaldson Hotel and the NP Avenue/Center Avenue Bridge over the Red River, and no visual effects to the eight other historic properties in the 2nd Street levee and floodwall viewshed.

Cemeteries

With the Project in place, 28 of the 54 cemeteries identified are located within the protected area. In the staging area, seven cemeteries would be impacted with inundation depths estimated to rise between 0.3 to 8.3 feet and inundation time increasing by 2 to 7.5 days for the 100-year flood event. There are 15 cemeteries outside of the staging area boundary identified in the Cemetery Study. Of those 15, four would experience estimated inundation depths of between 0.1 to 0.5 feet (1.2 to 6 inches) and an additional flooding time between 0 and 3 days for the 100-year flood event. Cemeteries upstream of the Project staging area include Wolverton/Salem Lutheran Cemetery in Wilkin County, Minnesota and South Pleasant/Lium Cemetery, South Pleasant Church Cemetery, and Eagle Valley Evangelical Cemetery in Richland County, North Dakota.

3.12.2.2 Base No Action Alternatives

Cultural resources surveys have been completed for portions of the project area. These surveys identified NRHP properties and NRHP-eligible properties. Additional surveys would be needed to fully evaluate the current affected environment. Under the Base No Action Alternative, cultural resources within the floodplain would continue to be affected during flood events. For example, 43 of the 54 known cemeteries in the project area are currently affected during a 100-year flood. Regulations governing cultural resources under the NHPA (16 U.S.C. 470), including Section 106, would apply under the Base No Action Alternative.

3.12.2.3 No Action Alternatives (with Emergency Measures)

Conditions for the No Action Alternative (with Emergency Measures) would be similar to the conditions described for the Base No Action Alternative.

3.12.2.4 Northern Alignment Alternative

Cultural resources surveys have been completed for portions of the NAA and its staging area (Figure 1). Previously surveyed areas include the former Storage Area #1, the overflow embankment in North Dakota, the previous location of the Minnesota tieback embankment, and the OHB ring levee. The surveys have identified cultural resource sites within the NAA project area that may potentially be impacted both directly and indirectly by the NAA. Direct impacts to cultural resources from construction of the diversion channel for the NAA are anticipated to be the same as those described for the Project. The location of the NAA control structures, tieback embankment, and staging area would be located 1.5 miles downstream when compared to the Project, and therefore, the identified NRHP eligible or recommended eligible sites would be different from the Project for these features. This could change the potential impact on these sites as some that were identified as located in the protected area under the Project, would be potentially impacted under the NAA.

It is important to note that as discussed above in Sections 3.12.1.1 and 3.12.2.1, there are several areas within the NAA APE that have not had cultural resource surveys completed. The following discussion on potentially impacted sites should not be considered complete but rather includes the known cultural resource sites identified to date. Future surveys would need to be conducted to fully consider NAA impacts to NRHP listed or eligible historic properties and determine avoidance, minimization or mitigation actions necessary. The NAA would be surveyed prior to the start of NAA construction as previously described for the Project. The USACE would follow the stipulations in the Project's Programmatic Agreement for completing a Phase I cultural resources survey for the NAA and would survey the NAA staging area using the same approach as described in Section 3.12.2.1 Staging Area paragraphs above.

As mentioned above, the NAA includes potential impacts to cultural resource sites identified for the Project as listed in Table 3.50. In addition to potentially impacting the sites identified in Table 3.50 for the Project, the NAA would also potentially impact cultural resource sites identified in Table 3.51. The NAA would potentially impact three NRHP-eligible sites, one NRHP-recommended eligible site, and one sites listed as NRHP-undetermined eligibility. Table 3.51 provides a summary of properties that have been identified within the surveyed area for the NAA.

Table 3.51 Additional Site Identification Results for the NAA

Cultural Resource Numbers	Site Type	National Register of Historic Places Eligibility
Connecting Channel		
32CS5074	Farmstead	Recommended not eligible
32CS5182	Historic archeological site	Recommended not eligible
Staging Area		
Cemetery (32CS114)	St. Benedicts Church	Undetermined eligibility
32CS5137	Historic archeological site	Recommended eligible
32CS5099	Historic archeological site	Recommended not eligible
32CS5128	Historic archeological site	Recommended not eligible
32CS5158	House/Farm	Eligible
32CS5169	House/Farm	Eligible
32CS5181	Historic archeological site	Recommended not eligible
32CS5182	Historic archeological site	Recommended not eligible
32CS5185	Historic archeological site	Recommended not eligible
32CSX337	Prehistoric isolated find	Recommended not eligible
32CSX366	Prehistoric isolated find	Recommended not eligible
32CSX367	Prehistoric isolated find	Recommended not eligible
32CSX368	Prehistoric isolated find	Recommended not eligible
CY-KUR-010	Flood Control Canal: County Ditch No. 11	Eligible

Source: USACE

Cemeteries

With the NAA in place, 27 of the 54 cemeteries identified are located within the protected area. Five cemeteries are located within the NAA staging area boundary, St. Benedicts Cemetery, Lower Wild Rice and Red River Cemetery, Hoff Cemetery, Clara Cemetery, and Roen Family Cemetery. There are 18 cemeteries outside of the staging area boundary identified in the Cemetery Study. Cemeteries upstream of the NAA staging area boundary that are anticipated to experience flooding greater than what is currently experienced would also be reviewed for potential impacts and include the North Pleasant Cemetery, Hemnes Cemetery, and Comstock Cemetery.

As previously described for the Project, NRHP-listed or eligible sites would require avoidance, minimization or mitigation for NAA impacts. Impacts would be determined at a particular site, building or structure by comparing existing conditions to conditions during construction and operation. Sites recommended as not eligible for the NRHP listing would not require mitigation under Section 106 of the NHPA. Mitigation, as further described in Section 3.12.3, is required for both archaeological and historic sites prior to construction.

3.12.3 Mitigation and Monitoring Measures

Compliance with Section 106 of the NHPA requires federal agencies to avoid and minimize impacts to NRHP properties and NRHP-eligible properties. This is accomplished by first surveying and identifying potential properties, which has already been completed for part of the Project, including some additional investigations at specific properties for further evaluation. Not all portions of the Project have been surveyed, and therefore, additional Phase I cultural resource surveys and potential subsequent Phase II investigations would be needed prior to Project construction. Additional measures beyond Phase I and Phase II investigations may be identified. This would include Phase III mitigation to gather enough data from important sites or portions of the sites to mitigate for adverse effects from Project activities. Phase III mitigation would locate, define, and recover and record detailed data from areas impacted, including artifact concentrations and other important historical and cultural features. Phase III mitigation could include excavation and preservation of artifacts of an archaeological site or the creation of written site histories, photographs, and scaled drawings of architectural buildings and structures. A Programmatic Agreement for the Project was negotiated and signed per 36 CFR Part 800, Protection of Historic Properties, section 14(b), as a method for the St. Paul District, USACE to comply with Section 106 of the NHPA, as amended.

The Programmatic Agreement defines the Project APE and contains stipulations for cultural resources avoidance, minimization, and mitigation measures. The Agreement covers the construction footprint, work limits, in-town levees, staging area, and environmental mitigation sites that are part of the Project, including the Drayton Dam and Wild Rice River Dam. The stipulations are listed below by responsible party:

USACE Cultural Resources Responsibilities:

- Ensure that archeologists, historians, and architectural historians, meeting the professional qualification standards given in the Secretary of the Interior's *Standards and Guidelines for Archeology and Historic Preservation*, conduct or supervise all Project-related cultural resources activities.

- Avoid or minimize Project-related adverse effects to historic properties to the extent practicable. If impacts are unavoidable, the USACE will coordinate and implement a Memorandum of Agreement with appropriate parties (Phase III Mitigation).
- Consult and coordinate with appropriate tribes to identify sites of traditional religious or cultural importance sites within the Project area. Avoidance of impacts will be taken to the extent practicable and any remaining effects will be mitigated per a Memorandum of Agreement between the appropriate parties.
- Determine specific locations to be monitored by a qualified professional archeologist during Project construction.
- Cease all work in the vicinity, in the event of the discovery of an unidentified site or property that may be eligible for inclusion in the NRHP, until the site or property can be evaluated. Project activities not in the area of the discovery would be allowed to continue.
- Ensure that all draft and final reports resulting from actions related to the Agreement be provided to the appropriate parties.
- Consult with the appropriate parties if a dispute arises. If the USACE is unable to resolve the dispute with the parties, the Corps will provide the Advisory Council with the appropriate documents.

USACE, its contractors, or the City of Fargo, North Dakota, and the City of Moorhead, Minnesota, (Cities') contractors Cultural Resources Responsibilities:

- Conduct a Phase I survey of all previously uninventoried project areas.
- Evaluate the NRHP eligibility of all cultural resources sites or structures over 50 years old located within the APE for Phase II Testing and Evaluation.
- Comply with Native American Graves Protection and Repatriation Act for federal or tribal lands, and with the appropriate state's burial laws for all other lands if any human burials are encountered during cultural resources field work or Project construction.
- Ensure that all materials and records resulting from cultural resource tasks related to the Project, be curated in accordance with 36 CFR Part 79, "Curation of Federally-Owned and Administered Archeological Collections" at an appropriate facility, or return the artifacts to the respective landowner after artifact analysis is completed.

Amendment No. 1 to the Agreement was finalized in 2013 and was included with the Supplemental EA dated September 2013. The Amendment, which was signed by the primary and concurring parties to the Agreement, added project-related environmental mitigation areas and project-related in-town levees to the APE and increased the indirect (visual) APE effects to a uniform one-half mile from all above-ground Project features. Visual effects to historic properties within the one-half mile viewshed are avoided or minimized by generally limiting the above ground height of the project feature to 20 feet or less, which would have little to no visual impact at more than one-eighth mile from the feature. Use of neighborhood-compatible formliner patterns on the in-town floodwalls is used to minimize visual impacts to historic buildings and structures.

Cemeteries

Potential mitigation measures were identified in the Cemetery Study, including:

- Construction of earthen berms around entire cemeteries, along rivers, or in other strategic areas

- Armor areas of high potential erosion
- Anchor gravestones and/or coffins/vaults
- Use columbaria from which cinerary urns containing cremated remains could be removed prior to flooding
- Adaptive management
- Flowage easements
- Cemetery relocation

Mitigation measures for cemeteries have not been finalized. However, all cemeteries within the Project and NAA staging areas would be reviewed to determine potential impacts and mitigation. Additionally, cemeteries located upstream of the staging area boundaries that would experience additional flooding above flood depths that are currently experienced would also be reviewed to determine potential impacts and mitigation. Information provided in the study will be used as a tool to determine specific mitigation measures for impacted cemeteries once Project design is finalized.

3.13 INFRASTRUCTURE AND PUBLIC SERVICES

Infrastructure and public services are the systems in place necessary for economic activity and development. Public infrastructure includes roads, power and water supplies, and other structures that provide utility, such as pipelines, bridges, and buildings. Public services include the U.S. Postal Service (USPS), emergency response, and public school districts.

This section describes the existing infrastructure and public services within the project area and the potential impacts to infrastructure and public services from construction and operation of the Project. The Base No Action and No Action Alternative (with Emergency Measures) are also discussed.

The FFREIS and Supplemental EA identified existing infrastructure and public services in the project area as well as evaluated potential infrastructure and public services impacts from the Project. Additional information was not available; however, details beyond those provided in these environmental review documents are included in this EIS.
Two transportation studies were developed after publication of the FFREIS and Supplemental EA that evaluated potential impacts to roads and bridges for automobile traffic. These studies include:

- *North Diversion Master Transportation Plan – Fargo-Moorhead Metropolitan Area,* prepared by Kadrmas, Lee & Jackson and dated March 2012 (North Transportation Plan).

- *South Diversion Master Transportation Plan – Final Report*, prepared by Kadrmas, Lee & Jackson and dated October 2013 (South Transportation Plan).

The purpose of the North Transportation Plan was “to analyze the disruptions to roadway system continuity for the north section of the Red River diversion alignment (Maple River to the outfall), analyze the resulting impacts these disruptions have on roadway users and formulate recommendations intended to mitigate these impacts.” The North Transportation Plan included all roadways within four miles of the proposed diversion channel alignment between the Maple River and the outfall into the Red

River. The North Transportation Plan also briefly addresses public services in the study area, such as emergency response, postal services, and educational facilities.

The South Transportation Plan was "to analyze disruptions to roadway system connectivity, accessibility and mobility for the diversion channel and associated embankments, to analyze resulting impacts these disruptions have on roadway users and formulate recommendations intended to mitigate the impacts." The South Transportation Plan included all roadways within four miles of the proposed 23-mile section of diversion channel alignment, 4-mile overflow embankment and the 6-mile tieback embankment between the diversion channel origin south of the F-M urban area, north to the Maple River. The South Transportation Plan also briefly discusses railway infrastructure affected by the Project, which is further discussed in Section 3.13.3 – Proposed Mitigation and Monitoring Measures.

Two utility plans were reviewed that were developed to be used by the USACE as utility relocation plans:

- *Fargo-Moorhead Metro Diversion Project: Utility Relocation Plans Reaches 1 through 3*, prepared by Houston-Moore Group and dated August 8, 2012 (Relocation Plans 1 through 3).

- *Fargo-Moorhead Metro Diversion Project: Utility Relocation Plans Reaches 4 through 7*, prepared by Houston-Moore Group and dated August 27, 2012 (Relocation Plans 4 through 7).

The purpose of the Utility Relocation Plans 1 through 3 was to provide the USACE with preliminary utility relocation plans for the Project from the Red River outlet to the west side of I-29 or channel station 325+00. This section of the Project impacted 19 existing utility crossings.

Utility Relocation Plans 4 through 7 includes preliminary utility relocation plans for the Project from the west side of I-29 or channel station 325+00 to the Maple River or channel station 725+00. This section of the Project impacted 16 existing utility crossings.

3.13.1 Affected Environment

3.13.1.1 Roads and Bridges

The project area has an established transportation system serving both rural and urban needs, and includes interstate highways, state highways, county roads, township roads and railways. Figure 22 provides an overview of the transportation system, Figures 4 and 5 provide greater details. The Transportation Plans identified a number of roads and bridges in the project area that would be affected by the Project and Project Alternatives. Specific impacts for the Project and Project Alternatives are discussed under Section 3.13.2-Environmental Consequences.

3.13.1.2 Railroads

There are two rail lines in the project area that are within the affected environment. The Burlington Northern Santa Fe (BNSF) with its Dakota division headquartered in Fargo, and the Red River Valley & Western Railroad, a short-line regional railroad serving industrial parks and properties in rural communities throughout Cass County, North Dakota. The Red River Valley & Western interchanges with the BNSF Railroad in Casselton, North Dakota and with the Canadian Pacific Railroad just west of Cass County.

3.13.1.3 Utilities

There is an established network of utilities in the project area. These include electric, natural gas, water, sewer, storm water, telephone, and internet. The utility system is operated and maintained by both public and private entities.

3.13.1.4 Public Services

Public services are provided by the local units of government, such as the counties, cities, and townships. These services include emergency response services, such as law enforcement, fire, and medical. Some of the local governments in the project area have city police departments, while others rely on the county sheriff's departments. These law enforcement agencies patrol both the rural and urban areas of the project area in Minnesota and North Dakota. Fire departments are located within the F-M urban area, while rural areas and smaller communities in the project area are typically served by volunteer departments. Both law enforcement agencies and fire departments respond to emergency calls that are coordinated through a 911 dispatch service. First responders and emergency medical technicians (EMTs) are dispatched to emergency calls as needed in the project area. Existing roadways are used to respond to calls and transport patients to local medical services. Air support is dispatched to an accident as needed for critical situations.

Several school districts and post-secondary educational facilities are located within the project area. In North Dakota, the Central Cass, Kindred, Mapleton, Northern Cass, Richland, and West Fargo School Districts are located in the project area. In Minnesota, the Barnesville, Breckenridge, and Moorhead School Districts are located in the project area. Each school district has bus routes that use the public road network which are travelled daily during the school year to transport students to and from school and school activities.

The project area crosses through several USPS zip codes with delivery service. In North Dakota, the following zip codes are located within the project area: 58005, 58015, 58021, 58042, 58047, 58051, 58059, 58075, 58077, and in Minnesota, 56525, 56560, 56580, and 56594. Each zip code has their own rural mail delivery routes and uses the public road network to deliver mail to both urban and rural homes.

3.13.2 Environmental Consequences

3.13.2.1 Proposed Project

The construction and operation of the Project would have impacts on existing infrastructure and require modification and/or relocation of existing roads, bridges, railroads, and utilities. Impacts to infrastructure include severed roadways by the diversion channel, roadway alterations, reconstruction, and rerouting, and raised roadways to higher elevations to provide access during flooding, as well as potential detours and rerouting of existing service routes. Public services would also be affected by the construction and operation of the Project, such as detours and rerouting of existing service routes.

3.13.2.1.1 Roads and Bridges

The Project would result in the modification of traffic patterns for local residences and farmsteads that are close to the alignment, and would affect connectivity and accessibility to various locations and properties in the project area. Figures from the Transportation Plans and publicly available maps were used to provide the following list of roads that would be affected by the Project.

The Project also requires numerous infrastructure components. These include, for example, inlets, culverts, spillways, and hydraulic structures. A detailed Project description is provided in EIS Section 2.1 that describes the Project components and functionality.

Diversion Channel

Project construction and operation would cause numerous roadways to be severed or rerouted to other existing roadways due to termination at the diversion channel and associated embankments. The Transportation Plans indicate the Project would primarily impact township roads, county roads, state highways and interstates and their respective bridges. The proposed diversion channel and embankment locations would impact roads listed below (see Figures 23 and 24).

Cass County, North Dakota

- I-29/U.S. Highway 81
- I-94/State Highway 52
- County Road 4/25th Street Southeast
- County Road 6/76th Avenue South/44th Street Southeast
- County Road 8/40th Avenue West/41st Street Southeast
- County Road 10/12th Avenue Northwest/36th Street Northeast
- County Road 14/100th Avenue South/46th Street Southeast
- County Road 16/124th Avenue South/48th Street Southeast/
- County Road 17/170th Avenue Southeast
- County Road 18/52nd Street SE
- County Road 20/40th Avenue North/33rd Street Southeast
- County Road 21/173rd Avenue Southeast/38th Street South
- County Road 22/64th Avenue North/31st Street Southeast
- County Road 31/173rd Avenue Southeast
- County Road 32/28th Street Southeast
- County Road 81
- County Road 81/175th Avenue Southeast
- 13th Avenue West/38th Street Southeast
- 19th Avenue North/35th Street Southeast
- 21st Avenue West /39th Street, Southeast
- 32nd Avenue North/34th Street Southeast
- 32nd Avenue West/40th Street Southeast
- 52nd Avenue North/32nd Street Southeast
- 52nd Avenue West /42nd Street Southeast
- 64th Avenue South/43rd Street Southeast
- 76th Avenue North/30th Street Southeast

- 112th Avenue South/47th Street Southeast
- 167th Avenue Southeast/38th Street West
- 168th Avenue Southeast
- 169th Avenue Southeast
- 170th Avenue Southeast
- 171st Avenue Southeast
- 171st Avenue Southeast/57th Street South
- 172nd Avenue Southeast
- 172nd Avenue Southeast/45th Street South
- 174th Avenue Southeast
- Wall Avenue/45th Street Southeast
- 15th Street West
- 24th Street Southeast
- 27th Street Southeast
- 29th Street Southeast
- 37th Street Southeast
- 38th Street Southeast
- 38thStreet Northwest/105th Street North

North Dakota Overflow Embankment

The Project includes construction of an overflow embankment in North Dakota. Four roads would be impacted by the construction of the overflow embankment. Two of the four roads, 50th St SE and 51st St SE, would have crossings constructed. Utilities located in the overflow embankment area would be evaluated during the Project design phase. Known utilities in the overflow embankment area include, but are not limited to, electric power lines and rural water supply facilities.

Minnesota Tieback Embankment

The Project includes construction of a tieback embankment in Minnesota. Construction of the tieback embankment would impact five roads. Two roads, 28th Street South and Clay County Road 59, would end at the tieback embankment. U.S. Highway 75, Clay County State Aid Highway 7 and Clay County Road 61 would have crossings constructed. U.S. Highway 75 would also require a grade raise. Utilities located in the tieback embankment area would be evaluated during the Project design phase. Known utilities in the tieback embankment area include, but are not limited to, electric power lines and rural water supply facilities.

In-Town Levees and Floodwalls

The Project includes construction of in-town levees. Construction of the 2nd Street floodwall would require realignment of 2nd Street North and include removable floodwalls across 1st Avenue and 2nd Street South. Construction of the El Zagal levee would require the permanent closure of one block of 14th Avenue North between Oak and Elm Street North along with a removable floodwall across Elm Street North at 14th Avenue North. Energy, water, and communication utilities would be relocated to accommodate these floodwalls and levees.

Staging and Inundation Areas

Traffic patterns, primarily within the staging area, would permanently change due to construction and alignment of the diversion channel and tieback embankment. This would alter the travel from locations where upstream inundation is greatest to Fargo and Moorhead. As a result, some of the severed roadways would be rerouted onto roadways with connectors across the diversion channel. These connecting roadways would then be used as a throughway for those commuting to and from the F-M urban area on I-29 or to and from locations to the east or west.

Project operation would temporarily store water, causing increased inundation, leading to changes in traffic patterns. Water in upstream inundation areas would prevent commuting along East –West routes due to inundation elevations overtopping some roadways. Interstate 29 and U.S. Highway 75 would be elevated to maintain traffic routes during high flows. The BNSF railroad at this location would also be raised to a higher elevation through the inundation area. Standard safety rules, laws and regulations would be applied to raised highways. All other roadways within the inundation areas would be allowed to flood when Project operations require staging of flood water. Local roads would remain the responsibility of local communities and additional bridges could be constructed at non-federal expense. Utilities located in the inundation area would be evaluated during the Project design phase. Known utilities in the inundation area include, but are not limited to, electric power lines and rural water supply facilities.

Oxbow/Hickson/Bakke Ring Levee

The OHB ring levee, shown on Figure 4, was evaluated for potential impacts in *Technical Memorandum Oxbow, Hickson, Bakke Ring Levee*, prepared by Houston-Moore Group, and dated March 12, 2013 (OHB Ring Levee Memorandum). OHB ring levee construction would impact transportation connections to the OHB area within the levee. These include impacts to Cass County Highway 81, Cass County Road 18, and Cass County Highway 25. The OHB ring levee Memorandum recommends several road improvements to avoid and minimize significant impacts, which are discussed in Section 3.13.3 – Mitigation and Monitoring Measures.

Comstock Ring Levee

The Project includes construction of a levee surrounding the city of Comstock, similar in concept to the OHB ring levee, as shown on Figure 5. The levee would be built to FEMA certification requirements. To meet the FEMA requirements the levee must maintain a freeboard of three to three and a half feet above the 100-year floodplain elevation. This would require Clay County Highway 2 is to be raised to a higher elevation at the edge of the driving lane to equal the height of the levee at that location. The road raise would require the speed limit west of the levee on Clay County Highway 2 to be reduced to 40 miles per hour. Where the levee crosses Clay County Highway 2 east of Comstock, an earthen levee would be constructed to protect against waters above the 100-year flood elevation. The BNSF railroad closure on the north and south side would also need to have earthen closures constructed to provide protection above a 100-year flood. Additional details on the proposed Comstock ring levee are provided in Section 2.1 – Proposed Project.

Connectivity

Connectivity refers to the frequency of crossings connecting both sides of the proposed diversion channel. The proposed diversion channel and tieback embankment would cut through the existing grid of township, county and state roads resulting in gaps in connectivity to roadways aligned both north and south, and east and west. This would sever roadways and cause a disconnect in that road and established traffic routes. The most recent Project design would cause disconnects on 15 east-west and 12 north-south county and township roadways. The Project includes bridges and road raises to maintain connectivity on county roads in addition to I-29 and I-94 and U.S. Highway 75 as discussed in Section 3.13.3 – Proposed Mitigation and Monitoring Measures; connections would be available at an average spacing of approximately three miles along the diversion channel and tieback embankment.

Accessibility

Accessibility refers to the ability to access a property from an adjacent roadway. The construction of the proposed diversion channel may completely restrict access to sections of land/properties that currently have access. The Transportation Plans determined construction of the proposed diversion channel and tieback embankment would eliminate access to two parcels from existing roadways in the northern portion of the project area and eight parcels from existing roadways in the southern portion of the project area. Access would be provided to these parcels as further discussed in Section 3.13.3 – Proposed Mitigation and Monitoring Measures

Mobility

Mobility refers to the efficient movement of people and goods. Disruptions in existing roadways caused by the proposed diversion channel and tieback embankment may cause traffic to relocate to roads that are not designed for increased traffic loads. The majority of township and county roads affected by the proposed diversion channel are dirt or gravel roads with intermittent areas of paved roadway surfaces at higher volume locations. There would be a change in existing traffic patterns and may increase traffic on roads that were not constructed to handle higher levels of traffic. Increased traffic on roads that are not constructed to handle traffic, such as dirt or gravel roads, could result in deterioration of those roadways, requiring more frequent repair or reconstruction.

Construction Traffic

Diversion channel construction, which includes construction of associated bridges and roads, would result in an increase of traffic. In order to accommodate traffic impacts during construction, temporary construction bypass routes would be established for use until construction of a particular portion of the Project is complete. Construction may take several months or several years to complete. Traffic during construction would be routed onto existing infrastructure if available within a reasonable distance. Appropriate placement of construction and safety signage and use of road detours would help minimize impacts. Standard safety rules, laws, and regulations for highway travel with heavy equipment would have to be complied with. These impacts would be temporary, occurring only during Project construction.

Circuitous bypass routes would be established at County Roads 32 and 22, as they are lower volume county roads. On higher volume county roads, such as County Road 4, 20, 31, and 81, a new bypass road would be constructed with an offset 200 feet from the existing roadway during construction. In addition, construction contractors would be instructed to not impede any local traffic.

New temporary bypass routes directly adjacent to the existing roadways of Cass County Road 10, Cass County Road 14, and Cass County Road 81 would be provided to maintain traffic during bridge construction.

3.13.2.1.2 Railroads

There are several existing rail lines in both North Dakota and Minnesota that would potentially be affected by the construction of the Project (see Figures 23 and 24). These include:

<u>North Dakota</u>

- BNSF Railroad near I-29/County Road 81 and 27th Street Southeast
- BNSF Railroad near County Road 20
- BNSF Railroad south of County Road 10
- Red River Valley Line Railroad near County Road 14

<u>Minnesota</u>

- BNSF Railroad east of State Highway 75

Potential impacts could include the inability to deliver goods by railway in certain areas or delivery delays in other areas. Railways would require relocation, grade raises or other modifications. Proposed railway impacts would be further determined during the Project design phase. Considerations for railroad modifications are discussed in Section 3.13.3 – Proposed Mitigation and Monitoring Measures.

3.13.2.1.3 Utilities

Project construction and operation would impact numerous public utilities such as electric, water, sewer, storm water, gas, telephone, and internet. Impacts resulting from the construction and operation of the Project may include relocation of utilities and temporary disruption of services. Specific parcels would be identified during final design of the Project and arrangements made for utility relocation or modification. Considerations for utility modifications are discussed in Section 3.13.3 – Proposed Mitigation and Monitoring Measures.

<u>Oxbow/Hickson/Bakke Ring Levee</u>

Utilities impacted by the OHB ring levee include the existing sanitary sewer system, currently serving Oxbow Drive and Oxbow Circle, which generally flows west to east to a lift station outside of the OHB ring levee area. Removal of this lift station and installation of a new lift station within the protected area of the OHB ring levee would maintain sewer service to that portion of the City. Areas of Oxbow, Hickson, and Bakke are served by private septic systems. These septic systems are not anticipated to be impacted by the Project and these properties may be connected to the sanitary system in the future.

The existing storm water system generally slopes from west to east and ultimately outfalls into the Red River. The storm water system would be modified to reduce the number of pipes that would cross the levee. During times of flooding, the storm water pump station would pump water out of a ponding area and into the Red River. In addition, storm water lines would need to be installed to service the new proposed Oxbow Country Club and golf course.

The OHB ring levee would install a pipe parallel to the golf course, which would connect with the waterline at Riverbend Road and Oxbow Drive. In addition, new water service would be installed for the proposed Oxbow addition, which would tie into the existing water main located near the intersection of Sunset Drive and Riverbend Road. Water lines would also need to be installed to service the new Oxbow Country Club and golf course.

Overall, the proposed modifications to the sanitary sewer system, existing water main, and existing storm water system would avoid significant impacts to this public infrastructure for those areas of Oxbow that would be affected. The OHB ring levee is not anticipated to cause impacts to the sanitary, water, or storm water infrastructure in the Hickson or Bakke communities.

3.13.2.1.4 Public Services

During construction, disruptions to existing roadways caused by the proposed diversion channel and tieback embankment may cause temporary delays in public services, such as emergency response (police, fire, medical), postal deliveries, and school bus services. However, the Project has the potential to provide long-term benefits to public facilities and services by reducing the potential damage to facilities and disruption in delivery of services during future flood events.

The North Transportation Plan evaluated public services such as emergency response, postal service, and schools. Based on that evaluation, road configurations and bridge locations proposed for Project mitigation, as described in Section 3.13.3, would not affect emergency response times as long as a bridge over the proposed diversion channel is provided for each county road and a combined bridge for County Road 4 and 31 is provided. School districts were consulted for the North Transportation Plan and also indicated the proposed road configurations and bridge locations would not significantly impact bussing routes within the area.

The USPS indicated the proposed road configurations and bridge locations would not significantly impact main service within the area (i.e., area evaluated for the North

Transportation Plan). However, the USPS is concerned about phasing and timing of Project construction and the potential impact it would have on mail sorting prior to delivery. As roadways are closed, the USPS would need to reconfigure their mail delivery routes. However, before a route can be altered, the mail needs to be sorted at the post office and sequenced for each route. Each time the routes are reconfigured due to road closures, it would cost the USPS time and expense to reroute and re-sort the mail.

The South Transportation Plan did not evaluate public services, and therefore a detailed assessment of the potential impacts of the Project was not completed for that area. It is assumed potential impacts in the south area would be similar to those described for the north area, with the exception of the upstream inundation area, which would experience more significant impacts during Project operation due to flooding and road closures in many areas. It is anticipated the need for public services would be minimal for properties located within the staging area boundary, as there would be few residences remaining in that area. Access to the remaining residences would be maintained. An assessment would be completed prior to Project construction.

3.13.2.2 Base No Action Alternative

The Base No Action Alternative would result in numerous highway and railroad bridge closures and the airport closure during flooding events. The cities of Fargo and Moorhead each have ongoing and future flood risk reduction projects in the construction and planning phases. These projects provide benefit in reducing the potential for flooding in the cities of Fargo and Moorhead, and therefore, the potential impacts on infrastructure and public services. The magnitude of flooding under the Base No Action Alternative would likely be greater on infrastructure and public services, because emergency measures, such as sandbagging and temporary levee building would not be implemented, allowing more extensive flooding in some areas. Infrastructure could be damaged or destroyed and the delivery of public services could be significantly inhibited in certain flood areas.

3.13.2.3 No Action Alternative (with Emergency Measures)

The No Action Alternative would result in numerous highway and railroad bridge closures and the airport closure during flood events. The cities of Fargo and Moorhead each have ongoing and future flood risk reduction projects. These projects provide benefit in reducing the potential for flooding in Fargo and Moorhead, and therefore also reduce the potential magnitude of impact on infrastructure and public services. Emergency measures, such as sandbagging and temporary levees, would be constructed where gaps in FDR project protection exist to tie into existing levees. A temporary levee may be constructed across a roadway, which would disrupt traffic flow in that area. Emergency measures could also be targeted toward specific infrastructure, such as a water treatment plant, as needed to reduce flood risk.

Predicting whether the emergency measures would be effective enough to avoid impacts to public infrastructure and public services is dependent on each flooding event. Emergency measures have been effective in the past when there has been enough lead time to prepare for flooding. However, there is a risk of the temporary structures failing, which would result in significant flooding in certain areas and potential significant impacts to infrastructure and delivery of public services.

3.13.2.4 Northern Alignment Alternative

Under the NAA, design, construction methods, and operation would be similar to those previously described for the Project but the tieback embankment and control structures would be located approximately 1.5 miles north from the Project alignment. As with the Project, the NAA would also require numerous infrastructure components, including, for example, inlets, culverts, spillways, and hydraulic control structures. The NAA components and functionality would be similar to what was previously described for the Project in EIS Section 2.1 and in the sections above.

A Transportation Plan has not been completed for the NAA. However, many of the impacts associated with the Project would be the same for the NAA with the exception of the location and construction of the tieback embankment and control structures as noted above. The Project and NAA have similar inundation footprints, so many of the same areas get impacted, only at varying depths. The NAA would cause new inundation impacts in the area between the Project embankment and NAA embankment, but would also remove impacts near Richland and Wilkin counties. The impacts identified specific to the NAA include new road crossings at Cass County Road 16 and 49th Street Southeast for the overflow embankment, road grade raises in the NAA inundation area, and impacts to the bridge at Cass County Road 16 and Clay County Road 8. Utility impacts and necessary modifications and mitigations would be further determined during the NAA design phase. Table 3.52 provides a summary of impacts specific to the NAA. Impacts from the NAA that would be the same as those previously described for the Project are not listed. Differences to infrastructure impacts between the NAA and the Project are due to the location of the NAA tieback embankment and inundation area. Specific infrastructure impacts occurring with the NAA would be mitigated in a similar manner to what is described in Section 3.13.3 – Proposed Mitigation and Monitoring Measures for the Project.

Table 3.52 NAA Infrastructure Impacts[1]

Type	NAA	Notes
Road Crossing	New crossings at Cass County Road 16 and at 49th Street Southeast	New overflow embankment crossings relocated from 51st Street Southeast and 50th Street Southeast for the Project
Road grade raise	I-29 through NAA inundation area	Segment of I-29 north of the Project embankment would require road raise
Road grade raise	U.S. Hwy 75 through NAA inundation area	Segment of U.S. Hwy 75 north of the Project embankment would require road raise
Bridge impact	Cass County Road 16/Clay County Road 8	Bridge at Red River would likely be inaccessible during flood event operation

[1]Infrastructure impacts listed are those that are specific to the NAA.

Similar to the Project, it is expected that operation of the NAA would cause increased upstream flooding, resulting in many road closures. The bridge at Cass County Road 16/Clay County Road 8 would not be accessible during operation. It is anticipated the need for public services would be minimal within the staging area boundary, because the Diversion Authority has indicated structures would be mitigated through acquisition in that area. An assessment of structural impacts would be completed prior to NAA construction.

Construction of the NAA diversion channel and tieback embankment may cause disruptions to existing roadways similar to what was previously described for the Project. This may result in temporary delays for public services, such as emergency response (e.g., police, fire, medical), postal deliveries, and school bus services. The NAA would provide long-term flood risk reduction benefits to public facilities and services by reducing the potential damage to facilities and disruption in delivery of services during future flood events within the area downstream of the NAA.

Mitigation, similar to the Project, would be required for the NAA through reconstruction of roads, construction of new bridge crossings, and relocation of utilities as further described in Section 3.13.3. A transportation study of the area upstream of the tieback embankment would need to be completed to identify impacts to infrastructure from inundation. The infrastructure impacts noted in Table 3.52 reflect impacts that would apply to the mitigation listed in Section 3.13.3 – Proposed Mitigation and Monitoring Measures. These include the identified road raises and maintaining crossings at the tieback embankment at 50th Street South/ County Road 66 (MN), 40th Street South/ County Road 7 (MN), US Hwy 75, County Road 81, I-29, and 170th Street Southeast/ County Road 17 (ND). All other existing roads are anticipated to end at the at the NAA tieback embankment. When not in operation, crossings would be provided approximately three miles or less apart, similar to the Project. Bridge, surface upgrades, and new road development would be completed in the NAA upstream inundation area as needed, similar to the level of improvements proposed for the Project. Where utilities are impacted by the NAA, an evaluation, using the same criteria as described for the Project (Section 3.13.3.3), would be made to determine if utility relocation or other mitigation is warranted.

3.13.3 Proposed Mitigation and Monitoring Measures

Mitigation measures for Project impacts were identified in the Transportation Plans and Utility Relocation Plans, which included constructing bridges, relocating roadways, terminating roadways, improving roadways, modifying railroads, and relocating utilities. These measures are necessary to avoid and minimize the potential impacts of the Project. Implementation of the proposed mitigation measures reduces potential Project impacts. Once final Project design is completed the Transportation Plans and preliminary Utility Relocation Plans would be updated to reflect the final design features and mitigation needed for the Project.

3.13.3.1 Roads and Bridges

Construction of road and rail bridges over the diversion channel would be completed to mitigate transportation connectivity impacts. Bridges would be constructed approximately every three miles to cross the diversion channel. These bridges would provide access for emergency vehicles, school bus routes, and general traffic. During construction, road and rail detours or bypasses would be provided to address impacts during construction.

Connectivity

Increased connectivity, through the use of bridges and grade raises, between both sides of the proposed diversion channel would help distribute traffic, reduce travel distances, and at times improve routing options for roadway users. The following roadways would require improvements to maintain connectivity across the diversion channel and tieback embankment:

Cass County, North Dakota

- I-29/State Highway 81 North Bound (crossed twice by Project)
- I-29/State Highway 81 South Bound (crossed twice by Project)
- I-29/State Highway 52 West Bound
- I-94/State Highway 52 East Bound
- Combination of Cass County Road 4/25th Street Southeast and Cass County Road 31/173rd Avenue Southeast
- Cass County Road 6/76th Avenue South/44th Street Southeast
- Cass County Road 8/40th Avenue West/41st Street Southeast
- Cass County Road 10/12th Avenue Northwest/36th Street Northeast
- Cass County Road 14/100th Avenue South/46th Street Southeast
- Combined Cass County Road 16/124th Avenue South/48th Street Southeast and County Road 17/170th Avenue Southeast
- Cass County Road 18/52nd Street Southeast
- Cass County Road 20/40th Avenue North/33rd Street Southeast
- Cass County Road 22/64th Avenue North/31st Street Southeast
- Cass County Road 81
- Cass County Road 81/175th Avenue Southeast
- 13th Avenue West/38th Street Southeast and 167th Avenue Southeast/38th Street West (Cass County, North Dakota)
- BNSF Railway crossings
    - Hillsboro Subdivision Line, crosses near I-29/County Road 81 and 27th Street Southeast
    - Fargo-Nolan Line, crosses near County Road 20
    - KO Subdivision, crosses south of County Road 10
- Red River Valley and Western Railway crossing
    - Horace-Edgeley Line, crosses near County Road 14

Clay County, Minnesota

- U.S. Highway 75
- U.S. Highway 75 would also be raised throughout the inundation area including grade raises for each intersecting roadway.
- Clay County State Aid Highway 7
- Clay County Road 61
- BNSF Railway crossing near U.S. Highway 75

Accessibility

The North Transportation Plan recommends construction of two gravel roadway connections to County Road 4 and 169th Avenue Southeast to re-establish accessibility to two affected parcels. Accessibility to all other properties along the proposed diversion channel would be maintained by installing a connection between 27th Street and County Road 81.

To maintain farming accessibility, a box culvert would be installed where Drain 13 crosses 170th Avenue Southeast to provide access to the area south of Drain 30 between 170th Avenue Southeast and the diversion channel. The North Transportation Plan recommends that all existing roadways not identified as diversion channel crossings should either be terminated as dead-ends at the diversion channel or removed completely if the road is less than one-fifth of a mile.

The South Transportation Plan determined construction of the proposed diversion channel and tieback embankment would affect eight parcels from existing roadways, and therefore, prevent access to these parcels. A cost analysis completed for the South Transportation Plan recommends that parcels would either be purchased or new roadways be constructed as mitigation for the Project. The cost/benefit of mitigation for these parcels would be evaluated on a case by case basis.

The South Transportation Plan also recommends that existing roadways that have not been identified as diversion channel crossings should terminate as dead-ends where they meet the diversion channel to allow for better accessibility to those properties. It is also recommended that the section of 26th Street West located between the diversion channel and 21st Avenue West be considered for removal as this roadway does not provide accessibility benefits.

Mobility

Improvements to 167th Avenue Southeast would be completed to collect higher volumes of traffic due to township road terminations at the diversion channel. Recommended improvements include upgrading five miles of dirt roadways into gravel roadways and installing two new box culverts.

Additionally, 38th Street West from Cass County Road 8 to 43rd Street SE/64th Avenue South as well as 38th Street West from Cass County Road 14 to Cass County Road 16 would be upgraded from dirt roads to gravel roads. A “collector roadway”, between crossings at 38th Street SW and Cass County Road 8 (40th Avenue West/41st Street SE), would be developed using existing infrastructure. This corridor would require the following mobility improvements:

- Improve 15th Street Southwest from Cass County Road 8 (40th Avenue South/41st Street Southeast) to 21st Avenue West/39th Street Southeast, including realignment of the intersection of 15th Street Southwest with 21st Avenue West/39th Street Southeast.
- Improve the curve that transitions 15th Street Southwest to 13th Avenue West to meet design standards for a 55 mile per hour curve.

3.13.3.2 Railroads

Improvements and/or modifications to the rail lines were not evaluated in the Transportation Plans. The South Transportation Plan suggested future studies be conducted regarding rail lines. Any improvements and/or modifications to the railroads would need to be coordinated with BNSF and the Red River Valley & Western Railroad. Two modifications identified to address railroad transportation issues included raising the rail lines or relocating them. Specifically, the South Transportation Plan suggested the following:

- Evaluate an improvement plan for the rail line through Comstock. If the rail line was raised through Comstock, adjacent buildings would be impacted. If the rail line was relocated, the grain elevators would have to be relocated as well, which is not feasible. If no improvements were made, there would be rail line closures during each flood event.
- Evaluate whether the removal of the rail line through Horace is feasible. The rail line ends two miles past the diversion channel in Horace, and trains run once every two weeks, with most grain hauling occurring by truck.

3.13.3.3 Utilities

Utilities that cannot withstand occasional flooding in the inundation area would be abandoned, modified, or relocated, depending on the situation in accordance with applicable regulations. All utilities that would be severed by construction of the Project would be relocated prior to construction to reconnect affected parcels. If the in-town levees or ring levees are constructed, utilities affected by construction would also be modified or relocated. Specific improvements and/or modifications to the utility systems would be evaluated during final design of the Project. Parcels needing improvements, modifications, or relocations of utilities would be identified during that evaluation.

3.13.3.4 Public Services

The proposed road configurations and bridge locations were determined to not significantly affect emergency response times, USPS delivery service, and school bussing routes. However, the USPS expressed concern about phasing and timing of Project construction and the impact it could have on mail delivery routes. The Diversion Authority should coordinate, as possible, with the USPS to provide sufficient notice for road closures.

3.14 LAND USE PLANS AND REGULATIONS

There are a number of LGUs within the project area that have planning and zoning authorities. Various zoning ordinances and comprehensive growth and development plans are in place for the counties, townships, municipalities, and watershed districts. Some municipalities and townships do not have their own planning and zoning, and rely on other LGU regulatory authorities, such as the county. This section describes relevant information from county and city land use plans, regulations, and flood damage reduction plans in the project area. Compatibility with these plans and ordinances is discussed, and potential permits and zoning issues are identified for those LGUs who would be affected by the Project; either from Project operation or from Project construction activities.

3.14.1 Affected Environment

The Project is sponsored by a federal agency (USACE) and the Diversion Authority which is comprised of the following LGUs: Cass County (ND), Clay County (MN), City of Fargo (ND), City of Moorhead (MN), Cass County (ND) Joint Water Resources District, and the Buffalo-Red River Watershed District (MN). Coordination with all affected units of government is ongoing as part of Project development. There are a number of LGUs in the project area that implement planning, zoning or both. In general, communities within the project area have adopted measures through planning and zoning to reduce flood risk. These LGUs include counties, townships, municipalities, and watershed management organizations.

3.14.1.1 Counties in Project Area

There are four counties in the project area: Cass County and Richland County, North Dakota and Clay County and Wilkin County, Minnesota. These counties have established some form of land use management, which may include planning, zoning or both; the counties have also established development goals and objectives to alleviate the impacts of flooding. Richland County has delegated its land use management to its townships and municipalities.

Table 3.53 Summary of North Dakota County Land Use Management within the Project Area

North Dakota Counties	Land Use Management: Planning (P), Zoning (Z) or Both	
Cass County, ND[1]	Both	Zoning delegated to townships and municipalities. In areas without township or municipality jurisdiction, the County has Subdivision and Floodplain Ordinances and a Comprehensive Plan
Richland County, ND	None	Delegated to townships and municipalities.

[1]Project construction footprint is within LGU

In Cass County, most zoning is carried out by individual townships and municipalities. However, Cass County currently administers three land use and zoning documents: the County's Comprehensive Plan, Ordinance #1998-2 (Flood Damage Prevention), and the Subdivision Ordinance. All of these documents are in effect where township or municipal zoning does not regulate these land uses.

The Comprehensive Plan was last adopted in 2005. There are six goals identified, each with established objectives and policy guidelines to base and establish the County's policies towards development and growth. The six goals include:

1) To achieve orderly, balanced, and sensible development.
2) To provide the citizens of Cass County with essential public facilities, services, and infrastructure.
3) To provide an efficient, safe, environmentally sensitive, and cost effective county transportation system.
4) To use and preserve natural resources in an environmentally sound manner.
5) To preserve and maintain Cass County's rural heritage.

6) To ensure and maintain public participation in the decision-making, influencing the future of Cass County and its citizens.

On February 2, 1998, Cass County implemented Ordinance #1998-2 (Flood Damage Prevention). This ordinance applies to all areas within the jurisdiction of Cass County, but outside of the boundaries of a city or township Flood Damage Prevention Ordinance, to “promote public health, safety, and general welfare and to minimize public and private losses due to flood conditions in specific areas.” In order to accomplish this, the ordinance provides methods and provisions to reduce flood losses.

On March 6, 2006, Cass County implemented a subdivision ordinance, which was revised March 5, 2012. Section 612 of the Subdivision Ordinance regulates the floodplain. This section of the ordinance requires the 100-year floodplain (base flood elevation) and/or floodway be identified within a proposed subdivision. All proposed developments, except those in townships with adopted floodplain management regulations, shall be built pursuant to the Cass County Flood Damage Prevention Ordinance #1998-2.
Richland County does not manage planning or zoning at the county level, rather the responsibility lies within each city or township. The Richland County Water Resource Board requires permits for culverts, ditching, and drain tile.

Table 3.54 Summary of Minnesota County Land Use Management within the Project Area

Minnesota Counties	Land Use Management: Planning (P), Zoning (Z) or Both	
Clay County, MN[1]	Both	Cities and townships have their own planning and zoning authority.
Wilkin County, MN	Z	Wilkin County has zoning authority for townships in project area. County also has a Water Management Plan.

[1]Project construction footprint is within LGU

In Clay County, Minnesota, most planning and zoning occurs at an individual township and municipality level. Similar to Cass County, North Dakota, Clay County has county level ordinances that apply where the townships do not regulate a certain land use. Clay County Zoning Ordinance 2012-1, adopted March 13, 2012, replaces Chapter 8 of the Clay County Code and adopts all FEMA and MNDNR requirements resulting from the revised Clay County FIRM. The ordinance was adopted to identify and enforce regulations in Special Flood Hazard Areas, which are Zone AE and Zone A on the FIRM for Clay County. SFHAs are considered those subject to periodic inundation that results in potential loss of life, loss of property, health and safety hazards, disruption of commerce and governmental services, extraordinary public expenditures on flood protection and relief, and impairment of the tax base.

Chapter 5 of the Clay County Zoning Ordinance establishes Flood Hazard Zones and Districts: General Floodplain, Floodway, and Flood Fringe Districts. The County ordinance (Amended January 2011) identifies a levee, dike or floodwall built by a unit of government as a permitted use. A ring levee is considered a conditional use. Floodway District standards for conditional uses (Chapter 8-5A-6 subpart D1) may not cause any increase in the stage of the 100-year or regional flood or cause an increase in flood damages in the reach or reaches affected. Additionally, structural works for flood control (Chapter 8-5A-6 subpart D6) that will change the course, current, or cross section of protected wetlands or public waters will be subject to Minnesota Statute, Chapter 103G. Levees, dikes, or floodwalls intended to remove areas from the regulatory floodplain shall not be allowed in the floodway, and structural works for flood control constructed in the floodway to protect individual structures or agricultural crops or farmsteads shall not cause an increase to the 100-year or regional flood.

Wilkin County currently administers countywide zoning in the project area. The zoning ordinance establishes five primary categories of zoning districts to meet the County's planning, development, and preservation needs: Floodplain, Shoreland, General Agriculture, General Residence, Airport, and Commercial/Industrial. The Floodplain District, Section 10 of the Wilkin County Zoning Ordinance, provides the permissible uses and procedures for projects proposed within the Floodplain District. These include Floodway, Flood Fringe, and General Flood Plain Districts.

3.14.1.2 Affected Townships in the Project Area

There are a number of townships in the project area that would be affected by the Project. Most of these townships, in both Minnesota and North Dakota, have some form of land use management, meaning they have the authority or requirement for permits and approvals for development through planning, zoning or both. The townships within the project area in North Dakota that administer zoning ordinances include: Harwood, Mapleton, Normanna, Pleasant, Stanley, and Warren. Pleasant Township also administers a floodplain ordinance.

Table 3.55 Summary of North Dakota Township Land Use Management within the Project Area

North Dakota Townships[1]	Land Use Management: Planning (P), Zoning (Z) or Both	
Harwood Township, ND	Z	
Mapleton Township, ND[2]	Z	
Normanna Township, ND[2]	Z	
Pleasant Township, ND[2]	Z	Floodplain Ordinance
Raymond Township, ND	None	Cass County planning and zoning applies.
Stanley Township, ND	Z	
Warren Township, ND[2]	Both	Comprehensive Plan
Wiser Township, ND[2]	Z	

[1]Berlin Township, ND would be within the construction footprint, information to date of this EIS has been unable to be obtained regarding Land Use Management

[2]Project construction footprint is within LGU

Townships within the project area in Clay County, Minnesota that administer a zoning ordinance include: Georgetown, Glyndon, Kragnes, Kurtz, Moorhead, and Oakport Townships. Holy Cross and Wolverton Townships do not administer a zoning ordinance, and therefore fall under the jurisdiction of Clay County and Wilkin County, respectively. Moorhead and Oakport Townships are within the Moorhead urban area and work closely with the City as parts of these townships are planned for future annexation into the City.

Table 3.56 Summary of Minnesota Township Land Use Management within the Project Area

Minnesota Townships	Land Use Management: Planning (P), Zoning (Z) or Both
Georgetown Township, MN	Z
Glyndon Township, MN	Z
Holy Cross Township, MN	None, Clay County planning and zoning applies.
Kragnes Township, MN	Z
Kurtz Township, MN	Z
Moorhead Township, MN	Z
Oakport Township, MN	Z
Wolverton Township, MN	None, Wilkin County planning and zoning applies.

3.14.1.3 Affected Cities in the Project Area

There are a number of cities in the project area that would be affected by the Project, including the large cities of Fargo and Moorhead, small communities outside of the immediate F-M urban area, and those located upstream of the tieback embankment. The cities of Moorhead and Fargo have established development goals and objectives to alleviate the impacts of flooding. Plans and ordinances for the cities of Moorhead and Fargo reference levees, flood walls, dikes, diversions, and property buyouts, as planned and regulated uses. These types of developments would typically require a permit from each of the cities if the development occurs within city limits.

In North Dakota, the project area includes the cities of Argusville, Briarwood, Christine, Fargo, Frontier, Harwood, Horace, Kindred, Mapleton, Oxbow, North River, Prairie Rose, Reile's Acres, and West Fargo. All but two of these cities administer land use management through planning and zoning ordinances; Christine and North River's land use management is administered through their respective townships. Fargo has extensive planning and zoning related to floodplain management, including local flood risk reduction projects. Chapter 2 – Proposed Project and Alternatives provides information on local flood risk reduction projects in Fargo.

Table 3.57 Summary of North Dakota City Land Use Management within the Project Area

North Dakota Cities	Land Use Management: Planning (P), Zoning (Z) or Both	
Argusville, ND[1]	Both	
Briarwood, ND	Both	
Christine, ND	None	Eagle Township zoning applies.
Fargo, ND[1]	Both	Land Development Code
Frontier, ND	Z	
Harwood, ND	Z	City Ordinances

North Dakota Cities	Land Use Management: Planning (P), Zoning (Z) or Both	
Horace, ND[1]	Z	Land Use Ordinance
Kindred, ND	Both	
Mapleton, ND	Z	
Oxbow, ND	Z	
North River, ND	None	Reed Township zoning applies.
Prairie Rose, ND	Z	
Reile's Acres, ND	Both	
West Fargo, ND[1]	Both	Comprehensive Plan

[1]Project construction footprint is within LGU

There are five cities in Minnesota within the project area that would be affected by the Project: Comstock, Dilworth, Georgetown, Moorhead, and Wolverton. All five administer land use management through planning, zoning or both. Moorhead has extensive planning and zoning related to floodplain management, including local flood risk reduction projects. Chapter 2 – Proposed Project and Alternatives provides information on local flood risk reduction projects in Moorhead.

Table 3.58 Summary of Minnesota City Land Use Management within the Project Area

Minnesota Cities	Land Use Management: Planning (P), Zoning (Z) or Both	
Comstock, MN	Both	
Dilworth, MN	Z	
Georgetown, MN	Z	Floodplain Only
Moorhead, MN[1]	Both	Comprehensive Plan; Growth Plan
Wolverton, MN	Both	

[1]Project construction footprint is within LGU

3.14.1.4 Other Local Government Units in the Project Area

In addition to counties, townships, and municipalities, other types of LGUs also have planning and zoning in the project area. There are a number of watershed management organizations in the project area that are actively advocating for flood management through various flood risk reduction projects, and planning, and in some cases rules and permits in conjunction with other permits and approvals required by LGUs. Table 3.59 provides a summary of watershed management organizations within the project area.

Table 3.59 Summary of Other Local Government Units Land Use Management within the Project Area

Watershed Management Organizations	Land Use Planning
Cass County Joint Watershed District, ND	Project review in the district
Red River Joint Water Resource District, ND	2007 – 2009 Water Management Strategy

Watershed Management Organizations	Land Use Planning
Buffalo-Red River Watershed District[1], MN	Projects, rules, permits, and plans, such a watershed management plan
Red River Watershed Management Board, MN	Red River Watershed Management Board Policy Manual

[1]Project construction footprint is within LGU

Cass County Joint Watershed District

Cass County is divided into four water resource districts, each governed by a board of individuals: the Maple River, Rush River, North Cass, and Southeast Cass. Combined these districts form the Cass County Joint Watershed District (CCJWD). Each district is responsible for water management, drain and flood control issues. The Project would be located in the Maple River, Rush River, and Southeast Cass Watershed Districts. The CCJWD does not have regulatory authority for planning and zoning, but are active in review of projects in the districts.

Red River Joint Water Resource District

The Red River Joint Water Resource District was formed in 1979 and stretches the length of the Red River from Richland County in the south to Pembina County in the north, encompassing 14 individual water resource districts in North Dakota. The goal of the District is to provide a coordinated and cooperative approach to water management in the North Dakota portion of the Red River Basin. The District does not have regulatory authority for planning and zoning, but is active in review of projects and providing coordination between the districts.

Buffalo-Red River Watershed District

The Buffalo-Red River Watershed District (BRRWD) is a LGU and drainage authority in Minnesota. Operation of the BRRWD is in accordance with their “Watershed Management Plan” which is required by the BWSR. The BRRWD covers Clay and Wilkin Counties in the Minnesota portion of the project area and two other Minnesota counties which are outside of the project area. The BRRWD is divided into seven planning regions; the Project is in the Western Planning Region. The BRRWD Western Planning Region has two goals: improve existing hydrologic conditions in watercourses; and reduce erosion and resulting sedimentation in watercourses. The BRRWD implements its goals through planning, project implementation, and rules and permitting.

Red River Watershed Management Board

The Red River Watershed Management Board (RRWMB) is an organization with the mission “to institute, coordinate, and finance projects and programs to alleviate flooding and assure beneficial use of the water in the water of the Red River and its tributaries.” The RRWMB, previously known as the Lower Red River Watershed Management Board, was created by an act of the Minnesota Legislature in 1976. As of 2004, the RRWMB had participated in over 40 floodwater retention projects in the Red River Basin.

Under a joint powers agreement, eight watershed districts comprise the RRWMB: the Joe River, Two Rivers, Roseau River, Middle-Snake-Tamarac Rivers, Red Lake, Sand Hill River, Wild Rice, and Bois de Sioux. Each district manages its individual watershed and each district has a seat on the RRWMB. The jurisdiction and authority of the RRWMB covers the area of the eight districts. The northeastern edge of the project area is located in the Wild Rice district. RRWMB does not have regulatory authority for planning and zoning. Their activities generally focus on flood damage reduction projects.

3.14.1.5 Plans and Regulations in the Project Area

Plans and regulations for each LGU in the project area were identified in Section 3.14.1 – Affected Environment. Table 3.60 provides additional details for potentially applicable zoning ordinances, comprehensive growth and development plans, and other relevant local plans that were reviewed for this EIS.

Table 3.60 Summary of Plans and Regulations

Jurisdiction	Document	Date	Summary	Affected Communities
North Dakota				
Counties				
Cass County, North Dakota	Cass County Comprehensive Plan	2005	This plan is a framework for Cass County's policies on development and growth. The document reviews current status of the county and creates a general work plan to establish how goals and objectives will be executed.	Cass County: Townships: Barnes, Berlin, Harwood, Mapleton, Pleasant, Raymond, Reed, Stanley, Warren Cities of: Argusville, Briarwood, Fargo, Frontier, Harwood, Horace, Kindred, Mapleton, North River, Oxbow, Prairie Rose, Reile's Acres, West Fargo;
Cass County, North Dakota	Flood Damage Prevention: Ordinance #1998-2	Feb. 2, 1998	The purpose of this plan is to promote public health, safety, and general welfare, and to minimize public and private losses due to flood conditions in specific areas by provisions outlined in the ordinance.	Cass County: outside the boundaries of Flood Damage Prevention Ordinances of the following, if applicable: Townships: Barnes, Berlin, Harwood, Mapleton, Pleasant, Raymond, Reed, Stanley, Warren Cities of: Argusville, Briarwood, Fargo, Frontier, Harwood, Horace, Kindred, Mapleton, North River, Oxbow, Prairie Rose, Reile's Acres, West Fargo
Townships[1]				
Harwood Township, Cass County, North Dakota	Harwood Township Zoning Ordinance	2005	The zoning ordinance details the specific definitions, laws, zoning, and ordinances for the township.	Harwood Township
Mapleton Township, Cass County, North Dakota	Mapleton Township Zoning Ordinance	May 2006, Amended June 23, 2008	The zoning code of Mapleton Township details the specific definitions, laws, zoning, and ordinances for the Township. The zoning code adopts the comprehensive plan as its basis.	Mapleton Township, City of: West Fargo

Jurisdiction	Document	Date	Summary	Affected Communities
Normanna Township, Cass County, North Dakota	Normanna Township Zoning Regulation	2004	The zoning code of Normanna Township details the specific definitions, laws, zoning, and ordinances for the Township. The zoning code adopts the comprehensive plan as its basis.	Normanna Township, City of: Kindred
Pleasant Township, Cass County, North Dakota	Pleasant Township Floodplain Ordinance	2004	The zoning code of Pleasant Township details the specific definitions, laws, zoning, and ordinances for the current Flood Hazard areas and plans to prevent creation of Flood Hazard areas within the Township.	Pleasant Township, Cities of: Horace, Oxbow
Pleasant Township, Cass County, North Dakota	Pleasant Township Zoning Ordinance	2004	The zoning code of Pleasant Township details the specific definitions, laws, zoning, and ordinances for the Township. The zoning code adopts the comprehensive plan as its basis.	Pleasant Township, Cities of: Horace, Oxbow
Stanley Township, Cass County, North Dakota	Stanley Township Zoning Ordinance	August 9, 2005	The zoning code of Pleasant Township details the specific definitions, laws, zoning, and ordinances for the Township. The zoning code adopts the comprehensive plan as its basis.	Stanley Township, Cities of: Briarwood, Fargo, Frontier, and Horace
Warren Township, Cass County, North Dakota	Warren Township, Cass County ND, Zoning Regulations	Adopted Oct. 29, 2004; Amended Sept. 14, 2005; Amended Feb. 7, 2012	The zoning code of Warren Township details the specific definitions, laws, zoning, and ordinances for the Township. The zoning code adopts the comprehensive plan as its basis.	Warren Township, City of: Horace
Municipalities[2]				
Argusville, North Dakota	City Ordinance IV-Planning and Zoning	October 1, 2012	The objective of the document is to implement the plans and policies of the City of Argusville of the use and enjoyment of land resources.	Argusville

Jurisdiction	Document	Date	Summary	Affected Communities
Fargo, North Dakota	Fargo Growth Plan	2007	This document is an updated version of the City of Fargo's original growth plan. The essential intent is to plan land uses based on realistic controlled future growth throughout the community while addressing issues that hinder current growth. The plan touches on issues of residential, commercial and public property uses.	Fargo
Fargo, North Dakota	Fargo Comprehensive Plan – Go 2030	May 24, 2012	This plan is an update to the Fargo Growth Plan of 2007. The 2007 Plan is currently used to regulate, since this 2012 plan is in a draft phase.	Fargo
Fargo, North Dakota	City of Fargo Land Development Code – Chapter 20 – City Planning and Zoning Fargo Municipal Code	August 2009	This document presents the zoning for the City of Fargo and related ordinances.	Fargo
Fargo, North Dakota	Comprehensive Review of Potential Flood Mitigation Options	March 13, 2012	This map provides information on areas protected by existing and future flood risk reduction projects.	Fargo
Frontier, North Dakota	Zoning Ordinance for the City of Frontier, North Dakota	October 9, 2000	This document is intended to promote the public health, safety, and general welfare of the City of Frontier, and also secure orderly development and protection of the City's resources.	Frontier
Harwood, North Dakota	Harwood City Ordinances	October 1, 2006	This document is intended to implement the plans and policies of the City of Harwood for land uses within the City.	Harwood
Horace, North Dakota	The Revised Ordinances of 2003, City of Horace, North Dakota	February 3, 2003	This document is intended to implement the plans and policies of the City of Horace for land uses within the City.	Horace

Jurisdiction	Document	Date	Summary	Affected Communities
Reile's Acres, North Dakota	Ordinance Book of the City	June 14, 2011	This document is intended to implement the plans and policies of the City of Reile's Acres for land uses within the City.	Reile's Acres
West Fargo, North Dakota	City of West Fargo Comprehensive Plan	January 2008	The comprehensive plan for West Fargo outlines the City's current position on growth trends and the City's envisioned growth. The plan considers current and potential issues and associated policies. These range from school districts, infrastructure, community "feel", and land use. Additionally, this plan considers flood strategies as a necessity for devising new growth/development strategies.	West Fargo
West Fargo, North Dakota	West Fargo Zoning Code	2007	The zoning code of West Fargo details the specific definitions, laws, zoning, and ordinances for the City. The zoning code adopts the comprehensive plan as its basis.	West Fargo
Minnesota				
Counties				
Clay County, Minnesota	Clay County Comprehensive Plan	July 2, 2001	This plan is a framework to establish Clay County's policies toward development and growth. The document reviews current status of the county and creates a general work plan to establish how goals and objectives will be executed.	Clay County: Townships: Alliance, Elmwood, Holy Cross, Georgetown, Glyndon, Kragnes, Kurtz, Moland, Morken, Oakport, Viding Cities of: Comstock, Dilworth, Georgetown, Moorhead, Sabin
Clay County, Minnesota	Clay County Ordinance 2012-1	March 13, 2012	This is the general ordinance to promote health and human safety, including safety from flood.	Clay County: Townships: Allliance, Elmwood, Holy Cross, Georgetown, Glyndon, Kragnes, Kurtz, Moland, Morken, Oakport, Viding Cities of: Comstock, Dilworth, Georgetown, Moorhead, Sabin

Jurisdiction	Document	Date	Summary	Affected Communities
Clay County, Minnesota	Clay County Ordinance 2012-3	November 13, 2012	This document adds the definition of a retreat center to the nomenclature of the Clay County Development Code. Regarding flooding, retreat centers can have a conditional use in 0.1% chance floodplains.	Clay County: Townships: Allliance, Elmwood, Holy Cross, Georgetown, Glyndon, Kragnes, Kurtz, Moland, Morken, Oakport, Viding Cities of: Comstock, Dilworth, Georgetown, Moorhead, Sabin
Clay County, Minnesota	Clay County Ordinance 2012-4	December 27, 2012	This document repeals and re-adopts various sections of Chapters 1, 3, 5, 7 and 8 of the Clay County Development Code.	Clay County: Townships: Allliance, Elmwood, Holy Cross, Georgetown, Glyndon, Kragnes, Kurtz, Moland, Morken, Oakport, Viding Cities of: Comstock, Dilworth, Georgetown, Moorhead, Sabin
Clay County, Minnesota	Local Water Management Plan 2006 - 2015	December 20, 2005 Amended 2010	Administered by the Clay Soil and Water Conservation District. The purpose of the plan is to identify existing or potential problems and opportunities to protect, manage, or develop water resources and related land resources within the county; develop and implement plans of action to promote sound hydrologic management of water and related land resources within the county; and to work toward effective environmental protection and management within the county.	Clay County: Townships: Allliance, Elmwood, Holy Cross, Georgetown, Glyndon, Kragnes, Kurtz, Moland, Morken, Oakport, Viding Cities of: Comstock, Dilworth, Georgetown, Moorhead, Sabin
Wilkin County, Minnesota	Zoning Ordinance	January 1, 2004 Amended June, 2014	This ordinance is intended to promote public health, safety, morals, and general welfare; provide for adequate light, air, and water; provide for safety from fire, flood, and other dangers, conserving the value of properties and encouraging the most appropriate use of land; and preserve and enhance the quality of surface and ground water.	Wilkin County: Township: Eagle, City of Wolverton

Jurisdiction	Document	Date	Summary	Affected Communities
Wilkin County, Minnesota	Local Water Management Plan 2008 – 2017	2008	The purpose of the Plan is to identify existing and potential problems, opportunities for protection, management, and development of water and land resources in the county; promote hydrologic management of water and related land resources in the county through action plans; and to work toward effective environmental protection and management of the water and land resources in the county.	Wilkin County: Township: Eagle, City of Wolverton
Wilkin County, Minnesota	Draft Comprehensive Plan	2014	Wilkin County currently has a preliminary draft comprehensive plan, but was not adopted at the time of EIS publication.	Wilkin County: Township: Eagle, City of Wolverton
Townships				
Oakport Township, Minnesota	Alternative Urban Areawide Review and Mitigation Plan	April 9, 2009	An Alternative Urban Areawide Review was completed for a large development area near the border with the City of Moorhead in an area of the township that is slated for annexation in 2015.	Oakport Township
Municipalities				
Dilworth, Minnesota	City of Dilworth, Minnesota Zoning Ordinance	December 13, 2010	This document is intended to implement the Comprehensive Plan and promote the public health, safety, and general welfare of the people of Dilworth	Dilworth
Moorhead, Minnesota	Comprehensive Plan for the City of Moorhead	July 19, 2004	This document is a comprehensive plan for guiding the growth and redevelopment of Moorhead. The plan includes general directions, policies, and strategies for reaching growth goals. Components of the plan include land use, infrastructure, and economic development.	Moorhead

Jurisdiction	Document	Date	Summary	Affected Communities
Moorhead, Minnesota	Comprehensive Plan Addendum City of Moorhead	November 9, 2009	This addendum to the Moorhead's comprehensive growth plan primarily relies on information provided in the original plan with updating of relevant sections, policies, and plans. In general, it assesses the amount of household growth that Moorhead is expected to achieve in the next 25 years.	Moorhead
Moorhead, Minnesota	Moorhead Growth Plan Update	2009	This update to Moorhead's comprehensive growth plan divides the major growth areas of the city into sections and considers each individually. These zones are the East District, Southeast District, South Central District and the Southwest District. Some public amenities and public works projects are updated.	Moorhead
Moorhead, Minnesota	Zoning Ordinance of the City of Moorhead	January 1, 2005	This is the general ordinance to promote health and human safety, including flood control.	Moorhead
Moorhead, Minnesota	Moorhead Ordinance 2013-16, 2013-20, 2013-21, 204-01	Sept. 16 2013 – Feb. 10, 2014	This document considers various changes and additions to Moorhead's City Ordinance. Changes/additions include signage, private colleges, and off street parking regulations.	Moorhead
Other Local Government Units				
Buffalo-Red River Watershed District, Minnesota	Western Planning Region Planning Summary	June 2010	The purpose of the Summary is to identify resource issues and problems, describe previous efforts to correct issues and problems and identify possible solutions for current issues. The document is a tool for gathering input and should be used alongside the Watershed Management Plan.	Counties: Clay, Wilkin Townships: Kurtz, Holy Cross, City: Comstock

Jurisdiction	Document	Date	Summary	Affected Communities
Buffalo-Red River Watershed District, Minnesota	Watershed Management Plan	June 2010	The purpose of this document is to identify problems, issues, goals, and short and long term strategies to address issues and attain the goals.	Counties: Clay, Wilkin Townships: Kurtz, Holy Cross, City: Comstock
Red River Watershed Management Board, Minnesota	Policy Manual 3rd Revision	March 2004	This document outlines the history, authority, roles, and responsibilities of the Red River Watershed Management Board.	Clay and Wilkin counties, along with others outside the project area

Source: Diversion Authority Land Use Summary March 2014, and Wenck April and June 2014

3.14.2 Environmental Consequences

The current plans and zoning ordinances for each of the LGUs in the project area that would be affected by flooding and/or Project and Project alternatives were evaluated. This included evaluation of current and future plans for growth in a community and regulations in place to manage flood risk through land use and floodplain ordinances. Potential conflicts with the plans and zoning ordinances are identified were applicable.

3.14.2.1 Proposed Project

The Project would affect a number of LGUs within the project area as previously discussed in Section 3.14.1. Each of the planning and zoning ordinances were evaluated for compatibility with the Project. Summaries of these evaluations are included below. The intent of this EIS section is to provide a general overview about the affected LGUs and any regulations or permits that may be applicable. Individual LGU plans and zoning ordinances referenced in this section should be reviewed for further detail for compatibility during Project design and prior to implementation.

Permits and other approvals from LGUs may apply to the Project, and are further discussed in Section 3.14.3 – Proposed Mitigation and Monitoring Measures and also in Section 1.4 – Government Approvals. Additionally, the Project would make it necessary to modify existing Flood Insurance Study mapping because of changes to regulatory floodways, BFEs or extent of SFHAs. The Diversion Authority, the USACE, and FEMA are currently discussing FEMA's CLOMR requirements. The NFIP participating communities with FIRMs affected by the Project would require map revisions through the FEMA LOMR process. This is further discussed in Section 1.4 – Government Approvals and Section 3.2 – FEMA regulations and the CLOMR Process.

3.14.2.1.1 Counties Affected by the Project

<u>North Dakota</u>

Cass County, North Dakota

The Project would be consistent with the Cass County Comprehensive Plan by reducing flood risk in the urban areas of the County. Flooding of the staging area would discourage development in the rural area south of the tieback embankment. The Project would also be consistent with the goals of the Flood Damage Prevention Ordinance, as flood risk would be reduced in large population areas.

Richland County, North Dakota

No Project construction would be located within Richland County, and therefore, no County permits or approvals would be required. Where Project operation causes additional flooding, a zoning amendment may be required by the County or affected communities.

Minnesota

Clay County, Minnesota

Planning and zoning is administered at the township and municipal level in Clay County. Overall, most of the zoning in Clay County is considered Agricultural Preservation, which promotes agricultural land use and protects it from encroachment by non-agricultural development.

Project infrastructure located within Clay County would be the Red River control structure, Minnesota tieback embankment, Comstock ring levee, and levees and dikes that are planned to be built within Moorhead, Minnesota. This construction may be required to comply with the Clay County ordinance (if located outside Moorhead City limits) and the City of Moorhead ordinance (if located inside Moorhead City limits). Where Project operation causes additional flooding, a zoning amendment may be required. LGU approvals are further discussed in Section 3.14.3 and in Section 1.4 – Government Approvals.

Wilkin County, Minnesota

The Wilkin County Local Water Management Plan 2008 – 2017 considers installing structures to reduce flood damages. These structures were not proposed as part of the Project, and therefore, were not evaluated for impacts in this EIS. No Project construction would occur within Wilkin County. However, Section 20.05 of the Wilkin County Zoning Ordinance, amended June 2010, requires a zoning amendment for any impoundment greater than 640 acres in size. Where Project operation causes additional flooding, a zoning amendment may be required by the County or affected communities.

3.14.2.1.2 Townships Affected by the Project

North Dakota

Berlin Township, North Dakota

Berlin Township, North Dakota would be impacted by the diversion channel construction footprint. Any approvals needed for the Project would be managed by Cass County where township regulations do not cover certain land uses.

Harwood Township, North Dakota

Harwood Township, North Dakota would be impacted by the diversion channel construction footprint. Any approvals needed for the Project would be managed by Cass County where township regulations do not cover certain land uses.

Mapleton Township, North Dakota

Mapleton Township, North Dakota, would be bisected by the diversion channel. The Project would be consistent with the Mapleton Township Land Use Ordinance by assisting to conserve and enhance the value of the land within the Township by reducing flood risk in the area. The diversion channel would not be consistent with the Comprehensive Plan goal to facilitate traffic movement as some roads would be severed by the project, as further discussed in Section 3.13 – Infrastructure and Public Services. Township approvals for Project construction may be required as discussed in Section 3.14.3.

Pleasant Township, North Dakota

The diversion channel would be located on the northern boundary of Pleasant Township, North Dakota. The diversion channel would not be consistent with the Comprehensive Plan goal to facilitate traffic movement as some roads would be severed by the Project, as further discussed in Section 3.13 – Infrastructure and Public Services. Township approvals for Project construction may be required as discussed in Section 3.14.3.

A large portion of the township would be included in the staging area. The Project may not be consistent with the Pleasant Township Zoning Ordinance purpose and intent to "protect public health, safety, morals, comfort, convenience, prosperity and general welfare of the Township of Pleasant" due to Project operation of the staging area that would flood land that is not part of the existing 100-year floodplain. A zoning amendment or floodplain permit may be required for the Project.

Raymond Township, North Dakota

Raymond Township, North Dakota would be bisected by the diversion channel. Raymond Township does not have its own zoning ordinance. Any approvals needed for the Project would be managed by Cass County.

Warren Township, North Dakota

The diversion channel would be located on the eastern edge of Warren Township, North Dakota. The Project would be consistent with the Warren Township zoning regulations by assisting to conserve and enhance the value of the land within the Township by reducing flooding in the area. The diversion channel would not be consistent with the Comprehensive Plan goal to facilitate traffic movement as some roads would be severed by the Project, as further discussed in Section 3.13 – Infrastructure and Public Services. Township approvals for Project construction may be required as discussed in Section 3.14.3.

Wiser Township, North Dakota

Wiser Township, North Dakota would be impacted by the diversion channel construction footprint. Any approvals needed for the Project would be managed by Cass County where township regulations do not cover certain land uses.

Other Townships

Barnes and Reed Townships, North Dakota are located within the protected area of the Project. Any approvals needed for the Project for the portions of these townships located outside of municipal boundaries, such as the cities of Fargo and West Fargo, would be managed by Cass County where township regulations do not cover certain land uses.

<u>Minnesota</u>

Oakport Township

Oakport Township implemented an Alternative Urban Areawide Review (AUAR) and Mitigation Plan in April 2009. The AUAR is intended to review the cumulative impacts of development. Portions of Oakport Township are scheduled to be annexed into the City of Moorhead January 1, 2015. The Project would not be in conflict with the AUAR as flooding within the Oakport area would be reduced when the Project is in operation. After annexation, the City of Moorhead planning and zoning would apply to this area.

Other Townships

Georgetown, Glyndon, Kragnes, Kurtz, and Moorhead Townships have planning and zoning authority outside of municipal boundaries. The current plans and zoning ordinances in place appear compatible with the Project. Clay County regulations apply where township regulations do not cover certain land uses. Adverse impacts to these townships from the Project are not anticipated as they are located in areas north of the staging area and are intended to benefit from reduced flood risk. It is not anticipated that the Project would require approval by these townships. However, the local planning and zoning approval process for each of these townships may apply.

Holy Cross Township is located in the staging area and would have new flood inundation from the Project. Clay County administers planning and zoning in this township. Wolverton Township in Wilkin County is also located in the staging area where new flood inundation would occur. Wilkin County administers planning and zoning for this township, and some Wilkin County permits and approvals may apply.

3.14.2.1.3 Cities Affected by Project

<u>North Dakota</u>

Argusville, North Dakota

The City of Argusville, North Dakota, Title IV Planning and Zoning Ordinance 4-0401, states one of the goals of the City's Comprehensive Plan is to "encourage the most appropriate use of land in the city and its one mile planning area." The Project would be consistent with this goal and could reduce flooding in the City of Argusville and the one-mile planning area. The diversion channel would be located on the southeastern edge of the one-mile planning area of the City. To aid in planned development, Argusville has an Extra Territorial Area within one mile of the corporate city limits under the authority of the North Dakota Century Code. However, because the Project is within the one mile area, City approval may be required, as further discussed in Section 3.14.3.

Fargo, North Dakota

The Project would be consistent with the City of Fargo Growth Plan 2007 by reducing flood risk, and therefore, aiding planned growth within the F-M urban area. The Project would also comply with the Fargo Land Development Code by working “to protect the health, safety, and general welfare of the citizens of Fargo” by reducing flooding within the Fargo municipality. The diversion channel and the staging area of the Project would be located to the west and south of Fargo’s city limits and outside of the City’s planning and zoning authority. In-town levees, flood walls, and dikes would be constructed within the city limits of Fargo, and therefore, may require City approvals, as further discussed in Section 3.14.3. In general, the Project would allow for development in areas that would otherwise be inundated by flooding during the 100-year or greater event.

Horace, North Dakota

The diversion channel would bisect both the southwestern and northwestern city limits of Horace, along with running through the western side of City’s extra-territorial jurisdiction. One of the goals of the City of Horace Land Use Ordinance is to, “To protect the value of land and buildings and maintain harmony and consistency among land uses.” The Project is anticipated to reduce flooding within this area as flood waters would be channeled into the diversion channel, which is intended to protect land and structures. The Project may allow for development in some areas of Horace that would otherwise be inundated by flooding during the 100-year or greater event.

Oxbow-Hickson-Bakke Communities, North Dakota

The communities of Oxbow, Hickson, and Bakke, located in Pleasant Township, Cass County, North Dakota would be affected by the Project. The OHB ring levee is currently being built to an elevation to protect the communities to the without Project existing 100-year condition. If the Project is completed, the OHB ring levee would be raised to an elevation above expected operational pool elevations. Permits for the construction of the OHB ring levee were issued in July 2014.

West Fargo, North Dakota

A strategic issue of the 2008 West Fargo Comprehensive Plan is maximizing flood protected areas as a key aspect to reinvesting in the community. The Plan acknowledges that for growth of West Fargo to occur, additional flood protection is needed. The Project would align with the goals of the Plan by reducing flood risk in West Fargo and allowing for development to extend into areas of existing floodplain with reduced risk of flooding. Under current municipal boundaries, the diversion channel is west of the city limits, but bisects, the extraterritorial area, and therefore, may require city approval.

Minnesota

Moorhead, Minnesota

A strategic initiative of the City of Moorhead Comprehensive Plan Addendum 2009 is Flood Risk Reduction. The Project would be consistent with this initiative in that the diversion channel would work to reduce flooding within the Moorhead municipality and aid the planned growth of Moorhead by reducing flood risk in the existing floodplain. The diversion channel and the staging area of the Project would be located to the west and south of Moorhead, and therefore, are not under the City's jurisdiction. In-town levees, flood walls, and dikes would be the direct impacts to the city of Moorhead constructed within the city limits of Moorhead, and therefore, may require City approvals, as further discussed in Section 3.14.3.

3.14.2.1.4 Other Local Government Units Affected by Project

North Dakota

There are two joint water resource districts in the project area in North Dakota, the Cass County Joint Watershed District and the Red River Joint Water Resource District. Both of these districts review projects and provide comments to Diversion Authority, but neither has regulatory authority.

Cass County Joint Watershed District

The Project would be located in the Maple River, Rush River, and Southeast Cass Watershed Districts. The CCJWD does not have regulatory authority for planning and zoning, but are active in review of projects in the districts. The CCJWD would be notified of the Project and provide review of the Project.

Red River Joint Water Resource District

The Project would be located with the Red River Joint Water Resource District (RRJWD) along the Red River in North Dakota. The RRJWD does not have regulatory authority for planning and zoning, but is active in review of projects and providing coordination between the districts. The RRJWD would be notified of the Project and provide review of the Project.

Minnesota

Two of the watershed management organizations in the project area are in Minnesota, the Buffalo-Red River Watershed District and the Red River Watershed Management Board. Both have been established planning in the respective areas and have stakeholder involvement with the Project.

Buffalo-Red River Watershed District

The BRRWD Western Planning Region has two goals: improve existing hydrologic conditions in watercourses; and reduce erosion and resulting sedimentation in watercourses. The Project would alter hydrologic conditions by regulating the flow in the Red River during 10-year and greater flood events. The Project may also potentially reduce erosion and sedimentation in the watershed by managing the flow and reducing the high flow events in some portions of the watershed. This could reduce erosion and the amount of sediment moving downstream of some rivers and tributaries.

The BRRWD is also involved with the implementation of the MPCA Watershed Restoration and Protection Strategy (WRAPS). The WRAPS for the Buffalo River has been completed and is currently pending approval from the MPCA. The WRAPS for the Upper Red River is scheduled to be completed in December 2015. It is anticipated that concepts and strategies presented in the WRAPS would be considered by the Diversion Authority during Project planning and construction, and would be considered during BRRWD's Project review and permitting process.

The BRRWD would also be involved in implementing the Ditch Law under Minnesota Statute 103E. However, the Ditch Law would also not be taken into consideration until the effects of Project operation can be monitored and quantified.

Red River Watershed Management Board

The Red River Watershed Management Board watershed districts would be involved with review and comment on the Project. Areas within the RRWMB area would experience altered hydrologic conditions from the Project regulating the flow in the Red River during 10-year and greater flood events. The Project may potentially reduce erosion and sedimentation in some portions of the watershed by managing the flow and reducing the high flow events. This could reduce erosion and the amount of sediment moving downstream in some rivers and tributaries. The Red River Watershed Management Board has provided information and data about the watershed that has been used for planning and EIS development.

3.14.2.2 Base No Action Alternative

Under the Base No Action, land use plans and zoning ordinances would continue to be in place in the project area. These plans and regulations would be revised over time to reflect growth trends and future needs of each community, including regulation of floodplain development where required and appropriate. Watershed management organizations would also continue planning and implementing projects as feasible.

3.14.2.3 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) would be similar to that which was described for the Base No Action Alternative with the addition of emergency measures. Plans and regulations for emergency measures would be revised as needed over time and implemented during periods of flooding in the project area. Watershed management organizations would also continue planning and implementing projects as feasible.

3.14.2.4 Northern Alignment Alternative

Under the NAA, design, construction methods, and operation would be similar to those previously described for the Project, but portions of the NAA (control structures, embankment and connecting channel, overflow embankment, tieback embankment, and staging area) are moved approximately 1.5 miles north of their locations as proposed for the Project. The location of the NAA did not significantly change the LGUs relevant to the Project. The connecting channel would be located in Stanley Township, Cass County instead of in Pleasant Township, Cass County. A portion of the connecting channel would be located in Stanley Township under the Project design, and therefore, the NAA would not result in additional permits from Stanley Township. The NAA tieback embankment would be located in Kurtz Township, which is the same as the Project. Zoning ordinances, comprehensive growth and development plans, and other relevant local plans that were identified and reviewed for the Project are also relevant to the NAA.

Under the NAA, Comstock is not anticipated to have new flood inundation that would impact existing structures during the 100-year flood, and therefore construction of a community ring levee is not included with this alternative. A permit may still be required for improvements needed to provide flood protection the sewage treatment lagoons as a result the NAA.

Generally, the NAA is similar to the Project in regards to the applicable zoning ordinances, comprehensive growth and development plans, and other relevant local plans reviewed for this EIS. Permits and approvals from each of the LGUs, as described for the Project in Section 3.14.3 and in Section 1.4, may also be required for the NAA Additionally, communities in which the NAA affects the existing Flood Insurance Study mapping would be required to go through the CLOMR process as described for the Project in Section 1.4 and Section 3.2.

3.14.3 Mitigation and Monitoring Measures

Construction and operation of the Project would affect multiple LGUs. Project construction may require permits and LGU approval including conditional use permits (CUP). Additionally, the impact of the Project on the existing floodplain may require LGU review of current floodplain ordinances and maps. Zoning amendments may be considered by the LGUs prior for Project operation and impacts may be monitored and quantified. Table 3.61 provides a summary of permits and possible approvals that may be needed for Project construction and operation.

Table 3.61 Local Government Permitting and Approvals That May Be Needed for Project Construction or Operation

Project Construction Footprint		
Permitting Authority	**Potential Permits**	**Notes**
North Dakota		
Cass County, North Dakota	Zoning amendment (potential)	A zoning amendment may be required due to possible changes to existing floodplain.
Harwood Township, North Dakota	Building permit	
	Floodplain permit	
Mapleton Township, North Dakota	Conditional Use permit and Site Approval	CUP may be needed due to severed roads during Project construction.
Pleasant Township, North Dakota	Conditional Use permit and Site Approval	CUP may be needed due to severed roads during Project construction.

Project Construction Footprint		
Permitting Authority	**Potential Permits**	**Notes**
Warren Township, North Dakota	Site Approval for General Ground Excavation with Conditional Use Permit	CUP may be needed due to severed roads during Project construction.
City of Argusville, North Dakota	Conditional Use permit and Site Approval	
City of Horace, North Dakota	Conditional Use permit and Site Approval	CUP may be needed due to severed roads during Project construction.
City of Fargo, North Dakota	Floodplain Permit	
	Storm water Permit	
City of West Fargo, North Dakota	Conditional Use permit	CUP may be needed due to severed roads during Project construction.
Cass County Joint Water Resource District, North Dakota	Subsurface Drain/Application to Drain	
	Application to Drain	
Minnesota		
Clay County, Minnesota	Floodplain permit	
City of Moorhead, Minnesota	Floodplain Permit	
	Storm water Permit	
Buffalo-Red River Watershed District, Minnesota	Construction/Floodplain Approval	Permit may be needed per Rules Section 8
Two Rivers Water Resource District, Minnesota	Two Rivers Water Resource District Application	Drayton Dam mitigation project
Project Staging Area and FEMA Revision Reach		
Permitting Authority	**Permit Needed**	**Conditions, if applicable & Comments**
North Dakota		
Permits in the staging area and FEMA revision reach may be required depending on impacts observed during Project operation and depending on the applicability. At this time, some local governments are unsure whether or not certain permits would be required as the actual impact of Project operation is uncertain.		
Minnesota		
Buffalo-Red River Watershed District	Construction/Floodplain Approval	
Permits in the staging area and FEMA revision reach may be required depending on impacts observed during Project operation and depending on the applicability. At this time, some local governments are unsure whether or not certain permits would be required as the actual impact of Project operation is uncertain.		

3.15 DAM SAFETY

This section describes the regulatory framework for dam safety and the dam safety permit under Minnesota Statutes and Rules and the regulatory implications to the Project and Project Alternatives as applicable. A summary of information reviewed as it relates to the dam safety permit is provided as well. The Project consists of three control structures (structures designed to control flood waters), an earthen tieback embankment, and overflow embankment (Figure 2). The embankment system and control features together are considered a Class I dam under Minnesota Rules. Under the Minnesota Rules 6115.0300 through 6115.0520 construction of a Class I dam requires a dam safety permit from the MNDNR. To date, a dam safety permit application has not been officially submitted by the Diversion Authority.

3.15.1 State Regulatory Framework and Process

The MNDNR Dam Safety Program (Program) was established in 1978 in response to the National Dam Safety Program Act. The purpose of the Program is to protect the health, safety, and welfare of the public by ensuring that dams are safe. Minnesota Statutes, Section 103G.515, authorize the MNDNR to inspect dams and issue orders directing dam owners to make necessary repairs. The same section directs the MNDNR to adopt rules governing dam safety. The specific rules governing the Program are defined in Minnesota Rules, parts 6115.0300 through 6115.0520.

The Program sets minimum standards for dams and regulates the design, construction, operation, repair and removal of dams. Both privately and publicly-owned dams are regulated. Although the embankment system and control features (referred to herein this section as the dam) would be designed to meet USACE dam safety standards, dams regulated in Minnesota would also be required to meet Minnesota dam safety criteria regulated under Minnesota Rules.

Under the Minnesota Rules 6115.0300 through 6115.0520 MNDNR dam safety permits are required to construct, alter, repair, remove or transfer ownership of a regulated dam. Regulated dams subject to existing dam safety rules are defined in Minnesota Rules 6115.0320, subpart 5, and typically include dams with a height of greater than six feet and an impoundment volume greater than 15 acre-feet.

Under Minnesota Rules Chapter 6115, a dam is defined as any artificial barrier, together with appurtenant works, which does or may impound water and/or waste materials containing water. Minnesota Rules, part 6115.0340 classifies dams into three hazard classifications; those dams where failure, misoperation, or other occurrences or conditions would probably result in:

- Class I: any loss of life or serious hazard, or damage to health, main highways, high-value industrial or commercial properties, major public utilities, or serious direct or indirect, economic loss to the public;
- Class II: possible health hazard or probable loss of high-value property, damage to secondary highways, railroads or other public utilities, or limited direct or indirect economic loss to the public other than that described in Class III; and
- Class III: property losses restricted mainly to rural buildings and local county and township roads which are an essential part of the rural transportation system serving the area involved.

Dams may also be classified as "no hazard," meaning there is no potential for loss of life or adverse impacts to health or safety.

3.15.1.1 MNDNR Dam Safety Permitting Process and Permit Decision Criteria

Minnesota Rules, part 6115.0410 details the documents necessary for the dam safety permit application process. The permitting process requires the submittal of a permit application including a preliminary report. The preliminary report would need to include:

a. A general statement setting forth the effect on the environment.
b. Maps showing project locations and adjacent governmental boundaries and local infrastructure.
c. A written report of surface conditions, i.e., geology, topography, which is based on a field examination by the applicant's engineer and other qualified personnel.
d. Typical cross-sections of the dam accurately showing elevations, proposed impoundment levels, and top width.
e. Logs of borings in the foundation and in the borrow areas, and results of seismic and resistivity subsurface investigations, when they are readily available.
f. Preliminary design assumptions, operational aspects, tentative conclusions, and references.
g. A preliminary cost estimate.
h. Where applicable, future plans on ultimate project size including dams and impoundments.
i. A general description of all other activities and elements related to and part of the total dam project, such as operational plans and details of smaller dams, dikes, diversions, reclaim water facilities, and other facility and utility lines including pipelines, roads, and railroads.

Following acceptance and agreement by the MNDNR of the preliminary report, a final design report along with plans and specifications and the initial inspection fee must be submitted for approval. The final design report includes more detail than was required for the preliminary report. Typical information required includes but is not limited to geologic considerations, hydrologic studies, geotechnical information, considerations of construction materials and their properties; analytical determinations, analytical and design details of facilities, operations aspects, surveillance and inspection programs and a detailed cost estimate (see Minnesota Rules, part 6115.0410 for more details on required submittal documents).

The plans and specifications are required to include scaled drawings of the structure(s). Information provided with drawings includes general and technical provisions as well as any special conditions. State rules require that a professional engineer registered in the state of Minnesota who is proficient in dam engineering, prepare the engineering documents, plans, and specifications; inspect the construction; and establish operation and maintenance procedures for the structure(s).

Permit Approval or Denial

The approval or denial of a permit would be based on the potential hazards to health, safety, and welfare of the public and the environment including probable future development of the area downstream or upstream of the dam. For a Class I dam, the MNDNR would need to determine the proposal is adequate and that it shows a "lack of other suitable feasible and practical alternative sites, and economic hardship which would have major adverse effect on population and socioeconomic base of the area affected" (Minnesota Rules, part 6115.0410 subp. 8). The proposal must adequately identify the need in terms of quantifiable benefits; the structural integrity of the dam and associated features under all conditions of construction and operation; discharge and storage capacity of handling the design flood; and compliance with prudent, current environmental practice throughout its existence.

Other considerations for permit approval or denial include Minnesota Statutes, Section 116D.04 Subd. 6 and Minnesota Statutes, Section 103G.245. Minnesota Statute, Section 116D.04 Subd. 6 reads that a permit cannot be granted where the "…action or permit has caused or is likely to cause pollution, impairment, or destruction of the air, water, land or other natural resources located within the state, so long as there is a feasible and prudent alternative consistent with the reasonable requirements of the public health, safety, and welfare and the state's paramount concern for the protection of its air, water, land and other natural resources from pollution, impairment, or destruction. Economic considerations alone shall not justify such conduct." In accordance with Minnesota Statutes, Section 103G.245, a permit may be issued only if it will involve minimum ecological impacts. However, "if a major change in the resource is justified, then the permit must include provisions to compensate for the detrimental aspects of the change." Examples of provisions, or conditions of the permit, may include construction and operational restrictions, inspection schedules, construction and operational reports, operation and maintenance plans as well as required mitigation.

The information provided in this EIS and associated environmental review documents serve and must be used as a guide as part of decision making in issuing, amending, and denying permits and carrying out other responsibilities of governmental units to avoid or minimize adverse environmental effects and to restore and enhance environmental quality (Minnesota Rules, parts 4410.0300 and 4410.7055). As such, in accordance with Minnesota Rule, part 4410.3100, the permit may not be granted (or a project started) until the EIS is determined adequate.

Minnesota Rules, part 4410.2900 states that final decisions on permits must be made within 30 days following the determination of adequacy of a final EIS, on those permits which were identified as permits required in the scoping process and for which information was developed concurrently with the preparation of the EIS. This is also in accordance with Minnesota Executive Order 11-04 which states that "Commissioners (of Natural Resources) shall establish a goal for each of their agencies to decide within 30 days after an environmental impact statement is finally approved, whether to issue the permit." Minnesota Rule, part 4410.2900 does allow the 30-day period to be extended with the consent of the permit applicant, where a longer period is required by federal law or state statute, or where a longer period is permitted by Minnesota Statutes, section 15.99. Pertaining to the Project, the EIS presents the most current Project design; however, as noted within other chapters and sections within the EIS, the Project design has not been finalized. Several studies are underway or would need to be conducted that would be used in refining and further developing the Project design to avoid and minimize Project construction and operation impacts as well as to determine mitigation needs that have yet to be identified. Many of these studies would be required materials for the dam safety permit application that has yet to be submitted. Therefore, in accordance with Minnesota Rules 4410.2900 language above, not all information required for permit decision making has been developed concurrently with the preparation of the EIS. As such, it is an understanding between the Diversion Authority, USACE and MNDNR, as the permitting authority, that the dam safety permit decision will not be made within the 30-day period following an adequacy determination.

3.15.2 Affected Environment

Three large rivers converge in the project area, the Red River, the Wild Rice River, and the Sheyenne River. Tributaries that feed into these systems include the Maple River, Wolverton Creek, the Lower Rush River, and the Rush River. There are no Class I dams currently within and near the project area; however, there are smaller impoundments (dams and their reservoirs) located on other portions of these rivers, including the Drayton and Hickson dams on the Red River, three smaller dams within the F-M urban area on the Red River, and the Wild Rice Dam on the Wild Rice River outside of the project area.

Large portions of the project area are used for agricultural purposes and include systems related to agricultural activities such as drainage tiles and ditches. The F-M urban area that includes the cities of Fargo and Moorhead, as well as neighboring suburbs, lies in the middle of the project area and downstream of the convergence of the Red and the Wild Rice Rivers. The proposed Class I dam would be located upstream of the F-M urban area. The Sheyenne River converges with the Red River further downstream of the F-M urban area.

3.15.3 Environmental Consequences

The Project must be designed to provide the appropriate measures and factors of safety to meet the requirements of the MNDNR dam safety permit. Failure of the embankments, control structures or its components due to inadequate design, improper operation, inadequate maintenance, or unusually larger flood events that exceed the design capacity could allow flood water into the protected area, north of the dam. The effects of failure could be catastrophic, causing loss of life and significant property damages, depending on the magnitude and timing of the flood stage increases. The dam safety permit review and decision process helps provide assurances and safeguards from these types of impacts from occurring.

3.15.3.1 Proposed Project

The current alignment and design considerations for the Project are described in Chapter 2 and shown in Illustrations 2-1 and 2-2, and Figure 2. The embankment system and control features together are considered a Class I dam under Minnesota Rules and would require a dam safety permit from the MNDNR.

Much of the content reviewed and included in the EIS from the FFREIS, the Supplemental EA, the PFSAA (HMG, 2012) and other Project studies will help fulfill the preliminary report submittal requirements for the dam safety permit application (as detailed above). However, many of these studies were conducted to meet the intent of a feasibility level study and provide preliminary design and cost estimates; therefore, they were based on earlier design concepts that may not be applicable to current or future Project designs.

Additional and updated studies would be required during future design phases to satisfy the requirements needed to obtain the necessary dam safety permit. This includes development of an OMRR&R Manual that would be completed once Project designs are finalized. Ongoing coordination with MNDNR permitting staff is necessary to define what is necessary to include in a complete application package that includes all requirements and to ensure that information is applicable to the Project as proposed.

The components evaluated to date include the river control structures and some of the embankment system. Several of the studies and Project information that is available and would be relevant to the dam safety permit include the following:

- Risk of Failure – Loss of Life (FFREIS – Appendix D, Attachment 1 and 2, FFREIS 2011);
- Project component maps, plans, and illustrations (various resources);
- Maps of project area features (e.g., historical properties, transportation, utilities, and survey locations) (various resources);
- Geotechnical Assessments: physiography, topography, geology, structure, site hydrogeology, and seismic risk and earthquake history analysis (FFREIS - Appendix I – Geotechnical Design and Geology, FFREIS 2011; PFSAA Report, HMG, 2012);
- Structural design assumptions: control structures and embankment system (FFREIS 2011; PFSAA Report, HMG, 2012);
- Hydrology and hydraulic modeling (EIS);
- Preliminary Cost Estimate (PFSAA Report, HMG, 2012);
- Operation Plan (USACE, 2014c);
- Various mitigation, monitoring, and other Project plans (various sources, as deemed applicable by permitting staff);
- Socioeconomics information (FFREIS 2011; HMG, 2015); and
- Environmental review documents (FFREIS 2011; Supplemental EA 2013; MNDNR EIS – in-progress)

3.15.3.1.1 Dam Safety Permit – Health, Safety, and Welfare

The most fundamental permit requirements focus on public safety. That is because the purpose of the Program is to safeguard against risk of failure and to ensure that dams are safe. It should be clarified that “risk” is the probability of failure times the consequences of failure.

Unlike environmental review, the dam safety permit application process does not typically include a public review component nor does it necessarily involve or include access to all decision makers. For those projects such as this one that require environmental review, the environmental review process offers an opportunity for the public and other interested parties to participate through public review and comment periods. Therefore the focus of the remainder of this section will be on disclosing what is known in regard to public safety and the consequences of a dam failure.

The FFREIS discusses the risks associated with structure failure in Attachments 1 and 2 of Appendix D (USACE 2011). The results of these analyses provide an idea of what loss of life (LOL) consequences could occur as a result of structure (e.g., levee, dam) failure under existing conditions and Project scenario but it is important to note that they were not based on current designs or hydrology models and that they should not necessarily be compared to each other as methods and flood scenarios differed between the analyses.

Attachment 1 estimates LOL under existing conditions due to levee overtopping or a levee breach in the F-M urban area under the anticipated and unanticipated scenarios for 10-year, 20-year, 50-year, 100-year, 200-year and 500-year flood events. Anticipated scenarios mean that a potential failure is known and there is time to issue a public evacuation notice to 100 percent of the population. Unanticipated scenarios are ones in which there is no advance warning. The breach is assumed to occur at peak flood level. Existing conditions LOL estimates are included to provide a baseline for Project LOL estimates.

Table 3.62a shows the estimated LOL for each flood event under existing conditions with two assumptions. The first assumption is an anticipated failure in which an estimated 98 percent of the population would be evacuated, and the second assumption is an unanticipated failure with zero percent evacuation. Worst case results are presented (i.e., upper extremes). The LOL analysis for existing conditions estimates LOL for the 100-year flood with zero percent evacuation to be 200 lives. The 500-year LOL estimate for zero percent evacuation is 594 lives.

Table 3.62a: Estimated Maximum Loss of Life in the F-M Urban Area - Existing Conditions Due to Levee Overtopping or a Levee Failure [1]

Flood Event	Population At Risk[1]	Existing Conditions (Base No Action Alt.)[2]	
		Anticipated 98% Evac.	Unanticipated 0% Evac.
10-year	858	1	32
20-year	1,501	1	54
50-year	2,177	2	90
100-year	18,050	4	200
200-year	64,670	8	394
500-year	133,403	12	594

Source: FFREIS – Appendix D, Attachment 1, USACE 2011
[1]Population was estimated by determining which structures would be impacted during an individual flood event (flood depth grids). Population associated with each structure was calculated as the total metro population (202,684 people) divided by the number of structures.
[2] "Existing conditions" for the purposes of the EIS is considered similar to the Base No Action Alternative.

Attachment 2 in Appendix D of the FFREIS is a draft report that provides preliminary results for a LOL analysis under Project conditions with a levee breach scenario. At the time of the draft report, the Locally Preferred Plan (LPP) was different than the plan presented in the Supplemental EA (USACE 2013c), but the results present an idea of the risk reduction as it relates to LOL. (Note: The LPP, as evaluated in the FFREIS, was later modified for evaluation in the Supplemental EA as the Southern Alignment Alternative, the embankment use for this analysis was for Storage Area 1 – a feature that is not included in current Project plans). The results presented in the draft report evaluate LOL under a night scenario and a day scenario. Scenarios were run for the 10-, 100-, and 500 x 2-year flood events. The worst-case scenario s (i.e., upper extreme numbers during the day) are included in Table 3.62b below. The worst consequences of LOL occur during an Unanticipated Event in which it was estimated that the

LOL for a 100-year flood event would result in 31 lives. As expected, a 500 x2-year flood event (a 500-year flood peak times two) has the highest LOL; however, that scenario is unlikely to occur and was included as a way to measure what an extreme worst-case scenario LOL would be. An existing conditions analysis using the same data and methods was being completed as part of this study; however, results were not finalized and published as Project design changes occurred.

Table 3.62b: Estimated Maximum Loss of Life in the F-M Project Area – Project Condition Due to a Levee Breach of the Storage Area[1]

Flood Event	Population At Risk[2]	Project Conditions[1]
10-year Breach	863	0
100-year Breach	18,976	31
500x2 year (No Breach)	20,877	9
500x2 Breach	74,694	350

Source: FFREIS – Appendix D, Attachments 1 and 2, USACE 2011

[1] "Project conditions" for the purposes of the EIS is considered to be similar to the Project; however, this was based on a previous design and Project feature (Locally Preferred Plan / Storage Area 1) that has changed since the FFREIS.

[2] Population was estimated by determining which structures would be impacted during an individual flood event (flood depth grids). Population associated with each structure was calculated as the total metro population (202,684 people) divided by the number of structures.

These results provide valuable insight to what the consequences of a dam failure may be to human safety under existing and Project conditions. However, a dam breach analysis that considers current (or final design plans and flood scenarios/updated hydrology) would be necessary to meet permit requirements. The dam breach analysis would model a hypothetical breach of the tieback embankment or one of the gates during flooding conditions to find out how high the water would rise in the river downstream of the dam – similar to the LOL analysis completed and provided with the FFREIS. A map would need to be developed that would show the affected area, which would be used in the development of an emergency action plan. Further details would be coordinated between the USACE, Diversion Authority, and MNDNR.

3.15.3.2 Base No Action Alternative

Under the Base No Action, flooding would continue in the project area. A Class I dam on the Red River and Wild Rice River would not be constructed. Potential flood risk reduction from the Project would not be realized. Loss of life under existing conditions for the 100-year flood with a 98 percent anticipated failure and evacuation would be four. Under a zero percent evacuation the loss of life is estimated to be 200 lives (FFREIS – Appendix D - Attachment 1, FFREIS 2011).

3.15.3.3 No Action Alternative (with Emergency Measures)

Conditions under the No Action Alternative (with Emergency Measures) would be similar to the Base No Action Alternative as no high-hazard dam would be constructed. Differences include sandbagging and temporary levees being installed along the Red River through the F-M urban area. Sandbagging and temporary levees, although providing some level of protection from flood waters, may increase the risk to human health and safety due to the increased likelihood of failure of emergency measures. These efforts would also result in higher flood stages through Fargo/Moorhead and in upstream areas and loss of life associated with an unanticipated failure would likely be higher than what was estimated for the Base No Action Alternative under unanticipated failure scenarios.

3.15.3.4 Northern Alignment Alternative

In general, the NAA design, construction, and operation would be similar to those proposed for the Project, including the construction of an embankment system and control structures. Therefore, the NAA would require a MNDNR dam safety permit.

Feature location and operation NAA project differences from the Project include:

- Tieback embankment and control structures locations. NAA structures would be located approximately 1.5 miles north of the Project tieback embankment and control structure locations (Figure 6). The Red and Wild Rice River control structures would be constructed adjacent to the Red River in Kurtz Township (Clay County, MN) and Wild Rice River in Stanley Township (Cass County, ND). The control structures would be constructed adjacent to the existing channels in order to keep the sites dry during construction.
- Upstream staging elevation operation. A maximum stage of 35.0 feet would be maintained at the Fargo gage until the upstream staging elevation would reach 919.3 feet, which is anticipated to occur with the 100-year flood.

NAA components would generally be designed the same as Project components (Chapter 2). Currently it is estimated, based on the EIS conceptual NAA, that the embankments may need to be designed at a higher elevation to be able to meet peak flood and freeboard needs and that the linear length of the connecting channel would also likely need to be longer than that proposed for the Project to adjust for 1.5 mile alignment change. However, specific design details would need to be developed for the NAA to be able to define these impacts and potential human health risks more accurately. It is anticipated that similar design methodologies would be used as those applied for the Project. Some of the previously completed studies, as described above under subsection 3.15.3.1, may still be applicable and used in part to meet permit requirements; however, a more thorough review would be necessary with a focus on the NAA and feature locations. As with the Project, it is likely that these studies would require updating or that additional studies may be necessary in order to meet the preliminary report submittal requirements for the dam safety permit.

A detailed cost estimate has been prepared for the NAA and is included as an Appendix to the Fargo-Moorhead Area Diversion Project Socio Economics Technical Report In Support of Minnesota EIS (HMG, 2015b) included as Appendix I of this EIS. The costs estimate was based on the conceptual NAA and included assumptions from the PFSAA report for the VE-13 Option C alternative in absence of specific NAA details. The cost estimate was presented in 2010 US Dollars ($) and does not include escalation or operation and maintenance costs. Updated cost estimates would be needed to meet permit requirements.

As the design, construction, and operation is generally the same for the NAA as it is for the Project, the LOL analysis discussed above under the Project provides an idea of what risk the NAA dam would have to human health and safety in the event of failure. A dam breach analysis would need to be completed that would include detailed and current design plans to meet dam safety permit requirements.

3.15.4 Proposed Mitigation and Monitoring Measures

Proposed mitigation and monitoring and mitigation and monitoring recommendations are detailed within Chapters 3, 5, and 6; and Appendix B of this EIS. Mitigation and monitoring plans may need to be included with the dam safety permit application. Specifically those that are directly associated with the dam construction and operation such as restoration activities or aquatic habitat improvements. The dam safety permit may also require – through permit conditions - additional mitigation above and beyond that which is proposed or may require plans in place to address impacts that may occur such as the Draft AMMP included with this EIS.

As stated above, an official dam safety permit application has not been submitted by the Diversion Authority. Although information presented within this EIS and associated environmental review documents serves and must be used as a guide as part of decision; a complete permit application must still be submitted and undergo an official review process as outlined above. A thorough review of available studies and current design plans would occur during that time by MNDNR permitting staff, utilizing available data referenced and developed during the environmental review process. Additional discussions would occur between the USACE, Diversion Authority, their representatives, and MNDNR permitting staff to assess the dam safety permit requirements specific to this Project.

3.16 SOCIOECONOMICS

Socioeconomics is an evaluation of how economic activity can affect the social or human and community well-being and how those social or human aspects can also affect the economic or financial status and livelihood of a given area, such as a defined project area. There are many factors that can influence socioeconomics. Depending on which of those factors is affected and to what extent could result in various changes to the social and economic condition of the project area. Some of the factors potentially influencing socioeconomics as a result of the Project include economic growth, health and safety, impacts to communities from relocation of its residents, and economic costs, including lost income or reduced property values.

The discussion provided within this section satisfies Minnesota Rules part 4410.2300(H) that states that the EIS should include (for Project and each major alternative) "a thorough but succinct discussion of potentially significant adverse or beneficial effects generated in the areas of environmental, economic, employment, and sociological impacts, whether they be direct, indirect, or cumulative." The rule further states that the "data and analyses shall be commensurate with the importance of the impact and the relevance of the information to a reasoned choice among alternatives and to the consideration of the need for mitigation measures."

This section also addresses public comments received during the SEAW public comment period regarding the socioeconomic effects of the Project. This includes a quantitative and qualitative evaluation of the social and economic effects of reducing flood risk within the F-M urban area (i.e., the protected area) while increasing flood impacts in the surrounding rural areas south of the tieback embankment (i.e., the unprotected area); and reviews the flood damages/fighting, development, and social outputs of North Dakota and Minnesota.

The USACE completed an extensive economic and social analysis as part of the FFREIS in 2011 using a number of models, data inputs, observations and studies for the Project and its alternatives under consideration at that time (FFREIS Appendices C—"Economics" and D—"Other Social Effects"). Factors related to the human impacts of the Project and alternatives were considered by the USACE as OSE. The USACE study area extended along the Red River, between Abercrombie (ND), and the Canadian border and included portions of 12 counties in North Dakota and Minnesota. Major socioeconomic characteristics and trends, including demographics and economics were evaluated in order to provide a context from which to assess impacts of the Project (referred to as the LPP in the FFREIS and associated documents) and alternatives. Cost-benefit ratios were included as part of that analysis as well as descriptions of the residual risk associated with the various alternatives. Other Social Effects (OSE) which are factors that consider the human impacts of the Project and alternatives were considered when determining which alternative provided the highest social benefit. With the exception of the Project, the alternatives included within those studies are not considered in this EIS.

The socioeconomic analysis completed for this EIS uses new and updated H and H modeling information; a different no action alternative (or baseline) for the analysis; updated Project designs and Project modifications; analysis of the NAA; additional supplemental resources (e.g., organic farms inventory and the MNDNR structure count analysis) as well as regional and local information. Most of the information presented and discussed within this section is focused on the F-M urban area and the rural areas located south of the tieback embankment within and adjacent to the staging area, as those are the areas that are anticipated to be affected most by the Project. Because many of the models, data inputs, and studies used for the FFREIS are different from those used for the socioeconomic analysis in this EIS, a side-by-side comparison of the two analyses is not included in this discussion. However, these resources have been used to the extent that they are relevant and applicable to this discussion.

Primarily, the socioeconomic analysis completed for this EIS included review of:

- FFREIS, including Appendices C—"Economics", D—"Other Social Effects", G—"Real Estate", and U—"Summarized Comments and Corps Responses" (2011),
- Supplemental EA (2013),
- Ag Policy Group Mitigation Plan (2015) (Appendix J),
- *Final Technical Report: Fargo-Moorhead Area Diversion Project Socio Economics Technical Report In Support of Minnesota EIS* (HMG, 2015a) (SE Report) (Appendix I),
- *Final Technical Memorandum: Opinion of Probable Construction Cost of Support MN/DNR Northern Alignment Evaluation* (HMG, 2015b) (SE Report-Appendix A), and
- *Technical Memorandum: Organic Farms Inventory* (Wenck, 2015) (Appendix K).

This subsection follows a similar format as other sections within Chapter 3. Current economic conditions are discussed to provide a base from which to consider potential Project and alternatives impacts. Details regarding the models and methodologies used for the quantitative and qualitative evaluations are included to provide context to the data and discussions provided within the tables and text. Estimated Project construction, operation and maintenance costs have been included to provide context for the overall Project and its potential economic impact on the project area. Potential socioeconomic impacts are discussed quantitatively where feasible, and qualitatively to evaluate the Project and its alternatives potential effects on public services, structures, structure function, flood insurance, effects of relocations, and agriculture.

3.16.1 Affected Environment

According to the Greater Fargo Moorhead Economic Development Corporation:

> *"Fargo Moorhead is a metropolitan area with a vibrant population of roughly 224,000 and almost 30,000 college students. The Fargo Moorhead community is known for steady growth, a highly- trained workforce, business friendly environment, outstanding quality of life and reasonable costs of living and doing business."*[2]

Also according to the Greater Fargo Moorhead Economic Development Corporation website, the F-M area has been ranked as #1 in Forbes Best Small Places for Business and Careers, July 2014; as one of the "10 Best Cities for Finding a Job" by U.S. News & World Report, January 2012; ranked fifth as one of "America's Best Places to Live" by Moving.com; and ranked third in the Eight Annual Farmers Insurance Study for the "Most Secure Places to Live in the U.S., December, 2011. The F-M urban area serves as the regional center for healthcare, education, government, and commerce.

Flooding poses a considerable risk of damage to urban and rural infrastructure; disruptions to transportation corridors; and damages to businesses and homes. According to the OSE study completed by the USACE (FFREIS Appendix D), the threat of catastrophic flooding and the frequency and magnitude of recent floods results in high stress levels which takes a toll on both mental and physical well-being of the residents and business owners within the F-M area. In recent history, the two flooding events that have had the greatest physical and emotional effect on the communities of Fargo and Moorhead are the 1997 and 2009 flood events.

3.16.1.1 Socioeconomic Conditions

The following presents an overview of the major socioeconomic trends for the four counties that comprise the project area: Cass and Richland County (ND); and Clay and Wilkin County (MN). Included in the analysis for context are the state and national averages. Major socioeconomic trends reviewed include: demographics, employment and income, housing, and fiscal resources. Information from a variety of references and sources were used in the socioeconomic analysis, including data through approximately 2012 as the most recent publicly available data. Primary data sources for the analysis include: 1980, 1990, 2000, and 2010 census data; American Community Survey; Bureau of Labor Statistics; Bureau of Economic Analysis. The Base No Action Alternative serves as the baseline for existing conditions for this socioeconomic conditions analysis. Data was compiled as part of the Socioeconomic (SE) Report completed for this EIS.

3.16.1.2 Population

The 2010 census reports the population of the four counties that consist of the project area at 231,674 (Table 3.63). Clay and Cass counties account for approximately 209,000 or about 90 percent of this population. Cass County has demonstrated historically high average growth from 1980 to 2010 with the average consistently above the state and national averages. County

[1]Greater Fargo Moorhead Economic Development Corporation, http://gfmedc.com/ accessed 2/3/2015

growth has been centered on Fargo. Clay County and Moorhead have not had the same high growth until the more recent period of 2000 to 2010. Conversely, Wilkin and Richland counties have experienced consistent decline over the same periods.

Table 3.63 Historical Population Trends: National, State, County, and City

Location	1980	1990	Percent Change 1980-1990	2000	Percent Change 1990-2000	2010	Percent Change 2000-2010
United States	231,103,121	253,498,149	9.7%	281,421,906	11.0%	308,745,538	9.7%
Minnesota	4,075,970	4,375,099	7.3%	4,919,479	12.4%	5,303,925	7.8%
Clay County, MN	49,327	50,422	2.2%	51,229	1.6%	58,999	15.2%
Moorhead, MN	29,998	32,295	7.7%	32,177	-0.4%	38,065	18.3%
Wilkin County, MN	8,454	7,516	-11.1%	7,138	-5.0%	6,576	-7.9%
North Dakota	652,717	638,800	-2.1%	642,200	0.5%	672,591	4.7%
Cass County, ND	88,247	102,874	16.6%	123,138	19.7%	149,778	21.6%
Fargo, ND	61,383	74,111	20.7%	90,599	22.2%	105,549	16.5%
Richland County, ND	19,207	18,148	-5.5%	17,998	-0.8%	16,321	-9.3%
County Totals	165,235	178,960	8.3%	199,503	11.5%	231,674	16.1%

Source: U.S. Census Bureau, American Fact Finder.
Note: 1980 and 1990 data for each location obtained from Decennial Census, U.S. Census Bureau

The cities of Fargo and Moorhead account for approximately two-thirds of the population in the four-county study area. The remaining 88,000 persons reside outside of the two cities (44,000 in Cass County; 21,000 in Clay County; 16,000 Richland County; and 6,600 Wilkin County).

3.16.1.3 Educational Attainment

Approximately 43 percent of the population 18 and over within the four counties have some college or an associate's degree according to the Census Bureau (Table 3.64). The F-M urban area and greater Cass and Clay counties have a lower incidence of population without a high school diploma or equivalent than the national and respective state averages (5-6 percent).

Table 3.64 Highest Educational Attainment 2010-2012

Location	Population 18 and Over	Less than High School graduate	High School graduate (includes equivalency)	Some college or associate's degree	Bachelor's degree or higher
United States	237,706,206	14%	28%	31%	26%
Minnesota	4,067,888	8%	27%	35%	30%
Clay County, MN	45,972	6%	29%	41%	25%
Moorhead, MN	30,818	6%	25%	44%	26%
Wilkin County, MN	4,985	11%	29%	44%	15%

Location	Population 18 and Over	Less than High School graduate	High School graduate (includes equivalency)	Some college or associate's degree	Bachelor's degree or higher
North Dakota	534,217	9%	27%	40%	25%
Cass County, ND	119,948	5%	20%	42%	33%
Fargo, ND	87,205	6%	19%	42%	33%
Richland County, ND	12,813	10%	27%	46%	18%

Source: U.S. Census Bureau, American Fact Finder.

3.16.1.4 Housing

There are two measures of housing relevant to flood risk; first total housing provides an estimate of the stock of residential buildings in the four-county area. The second measure is the number of available housing units, which indicates the relative availability of housing for residents to use for temporary relocations during flooding or for permanent relocations due to project construction. As Table 3.65 shows, the majority of the total housing units are located in Cass and Clay counties within the F-M urban area.

Table 3.65 Total Housing Units

Location	2000	2010	2000-2010 Percent Change
United States	115,904,641	131,704,730	14%
Minnesota	2,065,946	2,347,201	14%
Clay County, MN	19,476	23,959	23%
Wilkin County, MN	3,105	3,078	-1%
Moorhead, MN	12,180	15,274	25%
North Dakota	289,677	317,498	10%
Cass County, ND	53,790	67,938	26%
Richland County, ND	7,575	7,503	-1%
Fargo, ND	41,200	49,956	21%

Source: U.S. Census Bureau, American Fact Finder

Available housing has been on the rise in both Cass and Clay counties, including the cities of Fargo and Moorhead, outpacing the national and state averages between 2000 and 2010, according to the Census American Fact Finder (Table 3.66).

Table 3.66 Available Housing Units

Location	2000	2010	2000-2010 Percent Change	2010 Median	
				$ Value	$ Monthly Rent
United States	10,424,540	14,988,438	44%	$187,500	$850
Minnesota	170,819	259,974	52%	$202,700	$762
Clay County, MN	1,076	1,680	56%	$154,900	$636
Moorhead, MN	520	970	87%	$153,500	$662
Wilkin County, MN	353	388	10%	$102,800	$496
North Dakota	32,525	36,306	12%	$117,200	$567
Cass County, ND	2,475	4,039	63%	$151,300	$611
Fargo, ND	1,932	3,165	64%	$149,400	$606
Richland County, ND	690	852	23%	$93,400	$454

Source: U.S. Census Bureau, American Fact Finder

3.16.1.5 Employment and Income

Employment trends in the four-county area are positive for Minnesota and North Dakota as indicated by the data presented below (Table 3.67). With the exception of Richland County, the counties and Fargo and Moorhead demonstrated positive growth in employment as well as declines in their respective unemployment rates. Additionally, all four counties have unemployment well below the national average.

Table 3.67 Civilian Labor Force Estimates – 2010-2012

Location	2010	2012	2010	2012	2010	2012	2010	2012
	Labor Force		Employment		Unemployment		Unemployment Rate (%)	
United States[1]	153,889	154,975	139,064	142,469	14,825	12,506	9.6	8.1
Minnesota	2,938,795	2,954,950	2,721,194	2,789,861	217,601	165,089	7.4	5.6
Clay County, MN	33,883	35,115	32,009	33,427	1,874	1,688	5.5	4.8
Moorhead, MN	21,967	22,880	20,871	21,906	1,096	974	5	4.3
Wilkin County, MN	3,815	3,783	3,606	3,605	209	178	5.5	4.7
North Dakota	378,342	397,892	364,053	385,718	14,289	12,174	3.8	3.1
Cass County, ND	89,319	89,968	86,177	87,344	3,142	2,624	3.5	2.9
Fargo, ND	62,742	63,019	60,528	61,183	2,215	1,836	3.5	2.9
Richland County, ND	9,068	8,554	8,720	8,242	348	312	3.8	3.6

Source: U.S. Bureau of Labor Statistics, Local Area Unemployment Statistics, http://www.bls.gov/lau, Downloaded April 27,2015.

[1]Numbers in Thousands

In both Cass and Clay counties and the cities of Fargo and Moorhead, unemployment has remained well below the national average (Table 3.68). Unemployment rose slightly during the recession period from 2008-2010, but has been declining since.

Table 3.68 Unemployment Rate (%): National, State, County, and City (2002-2012)

Location	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
United States	5.8	6.0	5.5	5.1	4.6	4.6	5.8	9.3	9.6	8.9	8.1
Minnesota	4.5	4.9	4.6	4.2	4.1	4.7	5.4	8.0	7.4	6.5	5.6
Clay County, MN	3.6	3.6	3.6	3.5	3.3	3.5	3.7	5.0	4.8	5.1	4.2
Moorhead, MN	3.0	3.1	3.2	3.0	2.8	3.0	3.1	4.2	4.2	4.4	3.7
Wilkin County, MN	3.9	3.9	3.8	3.8	3.8	3.9	4.4	5.6	4.8	4.8	4.1
North Dakota	3.5	3.6	3.5	3.4	3.2	3.1	3.1	4.1	3.8	3.4	3.0
Cass County, ND	2.7	2.9	2.7	2.7	2.5	2.6	2.7	4.1	3.8	3.5	3.3
Fargo, ND	2.8	3.0	2.8	2.7	2.5	2.6	2.7	4.2	3.8	3.5	3.2
Richland County, ND	3.4	3.6	3.4	3.4	3.4	3.3	3.8	5.1	4.1	4.0	3.7

Source: U.S. Bureau of Labor Statistics, Local Area Unemployment Statistics, http://www.bls.gov/lau, Downloaded March 12, 2014.

Per capita income is a measure of income that is typically used to compare the prosperity of the population of an area. Table 3.69 presents an overview of per capita income for the four-county area, Minnesota, North Dakota, and the United States. With the exception of Clay County, per capita income in Cass, Wilkin, and Richland counties exceed the national average and are growing much faster than the nation. The per capita income in Richland and Wilkin counties is growing faster than Clay and Cass counties. In general, per capita income in North Dakota is growing at a faster rate than Minnesota.

Table 3.69 Per Capita Income

Location	2007	2008	2009	2010	2011	2012	2007-2012 Percent Change
United States	$39,804	$40,873	$39,357	$40,163	$42,298	$43,735	9.9%
Minnesota	$41,588	$43,068	$41,202	$42,616	$45,135	$46,925	12.8%
Clay County, MN	$31,842	$34,083	$33,219	$34,563	$36,595	$38,549	21.1%
Wilkin County, MN	$33,858	$41,661	$35,612	$41,699	$43,529	$52,343	54.6%
North Dakota	$36,127	$40,880	$40,005	$43,232	$47,218	$54,871	51.9%
Cass County, ND	$38,387	$42,336	$40,888	$42,805	$46,311	$49,402	28.7%
Richland County, ND	$32,321	$39,512	$34,369	$41,042	$43,727	$53,553	65.6%

Source: U.S. Bureau of Economic Analysis, National, State, and Regional Data
Note: Data for Fargo and Moorhead collected at the Metropolitan Statistical Area (MSA) level.

Another measure of wealth is median household income as reported by the Census Bureau (Table 3.70). The median household income in the four-county area is below the national average between 2000 and 2010. However, during the two periods the median household income demonstrated strong growth with increases between 19 and 34 percent (U.S. average 19 percent, Minnesota 18 percent, and North Dakota 41 percent).

Table 3.70 Median Household Income (2000 & 2010)

Location	Median Household Income	
	2000	2010
United States	$41,994	$50,046
Minnesota	$47,111	$55,422
Clay County, MN	$37,889	$48,395
Moorhead, MN	$34,781	$44,683
Wilkin County, MN	$38,093	$48,611
North Dakota	$34,604	$48,878
Cass County, ND	$38,147	$50,932
Fargo, ND	$35,510	$42,144
Richland County, ND	$36,098	$48,821

Source: U.S. Census Bureau, Small Area Estimates Branch, Internet
Release Date: November 2011

The industry breakdown for earnings by place of work is shown below in Table 3.71. Earnings by place of work indicate that in Clay County, Agriculture and Government Services are the largest sectors by income even though they are not the highest for number employed. In Cass County, Government is also a source of high earnings for the study area along with Health Care, Wholesale Trade, Manufacturing, and Construction. In Richland County, Agriculture, Manufacturing, and Government Services are the largest sectors by income. In Wilkin County, Agriculture is by far the largest sector of employment by income.

Table 3.71 Components of Personal Income, in Millions of Dollars (2012)[1,2]

2012 North American Industry Classification System Industry	Location							
	United States	Minnesota	Clay County, MN	Wilkin County, MN	North Dakota	Cass County, ND	Richland County, MN	F-M urban area
Total earnings (by place of work)	9,821,404.0	190,045.9	1,121.4	204.9	31,093.4	6,918.1	656.5	8,039.5
Farming	99,786.0	7,143.3	149.2	93.2	4,306.6	338.4	254.2	487.6
Forestry, fishing, and related activities	27,819.0	457.3	(D)	(D)	120.8	(D)	(D)	(D)
Mining	168,326.0	901.4	(D)	(D)	2,790.9	(D)	(D)	(D)
Utilities	79,326.0	1,660.3	(D)	(D)	420.6	16.9	(D)	16.9 (E)
Construction	517,367.0	8,954.4	61.5	3.5	2,541.0	500.5	33.4	562.0

2012 North American Industry Classification System Industry	Location							
	United States	Minnesota	Clay County, MN	Wilkin County, MN	North Dakota	Cass County, ND	Richland County, MN	F-M urban area
Manufacturing	972,055.0	24,415.6	66.9	0.5	1,504.9	570.9	112.4	637.8
Wholesale trade	502,780.0	12,163.5	72.4	15.9	2,053.5	583.7	28.9	656.1
Retail trade	586,086.0	9,902.9	79.6	5.4	1,709.4	470.8	23.5	550.4
Transportation and warehousing	332,747.0	5,824.0	(D)	(D)	1,835.8	251.1	(D)	(D)
Information	313,717.0	4,990.3	8.4	(D)	485.9	275.8	3.4	284.2
Finance and insurance	690,829.0	16,065.9	24.4	(D)	1,151.9	515.4	9.7	539.7
Real estate and rental and leasing	181,390.0	3,244.0	6.8	(D)	616.8	260.5	2.9	267.3
Professional, scientific, and technical services	974,178.0	14,915.3	34.3	1.3	1,226.9	445.8	13.7	480.1
Management of companies and enterprises	257,268.0	9,780.2	28.6	0.0	398.0	218.5	(D)	247.1
Administrative and waste management services	392,535.0	5,830.9	11.2	(D)	558.2	207.3	(D)	218.6
Educational services	164,466.0	2,752.9	(D)	0.9	119.6	24.5	(D)	(D)
Health care and social assistance	1,075,222.0	23,163.1	(D)	21.7	2,977.4	933.6	(D)	933.6 (E)
Arts, entertainment, and recreation	105,335.0	1927.7	4.1	0.1	89.6	31.7	0.8	35.8
Accommodation and food services	306,546.0	4,469.9	30.1	2.0	737.9	210.2	6.8	240.3
Other services, except public administration	355,6850.0	6,187.9	48.1	15.6	823.9	198.2	12.7	246.3
Government and government enterprises	1,717,941.0	25,166.7	244.2	20.3	4,623.8	850.4	93.8	1,094.6

Source: U.S. Bureau of Economic Analysis

[1](D) – Data subject to non-disclosure but the estimates for these items are included in total.

[2](E) – The estimate shown here constitutes the major portion of the true estimate.

3.16.2 Environmental Consequences

This subsection quantitatively evaluates the costs of the Project (including mitigation) as well as the flood damage reduction benefits arising from operation of the Project and mitigation actions.

Quantitative analysis was also completed for the NAA and the Base No Action Alternative. Potential quantitative impacts for the No Action Alternative (with Emergency Measures) were extrapolated from the Base No Action Alternative as applicable.

The quantitative analysis was primarily summarized from the SE Report (Appendix I) prepared for the purposes of this EIS. The SE Report study area included four counties; Cass and Richland counties, ND; and Clay and Wilkin counties, MN and focused primarily on the cities of Fargo and Moorhead, (i.e., the protected area), the areas containing the Project features, and those which would be inundated by Project operation (i.e., part of the unprotected area) (Figure 26).

To supplement the structure data presented in the SE Report, the MNDNR completed an ArcGIS structure count analysis that looked at impacts to residential and non-residential structures under the Project, Base No Action Alternative, and NAA conditions specifically within the unprotected area south of the tieback embankment. The area of analysis included the staging area as well as inundated areas outside of the staging area boundary, regardless of flood depth. The F-M urban area was not included as part of this analysis as the intent was to provide a more exact representation of the number and type of structures that would be impacted within the unprotected area. Analysis also looked at the number of parcels that would be impacted (i.e., contained one or more impacted structures). Structure counts were completed by the MNDNR using geographic information system (GIS) data provided by the USACE. USACE data was derived by interpreting aerial photos to identify and classify structures as either residential or non-residential (2014). USACE data was not field-verified.

The Modeling and Evaluation Approach subsection below provides a summary of the modeling exercises and methodologies used to generate the data for both the SE Report and MNDNR analyses.

As mentioned above, this socioeconomic evaluation also considers social implications from the Project and alternatives that cannot be quantified by models or statistical analysis for example, and require a qualitative approach to evaluate potential impacts. These social impacts include topics such as flood related-losses for agricultural produces, implications to transportation networks, and community and individual well-being. The primary resources for the qualitative evaluations were the FFREIS Appendix D—"Other Social Effects", the *Technical Memorandum: Organic Farms Inventory* (Wenck 2015), and supplemental discussions that occurred between the MNDNR, USACE, and Diversion Authority during the production of this EIS. A description of the USACE OSE study is included below under Modeling and Evaluation Approach. Organic farms are discussed in more detail under subsection 3.16.2.5.5 and in Appendix K.

3.16.2.1 Modeling and Evaluation Approach

Approaches to the SE Report Analysis, MNDNR structure count analysis, and qualitative discussions are provided in detail below.

3.16.2.2 SE Report

Impacts of the Project and alternatives were evaluated using standard flood risk assessment methodologies. Flood risk is considered a function of flood impacts or consequences and the likelihood of those impacts occurring. The likelihood is measured by the return period of a flood. The flood risk analysis was carried out using a combination of economic frameworks, including physical flood damage models and economic impact models.

The physical flood damage model provides measures of direct impacts, which are referred to as impacts to capital stock (buildings, contents, and vehicles). The results of the physical flood damage models were used to estimate indirect effects, which are referred to as the loss of building function. Impacts to loss of building function may include costs associated with relocating businesses and residents to temporary facilities; and losses of income earned from sales (economic output). The economic impacts associated with the flood damage modeling contain a degree of uncertainty which cannot be quantified. The models introduce uncertainty in both the engineering (H and H) and economic modeling. The key sources of uncertainty in the model include:

- Choice of distributions for stream flow and rainfall associated with future hydrologic events;
- Simplification of complex phenomena in hydraulic modeling;
- Estimation of relationships between flood depth and inundation damages; and
- Structural and geotechnical performance of flood measures when subjected to flooding.

Based on this, the flood damage modeling are assumed to provide a mid-point estimate of the impacts within the SE Report study area.

Cost estimates of actions are combined with economic impact models to evaluate the indirect regional benefits to employment and income patterns. Furthermore, the effect of a flood on the environment, human or community well-being, or the loss of life are difficult to quantify, and are therefore considered to be intangible impacts, whereas, the tangible dollar losses from a damaged building or ruined inventory in a warehouse are more easily calculated.

The combined sets of impacts and models used to evaluate the impacts are shown below in Table 3.72. Model frameworks are discussed in more detail in the following SE Report subsections.

Table 3.72 Model Frameworks for Fargo Moorhead SE Report Socioeconomic Analysis

Model	Model Framework	Impacts Evaluated	Model Outputs
Direct Impacts of Flood Risk			
HAZUS	GIS	Impacts to capital stock	Physical Flood Damages, ($'s)
Basement Flooding Model	MS Excel	Impacts to capital stock	Physical Flood Damages, ($'s)
Indirect Impacts of Flood Risk			
Business Loss Model	MS Excel	Direct effects of building function due to flooding	Relocations Costs ($'s) Output Impact ($'s)
Input-Output	IMPLAN	Secondary effects of building function due to flooding	Economic Output, Employment, Income, Tax Generation
Construction, and Operation and Maintenance Impacts			
Input-Output	IMPLAN	Direct and Secondary effects of project construction	Economic Output, Employment, Income, Tax Generation

3.16.2.2.1 FEMA HAZUS®- MH

The HAZUS model is designed to be a flexible model and comes with prepackaged default datasets and it also includes functionality for the user to add customized area-specific data (both engineering and economic). The model's flexibility allows the user to conduct analysis with multiple levels of detail depending on data format and availability as presented for this analysis in Table 3.73. However, the HAZUS model output is dependent on the detail of the input data. For this analysis, detailed engineering data was available for the entire project area; however, detailed economic data was available for only a portion of the project area. Therefore, two HAZUS analyses were conducted; one for the area which contained the more detailed economic data and the engineering data, and one for the area which contained only the engineering data.

Table 3.73 SE Report HAZUS Modeling Level of Effort

HAZUS Level of Analysis	Data Inputs	Application to the Project	H and H Inputs	Economic Inputs
1	Default hazard inventory and damage information	NA	NA	NA
2	Combinations of local and default hazard, building, and damage data	Outside City Reach (Including Inundation Areas and Diversion Channel)	Depth Grids (10-, 25-, 50-, 100-, 500-year)	NA – Used Default Data
3	Input detailed engineering and user supplied structure and damage information	In-Town Reach (Fargo and Moorhead)	Depth Grids (10-, 25-, 50-, 100-, 500-year)	COE Structure Inventory and Depth Damage Functions(DDFs)

Flood depth grids for the 10-year flood (10-percent chance flood), 25-year flood (4-percent chance flood), 50-year flood (2-percent chance flood), 100-year flood (1-percent chance flood), and 500-year flood (0.2-percent chance flood) events were prepared for the HAZUS model.

The In-Town Reach of the study area (comprised primarily of Fargo and Moorhead cities as shown in Figure 26) is modeled as a Level 3 analysis. Before using USACE's structure inventory in the HAZUS model, the inventory information was updated from 2009 to 2013 dollars. To adjust to depreciated replacement value, necessary for the damage analysis, adjustment factors developed by the USACE FFREIS Appendix C –"Economics" (FFREIS 2011) for residential and non-residential properties were applied.[3]

The remaining areas, which include the inundation area upstream of the tieback embankment and diversion channel, were evaluated at a Level 2 analysis based on census tract with aggregation to the county level (Figure 26). Using a Level 2 analysis does not provide the same level of accuracy or detail as the Level 3 model. While Level 3 applied detailed inventory and hazard improvements, the Level 2 analysis uses locally produced depth grids with national default inventories. The results are still more exact than what would result from a Level 1 analysis, which uses only national default inventories; however, since some of the input utilizes default, prepackaged datasets, the output is not as exact as that the results presented for the F-M urban area and portions of Cass and Clay counties and therefore, provides less detail to evaluate the Project and alternatives.

3.16.2.2.2 Microsoft® Excel

A characteristic of the SE Report study area is the potential for basement flooding through sewer backups of sanitary sewer lines. In this condition, homes that may not be flooded directly by flood waters may be indirectly flooded as a result of water backing up through sewer lines.

[3] These factors were estimated by the USACE based on a comparison of a sample of assessed values from the structure inventory to estimates of depreciate replacement value from Marshal and Swift cost estimating.

HAZUS is not able to model this aspect due to its reliance on GIS depth grids and lack of inputs for structure elevation information beyond foundation heights. Thus, a second flood damage model was developed to evaluate this set of damages.

This model was created in Excel with a subset of the structure inventory, the low entry elevations, and depth damage curves from the HAZUS model. To complete the basement flooding analysis, structures needed to be matched with a maximum water surface elevation for the sewer basin. To accomplish this:

1. Flooding depths were assigned at each structure location in ArcGIS. Structures were matched with sewer basins;
2. The maximum water surface elevations were determined for each sewer basin for the 10- to 500-year return periods based on the depth of flooding at each structure in the corresponding basin.
3. The maximum basin water surface elevation was then assigned back to each structure.

Depth damage curves were then applied in the basement flooding analysis following a similar process as HAZUS to estimate structure damages. The results were combined with the HAZUS estimates to give the full value of structure and content damage estimates.

3.16.2.2.3 IMPLAN®

IMPLAN (IMpact Analysis for PLANning) was used to estimate regional economic effects. IMPLAN is a computer-driven system of software and data commonly used to perform economic impact analysis. The data is annually updated using information collected at the national, state, county, and local level.

IMPLAN is based on the principles of input-output (I-O) analysis. I-O analysis represents a means of measuring the flow of commodities and services among industries, institutions, and final consumers within a study area. I-O models capture all monetary market transactions in an economy, accounting for inter-industry linkages and availability of regionally-produced goods and services. The resulting mathematical formulae allow I-O models to simulate or predict the economic impacts of a change in one, or several, economic activities on a study area.

I-O analyses use four main metrics to measure economic impacts – employment, labor income, value added, and industry output, defined as follows:

- Employment is measured by the number of full- and part-time jobs.
- Labor income represents the sum of employee compensation and proprietor income.
- Value added consists of four components –
  - employee compensation,
  - proprietor income,
  - other property income, and
  - indirect business tax.
- Industry output refers to the value of goods and services produced in a region.

3.16.2.2.4 MNDNR ArcGIS Structure and Developed Parcel Analysis

The MNDNR completed an ArcGIS analysis in order to obtain individual structure and/or structure parcel data specifically for the upstream inundation area (i.e., unprotected area) as this is the area that would experience the majority of the negative effects resulting from the Project. The structure analysis was completed to provide a more detailed assessment of impacted structures within the unprotected area. As noted above (Table 3.73), one of the weaknesses of a HAZUS Level 2 analysis is the inability to generate very accurate output as the input is based on census block-level data and supplemented by national default inventories where census block data is not available.

Structure data was obtained from the USACE and included point location and structure type (residential or non-residential) that was completed through a GIS desktop exercise by MNDNR in 2015. Residential structures were defined as structures that were used as living spaces (e.g., apartment complexes, townhomes, and single family homes). Non-residential structures are all other structure types including garages, barns, sheds, pole-sheds, and commercial structures. The inundation areas were modeled for three scenarios (i.e., the Project, the Base No Action Alternative, and the NAA) at four different flooding events—10-, 25-, 50-, 100-, and 500-year floods. Structures were “counted” where a flood impact was observed. Impact was defined for this analysis as a flood level greater than zero measured at the structure location. County parcel data obtained from the respective counties (Clay and Wilkin counties, MN; and Cass and Richland counties, ND) were then layered with the USACE structure inventory data and inundation areas modeled for scenario and flood events. The results (discussed in detail in subsection 3.16.2.5—Impacts to Structures and Structure Functions) are presented by county, parcel, structure type, flood event, and project scenario.

3.16.2.2.5 Qualitative Discussion Approach

The USACE OSE analysis evaluated alternative plan formulation, and informed the decision-making process for determining an alternative that maximized social benefits. Although the OSE study evaluated different or variations of alternatives not evaluated in this EIS, much of the information gathered for that study is applicable as it provides a basis for current social status as well as potential social outcomes under Project conditions. Relevant information and results from the OSE study have been used for discussion of the Project and alternatives as applicable. The LPP (in the FFREIS), further revised and referred to as the Federally Recommend Plan (FRP) in the Supplemental EA, is comparable to the Project as discussed in this EIS.

The baseline profile in the OSE study was framed around seven social factors used to describe the social structure of a community that included: Health and Safety, Economic Vitality, Social Connectedness, Identity, Social Vulnerability and Resiliency, Participation, and Leisure and Recreation. A set of metrics that were pertinent to each social factor were scored and evaluated to determine the potential impacts on a community as a result of implementing an alternative. The baseline profile in the OSE study represents existing conditions.

This EIS builds upon the OSE study and provides additional qualitative discussion as it relates to the Project and its alternatives. These discussions provide additional context and consideration for potential impacts in the project area, such as impacts to public services and agriculture, effects of relocations, and other social and economic effects. Where applicable and available, quantitative data was included with the qualitative discussion in order to provide a more complete context of the potential for socioeconomic impacts from the Project and its alternatives.

In addition, the social and economic impacts for particular areas of interest have also been discussed for the Project and Project alternatives that include the areas of:

- Minnesota;
- North Dakota;
- The protected area: the F-M urban area and those areas north of the tieback embankment have been described as the area that would benefit most from the construction and operation of the Project; and
- The unprotected area: the area upstream of the tieback embankment that includes the staging area and surrounding inundated areas and that would experience the majority of the negative effects from implementation of the Project.

These geographical extent discussions may include quantitative information as well when applicable.

3.16.2.3 Proposed Project

Economic impacts from the Project were evaluated based on potential to reduce flood damage and flood fighting costs using the previously described methodologies. Floodplains for the 10-, 25-, 50- 100-, and 500-year flood events with the Project in place were developed for analysis using HAZUS as described above. An example of these floodplains (100-year flood) is shown in Figure 26.

Evaluation of potential socioeconomic impacts included review of construction, operation and maintenance costs; impacts on infrastructure and public services; structures and structure function; flood insurance; the effects of relocations; and impacts on agriculture.

3.16.2.4 Construction, Operation and Maintenance

The Project is estimated to cost $1.789 billion (2010 price level)[4]. Construction is anticipated to occur over an 8-year period with maintenance occurring every year following construction. Table 3.74 provides a summary of construction costs included for the Project. Note that proposed mitigation costs such as land acquisitions and road relocations are included as part of the construction costs.

[4] Flood Diversion Authority, *Final Technical Memorandum, Opinion of Probable Construction Cost to Support MN/DNR EIS Northern Alignment Evaluation*, January 9, 2015.

Table 3.74 Estimated Project Construction Cost

Construction Component	Project Cost (2010 dollars) [1,2,3,4,5,6,7,8,9,10]
Land Acquisition and Damages (right-of-way and easements)	$283,000,000
Relocations (utility relocations, roadway improvements and construction)	$153,000,000
Fish and Wildlife Facilities	$61,000,000
Railroad Bridges	$59,000,000
Channels and Control Structures	$771,000,000
Levees, Floodwalls, and Embankments	$162,000,000
Recreation Facilities	$29,000,000
Planning, Engineering, and Design	$187,000,000
Construction Management[8]	$87,000,000
TOTAL	$1,789,000,000

Source: HMG, 2015b

1 Costs are rounded to the nearest $1 million.

2 2010 U.S. Dollars ($) construction costs; escalation is not included (estimate is not fully funded).

3 Methodology similar to *Post-Feasibility Southern Alignment Analysis* (USACE 2012) phase except where feature designs differ as stated in this report.

4 Contingency included. Contingency is an allowance for costs that will be in the Project Cost and are not included in the Contract Cost. Does not account for changed conditions either in the final design or during construction.

5 Changes to 2010 material, labor, equipment or fuel opinion of cost are not reflected in the project costs presented above.

6 Limited design work completed (<5%). Based on screening-level project definition. This screening-level (Class 5, <5% design completion per ASTM E 2516-06 and USACE EI 01D010 [9/1/97]) cost estimate is based on screening-level designs, alignments, quantities and unit prices. Costs will change with completion of further design. A construction schedule is not available at this time. The estimated accuracy range for the total project cost as the project is defined is -50% to +100%.

7 Quantities based on design work completed.

8 Construction Management is estimated as 7% of construction costs.

9 Land Acquisition and Damages includes Lands and Damages within the USACE-defined staging area; and Mitigation Area Easements

10 Land Acquisition and Damages were based on both USACE detailed data and GIS data residential and non-residential data obtained through USACE 2014 desktop analysis.

Economic activity (e.g., employment and income) would increase during Project construction and following construction during annual maintenance activities and during Project operation (Table 3.75). The total impact from construction spending is estimated to be $3.0 billion for the Project and is anticipated to occur over an eight-year period.

Table 3.75 Proposed Project Economic Impacts from Construction, Operation and Maintenance ($Millions)

Description	Proposed Project	
	Direct Impact	Total Impact[1]
Total Construction Impacts		
Output	$1,790	$3,021
Employment (in jobs)	11,333	20,744
Labor Income	$778	$1,219
Gross Regional Product	$820	$1,548
Total State and Local Tax	$106	$106
Annual Operations and Maintenance Impacts		
Output	$3	$5
Employment (in jobs)	20	37
Labor Income	$1	$2
Gross Regional Product	$1	$3
Total State and Local Tax	>$1	>$1

Source: HMG, 2015a

[1]Total impact includes the direct impact (i.e., direct economic effects (direct response of an industry)), the indirect effects (changes in output, income, and employment caused by direct impacts), and the induced economic effects (changes in output, income, and employment caused by expenditures associated with new household income generated by direct and indirect economic effects).

The estimated annual Operation and Maintenance (O&M) for the Project is $3 million. It is estimated that the O&M would support an additional $5 million in regional sales activity. The annual O&M output would continue for the life of the Project with the assumption that the estimated impacts would remain similar each year. O&M would generate approximately 20 jobs with average incomes of $70,000 per employee. It is estimated that annual spending, employment, and indirect and induced effects would generate approximately $190,000 in new tax revenues per year following construction.

3.16.2.4.1 Infrastructure and Public Services

The construction and operation of the Project, including ring levees, in-town levees, floodwalls, staging area, and surrounding inundation areas would have impacts on existing infrastructure and public services, such as emergency response services, potentially leading to impacts on socioeconomics in the project area. Section 3.13 provides greater detail on potential impacts to infrastructure and public services. The following provides a summary of impacts that could affect socioeconomics in the region as it relates to transportation, utilities, healthcare facilities, and emergency response.

<u>Transportation Impacts</u>

There would be a number of transportation impacts associated with construction of the Project. These include severed roadways by the diversion channel, roadway alterations, reconstruction, rerouting, and raised roadways to higher elevations to provide access during flooding. Detours and permanent changes of existing traffic patterns may also occur as a result of the Project. Bridges would be constructed approximately every three miles to cross the proposed diversion channel. These bridges would provide access for emergency vehicles, school bus routes, postal workers, and local traffic. Bridges would be constructed prior to excavation of the diversion channel to reduce impacts to traffic. This would limit detour routes created by Project construction to less than four miles with most detours less than two miles. Project construction activity could cause short-term negative impacts on existing community traffic patterns.

Compared to baseline conditions, the Project would decrease inundation in the F-M urban area, which would greatly reduce the need to close highway and railroad bridges and the airport in the protected area. Increased and new inundation caused by Project operation within the unprotected area would result in the modification of traffic patterns in the rural area for local residences and farmsteads. Altered traffic patterns may result in increased volumes on corridors not planned or designed to carry increased loads. However, a number of residences and farmsteads in the unprotected area, specifically within the staging area, would be acquired which would reduce the need to have access to the area.

All existing roads within the staging area boundary would remain in place, allowing access to agricultural land in the staging area. In some locations, farm fields would be bisected by the diversion channel, which could result in “remnant” parcels that are separated from the associated farm operations. Owners of such parcels would be given a purchase offer in accordance with the Uniform Act[5]. In cases where ownership of the parcel remains intact, additional transportation time for farm equipment and modifications to parcel access could be necessary. These changes would result in minor impacts to daily traffic patterns.

During Project operation, flood inundation would prevent commuting along east-west routes across the inundation area. Interstate 29 (ND), U.S. Highway 75 (MN), and the railroad line running through Comstock (MN) would be raised to provide access so that traffic could continue across the inundation area during Project operation. Egress and ingress from the OHB ring levee would be provided to I-29. The Comstock ring levee would provide egress and ingress via County Road 2 to U.S. Highway 75 or County Road 2 traveling to the east. The County Road 18 Bridge at the Red River would close during Project operation due to flooding, while the County Road 16 Bridge at the Red River would be located within the protected area and experience reduced flooding than what is currently experienced. It is anticipated that transportation routes would temporarily change during Project operation, but that interstate commerce, emergency services, and commuting to the F-M urban area for work, shopping, and medical services would continue.

Rural residents living west and east of the inundation area and outside of the ring levees, normally using I-29 (ND) or U.S. Highway 75 (MN) to drive to the F-M urban area, Christine (ND); Wolverton (MN); or points south, may be required to use alternate routes. It is anticipated that the alternate routes would not significantly increase travel distances.

[5] Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, P.L. 91-646, as amended, 42 U.S.C §4601, et seq. Portions of this Act deal with the appraisal of real property.

Utilities

Project construction and operation would impact an established network of public utilities primarily located in the unprotected areas, such as electric, water, sewer, stormwater, gas, telephone, and internet. Impacts resulting from the construction and operation of the Project may include relocation of utilities and temporary disruption of services. Specific parcels would be identified during final design of the Project and arrangements made for utility relocation or modification. Utilities that cannot withstand occasional flooding in the inundation areas would be abandoned, modified, or relocated, depending on the situation in accordance with applicable regulations. All utilities that would be severed by construction of the Project would be relocated prior to construction to reconnect affected parcels. Individual parcels may experience temporary disruptions in service during reconnection.

A utility relocation plan would be developed once the final Project design is completed, prior to Project construction. A summary of estimated utility relocations costs, based on preliminary design, is provided in Table 3.76.

Table 3.76 Summary of Utility Relocation Costs for the Project

Utility Relocation	Proposed Project
Electric Power	$9,921,400
Natural Gas Pipeline	$997,600
Petroleum Pipelines	$1,016,000
Fiber Optic Lines	$5,376,400
Water Utilities	$2,313,000
Sanitary Sewer	$369,400
Total Utility Relocation Cost	**$19,993,800**

Source: HMG, 2015a

Health Care Facilities

Major health care facilities in the project area are located in the F-M urban area, and serve local and regional healthcare needs. Facilities are located both in North Dakota and Minnesota. Under the Project, health care facilities in the F-M urban area would be protected from major flooding. Hospitals would no longer be required to evacuate patients due to large flood events. Residents located within the F-M urban area would be able to readily access general and emergency healthcare.

Residents located in the unprotected areas upstream of the Project may be required to travel further distances to access healthcare. Residents located within the protected areas of the OHB ring levee and Comstock ring levee would have access maintained to I-29 and U.S. Highway 75, respectively, and therefore, the Project is not anticipated to be impact their access to healthcare facilities in the F-M urban area. Other residents located within or near the inundation area would access healthcare facilities in the urban area or other healthcare facilities outside of the project area by using designated detour routes or alternate routes outside of the inundation area. Table 3.77 provides a summary of potentially accessible healthcare facilities in Minnesota and North Dakota, and their estimated approximate distances from Comstock (MN) or Oxbow

(ND). These communities were chosen to provide a general representation of residences in the rural, inundation area. It is anticipated that the majority of rural residences in the staging area outside of the ring levees could be relocated through mitigation.

Table 3.77 Proposed Project Nearest Healthcare Facilities Outside of Inundation Area (Comstock / Oxbow)

Healthcare Facility	Distance from Comstock, MN	Distance from Oxbow, ND
Good Samaritan Center Barnesville, MN	15 miles	20 miles
Various Healthcare Facilities F-M urban area	20 miles	20 miles
St. Francis Healthcare Campus Breckenridge, MN	30 miles	40 miles
Lisbon Medical Center Lisbon, ND	60 miles	60 miles

Emergency Services

Emergency response services include law enforcement, fire, and medical services. Law enforcement agencies patrol both the rural and urban areas of the project area in Minnesota and North Dakota. Emergency services are provided during significant flood events and dispatched to calls, as needed, 24 hours per day.

During construction, disruptions to existing roadways caused by the proposed diversion channel and tieback embankment may cause temporary delays in public services, such as emergency response (police, fire, medical), postal deliveries, and school bus services. However, the Project has the potential to provide long-term benefits to public facilities and services by reducing the potential damage to facilities and disruption in delivery of services during future flood events within the urban area.

The unprotected areas would experience more substantial impacts during Project operation due to flooding and road closures in many rural areas. However, within the staging area boundary, it is anticipated the need for emergency services would be minimal, as there would be few residences remaining in that area. Egress and ingress would be provided and maintained for residents allowed to remain in the staging area (e.g., those within Comstock and OHB ring levees).

Local emergency flood plans may need to be revised based on the Project design. This includes revisions of existing evacuation routes and modification of flood fighting measures and locations. New emergency flood plans may be needed in areas that would potentially experience new inundation. If an evacuation is required, including for residents living within the ring levees, an evacuation notice would be issued. If residents do not evacuate after an evacuation notice, they are accepting some level of responsibility for this risk. However, if needed, emergency services would be provided to assist stranded persons affected by the flood, including those located in the staging area or within a ring levee.

3.16.2.5 Impacts to Structures and Structure Function

Impacts to structures considers direct impacts from flood inundation and indirect impacts, such as the cost associated with disruption from flooding, relocation, and business loss, and induced impacts related to income and employment, for example. This section is intended to provide a general estimate of impacted structures and estimate of the cost in damages and mitigation of those structures. Upon final Project design and prior to construction, a detailed analysis would be completed, including field verification where necessary, to determine what structures would be impacted and considered for acquisition, along with the cost of those structures. Acreage impacts would also be considered. The subsections that follow are for informational purposes and are not intended to provide exact structure impact totals. Additional information on mitigation, including the structure acquisition process, is provided in Section 3.16.3.

The structure counts included in the following analysis originated from several sources. As depicted in Figure 26, the SE Report primarily used structure information that either used USACE detailed data collected during the FFREIS (HAZUS Level 3) or Census data (more generalized) (HAZUS Level 2) as previously described in the Models and Evaluation Approach subsection above. Structure impacts were determined by HAZUS for the 10-, 25-, 50-, 100-, and 500-year flood events. The MNDNR applied an ArcGIS structure count analysis to further refine the structure counts in the inundation area south of the tieback embankment as this area was considered to require the majority of the mitigation for inundation impacts. The MNDNR used GIS data provided by the USACE that was obtained by the USACE through a GIS desktop exercise (2014) by interpreting aerial photographs to identify and classify structures as either residential or ono-residential. The MNDNR ArcGIS analysis for the inundation area did not look at cost as this would be determined based on USACE mitigation criteria.

Cost associated with Project construction, including mitigation, was based on methodology used in the FFREIS and 2012 Post Feasibility Southern Alignment Analysis (PFSAA). The structure GIS data obtained through the desktop exercise (same as those used in the MNDNR structure count analysis) were used in conjunction with the USACE detailed data for those analyses.

3.16.2.5.1 Impacts to Structures

Table 3.78 summarizes the SE Report’s estimated impacts to structures (protected and damaged) expected from Project implementation. The Base No Action Alternative was used as the baseline for the SE Report study and thus is included to represent flood impacts to structures under the existing conditions. Benefits from flood damage reduction to structures from Project operation begin to occur around the 25-year flood event and incrementally thereafter. Benefits continue beyond the 100-year flood; however the benefit is maximized under the 100-year flood event.

Approximately 17,486 structures within the SE Report study area under the Base No Action Alternative conditions are impacted by flooding during the 100-year flood. Under Project conditions, the number of structures subject to flooding during the 100-year flood would decrease to 921. Approximately 96 percent of the structures protected under Project conditions are those located within the F-M urban area, the protected area. The majority of structures that are protected within Cass and Clay counties, outside of the F-M urban area, (approximately 700) are located north of the tieback embankment within the protected area. Richland County would be expected to have an additional 2 structures impacted and Wilkin County impacted structures would remain the same at 3. These estimates were calculated using the HAZUS Level 2 and Level 3 modeling, which was previously explained in Section 3.16.2.1.1.

Table 3.78 Structures Impacted by the Proposed Project During the 10-year, 25-year, 50-year, 100-year, and 500-year Flood Events[1]

Location	10-year Flood	25-year Flood	50-year Flood	100-year Flood	500-year Flood
North Dakota					
Fargo Damaged Structures[2]					
Base No Action Alt.	502	3,473	11,673	15,767	26,060
Proposed Project	481	480	487	490	12,094
Protected Structures	**21**	**2,993**	**11,186**	**15,277**	**13,966**
Remaining Cass County Damaged Structures[3]					
Base No Action Alt.	236	549	723	947	1,368
Proposed Project	198	309	310	320	551
Protected Structures	**38**	**240**	**413**	**627**	**817**
Richland County Damaged Structures[4]					
Base No Action Alt.	0	0	4	18	53
Proposed Project	0	0	4	20	53
Protected Structures	**0**	**0**	**0**	**-2**	**0**
Total Protected (Proposed Project) – North Dakota	**59**	**3,233**	**11,599**	**15,902**	**14,783**
Total Damaged (Proposed Project) – North Dakota	**679**	**789**	**801**	**830**	**12,698**
Minnesota					
Moorhead Damaged Structures[2]					
Base No Action Alt.	9	23	210	616	1,382
Proposed Project	8	10	9	11	382
Protected Structures	**1**	**13**	**201**	**605**	**1,000**
Remaining Clay County Damaged Structures[3]					
Base No Action Alt.	12	66	104	135	230
Proposed Project	12	62	66	77	136
Protected Structures	**0**	**4**	**38**	**58**	**94**
Wilkin County Damaged Structures[4]					
Base No Action Alt.	0	1	1	3	37
Proposed Project	0	1	2	3	37
Protected Structures	**0**	**0**	**-1**	**0**	**0**
Total Protected (Proposed Project) – Minnesota	**1**	**17**	**238**	**663**	**1,094**
Total Damaged (Proposed Project) – Minnesota	**20**	**73**	**77**	**91**	**555**
Structures Protected (Proposed Project) within FM urban area[2]	**22**	**3,006**	**11,387**	**15,882**	**14,966**
TOTAL Protected Structures	**60**	**3,250**	**11,837**	**16,565**	**15,877**

(Proposed Project)[4]					
TOTAL Damaged Structures (Base No Action Alt.)[5]	**759**	**4,112**	**12,715**	**17,486**	**29,130**
TOTAL Damaged Structures (Proposed Project)	**699**	**862**	**878**	**921**	**13,253**

Source: HMG, 2015a

[1]Structure numbers should not be compared to those represented in Table 3.82. Methods and data sources applied were different.
[2]Based on HAZUS level 3 evaluation using COE HEC-FDA structure inventory
[3]Based on HAZUS level 2 evaluations with HAZUS default county data for remaining portions of Clay and C ass counties not covered by the structure inventory
[4]Based on HAZUS level 2 evaluations with HAZUS default county data for Richland and Wilkin counties
[5]Includes both the level 3 and level 2 analysis results

The following table displays the estimated cost of damages under Project conditions. Costs were estimated for structures but, also included are estimates for structure content and vehicle damages. The computed average annual damages for the SE Report study area are approximately $9 million (Table 3.79). The majority (78%) of those damages are to buildings (such as residential, commercial, and industrial properties) and their contents.

Table 3.79 Proposed Project Estimated Residual Damages to Buildings and Contents; and Vehicles ($ Millions)

Return Period	10-year Flood	25-year Flood	50-year Flod	100-year Flood	500-year Flood	Average Annual Damage[1]
Damages - North Dakota						
Fargo						
Buildings and Contents	$25	$41	$44	$48	$801	$7
Vehicles	$9	$11	$11	$11	$46	$1
Total Fargo	$35	$51	$54	$59	$847	$8
Remaining Cass County						
Buildings and Contents	$0	$1	$1	$1	$2	$0
Vehicles	$1	$1	$2	$2	$3	$0
Total Remaining Cass County	$1	$2	$3	$3	$5	$0
Richland County						
Buildings and Contents	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$0	$1	$1	$0
Total Richland County	$0	$0	$0	$1	$1	$0
Total North Dakota	$36	$53	$57	$63	$853	$8
Damages – Minnesota						
Moorhead						
Buildings and Contents	$0	$3	$4	$4	$24	$0
Vehicles	$6	$7	$7	$7	$10	$1
Total Moorhead	$7	$10	$11	$12	$34	$1
Remaining Clay County						
Buildings and Contents	$2	$2	$2	$2	$3	$0
Vehicles	$1	$1	$1	$1	$2	$0
Total Remaining Clay County	$3	$3	$3	$3	$5	$0
Wilkin County						
Buildings and Contents	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$0	$0	$1	$0
Total Wilkin County	$0	$0	$0	$0	$1	$0
Total Minnesota	$10	$13	$14	$15	$40	$1
Total Damages						
Buildings and Contents	$29	$47	$52	$57	$830	$7
Vehicles	$18	$21	$22	$22	$63	$2
Total	$47	$68	$74	$79	$893	$9

Source: HMG, 2015a

[1]Average Annual Damage represent the amount of damage that would occur in any given year, and if that year were repeated infinitely many times over. The average value is based on the frequency of recurrence for each flood event (FFREIS Appendix C "Economics").

It should be noted that when interpreting the cost of damages provided in Table 3.79, costs are rounded off the nearest $ 1 million and were calculated using HAZUS Level 2 and 3 analysis as detailed above (Figure 26). Therefore, estimates provided for those within the HAZUS Level 2 areas are, 1) not as precisely represented in terms of building and contents model inputs as those from HAZUS Level 3 areas; and, 2) as those areas have less buildings, contents, and vehicles; rounding to the nearest million may inadvertently misrepresent estimated flood damage costs and average annual damage costs, particularly from a cumulative cost perspective.

Project operation would result in the impoundment of floodwaters upstream of the tieback embankment for flood events greater than the 10-year flood and would begin to cause damages to structures within that area if mitigation did not occur. Mitigation would be required for those structures/properties that would be impacted by the impoundment in the form of a property buyout, flowage easement, structure relocation, or other non-structural measure (includes both those structures/properties that are currently flooded and those that would be newly inundated by Project operation) (see subsection 3.16.3 Proposed Mitigation and Monitoring Measures for more details).

The majority of property buyouts that include structures would occur in the staging area and would be for those properties that are impacted by 2 feet of flooding or greater (those with up to 2 feet of flooding may be purchased as well depending on site conditions). Property buyouts would also occur for those properties affected directly by the construction of the diversion channel and tieback embankment. Buyouts associated with diversion channel construction are anticipated to be primarily land acquisition using right-of-way and easements. Flowage easements would be acquired for all inundated land within the staging area. Farmsteads would be given additional consideration (see subsection - Agricultural Impacts).

Table 3.80 provides a summary of the estimated cost for land acquisition and damages. As the majority of the land acquisition and damages mitigation would occur within the defined staging area and as this was a defined USACE boundary for which the flood water storage was necessary, the USACE used the staging area as a boundary for determining costs. As discussed in other subsection topics, there are other properties, undeveloped land and residential/ commercial properties, which would require mitigation outside of the staging area. Those costs would be included in a final cost for land acquisition and damages that would be determined once design plans were finalized.

Table 3.80 Proposed Project Summary of Estimated Cost of Land Acquisition and Damages

Item Description	Proposed Project
Right-of-Way and Easements – Construction Footprint[1]	$ 41,464,402
Right-of-Way and Easements – Staging Area	$ 223,558,278
TOTAL: Lands and Damages[2 3]	$ 265,022,680

Source: HMG, 2015b
[1]Project construction footprint includes areas associated with the construction of the diversion channel, embankment systems, levees, and other flood control features.
[2]With 25% Contingency
[3]Costs are associated with a 100-year flood event.

The cost of acquisition, including right-of-way and easements, is the second largest Project cost behind construction of channels and control structures. Table 3.81 provides a breakdown of property acquisition and easements for the Project for the Sheyenne structure site to the inlet weir, the diversion and embankment footprints, and staging area. Note that numbers presented are for the construction footprint and staging area only as with Table 3.80 above. Other property acquisitions and easements will occur outside of these locations as well, such as in-town levee and floodwall acquisitions and other easements and potential acquisitions that will be necessary within the inundation area and mitigation areas; however, these are not anticipated to have a large impact on the estimates provided below.

Table 3.81 Proposed Project Property Acquisitions, Easements, and Costs

Type of Property[1]	Proposed Project	
	Fee Title	Easement
Sheyenne Structure Site to Inlet Weir		
Acres	170	5
Non-Residential	0	
Residential	0	
Total Cost[1]	$1,756,000	$8,063
Diversion and Embankment Footprints		
Acres	717	62
Non-Residential	11	
Residential	3	
Total Cost[1]	$10,548,000	$100,000
Staging Area		
Acres	25,842	6,413
Non-Residential	434	162
Residential	71	20
Total Cost[2]	$210,504,000	$3,085,000

Source: HMG, 2015b
[1]Land Acquisition and Damages were based on both USACE detailed data and GIS residential and non-residential structure data obtained through USACE 2014 desktop analysis.
[2] Reflects cost as rounded estimates to the nearest thousand. Includes administrative costs and 25% contingency.

Using the HAZUS Level 2 analysis reduces the ability to get detailed structure count information, particularly the Level 2 analysis that was applied to the unprotected, rural areas. In order to gain a more exact impacted structure count for the unprotected area, MNDNR completed an ArcGIS structure count analysis using structure GIS data obtained through a desktop analysis (USACE 2014). As depicted in Figure 27, the MNDNR analysis focused on the inundated area south of the tieback embankment that includes both the staging area and the inundated area outside of the staging area (i.e., the unprotected area). Because data and methodologies applied differ from the SE Report analysis completed, the numbers presented in Table 3.78 above and Table 3.82 below should not be compared. The Base No Action Alternative was used in this analysis to provide a baseline with which to gage Project-impacted structures. The Base No Action Alternative study area focuses on the same unprotected area as was used for the Project for the analysis.

The proposed ring levees to OHB (ND) and Comstock (MN) were considered in this structure count analysis. The Comstock ring levee would surround 46 existing residential structures, of which 26 would be impacted up to one foot without the levee. The Comstock ring levee will also include areas for future growth and possible relocation from other areas affected by the Project. In OHB, the ring levee would surround 103 existing residential structures, of which 13 would be impacted under existing conditions in a 100-year flood. An additional 60 home lots would be created within the ring levee to accommodate relocations within OHB and from other areas affected by the Project.

The results of the MNDNR analysis indicated in Table 3.82 below that within the unprotected area residential structure impacts are the same as those experienced under existing conditions during the 10-year flood. This is expected as the Project would not operate until it exceeds the threshold of the 10-year flood. However, during the 25-year flood, when the Project is in operation, the number of structures impacted increases substantially from 138 to 506 total structures, about 18 percent of those impacts would be to residential structures; 15 in Minnesota and 75 in North Dakota.

Impacts to both structure types continue to increase beyond the 25-year flood; however, not as drastically. Impacts to non-residential structures are much greater for all events. This is expected as many of these rural properties, whether residential, farm, or commercial, contains more than one structure in addition to a home. For the 100-year flood, 702 of the 828 structures impacted are to non-residential structures. The remaining 15 percent is to residential structures, of which 28 would be impacted in Minnesota and 98 within North Dakota.

Table 3.82 Proposed Project Number and Type of Structures Impacted under 10-year, 25-year, 50-year, 100-year, and 500-year Floods within the Upstream Inundation Area[1,2,3,4,5,6]

Return Period	10-year Flood		25-year Flood		50-year Flood		100-year Flood		500-year Flood	
Scenario	**Base No Action Alt.[7]**	**Project**	**Base No Action Alt.**	**Project**	**Base No Action Alt.**	**Project**	**Base No Action Alt.**	**Project**	**Base No Action Alt.**	**Project**
North Dakota										
Cass County Non-Residential[5]	23	23	106	249	193	301	228	319	350	351
Cass County Residential	0	0	9	75	18	88	43	93	149	96
Richland County Non-Residential	3	3	13	19	33	52	74	94	264	276
Richland County Residential	0	0	0	0	0	2	2	5	41	45
Total Non-Residential -North Dakota	**26**	**26**	**119**	**268**	**226**	**353**	**302**	**413**	**614**	**627**
Total Residential – North Dakota	**0**	**0**	**9**	**75**	**18**	**90**	**45**	**98**	**190**	**141**
Minnesota										
Clay County Non-Residential	2	2	5	133	30	211	49	241	114	250
Clay County Residential	0	0	0	15	0	20	2	22	7	23
Wilkin County Non-Residential	2	2	5	15	21	29	36	48	145	151
Wilkin County Residential	0	0	0	0	1	2	4	6	43	49
Total Non-Residential - Minnesota	**4**	**4**	**10**	**148**	**51**	**240**	**85**	**289**	**259**	**401**
Total Residential - Minnesota	**0**	**0**	**0**	**15**	**1**	**22**	**6**	**28**	**50**	**72**
Total Non-Residential Structures	**30**	**30**	**129**	**416**	**277**	**593**	**387**	**702**	**873**	**1,028**
Total Residential Structures	**0**	**0**	**9**	**90**	**19**	**112**	**51**	**126**	**240**	**213**
Total Structures	**30**	**30**	**138**	**506**	**296**	**705**	**438**	**828**	**1,113**	**1,241**

Source: MNDNR, 2015

[1]Structures included within the analysis are those found within the counties identified and limited to the upstream inundation area.
[2]Impact is not defined by a set flood depth. If a structure is impacted by water by any extent, it is considered an impact.
[3]Structures impacted are not differentiated by currently inundated and newly inundated structures.
[4]GIS structure data was obtained and provided by the USACE through a desktop analysis, 2014 and has not been field-verified
[5]Non-residential includes all other structures that are not used for residential purposes, including commercial structures.

[6]Structure numbers should not be compared to those represented in Table 3.78. Methods and data sources applied were different.
[7]Base No Action Alternative numbers were included as this Alternative was used to present current conditions.

As mentioned above, properties typically contain more than one structure. In the case of a farm or commercial property, several structures could be present. Only looking at the number of structures makes it difficult to assess the number of properties/property owners that would be affected by the Project. The MNDNR used the structure data presented in Table 3.82 above and overlaid it with parcel boundaries. A property that had one or more impacted structure(s) was included in the analysis and was given a count of one. Table 3.83 provides a breakdown of the number and type of parcels that would be impacted by the Project within the unprotected area. It would be expected that overall, the results below would follow a similar trend as those observed in Table 3.82 above. It should be noted that the analysis did not sort through individual property owners, only by parcels so if a property owner owned more than one parcel, each parcel would be represented in the Table 3.83 count below.

Similar to Table 3.82 above, the number of impacted parcels between the baseline and the Project remains the same during the 10-year flood. Impacts within the inundation area are greater than the Base No Action Alternative (baseline) under the 25-, 50-, and 100-year floods, when the Project is in operation; the 25-year flood experiencing the greatest increase in parcels impacted from 44 parcels to 149 parcels (Table 3.83).

Table 3.83 Proposed Project Number of Parcels Impacted under 10-year, 25-year, 50-year, 100-year, and 500-year Floods within the Upstream Inundation Area[1 2 3 4 5]

Return Period	10-year Flood		25-year Flood		50-year Flood		100-year Flood		500-year Flood	
Scenario	**Base No Action Alt.[6]**	**Project**	**Base No Action Alt.**	**Project**	**Base No Action Alt.**	**Project**	**Base No Action Alt.**	**Project**	**Base No Action Alt.**	**Project**
North Dakota										
Cass County	12	12	28	101	61	119	91	122	218	131
Richland County	3	3	10	13	19	31	32	41	102	109
Total Parcels - North Dakota	**15**	**15**	**38**	**114**	**80**	**150**	**123**	**163**	**320**	**240**
Minnesota										
Clay County	1	1	3	27	10	36	12	42	19	43
Wilkin County	2	2	3	8	9	15	21	25	91	94
Total Parcels - Minnesota	**3**	**3**	**6**	**35**	**19**	**51**	**33**	**67**	**110**	**137**
Total Parcels	**18**	**18**	**44**	**149**	**99**	**201**	**156**	**230**	**430**	**377**

Source: MNDNR, 2015
[1]Structures used for determining parcel inclusion are those found within the counties identified and limited to the upstream inundation area.
[2]Impact is not defined by a set flood depth. If a structure is impacted by water by any extent, it is considered an impact.
[3]Parcels impacted are not differentiated by currently inundated and newly inundated parcels.
[4]Parcels included in counts were those found to contain impacted structures. Undeveloped land was not included in this analysis.
[5]Structures used in analysis were identified and provided by the USACE through a GIS desktop analysis, 2014 and has not been field-verified
[6]Base No Action Alternative numbers were included as this Alternative was used to present current conditions.

3.16.2.5.1.1 Loss of Structure Function

Damages to structures can result in regional economic losses through the loss of functionality. This includes costs associated with business or resident relocations to temporary facilities, losses of income earned from sales (economic output) and the effects on local and state taxes for example. The SE Report provided an estimate of "loss of structure function" costs for the Project as summarized in Table 3.84 below. Similar to other analysis completed in the SE Report, the Base No Action Alternative was used as a baseline for representing existing conditions and thus is included below for that purpose. Costs have been rounded off to the nearest $1 million.

Average annual relocation and disruption costs are $8 and $1 million, respectively. Those are all estimated to be from North Dakota; however, it is important to consider that rounding off to the nearest million could omit costs for Minnesota as Minnesota does experience losses that may not be completed captured in this representation. Project losses for jobs would total 1,448; 10 percent of those impacts would be to Minnesotans.

Table 3.84 Proposed Project Annual Impacts from Loss of Building Function ($ Millions)

Description	Proposed Project		Base No Action Alternative
	Direct Impact[1]	Total Impact[2]	Total Impact
North Dakota Losses			
Business Losses			
Output	$119	$183	$1,512
Employment (in jobs)	825	1,298	15,782
Labor Income	$41	$65	$548
Gross Regional Product	$65	$103	$866
Total State and Local Tax	$12	$12	$110
Disruption Costs	$1	$1	$3
Relocation Costs	$8	$8	$53
Minnesota Losses			
Business Losses			
Output	$14	$18	$43
Employment (in jobs)	117	149	380
Labor Income	$5	$6	$14
Gross Regional Product	$7	$10	$23
Total State and Local Tax	$2	$2	$4
Disruption Costs	$0	$0	$1
Relocation Costs	$0	$0	$2
Total Losses			
Business Losses			
Output	$133	$200	$1,555
Employment (in jobs)	942	1,448	16,162
Labor Income	$46	$71	$562
Gross Regional Product	$72	$113	$889
Total State and Local Tax	$14	$14	$113
Disruption Costs	$1	$1	$4
Relocation Costs	$8	$8	$55

Source: HMG, 2015a

[1]Direct Impacts are those that direct to the industry.

[2]Total Impacts include direct impacts[1]Total impact includes the direct impact i.e., direct economic effects (direct response of an industry), the indirect effects (changes in output, income, and employment caused by direct impacts), and the induced economic effects (changes in output, income, and employment cause by expenditures associated with new household income generated by direct and indirect economic effects).

3.16.2.5.2 Flood Insurance

With the Project, it is anticipated that substantial savings could be realized to numerous property owners within the project area due to the reduced numbers of impacted structures expected to occur during a 100-year flood event as noted in Tables 3.78 and 3.83 above. The cost savings would apply both to those within the protected and unprotected areas as the properties would be removed from the floodplain, either from Project operation protection north of the tieback embankment, or through mitigation actions within the staging area and within the FEMA revision reach (or the area defined by the Red River profile and limited to where the Project would alter the river profile flood elevation by more than 0.5 feet) (see 3.16.3 Proposed Mitigation and Monitoring or subsection 3.2 FEMA Regulations and the CLOMR Process for more details).

The NFIP indicates the average flood insurance policy costs about $650 per year. These costs are significantly higher for properties in high risk areas and significantly higher for properties with basements below the base flood elevation. For example, a policy that includes $250,000 in coverage for the structure and $150,000 in coverage for contents has a premium of $1,958 per year ($1,191 for structure only) and this cost is expected to increase 10 percent-18 percent per year as the Homeowner Flood Insurance Affordability Act is implemented. The cost savings would increase as the Biggert Waters Flood Insurance Reform Act of 2012 and subsequent 2014 Homeowner Flood Insurance Affordability Act are implemented.

Newly inundated properties located outside the FEMA revision reach are anticipated to have less than six inches of flooding. For newly inundated insurable structures located within Minnesota, State law (Minnesota Rules 6120.5700, subpart 4a) requires mitigation. Minor site modifications, such as landscaping, could be used as mitigation to exceed the 100-year flood elevation. If the mitigation, (e.g., landscaping) is done before the LOMR at the end of the Project, mandatory flood insurance would not be required. However, if mitigation was not completed, flood insurance would be required. For newly inundated insurable structures located within North Dakota, communities and property owners would have to work with the North Dakota State Engineer and USACE to determine what mitigation would be necessary.

3.16.2.5.3 Effects of Relocations and Flowage Easements

The Project would result in substantial social disruptions for the communities and residents within the upstream inundation area, with the potential for a large number of residents to be displaced. The relocations would disrupt community activities such as school and church functions, as well as the social networks among residents.

Relocations may also result in social and economic effects such as loss of tax revenue for local municipalities and local government and a reduction of student populations and property tax base for local school districts (however, the larger tax-base communities such as OHB and Comstock will persist as they will be protected by ring levees). Land values and future land development would be impacted by restrictions imposed by flowage easements and increased flood risk. Business owners may also be required to relocate which may affect the economic vitality of the community.

Below provides a qualitative discussion on potential social and economic effects of relocation and flowage easements or considerations for those who may be impacted drawing from the concerns and potential impacts noted above.

Property Owners

Mitigation in the inundation area, specifically the staging area and remaining areas within the FEMA revision reach, would include a number of property buyouts (relocations), non-structural measures (flood risk reductions), and flowage easements (legally allows temporary flooding of property for Project operation) (see Chapter 2 and 3.16.3 Proposed Mitigation and Monitoring below for further discussion). Depending on the anticipated depth of flooding, current property owners within the staging area who are impacted by Project operation may be required or offered the option to relocate to areas outside the staging area or within the protected communities of OHB and Comstock. Implementation of these buyouts, relocations, and non-structural measures cause stress and disruption for those residents. Property owners who are required to leave could experience stress related to the inconvenience of relocating and the disruption of established personal routines and connections.

The USACE would evaluate Project inundation impacts to undeveloped and developed land outside the FEMA revision reach through a takings analysis on a case-by-case basis to determine appropriate mitigation measures (see 3.16.3 Proposed Mitigation and Monitoring for more details). Mitigation measures would likely be similar to those proposed for the staging and FEMA revision reach areas. Implementation of mitigation would likely cause stress and disruption to residents and properties owners similar to as those within the staging area and FEMA revision reach as discussed above.

Property owners may also be affected through loss of income from renters; either residential or business (including agricultural lands – see 3.16.2.2.7 Agricultural Impacts below). Renters of residential and commercial structures or agricultural properties may be required to relocate or find that new restrictions are less desirable and choose to find other arrangements.

Considerations for relocation effects on property owners:

- Impacts to property values are difficult to assess as property values are based on many market factors including location, proximity to jobs, goods and services, weather and climate, quality of soil, natural amenities, such as a river, lake, or golf course, national, regional, and local economies. Due to these factors, it is unknown how property values would be affected following Project construction and after mitigation is complete.
- Pertaining to property compensation, landowners will be compensated per federal law[6]. Compensation would be based on the degree of impact, the assessed value of land, and the type of real estate acquired (fee or easement).

[6] The 5th Amendment of the U.S. Constitution requires just compensation when private property is taken for public use. CFR 49 Part 24 - Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended, details benefits to the property owner and/or displaced residential renters for Federal and Federally Assisted Programs.

- As noted above, a portion of the farmsteads and residences that would be impacted in the inundation area are currently at flood risk. In those scenarios, the residents may benefit from Project mitigation as their property would be protected by the OHB and Comstock ring levees, purchased and/or relocated, receive compensation through flowage easements, or mitigated by some other means.

Community Ring Levees

The Project includes the construction of ring levees that would provide flood protection for the communities of OHB, as well as one for the community of Comstock (MN). While the ring levees do reduce flood risk to those who would reside and work within the levee, they would result in social impacts, including disruptions during construction as well as the perception of living behind a levee.

The OHB ring levee is already under construction. Design and construction activities were coordinated with the affected communities. Pertaining to Comstock, the conceptual ring levee includes areas for storm water retention as well as years of future growth. As design for the ring levee moves forward, additional coordination with the community of Comstock would take place to better define the design of the ring levee. This would include coordination on alignment, location and size of future growth areas, and other features associated with the ring levee. Consideration would also be given to the potential for other impacted residents in the staging area to relocate within the Comstock ring levee.

Due to the additional flood risk of the Project, the residents of Comstock would be expected to experience higher levels of stress and anxiety than they do under the baseline condition. Comstock is currently located outside of the existing 100-year floodplain; however, during large flood events it has been necessary to employ emergency measures to reduce impacts from ditch and drainage way backups resulting from Wolverton Creek floodwaters. It is expected that flooding would reduce the economic vitality of the area as businesses might relocate to other areas not prone to flooding. The ring levee may restrict future development due to the increased flood risk in and around the area.

Century, Centennial and Sesquicentennial Farms

The area has a long history of farming dating back to settlement activities in the mid-1800s (USACE, FFREIS 2011). Although the number of farms is in decline, there are some that that are still active that have been established for over a century. If the farm has been owned or lived on by the same family for 100 years or more, the farm may be designated or would be eligible for “Centennial Farm” status (North Dakota Centennial Farm Program). In Minnesota, a farm must be owned by the same family for at least 100 years and be at least 50 acres in size, to be designated or eligible to be listed as a “Century Farm” or if you meet the same requirements but have owned your farm for 150 years or more you would be considered a “Sesquicentennial Farm” (Minnesota Farm Bureau). An inventory of Century Farms or Centennial or Sesquicentennial Farms was not included as part of this discussion. To be listed a landowner or family must complete and submit an application to their respective state programs. A complete list of designated Centennial/Century Farms in North Dakota can be accessed by visiting the Lewis and Clark Interpretive Center located in Washburn, North Dakota or in Minnesota a complete listing of these farms can be found on the Minnesota Farm Bureau Webpage at http://www.fbmn.org/pages/century-and-sesquicentennial-farm.

The USACE cultural investigations completed so far for the Project have found that several farmsteads may be eligible for listing on the NRHP (see 3.1.2 Cultural Resources). Presumably, some of these might be Century Farms. While farming of the land may continue, people would not be allowed to reside in large parts of the staging area and possibly within other newly inundated areas. Potential mitigation for these properties would be similar as discussed above and if found to be eligible for the NRHP would also follow mitigation procedures as laid out in the Programmatic Agreement (FFREIS Attachment 3, USACE, 2011).

Given the historical context of these farms in addition to the family heritage these families would have to a particular farm, social impacts to those families who claim family heritage ties to the land would likely be emotionally taxing if required to relocate due to increased inundation or new inundation impacts.

School Districts

The fiscal requirements and resources of the school districts would both be positively and negatively affected by the Project. Local school district officials have concerns the student population and future development of local school districts within the upstream inundation area could be affected by the Project due to relocations or flowage easements, resulting in reduced property tax base. Implementation of the Project may result in school districts within the upstream inundation area to experience changes in student population; however, the extent of these changes and resulting impacts are not definitively known. Area residents who are relocated may choose to keep children enrolled in the same school, resulting in very minimal impacts to school districts; however, some students may enroll in a different school. If the tax valuation of properties in the school districts is affected, this would need to be addressed at the local level and could be discussed further with the Diversion Authority.

The OHB and Comstock ring levees are not anticipated to negatively impact the tax base or the population within the Kindred and Barnesville school districts because the levees would allow people to remain in their school districts. Forty two (42) homes in Oxbow would be impacted by the OHB ring levee construction and would be replaced in Oxbow as part of the Project. The Diversion Authority has, however, agreed to compensate the City of Oxbow and the Kindred school district for the loss of tax base caused by property (42 homes) being taken out of service for construction of the OHB ring levee project for a period of up to four years. In addition, the OHB ring levee provides approximately 60 additional residential development lots for other displaced residents within the upstream inundation area, if they choose, to move to Oxbow and the Kindred school district. If this occurs, this would positively impact the school district. The Comstock ring levee concept preserves all existing community development and allows for future growth which would positively impact the Barnesville school district.

It is possible that school district boundaries may be adjusted to offset shifts in student population or for loss of tax revenue; however, this is not expected to occur. Such proposals and decisions would be under the authority of the Minnesota Department of Education and the North Dakota Department of Public Instruction and their respective state agencies.

Municipal and Local Governments -Tax Bases

Municipalities and other local governments within the upstream inundation area may experience impacts from the Project from a decreased tax base due to relocations. However, while that may occur, the property tax base for many of these impacted districts within the inundated area is largely agricultural in nature. Agricultural property value is influenced by the market value of crops and the soil quality of the land. Inundated agricultural land would be considered for flowage easements, and would still be capable of being farmed for crops. The flowage easements may depreciate the real estate value and demand for the land, but may not affect agricultural property value as much as inundation of land zoned for residential or commercial.

3.16.2.5.4 Effects on Property Improvements

Flood waters have the potential to cause impacts and damages to not only structures on a property but to improvements on the property such as wells and septic systems. These types of site improvements are primarily associated with rural properties or small towns and developments. Flood waters could contain of chemical or biological hazards that could contaminate drinking wells. Flood waters could also become contaminated through septic system failures.

Drinking Water and Well Contamination

There are a number of existing private wells in the project area that currently supply drinking water to residents, agricultural operations, and other activities. Project construction may impact existing wells near the diversion channel and the associated embankment systems. Wells and structures within the Project construction footprint would be removed or abandoned in accordance with applicable local, state, and federal regulations, including Minnesota Rules 4725 – Wells and Borings and North Dakota Century Code. Wells immediately adjacent to the Project construction footprint would be identified and monitored to quantify any impacts.

Flood inundation has the potential to impact existing wells and drinking water supplies. It is likely that several private wells would be affected by the Project. Where structures and farmsteads are removed, wells would be abandoned per applicable regulations. Where wells that may be affected by operation of the Project would remain, appropriate modifications would be made to prevent contamination of groundwater/drinking water. The number and locations of affected wells would be determined during the design phase of the Project. Any impacts to drinking water supplies would be mitigated as appropriate, including proper abandonment or modification for flood protection. Any actions needed to prevent contamination of wells would be part of the Project and the responsibility of the USACE and the Diversion Authority.

Minnesota Rules 4725 regulates wells for groundwater and drinking water sources. The requirements regarding flood protection for water-supply wells are outlined in Minnesota Rules 4350 Subp. 2. The requirements do not apply to areas protected by FEMA accredited flood control structures. Some of these requirements include construction of a water-supply well to prevent the entry of flood water into the well.

The MN Department of Health advises well owners that flood water has the potential to contaminate water-supply wells and provides guidance on how to take precautions prior to flood events to protect water-supply wells. The MN Department of Health guidance also outlines procedures for taking proper measures, such as disinfecting, if a water-supply well becomes contaminated by a flood event (http://www.health.state.mn.us/divs/eh/wells/natural/index.html).

Septic System Compliance

In newly inundated areas, existing septic systems and other Subsurface Sewage Treatment Systems (SSTS) that serve commercial, industrial, and residential properties could be deemed non-compliant with state and local rules/ordinances. SSTS components that are discharging effluent to subsurface soils compromised by rising flood waters can pollute ground and surface water with pathogens, viruses, and nutrients such as nitrogen and phosphorus.

In Minnesota, Minnesota Rules Chapter 7080.2270 indicates that placement of SSTS components are not allowed in a floodway and should be avoided within the 100-year floodplain. An elevated drain field, known as a mound system, is allowed in a floodplain when no other option is available provided the bottom of the mound is at least 0.5 feet above the 10-year flood elevation. During flood events and inundation of the SSTS, the structure must cease producing wastewater and have an adequate backflow prevention to prevent flood waters into the structure. Once a septic tank has been inundated, the solids and liquids must be removed by a licensed company and disposed at an approved facility once flood waters recede and prior to being put back into use. The pumping and hauling costs on a one time basis could be approximately $250-$500.

Residential homes with SSTS that are located in newly inundated areas could realize an investment of approximately $15,000-$20,000 to either flood proof their existing system and/or relocate a system to another location on their property above the 100-year floodplain where floodproofing or other restrictions are not required. Commercial and industrial facility SSTS upgrade costs would depend on the size of the facility but tend to be equal to or greater than that of a residential home. Improvements to SSTS require design or engineered plans that are submitted to the local jurisdictional agency for permitting. For larger SSTS, permitting is completed through the state agency; in Minnesota it is the MPCA, in North Dakota it is the NDDH.

3.16.2.5.5 Agricultural Impacts

Potential agricultural impacts were evaluated for traditional agricultural activities and organic farms, including property value, crop loss, grain and feed spoilage, and loss of organic certification. Traditional and organic farms were evaluated separately due to the requirements for organic certification, which may influence the value of the property and the potential loss of income from flood inundation.

Agricultural Property Value

Agricultural property value is influenced by the location of the land and the production quality of the soil on the land. Flowage easements would be required for land within the staging area and possibly for property outside the staging area that would be inundated during Project operation. Landowners would be compensated for flowage easements acquired. It is anticipated that agricultural land in the inundation area could continue to be farmed with the Project. However, this land may experience increased flood depths and duration or may be more susceptible to new flood inundation with the operation of the Project. The extent of flood impacts on agricultural productions would vary depending on when the flood event occurs. If flooding occurs prior to the growing season there may not be any impact to agricultural production.

Due to growing season restrictions, final planting dates for crops range between end of May for corn, to early June for soybeans and flax. Farmers would have until this time for stored water to clear and for land to dry enough for planting to occur. If stored water is still present and/or the land has not dried prior to these timeframes, crop plantings would not be feasible resulting in agricultural losses and/or limited production. The Project is designed to pass 17,000 cfs through the protected area before the Project would be operated. Based on a review of historic flood events, the Project would not likely operate during the summer.

Due to the increased level of flood risk, construction of farm buildings to support agricultural activities would be limited due to restrictions imposed from flowage easements. Existing agricultural structures, especially livestock-related structures would not be compatible with flooding in the staging area and within the FEMA revision reach, and therefore, would likely be relocated. The USACE and Diversion Authority have not made final determinations about whether any existing non-residential structures would be allowed in the staging area or FEMA revision reach. This could impact farm activities with farm equipment and other supplies that need to be brought into the area rather than being able to store them for use in the immediate vicinity.

Long-term land values are not anticipated to be impacted by the Project as farming could continue within the unprotected area. However, there is a potential for land values to decrease as the land may be less desirable to purchase or rent following implementation of the Project.

Grain and Livestock Feed Spoilage

Grain and livestock production are common in the project area and typically involve storage of grain and other feed for consumption at a later date by livestock or to sell as a commodity at market rate. Significant quantities of bulk grain are typically stored in large grain bins, silos or other storage structures throughout the project area. Bulk grain usually has low moisture content prior to storage in order to prevent decomposition during storage. Other livestock feed may also include silage that is transferred as wet feed material to silos or other storage structures. Grain and feed materials are an integral part of a farm operator’s income. Both result either directly or indirectly through the consumption and growth of the livestock in variable levels of income for the farm.

Grain and feed storage structures located in the flood inundation areas have the potential to become contaminated by floodwater and/or take on excessive moisture, which can lead to unusable materials, thus spoiling the grain and feedstock. During flood events it is not feasible to move large quantities of stored grain and feed. Without grain or feedstock, the income to the individual farm operations could be impacted.

Based on review of aerial photographs and available property information, the majority of the non-residential structures are located within the existing 100-year floodplain. Based on the active agricultural operations in the area, it is likely that some of these non-residential structures are used for storage, and, likely flood under the Base No Action Alternative.

The Project has the potential to increase the risk of flood inundation, especially in areas upstream of the tieback embankment, where inundation may be deeper than existing conditions and new inundation may occur to areas not previously impacted by flooding. Livestock production would not be compatible with flooding in the staging area, and therefore, livestock operations would be relocated. This would minimize the potential risk of impacts to storage of livestock feed. USACE and the non-Federal sponsor have not made final determinations about whether any existing non-residential structures would be allowed in the staging area. However, it is unlikely that vulnerable grain storage facilities would be allowed to remain below the 100-year flood elevation. Mitigation of structures is proposed and described in Section 3.16.3 below.

Organic Farms Certification

Organic certification applies to the farm operation and the products produced by the operation. The farmer receives organic certification for the land on which the crops are grown; however, certification is non-transferable and does not stay with the land if the land is sold. The technical memorandum prepared for this EIS includes a more detailed discussion on the organic certification process. This technical memorandum is included as Appendix K of the EIS.

Table 3.85 provides a summary of the four known organic farms within the vicinity of the Project inundation areas. Each organic farm includes several parcels of land associated with the organic certification. These parcels of land are not typically contiguous. Appendix K Figure 1 shows the location of the parcels that contain organic acreage relative to the Project staging area boundary and new flood inundation. The total parcel-based land acreage calculated was 4,370 acres. All of this land, except two parcels in Farm 4, is located in Minnesota. Appendix K Figure 1 shows the four identified organic farms relative to the Project staging area and 100-year flood inundation area during Project operation.

Table 3.85 Organic Farms Located Within the Vicinity of the Proposed Project Inundation Areas During the 100-year Flood[1]

Farm	Crops/ Forages	Farmer Reported Organic Acres	Parcel Acres	Acres within Project Staging Area Boundary
Farm 1	Soybeans, Spring Wheat, Corn, Flaxseed	889 Acres	998 Acres	843 Acres
Farm 2	Alfalfa, Corn, Soybeans, Pasture	1,256 Acres	1,330 Acres	606 Acres
Farm 3	Soybeans, Wheat, Corn, Alfalfa	767 Acres	835 Acres	241 Acres

Farm	Crops/ Forages	Farmer Reported Organic Acres	Parcel Acres	Acres within Project Staging Area Boundary
Farm 4	Corn, Soybeans, Wheat	715 Acres	1,208 Acres	1,208 Acres

[1]This table provides a summary for organic farms located within the vicinity of inundation areas and identifies parcel acres located within the staging area boundaries. It does not reflect acreages of inundation. Estimated acres of inundation are presented in Table 3.86 below.

The potential for contamination of an organic farm could result from contact with floodwater containing prohibited substances per the USDA National Organic Program List. A third-party certifying agency would determine whether floodwater on a parcel of land would affect a particular farm's organic certification.

According to USDA National Organic Program (7 CFR 205), a farm would not necessarily lose their organic certification due to potential contamination from natural disasters such as floods. In the instance of a flood, a temporary variance may be issued to farms that experience negative effects. If the crops are found to have a certain level of contamination of prohibited substances, the USDA would allow them to continue growing and harvesting crops in that field as organic, but require them to sell them as traditional for three years in an effort to transition their field back to certified organic. The USDA National Organic Program (7 CFR 205.290) does not differentiate between natural and man-induced flooding as it relates to granting temporary variances for damages caused by flood.

The 100-year flood event under Project conditions was evaluated to determine where a particular parcel of identified organic farm land was located relative to existing and new flood inundation. Table 3.86 provides a summary of total acres for the identified organic farm parcels along with percentages of flooded acres. Approximately 2,200 acres of new inundation, approximately half of the overall identified organic farm acreage, would occur as a result of Project operation. This would have an effect on all four farms. Appendix K Figure 2 shows the areas of flood inundation for flooded and non-flooded acreage associated with operation of the Project during the 100-year flood. As presented in Table 3.86, the Project would flood significant portions of Farm 1 (over 900 acres) and Farm 4 (approximately 850 acres). The Project would also flood 369 acres of Farm 2 and 80 acres of Farm 3.

Table 3.86 Organic Farm Acreage By 100-Year Flood Event for Proposed Project [1 2 3 4]

Farm		Proposed Project Area (acres)	Proposed Project Percent of the Total Parcel Acreage (%)
Farm 1	*Flooded*	*913*	*90%*
998 acres	*Non-flooded*	*85*	*9%*
Farm 2	*Flooded*	*369*	*28%*
1,330 acres	*Non-flooded*	*961*	*72%*
Farm 3	*Flooded*	*80*	*10%*
835 acres	*Non-flooded*	*755*	*90%*
Farm 4	*Flooded*	*848*	*70%*
1,208 acres	*Non-flooded*	*360*	*30%*
TOTAL	*Flooded*	*2,210*	*51%*
4,370 acres	*Non-flooded*	*2,160*	*49%*

[1]Total acres for each farm are based on the total acreage in the parcel, not the total acres that are actually farmed. Acreages Acreages were rounded to the near acre. Totals and percentages provided are rough estimates based on rounded acreage.
[2]Flooded and Non-flooded conditions are based on the USACE elevations modeled for the 100-year flood. Flood indicates the estimated acreage that is anticipated to be inundated during the 100-year. Non-flood indicates the estimated acreage that is anticipated to not be inundated during the 100-year flood.
[3]Proposed Project 100-year flood refers to the additional area that would flood for the 100-year flood during Project operation.
[4]Total farm acreage is based on total parcel acreage for the Parcel Identification Numbers provided by the farmers, which includes their reported organic farm acreage. In all cases the organic farm acreage reported by the farmer is less than the total parcel acreage associated with the farmed Parcel Identification Numbers. ArcGIS was used to map and evaluate the organic farm acreage using the available Parcel Identification Numbers data. Surveys and delineations of actual organic farm acreage were not available, and therefore, the Parcel Identification Number information was the best available information at the time of EIS publication.

The potential financial impact of crop loss or loss of organic certification is dependent on a number of variables, including market rate for organic versus traditional crops, and buyer perceptions associated with purchasing organic products grown under flooded conditions. As discussed, many factors influence the significance of the potential impact on agricultural land and organic farms from the Project. Mitigation has been proposed for agricultural and organic farm impacts, including flowage easements and land acquisition. Estimated costs for land acquisition, including right-of-way and easements are provided above in subsection 3.16.2.2.1. Mitigation is further described in subsection 3.16.3 Proposed Mitigation and Monitoring Methods below.

3.16.2.5.6 Flood Fighting

The stress associated with the continued threat of flooding and the flood fight efforts is currently a significant issue in the F-M area (FFREIS, Appendix D, 2011). Project construction and operation would reduce the stress experienced by communities and individual property owners/renters in the protected areas by reducing the threat of flooding and flood fighting efforts. Historically, constructing the emergency levees has taken significant financial and human resources, has caused business and traffic disruptions, and was wearing on the social fabric of the communities. Although constructing emergency levees have been successful in the past, they are at high risk of catastrophic failure, which would result in significant damage in the surrounding area and potential loss of life. The Project is expected to reduce the need for flood fighting in the F-M urban area, and therefore, reduce disruption to normal community activities that have typically occurred during past flood events. The Project would also reduce threats to life/safety associated with floodfighting and emergency personnel both in the protected area and mitigated unprotected area.

Although the risk, depth, and duration of flooding may increase under Project conditions within the unprotected area, many of these property owners already experience the social and financial burdens associated with flooding. Many of these residents will be relocated to areas outside of the floodplain or to the protected ring-levee communities. Other residents and property owners will be mitigated for impacts through nonstructural measures or by flowage easements. Therefore, it is expected that Project mitigation would overall reduce the social and economic costs to those within the unprotected areas as well. Overall risk, stress and economic burdens associated with flood fighting will be reduced up to a 500-year event.

3.16.2.5.7 Geographical Extent Social and Economic Impacts: Minnesota and North Dakota; Protected and Unprotected Areas

Minnesota and North Dakota

Some comments received during the federal process and again during the SEAW public comment period pertained specifically to Minnesota's involvement in the Project. Some Minnesotan's expressed concern for the burden that would be placed on Minnesotans when Minnesota did not face the same flood threats and flood damages that Fargo experienced (see USACE FFREIS Appendices R and S, 2011; USACE Supplemental EA, Appendices E and F; MNDNR FSDD, Public Comments and Agency Responses to Public Comments Received, 2014).

The Red River floodplain extends to both the North Dakota and Minnesota side of the Red River; both states have been impacted by flooding on the Red River (Figure 31). Both cities have completed, funded, and proposed FDR projects; Moorhead $137,281,000; and Fargo $187,274,000 (see Chapter 2) so overall flood reduction benefits would be experienced by both Minnesota and North Dakota. For example, the number of structures impacted during a 25-year flood through a 500-year flood would be reduced under Project conditions for both states.

The average annual damage under the Project for the study area is approximately $10 million. Damages in North Dakota and Minnesota are estimated to be reduced by 84 percent and 38 percent, respectively, from the existing conditions. Using the information from Tables 3.78 and 3.79, the Project would provide direct protection primarily to North Dakota. The damage reduction benefits in North Dakota would be focused primarily on the Fargo urban area (Fargo and West Fargo). The Project would begin to provide benefit in Fargo at the 10-year flood with increasing performance up to the 500-year flood with maximized benefits experienced up to the 100-year flood The Project would begin to provide measurable protection to Minnesota between the 50-, 100-, and 500-year floods; the benefited area being the Moorhead urban area.

It is important to note that when considering the quantitative information presented above regarding costs and damages, for example, that social conditions of the area be considered as well. Focusing on the F-M urban area, Moorhead in the last four decades has experienced a slower growth rate than Fargo, ND and is smaller in population than Fargo, making up about 27 percent of the overall population between the two cities. Due to the urban size differences, it would be expected that numbers presented such as number of jobs, damages and costs would be less for Minnesota.

Regardless of these differences, the two cities do share economic vitality. If Moorhead were to be protected from a large-scale flood event such as a 100-year flood, and Fargo was not protected, it is likely that Minnesota would still be affected both socially and economically. Socially, stress from the fear of flood damage and human safety would be reduced. However, the stress of a neighboring community experiencing flood damage that shares in social and economic vitality would occur. Many Minnesota damages and losses quantitatively described above would still occur, albeit reduced. Minnesota would for example, experience loss of employment or income as many residents reside in one state but, work in the other. According to the Greater Fargo Moorhead Economic Development Corporation, 13,377, or about 39 percent of Clay County residents work in Cass County. Alternately, 4,646 Cass County residents are employed in Clay County, or about five percent. Local businesses depend on customers from both cities/states. Impacts to shared public infrastructure and services such as utilities or emergency services could also affect those in Minnesota.

Both states would experience social and economic impacts from implementation of the Project. Residences and businesses may directly be impacted by construction or operation of the Project, resulting in property buyouts or other measures (see subsection 3.16.2.2.5 Effects of Relocations and Flowage Easements). The local governments would be expected to cover some of the Project construction, operation and maintenance costs(see FFREIS Section 3.14 Implementation Requirements); however, the Project is expected to provide employment opportunities and income (both direct and indirect) from the operation and maintenance of the Project.

The area upstream of the tieback embankment, referred to as the unprotected area, would experience the majority of negative impacts from the Project and would affect both states. In comparing existing condition flood inundation to Project flood inundation within the unprotected area during the 100-year flood, North Dakota would experience a decrease of inundation acres of 26 percent (or approximately 9,000 acres less inundation); Minnesota would experience an increase of flood inundation acreage of 133 percent (or approximately 10,000 acres of new inundation). Under the same flood event 317 total structures would be impacted in Minnesota while 511 total structures would be impacted in North Dakota. Structures that occur within the FEMA revision reach would be mitigated by the USACE and Diversion Authority as described throughout this section. Mitigation for structures outside the FEMA revision reach would be determined on a case-by-case basis. Both states would have communities that would benefit from the protection of a ring levee within the staging area; OHB and Comstock.

Protected and Unprotected Areas

Conclusions from the USACE's OSE study indicate that while the Project would reduce the stress, anxiety, and related psychological effects of flood and flood potential to those in the F-M urban area, the Project would cause considerable social disruptions for the communities and residents within the inundated areas, particularly those within the upstream inundation area south of the tieback embankment. Similar concerns were communicated in comments received during the federal process and again during the SEAW public comment period. Some communities and individuals expressed that the Project would unfairly place the burden of social and economic losses to those who reside and or work outside of the F-M urban area; and that the stress and economic hardship the Project would place on these communities and individuals was great (see USACE FFREIS Appendices R and S, 2011; USACE Supplemental EA, Appendices E and F; MNDNR FSDD, Public Comments and Agency Responses to Public Comments Received, 2014).

The protected area would gain from the Project from a reduced flood risk perspective. The stress associated with the continued threat of flooding and the flood fight efforts is currently a significant issue to these communities (FFREIS, Appendix D, 2011). Project construction and operation would reduce the stress experienced by communities and individual property owners/renters by reducing the threat of flooding and flood fighting efforts (see above discussion under 3.16.2.2.7 Flood Fighting).

Although many communities and rural properties located within the unprotected area experience flooding under existing conditions; Project operation would increase flood water depth in many areas and would also result in new inundation to areas that currently are not within the floodplain. Currently, this area is at risk of local levees overtopping; however, the increased frequency of flood events and increased water levels resulting from Project operation would increase this risk and thereby stress for potential property damages and loss of life for residents, local business owners, and or farmers. It should be noted; however, that it is anticipated that relocated residents from within the unprotected area would settle in areas not prone to flooding, or within the communities of OHB and or Comstock, which would be protected by ring levees. This would reduce flood-related stress and reducing overall social impacts from a flood-risk reduction project.

Health and safety and economic vitality were two factors identified to be most important to all residents within the USACE's OSE study area. Implementation of the Project would considerably improve both of these factors for residents within the protected area. Protection of medical infrastructure and economic activities within the F-M urban area would also indirectly benefit the entire study area. However, many of those within the unprotected area would not receive any direct benefits and would be negatively affected due to increased flood risk and Project-associated actions (e.g., buyouts, relocations) Residents within the unprotected area (identified generally as Area 1 for the OSE study) were likely to experience considerable negative impacts from a Social Connectedness and Economic Vitality social factors due to the number of relocations associated with mitigation measures.

Pertaining to economic vitality, the F-M urban area, as part of the protected area, serves as a regional center for employment, commerce, and educational and training opportunities. Implementation of the Project would reduce the flood risk and damages that would otherwise result in business losses, potentially higher unemployment, and add to the economic vitality of the F-M urban area. However, the unprotected area would experience negative effects to economic vitality. Induced flooding and acquisitions of structures would require businesses to relocate to other areas and may result in associated loss of employment. Future land development would be limited due to restrictions imposed by flowage easements and increased flood risk. Relocations would likely result in a loss of tax revenue and may impact local municipalities and local governments to provide services to the remaining residents and businesses within their jurisdictions; however, the effect of loss of tax revenue is less of an impact considering the inclusion of the OHB ring levee as Project component (see above discussions under 3.16.2.2.5 Effects of Relocations).

The USACE's OSE study concluded that regarding the negative impacts that would be experienced by those within the unprotected areas, reducing flood risk and flood costs from a long-term perspective would benefit not only those residents, business owners, workers, and public servants within the protected area; but to all within the study area and region. Therefore, implementation of a flood-risk reduction project was regarded as providing the greatest social benefit to the area.

It is important to note when considering the conclusions of the OSE study that the OHB ring levee was not a Project component at the time of the OSE study. Conclusions of the OSE study assumed that the communities of Oxbow, Hickson, and Bakke would be impacted by the Project. This would have increased the number of residents and businesses that would be affected by the Project as well as tax base revenues as the communities of Oxbow, Hickson, and Bakke combined represent one of the larger population bases within the unprotected area.

3.16.2.5.8 Base No Action Alternative

The Base No Action Alternative includes the potential flood risk reduction impact of existing and currently funded permanent projects such as levee construction (i.e., structural measures) and property buyouts (i.e., non-structural measures). This alternative does not include emergency measures currently pursued in the project area as necessary due to flooding, and therefore, the Base No Action Alternative would have flooding where the water level exceeds the tie-in of levees to natural ground. Figure 12 illustrates the current areas of flooding in the F-M area during the 100 year flood. As shown in Figure **Error! Reference source not found.** 12 flooding during the 100-year flood would flow around the levees where the water level exceeds the tie-in elevations to natural ground. Additional information on the Base No Action Alternative is presented in Section 2.2 – No Action Alternatives.

The Base No Action Alternative for this EIS includes all of the permanent levee segments identified in the FFREIS; however credit given to existing levees varied (FFREIS Appendix H – "Credit to Existing Levees" as no credit was given for emergency measures that were necessary to fill gaps between the existing permanent level segments. The FFREIS No Action Alternative also did not include the in-town levees that are currently proposed or under construction as part of the Base No Action Alternative.

3.16.2.5.9 Construction, Operation and Maintenance

The Base No Action Alternative would include construction and maintenance of FDR projects, but would not include construction, operation and maintenance of a large-scale flood control project. It should be noted that the economic impacts of smaller FDR projects were not evaluated for any of the alternatives in the SE Report (HMG, 2015a).

3.16.2.5.10 Infrastructure and Public Services

The existing network of infrastructure and public services would continue to be operated and maintained, including during flood events as feasible. During flood events under the Base No Action Alternative, many roads and utilities in the urban and rural areas are impacted with inundation. This results in impacts potential loss of water and sewage services, contamination of public water supplies, compromised natural gas systems, and other utility damages, as well as potential impacts to travel and emergency services response times.

The USACE provided an evaluation of impacts to transportation systems in the FFREIS Appendix D (transportation study). The transportation study evaluated impacts to vehicle traffic, rail systems, and air travel from the historic flood in 2009. The evaluation found significant impacts to transportation networks with the 2009 event (which equates to approximately a 50-year flood. In particular, roadway impacts included:

- Submerging of roadways from overland and riverine flooding from the Red, Wild Rice, Sheyenne, Maple, Rush, and Lower Rush Rivers;
- Roadway used for temporary levees;
- Central travel corridors repurposed to sand bag distribution routes; and
- Congestion increased with emergency responders.

USACE found that transportation impacts increase for flood fighting activities with a 50-year event and greater due to increased flood fighting activities. Furthermore, transportation impacts increase significantly from local detours with the 100-year and 500-year floods as flood inundation limits and duration increase.

The transportation study found that air and rail traffic are unaffected until a 100-year event. Under current conditions the railroads crossing the Red River at Fargo must be shut down to build dikes across the rail embankment during the 100-year event and above, which shuts down the rail traffic through the Fargo-Moorhead area and impacts the operation of the rail yard in Fargo and rail yard in Dilworth. According to the May 2014 North Dakota State Freight Plan, produced by North Dakota Department of Transportation (NDDOT), 127 trains per day passed through Fargo-Moorhead in 2012. The USACE estimated equivalent expected annual damages to transportation for the FFREIS No Action Alternative condition to be of $3.7 billion (October 2011 dollars).

3.16.2.5.11 Impacts to Structures and Structure Function

Under the Base No Action Alternative, structures and structure functions would continue to be impacted. Although flood risk is reduced by existing and currently funded projects, the F-M area would experience substantial losses during flood events. During large scale flood events, these losses would expect to increase dramatically when flood waters begin to flow around the levees where the water level exceeds the tie-in elevations to natural ground. Considerations for interpretation of information presented in tables below are similar to those described for the Project.

3.16.2.5.11.1 Impacts to Structures

Table 3.87 summarizes the SE Report's estimated impacts to structures (damages) that occur under the Base No Action Alternative condition. Over 17,400 structures in the study area under current conditions are subject to flooding during the 100-yr flood. Ninety-four percent of structure impacts occur within the F-M urban area; however, only four percent of those occur within Minnesota. Table 3.87 presents the 100-year flood scenario for the Base No Action Alternative.

Table 3.87 Structures Impacted under the Base No Action Alternative During the 10-year, 25-year, 50-year, 100-year, and 500-year Flood Events

Location	10-year Flood	25-year Flood	50-year Flood	100-year Flood	500-year Flood
North Dakota					
Fargo Damaged Structures[1]	502	3,473	11,673	15,767	26,060
Remaining Cass County Damaged Structures[2]	236	549	723	947	1,368
Richland County Damaged Structures[3]	0	0	4	18	53
Total Damaged – North Dakota	**738**	**4,022**	**12,400**	**16,732**	**27,481**
Minnesota					
Moorhead Damaged Structures[1]	9	23	210	616	1,382
Remaining Clay County Damaged Structures[2]	12	66	104	135	230
Wilkin County Damaged Structures[3]	0	1	1	3	37
Total Damaged – Minnesota	**21**	**90**	**315**	**754**	**1,650**
Structures Damaged within FM urban area[1]	**511**	**3,496**	**11,883**	**16,383**	**27,442**
TOTAL Damaged Structures (Base No Action Alt.)[4]	**759**	**4,112**	**12,715**	**17,486**	**29,131**

Source: HMG, 2015a

[1]Based on HAZUS level 3 evaluation using COE HEC-FDA structure inventory

[2]Based on HAZUS level 2 evaluations with HAZUS default county data for remaining portions of Clay and C ass counties not covered by the structure inventory

[3]Based on HAZUS level 2 evaluations with HAZUS default county data for Richland and Wilkin counties

[4]Includes both the level 3 and level 2 analysis results

The SE Report's estimated damages for the Base No Action Alternative, average annual damages, are approximately $51 million (Table 3.88). This includes damages not only to the structures identified in Table 3.87 above but also damage costs associated with structure contents and vehicles. The majority (92%) of those damages are to residential, commercial, and industrial properties and their contents.

Under the Base No Action Alternative, nearly all of the flood damages (99%) are located in the F-M urban area. The largest damages (96%) are in the Fargo ($48 million) and three percent of the total damages ($2 million) are in Moorhead.

Table 3.88 Base No Action Alternative Estimated Damages to Buildings and Contents; and Vehicles ($ Millions)

Return Period	10-year	25-year	50-year	100-year	500-year	Average Annual Damage[1]
Damages - North Dakota						
Fargo						
Buildings and Contents	$28	$156	$720	$1,322	$3,952	$46
Vehicles	$10	$15	$43	$64	$188	$3
Total Fargo	$38	$170	$763	$1,386	$4,140	$48
Remaining Cass County						
Buildings and Contents	$0	$1	$1	$1	$2	$0
Vehicles	$1	$1	$2	$2	$3	$0
Total Remaining Cass County	$1	$2	$3	$3	$5	$0
Richland County						
Buildings and Contents	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$0	$1	$1	$0
Total Richland County	$0	$0	$0	$1	$1	$0
Total North Dakota	$39	$172	$766	$1,390	$4,146	$48
Damages - Minnesota						
Moorhead						
Buildings and Contents	$0	$2	$14	$29	$66	$1
Vehicles	$6	$7	$9	$11	$15	$1
Total Moorhead	$7	$10	$24	$40	$81	$2
Remaining Clay County						
Buildings and Contents	$2	$2	$2	$2	$3	$0
Vehicles	$1	$1	$1	$1	$2	$0
Total Remaining Clay County	$3	$3	$3	$3	$5	$0
Wilkin County						
Buildings and Contents	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$0	$0	$1	$0
Total Wilkin County	$0	$0	$0	$0	$1	$0
Total Minnesota	$10	$13	$27	$43	$87	$2
Total Damages						
Buildings and Contents	$31	$161	$739	$1,355	$4,024	$47
Vehicles	$18	$25	$55	$79	$208	$4
Total	$50	$187	$794	$1,434	$4,232	$51

Source: HMG, 2015a
[1] Average Annual Damage represent the amount of damage that would occur in any given year, and if that year were repeated infinitely many times over. The average value is based on the frequency of recurrence for each flood event (FFREIS Appendix C "Economics").

The $51 million in damages estimated varies from the USACE 2011 study, which computed existing conditions damages of $194 million with USACE Hydrologic Engineering Center's Flood Damage Reduction Analysis (HEC-FDA).7 Differences between the models make a comparison of results difficult. Notable reasons for the difference in damage estimates are:

- Inclusion of funded and recently constructed levees in the Base No Action Alternative
- Updated hydraulics
- Conversion of model frameworks from HEC-FDA to HAZUS.

Proprietary information about commercial damages is protected by non-disclosure agreements; therefore the data was removed from the HEC-FDA inventory by the USACE prior to releasing the model to the MNDNR. These commercial properties accounted for approximately $20 million in damages in the USACE damage estimate and are not accounted for in this analysis.

The MNDNR completed a more detailed structure count analysis for the area encompassing the staging areas and the additional upstream inundated areas associated with the Project and NAA alternatives. The number of structures and parcels impacted within the same geographic area under the Base No Action Alternative were also counted for comparison with the action alternatives. The numbers are included in Tables 3.82 and 3.83 above.

3.16.2.5.11.2 Loss of Structure Function

Average annual direct and indirect impacts from loss of building function are summarized below in Table 3.89. The Base No Action Alternative would maintain the flood related relocation costs. The estimated average annual existing relocation costs are approximately $55 million.

Impacts to business losses were estimated with the direct impacts to output run through the IMPLAN model, resulting in average annual impacts. The IMPLAN model provided average annual estimated indirect impacts to output; average annual direct and indirect impacts to employment, labor income, and value added; and average annual impacts to taxes. Existing conditions flooding generated an average annual direct loss of $1,013 million in business output. During flooding approximately 9,500 jobs are impacted with average income losses of $48,000 per employee. When combined with the indirect and induced impacts, flooding generates over $1.6 billion in business output losses and affects nearly 16,000 jobs. Additionally, business activity losses

[7] "The socioeconomic analysis incorporates new and updated economic and hydraulic information in addition to what was incorporated into economic models developed for the FFREIS. Therefore, the EIS model outputs are not a side-by-side comparison of economic model outputs developed for the FFREIS and will not be comparable to model outputs that were presented in the FFREIS or model outputs that would result from applying the model platform used for the FFREIS."

(economic output and employment) reduce overall tax collections by approximately $114 million.

Table 3.89 Base No Action Alternative Summary of Average Annual Impacts from Loss of Building Function ($ Millions)

Description	Direct Impact	Indirect Impact	Induced Impact	Total Impact
North Dakota				
Business Losses				
Output	$980	$266	$266	$1,512
Employment	9,202	3,018	3,562	15,782
Labor Income	$350	$101	$96	$548
Gross Regional Product	$547	$157	$163	$866
Total State and Local Tax	$110	NA	NA	$110
Disruption Costs	$3	NA	NA	$3
Relocation Costs	$53	NA	NA	$53
Minnesota				
Business Losses				
Output	$33	$6	$4	$43
Employment	299	46	35	380
Labor Income	$11	$2	$1	$14
Gross Regional Product	$17	$3	$2	$23
Total State and Local Tax	$4	NA	NA	$4
Disruption Costs	$1	NA	NA	$1
Relocation Costs	$2	NA	NA	$2
Total				
Business Losses				
Output	$1,013	$272	$270	$1,555
Employment	9501	3064	3597	16162
Labor Income	$361	$103	$97	$562
Gross Regional Product	$564	$160	$165	$889
Total State and Local Tax	$114	NA	NA	114
Disruption Costs	$4	NA	NA	$4
Relocation Costs	$55	NA	NA	$55

3.16.2.5.12 Flood Insurance

It is assumed that the Base No Action Alternative would not reduce flood insurance requirements beyond those potentially impacted by the already completed and currently funded permanent projects.

3.16.2.5.13 Effects of Relocations and Flowage Easements

Under the Base No Action Alternative, some portions of the F-M urban area would continue to flood. FDR projects (e.g., in-town levees and floodwalls) and plans for additional property buyouts in these areas would continue as funding and feasibility allows. This may result in some relocation of residences and businesses, but is not expected to cause noticeable effects on communities, school districts or the local tax base. Many buyouts have already occurred, and property owners in the F-M urban area have relocated out of the floodplain or to locations protected by in-town levees and floodwalls. These relocations have affected individual neighborhoods. Individual property owners living in flood-prone areas, urban or rural, may chose at any time to relocate. This level of relocation is not anticipated to cause significant socioeconomic impacts.

3.16.2.5.14 Effects on Property Improvements

Flood waters have the potential to cause impacts and damages to not only structures on a property but to improvements on the property such as wells and septic systems. The potential impact of flood inundation on wells and septic systems under the Base No Action Alternative would be similar to those described for the Project. Where there is potential for flood inundation under the Base No Action Alternative, Minnesota Rules 4725, which regulates wells for groundwater and drinking water sources, would be followed for requirements regarding flood protection for water-supply wells. In Minnesota, septic systems are regulated by Minnesota Rules Chapter 7080.2270, which require placement of SSTS components outside of a floodway and avoidance of the 100-year floodplain.

3.16.2.5.15 Agricultural Impacts

The majority of the project area isrural and is currently used for agriculture. Under the Base No Action Alternative, agricultural land currently subject to flooding during the 100-year flood would continue to be inundated by flood water. As previously described above, there are 4 organic farms located within the vicinity of the inundation area in addition to the traditional agricultural operations. Of the four organic farms, as summarized in Table 3.90, Farm 1 and Farm 2 each have over 100 acres that is inundated during the Base No Action 100-year flood. Farm 3 has approximately 10 acres of inundation, while Farm 4 does not flood during the 100-year flood. Approximately 310 acres of organic farm land, or approximately seven percent, flood during the existing 100-year flood.

Table 3.90 Organic Farm Acreage By 100-Year Flood Event for Base No Action Alternative[1 2 3 4]

Farm		Area (acres)	Percent of the Total Acreage (%)
Farm 1	*Flooded*	*131*	*13%*
997 acres	*Non-flooded*	*867*	*87%*
Farm 2	*Flooded*	*168*	*13%*
1,330 acres	*Non-flooded*	*1,162*	*87%*
Farm 3	*Flooded*	*10*	*1%*
835 acres	*Non-flood*	*824*	*99%*
Farm 4	*Flooded*	*0*	*0%*
1,208 acres	*Non-flooded*	*1,208*	*100%*
TOTAL	*Flooded*	*309*	*7%*
4,370 acres	*Non-flooded*	*4,061*	*93%*

[1]Total acres for each farm are based on the total acreage in the parcel, not the total acres that are actually farmed. Acreages were rounded to the near acre. Totals and percentages provided are rough estimates based on rounded acreage.
[2]Flood and Non-flood conditions are based on the USACE elevations modeled for the 100-year flood. Flood indicates the estimated acreage that is anticipated to be inundated during the 100-year. Non-flood indicates the estimated acreage that is anticipated to not be inundated during the 100-year flood.
[3]Base No Action Alternative 100-year flood refers to the area that would flood under the existing 100-year flood. This flood inundation would occur whether or not the Project or NAA were constructed and operated.
[4]Total farm acreage is based on total parcel acreage for the PIDs provided by the farmers, which includes their reported organic farm acreage. In all cases the organic farm acreage reported by the farmer is less than the total parcel acreage associated with the farmed PIDs. ArcGIS was used to map and evaluate the organic farm acreage using the available PIDs data. Surveys and delineations of actual organic farm acreage were not available, and therefore, the PID information was the best available information at the time of EIS publication.

The Base No Action Alternative would pose potential financial impacts from crop loss or loss of organic certification where flooding occurs. The magnitude of these impacts would be dependent on a number of factors, such as timing and extent of flooding and type of crop. Effects of flooding to organic farm certification would be determined on a case-by-case basis (Appendix K).

3.16.2.5.16 Flood Fighting

Under the Base No Action Alternative, flood fighting and other emergency measures would not be implemented. Where levees and other permanent structures cannot hold back the flood water due to elevation, areas behind the structures would be inundated with flooding.

3.16.2.5.17 Geographic Extent Social and Economic Impacts: Minnesota and North Dakota, Protected and Unprotected Areas

<u>Minnesota and North Dakota</u>

Under the Base No Action Alternative, the flooding conditions in Minnesota and North Dakota would remain the same and would not be influenced by a large-scale flood control project. Flood damages and the social and economic effects resulting from large flood events would continue under the Base No Action Alternative. The estimated average annual damages for the F-M area are approximately $51 million (HMG, 2015a). The majority (92%) of the damages are to residential, commercial, and industrial properties and their contents. Appreciable damage begins with the 10-year flood and increases significantly at the 50-year flood and above. Nearly all of the flood damages (99%) are located in the F-M urban area. The largest damages (96%) are in Fargo ($48 million) and three percent of the total damages ($2 million) are in Moorhead.

Protected and Unprotected Areas

Under the Base No Action Alternative, communities, residents, and businesses would continue to experience flooding resulting in social and economic impacts, including emotional, physical, and financial loss. Completed and planned permanent levees and floodwalls reduce some of the risk and extent of flooding within the F-M urban area. Section 2.2 provides greater detail on the levee locations, elevations, and level of protection. The remaining areas, primarily rural areas and some of the F-M urban area, depending on the magnitude of the flood, would be impacted by flood inundation and considered unprotected.

3.16.2.6 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) includes the potential flood risk reduction impact of existing and currently funded permanent projects such as levee construction and property buyouts. This alternative also assumes that emergency measures similar to those that have been historically implemented in the project area would continue to be implemented as necessary due to flooding. Additional information on the Base No Action Alternative (with Emergency Measures) is presented in Section 2.2 – No Action Alternatives.

3.16.2.6.1 Construction, Operation, and Maintenance

The No Action Alternative (with Emergency Measures) would include construction and maintenance of FDR projects, but would not include construction, operation and maintenance of a large-scale flood control project.

3.16.2.6.2 Infrastructure and Public Services

The existing network of infrastructure and public services would continue to be operated and maintained, including during flood events as feasible. During the 100-year flood under the No Action Alternative (with Emergency Measures) impacts to infrastructure and public services would be similar to what was previously discussed for the Base No Action Alternative. Under the No Action Alternative (with Emergency Measures), flood inundation of infrastructure in the urban area may be less, as temporary flood protection measures could be implemented to protect specific infrastructure as needed and feasible. These emergency measures may also be able to keep certain travel routes open that would otherwise be inundated under the Base No Action Alternative.

3.16.2.6.3 Impacts to Structures and Structure Function

The uncertainty of the effectiveness of emergency measures in fighting floods is beyond the capabilities of HAZUS modeling, and therefore, this alternative was not quantifiably analyzed. However, it is estimated that impacts to structures would be somewhat similar, but not the same as those presented above in Tables 3.87, 3.88, and 3.89 under the Base No Action Alternative discussions.

3.16.2.6.4 Flood Insurance

It is assumed that the Base No Action Alternative would not reduce flood insurance requirements beyond those potentially impacted by the already completed and currently funded permanent projects.

3.16.2.6.5 Effects of Relocations and Flowage Easements

Under the No Action Alternative (with Emergency Measures), effects of relocations would be similar to those described for the Base No Action Alternative. Implementing emergency measures has reduced flood risk in the past, but would have uncertainty in having consistent success in implementing these measures in the future. Uncertainty may result in individual property owners deciding to relocate out of the flood-prone areas. This level of relocation is not anticipated to cause significant socioeconomic impacts.

3.16.2.6.6 Effects on Property Improvements

Flood waters have the potential to cause impacts and damages to not only structures on a property but to improvements on the property such as wells and septic systems. The potential impact of flood inundation on wells and septic systems under the No Action Alternative (with Emergency Measures) would be similar to those described for the Project. Where there is potential for flood inundation under the No Action Alternative (with Emergency Measures), Minnesota Rules 4725, which regulates wells for groundwater and drinking water sources, would be followed for requirements regarding flood protection for water-supply wells. In Minnesota, septic systems are regulated by Minnesota Rules Chapter 7080.2270, which require placement of SSTS components outside of a floodway and avoidance of the 100-year floodplain.

3.16.2.6.7 Agriculture

Under the No Action Alternative (with Emergency Measures), impacts to agriculture would be similar to those described for the Base No Action Alternative. However, additional acres of agricultural land may be impacted under the No Action Alternative (with Emergency Measures) due to increased inundation upstream in the rural areas from implementation of emergency measures in the urban area.

3.16.2.6.8 Flood Fighting

Emergency measures are intended to temporarily protect specific areas from flooding that do not have permanent flood damage reduction projects in place or enhance existing flood damage reduction projects, where there are gaps in levee protection between each of the individual projects, for example. Where gaps in protection exist, a temporary levee may be constructed to tie into existing levees to reduce flood risk from occurring behind the levee or overtopping an existing levee. Implementation of emergency measures could result in upstream stage increases larger than those under full levee protection for the Base No Action Alternative. This alternative could reduce flood risk in some areas not protected under the Base No Action Alternative, while increasing flooding in other areas upstream.

Flood forecasting, through modeling and other methods, is used to predict the flood crest and its timing as a specific gauge. This allows the F-M area to prepare and implement emergency measures as needed. However, flooding is a natural occurrence that is complex and uncertain. This means that communities are require to plan for a wide range of flood stages, especially when probabilistic forecasts are made. Uncertainties with flood forecasting along with several other factors have made the probability of having consistently successful emergency efforts in the future low, especially for flooding events larger than the 100-year flood. These factors include variable and extreme temperatures and weather conditions during March and April when flooding typically occurs. These conditions also complicate flood crest predictions and emergency measures implementation. Winter snowfall and precipitation can be monitored to predict potential levels of spring runoff that influence flooding and flood levels. Flood crest elevations are predicted in the project area by the National Weather Service in order to provide as much time as possible to implement emergency measures. The flood crest is the highest level of a flood as it passes a particular location. The higher the flood's crest elevation, the more time and effort are needed to construct emergency measures.

Local governments in the project area have flood emergency plans in place outlining the implementation steps, emergency measures, and the locations for each of the measures. These emergency measures may include temporarily raising permanent levees, constructing temporary levees and other temporary flood barriers in various areas, and sandbagging. The locations of each type of emergency measure are mapped with instructions for implementation at various times and stages of flooding. Emergency measures, primarily implemented in the F-M urban area, require significant financial and human resources. During past large flood events, such as the 2009 flood, 80 miles of temporary emergency levees were constructed, requiring more than 7.3 million sandbags and thousands of volunteers. Construction of emergency measures typically occurs on frozen ground, which adds to greater difficulty and risk to implementation. Additionally, due to successful emergency measures in the past, there is a perceived sense of security that may not reflect the true flood risk in the area. This has led to people staying to fight the flood rather than evacuate, which puts a greater number of people at risk if the emergency measures suddenly fail, during large flood events.

3.16.2.6.9 Geographic Extent Social and Economic Impacts: Minnesota and North Dakota, Protected and Unprotected Areas

<u>Minnesota and North Dakota</u>

Under the No Action Alternative (with Emergency Measures), the flooding conditions in Minnesota and North Dakota would remain the same and would not be influenced by a large-scale flood control project. Flood damages and the social and economic effects resulting from large flood events would continue as would flood fighting efforts. Under the No Action Alternative (with Emergency Measures) the estimated average annual damages for the F-M area are anticipated to be slightly less than those presented for the Base No Action Alternative; however, there is an additional cost of implementation of emergency measures, which varies depending on the magnitude of the flood.

<u>Protected and Unprotected Areas</u>

Under the No Action Alternative (with Emergency Measures), there are areas within the F-M urban area that are protected by permanent levees and floodwalls, plus implementation of temporary levees and floodwalls, and sandbagging, which would reduce the flood inundation in the F-M urban area. Section 2.2 provides greater detail on the levee elevations and level of protection. In general, implementation of emergency measures could protect the F-M urban area to at least a 50-year flood. However, there is high risk involved with relying on temporary measures for protection, which could result in catastrophic failure.

Areas outside of the F-M urban area are considered unprotected. These areas are primarily rural where permanent and emergency measures have limited use. Small communities may implement flood fighting measures depending on the flood, as well as some individual property owners to protect their homes or other property. Depending on the magnitude of the flood, the unprotected areas would be impacted by flood inundation, which would cause damage to property, potential income loss, and effects on the emotional and physical well-being of individuals, families, and communities. During flood events, many communities and rural properties located within the unprotected area would be flooded by the Red River and its tributaries.

3.16.2.7 Northern Alignment Alternative

The NAA was analyzed for its impacts on flood damage reduction and other social and economic factors using the previously described models, approaches, and considerations. Floodplains for the 10-, 25-, 50-, 100-, and 500-year floods with the NAA in place were developed for analysis under HAZUS. The extent of inundation from the 100-year flood under the Northern Alignment Alternative is shown in Figure 14.

3.16.2.7.1 Construction and Operations & Maintenance

The NAA is estimated to cost $1.87 billion (2010 price level)[8]. Construction is anticipated to occur over an 8-year period with maintenance occurring every year following construction. Table 3.91 provides a summary of construction costs included for the NAA. Note that proposed mitigation costs such as land acquisitions and road relocations are included as part of construction costs.

Table 3.91 Estimated Northern Alignment Alternative Construction Cost

Construction Component	NAA Cost (2010 dollars) [1 2 3 4 5 6 7 8 9 10]
Land Acquisition and Damages (right-of-way and easements)	$351,000,000
Relocations (utility relocations, roadway improvements and construction)	$149,000,000
Fish and Wildlife Facilities	$61,000,000
Railroad Bridges	$59,000,000
Channels and Control Structures	$784,000,000
Levees, Floodwalls, and Embankments	$163,000,000
Recreation Facilities	$29,000,000
Planning, Engineering, and Design	$187,000,000

[8] Flood Diversion Authority, *Final Technical Memorandum, Opinion of Probable Construction Cost to Support MN/DNR EIS Northern Alignment Evaluation*, January 9, 2015.

Construction Component	NAA Cost (2010 dollars) [1 2 3 4 5 6 7 8 9 10]
Construction Management[8]	$87,000,000
TOTAL	$1,870,000,000

Source: HMG, 2015b
1 Costs are rounded to the nearest $1 million.
2 2010 U.S. Dollars ($) construction costs; escalation is not included (estimate is not fully funded).
3 Methodology similar to PFSAA phase except where feature designs differ as stated in this report.
4 Contingency included. Contingency is an allowance for costs that will be in the Project Cost and are not included in the Contract Cost. Does not account for changed conditions either in the final design or during construction.
5 Changes to 2010 material, labor, equipment or fuel opinion of cost are not reflected in the project costs presented above.
6 Limited design work completed (<5%). Based on screening-level project definition. This screening-level (Class 5, <5% design completion per ASTM E 2516-06 and USACE EI 01D010 [9/1/97]) cost estimate is based on screening-level designs, alignments, quantities, and unit prices. Costs will change with completion of further design. A construction schedule is not available at this time. The estimated accuracy range for the total project cost as the project is defined is -50% to +100%.
7 Quantities based on design work completed.
[8] Construction Management is estimated as 7% of construction costs.
[9] Land Acquisition and Damages includes Lands and Damages within the USACE-defined staging area; and Mitigation Area Easements
[10] Land Acquisition and Damages were based on both USACE detailed data and GIS residential and non-residential GIS data obtained through USACE 2014 desktop analysis.

The NAA would have similar impacts on economic activity (e.g., employment and income) during construction and annual O&M as previously described for the Project (Table 3.92). Total impact from construction spending is $3.1 billion for the NAA. Construction impacts would be spread over eight years. Annual spending, employment, and indirect and induced effects would generate $190,000 in new tax revenues per year following construction. Tax revenues would be used by local governments to fund public services and infrastructure.

Table 3.92 Northern Alignment Alternatives Economic Impacts from Construction, Operation and Maintenance ($Millions)

Description	Northern Alignment Alternative	
	Direct Impact	Total Impact[1]
Total Construction Impacts		
Output	$1,791	$3,100
Employment (in jobs)	12,045	22,049
Labor Income	$827	$1,295
Gross Regional Product	$872	$1,645
Total State and Local Tax	$113	$113
Annual Operations and Maintenance Impacts		
Output	$3	$5
Employment (in jobs)	20	37
Labor Income	$1	$2
Gross Regional Product	$1	$3
Total State and Local Tax	>$1	>$1

Source: HMG, 2015b
[1] Total impact includes the direct impact i.e., direct economic effects (direct response of an industry), the indirect effects (changes in output, income, and employment caused by direct impacts), and the induced economic effects (changes in output, income, and employment cause by expenditures associated with new household income generated by direct and indirect economic effects).

3.16.2.7.2 Infrastructure and Public Services

The NAA is anticipated to result in traffic impacts similar to those previously described for the Project with the exception that the NAA would close the County Road 16 bridge in ND over the Red River during Project operation and similar to the Base No Action, may impact the County Road 18 bridge during large flood events. Section 3.13 provides greater detail on potential impacts to infrastructure and public services.

Transportation impacts under the NAA are anticipated to be similar to those previously described for the Project. The NAA would reduce impacts to transportation networks within the urban area. Impacts to air and rail would also be reduced. Road closures noted under the Base No Action Alternative would be reduced in the urban area. The NAA would generate transportation impacts from closures to roadways and bridges in the rural areas where the inundation area or diversion channel occur. Under the NAA, flooding would create approximately $333,000 (2009 dollars) in average annual transportation impacts.

Based on preliminary design, impacts to utilities from the NAA would be similar to those described for the Project. Table 3.93 provides a summary of utility relocation costs for the NAA.

Table 3.93 Summary of Utility Relocation Costs for the Northern Alignment Alternative

Utility Relocation	Northern Alignment Alternative
Electric Power	$9,921,400
Natural Gas Pipeline	$997,600
Petroleum Pipelines	$1,016,000
Fiber Optic Lines	$5,376,400
Water Utilities	$2,313,000
Sanitary Sewer	$369,400
Total Utility Relocation Cost	**$19,993,800**

Source: HMG, 2015b

Under the NAA, access to healthcare facilities and emergency services would be similar to those previously described for the Project.

3.16.2.7.3 Impacts to Structures and Structure Function

The NAA would impact structures and structure function similar to what is described above under the Project. Subsection 3.16.2.2.3 includes a brief discussion on structure and structure function analyses completed and discussed herein as well as considerations in interpreting the information presented. Costs associated with NAA construction, including mitigation, were based on methodology used in the FFREIS and PFSAA (HMG, 2012).

3.16.2.7.3.1 Impacts to Structures

Similar to the Project, the SE Report results indicated that benefits from flood damage reduction to structures would begin to occur around the 25-year flood and incrementally thereafter, maximizing under the 100-year flood. Out of the number of structures protected under the NAA during the 100-year flood, 91 percent of those would be within the F-M urban area. Two additional structures would be impacted in Richland County under the NAA. Wilkin County structure impacts would be expected to remain the same as the Base No Action Alternative (baseline conditions for study).

North Dakota would experience the greatest number of structure impacts under all flood scenarios. Under the 100-year flood, the number of structures impacted is 829 (about 90 percent); for Minnesota, the number of structures impacted is 91 (or 10 percent).

Table 3.94 Structures Impacted by the Northern Alignment Alternative During the 10-year, 25-year, 50-year, 100-year, and 500-year Flood Events [1]

Location	10-year Flood	25-year Flood	50-year Flood	100-year Flood	500-year Flood
North Dakota					
Fargo Damaged Structures[2]					
Base No Action Alternative	502	3,473	11,673	15,767	26,060
Northern Alignment Alternative	474	473	479	489	12,108
Protected Structures	**28**	**3,000**	**11,194**	**15,278**	**13,952**
Remaining Cass County Damaged Structures[3]					
Base No Action Alternative	236	549	723	947	1,368
Northern Alignment Alternative	198	309	310	320	551
Protected Structures	**38**	**240**	**413**	**627**	**817**
Richland County Damaged Structures[4]					
Base No Action Alternative	0	0	4	18	53
Northern Alignment Alternative	0	0	4	20	53
Protected Structures	**0**	**0**	**0**	**-2**	**0**
Total Protected – North Dakota	**66**	**3,240**	**11,607**	**15,903**	**14,769**
Total Damaged (NAA) – North Dakota	**672**	**782**	**793**	**829**	**12,712**
Minnesota					
Moorhead Damaged Structures[2]					
Base No Action Alternative	9	23	210	616	1,382
Northern Alignment Alternative	8	10	9	11	382
Protected Structures	**1**	**13**	**201**	**605**	**1,000**
Remaining Clay County Damaged Structures[3]					
Base No Action Alternative	12	66	104	135	230
Northern Alignment Alternative	12	62	66	77	136
Protected Structures	**0**	**4**	**38**	**58**	**94**
Wilkin County Damaged Structures[4]					
Base No Action Alternative	0	1	1	3	37
Northern Alignment Alternative	0	1	2	3	37
Protected Structures	**0**	**0**	**-1**	**0**	**0**
Total Protected – Minnesota	**1**	**17**	**238**	**663**	**1,094**
Total Damaged (NAA) – Minnesota	**20**	**73**	**77**	**91**	

Location	10-year Flood	25-year Flood	50-year Flood	100-year Flood	500-year Flood
					555
Structures Protected within FM urban area[1]	29	3,013	11,395	15,883	14,952
TOTAL Protected Structures (NAA)[5]	**2**	**3,257**	**11,845**	**16,566**	**15,863**
TOTAL Damage Structures (Base No Action Alternative)[4]	**759**	**4,112**	**12,715**	**17,486**	**15,178**
TOTAL Damaged Structures (NAA)	**692**	**855**	**870**	**920**	**13,267**

Source: HMG, 2015b

[1]Structure numbers and type should not be compared to those represented in Table 3.96. Methods and data sources applied were different.
[2]Based on HAZUS level 3 evaluation using COE HEC-FDA structure inventory
[3]Based on HAZUS level 2 evaluations with HAZUS default county data for remaining portions of Clay and C ass counties not covered by the structure inventory
[4]Based on HAZUS level 2 evaluations with HAZUS default county data for Richland and Wilkin counties
[5]Includes both the level 3 and level 2 analysis results

Table 3.95 below presents the residual damages under NAA that includes not only damages to the structures identified in Table 3.94 above, but also costs associated with structure contents and vehicles (SE Report). The average annual damages within the SE Report study area are approximately $10 million. Under NAA conditions, damages in Fargo and Moorhead are reduced by 84 percent and 38 percent, respectively, from the Base No Action Alternative (baseline conditions). Damages in the surrounding areas increase by approximately four percent (increase of $40,000 in average annual damages); however the damages in the surrounding areas remain less than 1% of the overall total damage estimate.

A review of the SE Report results indicates that increased flood depths result in an increase in expected damages to properties already at risk. The overall net impact to Richland and Wilkin counties is $187 and $532 in average annual damages respectively.

Table 3.95 Northern Alignment Alternative Estimated Residual Damages ($ Millions)

Return Period	10-year	25-year	50-year	100-year	500-year	Average Annual Damage[1]
Damages - North Dakota						
Fargo						
Buildings and Contents	$25	$41	$44	$48	$802	$7
Vehicles	$9	$11	$11	$11	$46	$1
Total Fargo	$35	$51	$54	$59	$848	$8
Remaining Cass County						
Buildings and Contents	$0	$1	$1	$1	$2	$0
Vehicles	$1	$1	$2	$2	$3	$0
Total Remaining Cass County	$1	$2	$3	$3	$5	$0
Richland County						
Buildings and Contents	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$0	$1	$1	$0
Total Richland County	$0	$0	$0	$1	$1	$0
Total North Dakota	$36	$53	$57	$63	$854	$8
Damages – Minnesota						
Moorhead						
Buildings and Contents	$0	$3	$4	$4	$24	$0
Vehicles	$6	$7	$7	$7	$10	$1
Total Moorhead	$7	$10	$11	$12	$34	$1
Remaining Clay County						
Buildings and Contents	$2	$2	$2	$2	$3	$0
Vehicles	$1	$1	$1	$1	$2	$0
Total Remaining Clay County	$3	$3	$3	$3	$5	$0
Wilkin County						
Buildings and Contents	$0	$0	$0	$0	$0	$0
Vehicles	$0	$0	$0	$0	$1	$0
Total Wilkin County	$0	$0	$0	$0	$1	$0
Total Minnesota	$10	$13	$14	$15	$40	$1
Total Damages						
Buildings and Contents	$29	$47	$52	$57	$831	$7
Vehicles	$18	$21	$22	$22	$63	$2
Total	$47	$68	$74	$79	$894	$9

Source: HMG, 2015b

1[1] Average Annual Damage represent the amount of damage that would occur in any given year, and if that year were repeated infinitely many times over. The average value is based on the frequency of recurrence for each flood event (FFREIS Appendix C “Economics”).

Table 3.96 provides a summary of the estimated cost for land acquisition and damages for the NAA. As the majority of the land acquisition and damages mitigation would occur within the defined staging area and as this was a defined USACE boundary for which the flood water storage was necessary, the USACE used the staging area as a boundary for determining costs. As discussed throughout this document, there are other properties, undeveloped land and residential/commercial properties, which would require mitigation outside of the staging area. Those costs would be included in a final cost for land acquisition and damages that would be determined once design plans were finalized.

Table 3.96 Northern Alignment Alternative Summary of Estimated Cost of Land Acquisition and Damages

Item Description	Northern Alignment Alternative
ROW and Easements – Construction Footprint[1]	$ 38,838,912
ROW and Easements – Staging Area	$ 294,942,383
TOTAL: Lands and Damages[2 3]	$333,781,295

Source: HMG, 2015b

[1]Project construction footprint includes areas associated with the construction of the diversion channel, embankment systems, levees, and other flood control features.

[2]With 25% Contingency

[3]Costs are associated with a 100-year flood event.

The cost of acquisition, including right-of-way and easements, is the second largest NAA cost behind construction of channels and control structures. Table 3.97. provides a breakdown of property acquisition and easements for the NAA. Note that numbers presented are for the construction footprint and staging area only. Other property acquisitions and easements would occur outside of these locations as well, such as in-town levee and floodwall acquisitions and other easements and potential acquisitions that would be necessary within the inundation area and mitigation areas; however, these are not anticipated to have a large impact on the estimates provided below.

Table 3.97 Northern Alignment Alternative Property Acquisitions, Easements, and Costs

Type of Property[1]	Northern Alignment Alternative	
	Fee Title	Easement
Sheyenne Structure Site to Inlet Weir		
Acres	196	8
Non-Residential	0	
Residential	0	
Total Cost[1]	$2,025,000	$13,000
Diversion and Embankment Footprints		
Acres	453	44
Non-Residential	7	
Residential	5	
Total Cost[1]	$7,678,000	$71,000
Upstream Staging Area		
Acres	28,356	4,997
Non-Residential	677	94
Residential	132	20
Total Cost[2]	$285,202,000	$9,741,000

Source: HMG, 2015b

[1]Land Acquisition and Damages were based on both USACE detailed data and structure count information obtained through USACE 2015 desktop analysis.

[2] Reflects cost as rounded estimates to nearest thousand, includes administrative costs and 25% contingency.

The MNDNR's ArcGIS structure count analysis results are included below in Table 3.98. Under the 10-year flood, impacts to structures are increased only slightly over the Base No Action Alternative (baseline used for analysis) from 36 to 40. All impacts would be to non-residential structures. Impacts to structures increase substantially during the 25-year flood, impacting 817 structures under Project operation; 596 more than the Base No Action Alternative of which 139 are to residential structures. The majority of those impacts to residential structures would be to those residing in North Dakota (76 percent, or 106 out of the 139 residential structures impacted). Under the 100-year flood, impacts to structures would increase approximately 34 percent (from 706 to 1,102 structures impacted). Residential structures impacts make up 17 percent of those impacts (or 186 out of 1,102 total structures impacted). Non-residential structures make up the majority of structures impacted under all floods with the largest percentage of impacts occurring in Cass County. Note that Table 3.98 numbers should not be compared to Table 3.94 above as detailed in subsection 3.16.2.1, data and methods applied differ.

Table 3.98 Northern Alignment Alternative: Number and Type of Structures Impacted under 10-year, 25-year, 50-year, 100-year, and 500-year Floods within the Upstream Inundation Area1 2 3 4 5 6

Return Period	10-year Flood		25-year Flood		50-year Flood		100-year Flood		500-year Flood	
Scenario	**Base No Action Alt.[7]**	**NAA**	**Base No Action Alt.**	**NAA**	**Base No Action Alt.**	**NAA**	**Base No Action Alt.**	**NAA**	**Base No Action Alt.**	**NAA**
North Dakota										
Cass County Non-Residential[5]	28	32	177	454	331	491	424	510	594	561
Cass County Residential	0	0	10	106	30	127	65	133	201	143
Richland County Non-Residential	3	3	13	14	33	37	74	79	264	275
Richland County Residential	0	0	0	0	0	0	2	3	41	44
Total Non-Residential -North Dakota	**31**	**35**	**190**	**468**	**364**	**528**	**498**	**589**	**858**	**836**
Total Residential – North Dakota	**0**	**0**	**10**	**106**	**30**	**127**	**67**	**136**	**242**	**187**
Minnesota										
Clay County Non-Residential	3	3	16	201	71	282	98	291	228	340
Clay County Residential	0	0	0	33	1	44	3	45	28	47
Wilkin County Non-Residential	2	2	5	9	21	23	36	36	145	150
Wilkin County Residential	0	0	0	0	1	1	4	5	43	47
Total Non-Residential - Minnesota	**5**	**5**	**21**	**210**	**92**	**305**	**134**	**327**	**373**	**490**
Total Residential - Minnesota	**0**	**0**	**0**	**33**	**2**	**45**	**7**	**50**	**71**	**94**
Total Non-Residential Structures	**36**	**40**	**211**	**678**	**456**	**833**	**632**	**916**	**1,231**	**1,326**
Total Residential Structures	**0**	**0**	**10**	**139**	**32**	**172**	**74**	**186**	**313**	**281**
Total Structures	**36**	**40**	**221**	**817**	**488**	**1,005**	**706**	**1,102**	**1,544**	**1,607**

Source: MNDNR, 2015

[1]Structures included within the analysis are those found within the counties identified and limited to the upstream inundation area.
[2]Impact is not defined by a set flood depth. If a structure is impacted by water by any extent, it is considered an impact.
[3]Structures impacted are not differentiated by currently inundated and newly inundated structures.
[4]GIS structure data obtained and provided by the USACE through a GIS desktop analysis, 2014 and has not been field-verified
[5]Non-residential includes all other structures that are not used for residential purposes, including commercial structures.

[6]Structure numbers and type should not be compared to those represented in Table 3.94. Methods and data sources applied were different.
[7]Base No Action Alternative numbers were included as this Alternative was used to present current conditions.

Similar to Table 3.98 above, the number of impacted parcels between the baseline and the NAA remains relatively the same during the 10-year flood (from 19 to 20 parcels impacted) (Table 3.99). Impacts within the inundation area are greater than the Base No Action Alternative (baseline) under the 25-, 50-, and 100-year floods, when the NAA is in operation; the 25-year flood experiencing the greatest increase in parcels impacted from 79 parcels to 226 parcels; 57 of which would be to those within Cass County.

Table 3.99 Northern Alignment Alternative Number of Parcels Impacted under 10-year, 25-year, 50-year, 100-year, and 500-year Floods within the Upstream Inundation Area[1,2,3,4,5]

Return Period	10-year Flood		25-year Flood		50-year Flood		100-year Flood		500-year Flood	
Scenario	**Base No Action Alt.[6]**	**NAA**	**Base No Action Alt.**	**NAA**	**Base No Action Alt.**	**NAA**	**Base No Action Alt.**	**NAA**	**Base No Action Alt.**	**NAA**
North Dakota										
Cass County	12	13	57	157	115	177	153	184	298	201
Richland County	3	3	10	11	19	21	32	36	102	108
Total Parcels - North Dakota	**15**	**16**	**67**	**168**	**134**	**198**	**185**	**220**	**400**	**309**
Minnesota										
Clay County	2	2	9	53	17	62	19	64	51	69
Wilkin County	2	2	3	5	9	10	21	21	91	94
Total Parcels - Minnesota	**4**	**4**	**12**	**58**	**26**	**72**	**40**	**85**	**142**	**163**
Total Parcels	**19**	**20**	**79**	**226**	**160**	**270**	**225**	**305**	**542**	**472**

Source: MNDNR, 2015
[1]Structures used for determining parcel inclusion are those found within the counties identified and limited to the upstream inundation area.
[2]Impact is not defined by a set flood depth. If a structure is impacted by water by any extent, it is considered an impact.
[3]Parcels impacted are not differentiated by currently inundated and newly inundated parcels.
[4]Parcels included in counts were those found to contain impacted structures. Undeveloped land was not included in this analysis.
[5]Structures used in analysis were identified and provided by the USACE through a GIS desktop analysis, 2014 and has not been field-verified.
[6]Base No Action Alternative numbers were included as this Alternative was used to present current conditions.

3.16.2.7.3.2 Loss of Structure Function

Under the NAA, average annual relocation and disruption costs are $9 and $1 million, respectively (Table 3.100). These costs are all estimated to be from North Dakota; however, Minnesota does experience relocation and disruption costs resulting from floods. The figures presented in Table 3.100 are rounded up to the nearest million; therefore, Minnesota's average annual relocation and disruption costs when totaled do not add up to an amount that when rounding to the nearest millionth would be captured. Business losses in general would be greatest in North Dakota. Loss of structure function would result in

2,081 employment losses during floods; of which 84 percent would be to North Dakotans and 16 percent to Minnesotans.

Table 3.100 Northern Alignment Alternative Summary of Annual Impacts from Loss of Building Function ($ Millions)

Description	Northern Alignment Alt.		Base No Action Alt.
	Direct Impact[1]	Total Impact[2]	Total Impact[3]
North Dakota Losses			
Business Losses			
Output	$154	$239	$1,512
Employment (in jobs)	1,121	1,756	15,782
Labor Income	$56	$88	$548
Gross Regional Product	$84	$136	$866
Total State and Local Tax	$15	$15	$110
Disruption Costs	$1	$1	$3
Relocation Costs	$9	$9	$53
Minnesota Losses			
Business Losses			
Output	$24	$32	$43
Employment (in jobs)	260	325	380
Labor Income	$9	$11	$14
Gross Regional Product	$13	$17	$23
Total State and Local Tax	$2	$2	$4
Disruption Costs	$0	$0	$1
Relocation Costs	$0	$0	$2
Total Losses			
Business Losses			
Output	$178	$271	$1,555
Employment (in jobs)	1,381	2,081	16,162
Labor Income	$65	$99	$562
Gross Regional Product	$97	$153	$889
Total State and Local Tax	$17	$17	$113
Disruption Costs	$1	$1	$4
Relocation Costs	$9	$9	$55

Source: HMG, 2015a

[1]Direct Impacts are those that direct to the industry.

[2]Total Impacts include direct impacts[1]Total impact includes the direct impact i.e., direct economic effects (direct response of an industry), the indirect effects (changes in output, income, and employment caused by direct impacts), and the induced economic effects (changes in output, income, and employment cause by expenditures associated with new household income generated by direct and indirect economic effects).
[3]Base No Action Total Impact was used to represent a baseline for current costs and losses.

3.16.2.7.4 Flood Insurance

The NAA would result in similar impacts to flood insurance as those previously described for the Project as detailed in Section 3.16.2.1.2.

3.16.2.7.5 Effects of Relocations and Flowage Easements

A detailed discussion is provided above under Effects of Relocations and Flowage Easements for the Project and provides information regarding potential impacts related to property owners, ring levees, century, centennial and sesquicentenntial farms, school districts, and municipal and local government tax bases. It is anticipated that potential effects of relocations and flowage easements would generally be similar to those described for the Project. An exception would be regarding the number of structures and parcels impacted under this alternative (Tables 3.98 and 3.99 above) and who would be impacted. The NAA tieback embankment is located approximately 1.5 miles north of the Project tieback embankment. That would shift the boundaries of the protected versus unprotected area north impacting structures within the 1.5 mile in between area that would have been protected and reducing or removing impacted properties on the southern end of the staging area within Richland and Wilkin Counties.

3.16.2.7.6 Effects on Property Improvements

The potential impact of flood inundation on wells and septic systems under the Northern Alignment Alternative would be similar to those described for the Project. Where there is potential for flood inundation under the Northern Alignment Alternative, Minnesota Rules 4725, which regulates wells for groundwater and drinking water sources, would be followed for requirements regarding flood protection for water-supply wells. In Minnesota, septic systems are regulated by Minnesota Rules Chapter 7080.2270, which require placement of SSTS components outside of a floodway and avoidance of the 100-year floodplain.

3.16.2.7.7 Agricultural Impacts

General agricultural impacts resulting from the NAA are anticipated to be similar to those described for the Project. However, NAA impacts related to organic farms would result in different impacts compared to the Project. Under the NAA, four farms would be potentially impacted by new flood inundation (Table 3.101). Of the four farms impacted by the NAA, two of the farms would not be significantly impacted, based upon the percentage of their overall acreage, compared to existing conditions. Two of the four organic farms have parcels located within the NAA staging area boundary (Appendix K Figure 3).

Table 3.101 Organic Farm Acres Located Within the Vicinity of the Northern Alignment Alternative Inundation Areas During the 100-year Flood Event*

Farm	Farmer Reported Organic Acres	Farm Total Acres	Acres within NAA Staging Area Boundary
Farm 1	889 Acres	995 Acres	706 Acres
Farm 2	1,256.1 Acres	1,330 Acres	None
Farm 3	767.16 Acres	835 Acres	None
Farm 4	714.6 Acres	1,208 Acres	474 Acres

*This table provides a summary for organic farms located within the vicinity of inundation areas and identifies acres located within the staging area boundary. It does not reflect acreages of inundation. Estimated acres of inundation are presented in Table 3.102 below.

Table 3.102 provides a summary of total acres for the identified organic farm parcels along with percentages of flooded acres. This table implies a rough estimate and percentage for how much of the identified organic farm acreage would be flooded under the NAA during a 100-year flood event. Within the NAA flood inundation area, approximately 1,265 acres would flood (Table 3.102). Figure 14shows the areas of flood inundation associated with the operation of the NAA during the 100-year flood event. Flood inundation from operation of the NAA would most significantly impact Farm 1 (610 acres of inundation) and Farm 4 (approximately 440 acres of inundation). During the 100-year event, Farm 2 and Farm 3 would experience a similar acreage of flooded area under NAA as they experience under the Base No Action Alternative (Table 3.102).

Table 3.102 Organic Farm Acreage By 100-Year Flood Event for the Northern Alignment Alternative[1,2,3,4,5]

Farm		Area (acres)	Percent of the Total Acreage (%)
Farm 1	*Flooded*	*610*	*61%*
998 acres	*Non-flooded*	*388*	*39%*
Farm 2	*Flooded*	*187*	*14%*
1,330 acres	*Non-flooded*	*1,143*	*86%*
Farm 3	*Flooded*	*24*	*3%*
835 acres	*Non-flooded*	*811*	*97%*
Farm 4	*Flooded*	*443*	*37%*
1,208 acres	*Non-flooded*	*765*	*63%*
TOTAL	*Flooded*	*1,265*	*29%*
4,370 acres	*Non-flooded*	*3,105*	*71%*

1 Total acres for each farm are based on the total acreage in the parcel, not the total acres that are actually farmed. Acreages were rounded to the near acre. Totals and percentages provided are rough estimates based on rounded acreage.

[2]Flooded and Non-flooded conditions are based on the USACE elevations modeled for the 100-year flood. Flood indicates the estimated acreage that is anticipated to be inundated during the 100-year. Non-flood indicates the estimated acreage that is anticipated to not be inundated during the 100-year flood.

[3]NAA 100-year flood refers to the additional area that would flood for the 100-year flood during Project or NAA operation.

[4]Total farm acreage is based on total parcel acreage for the PIDs provided by the farmers, which includes their reported organic farm acreage.

[5]In all cases the organic farm acreage reported by the farmer is less than the total parcel acreage associated with the farmed PIDs. ArcGIS was used to map and evaluate the organic farm acreage using the available PIDs data. Surveys and delineations of actual organic farm acreage were not available, and therefore, the PID information was the best available information at the time of EIS publication.

Mitigation for potential impacts to agriculture and organic farms would be similar to that proposed for the Project and is further discussed in Section 3.16.3.

3.16.2.7.8 Flood Fighting

The social and economic effects from flood fighting for the NAA would be similar to those previously described for the Project. The stress, disruption, and financial burdens associated with the continued threat of flooding and the flood fight efforts would be reduced in the F-M urban area with construction and operation of the NAA. Many residents in the unprotected, rural areas are currently at risk of flooding under the Base No Action Alternative. Where the NAA would cause increased flood inundation, mitigation through relocation or flowage easements would be considered for property owners. Additional information on mitigation is provided in Section 3.16.3.

3.16.2.7.9 Geographic Extent Social and Economic Impacts: Minnesota and North Dakota, Protected and Unprotected

Minnesota and North Dakota

The NAA is estimated to result in similar flood damages as those described for the Project. The NAA flood reduction benefits in Minnesota and North Dakota are also estimated to be similar to those described for the Project with flood reduction benefits primarily occurring in North Dakota in the Fargo and West Fargo urban areas. Measurable protection benefits from the NAA would occur in Minnesota, primarily in the Moorhead urban area between the 50-, 100-, and 500-year floods. Under the NAA, both Minnesota and North Dakota would experience some negative effects from operation of the NAA, particularly if they are located within the upstream inundation area.

Protected and Unprotected Areas

The NAA would reduce emotional, physical, and financial impacts in the protected area similar to those described for the Project. This would be accomplished by reducing flood risk, primarily in the F-M urban area through construction and operation of the NAA. Implementation of the NAA would improve health and safety, and economic vitality (e.g., employment, public services, education) in the protected area.

Areas south of the tieback embankment are considered the unprotected areas and would experience increased flood inundation and associated social and economic impacts to those described for the Project, including relocations, potential loss of income, and potential effects on property values. The geographic extent of the NAA would be slightly different from the Project as it would be moved north, which would result in less flood inundation, a slightly smaller flood inundation area, and a smaller protected area. A ring levee would be constructed for Oxbow, Hickson and Bakke, but would not be necessary for Comstock. However, protection would be necessary for the Comstock sewage lagoons. The OHB ring levee would provide permanent protection for Oxbow, Hickson, and Bakke. Comstock may still require the use of emergency measures for large flood events to protect against floodwater impacts from Wolverton Creek to drainage ways and ditches within and adjacent to the community.

3.16.3 Proposed Mitigation and Monitoring Measures

The discussion below focuses provides an overview of mitigation required by the FEMA CLOMR process (agreed to by the USACE) (details on the FEMA CLOMR process can be found in 3.2 FEMA Regulations and the CLOMR Process) and proposed mitigation by the USACE and Diversion Authority outside of the FEMA CLOMR process relating to social and economic impacts resulting from construction and operation of the Project. Details regarding proposed mitigation and monitoring for topics included in the discussion above such as Infrastructure and Public Services are included within their respective EIS sections.

3.16.3.1 FEMA/USACE Coordination Plan Mitigation

The USACE and FEMA have developed a Coordination Plan (Appendix F) (April 2015) that outlines floodplain management requirements for the Project, including CLOMR requirements for floodplain map revisions and Project mitigation. This plan will be used to implement mitigation as it relates to FEMA CLOMR requirements in the project area.

FEMA Revision Reach

The mitigation discussed within the April 2015 FEMA/USACE Coordination Plan (Coordination Plan) is defined primarily by the FEMA revision reach. The FEMA revision reach is defined by the Red River profile and limited to where the Project will alter the river profile flood elevation by more than 0.5 feet. The actual revised reach will be determined once the Project design is finalized and updated H and H modeling (Phase 8) becomes available. Section 3.2 – FEMA and the CLOMR Process provides additional discussion on the FEMA map revision process.

According to the Coordination Plan, all impacted insurable structures within the FEMA revision reach will be mitigated. Impacts resulting from the Project will be mitigated through agreed methods consistent with those specified by the NFIP. For residential structures, these include elevation, relocation, buy-outs, and ring levees. For non-residential structures these include dry flood proofing, elevation, relocation, buy outs, and ring levees. Non-structural mitigation measures were developed based upon the actual risk to properties within the project area. The NRCS information, farmstead ring levee programs, and USACE experience was used to determine that farmstead ring levees greater than five feet were not practicable. The use of farmstead ring levees was not yet determined at the time of the EIS production.

Staging Area and Outside the Staging Area

The Coordination Plan requires that the areal extent of flood inundation required for operation of the Project, the staging area, be mapped as floodway in order to ensure that the required volume is available for the Project during the 100-year flood. Flowage easements would be obtained for all floodway designated areas (further discussion on flowage easements is included below). Any additional flood inundation area beyond the extents of what is required by the Project during the 100-year flood would be mapped as floodplain in order to portray the elevated flood risk outside of the required staging area.

FEMA/USACE Coordination Plan Mitigation Summary

Mitigation measures for residential and non-residential structures and lands, including agricultural lands, are summarized below in Table 3.103. Mitigation measures for residential structures (including homes, structures, and businesses) are primarily dependent upon the depth of flooding under a 100-year flood and location within the project area; e.g., whether it is located within the FEMA revision reach or staging area. To provide an idea of where mitigation approaches would be applied with respect to impact magnitude, Figures 32 and 33 depict locations of impacted residential and non-residential structures and parcels located within the unprotected area (MNDNR ArcGIS Structure and Developed Parcel Analysis, 2015) along with the anticipated 100-year flood inundation depths.

Table 3.103 FEMA/USACE Coordination Plan Structure and Land Mitigation Categories and Descriptions

Project Area Location	Resource Impacted[1]	Impact Magnitude	Mitigation Requirement or Approach and Description
FEMA Revision Reach	Residential and Non-residential Insurable Structures (not Farmsteads)	More than 2 feet, 100-Year Flood Depth	Acquisition or relocation of homes in manner consistent with federal guidelines and applicable state eminent domain law.
FEMA Revision Reach	Agricultural Farmstead	More than 2 feet, 100-Year Flood Depth	Similar process to residential. However, offer buyout of property prior to consideration of other options. Farmsteads are tied to their existing location, so nonstructural measures will be considered if it is feasible to remain on site.
FEMA Revision Reach	Residential and Non-residential Insurable Structures (*including* Farmsteads)	Up to 2 feet, 100-Year Flood Depth	Evaluate for non-structural measures, such as ring levees, relocation, or elevating structures. Acquisition may be considered in areas where risk and safety analysis indicated remaining in place may be inappropriate.
Staging Area	All Land (not including Agricultural Land)	100-Year Flood Inundation	Mapped as FEMA floodway – flowage easements would be obtained.
Staging Area	Agricultural Land	100-Year Flood Inundation	Mapped as FEMA floodway – flowage easements would be obtained.
Outside Staging Area	All Land	100-Year Flood Inundation	Mapped as FEMA floodplain – takings analysis would be performed and flowage easements would be obtained only where impacts rise to the level of a taking.[2]

Source: FEMA/USACE Coordination Plan, April 2015; Diversion Authority, USACE, and Project Consultants Communications, April 2015

[1]All structures discussed are those that are "existing" structures.

[2]Takings analysis is a legal analysis performed to determine if the impacts rise to the level of taking under the Fifth Amendment of the U.S. Constitution.

3.16.3.2 USACE and Diversion Authority – Other Proposed and Required Mitigation

In addition to FEMA CLOMR requirements, the USACE and or Diversion Authority have proposed specific agricultural lands mitigation, including organic farm considerations, as well as mitigation of structures for those areas located outside of the FEMA revision reach and additional considerations for undeveloped land located outside the staging area (within or outside of the FEMA revision reach).

Agricultural Mitigation

The Diversion Authority has developed a Draft Ag Impacts Mitigation Plan (January 2015) (Appendix J) to address impacts to agricultural lands, including organic farms. This mitigation may include flowage easements, voluntary acquisitions, supplemental crop insurance or other compensation for impacted agricultural land.

Flowage easements would be acquired over agricultural land within the staging area. As described above, flowage easements would provide the legal ability to inundate the property as part of the operation of the Project. Easements would include a one-time payment to the property owner at the time the easement is obtained. The value of the payment would be determined on an individual property basis by independent appraisal. The value may consider factors such as depth, duration, frequency of additional flooding, and highest and best use of property. It may also consider future impacts from delayed planting, yield loss, debris, and limitations to future land use. Additional uncertainty of whether organic certification would influence the value of the property, and therefore, the value of the flowage easement required by USACE. Organic certification is associated with the farmer and the land that the farmer uses for organic crops. Landownership may also be a factor for implementation of mitigation.

In addition to the flowage easement, the Diversion Authority is working on an additional mitigation alternative--voluntary relocation for organic producers. The Diversion Authority would work with interested organic farmers to appraise, purchase, and temporarily rent back their property prior to Project construction in order to establish organic certification on land outside of potential flood inundation impacts purchased by the farmer with proceeds of the sale. Organic certification may take up to five years depending on the land.

According to the FFREIS, USDA Risk Management Agency has indicated the purchase of crop insurance in the staging areas could still be obtained, however flood impacts resulting from the Project may not be covered. Federal crop insurance would apply to crops which can be planted prior to the established late planting dates. The Diversion Authority contracted with experts at North Dakota State University to determine the additional risk to agricultural producers in the staging area. The study findings would be used to guide supplement crop insurance risk policies which are currently under study and consideration. Such supplement risk policies could include provisions for “prevented planting” in the event that water is present past the final planting dates for a growing season. The risk policy could also provide coverage for damages caused by Project operations on planted crops (summer impacts). The Diversion Authority risk policy would be based on federal crop insurance programs and would be funded through the O&M for the Project.

Outside FEMA Revision Reach

As discussed above, the Coordination Plan will require that 100-year flood inundated lands located outside of the staging area be designated as floodplain. This includes lands within the FEMA revision reach as well as lands located outside of the FEMA revision reach. In addition to Coordination Plan requirements, the USACE has proposed that a takings analysis on a case-by-case-basis would be performed to determine mitigation needs for all inundated undeveloped land outside of the staging area. Flowage easements would be obtained only where the taking analysis determines impacts rise to the level of a taking under the Fifth Amendment of the U.S. Constitution.

The USACE has also proposed to perform a takings analysis for all structures impacted by the Project that are located outside of the FEMA revision reach. For areas outside of the FEMA revision reach that may experience inundation as a result of the Project up to 0.5 feet, the USACE would determine mitigation needs on a case-by-case basis through a legal process (i.e., takings analysis), as further discussed below.

State laws (Minnesota Rules 6120.5700, subpart 4a) pertaining floodplain allowances would need to be considered as well. The state of Minnesota has laws regarding mitigation requirements necessary to avoid mandatory flood insurance for those properties in which insurable structures may be impacted greater than 0.0 feet. Minor site modifications, such as landscaping, could be used as mitigation to exceed the 100-year flood elevation. If the mitigation, e.g., landscaping, is done before the LOMR at the end of the Project, mandatory flood insurance would not be required. However, if mitigation was not completed, flood insurance would be required. Otherwise more traditional mitigation such as relocation, floodproofing, or elevating structures would be necessary. For newly inundated insurable structures located within North Dakota, communities and property owners would have to work with the North Dakota State Engineer and USACE to determine what mitigation would be necessary.

What is a Takings Analysis?

A takings analysis is a legal analysis conducted to determine if the impacts in these areas rise to the level of a taking under the Fifth Amendment of the U.S. Constitution. Outside of the designated staging area, landowners will be compensated appropriately for any takings (FFREIS, 2011). Taking of private property by a government entity may occur for public use, such as construction of a road, school or environmental protection. If a taking occurs, the government entity must offer the property owner compensation for the land taken. The Fifth Amendment states, "...nor shall private property be taken for public use without just compensation." A taking requires a legal process to determine if a private landowner has lost any reasonably beneficial economic use of their land, and if so, is it to the level of a taking. If a taking is determined, compensation for the level of the taking would be determined.

Compensation for takings related to Project impacts outside of the FEMA revision reach would be determined through a legal process. Where appropriate, consideration could be given to the use of non-structural measures, such as acquiring structures, relocating structures to other parts of a property, and elevating structures above the design flood level. Compensation for a taking could use the criteria for the proposed mitigation for property within the FEMA revision reach or flowage easements could also be considered as another option.

OHB and Comstock Ring Levees

Ring levees for the communities of OHB and Comstock are included as Project components. The ring levees will serve to provide protection to these communities when the Project is in operation. Forty-two homes in Oxbow would be impacted by the OHB ring levee construction. These homes would be replaced within the ring levee at different site locations. In addition, 60 residential developmental lots will be added within the ring levee for other displaced residents within the unprotected area. The Diversion Authority has agreed to compensate the City of Oxbow and the Kindred School District for the loss of tax base caused by the temporary loss of the 42 homes for a period of up to four years. The Comstock ring levee concept currently does not impact homes and allows for future community development within the ring levee.

3.16.3.3 Property Acquisition and Estimated Costs

Property acquisitions would primarily be governed under Public Law 91-646, the "Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970" (Uniform Act) and grants protections and assistance for those affected by federally funded projects. The Uniform Act was enacted to assure that those whose real property is acquired or forced to move as the result of a federally funded project as treated fairly, equitably, and receive assistance in moving. The Surface Transportation and Uniform Relocation Assistance Act of 1987 designated the U.S. Department of Transportation as the federal Lead Agency for the Uniform Act and the Federal Highway Administration, Office of Real Estate Services has been delegated to carry out the duties including the development, issuance, maintenance of the government-wide regulation, assist other federal agencies, and report to Congress.

The majority of the property buyouts involving structures would occur in the staging area. Property buyouts would also occur for construction of the diversion channel and associate embankment systems. Buyouts associated with diversion channel construction are anticipated to be primarily land acquisition using right-of-way and easements. Table 3.104 provides a summary of the estimated the cost for land acquisition and damages.

Table 3.104 Summary of Estimated Cost of Land Acquisition and Damages

Item Description	Proposed Project	Northern Alignment Alternative
ROW and Easements – Construction Footprint[1]	$ 41,464,402	$ 38,838,912
ROW and Easements – Upstream Staging Area	$ 223,558,278	$ 294,942,383
TOTAL: Lands and Damages[2]	$ 265,022,680	$ 333,781,295

Source: HMG, 2015b

[1]Project construction footprint includes areas associated with the construction of the diversion channel, embankment systems, levees, and other flood control features.

[2]With 25% Contingency

4.0 Cumulative Effects

4.1 CUMULATIVE EFFECTS SCREENING SUMMARY

4.1.1 Federal Cumulative Impacts Analysis Definition

Federal environmental review is based on Council on Environmental Quality (CEQ) regulations (40 CFR §§ 1500-1508). The federal regulations implement the procedural provisions of the National Environmental Policy Act (NEPA) of 1969, as amended (42 U.S.C. § 4321 et seq.). CEQ identifies the following principles to be included in a cumulative effects analysis,

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.
   (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.)

4.1.2 Minnesota Cumulative Potential Effects Definition

Minnesota Rules require that cumulative potential effects are considered as part of environmental review of a project because the incremental effects of individual projects evaluated together may result in a significant environmental effect.

Minnesota Rules 4410.0200, subpart 11a defines cumulative potential effects as follows:

> *"The effect on the environment that results from the incremental effects of a project in addition to other projects in the environmentally relevant area that might reasonably be expected to affect the same environmental resources, including future projects actually planned or for which a basis of expectation has been laid, regardless of what person undertakes the other projects or what jurisdictions have authority over the projects. Significant cumulative potential effects can result from individually minor projects taking place over a period of time. In analyzing the contributions of past projects to cumulative potential effects, it is sufficient to consider the current aggregate effects of past actions. It is not required to list or analyze the impacts of individual past actions, unless such information is necessary to describe the cumulative potential effects. In determining if a basis of expectation has been laid for a project, an RGU must determine whether a project is reasonably likely to occur and, if so, whether sufficiently detailed information is available about the project to contribute to the understanding of cumulative potential effects. In making these determinations, the RGU must consider: whether any applications for permits have been filed with any units of government; whether detailed plans and specifications have been prepared for the project; whether future development is indicated by adopted comprehensive plans or zoning or other ordinances; whether future development is indicated by historic or forecasted trends; and any other factors determined to be relevant by the RGU."*

The Environmental Quality Board (EQB) provides guidance to Minnesota Rules (*May 2010 Guide to Minnesota Environmental Review Rules*, EQB 2010) when evaluating cumulative potential effects. Three main points of the guidance are as follows:

1. Individual projects (past and future) must be located within the environmentally relevant area and be reasonably expected to affect the same environmental resources as the project under review. The area of impact can vary based on the project and type of impact so it is not uncommon to have multiple environmentally relevant areas under review.

2. To account for past projects, current aggregate effects are used in place of an inventory of effects from individual projects. The existing conditions with respect to an environmental resource will be equal to the current aggregate effects from past projects.

3. Consideration of future projects includes only projects that have been actually planned or for which a basis of expectation has been laid. The Responsible Government Unit (RGU) must identify other projects that are reasonably likely to occur. Examples of documentation which would confirm that likeliness to occur include: permit records, detailed plans and specifications, adopted comprehensive plan, forecasted development trends, etc.

While CEQ guidance focuses more on the aggregate effects of past, present and future projects; EQB guidance indicates that past and present effects may be presented in aggregate, but an additional focus of the analysis is on specific known projects and planned future projects. However, since individual projects were not identified in the Final Feasibility Report and Environmental Impact Statement (FFREIS), assumptions were made during this analysis that the potential cumulative effects evaluated in the federal processes existed within the environmentally relevant area. Although the requirements between the NEPA and Minnesota Environmental Policy Act (MEPA) processes are different, the information presented within the FFREIS has merit and was utilized.

4.1.3 Federal Cumulative Impacts Analysis Methodology

The FFREIS defined the geographical extent broadly to include the Red River of the North Drainage Basin (Red River basin). It determined 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.

The FFREIS generalized past environmental impacts in addition to aggregate effects of the Project. The FFREIS identified significant cumulative ecological impacts which were organized into several resource categories. These resource categories are identified below in Table 4.1. The FFREIS did not identify specific projects for evaluation and determination of cumulative impacts. This resulted in a general evaluation of the potential aggregate cumulative impacts of the Project.

More detailed information regarding the cumulative impacts analysis can be found in the FFREIS. The Supplemental Environmental Assessment (Supplemental EA) did not identify any new cumulative impacts or conduct new analysis of cumulative impacts already identified in the FFREIS.

4.1.4 Minnesota State Cumulative Potential Effects Anlaysis Methodology

Minnesota Rules 4410.3900, subpart 3 states,

> *"If a federal EIS will be or has been prepared for a project, the RGU shall utilize the draft or final federal EIS as the draft state EIS for the project if the federal EIS addresses the scoped issues and satisfies the standards set forth in part 4410.2300."*

In compliance with Minnesota Rules, the first step of this analysis was to list the environmental resource categories from the FFREIS Cumulative Effects Analysis (see Table 4.1, Column A, below). The second step of the analysis, involved aligning the equivalent Minnesota (MN) Environmental Impact Statement (EIS) environmental impact category in Column B. Categories which were included in one analysis but did not have an equivalent in the other are noted as Not Applicable (N/A) in Table 4.1. For each environmental impact category, Column C indicates whether the FFREIS determined the Project could contribute to the potential for cumulative effects. Third, Column D indicates if, based on information presented in this EIS, the Project has the potential to contribute to cumulative effects. Where both the FFREIS and the Minnesota Department of Natural Resources (MNDNR) EIS identified the potential for environmental or social effects to a resource category, (i.e., a “yes” in columns C and D), the resource category was carried forward for further evaluation (a “yes” in Column E). If the resource category was identified in the FFREIS, but was not part of the scope of the MNDNR EIS, or was scoped into the MNDNR EIS but was found to not have the potential to contribute to cumulative impacts, then the resource category was not carried forward for further evaluation. Table 4.1 provides a summary of the cumulative effects categories identified for the FFREIS and the MNDNR EIS, which categories were identified in the FFREIS to have the potential to contribute to cumulative impacts, and which resource categories were carried forward in this cumulative potential effects analysis.

Table 4.1 Summary of Potential Cumulative Effects Categories

A	B	C	D	E
FFREIS Environmental Resource Category	**MNDNR EIS Equivalent Environmental Impact Category**	**Significant Potential Cumulative Effects Identified in the FFREIS**	**Significant Effects Identified in MNDNR EIS**	**Category Included as Option for Cumulative Potential Effects in MNDNR EIS**
Air Quality	None[9]	No	No	No
Aquatic Habitat	Fish Passage	Yes	Yes	Yes
Climate	N/A[10]	No	No	No
Cultural Resources	Cultural Resources	Yes	Yes	Yes
Social Effects	Socioeconomic	Yes	Yes	Yes
Fish Passage	Fish Passage	Yes	Yes	Yes
Geomorphology	Stream Stability	Yes	Yes	Yes
Prime and Unique Farmland	Cover Types	Yes	No	No

[9] None=Not a scoped category.

[10] N/A=Not traditional category in federal/state environmental review

A	B	C	D	E
FFREIS Environmental Resource Category	**MNDNR EIS Equivalent Environmental Impact Category**	**Significant Potential Cumulative Effects Identified in the FFREIS**	**Significant Effects Identified in MNDNR EIS**	**Category Included as Option for Cumulative Potential Effects in MNDNR EIS**
Recreational Opportunities	None	Yes	No	No
Shallow Groundwater	Potential Hazardous due to Past Land Uses	No	No	No
Threatened & Endangered Species	State-listed Species and Special Status Species	No	No	No
Upland/Riparian/Aquatic Habitat	Wildlife Resources	Yes	Yes	No
Water Quality	None	Yes	No	No
Hydrology & Hydraulics	Hydrology	Yes	Yes	Yes
Wetlands	Wetlands	Yes	Yes	Yes
N/A	Cold Weather Impacts	N/A	No	No
None	Invasive Species	None	No	No
None	Infrastructure and Public Services	None	No	No
None	Land Use Plans and Regulations	None	No	No
N/A	Dam Safety	N/A	No	No
Water Quantity	None	None	None	No
Economic Issues	N/A	None	N/A	No
Environmental Justice	N/A	None	N/A	No

The following environmental impact categories were identified as options for evaluation of cumulative potential effects in this EIS:

- hydrology,
- stream stability (geomorphology),
- wetlands,
- fish passage and mortality (including aquatic habitat),
- wildlife resources,
- cultural resources, and

- socioeconomics.

Proposed mitigation and monitoring measures for the Project, in combination with the past and reasonably foreseeable projects are reviewed holistically regarding the impacts to all seven primary environmental impact categories. A summary of all proposed Project mitigation and monitoring is discussed in Chapter 6.

Once the above seven environmental impact category options were established, a screening analysis was completed to define the total list of future projects that could contribute to cumulative environmental effects (Wenck, 2014). Minnesota Rules and EQB guidance were used in the screening analysis to define the environmentally relevant areas and the list of relevant reasonably expected projects for inclusion in this evaluation.

4.1.4.1 Defining the Environmentally Relevant Areas

The environmentally relevant area was examined for each environmental impact category option included in this analysis. Generally, the initial environmentally relevant area was estimated to include the entire F-M metro area, watersheds immediately upstream of the Project, and watersheds immediately downstream of the Project, to an estimated distance of twenty miles from the Project location. This general estimation was developed to conservatively capture an area which would receive any direct impacts from the Project which could contribute to cumulative potential effects. Within this general area, the environmentally relevant area for each environmental impact category was refined to the area of potential impact for the Project. Specific discussion of this area is specific to each environmental impact category and is included in each of the seven category analyses, in the Affected Environment/Environmentally Relevant Area section.

4.1.4.2 Identifying the Reasonably Foreseeable Projects

Once defined for an environmental impact category, the environmentally relevant area was reviewed for known projects that may have the potential to contribute to cumulative potential effects when combined with the construction and operation of the Project. The identified projects have a range of available information; from very little to detailed plans created about potential outcomes and concepts for projects. Numerous plans and studies have been completed in the Red River basin and adjoining watersheds that examine flood control, hydrology, geomorphology, water quality, and socioeconomics related to large-scale flooding events. Many of these studies do not identify specific project plans and have not resulted in specific permitted projects. Projects identified that were not fully planned, or those where a basis of expectation had not been laid, were not included in this analysis. The analysis does include projects that have been sufficiently planned and at a minimum, a permit application has been submitted. In some cases, project construction may have started or been recently completed.

Future projects that were determined to be in the environmentally relevant area, would have an impact on one of the resource categories, and had a reasonable expectation of occurring are shown on Figure XX and include:

4.1.4.2.1 Wolverton Creek Restoration and Sediment Reduction Project

Wolverton Creek is the outlet for numerous ditch systems and drainages with significant erosion that contributes high sediment loading and increased turbidity to the Red River. The Buffalo-Red River Watershed District (BRRWD), along with cooperation from Clay and Wilkin County Soil and Water Conservation Districts and Minnesota Board of Water and Soil Resources (BWSR), has been planning and developing the Wolverton Creek Restoration and Sediment Reduction project (Wolverton project) over the past several years.

The intent of the Wolverton Creek project to is to reduce erosion and sedimentation along the portions of the restored stream channel and areas downstream. The Wolverton project would be a restoration of Wolverton Creek from U.S. Highway 75 upstream to the east boundary of Section 17, T135N, R47W (Mitchell Township), Wilkin County. The Wolverton project includes: channel restoration to stabilize slopes and establish vegetation, side inlet sediment controls on gullies and ditches, buffer strips, channel grade control, and instituting conservation tillage programs, all to reduce erosion and sedimentation. The BRRWD received the Work in Public Waters permit from the MNDNR early in 2015 and expects to start construction in 2015.

4.1.4.2.2 Manston Slough Wildlife Pool Management

For over 140 years, excessive water has been a problem for Mitchell, Manston, and Meadows Townships in Wilkin County, Minnesota. A drainage ditch was constructed in 1897 to try to control water in the area which resulted in some success. In 2005, the BRRWD began working with local partners to develop a larger flood damage reduction and natural resources enhancement project for the area. In 2013, these efforts resulted in the BRRWD and BWSR working together to design and construct the Manston Slough Wildlife Pool Management project (Manston project), which was completed in 2014.

The Manston project consisted of installing a water control structure at the outlet and improving a number of roadways with additional clay embankment. The purpose of the water control structure was to fix the run-out elevation of Manston Slough at its pre-drainage level and allow for periodic drawdowns. The wetland pool will be managed with some level of permanent pool water during most times when flooding or drawdowns are not occurring. The storage area will have a temporary capacity of approximately 5,500 acre-feet at the emergency spillway crest. The size of the flood pool will range from approximately 1,080 acres (normal pool) to 4,110 acres (emergency spillway crest) in the Buffalo River watershed.

The Natural Resources Conservation Service (NRCS) secured numerous easements for the Manston project. State and local funds were secured including assessments to benefitted landowners. This resulted in restoration of over 2,000 acres of wetland and over 3,000 acres of upland. The Manston project provides flood storage and retention for flood reduction in adjacent and downstream areas. Additional project components include: waterfowl and wildlife habitat creation through restored wetland, recreational opportunities are created, enhanced quality of water flowing from the project, and groundwater recharge to the Buffalo aquifer.

4.1.4.2.3 Cass County Drain 21 and Drain 45 Channel Improvements

The Southeast Cass Water Resource District previously constructed drainage channels within their jurisdiction and purview to provide drainage for sections of land in Cass County, North Dakota. To accommodate future growth and continued adequate flow in the channels for adjacent benefiting properties, the BRRWD is proposing two improvement projects to Cass

County Drains 21 and 45 (Drain 21 and Drain 45). The channel improvements are located within the City of West Fargo. Both projects involve: excavation in the drainage channels to remove sediment, inverts re-graded to reduce erosion and sedimentation in the channel, and deepening of the channels to accommodate future growth of the City of West Fargo storm sewer infrastructure. The Drain 21 and 45 projects are being reviewed by the BRRWD and are expected to be constructed in 2015 or 2016.

4.1.4.2.4 Cass County Drain 30 Channel Improvements

The Rush River Water Resource District previously constructed drainage channels within their jurisdiction to provide drainage for land in Cass County, North Dakota. To ensure adequate flow through the channel and drainage system, the Rush River Water Resource District will improve Cass County Drain 30 in Harwood Township.

The Channel Improvements project (Cass Drain 30 project) will involve reconstruction of two miles of existing legal drain, which flows east to the Sheyenne River from a point near County Road 81. Cass Drain 30 has a drainage area of approximately 10 square miles. Approximately 30 percent of its flow is from Cass Drain 13, which collects flow from Interstate 29 (I-29). The Cass Drain 30 project involves excavation of the drainage channel, re-grading of the drain invert to reduce sedimentation in the upstream reach and erosion in the downstream reach, and flattening of the side slopes to reduce future slope failures. The Cass Drain 30 project is expected to be constructed in 2015 or 2016.

Table 4.2 provides a summary of reasonably foreseeable projects, their location, and the applicable environmental impact category option.

Table 4.2 Reasonably Foreseeable Projects

Reasonably Foreseeable Project	Project Location	Applicable Environmental Impact Category
Cass County Drain 21 Improvements	West Fargo, North Dakota	Hydrology Stream Stability Socioeconomics
Cass County Drain 45 Improvements	West Fargo, North Dakota	Hydrology Stream Stability Socioeconomics
Cass County Drain 30 Channel Improvements	Argusville, North Dakota Township 141 North, Range 49 West, Sections 8,9,16,17	Hydrology Stream Stability Wetlands Socioeconomics
Manston Slough Wildlife Pool Management	Buffalo Watershed, South Branch Buffalo River	Hydrology Stream Stability Wetlands Fish Passage Wildlife Resources
Wolverton Creek Restoration and Sediment Reduction project	Holy Cross Township, Clay County; and Wolverton Township, Roberts Township, and Mitchell Township, Wilkin County	Hydrology Stream Stability Wetlands Fish Passage Wildlife Resources

Reasonably Foreseeable Project	Project Location	Applicable Environmental Impact Category
		Cultural Resources

4.2 HYDROLOGY

4.2.1 Affected Environment/Environmentally Relevant Area

The Fargo-Moorhead (F-M) area has a long history of flooding due to the unique hydrology of the area. Since 1902, the Red River has exceeded the National Weather Service flood stage of 18 feet at the U.S. Geological Survey (USGS) gage in Fargo over 50 times, and including every year from 1993 through 2013 except 2012. The hydrologic record of the Red River shows a trend of increasing magnitude and frequency of flooding in recent decades. Agriculture, urban development, and expanded public infrastructure needs have altered the area's hydrology since the late 1800s. Additionally, the area is naturally prone to a higher risk of flood due to the large watershed area which drains through the Red River. There are a number of tributaries to the Red River; the main tributaries include the Wild Rice River, Sheyenne River, Wolverton Creek, and Buffalo River (which is downstream of the F-M urban area). The Sheyenne River also has tributaries prior to its confluence with the Red River downstream of the F-M urban area; these include the Maple River, Lower Rush River, and Rush River.

To reduce flooding from the Sheyenne River in West Fargo and Horace, the Federal Sheyenne River Project was authorized in 1986. The project includes modifications to Baldhill Dam, the Horace to West Fargo Diversion, and the West Fargo Diversion. The diversion projects were completed in 1994, and the modifications to Baldhill Dam were completed in 2004. There are also numerous drainage ditches and drain tiling systems in the project area that have altered the hydrology. These drainage systems are located throughout the project area with flow into tributaries to the Red River.

When flooding occurs in the project area, it typically occurs in the spring. As the Red River flows north, timing of the spring melt has an impact on flooding as the upstream watersheds start melting earlier in the spring and flow downstream into portions of the river that can remain frozen later into the season. This causes water to back up over a large area due to the flat topography of the Red River basin. Annual peak discharge data also suggests that there has been an overall increase in the total amount of water flowing through the Red River, resulting in an increase in the frequency and magnitude of flood events. The Red River has exceeded flood stage approximately half of the years during the past century. The recent past has seen a higher frequency of large flood events with 2009 being a record-setting year with a flood stage of 40.8 feet at the USGS Fargo stream gage. This increase in flood frequency and magnitude is likely due to many factors, including, but not limited to, effect of past and current land use that has resulted in tiling and drainage of watersheds, modification of streams, urbanization in the watershed, naturally-occurring wet/dry periods, and increases in impervious surface.

4.2.2 Environmental Consequences

Cumulative potential effects of the Project were evaluated based on the other relevant reasonably foreseeable projects. Additional drainage improvement projects, stream restorations, and development would continue into the foreseeable future further altering hydrology of the watershed.

4.1.1.1 Base No Action Alternative

The Base No Action Alternative, reviewed the current environment and construction of the Manston project, the Wolverton project, Drain 21 and Drain 45, and Cass Drain 30 project, and other similar potential projects, is anticipated to have hydrologic or hydraulic impacts, such as minor changes in flow or localized floodwater storage, with the intent of reducing flood risk through the F-M urban area. The aggregate of these projects also are intended to reduce erosion and sedimentation, and enhance wildlife habitat, although these benefits will primarily be realized within a localized area of each respective project and are not likely or proposed to provide basinwide flood risk reduction. The Base No Action Alternative is not anticipated to have a measureable cumulative potential effect when combined with the reasonably foreseeable projects.

4.1.1.2 No Action Alternative (with Emergency Measures)

Compared to the current conditions, the No Action Alternative (with Emergency Measures) increases the flood depth and flood extent immediately upstream of the F-M urban area. Water flows between the levees and emergency measures constructed throughout the F-M urban area will be constricted, causing higher water surface elevations upstream of the levees and increasing flood extents. This shift in water flows provides storage upstream of the levee and decreased peak flow rates through the F-M urban area.

Similar to the Base No Action Alternative, each of the reasonably foreseeable projects is anticipated to have a beneficial effect to reducing flood risk in localized areas. The No Action Alternative (with Emergency Measures) does not have the potential to contribute to cumulative potential effects on overall hydrology.

4.1.1.3 Proposed Project

The Project is intended to reduce flood risk in portions of the F-M urban area by controlling water flow and temporarily storing and diverting flow through a diversion channel. This would result in impacts to the hydrology and hydraulics of flood events in the F-M area. For the Project's proposed Protected Area, there would be a reduction of flood stage through the main stem of the Red River, as well as a reduction of the extent, depth and duration of flooding. For the Project's proposed Inundation Area, there would be an increase in the extent, depth and duration of flooding, and specific hydrologic impacts would vary based on location within the Inundation Area. Additionally, there would be a diversion of high flows from the Sheyenne and Maple Rivers into the Diversion Channel and lower portions of the Rush and Lower Rush Rivers would be abandoned and rerouted into the Diversion Channel. Proposed mitigation and monitoring measures are described in detail in Section 3.1.3.

The Wolverton project includes installing side inlets and buffer strips, which are not anticipated to have a significant effect on hydrology or hydraulics. However, portions of the Wolverton Creek near the confluence with the Red River may experience greater flood flows and flood duration during Project operation compared to current conditions.

The Manston Slough Wildlife Pool Management will provide 4,430 acre-feet of water storage in the Buffalo River watershed by installing an outlet structure and improving a number of roadways. This would alter the hydrology and hydraulics in the Buffalo River watershed during flood events by providing floodwater storage and retention. This would provide some flood control in that area of the watershed.

Hydrologic impacts could occur from the Cass Drain 21 and Cass Drain 45 projects as flows would likely be increased with re-grading and deepening of the channels through West Fargo. Additionally, both drains are intended to convey flood water to reduce localized flooding in West Fargo. Drain 21 currently drains to the Sheyenne River, while Drain 45 eventually drains to the Red River. Both of these drains would discharge downstream of the tieback embankments.

The Cass Drain 30 project is intended to re-grade and deepen the drainage channel. Cass Drain 30 would be altered by the Project as Cass Drain 30 would no longer flow into the Sheyenne River, but instead would flow into the diversion channel. Runoff from breakout flows in the local rivers result in overland flows of greater than the 100-year flood in the area near Cass Drain 30, and therefore, the inlet structure flowing into the diversion channel would be sized to accommodate the 100-year flood overland flow. The overall design of the drainage channel would be modified to accommodate operation and maintenance with the diversion channel. This includes considerations for flow capacity, flap gates to control water from backing out of the diversion channel during large flood events, and inlet structure design. The Cass Drain 30 project is anticipated to improve flows and drainage in the local area.

Of the reasonably foreseeable projects expected to have impacts to hydraulics and hydrology, only the Manston Project has the purpose of restoring pre-drainage conditions in the watershed and restoring wetlands. The purpose of the other projects included in this analysis, including the Project, is to improve hydrology and hydraulics to continue drainage of the landscape. The cumulative effect on hydrology and hydraulics in the Project area since settlement has been and continues to be significant. Agricultural drainage, increased precipitation, and development have altered the hydrology and increased the hydraulics of the watershed that requires ongoing maintenance to keep current land uses unchanged.

4.1.1.4 Northern Alignment Alternative

Since the environmentally relevant area would be the same as the Project, cumulative potential effects from the Northern Alignment Alternative (NAA) are anticipated to be similar to those described for the Project. However, flood evaluations, flood depths, and the duration of flood events would differ depending on the specific location within the Project Area.

4.3 STREAM STABILITY

4.3.1 Affected Environment/Environmentally Relevant Area

The Red River drainage basin is prone to flooding associated with spring snowmelt and summer runoff events. Flood flows tend to exceed the natural banks of the streams and can result in sediment deposition along the stream banks. In general, cohesive clay in the channel substrate of the streams in the project area provides resistance against significant channel migration. Comparison of historic to current aerial photographs of streams in the project area shows little channel movement horizontally or laterally over time, indicating relatively stable streams; however some localized channel migration has and could continue to occur.

4.3.2 Environmental Consequences

4.3.2.1 Base No Action Alternative

The Base No Action Alternative, including the current conditions and the Manston project, the Wolverton project, Drain 21 and Drain 45, and Cass Drain 30 project, would result in the continuation of sedimentation and deposition due to recurring flood damage, consistent with current geomorphic processes. Urbanization and additional development of the watershed creates impervious surface that can increase flow rates during rain events affecting the overall stream system, although increased stormwater management regulatory requirements have limited or reduced peak flow rates for new urban developments. Over time, the flow rates of streams during rain events have increased leading to greater potential for changes in geomorphology through increased erosion and sedimentation.

The aggregate effects of the reasonably foreseeable projects are anticipated to contribute to the stabilization of the local river geomorphology by providing localized flood storage, reducing erosion and sedimentation, and directing main water flow in specific channels. The Wolverton project is intended to restore the stream channel and stabilize the stream, providing some protection from significant geomorphological changes. The Manston project is designed to provide flood storage and maintain a stable pool elevation, which would have localized benefits of reducing the potential for sudden flow downstream, reducing associated erosion, sedimentation, and flooding, and minimizing the impact on geomorphology in the Buffalo River watershed. Cass Drain 21 and 45 projects are not anticipated to result in significant impacts to geomorphology as re-grading and deepening the drain channels would provide better water flow. Similarly, only localized impacts to geomorphology are anticipated with the Cass Drain 30 project.

4.3.2.2 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) would require sandbagging and temporary levees to protect adjacent floodplain areas, which would result in some stage increases upstream. Emergency measures are not anticipated to significantly change the depth, rate or duration of flow in the project area, and therefore, are not anticipated to cause significant changes to current geomorphology. The reasonably foreseeable projects are anticipated to contribute to the stabilization of geomorphology in specific areas where these projects are located.

4.3.2.3 Proposed Project

The Project is not anticipated to cause significant geomorphic changes upstream or downstream of the project area. Project design and mitigation and monitoring have been proposed to minimize impacts to the stream bed and to stream bank erosion and sedimentation that may impact geomorphology in the Project area. Within the Project's proposed Protected Area, the magnitude of high flow events would be limited, altering the natural hydrology of the area. Riparian vegetation would no longer experience inundation or significant burial as compared to current conditions. Additionally, trees and shrubs may encroach which may result in less bank slumping. Within the Project's proposed Inundation Area, there would be a direct impact to geomorphology due to increased depths and duration of flooding. Increased flooding durations could reduce soil bank strength and result in soil banks becoming more prone to collapse. This increased sedimentation would occur incrementally over decades and could result in indirect impacts, such as area vegetation becoming increasingly stressed, making it more susceptible to disease and insect infestations.

Within the Rush and Lower Rush Rivers, there would be direct geomorphological impacts due to potential aggradation from sediment. Regarding the proposed Project Control Structures, there will be an increased potential for bed and channel scour. Specific mitigation and monitoring measures, such as pre- and post-construction and operation monitoring, and altered Project operation, are discussed in detail in Section 3.3.3.

The Wolverton project includes the installation of side inlets and buffer strips which are intended to reduce erosion and sedimentation along Wolverton Creek. However, portions of the creek near the confluence with the Red River may experience increased flood depth and duration during Project operation potentially impacting geomorphology. Stream channels in the Wolverton project area typically consist of clay material that have compacted over time to form a stable stream bottom, and therefore, impacts from sedimentation are not anticipated to be significant from operation of the Project.

The Manston project is designed to provide flood storage and maintain a stable pool elevation. This would have localized benefits by reducing the potential for sudden flow downstream, and therefore, the potential for downstream erosion, sedimentation, and flooding would be reduced, minimizing the impact on geomorphology in the Buffalo River watershed.

Re-grading and deepening the drain channels as proposed for the Cass Drain 21 and 45 projects would provide better water flow. These projects are anticipated to manage water flows more effectively, supporting better flood control, which would continue to protect West Fargo and Horace areas and associated streams. Flood control and protection on the Sheyenne River influences stream stability in the protected areas by reducing flow rates during large floods and reducing the potential for sedimentation.

Localized impacts to geomorphology are anticipated with the Cass Drain 30 project as the channel is re-graded and deepened. This project is intended to reduce sedimentation in the upstream reach and erosion in the downstream reach, while flattening side slopes to reduce future slope failures. These measures are anticipated to help improve water quality downstream of this project.

Impacts from reasonably foreseeable projects are anticipated to be beneficial to the geomorphology of the Project area, due to reduction in erosion and sedimentation, stabilization of stream channels, increased control of water flow, and reduced flooding in localized areas. The Project is not anticipated to contribute to negative cumulative potential effects to stream stability in the project area or its vicinity.

4.3.2.4 Northern Alignment Alternative

Since the environmentally relevant area would be the same as the Project, cumulative potential effects from the NAA are anticipated to be similar to those previously described for the Project. However, impacts from the NAA would be shifted 1.5 miles downstream compared to impacts at the Project location.

4.4 WETLANDS

4.4.1 Affected Environment/Environmentally Relevant Area

Glacial Lake Agassiz lakebed contains fertile silty and clayey soils, which when drained, provide land suitable for agriculture. Historically, prior to settlement, this area was comprised of tall grass and wet prairies. According to the 1997 Minnesota Wetlands Conservation Plan (MNDNR 1997) less than 20 percent of the native wetlands in the Moorhead area and upstream sub-basins remain. Factors influencing the alteration and decline of wetlands primarily include urban development, such as housing developments, road construction, and construction-related activities; and agricultural activities, such as tiling, ditching and drainage for crop production, and plowing activities that have exposed loose, fine-textured soils, contributing sediment transport into nearby wetlands.

The vast majority of wetlands in the project area are seasonally flooded basins (potholes) located on agricultural land. Wetlands found within the active agricultural lands, such as row-cropped fields, provide limited levels of function due to extensive drainage by agricultural drain tiling and overall alteration that has taken place since pre-settlement. Seasonally flooded wetlands generally provide low function for the Minnesota Routine Assessment Methodology for Evaluation of Wetland Functions (MNRAM) categories of Maintenance of Hydrologic Regime and Maintenance of Wetland Water Quality in the agricultural land due to the extensive drainage systems in these areas.

Depressional wetlands within agricultural fields can, however, generally provide moderate to high function for the MNRAM categories of Flood/Storm Water Attenuation and also for Downstream Water Quality. Those wetlands that have been shaped into shallow field ditches provide a moderate level of temporary floodwater or stormwater storage. Field wetlands provide a moderate level of function for protection of downstream water quality because they are able to filter some of the nutrients in the agricultural runoff before it enters nearby waterways. Wetlands present in the project area, and associated impacts, are discussed in detail in EIS Section 3.4 - Wetlands.

4.4.2 Environmental Consequences

4.1.1.1 Base No Action Alternative

Under the Base No Action Alternative, wetland impacts from flood events would remain largely the same as under the current conditions. Flooding that could occur would be temporary, and impacts to wetlands would occur slowly over a long period of time as part of flood dynamics and from other system influences. Direct and indirect impacts to wetlands could occur with the natural expansion of the F-M urban area, as wetlands are converted to urban development.

The Wolverton project is intended to result in creating a low flow channel, and establishing vegetated buffers along the corridor, potentially encouraging the establishment of wetlands along the stream corridor, although there may be temporary impacts to wetlands during project construction.

The Manston project is anticipated to establish approximately 2,000 acres of wetland in the Buffalo River watershed within the Red River basin by constructing a water control structure. Temporary impacts to wetlands during the construction of the control structure may occur. The project will be managed to control the water pool elevation to pre-drainage conditions and also allow for periodic drawdowns to further restore and maintain wetlands.

Cass Drains 21 and 45 are not managed for wetlands, but may contain wetlands that have become established over time. Cass Drain 21 and 45 projects will deepen channels in order to continue to provide effective drainage in the West Fargo area. The drainage channels may have established wetlands, which will be removed as part of excavation. Additionally, drainage typically results in altered hydrology that can impact wetland areas. Cass Drains 21 and 45 are primarily in the urbanized area of West Fargo, and therefore, impacts to wetlands due to drainage channel improvements are not anticipated.

Cass Drain 30 provides drainage to a 10 square mile area, which includes areas that may have historically been or currently are wetland. The improvement project will excavate wetlands that have become established within the drainage channel. Improvements to this drainage will deepen channels in order to continue to provide effective drainage, water flow, and supply water to the Sheyenne River. The Sheyenne River has wetland areas within its corridor. The drainage area for Cass Drain 30 is primarily agricultural land, however, effective drainage in the area may impact any remaining wetland, which could result in less water storage areas in the Red River basin.

4.1.1.2 No Action Alternative (with Emergency Measures)

Emergency measures would be used to reduce flooding in the F-M urban area, which could displace the flow causing flooding in other areas. Flooding that could occur would be temporary, and wetland impacts would occur slowly over a long period of time as part of flood dynamics and from other system influences.

The Cities of Fargo and Moorhead have planned flood risk reduction projects that reduce flooding potential for properties along the Red River within the F-M urban area, and would use emergency measures, such as sandbagging and temporary levees, to protect certain areas that may require additional protection. These actions could reduce impacts to the protected areas, but potentially increase impacts to other areas, such as increased flooding upstream with the potential to impact upstream wetlands. Direct and indirect impacts to wetlands could occur with the natural expansion of the F-M area as wetlands become developed, resulting in required mitigation within the Red River basin.

4.1.1.3 Proposed Project

The Project would result in direct and indirect impacts to wetlands from construction and operation as described in detail in Section 3.4. Greater than 80 percent of pre-settlement wetlands in the project area have been drained or filled. The Project proposes to directly impact over 1,800 acres of wetland from the diversion channel, connecting channel, excavated material berms, shallow drainage ditches outside berms, tieback embankments, roads, control structures, hydraulic structures, and the Oxbow-Hickson-Bakke (OHB) Ring Levee with the potential for additional indirect impacts during Project operation. Most of the impacts occur in shallow open water wetland types, but the impacts also include 124 acres of forest and 62 acres of floodplain forest. The Project would also result in direct impacts to wetlands from the Comstock Ring Levee (estimated to be less than five acres) and from the Drayton Dam Mitigation Project (0.5 acres). Indirect and temporary wetland impacts to 151 (estimated) acres would occur in the Project's proposed Inundated Areas. Additional indirect impacts to wetlands would occur by changing wetland function and type from Rush and Lower Rush River bisect.

The wetland mitigation plan would be used during the federal and state permitting/approval processes to assess wetland impacts and determine appropriate replacement of those impacts. The Project would use an Adaptive Management Plan (AMP) for mitigation and monitoring of impacts, which includes the diversion channel conceptual wetland mitigation plan (wetland mitigation plan). The wetland mitigation plan is habitat-based with a goal of replacing impacted wetland habitat and certain functions rather than designing the plan purely on wetland design criteria. The AMP would also be in place for mitigation and monitoring of floodplain forest impacts. MNRAM would be used to evaluate the mitigation wetlands at the end of the monitoring period. Wetland mitigation for the Project would replace lost wetland and convert thousands of acres of agricultural land into wetland within the diversion channel. This would result in greater wetland acreage within the Red River basin. Additional detail describing mitigation and monitoring measures is provided in Section 3.4.

4.1.1.4 Northern Alignment Alternative

Since the environmentally relevant area is the same as the Project, cumulative potential effects to wetlands from the NAA and reasonably foreseeable projects would be similar to those described for the Project. However, the NAA has the potential to eliminate the need for the Comstock levee, eliminating the direct wetland impacts, (about 5 acres) and the NAA has estimated 3 acres fewer indirect wetland impacts in inundated areas as compared to the Project.

4.5 AQUATIC HABITAT AND FISH PASSAGE

4.5.1 Affected Environment/Environmentally Relevant Area

There are a number of species found in the Red River and its tributaries (roughly 80 native fish species) that are believed to use the Red River main stem seasonally for habitat and as a migration route. These fish and aquatic biota species have experienced decline of fish passage and aquatic habitat quality in the Red River watershed since settlement. This is for a variety of reasons, including dam construction limiting migration, siltation, channel modifications, and loss of necessary in-stream habitat. Habitat quality on the Red River and its tributaries is considered to be greatly reduced compared to pre-settlement conditions. Aquatic habitat on the Red River main stem has been affected by stream channelization, damming, land cover type changes, artificial drainage, and agricultural drain tiling. Area development has also altered the ability of fish to migrate within the Red River basin, due to construction of eight dams on the main stem and hundreds of dams on tributaries within the Red River basin. In the last 15 to 20 years, projects have been implemented to improve fish passage.

An EA examining fish passage in the Red River basin in Minnesota was completed by the United States Fish and Wildlife Service (USFWS) in 2005. This assessment identified over 400 dams and control structures that have been constructed throughout the watershed on the Red River and its tributaries. Additionally there have been thousands of culverts installed at road crossings on ditches and streams, which in some cases have become barriers to fish movement. These collective land use changes have impacted the habitat within and adjacent to rivers and streams in the Red River basin. Efforts have been made over the last decade by the MNDNR and other groups to remove or bypass migration barriers (such as low-head dams) on the Red River as well as tributaries throughout the watershed, resulting in improved fish passage at several dams in the watershed.

4.5.2 Environmental Consequences

4.1.1.1 Base No Action Alternative

The construction of the reasonably foreseeable projects would cause some localized impacts to aquatic habitat. However, these flood control projects are not anticipated to create barriers to fish passage in the watershed or contribute to fish stranding and mortality in adjacent floodplain areas in the watershed. Habitat within these rivers would continue to be influenced by the flooding patterns that currently occur and potentially contribute to channel scouring and/or siltation of aquatic habitat. Fish mortality in the form of fish stranding within floodplain areas adjacent to rivers would be expected to continue in a similar magnitude as currently occurs. This process is dependent on the frequency of current flood patterns on the Red River and its tributaries.

The Wolverton project is anticipated to restore potential habitat and reduce sedimentation in the stream, which would result in potential benefits to aquatic habitat. During the stream restoration process, there would be temporary impacts to aquatic habitat, fish and aquatic biota from construction. Once the stream is restored and re-established, the Wolverton project is anticipated to be beneficial for aquatic habitat and biota. The Manston project is anticipated to provide aquatic habitat for smaller fish and aquatic biota that is typical of small pools and deep wetland habitat. This would maintain water surface elevations and result in an overall beneficial impact within the Buffalo River watershed. The Cass Drain 21, 45, and 30 projects are not anticipated to have significant impacts on aquatic habitat or fish passage. Some aquatic habitat may exist in the drainages, but the quality of that habitat has not been assessed. It is anticipated that over the long term, the projects could provide some indirect improvements to aquatic habitat by providing more consistent water flow, reducing sedimentation, deepening the channels for fish that may enter the drainage system, and therefore, aquatic habitat or fish passage may be provided to a limited degree. However, these drain projects are man-made drainage ways that are not managed or intended for fish or aquatic biota.

4.1.1.5 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) would not add or remove barriers to fish passage within the Red River and its tributaries, and therefore, fish passage and migration within the watershed would not change from Base conditions.

4.1.1.6 Proposed Project

The Project has the potential to continue the degradation of aquatic habitat in the project area. Project construction would directly impact aquatic habitat on the Red (1.0 miles, 17 acres), Wild Rice (0.9 miles, 12 acres), Sheyenne (0.9 miles, 8.4 acres), Maple (1.1 miles, 11 acres), and would result in the loss of river channel to the Lower Rush and Rush Rivers, 2.7 and 2.3 miles, respectively. Potential aquatic habitat impacts include direct mortality to macroinvertebrates and fish from crushing and excavation; temporary fish relocation during project construction. Project operation could change pools, sedimentation, depths and velocities.

Impacts to fish passage and migration include the creation of impassable conditions due to flow velocities on the Red and Wild Rice Rivers for fish during operation; potentially impacting migrations of walleye, northern pike, and redhorse/white sucker; and access to Wolverton Creek. Abandonment of Rush/Lower Rush Rivers could impact fish migration from Red and

Sheyenne Rivers. In addition, if water recedes too quickly, fish may become stranded in the pools resulting in mortality.

Indirectly, aquatic habitat may be impacted from construction and operation of the Project that may result in altered hydrology, stream stability, and wetland impacts.

Project mitigation proposed for aquatic habitat/fish passage includes stream channel restoration projects, fish migration and connectivity projects, construction avoidance periods, and future studies to identify possible additional projects. Additional detail regarding proposed mitigation and monitoring measures can be found in Section 3.8.3.

4.1.1.7 Northern Alignment Alternative

Impacts and cumulative potential effects from the NAA are anticipated to be similar to those previously described for the Project. The location of the control structures on the Red and Wild Rice Rivers, and the tieback embankment would be located further downstream, and therefore, would impact a different location but with similar habitat.

4.6 WILDLIFE RESOURCES

4.6.1 Affected Environment/Environmentally Relevant Area

The majority of the project area is comprised of agricultural land and urban development. Due to settlement of the area, wildlife habitat has been limited to floodplain forests along stream corridors, remnant grasslands, shelterbelts around homesteads, and other areas that may not be developed. Both Minnesota and North Dakota have Comprehensive Wildlife Conservation Plans, State Wildlife Action Plans in Minnesota (SWAPs), developed and funded through federal grants and programs. These plans identify Species of Greatest Conservation Need (SGCN) and key habitats for conservation actions (MNDNR 2006). Key habitats are areas that historically supported SGCN. In Minnesota, the project area is in the Red River Prairie subsection. Key habitats include: prairie, wetland-nonforest, river-headwater to large, river-very large, and forest-lowland deciduous. Equivalent areas in North Dakota are: Tallgrass Prairie (Red River Valley); Rivers, Streams, and Riparian; and Wetlands and Lakes. The following provides a summary of key habitats in the project area and past land use changes. Additional details are provided in Section 3.9 – Wildlife Resources.

<u>Prairie</u>

Land use practices over the last century, including urban development and widespread agriculture, have significantly reduced the amount of native prairie habitat across Minnesota and North Dakota. While the prevalence of prairies has been reduced compared to pre-settlement levels, grassland and surrogate upland habitats are present in the project area. These include hayland, pasture, and planted shelterbelts (FFREIS, 2011). Shelterbelts, planted near farmsteads and homes or along field edges, are composed mostly of small shrubs and fast growing tree species, but can also include some coniferous trees, as well as grassy understory. These habitats support wildlife species at varying levels depending on the size of habitat tracts and their proximity to existing human developments or activities. Pasture and hayland also support a variety of migratory birds for foraging and nesting.

Wetland-Nonforest

Nonforested wetlands have declined in many subsections of Minnesota's ecological classification system, especially in the Prairie Parkland province, which includes the Red River Prairie subsection (MNDNR, 2006). Due to the decline of nonforested wetlands, several species of birds are considered SGCNs in Minnesota (MNDNR, 2006). In North Dakota, the majority of nonforested wetland habitat is found outside the Red River Valley.

River Habitat

Historically, the Red River, its backwaters, and upland areas supported several species of wildlife. Rivers and streams within the Red River Valley ecological section have been significantly altered since the time of settlement through intensive agriculture, wetland drainage, channelization of streams, and addition of dams (Aadland et al., 2005). Historically the pre-settlement vegetation of the Red River Prairie subsection was dominated by tall grass prairies and wet prairies but has been replaced by wide-spread agriculture (MNDNR, 2006). Many SGCNs therefore have been extirpated from the Red River (MNDNR, 2006), but some species may persist.

In order to facilitate crop production, the land has been extensively drained through tiling of wetlands, creation of ditches, and channelization of streams, including streams such as the Rush and Lower Rush Rivers. These land use alterations lead to changes in river habitat such as nutrients, and pollutants into the Red River and its tributaries, and alteration of flow regimes and increased sedimentation that reduces pool depth or covers hard substrates.

One of the other most significant changes to river habitats in the Red River basin is the creation of dams and flow control structures. The addition of these structures has altered the ability of fish to migrate within individual rivers and also through multiple rivers and streams across the overall watershed. This limitation of fish movement throughout the Red River watershed limits the access of fish to certain important habitat types such as native spawning areas or wetlands located in the upstream portions of the watershed. Reduced fish migrations can also impact other aquatic organisms, such as mussels, which depend on fish hosts for reproduction and dispersal (Aadland, 2010). Despite past alterations, river habitats within the Red River Prairie subsection support several significant fish and wildlife resources such as catfish and the reintroduction of lake sturgeon.

Forest-Lowland Deciduous

Large areas of floodplain forests have been lost since settlement within the project area (MNDNR, 2006). Floodplain forests were formerly dominant in the wide floodplains surrounding streams and rivers. However, conversion to agriculture and urbanization has reduced the floodplain forests to narrow margins along rivers and streams. Within the project area, floodplain forest is less prevalent than in other parts of Minnesota, such as along the Mississippi River. The remnant margins are essentially the only floodplain forest habitat remaining. Past habitat distribution shows that five to seven percent of the Red River Prairie subsection consisted of floodplain forest, but its occurrence is now less than one percent (MNDNR, 2006; Hagen et. al 2005). Since the project area was historically prairie, forest was uncommon but served as important nesting, breeding, and overwintering habitat for a variety of terrestrial wildlife species (FFREIS, 2011).

4.6.2 Environmental Consequences

4.6.2.1 Base No Action Alternative

Flooding would continue resulting in temporary displacement of wildlife. Natural habitat would generally remain fairly similar to existing conditions, with changes in vegetation communities occurring over time after flooding or other disturbance events. Development is expected to continue in the project area that has the potential to further turn natural habitat into urbanized area or agricultural land.

The Wolverton project would result in a more stabilized stream corridor that could result in additional wildlife habitat following completion of the project. This corridor would be susceptible to current flood dynamics and, during flood events, result in temporary displacement of wildlife. During the construction of the stream restoration project, wildlife may be negatively impacted due to displacement. Once vegetation is re-established along the corridor, wildlife is anticipated to return.

The Manston project would provide a consistent wetland pool, which would allow wetlands and wildlife habitat to establish. This would result in approximately 2,000 acres of wetland habitat and approximately 3,000 acres of upland habitat in the Buffalo River watershed within the Red River basin.

4.6.2.2 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) could result in minor, temporary impacts to wildlife habitat along the Red River within the cities of Moorhead and Fargo where levees and sandbags are used to control flooding. Wildlife may be temporarily displaced. These impacts would be minor as most emergency measures would occur in urban areas, where wildlife habitat is already disturbed by human activities. Natural habitat would generally remain fairly similar to existing conditions, with natural changes in vegetation communities over time after flooding or other natural disturbance events.

4.6.2.3 Proposed Project

The primary concerns for potential impacts to wildlife habitat would occur from construction and operation of the Project. Construction would impact floodplain forest and aquatic habitat, and would also convert agricultural land into upland and wetland through mitigation. Direct impacts to wildlife resources during construction include potential for direct mortality, displacement or increased exposure of less mobile species (i.e., small mammals, amphibians, reptiles, ground-nesting birds, including some migratory birds) to predators. Temporary impacts to wildlife resources from construction would primarily include displacement due to human presence, increased noise and visual disturbances. Impacts to riparian vegetation during construction may also cause stream bank destabilization.

Project operation has the potential to temporarily displace wildlife due to flooding in areas that would not be inundated under existing conditions. Project operation would cause potential impacts to forested areas that would not otherwise be affected and may not have species adapted to these flooding events. The direct impacts to floodplain forest habitat during project operation would have the longest potential temporal loss of habitat function as the loss of habitat would be immediate. Wildlife species migrate between habitat areas for foraging and cover in the region, meaning impacts to wildlife species and populations can occur indirectly due to impacts to habitat. Direct impacts to aquatic wildlife resources include 8-25 acres of stream channel habitat impacts, including the direct loss of stream channel aquatic habitat from abandonment of Rush/Lower Rush Rivers. During operation of the project, displacement and mortality may also occur to wildlife using the diversion channel due to a sudden flow of water.

Construction-related impacts would be mitigated by replacement of habitat in disturbed areas or at mitigation locations near the project area. All direct impacts to the floodplain forest would be mitigated at a 2:1 ratio in farmed wetlands along the Red River. There would likely be some temporal loss of habitat function during the period after habitats are impacted by the Project but before created mitigation habitats have matured and replaced the lost habitat function. All non-cropped upland habitat would be replanted with native species, particularly native grasses that are anticipated to have positive impacts on overall habitat value (FFREIS, 2011). Additional details about mitigation for wildlife resource impacts are provided in Section 3.9. The level of impacts would be dependent on the timing and duration of flood events and operation of the Project.

4.6.2.4 Northern Alignment Alternative

Since the environmental relevant area is the same as the Project, impacts and cumulative potential effects from the NAA are anticipated to be similar to those previously described for the Project. However, specific habitat acreages could vary, floodplain forest, wetlands, aquatic habitat and other cover types in the NAA embankment and control structure areas have not been surveyed, and therefore, exact acreages are unknown.

4.7 CULTURAL RESOURCES

4.7.1 Affected Environment/Environmentally Relevant Area

Cultural resources include a wide range of historic, archaeological and other resources related to past human activities. Prior to European settlement, the project area, as part of the Red River valley, was inhabited by Native American tribes. As settlers moved in, tribes relocated, leaving artifacts and evidence of their use of the area. The project area experienced significant settlement during the late 1800s. Settlement to this area was influenced by the U.S. Congress Homestead Act and development of the railroad, which brought homesteaders to the area, many of whom established farms. As time has passed, development has continued, while leaving archaeological and historic resources, such as Native American artifacts, structures, and historically significant places. Some of these cultural resources have been destroyed, while others have remained or are yet to be identified.

For the Project, cultural resource surveys are conducted within a defined Area of Potential Effect (APE). The APE is the area where historic properties may be impacted, directly or indirectly, which has been defined in a programmatic agreement. A Programmatic Agreement for the Project was negotiated and signed per 36 CFR Part 800, as a method for the St. Paul District USACE to comply with Section 106 of the National Historic Preservation Act (NHPA), as amended. The Programmatic Agreement identified the APE within which potential impacts to cultural resources were surveyed. In general, the APE is comprised of the Project construction footprint, Project mitigation areas, Project-related in-town levees, the viewshed to one-half mile from the diversion channel's centerline, and cemeteries in the inundation areas upstream of the tieback embankment where flood water depth is greater than under the Base No Action Alternative.

Phase I cultural resource surveys have been conducted for a majority of the current Project construction footprint, and portions of the staging area. A number of historic structures were found and evaluated for eligibility for the National Register for Historic Places (NRHP) listing. Additional surveys would be required following final Project design, prior to Project construction, to determine if there are additional NRHP eligible properties that should be evaluated and handled appropriately. Additional detail is provided in Section 3.12 – Cultural Resources.

4.7.2 Environmental Consequences

4.7.2.1 Base No Action Alternative

Cultural resources would continue to be affected during flood events consistent with current conditions. Forty-three of the total fifty-four known cemeteries in the Project area are currently affected during 100-year flooding events. Cultural surveys have not been conducted on the reasonably foreseeable projects, therefore, cultural resources cumulative effects, although applicable, cannot be fully assessed.

The Wolverton project would disturb the stream corridor. If cultural resources are present where ground disturbance occurs, it is anticipated that appropriate actions would be taken to avoid, minimize and mitigate any impacts to cultural resources.

4.7.2.2 No Action Alternative (with Emergency Measures)

Work associated with the Base No Action Alternative (with Emergency Measures) is planned to occur primarily within existing urban areas which are not known to have impacts to cultural resources.

4.7.2.3 Proposed Project

Potential impacts from the Project could occur to NRHP properties and NRHP-eligible properties. The Section 106 process includes the assessment of adverse effects to historic properties (36 CFR, subpart B § 800.5). Construction and operation of the Project has the potential to directly and indirectly impact NRHP and NRHP-eligible properties. Within the Construction Footprint and Staging Area of the Project there are 16 undetermined NRHP-eligible sites, two NRHP-listed sites, and eight recommended as NRHP eligible sites. Direct impacts include damage, destruction or physical alteration of a property, as well as removal of a property. Within the Protected Area there are 20 cemeteries which would be removed from current flooding risk. Within the inundation areas upstream of the tieback embankment, there are 12 cemeteries with varying level of impacts.

Indirect impacts include those associated with visual and noise impact from the Project. Cultural resources surveys have been completed for portions of the Project and its staging area.

Compliance with Section 106 of the NHPA requires federal agencies to avoid and minimize impacts to NRHP properties and NRHP-eligible properties. Some portions of the Project have been surveyed, but additional surveys would be needed for Project construction. A Programmatic Agreement for the Project was negotiated and signed per 36 CFR Part 800 to ensure the USACE complies with Section 106 of the NHPA. The Programmatic Agreement defines the Project APE and contains stipulations for cultural resources avoidance, minimization, and mitigation measures. The Agreement covers the construction footprint, work limits, in-town levees, staging area, and environmental mitigation sites that are part of the Project, including the Drayton Dam and Wild Rice River Dam.

It is unknown what surveys or mitigation measures, if any, are associated with the Wolverton project. However, the Project, in combination with the Wolverton project, is not anticipated to contribute to cumulative potential effects. Details are provided in Section 3.12 – Cultural Resources.

4.7.2.4 Northern Alignment Alternative

Impacts and cumulative potential effects from the NAA are anticipated to be similar to those previously described for the Project, with a few exceptions. The construction footprint and staging area would include 17 undetermined NRHP-eligible sites, three NRHP-eligible sites, nine NRHP-recommended eligible site, and one site listed as NRHP-undetermined eligibility. Within the Protected Area of the Project, 19 cemeteries would be removed from currently flooded areas. Within the inundation areas upstream of the tieback embankment, ten cemeteries would have flooding at varying levels of impact.

4.8 SOCIAL AND ECONOMIC

4.8.1 Affected Environment/Environmentally Relevant Area

The F-M area serves as a regional center for healthcare, government, employment, commerce, educational and training opportunities. Flooding in the Red River basin threatens the F-M area with risks of damage to urban and rural infrastructure; disruptions to transportation corridors; and damages to businesses and homes. Flooding also affects an individual's employment, income, and potentially their access to public services. The FFREIS identified the threat of catastrophic flooding and the frequency and magnitude of recent floods causes high stress levels, resulting in mental and physical effects on the well-being of residents and business owners. In the recent past, the floods of 1997 and 2009 have had the greatest physical and emotional effect on the communities of Fargo and Moorhead. Completed Flood Damage Reduction (FDR) projects have had beneficial social and economic impacts in the F-M area by reducing flood risk and flood damage to homes and businesses, and protecting critical infrastructure within the F-M urban area. The FDR projects provide some flood protection, but do not provide full flood protection for some areas. During significant flood events, the F-M area implements emergency response plans, which include evacuations, installation of temporary levees, sandbagging, and other measures. This requires considerable effort, financial resources, and coordination. The threat of flooding also causes significant stress (e.g., emotional, physical, and financial) on many individuals, families, and businesses located within the floodplain in both rural and urban areas.

4.8.2 Environmental Consequences

4.8.2.1 Base No Action Alternative

The Base No Action Alternative would continue the current flood risk in the Metro area. FEMA plans to update the National Flood Insurance Program maps in the future to reflect the current understanding of flood risk. Continuation of current conditions would not result in certifiable flood protection to the 100-year level needed for FEMA accreditation, so thousands of existing structures would be mapped into the regulatory floodplain. This could increase the need for flood insurance to these structures as part of obtaining financing for real estate transactions.

Cass Drain 21, 45, and 30 projects are anticipated to provide drainage and some flood risk benefits, but these benefits will mostly be contained within in localized areas.

4.8.2.2 No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) provides some flood risk reduction through the implementation of planned emergency measures in the Metropolitan Area. However, current conditions and emergency measures would not provide a certifiable 100-year level of protection needed for FEMA accreditation in the future. This alternative would be similar to the Base No Action Alternative with respect to the need for flood insurance to support financing for real estate transactions. The locations of each type of emergency measure are mapped with instructions for implementation at various times and stages of flooding. In general, the social and economic effects of the No Action Alternative (with Emergency Measures) are anticipated to be beneficial to the F-M urban area by reducing flood risk. However, emergency measures in the F-M urban area require significant financial and human resources, including thousands of volunteers. Further discussion on the social and economic implications of the No Action Alternative (with Emergency Measures) is provided in Chapter 4.

Cass Drain 21, 45, and 30 projects are also anticipated to provide drainage and some flood risk benefits in localized areas.

4.8.2.3 Proposed Project

The Project would cause new flood inundation in areas outside of the existing 100-year floodplain. The Project would also buy out properties within a designated staging area, which would potentially remove them from the tax base and school district of a particular local government area. The Project would also impact more agricultural land than the current 100-year flood event, which would economically impact individual farmers and landowners. There are also social implications to relocation of families and potentially generations of farmers within the staging area.

The Project would also significantly reduce the flood risk for some areas in the current 100-year floodplain. These areas near the F-M urban area may experience development at a greater rate. The rate of development would be determined based on market conditions, land use plans, local zoning regulations, and permitting approval.

Past projects appear to have resulted in potentially beneficial impacts on socioeconomics in the project area by providing some flood risk reduction in the F-M urban area through the construction of levees and removing properties from the floodplain. The Project is anticipated to provide additional flood risk reduction to the socioeconomics in the F-M urban area, but would also impact individual property owners and communities located outside of the benefitted area. This could have a potentially significant impact on certain individuals and possibly on communities in the F-M rural areas. Proposed mitigation for the social and economic impacts of this Project includes property acquisition and easements. The identified projects in the environmentally relevant area did not have significant social and economic impacts, and therefore, no mitigation was proposed. Proposed mitigation and monitoring may result in social and economic cumulative potential effects as property owners are relocated or property values are affected by easements. Proposed mitigation is further described in Section 3.16 - Socioeconomics. The overall social and economic impacts of the Project are positive. Negative social and economic impacts are primarily located within and adjacent to the footprint of constructed features or in the inundation areas upstream of the tieback embankment.

The Cass Drain 21 and 45 projects would improve water flow and drainage in West Fargo. Social or economic impacts for primarily private landowners could occur from the Cass Drain 30 project, which are anticipated to be beneficial. The Project would provide flood damage reduction to drainage areas similar to those served by the Cass Drain 21, 45, and 30 projects.

4.8.2.4 Northern Alignment Alternative

Impacts and cumulative potential effects from the NAA are anticipated to be similar to those previously described for the Project.

5.0 Comparison of Alternatives

The Project and three alternatives have been analyzed in this environmental impact statement (EIS) to provide information that identifies their potential significant environmental impacts. All of the impacts that were scoped in the Minnesota Department of Natural Resources (MNDNR) Final Scoping Decision Document (FSDD, 2014) were considered “potentially significant”; this EIS provides additional details on the potential for significance and measures needed to avoid impacts. The information provided “shall be used as a guide in issuing, amending, and denying permits and carrying out other responsibilities of governmental units to avoid or minimize adverse environmental effects and to restore and enhance environmental quality” (Minnesota Rules 4410.0300).

Complete descriptions of the Project and the three alternatives are provided in Chapter 2. A detailed analysis and discussion on the environmental consequences for each alternative are presented in Chapter 3. This chapter pulls information contained in Chapter 3, consolidates the environmental impacts, and focuses on comparing environmental consequences of the reasonable alternatives to the Project. The chapter also includes a discussion on how permitting or other regulatory agencies and local governments, particularly MNDNR, and other interested and/or affected parties can use this information in accordance with Minnesota Rules (4410.0300, 4410.3100, and 4410.7055).

5.1 REASONABLE ALTERNATIVES

According to Minnesota Rules 4410.3900 G, the EIS should compare the potentially significant impacts of the proposed project with those of other reasonable alternatives. The three alternatives analyzed in this EIS include the Base No Action Alternative, the No Action Alternative (with Emergency Measures), and the Northern Alignment Alternative (NAA). Only those alternatives that are considered “reasonable” are included in the Comparison of Alternatives. An alternative is deemed “reasonable” if it meets the project purpose (see also Chapter 1).

> The purpose of the Project is to reduce flood risk, flood damages, and flood protection costs related to flooding in the Fargo-Moorhead (F-M) urban area. To the extent technically and fiscally feasible, the Project will:
>
> 1. Reduce flood risk potential associated with a long history of frequent flooding on local streams including the Red River of the North, Sheyenne, Wild Rice (ND), Maple, Rush and Lower Rush Rivers passing through or into the F-M urban area;
> 2. Qualify substantial portions of the F-M urban area for 100-year flood accreditation (i.e. meets the standard to be shown on a Flood Insurance Rate Maps (FIRMs) as providing protection) by the Federal Emergency Management Agency (FEMA) under the National Flood Insurance Program (NFIP); and
> 3. Reduce flood risk for floods exceeding the 100-year flood or greater, given the importance of the F-M urban area to the region and recent frequencies of potentially catastrophic flood events.

5.1.1 Base No Action Alternative

The Base No Action Alternative includes the potential flood risk reduction impact of already completed and currently funded projects, such as levee construction and property buyouts. Under the Base No Action Alternative, there would be no dams on the Red and Wild Rice Rivers, no Oxbow-Hickson-Bakke (OHB) or Comstock ring levees, no embankments, no diversion channel, and no upstream staging area. Flooding would continue in the Project Area, causing approximately 170,000 acres of inundation and numerous social disruptions.

The Base No Action Alternative does not meet the project purpose because it: 1) doesn't reduce flood risk from the North Dakota tributaries, 2) doesn't qualify substantial portions of the F-M urban area for 100-year flood FEMA accreditation, or 3) doesn't protect from floods greater than the 100-year flood. Therefore, the Base No Action Alternative is not considered a "reasonable" alternative to compare to the Project, and will not be included in the Comparison of Alternatives.

5.1.2 Base No Action Alternative (with Emergency Measures)

The No Action Alternative (with Emergency Measures) includes the potential flood risk reduction impact of already completed and currently funded flood damage reduction projects. This alternative also assumes that emergency measures similar to those that have been historically implemented in the project area would continue to be implemented as necessary due to flooding.

For reasons similar to the Base No Action Alternative, the No Action Alternative (with Emergency Measures) does not meet project purpose; therefore, this alternative is not considered a "reasonable" alternative and will not be included in the Comparison of Alternatives.

5.1.3 Northern Alignment Alternative

The NAA is very similar to the Project. Many potential impacts of the Project also apply to the NAA. One of the primary differences between the two alternatives is the location of impacts in the southern Project Area. The NAA would move the southern earthen embankment system of the Project north approximately 1.5 miles. The remaining project features of the NAA would remain the same as the Project. The NAA consists of a dam and diversion channel system including, but not limited to: an earthen embankment system, excavated channels; a channel inlet control structure; river control structures on the Red and Wild Rice (ND) Rivers; an upstream floodwater staging area (staging area); hydraulic structures on tributaries; levees and floodwalls in the F-M urban area; non-structural features (such as buyout, relocation, or raising individual structures); and recreation features (such as multipurpose trails and pedestrian bridges). The NAA also includes environmental mitigation projects located inside and outside the project area.

The NAA does meet the project purpose; therefore, this alternative is considered a "reasonable" alternative and will be included in the Comparison of Alternatives. Because the Project and NAA impact footprints differ, some studies or investigations providing environmental effects may not have been conducted, or may not have been completed to the same extent as for the Project. Incomplete NAA impact information will be acknowledged within each EIS topic section. If the NAA is pursued beyond the EIS, additional site specific studies would need to be conducted and considered in the final design and construction plans.

Additionally, the design details or construction plans for the structures might need to be modified for reasons such as different topography, soil types, or land use. These potential differences or modifications are not anticipated to be significant; therefore, for the purposes of the EIS, the NAA design features are described as being similar to or the same as the Project.

5.2 COMPARISON OF ALTERNATIVES EVALUATION

The Comparison of Alternatives pulls environmental impact information found in Chapter 3 and consolidates it into the below table (Table 5-1). The intent of this table is to provide a side-by-side summary comparison of potential impacts and to acknowledge possible benefits of alternatives.

The Comparison of Alternatives Table (Table 5-1) consists of 6 columns. From left to right, the column contents are as follows:

1. Topic: All of the topic areas covered in Chapter 3 of this EIS. Under each topic name is the section number of Chapter 3 that can be referenced for more detailed information.
    a. Please note that some topics contain many bulleted items and wrap from one page of the table to the next.
2. Proposed Project: Project impacts (environmental or social) found in Chapter 3. Impacts can be positive or negative, qualitative or quantitative.
3. Northern Alignment Alternative: NAA impacts (environmental or social) found in Chapter 3. Impacts can be positive or negative, qualitative or quantitative. Components of the NAA and the Project that are the same, or similar, should be reviewed in the column for the Project. The NAA column contains only the information that is different from the Project.
4. Comparison: Generally, a statement of “No Difference”, “Same as Proposed Project”, or “Similar to Proposed Project”. If differences exist between Project and NAA, they are outlined. Differences can be positive or negative, qualitative or quantitative.
5. Mitigation: Mitigation or monitoring that is being proposed with the Project. Proposed mitigation for the Project also applies to the NAA. If there are differences in mitigation, they will be outlined in “Comparison” column.
6. Context & Comments: Statements that help to qualify a bulleted item from a preceding column(s), add context to an impact, or draw attention to a particular detail. Context and comments can be positive or negative, qualitative or quantitative.

5.3 USING COMPARISON OF ALTERNATIVES INFORMATION

Unlike Federal Council of Environmental Quality (CEQ) regulations, which require federal agencies to identify an agency-preferred alternative, the State’s statutes have no such requirement. As such, this EIS will not name a “preferred alternative.” Rather, the purpose of environmental review is to provide information to the public and units of government on the environmental impacts of a project before approvals or necessary permits are issued. After projects are completed, unanticipated environmental impacts can be very costly to undo, and environmentally-sensitive areas can be impossible to restore. Environmental review creates the opportunity to anticipate and correct these problems before projects are built (*EQB, 2015)*. While—as stated above—the EIS must be used a guide, the summary information presented in this chapter will add utility to the document as a guide in issuing, amending, and denying permits and carrying out other responsibilities of governmental units to avoid or minimize adverse environmental effects and to restore and enhance environmental quality.

The Comparison of Alternatives Table (Table 5-1) goes further to serve the purposes of *116D.04 Subd. 6* that states (<u>emphasis</u> added):

> *Subd. 6.Prohibitions. No state action significantly affecting the quality of the environment shall be allowed, <u>nor shall any permit for natural resources management and development be granted</u>, where such action or permit has caused or is likely to cause pollution, impairment, or destruction of the air, water, land or other natural resources located within the state,<u> so long as there is a feasible and prudent alternative </u>consistent with the reasonable requirements of the public health, safety, and welfare and the state's paramount concern for the protection of its air, water, land and other natural resources from pollution, impairment, or destruction. Economic considerations alone shall not justify such conduct.*

Permittees can use Table 5-1 to get a general sense of which alternative poses less environmental consequences and greater social/economic benefit. Details of bulleted items in Table 5-1 can be referenced and reviewed in Chapter 3 under the respective topic subsection (Chapter 3 subsections listed under each topic name in the table). When weighing information presented in the Comparison column, economic considerations alone shall not be used a basis to deny or grant a permit. Similarly, environmental impacts should be taken in context when making the judgment of which alternative to permit (see Context & Comments column). When considering permit conditions, permittees should also reference Chapter 6—Mitigation and Monitoring, which identifies additional proposed mitigation measures that could reasonably eliminate or minimize environmental impacts of the Project.

Table 5-5.1. Summary of Environmental and Sociological Effects by Alternative

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
Hydrology (see Section 3.1)	• 118,512.70 total inundated acres in Project Area, 100-year (includes base flooding). • 20,461.30 acres newly inundated in Project Area, 100-year. • 72,923.50 acres protected from inundation in Project Area. • Protected Area: Reduction of flood stage through the main stem of the Red River. Reduction of the extent, depth and duration of flooding. Flood damage reduction on lower Wild Rice River. • Inundation Area: Increase in the extent, depth and duration of flooding; impacts vary based on location. • Diversion of high flows from the Sheyenne and Maple	• Similar to Proposed Project, with the following differences: o 120,089.80 total inundated acres in Project Acres, 100-year (includes base flooding). o 15,744.80 acres newly inundated in Project Area, 100-year. o 66,629.90 acres protected from inundation in Project Area.	• 1,577.10 (1%) fewer total inundation acres in Project Area under Project, 100-year. • 4,716.50 (26%) fewer newly inundated acres in Project Area under NAA, 100-year. • 6,293.60 (9%) fewer acres protected in F-M urban area under NAA, 100-year.	• There are no specific “Hydrology” mitigation measures—proposed mitigation for inundation would be discussed under the resource affected. See other topic areas in this table, as well as Mitigation and Monitoring subsections of Chapter 3 and all of Chapter 6.	• Flood elevations, depths, and duration would differ depending on location (i.e., moving staging area approximately 1.5 miles north minimizes inundation impacts in Richland and Wilkin Counties, but increases inundation impacts between the NAA and Project alignments).

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	Rivers into the Diversion Channel. • Abandoned lower portions of the Rush and Lower Rush Rivers, rerouted into the Diversion Channel.				
FEMA (see Section 3.2)	• Areal extent of flood inundation required for Project operation in the staging area would be mapped as floodway. Any additional flood inundation area beyond the extent of what is required by the project during the 1-percent-annual-chance event will be mapped as floodplain. • A FEMA-approved CLOMR would be required. • After Project completion, a LOMR would be submitted.	• Same as under Proposed Project.	• No Difference.	• The April 2015 FEMA/USACE Coordination Plan (Appendix F) states that all impacted insurable structures within the FEMA revision reach will be mitigated.	• Flood inundation limits, exact structures mitigated and floodway/floodplain limits would differ depending on location (i.e., moving staging area approximately 1.5 miles north minimizes impacts in Richland and Wilkin Counties, but increases impacts between the NAA and Project alignments).
Stream Stability (see Section 3.3)	• Protected Area: limit magnitude of high flow events (>10-year event), altering the	• Similar to Proposed Project.	• No Difference.	• The EIS Draft AMMP (Appendix B) includes monitoring recommendations to	• NAA impacts are shifted 1.5 miles downstream of the Project. • Geomorphology Report

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	natural hydrology of the area. Riparian vegetation would not experience inundation nor significant burial. Trees and shrubs may encroach which may result in less bank slumping. • Inundation Area: direct impact by increased depth and duration of flooding. Increased duration could reduce soil bank strength and be more prone to collapse. Increased sedimentation will occur incrementally over decades. If flood inundation extends into the growing season, plants are likely to be stressed, which could make them susceptible to disease and insect infestations • Rush/Lower Rush Rivers: potential aggradation from			assess potential impacts pre-construction and post-operation. • Rush/Lower Rush Rivers: Abandoned river sections will be maintained by the water resource district. • To counteract the potentially high shear stresses and velocities, energy dissipation technologies would be incorporated into the structure designs. • Drawdown of the inundated area will be controlled to limit impacts to geomorphology.	relies on aerial photo and on-site surveys, so tree composition, root density and root depth could not be verified. Studies will need to be completed to determine role of vegetation and other aspects of bank stability. • Final design details of the dam and the operating plan were not available; therefore, the potential effects of Project on bed and channel scour are not known. • Monitoring the drawdown of the inundated area would be helpful to determine geomorphology impacts.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	sediment in abandoned river sections. • Control Structures: Increases potential for bed and channel scour.				
Wetlands (see Section 3.4)	• 1,820 wetland acres directly impacted from diversion channel, connecting channel, excavated material berms, shallow drainage ditches outside berms, tieback embankments, roads, control structures, hydraulic structures, and OHB Levee (1,820 acres; mostly seasonally flooded basin types, but also includes 62 acres floodplain forest). • Direct Wetland Impact from Comstock Levee (estimated to be less than 5 acres) • Direct wetland impact	• Similar to Proposed Project with the following differences: o Comstock ring levee would not be required. o Indirect and temporary impacts to 148 (estimated) acres in inundated areas.	• Wetlands between the Project and NAA alignments have yet to be field verified, so exact acreages are unknown. • Estimated 8 wetland acres (approximately 5 acres for Comstock levee and 3 acres indirect in inundation area; 0.4%) fewer impacts under NAA.	• Rush/Lower Rush River bisect impacts would be offset by diversion channel design. • A habitat-based wetland replacement approach is proposed (rather than acreage). • The USACE Adaptive Management Plan would include monitoring of impacts and use of financial assurances. • USACE, MNDNR, MPCA and LGUs have jurisdiction over wetland impacts and would approve mitigation for unavoidable wetland impacts. The majority of required coordination has	• About 84% of footprint wetlands are considered to be of low function, including all 8 acres that differ. • Drayton Dam: Most of the wetland areas within the footprint are along the MN bank. • The majority of the mitigation will be in the bottom and side slopes of the diversion channel.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	from Drayton Dam Mitigation Project (0.5 acres) • Indirect and temporary impacts to 151 (estimated) acres in inundated areas. • Indirect impact by changing wetland function/type from Rush/Lower Rush River bisect.			already been accomplished in the FEIS, 404 and Supplemental EA for wetland mitigation. Corps will follow applicable NEPA and CWA 404 rules for any future changes. • MNDNR's AMMP (Appendix B) includes additional wetland mitigation and monitoring recommendations.	
Cold Weather Impacts on Aqueduct Function (see Section 3.5)	• Freezing water could result in negative impacts to fish and other water-dependent resources as a result of temporary blocking of species passage and biotic connectivity. • Ice build-up within an aqueduct could alter channel flows and result in temporary increases in the upstream water levels.	• Same as under Proposed Project.	• No Difference	• Monitoring to assess potential impacts to fish migration on the Maple and Sheyenne Rivers would occur once Project features are in place and the Project is put into operation. An Aquatic Biological Monitoring Team in coordination with the Adaptive Management and Monitoring Team would collaborate on how best to identify and define fish passage	• If the aqueduct freezes, it is likely the natural channel will also freeze. • Maple River Aqueduct: The USACE Engineer Research and Development Center (ERDC) Cold Regions Research and Engineering Laboratory (CRREL) completed a report, which included the analysis of different operating scenarios and applying predicted results from computer modeling and analysis. • Post-construction and

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
				effectiveness. • Impacts to aquatic habitat on the Maple and Sheyenne Rivers would be verified through the comparison of IBI scores developed before and after construction.	Project operation monitoring efforts would be a key component in determining aqueduct impacts to the riverine systems and any adaptive management response.
Cover Types (see Section 3.6)	• Primary cover type impacts would occur to croplands and wetlands. • Permanent direct impacts under the footprint of the diversion channel, tieback embankments, and the Comstock and OHB levees. • Permanent direct impact from construction of the diversion channel would convert approximately 4,500 acres of cropland to grassland and wetland. • Indirect impacts from	• Similar to Proposed Project with the following differences: o The overall cover type acreage and location. o Comstock ring levee not needed; therefore direct impacts from a ring levee will not occur.	• Cover Types between the Project and NAA alignments have yet to be field verified, so exact acreages are unknown. • Less direct construction impact under NAA without Comstock ring levee.	• Cropland impacts would be mitigated by compensation to landowners such as land purchase and flowage easements. • Direct impacts to floodplain forest would be mitigated at a 2:1 ratio. • Type 1 wetlands (farmed) would be mitigated by creation of wetlands in the diversion channel on the bottom and side slopes.	• Row cropping will not be allowed on exterior embankments, but cutting/bailing of established grasses is possible (permanent vegetation cover and associated roots are critical to soil strength and overall structural integrity). • The floodplain forest is the only natural forest habitat in the Project area, with impacts totaling approximately 62 acres (46% of all floodplain forest wetland acres in Project Area).

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	inundation during flood events but would not cause a permanent conversion of existing cover types. • Project operation would result in approximately 18,630 acres of indirect cropland impacts in the inundation area during the 100-year flood event. • Grassland would increase between 3,900 and 4,600 acres as a result of Project construction. • Type 1 Wetlands (farmed) would be the primary wetland cover type impacted in the Project footprint, with impacts totaling approximately 1,200 acres. • Project operation would result in approximately 112 acres of indirect				

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	impacts to wooded/forest cover type in the inundation area during the 100-year flood event. • 70 acres of Wooded/Forest cover type (including shelterbelts and windbreaks) would be converted to grassland or wetland cover in the diversion channel. • Lawn/Landscaping impacts would occur primarily around urban or residential areas, where natural cover has already been converted to human uses. Less than 100 acres of this cover type would be converted to grassland or wetland cover in the diversion channel.				

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
Potential Environmental Hazards Due to Past Site Use (see Section 3.7)	• Direct impact from construction to parcels with recognized environmental conditions (RECs). • Operation has potential to periodically spread contaminants in inundated areas where ESAs have not been conducted.	• Similar to Proposed Project.	• No Difference.	• Once specific properties in the inundated areas are identified for acquisition, additional assessments, such as a Phase I ESA or subsequent Phase II ESA, would be conducted to provide details on the extent of potential contamination and specific removal and remediation measures that may be required to avoid impacts.	• None
Fish Passage and Mortality (see Section 3.8)	• Direct Impact on Red River: 1.0 miles, 17 acres. • Direct loss of river channel to Rush and Lower Rush Rivers: 2.3 and 2.7 miles, respectively. • Direct Impact on Wild Rice River: 0.9 miles, 12 acres. • Direct Impact on Sheyenne River: 0.9 miles, 8.4 acres. • Direct Impact on Maple River: 1.1	• Similar to Proposed Project.	• Similar impacts, but NAA may have slightly less fish passage impacts on Wolverton Creek and slightly more impacts on Wild Rice River. By shifting project 1.5 miles north, NAA would have slightly less impact to aquatic habitat on Wolverton Creek.	• Aquatic Habitat: macroinvertebrates expected to repopulate once habitat is reestablished. • Fish Passage: Multiple design elements would be required to ensure fish passage (e.g., natural roughness elements). Diversion outlet structure, Rush River structure, and diversion channel between these structures will allow fish	• Existing habitat for all streams in Project Area is rated as moderate to poor quality. • Impacts are dependent on Project operation, weather, final design of structures, and timing of operation with fish movement. • Fish Passage: NAA is located further away from the confluence of Wolverton Creek and Red River and closer to confluence of Wild Rice and Red Rivers, which could lower velocities on

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	miles, 11 acres. • Potential Aquatic Habitat Impacts: direct mortality to macroinvertebrate and fish from crushing and excavation; temporary fish relocation during project construction. Project operation could change pools, sedimentation, depths and velocities. • Fish Passage/Migration Impacts: Project would produce impassable conditions (flow velocities) on Red and Wild Rice Rivers for fish during operation, potentially impacting migrations of walleye, northern pike, and redhorse/white sucker; and access to Wolverton Creek. Abandonment of Rush/Lower Rush Rivers could impact			passage from the Red River to the Rush River. Design of all other structures is not final. • Fish Stranding: Operation would allow Diversion Channel flow to gradually decrease. Monitoring would need to occur. • Mitigation would include reconstruction of the Drayton Dam to include fish passage, removal of the Wild Rice River Dam and stream restoration projects, and meandering low flow channel in the Diversion Channel. • Proper design would eliminate the freezing aqueduct concern.	Red River and Wolverton during drawdown providing better fish passage. • Fish Stranding: This process naturally occurs during flood events. Dependent upon timing of receding water. • Aquatic Habitat: Impacts have potential to extend beyond the construction footprint.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	fish migration from Red/Sheyenne Rivers. Cold weather could freeze the river channel within the aqueduct. • Fish Stranding: If water recedes too quickly, fish may become stranded in pools and die.				
Wildlife Resources (see Section 3.9)	• Direct impacts during construction include potential for direct mortality, displacement or increased exposure of less mobile species (i.e., small mammals, amphibians, reptiles, ground-nesting birds, including some migratory birds) to predators. • Temporary impacts would primarily include displacement due to human presence, increased noise and visual disturbances related to construction.	• Same as under the Proposed Project. • Specific habitat acreages could vary, floodplain forest, wetlands, aquatic habitat and other cover types in the NAA embankment and control structure areas have not been surveyed, and therefore, exact acreages are unknown.	• No Difference.	• As outlined in the USACE Adaptive Management Plan, construction-related impacts would be mitigated by replacement of habitat in disturbed areas or at mitigation locations near the project area. • All direct impacts to the floodplain forest would be mitigated at a 2:1 ratio in farmed wetlands along the Red River. • All non-cropped upland habitat would be replanted with native species, particularly native grasses that are	• Sedimentation would occur incrementally over several decades, allowing vegetation communities to adapt in these conditions. • For floodplain forests, sites that are likely to be successful for restoration would be historic floodplains along rivers that are currently utilized for intensive agriculture. • Once construction and mitigation are completed, the proposed diversion channel has the potential to provide positive impacts by creating a potential new wildlife corridor and habitat in currently agricultural fields.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	• The impacts to floodplain forest would have the longest potential temporal loss of habitat function as the loss of habitat would be immediate. • 8-25 acres of stream channel habitat impacts. • Direct loss of stream channel aquatic habitat from abandonment of Rush/ Lower Rush Rivers. • Impacts to riparian vegetation during construction may also cause stream bank destabilization. • Displacement and mortality may also occur to wildlife using the diversion channel due to a sudden flow of water. • Wildlife migrate between habitat areas for foraging and cover in the region,			anticipated to have positive impacts on overall habitat value. • To minimize the potential for destabilization or bank erosion, control structures would be constructed in adjacent upland habitats to minimize the work within the active river channels.	

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	meaning impacts to wildlife species and populations can occur indirectly due to impacts to habitat.				
State-listed Species and Special Status Species (see Section 3.10)	• Lake Sturgeon: o Construction would temporarily displace lake sturgeon. o 49 acres of potential aquatic habitat distributed among the Red, Wild Rice, Sheyenne, and Maple Rivers. o Project operation could limit migration. • Black Sandshell: Direct impact from construction. Indirect impacts from increased sedimentation.	• Same as under Proposed Project.	• No Difference.	• Mitigation and monitoring effectiveness depend on commitments in USACE AMP.	• Impacts to migration would depend on timing of migration (beginning, middle, end), timing of project operation, and frequency of project operation.
Invasive Species (see Section 3.11)	• Construction has the potential to spread aquatic and terrestrial invasive species. Operating the staging area has the potential	• Same as under Proposed Project.	• No Difference.	• Mitigation would help but can be expensive and ineffective once large populations establish.	• Since most natural plant communities are limited to riparian areas in the project area, noxious weed spread into these areas is of particular concern for the

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	to spread terrestrial invasive species and noxious weeds into areas not previously exposed. • Direct impacts to natural vegetation, such as clearing or excavating, could result in noxious weeds spreading areas not previously exposed.				Project. • Noxious weed spread can increase herbicide use.
Cultural Resources (see Section 3.12)	• Channel: Direct impact to 3 NRHP-listed properties, 1 NRHP-eligible site and 4 properties with undetermined NRHP eligibility.[i] • Staging Area: 8 undetermined NRHP-eligible sites[i], 2 NRHP-listed sites, 8 recommended NRHP eligible. • In-town levees: Minor visual impacts. • Cemeteries: Protected Area--20 cemeteries removed from current flooding.	• Similar to Proposed Project, with the following differences: o Construction Footprint and Staging Area: 17 undetermined NRHP-eligible sites, 3 NRHP-eligible sites, 9 NRHP-recommended eligible site, and 1 sites listed as NRHP-undetermined eligibility.[i] o Cemeteries: Protected Area—19 cemeteries removed from current flooding. Upstream Inundation Area--10	• Full comparison cannot be made due to incomplete information. There are several areas within the NAA APE that have not had cultural resource surveys completed, so surveys would need to be conducted to fully compare NAA impacts. • Known impacts include: o Under NAA, potential impacts to 3 additional NRHP-eligible sites, 1 NRHP-recommended eligible site, and 1 site listed as NRHP-undetermined eligibility.[i] o 2 less NRHP-listed sites	Amendment No. 1 to the Programmatic Agreement added "project-related environmental mitigation areas" to the Project's area of potential effect to which the Programmatic Agreement applies. Cultural mitigation would occur at NRHP-eligible/listed properties/sites in these mitigation areas as per Programmatic Agreement.	• Full comparison cannot be made due to incomplete information. There are several areas within the NAA APE that have not had cultural resource surveys completed, so surveys would need to be conducted to fully compare NAA impacts.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	Upstream Inundation Area—12 cemeteries with varying level of impact.	cemeteries with varying level of impact.	impacted under NAA. o 2 less cemeteries impacted under NAA.		
Infrastructure and Public Services (see Section 3.13)	• Impacts to infrastructure include severed roadways by the diversion channel, roadway alterations, reconstruction, and rerouting, and raised roadways to higher elevations to provide access during flooding, as well as potential detours and rerouting of existing service routes. • The Transportation Plans indicate the Project would primarily impact township roads, county roads, state highways and interstates and their respective bridges. • The North Dakota Overflow Embankment would impact four roads.	• Similar to Proposed Project, with the following differences: o Comstock is not anticipated to have significant new inundation; therefore a ring levee would not be needed; however, wastewater treatment lagoons would need modification. o Specific road crossings, embankment crossings and road grade raises would be determined during the NAA design phase.	• No Difference.	• Bridges would be constructed approximately every three miles to cross the diversion channel. Grade raises would also maintain connectivity across embankments and the diversion channel. • Connections to re-establish accessibility of affected parcels are recommended by the North Transportation Plan. The South Transportation Plan recommends parcels affected by the Proposed Project be purchased or new roadways constructed on a case-by-case basis. • All utilities that would be severed by construction of the Project would be	• Roadways requiring improvements to maintain connectivity include, but are not limited to, 29, 81, 94, 52, 75, 10. • Improvements and/or modifications to the rail lines were not evaluated in the Transportation Plans. Any improvements/modifications would be coordinated with BNSF and the Red River Valley & Western Railroad. • The proposed road configurations and bridge locations were determined to not significantly affect emergency response times.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	• The tieback embankment in Minnesota would impact five roads. • Construction of in-town levees and floodwalls would require utilities to be relocated such as energy, water and communication utilities. • Traffic patterns, primarily within the staging area, would permanently change. • Known utilities located in the inundation area include, but are not limited to, electric power lines and rural water supply facilities. • Interstate 29 and U.S. Highway 75 would be elevated to maintain traffic routes during high flows while in operation. The BNSF railroad would also be raised to a higher elevation. All other			relocated prior to construction to reconnect affected parcels.	

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	roadways in the inundation areas would be allowed to flood. • OHB Levee construction would impact Cass County Highway 81, Cass County road 18, and Cass County Highway 25. • Comstock Levee would require Clay County Highway 2 to be raised to a higher elevation.				
Land Use Plans and Regulations (see Section 3.14)	• Under Project conditions, upstream flooding would discourage development in inundated areas. • The Project may not be consistent with Comprehensive Plan goals to facilitate traffic movement for the Townships of Mapleton, Pleasant or Warren. • The Project may not	• Similar to Proposed Project, with the following differences: • Environmental Land Use: Keeps 1.5 mile of current floodplain active. • Connecting channel would be located in Stanley Township, Cass County, instead of Pleasant Township, Cass County.	• Less environmental land use (floodplain) impacts under NAA. The total floodplain acreage between NAA and Project alignments is 7,604.90. Under NAA, less developable land south of Fargo. • Under NAA, less land use and regulation impacts to Richland and Wilkin Counties, but more impact to Cass and Clay Counties.	• MPCA's WRAPS would be considered during Project review and permitting process. • Minnesota Ditch Law (103E) would be considered after Project operation can be monitored and quantified.	• Comstock is not anticipated to have significant new inundation; therefore a ring levee may not be needed. • The 1.5 mile of floodplain between Project and NAA alignments will be active floodplain up to a 10-year event with either alternative. For the NAA, this 1.5 mile stretch, during project operation, won't be a natural floodplain since it will experience additional depth/duration inundation

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	be consistent with Pleasant Township's zoning ordinance to "protect public health, safety, morals, comfort, convenience, prosperity and general welfare." • The Project may not be consistent with Holy Cross Township's interim ordinance establishing a moratorium on water impoundment projects. • Project construction and operation may require various LGU approvals, Conditional Use Permits, review of floodplain maps, and zoning amendments.				from project operation, but it will still have floodplain benefits above the Project. The 1.5 area between the NAA and Project area alignments represents approximately 5% of the existing floodplain within the project area.
Dam Safety (see Section 3.15)	• Dam Safety permit required.	• Same as under Proposed Project.	• No Difference.	• N/A	• None.
Socioeconomics (see Section 3.16)	• Estimated cost $1.789 billion. • 828 Damaged Structures, 100-year: 511 (62%) in ND and 317 (38%) in MN.	• Similar to Proposed Project impacts, with the following differences: • Estimated Cost $1.87 billion.	• Construction cost $81 million less under Project. 274 (214 non-residential and 60 residential) fewer structures impacted by flooding under Project	• USACE/FEMA Coordination Plan states that all impacted insurable structures in FEMA revision reach will be mitigated.	• Cost alone is not sufficient cause to dismiss an alternative in State environmental review. • Comstock ring levee could allow for relocations of

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	• 230 parcels impacted, 100-year: 163 (71%) in ND and 67 (19%) in MN. • Estimated average annual damage: $9 million—reduction over Base No Action in ND and MN (84% and 38%, respectively). • Estimated Cost of Land Acquisition and Damages: $265,022,680. • Average annual relocation costs to ND and MN are $8 and $1 million, respectively. • Flood insurance costs reduced in F-M urban area. • Social disruptions in the upstream inundation area. • Potentially reduced tax revenue, student populations and property tax base in upstream inundation areas. • Buyouts, relocations	• 1,102 Damaged Structures, 100-year: 725 (65%) in ND and 377 (35%) in MN. • 305 parcels impacted, 100-year: 220 (72%) in ND and 85 (18%) in MN. • Estimated Cost of Land Acquisition and Damages: $333,781,295. • Average annual relocation costs to ND and MN are $9 and $1 million, respectively. Comstock would not need a ring levee; but would require sewage lagoon protection. • CR 16 impacted under NAA.	conditions, 100-year event. • 65 fewer parcels impacted by flooding under Project conditions, 100-year event. • Higher cost of land acquisition and damages (approximately $68 million) under NAA. • Approximately $1 million higher average annual relocation costs to ND under NAA. • Estimated cost of land acquisition and damages is $68,758,615 less under Project. • Loss of building function and average annual relocation costs $1 million less under Project. • Approximately 1,000 less acres of new inundation to organic farms under NAA. • 2 less (50%) organic farms affected under NAA. • CR 16 impacted under NAA and not under Project.	• Impacted property owners will be compensated for loss of property value via easements. • Residential structure mitigation options include elevation, relocation, buy-outs and ring levees. • Non-residential structure mitigation options include dry flood proofing, elevation, relocation, buy-outs and ring levees. • MN State Law (6120.5700 subpart 4a) requires mitigation for all impacts over 0.00'. • Well and septic system impacts would be mitigated by abandonment or modification. • Livestock feed impacts would be minimized by relocations. • Agricultural and organic farm mitigation options include flowage	displaced residences, which could increase the tax base for the City and the school district • If flooding occurs prior to the growing season there may not be impacts to agricultural properties. • Fargo and Moorhead share economic vitality. • All 4 organic farms in the Project area are located in MN. • Comstock may not need ring levee; therefore, residents would not have as high of potential for stress, loss of economic vitality, or restricted future development. Comstock population has been on the decline since 1930.

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	and non-structural measures could cause stress for those residents. • Property owners in inundated areas could experience loss of income and property value. • Temporary construction disruptions for residents behind community ring levees (e.g., OHB Levee). • Indirect impact to residents regarding perception of living behind a community levee. • Due to the additional flood risk of the Project, Comstock residents would be expected to experience higher levels of stress and anxiety than they do under the baseline condition. • Flooding could reduce			easements, voluntary land acquisitions, and supplemental crop insurance.	

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	the economic vitality of Comstock as businesses might relocate to other areas not prone to flooding. • The Comstock ring levee may restrict future development due to the increased flood risk in and around the area. Fiscal requirements and resources of school districts would be both positively and negatively affected by the Project. • Construction and operation could impact drinking water wells. • Construction and operation could impact newly inundated septic systems with a modification cost of $15-20,000 (residential). • Construction of new				

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	farm buildings in revision reach would be limited. • Existing farm buildings in staging area and revision reach would not be compatible with flooding. • Potential for grain and livestock feed spoilage in inundated areas. • Approximately 2,200 acres of new inundation to organic farms (between 4 organic farms; about 50% overall organic farm land) impacted by Project. • Construction and operation would reduce stress and threats to life/safety associated with flood fighting in protected and mitigated areas. • MN is affected socially and economically by flooding in Fargo (loss of employment or income).				

Topic	Proposed Project	Northern Alignment Alternative	Comparisons (Project and NAA)	Mitigation	Context & Comments
	• Operation and maintenance of the Project is expected to provide employment opportunities.				

6.0 Effectiveness of Proposed Mitigation Measures

Minnesota Rules 4410.2300 states that the EIS should include mitigation measures that could reasonably eliminate or minimize any adverse environmental, economic, employment, or sociological effects of the project. Chapter 6 provides an overview of Project mitigation and monitoring plans, including the types of mitigation proposed and regulatory considerations. For the purposes of this section the term "mitigation" refers to provisions to compensate for the detrimental aspects of change. The MNDNR evaluated the proposed mitigation and monitoring to assess potential effectiveness, and provides conclusions, recommendations, and identification of additional mitigation to further avoid, minimize, and/or compensate for Project impacts. Table 6.1 can be used as a guide for permitters when evaluating permit conditions.

In some cases, there is not complete agreement on whether or not mitigation is needed or if proposed mitigation is suitable. In those instances, the USACE has proposed the use of adaptive management to address the potential uncertainty of environmental effect. Adaptive management is proposed as a way to monitor impacts and mitigation, evaluate outcomes, and adjust implementation of mitigation measures if necessary to avoid, minimize, and/or compensate for Project impacts. The concept of adaptive management is a component in the majority of the proposed mitigation and monitoring measures proposed for the Project.

A Draft Adaptive Management and Monitoring Plan (Appendix B) was developed for this EIS as a collaborative effort between state and federal agencies, the Diversion Authority, and agency and organization representatives (consultants). The Draft AMMP is based from the Monitoring plans and potential mitigation measures for the Project that was identified in Attachment 6 of the FFREIS. This Chapter's adaptive management discussions, as well as the monitoring plans, will be revised as new information becomes available pertaining to Project design and/or Project operation; plan details, participants, funding or schedule refinement; as field data is collected and analyzed; or as necessary for permits by regulatory authorities.

6.1 INTRODUCTION

Mitigation, monitoring, and adaptive management would be implemented for the Project through a collaborative effort initially led by the USACE. Regulations governing the USACE require projects to take an adaptive management approach to implement monitoring and modify mitigation (USACE Implementation Guidance for Section 2036a of WRDA 2007, August 2009). The guidance requires mitigation plans to include the following:

1. Monitoring of the mitigation until successful;
2. Criteria for determining ecological success;
3. Description of available lands and the basis for the determination of availability;
4. Development of contingency plans (i.e., adaptive management);
5. Identification of the entity responsible for monitoring; and

6. Establishing a consultation process with appropriate federal and state agencies in determining the success of mitigation.

The mitigation and adaptive management approach includes four main components: impacts requiring mitigation in terms of lost habitat quality and quantity; recommended mitigation measures for each resource category; adaptive management to further evaluate potential impacts over time; and mitigation effectiveness. A key component to implement the proposed mitigation and monitoring measures is an adaptive management plan and adaptive management team.

Mitigation, monitoring, and adaptive management plans were initially developed as part of the FFREIS and provided a starting point for subsequent plan development as part of the state EIS analysis. Mitigation and monitoring measures were also suggested during the public comment period for the SEAW. These suggestions were evaluated against exclusionary criteria in Minnesota Rules 4410.2300(G) to determine what measures should be carried forward into the EIS for analysis. The potential mitigation and monitoring measures carried forward into the EIS are (FSDD 2014):

- Monitoring drawdown of the diversion channel to prevent fish stranding in the channel;
- Monitoring drawdown in the inundation area to prevent fish stranding in the floodplain upstream of the tieback embankment;
- Identification of monitoring and mitigation strategies for invasive species that can be incorporated into the Project operating plan;
- Monitoring of potential impacts of low-flow and no-flow conditions in the aqueducts on the Maple and Sheyenne Rivers using existing IBIs to inform future monitoring and mitigation efforts; and
- Assessment of the need for groundwater monitoring as part of the adaptive management plan.

Mitigation and monitoring measures identified through public comments have been incorporated into the EIS analysis, where appropriate, in Chapter 3 and in the subsections that follow in this chapter.

6.1.1 Types of Mitigation

There are several types of mitigation associated with the Project: adaptive management, mitigation for structure impacts (i.e., FEMA), and mitigation associated with land use or impacts to agricultural land from flood inundation (outside of FEMA requirements). The following provides discussion on each of the main types of mitigation. Adaptive management would be applied to the majority of the natural resource-related impacts, such as wetlands, fish and aquatic biota, and geomorphology. Structure mitigation would be required for existing insurable structures that would experience an increase in flood stage. Other mitigation measures associated with land use would be used as applicable to the potential impact.

6.1.1.1 Adaptive Management

Adaptive management is a process wherein management actions can be changed in response to a monitored response. Adaptive management is a “learning by doing” management approach which promotes flexible decision-making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood (National Academy of Sciences 2004). It is used to address the uncertainties often associated with complex, large-scale projects. In adaptive management, a structured process is used so that the “learning by doing” is not simply a “trial and error” process (Walters, 1986). The basic elements of an adaptive management process are: assess; design; implement; monitor; evaluate; and adjust.

For the Project, adaptive management includes three primary components: 1) evaluation of predicted environmental impacts, 2) assessment of the effectiveness of the mitigation features, and 3) modification of the Project as needed and feasible to ensure the level of environmental effects predicted in the EIS show no appreciable change to what has developed. There are goals for the adaptive management program for each of those components.

Evaluation of predicted environmental impacts.

1. Assess the accuracy of impact predictions by comparing impact predictions to observed physical parameters.
2. Improve the capability of the models used to identify and quantify project-induced impacts.

Assessment of the effectiveness of the mitigation features.

1. Determine if the mitigation projects are meeting pre-determined physical parameters (i.e., mitigation performance measures).
2. Determine the system's biological responses to parameters. The predictions will be compared to monitoring results to evaluate the overall effectiveness and ultimately the need for additional response actions.

Modification of Project mitigation.

1. Identify response actions – that if implemented – would keep the levels of observed environmental effects of the Project within the predicted or acceptable limits of change.
    a. The response actions could occur any time during the post-construction monitoring phase.
    b. Monitoring would continue for a period necessary to evaluate the effectiveness of the mitigation feature that was changed or mitigation that was added.
    c. In the case of Project operation modifications, it may be necessary to reevaluate existing models and flood event response and planning.

Adaptive management would be used for the majority proposed and recommended mitigation measures identified in the EIS. The majority of these measures relate to wetlands, fish, wildlife, wildlife habitat, cover types, and stream stability. Adaptive management would be considered during the permitting process for the Project and may be a condition of permits.

The following provides a discussion on the proposed USACE adaptive management concept and the EIS adaptive management and monitoring plan.

<u>USACE Adaptive Management</u>

The USACE proposed the use of adaptive management for Project impacts, including monitoring plans and mitigation measures, in Attachment 6 of the FFREIS. An Adaptive Management Plan (AMP) is proposed to implement effective adaptive management, which would utilize an Adaptive Management Team (AMT), establish goals and performance standards, develop and implement monitoring plans, and make future project modifications.

Establish an Adaptive Management Team

An AMT would provide support to the Project in meeting its goals and objectives through the application of a systemic approach to evaluating Project impacts, mitigation, and mitigation effectiveness. The USACE recommends the AMT consist of a multi-agency (State and Federal) staff from the appropriate disciplines, including engineering, planning, environmental science and resource management. The non-Federal sponsors would participate directly on the AMT and serve as the AMT leaders. The exact members of the AMT would be determined during development of detailed Project plans, but would likely include: USACE, non-Federal sponsors, U.S. Fish and Wildlife Service (USFWS), Environmental Protection Agency (USEPA), Natural Resource Conservation Service (NRCS), North Dakota Game and Fish (NDGF), North Dakota Department of Health (NDDH), North Dakota State Water Commission, Minnesota Department of Natural Resources (MNDNR) and Minnesota Pollution Control Agency (MPCA). The AMT would oversee the decision-making processes to plan, evaluate, and change Project features and mitigation.

Establish Goals, Objectives and Performance Standards Metrics

Performance metrics would be used during two adaptive management processes: 1) plan evaluation; and 2) assessment of plan performance. This includes metrics for quantifying impacts following Project construction and how mitigation effectiveness would be measured. These standards/metrics would be fully developed based on input from the AMT during future planning for monitoring and evaluation. At a minimum, the goal of mitigation would be to replace the habitat value lost through Project impacts. Performance standards/metrics would be developed in plan evaluation and evaluated regularly to ensure mitigation effectiveness.

Develop and Implement Monitoring Plans

Monitoring plans would include both pre and post-construction studies of biota and physical habitat. These studies are scheduled for impact and mitigation sites, allowing impacts to be verified, and for mitigation effectiveness to be evaluated. An essential element of adaptive management is the development and execution of a scientifically-rigorous monitoring and assessment program to analyze and understand system response to Project implementation. It is recognized that Project level monitoring would be limited by cost and duration based on current regulations and that Project level adaptive management plans would need to be designed to reflect this constraint.

Pre-construction monitoring efforts would be led by the USACE and the non-Federal sponsors. Following construction, monitoring and adaptive management would be the responsibility of the non-Federal sponsors with all monitoring done collaboratively with the AMT. Pre-construction monitoring data would provide the initial baseline, while post-Project construction monitoring data would identify any additional impacts requiring mitigation and mitigation effectiveness.

Future Project Modification

There are a number of uncertainties associated with identifying potential impacts and the effectiveness of mitigation. Some of these uncertainties include relying on scientific judgment to quantify potential benefits of mitigation, the need for pre- and post-monitoring to assess impacts and benefits of mitigation, and ongoing development of Project operational plans. Uncertainty associated with both the level and type of impacts and the effectiveness of mitigation would be addressed as part of the AMP. An accounting spreadsheet has been proposed by the USACE to tabulate the Project impacts, specific mitigation projects, timing, and expected benefits of these mitigation projects. Due to uncertainties, the accounting spreadsheet would be updated regularly to maintain an accurate account of Project conditions.

Future monitoring would verify the impact conclusions reached during environmental review of the Project and evaluate the effectiveness of mitigation. Monitoring activities, including review of results, would be performed collaboratively among the non-Federal sponsors, USACE, and the AMT partners. If future impacts are identified that were not mitigated for, or if mitigation has proven ineffective, the non-Federal sponsors would work with the USACE and the partner agencies to identify what can be done to rectify remaining issues. (MFR Aug. 2012)

Additional mitigation actions would be coordinated with appropriate USACE technical groups, through the Project Delivery Team, district quality control, agency technical review, and Independent External Peer Review (if needed), as outlined in the Mitigation Management Plan for each mitigation project. Mitigation actions would be coordinated with the sponsors. Adjustments to the proposed mitigation program outlined in the MFR (August 2012) are expected, and would be made as needed to mitigate for Project impacts. (MFR Aug. 2012)

EIS Adaptive Management and Monitoring

Since the FFREIS, the USACE and Diversion Authority have continued working with the MNDNR as well as other agencies and local governments on developing and revising monitoring approaches outlined in FFREIS Attachment 6. During this EIS process, MNDNR, in collaboration with agencies and local governments including the USACE and Diversion Authority, drafted an AMMP to further define the USACE AMP concept and mitigation and monitoring measures prior to Project construction, including establishment of inter-agency teams (Appendix B).

The Draft AMMP builds upon FFREIS Attachment 6 proposed survey monitoring plan, ongoing communications, and studies completed to date, and therefore, is similar to the USACE AMP. It takes the USACE AMP concept a step further toward implementation, including more detailed monitoring plans and identification of performance standards. The purpose of the Draft AMMP is to provide a framework for evaluating accuracy of predicted environmental impacts, assessing the effectiveness of the mitigation features, determining response actions if necessary, and modifying the Project as needed to ensure the levels of environmental effects observed post-Project operation are acceptable compared to predicted environmental impacts or mitigation performance criteria. Pre- and post-construction monitoring is included in the Draft AMMP along with performance criteria and recommended response actions where feasible.

Although the Draft AMMP was a collaborative agency and local government effort, the Draft AMMP was prepared for use in this EIS, and therefore, also includes MNDNR recommendations for the adaptive management approach, specific protocol, and additional studies different to or above that which the USACE and Diversion Authority have proposed. The USACE AMP and the Draft AMMP will continue to be revised through ongoing cooperation efforts, as pre-construction and operation monitoring results are assessed, Project designs are finalized, and as Project permitting requires. (It has yet to be determined if the USACE would fully adopt the Draft AMMP as it is presented in the EIS. A version of an AMP would continue to be revised by the USACE. The MNDNR may also require an updated version of the AMMP as a permit requirement. Ongoing coordination is necessary for efficiency and to meet Project needs).The Draft AMMP is provided in Appendix B and should be referenced for additional details.

Contingency Mitigation Funding

Federal Project funding would be provided through construction and until the Project is turned over to the non-Federal sponsors, a length of time that has not yet been determined. Thus, funding would be provided for construction of planned mitigation projects, and potentially some of the initial post-project monitoring. Additional (future) mitigation needs may require funding that has not yet been procured or authorized (i.e., contingency mitigation funding). The Project as proposed would require Minnesota permits, such as the Dam Safety and Public Waters Work permit; one of the many regulatory requirements may be the inclusion of provisions to compensate for the detrimental aspects of change (i.e., mitigation). Likewise, if mitigation needs are unknown at the time of application or it is determined that there is a potential for additional (future) mitigation needs, a permit may include a condition assuring that mitigation needs will be met or some other form of financial assurance, for example. At the time of this EIS publication, permit applications have not been submitted to the MNDNR. Permit application requirements and processes would be completed as per Minnesota Rules (see Chapter 2 and Chapter 3 for specific permits and information) and would consider information that has been collected for this EIS. Actual permit conditions would be determined through the permitting process. Below are possible options for providing assurance for contingency mitigation that could be considered by the non-Federal sponsors.

- The non-Federal sponsors could pass a resolution stating that they agree to fund contingency mitigation actions identified by monitoring and list how those actions would be paid for (details and feasibility of this option have not been fully explored at this time).

- Contingency mitigation funding could be through the planned Project Operations and Management fund. Funding for Project operation and maintenance is the responsibility of the non-Federal sponsors. Local tax revenue is the currently planned fund source for operation and maintenance expenditures. A portion of tax revenues received for operation and maintenance could be placed in a special fund established for unforeseen expenses, such as additional mitigation needs. Details and feasibility of this option have not been fully explored at this time.

- Non-Federal sponsors could collaborate with the Adaptive Management and Monitoring Team (AMMPT) (synonymous with the USACE's AMT except as defined in the Draft AMMP) and other appropriate local, state and federal agency representatives to identify the appropriate funding source. This could include the use of local or State funds to address remaining mitigation needs. The non-Federal sponsors could also coordinate with USACE for possible funding under the USACE's Continuing Authorities Program (CAP) or coordinate with their congressional leaders for authorization and appropriation of additional funds to address contingency mitigation.

6.1.1.2 Structure Mitigation

Flood inundation of structures resulting from the Project would require mitigation. Mitigation measures for residential lands are dependent upon the depth of flooding and location of structures (within or outside of the FEMA revision reach) and are summarized in Section 3.2 - FEMA Regulations and the CLOMR Process and within Section 3.16.3 – Socioeconomics.

FEMA would require mitigation for all impacted insurable structures within the FEMA revision reach which is defined by the Red River profile and limited to where the Project will alter the river profile flood elevation by more than 0.5 feet. This includes areas outside of the USACE defined staging area. Mitigation would follow agreed upon methods consistent with those specified by the National Flood Insurance Program (NFIP).

These guides are subject to further evaluation in future versions as the Project is finalized. In accordance with the NFIP, mitigation would be required for structures that are subject to increases in base flood elevation (BFE) greater than the tolerances set in the 44 CFR 60.3(d). As part of the CLOMR process, a list of properties that would be mitigated before project completion can be identified. Identified mitigations can be delayed until the Project affects the property flood risk. Structure mitigation could include relocation, buy-outs, elevation, ring levees, and dry proofing.

Additionally, 44 CFR Section 65.12 requires communities to apply to FEMA for conditional approval (see 44 CFR Part 72 of the NFIP regulations) of actions, which would cause increases in BFEs in excess of the limits, prior to permitting the encroachments to occur, and must:

- complete a request using the MT-2 application forms,
- provide an evaluation of alternatives,
- document individual legal notice to impacted property owners,
- obtain concurrence of CEOs of communities impacted by the proposed actions, and
- provide a certification that no structures are impacted by increased BFEs or a description of the proposed mitigation measures for all impacted structures.

Compliance with Minnesota mitigation will be required for all inundation areas in Minnesota Administrative Rules 6120.5700. This may require mitigation outside of the CLOMR revision reach but within the newly designated floodplain.

6.1.1.3 Other Mitigation

There are a number of mitigation measures that would be used for impacts to land from construction and operation of the Project as discussed throughout this Chapter.

The acquisition of flowage easements would be a primary mitigation used for lands inundated within the staging area and FEMA revision reach. This would apply to agricultural properties as well as undeveloped land. Flowage easements would provide the legal ability to inundate the property to operate the project. Easements would include a one-time payment to the property owner at the time the easement is obtained. The value would be determined on an individual property basis by independent appraisal. The value may consider factors such as depth, duration, frequency of additional flooding, and highest and best use of property. It may also consider future impacts from delayed planting, yield loss, debris, and limitations to future land use. Flowage easements may be acquired for those properties affected by Project operations outside of the staging area and FEMA revision reach. The determination would be based on the findings of a takings analysis to determine if the impact rose to the level of a taking under the Fifth Amendment of the U.S. Constitution and if so, the landowner would be appropriately compensated.

Property acquisitions would primarily be governed under Public Law 91-646, the “Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970” (Uniform Act) and grants protections and assistance for those affected by federally funded projects. This would apply to all necessary property acquisitions.

Mitigation is proposed for infrastructure impacted by the Project including: roads, bridges, and other infrastructure. Mitigation would occur by reconstruction and/or other improvements due to impacts from construction of the diversion channel and flood inundation. Mitigation could occur through constructing bridges, relocating roadways, terminating roadways, improving roadways, modifying railroads, and relocating utilities. This mitigation would be completed as part of Project construction.

6.1.2 Regulatory Considerations

For all mitigation measures, local, state, and federal rules need to be considered. Mitigation measures may require government approval prior to implementation. In accordance with Minnesota Rules Chapter 4410, any necessary environmental review must be completed prior to issuing project approvals or permits. This includes any local and state permits. Projects occurring within the state of North Dakota must also comply with respective local, state, and federal rules for project permitting and approval. If the mitigation is carried out by a federal agency, all applicable rules and procedures for project review and approval would be complied with, including any environmental review requirements.

Some mitigation measures would have state environmental review requirements that must be fulfilled before local or state permits can be issued. With this in mind, this EIS includes the following known mitigation projects: wetland mitigation within the proposed diversion channel, fish passage at the Drayton Dam, and Wild Rice Dam removal. As a prerequisite for federal permitting, the USACE has already completed federal environmental assessments for both the Drayton Dam and Wild Rice Dam mitigation projects.

Mitigation projects identified or developed through final project design and/or response actions identified through adaptive management may require environmental review, and/or local, state or federal permits, depending on the nature of the action and the implementing agency. For mitigation and monitoring projects that have not been reviewed as discussed above, the project proposer and the cooperating agency partners would be responsible for complying with local, state, and federal environmental review, permitting, and other regulatory requirements.

6.1.2 Mitigation Evaluation Process

Proposed mitigation was evaluated to determine if it would be adequate in addressing impacts identified for each resource category. In some cases no mitigation is proposed; in other cases, mitigation is proposed, but adaptive management is a strong component of that mitigation that requires ongoing monitoring; and finally there is uncertainty of some potential impacts, and therefore, mitigation has not been proposed at this time or the proposed mitigation could be inadequate by the responsible government unit and/or technical advisors of the EIS.

The following provides a summary of the approach used to evaluate the effectiveness of the proposed mitigation in Section 6.2.

Step 1: Review Proposed Mitigation

- If the resource category, as evaluated in Chapter 3, was determined to result in potential impacts, it was reviewed to determine if mitigation and monitoring are proposed.

- If mitigation and monitoring are not proposed for the potential impact, then mitigation and monitoring measures were identified and recommended for incorporation into the Draft AMMP.

- If mitigation and monitoring are proposed, the mitigation was evaluated to determine if it would be adequate relative to the potential resource impact.

Step 2: Evaluate Proposed Mitigation with Adaptive Management.

- The proposed mitigation was reviewed to determine if adaptive management would address any deficiencies, uncertainties, or influence the potential for success in addressing impacts. In some cases adaptive management was already proposed, while in other instances, adaptive management may not have been proposed, but the proposed mitigation would benefit from recommendations in the Draft AMMP.

Step 3: Evaluate Adaptive Management To Address Future Impacts.

- There are resources that may be impacted by the Project, for which data was inconclusive regarding the level of impact, and therefore, mitigation may not have been proposed or the proposed mitigation does not appear adequate to address current regulatory requirements. . In these cases, the potentially-impacted resources should be considered for inclusion in the AMMP.

6.1.3 Evaluation of Proposed Mitigation Measures

This section provides a summary of the USACE proposed mitigation and monitoring for each resource category analyzed in the EIS, evaluation of the effectiveness of the proposed mitigation and monitoring measures, and as needed, additional mitigation measures that could be implemented to enhance the effectiveness of the proposed mitigation and monitoring measures. This section also provides a summary table of the proposed mitigation and monitoring measures, along with recommended additional measures or other required mitigation and monitoring. Adaptive management would be used to enhance the proposed mitigation measures as applicable. The use of adaptive management for specific resource categories has been indicated where appropriate. The Draft AMMP is referenced in this section and is provided as Appendix B of the EIS. Table 6.1 summarizes the proposed mitigation and MNDNR recommended additional mitigation and monitoring or other required mitigation and monitoring. Note that the Draft AMMP is included in both the “proposed” and “recommended” columns. As previously noted, the Draft AMMP was a collaborate effort that was built off of the USACE AMP and contains additional details beyond what the AMP did but kept to the same concept as well as included new and additional recommendations. This table should be used as a reference for each of the resource topic discussions that follow the table.

Table 6.1 Summary of Proposed and Recommended Mitigation and Monitoring

EIS Topic	Impact Type (approx. acreage when applicable)	Proposed Mitigation and/or Monitoring Description (sources: FFREIS (AMP), Supplemental EA, Ag Impacts Mitigation Plan, Operating Plan, FEMA/USACE Coordination Plan, Draft AMMP)	EIS Recommended or Other Required Mitigation and Monitoring (sources: EIS and Draft AMMP)
Project Hydrology	Flood inundation beyond existing floodplain resulting in impacts to various natural resource features and socioeconomics as covered within the EIS.	-Mitigation specific to Project hydrology was not proposed in the USACE environmental review documents. Hydrologic changes in the project area caused by the Project may impact a number of resources. Mitigation specific to identified or potential resource impacts are discussed under the appropriate resource categories.	- Red River hydrology and hydraulics would be monitored from USGS gages as part of the Geomorphology Monitoring Plan. Three new gages would be added at the three control structures; diversion channel inlet, Red River, and Wild Rice River.
FEMA CLOMR	100-year flood inundation to residential and non-residential insurable structures.	-More than 2 feet flood inundation within FEMA revision reach: residential and non-residential: Acquisition or relocation of homes in manner consistent with federal guidelines and applicable state eminent domain law. Farmsteads would be offered buyout of property prior to consideration of other options as farmsteads are tied to their location. Non-structural measures would be considered if feasible. -Up to 2 feet flood inundation within FEMA revision reach: Would be evaluated for non-structural measures, such as ring levees, relocation, or elevating structures. Acquisition may be considered in areas where risk and	-Out-costs for ring levees (i.e., operation, maintenance, recertification) should be included with mitigation. Accredited levees must have government (local, state, federal) ownership and/or responsibility for inspection. -Minnesota state law does not allow for the development of structures within the floodway. This would apply to the Minnesota side of the staging area. -Minnesota state law requires mitigation for structures located within the floodplain – this would include the newly defined floodplain. Mitigation would need to be completed prior to the LOMR being issued or flood insurance would be

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		safety analysis indicates that leaving in place would be inappropriate.	required. Mitigation could include landscaping, structure relocation, flood-proofing, or elevating structures.
	100-year flood inundation to land including agricultural and organic farms.	-All land within the staging area would be mapped as FEMA floodway. Flowage easements would be obtained. -Land outside of the staging area would be mapped as FEMA floodplain. A takings analysis would be performed and flowage easements would be obtained only where impacts rise to the level of a taking.	

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Stream Stability	Modification and control of water flow from Project construction and Project operation (alteration of flood flow frequency and velocity; modification of existing floodway and floodplain; channel abandonment and aqueducts channel/substrate alteration effects).	-Monitoring and adaptive management to tract before and after Project changes and adjust management of the Project through Geomorphology Assessments. **-Geomorphology Assessment – Monitoring** - Includes: Pre- and post-construction geomorphic surveys: once prior to Project construction and twice following construction. The pre-construction survey was completed in 2010 and 2011 (Geomorphology Report of Fargo, North Dakota and Moorhead Minnesota Flood risk Management Project, West 2012). Post-construction would potentially occur at 5 -10 years and 20 years following completion of Project construction. Additional surveys may occur if deemed necessary through the adaptive management process. **-Geomorphic Assessment Tasks**: Analysis of hydrology, bank stability, sediment transport, and morphological classification.	-Monitoring (described below) would be the basis for identifying the need for additional response/mitigation actions as described in detail in the Draft AMMP. **-Cross Sections:** Pre-construction surveys to occur three times in the next five years. Post-construction surveys every two years for three sampling cycles (assumes Project operation has not occurred). Following three sampling events, Geomorphology Monitoring Team (GMT) would assess findings and determine whether more sampling is necessary and at what frequency. If Project is operated, sampling would occur as soon as possible following Project operation. -**Longitudinal Profile:** To collect bed topography data and other data that may otherwise be missed when performing cross-sections. Pre- and post-construction surveys to follow the same schedule as Cross Sections. (This was not completed during 2010-2011 geomorphology survey).

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			-Cross Section and Geomorphic Assessments Qualifications: To be completed by those trained in Rosgen III channel stability assessment. Data management analysis use of RIVERMORPH data management software package associated with the Rosgen Stream assessments. -**Hydrology and Hydraulic Monitoring:** United States Geological Survey (USGS) gages used in study area. Addition of three new gages at the three control structures; diversion channel inlet, Red River, and Wild Rice River. **-Bathymetry**: Every 10-20 years in absence of large geomorphic change events. **-Sediment Samples:** Of both instream and bed and bank samples to determine sediment load and particles. Pre- and post-construction surveys to follow the same schedule as Cross Sections. **-Bed Scour:** Monitoring at the water control structures should be completed

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			once the design and operating plan is finalized for these structures. **-Communication with Local Agencies:** Annual or more frequent communication should be established with representatives from local agencies regarding channel morphology. **-Field Reconnaissance:** A reconnaissance of the detailed study reaches should be conducted immediately prior to the completion of the Project and of the diversion channel immediately following its completion (to establish baseline as a conditions) and every five years thereafter for the first 10 years. If no significant changes are noted, reduce to every ten years. -**LiDAR**: Should be completed to compliment cross section data on the reaches in areas that are not surveyed. To occur once every three years focused in the river corridor. -**Water Quality:** Sample for water quality way to assess river response to Project.

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			Sampling frequency would be dependent on data being gathered (some continuous and some parameters would follow sediment sampling frequency). **-Aerial Photography:** To capture trends in the land surface – use and observations of impacts (Project and other causes). Every two years for five years or immediately following Project operation. If no significant changes have occurred after five years, the frequency can be reduced to every four to five years. If no significant changes have occurred after 15 years, the frequency can be reduced to every 10 years.
Wetlands	**Forested**		
	62 acres of direct impacts to floodplain forest.	**Mitigation**: -A 2:1 mitigation ratio would be applied for floodplain forest impacts. -Floodplain lands would be acquired that are currently in agriculture or pasture, and re-establish woodland on those tracts. Restore native floodplain forest and herbaceous vegetation. These areas would also provide wildlife habitat.	-Acquisition, monitoring, management, and easement acquisition should be the responsibility of the non-Federal sponsor.

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		-USACE would develop a site restoration plan, including tree planting areas, and clearing, treatment and management schedule of the site(s). A combination of direct seeding and seedling trees would be used as needed. Site(s) would be managed for effective growing. Site(s) would be protected and managed into perpetuity by an agreement for management as a wildlife management area by the MNDNR or North Dakota Game and Fish Department (NDGF).	
		Monitoring Plan: -Sites would be monitored for tree survival annually for 5 years, then tree survival and composition at 10 years. Tree survival and composition would be monitored every 5 years thereafter and following major wind storms.	-Monitoring through adaptive management (as detailed in the Draft AMMP) to evaluate whether the specific ratios proposed for wetland mitigation would replace lost function and temporal loss. The AMMPT would weigh in on monitoring reports and decide whether additional response actions are needed. The monitoring plan should also include a post-event assessment. Particularly if the Project would go into operation prior to good root establishment. The rate and amount of sedimentation could impact these species. Mitigation sites should be monitored for sedimentation impacts and habitat function. Monitoring would

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			evaluate impacts to wetland type and seed banks from various flood events. Wetland performance standards would include hydrology and vegetation observations over a period of several years. The Project consists of several monitored wetland types, each have different performance ranges for hydrology and vegetation.
	Non-forested		
	1,700 acres of non-forested wetland impact.	-Wetland replacement for diversion channel including side slopes and upland, at a 1.19:1 ratio and would be mitigated through revegetation/wetland creation at the bottom of the diversion channel and management of upland inside slopes.	-North Dakota wetland mitigation plan proposed wetland replacement based on function, not by specific wetland type. This would require monitoring and reporting of habitat function. A range of performance measure standards are discussed in the USACE AMP mitigation and monitoring plan for wetlands. -A project specific wetland replacement plan for Minnesota is needed and should be developed under the direction of the WCA LGU(s) per WCA requirements. -Wetland performance standards should include hydrology and vegetation observations over a period of several years. The Project consists of several

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			monitored wetland types, each have different performance ranges for hydrology and vegetation.
	OHB Levee		
	53 acres of direct impact.	-Mitigation sites include Forest River site (already constructed) and the Oxbow Country Club site. The remaining sites would be developed through Ducks Unlimited In-Lieu Fee Program.	-None recommended at this time
	Inundation Area		
	Potential impacts to wetland in the unprotected Project inundation area from sedimentation and subsequent function loss are unknown.	-Wetland mitigation is not specifically proposed for the staging area and inundation areas for potential indirect impacts resulting from sedimentation.	-Monitoring of the inundation areas should occur to assess potential indirect impacts to wetlands due to Project operation. Considerations for the wetland mitigation and monitoring plan should include sedimentation monitoring and habitat function monitoring. In the event that negative impacts are observed, additional replacement requirements that meet federal and state replacement requirements would also be necessary.
Cold Weather Impacts on Aqueducts Function	Potential impacts to fish passage and biological connectivity as well as habitat.	-The mitigation and adaptive management proposed under Fish Passage and Biological Connectivity that includes monitoring fish, macroinvertebrates, and physical habitat would apply.	-Monitoring of surface ice in the heated and unheated portions of the aqueduct compared to ice formation on the Maple and Sheyenne Rivers. -Monitoring of backwater stage increase

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			upstream of the proposed aqueducts compared to historic gage data.
Cover Types	Land, primarily cropland, would be acquired for construction of the diversion channel and other Project features. Impacts would occur primarily to croplands and wetlands.	-Cropland impacts would be mitigated by compensation to landowners for direct cropland impacts, such as land acquisition for Project construction. Owners of croplands that are purchased for the Project would be compensated at fair market value.	-Not applicable
	Direct and indirect impacts to forested and non-forested wetlands.	-Refer to Wetlands discussion.	-Refer to Wetlands discussion.
Potential Hazards Due to Past Site Use	Direct impacts to parcels from Project construction that may contain Recognized Environmental Conditions (RECs).	-Once Project designs are more refined and parcels have been identified for acquisition, the USACE would conduct additional Phase I Environmental Site Assessments (ESAs) and any necessary Phase II ESAs as recommended to determine if RECs are present and if remediation/mitigation is necessary. RECs could be mitigated through removal of REC, soil and groundwater remediation projects or other measures.	-Minnesota Rules 7035.0805 requires that a building survey be completed to identify potential asbestos containing materials, lead based paint, and any regulated/hazardous materials that require special handling or disposal prior to demolition of relocation of structures. Regulated materials would need to be mitigated/disposed of in accordance with local, state, and federal laws by a licensed hazardous waste contractor.
	Flood inundation to properties containing RECs.	-Mitigation for structures that would be impacted from inundation would be determined on a case-by-case basis as the level of impact (depth of flood impact) would be taken into	-RECs should be considered during property evaluations and should be identified and properly mitigated for those properties that would be affected by inundation as a result of Project

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		consideration when determining a mitigation course of action. Refer to FEMA CLOMR and Socioeconomics discussions for more details.	operation.
Fish Passage and Biological Connectivity	Channel abandonment: - Lower Rush River: 2.7 miles - Rush River:2.3 miles	-The diversion channel would be constructed to include a sinuous, low-flow channel and structure at the Rush River to allow for fish passage. This would provide mitigation for the lost channel portions of the Rush and Lower Rush Rivers.	-Monitoring would be the basis for identifying the need for additional response/mitigation actions. Ecological function of the proposed low-flow channel needs to be monitored post-construction and operation to determine its effectiveness. See Draft AMMP. -Construction Avoidance Periods: Proper timing of Project construction would need to be considered in order to minimize or avoid further potential impacts to the fish community.
	Red River connectivity – operation of control structure for floods above 17,000 cfs.	-Reduce frequency of operation by constructing in-town levees.	-Monitoring would be the basis for identifying the need for additional response/mitigation actions. See Draft AMMP.
	Red River connectivity - operation of control structure.	-Construct Drayton Dam Fish Passage, including installation of a new rock-ramp spillway and removal of portions of the existing dam.	-No additional recommendations at this time.
	Wild Rice River connectivity – operation of control structure.	-Remove the Wild Rice River Dam.	-No additional recommendations at this time.
	Impacts to connectivity in the	-Monitoring would occur following	-Monitoring for fisheries impacts should

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	project area.	Project operation as predefined locations. Techniques for monitoring would be determined following Project construction but would generally include evaluation of hydraulic conditions and biological sampling. See Draft AMMP for more details.	be evaluated on a broader scale, as a fish connectivity barrier on the main stem can have impacts on upstream and downstream reproduction. Monitoring plan sampling techniques need to take into account large river species. See Draft AMMP – Considerations for benthic fishes on the Red River.
	Impacts to aquatic biota and potential habitat in the project area.	-Fisheries, physical habitat, and macroinvertebrate assessments would be completed pre- and post-Project operation to establish baseline and Project conditions. At least two fish monitoring events would be conducted prior to construction of the Project and that the survey locations would include areas near the footprint of the Project structures (i.e., control structures, aqueducts, rock-ramps, etc.), as well as sites above or below the features. As of 2015, one pre-construction fish survey has already been completed. -Adaptive management would be used by the AMMPT to determine if additional mitigation is necessary based on assessment results.	-**F**ish community monitoring at all 23 sites from identified in the USACE assessment should be conducted at least two times prior to Project construction and two additional times prior to Project operation. It is recommended that monitoring be conducted on a two or three-year return frequency for the pre-construction/operation surveys. After the Project construction is complete, additional monitoring events and assessments would be required to monitor future changes and assess impacts. Beyond the 23 sites that have been established, additional monitoring sites may be necessary. See Draft AMMP.
	Direct impacts to aquatic habitat	- Stream restoration would be	- Possible stream restorations on a

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	from Project construction; -Maple River: 11 acres -Sheyenne River:8 to 9 acres -Wild Rice River:12 acres -Red River:14 acres	completed that includes stream remeandering, bank grading, riffles/grade control, riparian buffer strips and other actions. -The aquatic habitat within constructed channels would be measured (quantity and quality) and compared against pre-construction conditions to assess if additional aquatic habitat mitigation is necessary.	different river that is not impacted by the Project or that may be located outside of the project area. The stream reconstruction projects should be restricted to other streams within the Red River basin to ensure the impacts from the Project are offset within the overall watershed. Consider large restoration efforts basin-wide if monitoring shows significant impacts occurring. Large restoration efforts would require financial assurance. -Construction Avoidance Periods: Proper timing of Project construction would need to be considered in order to minimize or avoid further potential impacts to the fish community.
	Potential fish stranding after Project operation.	-Visual Assessment to evaluate fish stranding after Project operation would be completed by non-Federal sponsors. -Design change to include diversion inlet structure gates to allow for more control over receding waters within diversion channel.	-Operation should ensure that fish would have the ability to follow the receding hydrograph, i.e., prevent stranding.
Wildlife Resources	62 acres of direct impacts to floodplain forest.	-See descriptions under Wetlands as wildlife habitat replacement would be	-See descriptions under Wetlands as wildlife habitat replacement would be

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		incidental to wetland replacement.	incidental to wetland replacement.
	Aquatic footprint impacts; -Maple River: 11 acres -Sheyenne River: 8 to 9 acres -Wild Rice River: 12 acres -Red River:14 acres	See descriptions for Fish Passage and Biological Connectivity.	-See descriptions for Fish Passage and Biological Connectivity.
State-listed Species and Special Status Species	Interruption of bald eagle nesting.	-Bald eagles nests would be monitored during spring construction season. The project area would continue to be monitored during the upcoming years to ensure that no new nests would be impacted by Project construction. There would be raptor nest surveys completed in the spring of the year preceding construction within or near any affected wooded areas.	-No additional recommendations at this time.
	Mortality of mussels from Project construction.	-Additional mussel surveys are being considered for Project footprint areas to verify whether impacts to mussel resources would be substantial. This would include determining presence of the black sandshell, mapleleaf and Wabash pigtoe mussels.	-Recommend that additional mussel surveys be completed for Project footprint areas.
	Interruption of cardinal and whip-por-will nesting.	-To the extent practicable, vegetation clearing activities would be done so as to avoid affecting nesting individuals.	-No additional recommendations at this time.
	Interruption of bird nesting and rearing periods.	-Construction on forested land would occur during the winter months in order	-No additional recommendations at this time.

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		to not impact listed bird species during their nesting and rearing periods.	
Invasive Species	Invasive species establishment at disturbance sites (i.e., mitigation and construction sites).	-An invasive species management plan, including pre-construction monitoring data previously collected by the USACE and post-construction monitoring of biota and physical habitat for both construction sites and mitigation sites, would be prepared. The plan would outline the inspection procedures and occurrences to ensure compliance. Best Management Practices (BMPs) would be followed to prevent the introduction and spread of aquatic or terrestrial invasive species. -Wetland mitigation sites would be managed for invasive species. Invasive and/or non-native plant species would be controlled for three full growing seasons at floodplain forest mitigation sites. Control would consist of mowing, burning, disking, mulching, biocontrol and/or herbicide treatments as needed. By the third growing season, any planted areas one-half acre in size or larger that have greater than 50 percent areal cover of invasive and/or non-native species	-Control of invasive species may be needed at specific mitigation sites for functional lift/enhancement if monitoring shows that functions being replaced are not adequate. Minnesota wetland replacement requirements usually have specific performance criteria that must be met (e.g., max. percent cover of invasive species).

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		would be treated (e.g., herbicide) and/or cleared (e.g., disked) and then replanted with trees. - When construction activities are complete, disturbed areas would be seeded with native plant species or other plant species per Project plans and specifications. After native species have been planted, the seeded areas would be monitored per the Project plans and specifications. -The non-Federal sponsors would be responsible for noxious weed control on the whole Project perpetually as part of the Operation, Maintenance, Repair, Replacement and Rehabilitation manual (OMRR&R).	
	Invasive species spread and establishment in inundation areas.	-A monitoring plan would be prepared that would include procedures on survey for identifying invasive species, treatment plans, and follow-up surveys to confirm that treatments are effective. -Monitoring would be completed on an annual basis in accordance with the OMRR&R and adaptive management	-No additional recommendations at this time.

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		plan.	
Cultural Resources	Potential impacts to eligible or listed NRHP properties and cemeteries.	-USACE and Diversion Authority would comply with Section 106 through consultations and Programmatic Agreement with North Dakota and Minnesota State Historic Preservations Officers. Programmatic Agreement for the Fargo-Moorhead Metropolitan Area Flood Risk Management Project was signed in June and July 2011, and Amendment 1, signed in 2013. -Programmatic Agreement defines the Project Area of Potential Effects and contains stipulations for cultural resources avoidance, minimization, and mitigation measures. -Cemetery study: potential mitigation includes construction of earthen berms, armor areas prone to erosion, anchoring of gravestones and/or coffins/vaults, use of columbaria from which cinerary urns containing cremated remains could be removed prior to flooding, adaptive management, flowage easements, and cemetery relocation.	-No additional recommendations at this time.
Infrastructure and	Diversion channel construction	-Construction of road and rail bridges	-Construction of roads and bridges as

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Public Services	impacts on existing roads and bridges.	over the diversion channel would be completed to mitigate transportation connectivity impacts	well as changes to other infrastructure may cause impacts to resources, which should be evaluated accordingly during permitting.
	Flood inundation of existing roads.	-Connector roads would be constructed to maintain accessibility, such as road raises through the inundation area (i.e., I-29, Hwy 75, and Hwy 81).	-No additional recommendations at this time.
	Change in traffic patterns to roads that were not designed for increased traffic.	-Road improvements to maintain mobility.	-No additional recommendations at this time.
	Flood inundation of existing railroads	-Railroads would be raised as needed through the inundation area.	-Additional studies are needed to evaluate potential impacts of railroad improvements or raises.
	Project construction or flood inundation of existing utilities.	-Utilities that cannot withstand occasional flooding in the inundation area would be abandoned, modified, or relocated, depending on the situation in accordance with applicable regulations.	-Additional studies are needed to evaluate potential impacts of modifying or relocating utilities. For example, HVTL lines would require coordination and possible approval from the MN Public Utilities Commission.
Land Use Plans and Regulations	Increased flooding of the inundation area, restricting development and/or use of areas – depending on inundation depth and location (within or outside of the staging area).	-The USACE has indicated regulations would be followed as required by federal law, and would continue to work with state and local entities for Project implementation. -FEMA would require that the staging area be designated as floodway.	-Project construction may require permits and LGU approval. Conditional use permits (CUP) may be required. MNDNR may be involved with some of the local permit reviews, such as variances and CUPS that may include specific mitigation.

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		Inundation outside of the staging area but within the FEMA revision reach would be designated as floodplain. Development restrictions would apply per FEMA regulations. See FEMA CLOMR for more details.	-Zoning amendments could be needed at the county, township, and municipal level once the Project is in operation and impacts can be monitored and quantified. -Current floodplain ordinance and map revisal: the impact of the Project on the existing floodplain may require LGU review of current floodplain ordinances and maps. -Minnesota state law would not allow development to occur within the designated floodway (i.e., the staging area on the MN side). Existing structures that would be within the newly designated floodplain would require flood insurance or would need to be mitigated. Restrictions for future development on parcels within the floodplain would apply per MN law.
Dam Safety	Dam construction on the Red River and Wild Rice River.	-No specific mitigation was described in the USACE environmental review documents. The Project would require a MNDNR Dam Safety Permit, which has specific requirements for approval and possible mitigation.	-MNDNR Dam Safety Permit would include necessary design, mitigation, and operation conditions for the Project. Application requires that specific studies be completed (by licensed engineers) and approved prior to permit approval. See

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			Dam Safety for further details on application process and permit approval criteria.
Socioeconomics	Flood inundation to residential and agricultural farmsteads at various depths and agricultural land.	-See descriptions for FEMA CLOMR.	-See descriptions for FEMA CLOMR.
	Land, primarily cropland, would be acquired for construction of the diversion channel and other Project features.	See description for cropland acquisition for FEMA CLOMR and Cover Types.	-See descriptions for FEMA CLOMR and Cover Types.
	Comstock and Oxbow/Hickson/Bakke (OHB) ring levees.	-Comstock ring levee would be designed in collaboration with local officials and would allow for future development. All residents within Comstock would be protected by the ring levee. -OHB ring levee would require the relocation of 42 homes to different sites within the OHB levee. An additional 60 residential lots would be added within the ring levee for other displaced residents within the unprotected area. -The Diversion Authority would compensate the City of Oxbow and the Kindred School District for loss of tax base for a period of up to four years	-No additional recommendations at this time.

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		caused by the temporary loss of the 42 homes.	

6.1.4 Project Hydrology

Anticipated or potential environmental consequences from Project hydrology and hydraulic changes are discussed in more details in Section 3.1.

6.1.4.1 Summary of Proposed Mitigation and Monitoring

Hydrologic changes in the project area caused by the Project may impact a number of resources. Mitigation measures specific to Project hydrology were not proposed in the USACE environmental review documents. The USACE may be required to conduct H and H monitoring as part of the MNDNR Dam Safety Permit.

The Phase 7 EA unsteady HEC-RAS model was used during the evaluation of mitigation measures for the Project. The HEC-RAS model continues to be updated as the Project design is further refined.

6.1.4.2 Evaluation of Proposed Mitigation and Monitoring

A MNDNR Dam Safety Permit would be required for construction of the proposed control structures, tieback embankment and associated structures. Although mitigation was not proposed, the Project would need to comply with the requirements of the Dam Safety Permit, including H and H monitoring.

6.1.4.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

H and H monitoring would be implemented as part of long-term monitoring outlined in the Draft AMMP. H and H monitoring may also be required as part of the MNDNR Dam Safety permit. H and H monitoring and mitigation would utilize existing stream gages and add additional gages as needed. During critical events, field monitoring and measurements should be completed to validate gage information. The flow data would be used to compare existing hydraulic conditions to Project-predicted and Project-actual hydraulic conditions. This data would provide information on H and H impacts from Project operation. Flow data could also be used for future modeling and for planning and analysis as part of the Draft AMMP.

6.1.4.4 Additional Mitigation Needs

Hydrology and hydraulic monitoring of the Red River is included within the GMP. USGS gages within the project area would be utilized. In addition three new gages would be added at the three control structures; the diversion inlet channel, the Red River, and the Wild Rice River.

6.1.4.5 FEMA Regulations and the CLOMR Process

Section 3.2 provides a discussion on the potential impacts of the Project as it relates to FEMA requirements and the CLOMR process.

6.1.4.6 Summary of Proposed Mitigation and Monitoring

FEMA and the USACE have developed a Coordination Plan (FEMA/USACE Coordination Plan, April 2015) that outlines floodplain management requirements for the Project, including Project mitigation as applicable. The plan is defined primarily by the FEMA revision reach. All insurable structures within the FEMA revision reach will require mitigation. Mitigation would be in accordance with the NFIP and could include elevation, relocation, buy-outs, ring levees, and dry flood proofing. Mitigation options would be determined by flood inundation impact during a

100-year flood. Insurable structures that would experience greater than two feet of inundation within the FEMA revision reach would be acquired or relocated. Up to two feet inundation, structures would be evaluated for non-structural measures (acquisitions may still occur if there is a risk and safety issue).

The Coordination Plan also requires that the areal extent of flood inundation required for operation of the Project, the staging area, be mapped as floodway to ensure that the required volume is available for the Project during the 100-year flood. Flowage easements would be obtained for all floodway designated areas. Any additional flood inundation outside of the staging area would be mapped as floodplain.

6.1.4.7 Evaluation of Proposed Mitigation and Monitoring

Section 65.12 of the CFR requires communities to apply to FEMA for conditional approval (see 44 CFR Part 72 of the NFIP regulations) of actions which cause increases in BFEs in excess of the limits. In accordance with the NFIP, mitigation would be required for structures that are subject to increases in BFE greater than the criteria set in CFR 60.3(c) and (d) for the affected communities.

Mitigation for flood inundation of agricultural land, including organic farms, would consist of flowage easements. The value of the flowage easement would be determined based on impact and property value.

6.1.4.8 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

Appropriate mitigation would be determined through the FEMA CLOMR process. Because of the magnitude of the Project, FEMA has discussed interpreting standards so that the CLOMR includes a list of properties that must be mitigated before Project completion but that the mitigation of those properties can be delayed until the Project affects the property flood risk. Properties which do not fit into the USACE identified structure and land mitigation categories listed in Table 6.1 above would be reviewed on a case-by-case basis, and alternative mitigation options would be considered, including in areas outside of the staging area boundary.

6.1.4.9 Additional Mitigation Needs

It is recommended that costs for ring levees (i.e., operation, maintenance, and recertification) and other non-structural measures be included with mitigation. Accredited levees must have government ownership and/or responsibility for inspection.

Minnesota state law does not allow for the development of structures with a mapped floodway. This would apply to the Minnesota side of the staging area and should be disclosed to local governments for planning purposes.

Minnesota state law also requires mitigation for structures located within a designated floodplain. This would apply to all structures that would become part of the newly designated floodplain. Mitigation could include structure relocation, elevation, dry flood proofing, or ring levees. The mitigation would need to be completed prior to the LOMR being issues or flood insurance would be required.

Century farms may also require additional mitigation consideration if they are found to be eligible or listed on the NRHP. The non-Federal sponsor and USACE should coordinate with the state SHPOs accordingly.

6.1.5 Stream Stability

Section 3.3 discusses stream stability in the project area and how that may be affected by the Project. No significant impacts are anticipated as a result of the Project; however, due to the large scale of the Project and magnitude of hydraulic and hydrologic changes, it is uncertain how stream stability will be affected.

6.1.5.1 Summary of Proposed Mitigation and Monitoring

The USACE proposed completing geomorphic assessments pre- and post-construction and operation to determine if Project operation has an impact on stream stability. Although no specific mitigation approaches have been proposed, if impacts are observed, they may require mitigation or other measures, such as altered operation of the Project. Or additional geomorphic assessments may be necessary to determine Project impacts or mitigation needs.

6.1.5.2 Evaluation of Proposed Mitigation and Monitoring

The length of streams the Project combined with the uncertainty in the magnitude of the potential impacts requires monitoring and adaptive management. A Geomorphology Report (West 2012) has been completed for the Project, which provides a baseline from which to monitor and potentially implement adaptive management measures through coordination with an adaptive management team. Additional geomorphic studies would be completed again after Project construction and operation; potentially at 5 to 10 years and 20 years following Project completion. The USACE and Diversion Authority have been working with the MNDNR and other agencies to develop and refine measures identified in the FFREIS for pre- and post-construction and operation monitoring, including development of the Draft AMMP (Appendix B). The USACE AMP and the Draft AMMP will continue to be revised through ongoing cooperation efforts, as pre-construction and operation monitoring results are assessed, Project designs are finalized, and as Project permitting requires.

6.1.5.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

The intent of geomorphologic studies and monitoring is to provide information for use with adaptive management, which results in response actions as warranted. It is assumed monitoring would provide enough information for use by an adaptive management team to evaluate whether or not mitigation or changes in Project operation are needed to avoid and minimize Project impacts. Measures identified through monitoring may include additional studies, stream stabilization measures, and other coordinated efforts. It is anticipated that the Draft AMMP would provide specific protocols, response criteria/thresholds, and potential mitigation measures to identify and minimize impacts.

It is assumed that if impacts are identified through monitoring, that an adaptive management team would implement response actions in cooperation with appropriate agencies commensurate with the level of impact observed. This includes going through an approval process for implementing mitigation, which may include environmental review and/or permitting. Mitigation measures would need to comply with appropriate rules and regulations.

6.1.5.4 Additional Mitigation Needs

Additional measures were identified to continue to assess stream stability. This is due to the uncertainty that exists with potential impacts from Project construction and operation.

Project Design and Construction

The final structure design and operating plan would be developed by the USACE. Final design of hydraulic structures and the Project operating plan should account for dissipation technologies. Once the design is finalized, the shear stresses and velocities flowing out of the hydraulic control structures should be verified to be lower than the threshold values for stiff clay to minimize the potential for bed scour of the stream channel.

Project Operation

Following Project operation, receding water within in the inundation area could cause bank failure, and therefore would require drawdown to be slower than the typical receding limb of the flood hydrograph, in order to prevent greater risk of bank failures and stream instability. An adaptive management approach to the drawdown rate could start with the typical receding limb rate, and if increased amounts of bank failure are observed, the drawdown rate could be decreased systematically, until a solution is reached. Desaturation/drawdown impacts to downstream reaches, below the proposed hydraulic structures, are also possible due to an increased duration of bankfull flows.

Monitoring and Assessment

In addition to the proposed monitoring and mitigation measures in the FFREIS, four tasks were recommended in the Geomorphology Report to monitor the geomorphic response of the stream channels and diversion channel to the Project (WEST 2012) these, along with recommendations from the MNDNR are included in detail in the Draft AMMP Geomorphology Monitoring Plan (Appendix B) and summarized below.

- *Aerial Photography Evaluation*. Future aerial photography should be compared with previous aerial photography and bank line delineations to locate any areas of lateral shifts in the bank location. Significant shifts in channel locations with a rate of change greater than previously estimated should be flagged for further investigation and the bank lines should be delineated for comparison with future imagery data. Changes in vegetation type and density should also be evaluated. Although, there does not appear to be a direct link between vegetation and lateral channel stability, this evaluation could help identify areas where the geotechnical stability of the banks may have changed. An inventory of current slumps through aerial photography and LIDAR would provide a baseline for future changes resulting from the Project.

  Areas with significant changes in vegetation should be flagged for further investigation. Following completion of the Project, the aerial photography evaluation should occur at the same frequency as the availability of new aerial photography (every one to two years). If no significant changes have occurred after five years, the frequency can be reduced to every four to five years. If no significant changes have occurred after 15 years, the frequency can be reduced to every 10 years. This evaluation should be repeated at a minimum of every 10 years. It should also be conducted following significant flood events.

- *LIDAR.* LIDAR should be completed to compliment cross section data on the reaches that are not surveyed. These should occur once every three years and focused on the river corridor (see application with aerial photography evaluation above).

- *Bathymetry.* Should be used to assess bed topographic changes and sediment deposition within the streams. This could occur every 10-20 years in absence of a large known geomorphic change such as a large flood event. This information would be used in conjunction with other data collected to determine how the stream is evolving as a result of Project, natural, or other influences.

- *Sediment Sampling*. Sediment samples of both instream bed and bank samples should be collected to assess suspended sediment and bedloads. Pre-construction information has already been collected that could be used as a baseline for determining Project impacts.

- *Water Quality*. Assessing water quality is another way to assess a river's response to Project changes and the health of the system. Numerous parameters should be collected that include dissolved oxygen, suspended sediment concentrations, total suspended solids, turbidity, nutrients, specific conductance, pH, Ions and trace metals. Some of these parameters would be gathered continuously and some would follow sediment sampling frequency. Use of existing monitoring stations is recommended. New sites may need to be established as select locations.

- *Field Reconnaissance*. A reconnaissance of the detailed study reaches should be conducted immediately prior to the completion of the Project and of the diversion channel immediately following its completion (to establish baseline conditions) and every five years thereafter for the first 10 years. If no significant changes in the channel morphology are noted, the frequency can be reduced to every 10 years. If after 20 years, no significant changes in channel morphology are noted, the field reconnaissance efforts can cease. At a minimum, a color photographic log with GPS locations should be created to document the reconnaissance observations for comparison with previous documentation. Further, if significant changes are found to be occurring along certain streams or stream reaches, future reconnaissance efforts could be focused on only these locations. For each of the areas flagged for further investigation by the aerial photography evaluation, a site specific field reconnaissance should be conducted to understand the local conditions of the site and to help understand the causation for the noted changes. At a minimum, color photographs should be taken to document the conditions of the site. Subsequent visits to the site can be made at a frequency consistent with the magnitude and rate of the noted changes and the significance of the potential consequences resulting for those changes.

- *Cross Section Surveys*. A total of 206 cross sections have been established to allow for monitoring of changes in channel geometry following the completion of the Project. The cross sections were selected based on one of the following criteria:
    a. The cross section is located within a detailed study reach.
    b. One or more historic cross section surveys were conducted in the same location.

c. The cross section is located immediately upstream or downstream of the proposed diversion alignments.

Additional cross survey locations have been recommended by the MNDNR in effort to provide a more complete assessment of potential Project impacts. These are detailed in the Draft AMMP.

Cross section surveys should be conducted three more times within the next five years prior to construction (to establish baseline conditions and for comparison with previous surveys) and every two years for three sampling cycles (assuming Project operation has not occurred). Following three sampling events, the GMT would assess findings and determine whether more sampling is necessary and at what frequency. Further, if significant changes are found to be occurring only along certain streams or stream reaches, future cross section survey efforts could be focused on only those locations.

Cross section surveys should also be conducted immediately following the first significant flood event to evaluate the ability of the diversion channel to convey sediment. Periodic cross section surveys and the establishment and monitoring of pins or other gauging devices should be done after major flood events to confirm the rate and depth of sediment deposition.

- *Longitudinal Profile.* Longitudinal profiles capture additional information that would not be captured with cross sections alone such as stream length topography. Pre- and post-construction surveys should be completed in conjunction with cross sections. Note that these were not completed during the 2010-2011 geomorphology survey so no current baseline is available for future comparison.

- *Communication with Local Agencies*. Annual or more frequent communication should be established with representatives from local agencies with regard to channel morphology. Interested stakeholders in channel morphology would include the involved counties and cities, farming co-ops, USDA-NRCS, North Dakota and Minnesota Fish and Game agencies, USGS, US Fish and Wildlife, college extension services and involved irrigation and drainage districts. Such communication efforts would allow for the real or perceived changes in channel morphology identified by these agencies and/or their constituents to be documented and flagged for further evaluation. Regular communications would help focus the previously mentioned monitoring efforts and allow for concerns to be documented and appropriately addressed.

- *Bed Scour Assessments.* In addition to the Geomorphology Report recommendations, development of a specific monitoring and mitigation plan for bed scour at the water control structures would be necessary once the design and operating plan is finalized for these structures. Any bed scour at water control structures should continue to be monitored to confirm additional undercutting is not occurring. Periodic surveys of cross sectional shape would be completed and if scouring or undercutting is observed, additional energy dissipation strategies should be implemented. This mitigation measure would further limit the scouring and undercutting potential.

- *Hydrology and Hydraulic Monitoring.* Use of existing USGS gages within the staging area plus three new gages located at the three control structures; diversion channel inlet, Red River, and Wild Rice River.

Following Project operation, the hydrograph of water elevation stored in the inundation area should be recorded and compared to historic floods on record to determine if the operating plan is mimicking the existing hydrology or allowing a faster drawdown. The development of a separate monitoring plan would be important to determine if inundation area banks remain stable. The monitoring plan would include additional cross section surveys and field reconnaissance to locate and mark with global positioning system (GPS) any new bank failures following major flood events. Once it is understood, if there is additional bank failure in the inundation area and whether or not it is caused by the Project, the monitoring plan could be adjusted. If not, the frequency of monitoring could be reduced to every couple major flooding events or several years.

The MNDNR recommends that geomorhphologic assessments be completed by individuals trained in Rosgen III channel stability assessment. Field methods should also follow those learned in this training. This would ensure that data collected is consistent and that it follows acceptable field methodologies that are used by the MNDNR as well as by other agencies and consultants. RIVERMORPH is the recommended data management software associated with the Rosgen Stream Assessments.

6.1.6 Wetlands

This section describes the proposed wetland mitigation measures, discusses the effectiveness of the proposed mitigation and monitoring, and identifies where additional mitigation efforts may be needed. Additional information on mitigation and monitoring is provided in Section 3.4. The Project would have direct and indirect impacts to wetlands and floodplain forests. Indirect impacts to wetland features may occur from Project operation.

6.1.7 Summary of Proposed Mitigation and Monitoring

The Project would impact greater than 1,800 acres of wetlands; approximately 98 percent of those impacts would occur to wetlands located in North Dakota. Wetland acres that are impacted by the Project would be mitigated by methods including both: wetland creation and restoration of existing floodplain. Additionally, Ducks Unlimited (DU) in North Dakota has launched an in-lieu fee mitigation program that would locate, purchase, construct and monitor wetland restoration/creation sites for a per-acre fee. As a coordinating agency with the DU program, the Diversion Authority is proposing to use this program for some of the wetland mitigation needed in North Dakota.

The proposed wetland mitigation and monitoring include the following:

- Impacts to non-forested wetlands would be mitigated primarily by creating non-forested wetlands within the diversion channel bottom and along the side slopes. Non-forested wetlands are proposed to be mitigated by replacing lost wetland function and do not have a target acreage replacement ratio.
- Mitigation for impacts to forested wetlands would include restoration of existing floodplain agricultural land to floodplain forest wetlands. Impacts to forested wetlands have been proposed to be replaced at a 2:1 ratio (two acres of mitigation for each acre of impact).

- For all wetland mitigation, the project proposer would use the AMP to monitor the mitigation sites. Monitoring would include measurement of specific performance standards and the implementation of corrective action measures if the standards were not being met.
- In addition to monitoring, the MNRAM wetland assessment method or other agreed upon method will be used to assess the adequacy with which the mitigations replaced lost wetland function.
- Outside of the conceptual identification of wetland creation within the diversion channel, specific mitigation plans have not yet been developed. Detailed monitoring plans are also not yet available.
- In North Dakota, the USACE Omaha District would issue the CWA Section 404 permit for work to be completed by the non-Federal sponsor, and confirm wetland mitigation creation, monitoring completion, and compliance with performance standards.
- In Minnesota, the LGU in the county of wetland impact would lead the WCA approval process, monitoring completion and performance of mitigation sites, once selected. In addition, the USACE St. Paul District would perform the same CWA Section 404 oversight role in Minnesota for work to be completed by the non-Federal sponsor.

6.1.7.1 Evaluation of Proposed Mitigation and Monitoring

Preliminary wetland mitigation measures have been proposed for impacts to non-forested and forested wetlands. Monitoring of the mitigation projects would be required to ensure that predetermined performance standards are being met. The scope of the monitoring plan for the wetland mitigation projects would include the diversion channel conceptual wetland mitigation plan (non-forested), as well as a floodplain forest mitigation plan (forested). Adaptations from the monitoring plan would be created and submitted separately to satisfy the multiple permitting/approval processes.

6.1.7.2 Summary of Proposed Mitigation and Monitoring

The Project would impact primarily non-forested wetlands. The wetland mitigation plan has not yet been developed; however the current concept for mitigation of non-forested wetland impacts only identifies a means to replace wetlands in North Dakota (within the diversion channel). The proposed mitigation, monitoring, and maintenance within the diversion channel would be required to meet the CWA Section 404 permit.

Monitoring of the created wetlands within the diversion channel would be completed through the AMP. Regular monitoring of the wetland mitigation sites to ensure performance standards are met and implementing corrective actions when needed are proposed to replace lost wetland function. The MNRAM assessment tool – or similar agreed upon tool-would be used to measure performance standards, and identify deficiencies that require additional action.

Impacts to wetland in Minnesota would need to meet the requirements of WCA at impact sites located in Minnesota. Under the jurisdiction given by BWSR, the LGU within the county of impact must ensure adequate WCA replacement that meets all applicable replacement requirements (e.g., replacement ratios are met; monitoring plans are adhered to, maintenance activities, etc.). The project proposer has not yet identified specific mitigation plans for non-forested wetland impacts in Minnesota.

Table 6.2 Evaluation Summary of Non-forested Wetlands

Wetland Impact	Proposed Mitigation*	Replacement Provided	Identified Constraints	Potential Benefits
Non-forested	Creation of wetland habitat within the diversion channel. MN mitigation would follow WCA requirements.	Minimum 1:1 ratio for all non-forested wetland impacts in ND and replacement in MN consistent with WCA replacement standards. ND plan would emphasize replacement of lost function. MN plan would follow WCA requirements which use an acreage surrogate.	Replacement of habitat function; proposed mitigation for Project construction footprint only not indirect impacts. Tieback embankment footprint impacts in MN would require function and acreage replacement.	Potential for more diverse vegetation community with proper management.

*USACE proposes to use the AMP approach for monitoring in addition to permit requirements.

6.1.7.3 Forested Wetlands

Mitigation for forested wetland impacts would include restoring floodplain agricultural land to floodplain forest. Impacts to floodplain forest are proposed at a 2:1 replacement ratio (two acres of mitigation for each acre of impact). This replacement ratio may be sufficient to satisfy CWA Section 404 in North Dakota. The project proposer would monitor forested wetland sites and implement corrective actions based on monitoring observations to ensure predetermined performance standards are being met.

Due to the time required for forested wetland communities to become established, the effectiveness of restoring lands to new floodplain forest wetlands would be realized over a longer period of time, compared to a non-forested wetland. Temporal loss of wetland function and value while the mitigation sites mature is proposed to be compensated for through the 2:1 replacement ratio.

The USACE is currently managing floodplain forest wetland mitigation projects along other rivers in the region. Floodplain forests can take years to become established which results in a number of potential challenges to creating a successful restoration project. These challenges include: adequate hydrology, selection of properly sized and aged plantings at the start of the project, vegetation predation by deer, and controlling the spread of non-native and undesirable species. In partnership with the USACE through the implementation of the AMP, the project proposer intends to manage the proposed floodplain forest mitigation projects to ensure success. If the forested wetland mitigation projects are properly designed, timed, monitored, maintained, and managed, there is the potential that the impacts to forested wetlands from the Project could be successfully mitigated within the next 15-30 years.

The USACE has proposed a 2:1 replacement for forested wetland impacts for both Minnesota and North Dakota. This mitigation ration considered permanent (fill) impacts to forested wetlands and does not include impacts such as wetland conversion to another type. Upon application for WCA approval, the LGU would determine the adequate replacement ratio, which could be greater than 2:1. To satisfy the rules and requirements of WCA, forested wetland impacts, would need to be mitigated at project sites within Minnesota. The project proposer would have to develop a monitoring plan and performance standards that meet WCA, and also coordinate with the LGU's that administer WCA.

Table 6.3 Evaluation Summary of Forested Wetlands

Wetland Impact	Proposed Mitigation*	Replacement Provided	Identified Constraints	Potential Benefits
Forested	Restoration of agricultural lands to floodplain forest.	2:1 ratio for all forested wetland impacts (if replacement is required by MN, WCA could be >2:1). Plan would emphasize replacement of lost function.	Replacement requires extended time period that would create a temporal loss.	Potential for more diverse vegetation community with proper management.

*USACE proposes to use an adaptive management approach for monitoring in addition to permit requirements.

6.1.7.4 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

The proposed wetland mitigation intends to meet the CWA Section 404 permitting requirements for wetland impacts in North Dakota. Based on the conceptual information developed for the current Project design, lost wetland function (not type) could be replaced over the long-term in North Dakota for non-forested wetland impacts. A temporal loss is anticipated for forest wetland impacts, and there many challenges associated with forested wetland restoration that would require careful monitoring and management for success.

Per WCA rules, wetland impacts in Minnesota require mitigation to occur in Minnesota and site specific mitigation, monitoring, and maintenance plans still need to be developed.

It is anticipated that additional mitigation and monitoring plans would be created to address the permitting and approval processes of WCA and CWA Section 404. Considerations for wetland mitigation plans and inundation area monitoring should include: sedimentation monitoring, habitat function monitoring, type for type replacement where available, banking credit availability and cost, and intensive oversight for forested wetland projects to minimize temporal loss and ensure success. The ability of proposed wetland mitigation to adequately replace lost function would be dependent upon the overall success of the mitigation sites. Monitoring results of the maintenance measures for mitigation effectiveness would be overseen by and adaptive management team. Draft AMMP is provided as Appendix B, which provides additional detail on wetland monitoring.

6.1.7.5 Additional Mitigation Needs

Mitigation has not been proposed by the USACE for potential indirect impacts to wetlands in the inundation area. These impacts could include indirect effects from sedimentation and hydrology following Project operation. The project proposer has not provided an approach to address indirect wetland impacts within the inundation area. Monitoring of indirect wetland impacts in the inundation area would be included the state Draft AMMP developed and implemented by the non-Federal sponsor for the Project.

6.1.8 Cold Weather Impacts on Aqueduct Function

Section 3.5 provides a discussion on the potential impacts of cold weather on aqueduct function. The construction of the aqueducts will result in the loss of aquatic habitat and potential aquatic connectivity interruptions through channel abandonment and realignment.

6.1.8.1 Summary of Proposed Mitigation and Monitoring

Adaptive management was proposed for assessing potential impacts of cold weather on aqueduct function. Proposed mitigation and monitoring associated with other resource categories may also apply to cold weather impacts on aqueduct function. These include habitat loss and fish passage and biological connectivity as discussed in Section 3.8 – Fish Passage and Biological Connectivity, and also evaluated below in Section 6.2.8.

6.1.8.2 Evaluation of Proposed Mitigation and Monitoring

The design of the aqueducts needs to ensure that aqueduct function is maintained for connectivity, and therefore, monitoring associated with fish and aquatic biota would indicate if the aqueduct is functioning as designed. Monitoring would be required to determine if impacts on fish passage and biological connectivity occur. Adaptive management is intended to resolve potential issues associated with observed impacts.

Impacts to aquatic habitat on the Maple and Sheyenne Rivers would be verified through the comparison of IBI scores developed before and after construction, and quantified by calculating a Habitat Unit. A Habitat Unit is found by multiplying Impact Area and Habitat Quality. The effectiveness of mitigation would be determined as the Habitat Units lost through impact, compared to the Habitat Units gained through mitigation. This would also take into account the Habitat Units that are present within any newly constructed river channels to facilitate routing flow through Project features (e.g., water control structures and aqueducts) (FFREIS 2011).

Monitoring to assess potential impacts to fish passage on the Maple and Sheyenne Rivers would occur once Project features are in place and the Project is put into operation (post-construction monitoring). An Aquatic Biological Monitoring Team in coordination with the AMT would collaborate on how best to identify and define fish passage effectiveness.

6.1.8.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

The proposed mitigation and monitoring is intended to monitor the design of the aqueducts during cold weather conditions. The current design was based on a number of factors and is intended to provide fish passage and biological connectivity similar to those in the associated stream. Adaptive management would be used to resolve potential issues if the Project results in unanticipated impacts.

6.1.8.4 Additional Mitigation Needs

Ongoing observation and monitoring of the aqueducts on the Maple and Sheyenne Rivers during the winter months is needed. This would be necessary to determine how the structures respond to debris and ice flow accumulation as this would provide information on how the aqueduct is functioning compared to its anticipated design operation. This would include observation of the spillway as it relates to flow, upstream flooding (if any), and aquatic biota. Flow variations and other location conditions such as temperature and precipitation should be observed over several years following construction and during Project operation.

Additional monitoring measures detailed in the Draft AMMP (Appendix B) specific to fish monitoring include: netting, radio telemetry and/or hydroaccoustic monitoring, Passive Integrated Transponder tagging and sonar imaging (e.g., DIDSON sonars). These monitoring activities as well as others are discussed further in Section 6.2.8 – Fish Passage and Mortality and Draft AMMP.

6.1.9 Cover Types

Section 3.6 provides a discussion of potential impacts to cover types in the project area. The primary impacts to cover types occur to cropland and wetlands. A discussion on the effectiveness of wetland mitigation and monitoring measures is provided above in Section 6.2.4.

6.1.9.1 Summary of Proposed Mitigation and Monitoring

Cover type impacts would occur primarily to croplands and wetlands. Cropland impacts would be mitigated by compensation to landowners for direct cropland impacts, such as land purchase for Project construction. Owners of croplands that are purchased for the Project would be compensated at fair market value (FFREIS 2011). Where agricultural use is not feasible along the diversion channel, disturbed land would be seeded and revegetated with native plant species and managed as grassland.

Wetland acres that are impacted by the Project would be mitigated by various methods including: wetland replacement, wetland creation, and/or restoration of existing floodplain.

6.1.9.2 Evaluation of Proposed Mitigation and Monitoring

Proposed mitigation for cover types is intended to create wetland along the length of the diversion channel, which includes acquired cropland that would be converted to wetland. As described in Section 6.2.4, uncertainty associated with both the level and type of impacts and the effectiveness of mitigation would be addressed through adaptive management. This would allow impacts to be verified and mitigation effectiveness to be evaluated. Monitoring activities, including review of results, would be performed by the USACE AMT.

6.1.9.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

The proposed mitigation and monitoring is required for wetland permitting. Mitigation would comply with WCA and CWA Section 404. Monitoring is a standard regulatory requirement that ensures mitigation that is not successful is corrected or new compensation established.

6.1.9.4 Additional Cover Types Mitigation Needs

Additional mitigation has not been recommended for land acquisition. Monitoring of the inundation area for sedimentation impacts to wetlands is proposed as discussed in Section 6.2.4.

6.1.10 Potential Environmental Hazards Due to Past Site Use

Section 3.7 provides a discussion of impacts related to potential environmental hazards due to past site use. This includes review of completed Phase I Environmental Site Assessments in portions of the project area.

6.1.10.1 Summary of Proposed Mitigation and Monitoring

Mitigation is proposed for potential environmental hazards as part of the property acquisition process. The non-Federal sponsor would be responsible for property acquisition. The USACE would conduct Phase I ESAs and subsequent Phase II ESAs after property is identified for acquisition as part of the due diligence process. The non-Federal sponsor would be responsible for any required remedial actions or mitigation for the property prior to Project construction, including asbestos/lead and regulated materials building surveys. Any identified regulated materials would be mitigated according to existing rules and regulations by a licensed remediation contractor, such as removal and proper disposal of all hazardous substances, contaminated soils, relocation of utilities, and potentially the removal of various structures that may contain asbestos, lead, or other hazardous materials. Several Phase I ESAs have already been completed within the project area. Additional Phase I ESA or Phase II surveys would be completed as necessary once Project plans have been finalized and properties requiring acquisition have been identified.

6.1.10.2 Evaluation of Proposed Mitigation and Monitoring

Phase I ESAs and, as needed, Phase II ESAs would be completed for acquired property. Based on the identified contamination levels, a response action plan, detailing remediation plans and additional testing requirements may be generated. Impacts associated with the RECs could then be mitigated through soil and groundwater remediation projects or other measures as identified during the Phase II ESA. The mitigation would comply with rules and regulations associated with handling and remediation of RECs. A summary of the potential remedial actions and mitigation measures typically associated with each type of REC is provided in Section 3.7.

6.1.10.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

Phase I and Phase II ESAs would be completed as needed to identify potential RECs. The proposed mitigation and monitoring is required to comply with local, state, and federal regulations. The non-Federal sponsor would be required to comply with all applicable laws and regulations related to potential Hazardous, Toxic, and Radioactive Wastes (HTRW). It is anticipated that the non-Federal sponsor would obtain required permits and comply with regulations, which would be sufficient for mitigation of potential RECs and handling of HTRW.

6.1.10.4 Additional Mitigation Needs

In Minnesota, a building survey is required by Minnesota Rules 7035.0805 prior to demolition or relocation. A building survey would identify ACMs, LBP, and any regulated/hazardous materials that require special handling, recycling, and/or disposal. Any regulated materials would be mitigated according to local, state, and federal laws by a licensed hazardous waste remediation contractor or licensed asbestos abatement contractor, and disposed of properly.

It is recommended that RECs be considered during property evaluations completed within the staging area, FEMA revision reach, and all other areas that will experience new or additional flooding as a result of the Project. The RECs should be identified and properly mitigated for as appropriate (considering degree of impact).

6.1.11 Fish Passage and Biological Connectivity

Section 3.8 provides a discussion on potential impacts from Project construction and operation on fish migration and biotic connectivity within the project area.

6.1.11.1 Summary of Proposed Mitigation and Monitoring

Mitigation related to fish and aquatic biota is proposed for two primary impacts: aquatic habitat, and fish migration and connectivity. The proposed mitigation includes stream restoration projects, two dam projects in the project area and Project design features. Stream restoration projects are proposed as mitigation for direct impacts to aquatic habitat on the Red, Wild Rice, Sheyenne, and Maple Rivers. As mitigation for potential impacts to connectivity within the Red River basin, in-town levees were added to the Project design to reduce frequency of Project operation. To address impacts to fish passage and biotic connectivity, reconstruction of the Drayton Dam and removal of the Wild Rice Dam are proposed. Also, the Rush River control structure at the diversion channel would be designed so that it is passable for fish. Impacts to aquatic habitat on the Rush and Lower Rush Rivers between the diversion channel and the Sheyenne River would be mitigated through construction of a sinuous low-flow channel.

Pre- and post-construction monitoring efforts are proposed through the USACE AMP, including overall watershed fish community and IBI assessments, and monitoring efforts that would target the effectiveness of individual restoration projects. Additional monitoring efforts include:

- Biotic Assessment – pre- and post-construction of restoration sites
- Aquatic Connectivity and Fish Passage Assessment – post-construction to evaluate fish passage structures
- Visual Assessment – post-operation for fish stranding within the diversion channel

6.1.11.2 Evaluation of Proposed Mitigation and Monitoring

Stream channel restoration and projects at the Drayton and Wild Rice Dams would be evaluated for mitigation effectiveness.

Stream Channel Restorations

Mitigation is proposed through stream channel restoration projects. Stream restoration projects would offset the direct impacts to aquatic habitat on the Red, Wild Rice, Sheyenne, and Maple Rivers.

Specific stream restoration projects have not yet been identified and it is unknown where the stream restoration projects would occur. One of the limiting factors in planning a stream restoration project is landowner consent. The non-Federal sponsor would need to find willing landowner partners who are interested in allowing a stream restoration project to be constructed on their property. The stream restoration project would then need to have the land enrolled into an easement or deed restriction. Stream restoration projects could potentially be located on the same stream where impacts occur; however, it may be necessary to construct stream restorations on a different river within the watershed that is not impacted by the Project or that may be located outside of the project area. The process for determining stream restoration projects and finding willing landowners is under consideration, and would need to be further developed once Project design is finalized.

Until specific Project reaches are identified, it is not known to what extent the proposed stream restoration projects would serve as mitigation to offset Project impacts. A well designed and constructed stream restoration project would be able to offset and potentially improve aquatic habitat compared to existing conditions. As a result, stream channel restoration projects are suitable mitigation projects to replace the aquatic habitat in rivers, benefitting the fish and macroinvertebrate communities. The extent of adherence to natural channel design techniques (dimension, pattern, and profile) at stream restoration sites would determine effects on habitat and fish passage.

Mitigation is proposed through creation of a low flow channel within the diversion channel to offset direct impacts to aquatic habitat in the Rush and Lower Rush Rivers. From the Maple River downstream to the outlet of the diversion channel into the Red River, the low flow channel would be constructed in a sinuous, meandering nature. This would be done to provide habitat within the low flow channel, mimicking a more natural stream channel. The low flow channel in this lower section is expected to have flow conditions similar to the surrounding tributary flow conditions (i.e., continuous year round flow under average flow conditions in the Red River basin). The current design for the low flow channel is large with dimensions of approximately 84 feet wide by five feet deep, which is anticipated to create habitat. With continuous flow and a meandering nature, it is expected that the low flow channel would replace the function and value of the aquatic habitat lost in the Rush and Lower Rush Rivers. The extent of adherence to natural channel design techniques (dimension, pattern, and profile) within the diversion channel would determine effects on habitat and fish passage.

Fish Migration and Connectivity

There are two mitigation projects proposed to offset impacts to fish passage and connectivity in the watershed: Drayton Dam Project and Wild Rice Dam Project.

<u>Drayton Dam Project</u>

The Drayton Dam reconstruction project is proposed as mitigation for Project impacts to fish passage and biotic connectivity on the Red River, downstream of the F-M urban area. Design of the Drayton Dam project would be modeled after other USACE dam reconstruction efforts on the Red River, and would include construction of a new rock-ramp spillway using rip-rap, boulders and removal of portions of the existing dam. The new spillway would be sloped at the sides to maintain flows within the center of the channel, directing them away from the banks to reduce erosion, while also allowing fish passage through the center of structure. The project concept has been designed in conjunction with the MNDNR Stream Habitat Program.

The new rock-ramp spillway is estimated to be passable under most flow conditions. In addition to improving fish passage, the use of boulders and rip-rap to build the new structure would provide aquatic habitat for fish and invertebrates, benefiting the local biotic community. The creation of a new fish passage spillway that is passable under most flow conditions, while also removing a structure that is rarely passable, would be an effective means of mitigating for Project impacts. This project is expected to provide a net benefit to the Red River as compared to existing conditions.

<u>*Wild Rice Dam Project*</u>

The Wild Rice Dam removal project is proposed as mitigation for Project impacts to fish passage and biotic connectivity on the Wild Rice River. This low-head dam is located downstream of the proposed control structure. The Wild Rice Dam fragments habitat and interrupts fish passage on the Wild Rice River under most normal and low flow conditions, and is likely only passable at high flows. The removal of this dam would improve fish passage on the Wild Rice River in a manner similar to that described above for the Drayton Dam project. The removal of a permanent feature on the Wild Rice River, as compared to the potential interruptions to fish passage from the Project would provide a benefit to the fish community compared to existing conditions.

6.1.11.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

The combinations of proposed mitigation projects appear to have the ability to adequately offset Project impacts. This assumes that mitigation projects are properly designed, constructed, and implemented, and that the Project would be operated as proposed. Monitoring and adaptive management would be used to develop response actions as needed.

The following provides additional recommendations to consider for ensuring the effectiveness of the proposed mitigation. This includes monitoring and adaptive management. Monitoring for mitigation effectiveness would be overseen by the adaptive management team. The Draft AMMP provides additional detail on recommendations for fish and aquatic biota monitoring.

Stream Channel Restoration

The ability of proposed stream restoration projects to adequately offset impacts to aquatic habitat would be dependent upon the overall success of the mitigation sites. The stream restoration projects should be restricted to streams within the Red River basin to ensure the impacts from the Project are offset within the overall watershed. Monitoring and adaptive management would be used to further evaluate the effectiveness of the stream restoration sites and develop response actions as needed. There is currently no formalized plan for where and when stream restoration projects would occur, and therefore, uncertainty about finding willing landowners to participate, whether the location of the stream restoration project would provide adequate mitigation for Project impacts, and the overall success of using stream restoration projects.

The low flow channel within the diversion channel is anticipated to replace the aquatic habitat lost in the Rush and Lower Rush Rivers. Monitoring of the fish and aquatic macroinvertebrate community in the low flow channel would be needed to confirm that lost habitat, including function and value, is adequately replaced. The results of future monitoring would be used to determine the actual level of Project impacts and the potential need for implementation of adaptive management strategies.

Fish Migration and Connectivity

The Drayton Dam reconstruction and Wild Rice Dam removal projects would permanently improve fish passage and biotic connectivity within the Red River basin. The benefits of these projects would be evident under most flow conditions each year. These projects would also be adequate in offsetting impacts to fish migration during Project operation, which would not occur every year, but instead only when the 10-year flood event and greater flow conditions are present. The EAs completed for the two dam projects indicate that the USACE would monitor and apply adaptive management as needed.

Biotic Assessments on Red River Basin Sites

Rivers, their habitat, and the associated biotic communities are complex dynamic systems, and it is difficult to predict actual impacts of the Project or the true function and value of the mitigation projects until the actual conditions can be observed. As a result, future monitoring efforts would be a key component of the adaptive management strategy to monitor for impacts, as well as the level of success of individual or collective mitigation projects. Monitoring programs focused on key stone species, their movements within the watershed and the potential impacts of these movements by the Project may be needed, along with IBI monitoring, to identify potential Project impacts in the watershed.

Due to some of the observed variability between past monitoring efforts and the first pre-construction monitoring survey on the Red River, the Draft AMMP includes fish community monitoring at all 23 sites identified in the USACE assessment be conducted at least two additional times prior to Project operation. This would ensure there are at least three monitoring events used to establish baseline conditions which are the minimum number of events needed to establish a coefficient of variation for statistical analysis. This data could then be compared and further analyzed to better understand baseline conditions and assess potential future changes or impacts in the fish community. The Draft AMMP recommends monitoring be conducted on a two or three-year return frequency for the pre-construction/operation surveys.

After completion of Project construction, additional monitoring events and assessments would be required to monitor future changes and assess impacts. Fish community monitoring at all 23 sites should be conducted following the first year of Project operation. This could possibly be done the same year the Project is operated (e.g., the flood control structures are operated in March/April and the monitoring event is conducted in July/August of that same year) or, depending on flow conditions, could be conducted the following year. If possible, it may be beneficial to conduct post-Project operation monitoring the same year after initial operation occurs due to the possibility that the Project may be operating consecutive years. A one in 10-year flood event of 17,000 cfs could occur in back-to-back years, which could make it more difficult to compare the initial Project operation assessment to the baseline assessments.

After the initial post-operation assessment is conducted, comparisons and analysis of the fish community and IBI scores would be made to the pre-operation assessments. Additional follow-up post-construction monitoring is necessary to continue for two or three additional events beyond the initial assessment after first operation. It would be necessary to conduct these events on a two to five-year return frequency depending on flow conditions and results of the other assessments. Post-construction monitoring efforts would continue to follow the same sampling protocols, survey times, and analysis methods as were established in the initial USACE effort (URS, 2013), MPCA IBI (Sandberg, 2014), and NDDH IBI (Larsen, 2013).

Visual Assessment

If observation of future Project operations document significant incidents of fish stranding, then agency partners would discuss whether operational changes might help to minimize potential stranding, or whether additional actions would be considered to reduce stranding.

6.1.11.4 Additional Mitigation Needs

Additional mitigation and monitoring measures were identified that are considered enhancements to the proposed mitigation and may in some cases; improve the likelihood of successfully mitigating for Project impacts. These measures include construction avoidance periods, monitoring additional stream restoration sites, monitoring fish passage at the control structures, and using IBI as an evaluation tool.

Construction Avoidance Periods

Construction activities, connecting Project features to the existing river channels, could disrupt fish spawning if not timed properly. The majority of construction would take place in upland areas adjacent to the existing channels, which would minimize the disturbance to existing channels. Proper timing of in-channel construction should be considered in order to minimize or avoid further potential impacts to the fish community. In order to avoid disturbing spawning periods of the majority of the fish community, it is recommended that Project construction within the river channels be conducted from mid-summer through the fall and into early winter (potentially from mid-July into December or January).

Monitoring to Evaluate Stream Restoration Project Effectiveness

Beyond the 23 sites that have been established, additional monitoring sites may be necessary. These would likely be established on stream reaches targeted for stream restoration projects. When stream restoration projects are identified, reconnaissance would be made of the stream to assess the existing habitat, establish a reach for fish community surveys, and determine the types of features to be included within the restoration project, such channel modifications, habitat improvements, and bank stabilizations.

At least one pre-construction monitoring event is recommended at a stream restoration site along with at least two post-construction monitoring events. All stream restoration monitoring should follow the same protocols used for other surveys in the project area. It may take several years after construction for stream restoration projects to become fully established with vegetation and habitat. This means that post-construction monitoring events would be necessary three to five years after restoration is complete. Comparisons to pre-construction surveys would be necessary to determine if the restoration projects are successful and adequately serving as mitigation for Project impacts.

Control Structure Impacts on Fish Passage

The final channel and control structure designs should be reviewed by AMT partners to ensure the new features of the Project minimize the potential for impacts to fish passage.

Additional monitoring of Project operation is necessary to help ensure adequate mitigation. This is necessary to observe whether fish can pass through the control structures during Project operation or determining the impacts on fish stranding in the floodplain post-operation. It would be necessary to monitor the impacts to migrations or spawning when the Project is operated to determine the level of impact and the mitigation measures that may be needed to offset impacts.

Use of IBI for Evaluation

The fish community data from the pre-construction monitoring effort did not include IBI scores. However, for the purpose of this EIS, the MPCA and NDDH used the data to calculate IBI scores for all sites in the assessment. The follow-up surveys and assessments should follow the protocols and methodologies used in the initial assessment (URS, 2013), and if possible, should take place at the same time of year within the index period. This would ensure the best possible comparison of results and IBI scores across monitoring years. Sites on the Red River and Wolverton Creek would be scored using the MPCA Fish IBI protocols (Sandberg, 2014), and the sites on the rivers in North Dakota, including the Wild Rice, Sheyenne, Maple, Rush, and Lower Rush Rivers should be scored using the Bioassessment of Wadeable Streams established by the NDDH (Larsen, 2013).

In addition to reviewing total IBI scores between and across monitoring events, review of individual metrics would also provide insight into establishing baseline conditions and monitoring future changes. Due to the low scores on the sensitive species metric in the MPCA IBI and the limited number of sensitive species recently collected from Red River and tributary systems in the project area, the sensitive species metric scores may not be a good indicator of monitoring future changes or Project impacts.

Other metrics where sites have scored well, such as taxa richness of piscivorous species and relative abundance (%) of individuals that are tolerant, would be good metrics to track across monitoring events, including pre-construction, post-construction, and operation. A decrease in piscivorous taxa metric may indicate that important game fish, such as channel catfish, walleye or northern pike, are less prevalent in the project area. A decrease in the tolerant individuals' metric score would indicate a prevalence of tolerant individuals within the total catch at site, and may indicate the Project impacts, such as changes in the flow regime or habitat changes, are allowing only species tolerant of these conditions to persist.

6.1.12 Wildlife Resources

Section 3.9 provides a discussion of impacts to wildlife resources from the Project. Impacts are primarily related to floodplain forest wetland habitat and aquatic habitat, which have both been previously discussed in Subsections 6.2.4 and 6.2.8, respectively. This section provides a brief overview and references previous subsections.

6.1.12.1 Summary of Proposed Mitigation and Monitoring

Proposed mitigation for wildlife resources includes replacement of floodplain forest wetland habitat, and all non-cropped upland habitat would be replanted with native species. Additional discussion on proposed mitigation for wetlands as it relates to wildlife habitat is provided in Section 3.9.3. Impacts to aquatic habitat would be mitigated through stream channel restoration, which is further discussed in Section 6.2.8. Adaptive management would be used to monitoring mitigation effectiveness and resolve potential issues.

6.1.12.2 Evaluation of Proposed Mitigation and Monitoring

Monitoring of the created wetlands within the diversion channel would be completed through an adaptive management. Regular monitoring of the wetland mitigation sites to ensure performance standards are met and implementing corrective actions when needed are proposed to replace lost wetland function, including wildlife habitat.

CWA Section 404 requirements would be met for wetland impacts in North Dakota, including a wetland mitigation plan. Wetland impacts would be addressed per WCA in Minnesota. The project proposer has not identified how wetland impacts in Minnesota would be mitigated. To satisfy the rules and requirements of WCA forested wetlands impacts to wetland in Minnesota would need to be mitigated at project sites within Minnesota.

Stream restoration projects would offset the direct impacts to aquatic habitat on the Red, Wild Rice, Sheyenne, and Maple Rivers. Specific stream restoration projects have not yet been identified, and it is unknown where the stream restoration projects would occur if at all. The low flow channel within the diversion channel is anticipated to replace the aquatic habitat lost in the Rush and Lower Rush Rivers.

6.1.12.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

As described in Section 6.2.4, the proposed wetland mitigation intends to meet the CWA Section 404 permitting requirements for wetland impacts in North Dakota. Based on the conceptual information developed for the current Project design, lost wetland function (not type) could be replaced over the long-term in North Dakota for non-forested wetland impacts. This replacement of wetland is consistent with methods described in the State Wildlife Action Plans (SWAPS). A temporal loss is anticipated for forest wetland impacts and there are many challenges associated with forest wetland restoration that would require careful monitoring and management for success.

It is anticipated that additional mitigation and monitoring plans would be created to address the permitting and approval processes of WCA and CWA Section 404. The ability of proposed wetland mitigation to adequately replace lost habitat would be dependent upon the overall success of the mitigation sites. This could have an effect on wildlife in the short-term and long-term if habitat is not quickly and successfully re-established.

The ability of proposed stream restoration projects to adequately offset impacts to aquatic habitat would be dependent upon the overall success of the mitigation sites. Monitoring and adaptive management would be used to further evaluate the effectiveness of the stream restoration sites and develop response actions as needed. There is currently no formalized plan for where and when stream restoration projects would occur, and therefore, uncertainty about whether these projects would provide adequate mitigation for Project impacts. Monitoring and adaptive management would also be used for evaluating the effectiveness of the low flow channel for lost habitat impacts on the fish and aquatic macroinvertebrate community.

6.1.12.4 Additional Mitigation Needs

Monitoring and maintenance efforts are necessary for inclusion in the operation and maintenance plan for the Project, including permits, in order to accurately plan and fund monitoring efforts. Maintenance efforts would potentially include reseeding efforts, control of invasive understory species such as reed canary grass and removal of less desirable tree species to ensure they do not dominate the created habitat. In addition, the operation and maintenance plan should specify a schedule for surveys to measure regrowth of the floodplain forest mitigation area and to document potential unforeseen impacts from operation of the Project.

The temporal loss of floodplain forest habitat function and value while the mitigation sites mature should be given consideration as timing of mitigation establishment is important for not only wetland function, but also habitat quality. Restoration of the mitigation sites must be completed in advance or concurrently with the anticipated impacts to minimize temporal loss, or the required replacement ratio could be increased.

Additional monitoring is necessary to evaluate the effectiveness of stream restoration projects for replacing lost aquatic habitat. The use of IBI scores as an evaluating tool is also necessary for providing a consistent dataset from which to establish baseline data for comparison purposes. These mitigation measures are further discussed in Section 6.2.8.4 above.

6.1.13 State-listed Species and Special Status Species

Section 3.10 discusses potential impacts to state-listed species and special status species.

6.1.13.1 Summary of Proposed Mitigation and Monitoring

Mitigation and monitoring has been proposed to compensate for impacts to state-listed riverine species through implementation of an adaptive management plan implemented by the USACE AMT. The following monitoring and mitigation measures are proposed to identify, avoid, and/or minimize impacts:

- Pre- and post-construction studies of biota and physical habitat for both impact sites and mitigation sites.
- Survey for mussels on the Red River to assess impacts to the black sandshell.
- Upland restoration would be completed on disturbed areas using a habitat-based approach.
- Vegetation clearing would be completed to avoid impacts to nesting cardinals and whip-por-wills.
- Construction on forested land would occur during winter months.

6.1.13.2 Evaluation of Proposed Mitigation and Monitoring

Monitoring is critical to identify potential impacts to the sensitive and rare/listed species within the project area such as lake sturgeon and black sandshell in the Red River. The USACE AMT is responsible for review of monitoring protocols, results, and would identify response action mitigation for impacts to these species.

Mitigation is proposed in uplands to replace lost habitat and native prairie previously converted to agricultural land. This has the potential to create potential habitat for state-listed species, such as the burrowing owl and garita skipper, where it currently does not exist.

6.1.13.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

Mitigation proposed through upland restoration has the potential to improve habitat for state-listed species and special status species. Other construction related activities are intended to minimize impacts to these species.

Ongoing monitoring in the Red River would assess the impacts to species such as Lake Sturgeon and black sandshell. The impact that would occur to these species is currently unknown.

6.1.13.4 Additional Mitigation Needs

Gill netting or other appropriate sampling methods for benthic fish species whose presence and abundance would not be captured with general fish sampling methods proposed have been included in the Aquatic Biological Monitoring Plan as part of the Draft AMMP. Additional information regarding fish passage structures that could minimize the impacts to migrating lake sturgeon populations are further discussed in Section 3.8 – Fish Passage and Biological Connectivity.

6.1.14 Invasive Species

Section 3.11 discusses the potential impacts of invasive species in the project area. The primary concern is the establishment of invasive species and noxious weed populations at wetland mitigation sites and construction sites where the ground is disturbed.

6.1.14.1 Summary of Proposed Mitigation and Monitoring

Wetland mitigation sites would be managed for invasive species through the implementation of maintenance and monitoring plan required in permitting. Invasive and/or non-native plant species would be managed through active maintenance including: herbicide applications, physical manipulation, burning, and reseeding where necessary. Permits include performance measures and milestones for establishing native species/communities to ensure invasive and non-native species are not allowed to proliferate.

6.1.14.2 Evaluation of Proposed Mitigation and Monitoring

Monitoring and maintenance of mitigation and disturbed construction sites would reduce the potential introduction and spread of invasive species. Maintenance to remove invasive species can be expensive, but without regular management, populations can become established. Once large populations are established, maintenance becomes increasingly more difficult. It is anticipated that the non-Federal sponsor would comply with permit requirements that address invasive species and noxious weeds monitoring and maintenance.

Pre-construction monitoring data previously collected by the USACE and post-construction monitoring of biota and physical habitat for both impact sites and mitigation sites would be included as part of adaptive management implementation. Monitoring and mitigation site management would be overseen by the Adaptive Management Team and the permitting authorities. This would allow impacts to be verified and mitigation effectiveness to be evaluated. It is anticipated that response actions would be developed as needed. The non-Federal sponsor would be responsible for follow-up actions and additional mitigation if warranted.

6.1.14.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

The proposed mitigation and monitoring intends to manage and control the spread and establishment of invasive species and noxious weeds in the project area. A number of mechanical and chemical means are proposed that if implemented properly and managed on a regular basis would prevent the spread and establishment of invasive species. Some of the requirements for management invasive species would be included in the WCA and CWA Section 404 requirements and outlined in the wetland mitigation plans.

6.1.14.4 Additional Mitigation Needs

Additional mitigation details have been provided to enhance the proposed mitigation and minimize the spread and establishment of invasive species and noxious weeds from occurring as a result of Project construction and operation.

Construction

During construction, BMPs would be followed to prevent the introduction and spread of aquatic or terrestrial invasive species (MNDNR 2013b). Prior to transporting equipment to the project area, all equipment would be cleaned and free of soil and vegetation to prevent the spread of invasive species, including removal of attached zebra mussels, plant material, and mud, which may contain plant seeds, propagating parts or other invasive species. When Project construction occurs in areas of known noxious weed infestations, equipment working in these areas would be cleaned prior to moving from the area. The AMP would outline the inspection procedures and occurrences to ensure compliance with the proposed mitigation.

When construction activities are complete, disturbed areas would be seeded with native plant species or other plant species per Project plans and specifications. Native species are adapted to local climate and soil conditions, and after establishment, need little maintenance to thrive (MNDNR 2004). An established native plant community would reduce the amount of bare ground available for noxious weeds and invasive species to colonize, in addition to soil stabilization by deep spreading roots. Prior to planting, all source materials would be free of invasive plant seeds and other invasive species (e.g., emerald ash borer larvae, gypsy moth egg masses on woody plant material or zebra mussels on equipment used in water). After native species have been planted, the seeded areas would be monitored per the Project plans and specifications. The non-Federal sponsors would be responsible for noxious weed control on the whole Project perpetually as part of the Operations, Maintenance, Repair, Rehabilitation and Replacement (OMRR&R).

Operation

Operating the Project has the potential to spread terrestrial invasive species into areas not previously exposed during the 2-percent or greater flood event, and therefore, the non-Federal sponsors would maintain and control the spread of invasive species for the life of the Project as defined in the OMRR&R. A monitoring plan would include procedures on surveys for identifying noxious weed populations, treatment plans, and follow-up surveys to confirm that treatment measures are effective. Monitoring, maintenance, and control efforts would be done on an annual basis in accordance with the OMRR&R.

6.1.15 Cultural Resources

Section 3.12 discusses the potential impacts to cultural resources from the Project and provides a summary of known NRHP-listed and NRHP- eligible properties in the project area.

6.1.15.1 Summary of Proposed Mitigation and Monitoring

The Project is required to comply with Section 106 of the NHPA. A Programmatic Agreement is in place that addresses avoidance, minimization, and mitigation measures for NRHP eligible or listed properties and cemeteries, as well as any currently unknown eligible properties. Mitigation proposed for the Project, as part of the Programmatic Agreement, includes completing Phase I and Phase II cultural resources surveys prior to construction in areas not previously surveyed, cultural resources data recovery (as needed), and Historic American Building Survey/Historic American Engineering Record documentation.

A Programmatic Agreement for the Project was negotiated and signed per 36 CFR Part 800, Protection of Historic Properties, section 14(b), as a method for the St. Paul District, USACE to comply with Section 106 of the NHPA, as amended. The Agreement covers the construction footprint; work limits, in-town levees, staging area, and mitigation sites that are part of the Project, including the Drayton Dam and Wild Rice River Dam, and includes avoidance, minimization and mitigation stipulations for each responsible party.

6.1.15.2 Evaluation of Proposed Mitigation and Monitoring

Proposed mitigation is intended to comply with Section 106 of the NHPA, which includes completing Phase I cultural resource surveys and potential subsequent Phase II surveys prior to Project construction. Additional measures beyond Phase I and Phase II surveys may be identified.

6.1.15.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

Compliance with Section 106 of the NHPA would ensure impacts to NRHP listed and eligible properties are avoided, minimized or mitigated as appropriate. The Programmatic Agreement further outlines measures to avoid and minimize impacts to properties from the Project with specific roles and responsibilities. This provides a level of assurance that implementation would be successfully completed. Mitigation measures for cemeteries have not been finalized. Information provided in the Cemetery Study (USACE, June 2014) would be used to determine specific mitigation measures for impacted cemeteries once Project design is finalized.

6.1.15.4 Additional Mitigation Needs

There are no additional recommendations at this time.

6.1.16 Infrastructure and Public Services

Section 3.13 describes the anticipated impacts to roadways, bridges, other infrastructure, and public services in the project area as a result of Project construction and operation. Mitigation for these impacts was identified in transportation plans and preliminary utility relocation plans completed for the Project.

6.1.16.1 Summary of Proposed Mitigation and Monitoring

Proposed mitigation measures include: constructing bridges, relocating roadways, terminating roadways, improving roadways, modifying railroads, and relocating utilities. Utilities that cannot withstand occasional flooding would be abandoned, modified, or relocated, depending on the situation in accordance with applicable regulations. Mitigation for potential impacts to public services, such as emergency response and United States Postal Service (USPS) delivery, are not proposed as significant impacts are not anticipated.

6.1.16.2 Evaluation of Proposed Mitigation and Monitoring

Mitigation to specific roads (i.e., Interstate 29 and US Highway 75), bridges, and BNSF railroads has been proposed based on current Project design but could change when final design is completed. If Project design changes, mitigation design may also change to ensure disruption to transportation and public services is minimized. The goals of the mitigation are to address vehicle transportation connectivity, accessibility, and mobility within the project area, and therefore, minimize impacts to traffic and public services. Based on current designs, the proposed mitigation is anticipated to minimize long-term transportation connectivity impacts caused by the diversion channel and tieback embankment.

Accessibility to most properties along the diversion channel would be maintained. Several parcels have been identified along existing roadways that require mitigation for accessibility impacts. In these cases, a cost benefit analysis for acquisition or construction of new access roadways would be completed. All existing roadways not identified as diversion channel crossings would either be terminated as dead-ends at the diversion channel or removed completely if the road is less than one-fifth of a mile. The proposed mitigation would address property accessibility in the project area.

Mobility would be mitigated through completion of roadway improvements by allowing for higher traffic volumes. This includes upgrading to gravel roadways. Based on proposed road configurations and bridge locations, emergency response times, USPS delivery service, and school bussing routes would not be significantly affected.

Detailed analysis of potential Project impacts on railroads and utilities was not completed in either Transportation Plan. Additional review would be needed to identify specific railroad mitigation. Specific improvements and/or modifications to the utility systems would be evaluated during final design of the Project. Parcels needing improvements, modifications, or relocations of utilities would be identified during that evaluation. It is anticipated that mitigation for utilities would be implemented to ensure impacts are minimized and service is only disrupted temporarily if at all.

6.1.16.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

Once final Project design is completed the Transportation Plans and preliminary Utility Relocation Plans would be updated to reflect the final design features and mitigation needed for the Project. Construction of roads, bridges, and other infrastructure, including relocation of utilities would require permitting approval from appropriate authorities. The completion of mitigation projects to infrastructure would provide adequate transportation corridors and are not anticipated to disrupt public services. If the current Project design is altered prior to construction, the evaluation should be updated.

6.1.16.4 Additional Mitigation Needs

The USPS expressed concern about phasing and timing of Project construction and the impact it could have on mail delivery routes. The non-Federal sponsor should coordinate, as possible, with the USPS to provide sufficient notice for road closures.

6.1.17 Land Use Plans and Regulations

Section 3.14 provides a discussion on land use plans and regulations that may apply to the Project. This includes permits and approvals that may be required for Project construction and operation. A summary of permits and possible approvals that may be needed for Project construction and operation is provided in Section 3.14.3.

6.1.17.1 Summary of Proposed Mitigation and Monitoring

Project approval and permit processes at the local level would include review of applicable land use plans, watershed plans, zoning ordinances and other applicable plans in the project area.

6.1.17.2 Evaluation of Proposed Mitigation and Monitoring

It is anticipated that the USACE and non-Federal sponsor would work with state and local entities to obtain permits and approvals as needed for Project implementation. The permits and approvals may have specific requirements and conditions that would be met by the USACE and non-Federal sponsor as appropriate. This would ensure that permit requirements, including mitigation, are adequate.

6.1.17.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

Construction and operation of the Project would affect multiple LGUs. Locations of Project construction would require permits and LGU approval. At this time, some local governments are unsure whether or not certain permits would be required as the actual impact of Project operation is uncertain.

6.1.17.4 Additional Mitigation Needs

No additional mitigation needs have been identified beyond the state and local permitting and approval processes.

6.1.18 Dam Safety

Section 3.15 evaluates dam safety for the Project, including discussion on studies and analyses required for Project construction and operation.

6.1.18.1 Summary of Proposed Mitigation and Monitoring

Construction of the embankment system and control structures that constitute a Class I dam in Minnesota Rules would require a MNDNR Dam Safety permit. There are a number of requirements for initial approval and long-term maintenance of that permit. Specific mitigation measures and monitoring have been proposed for impacts associated with construction of the dam, such as wetland mitigation, and are discussed in the applicable sections.

6.1.18.2 Evaluation of Proposed Mitigation and Monitoring

No specific mitigation was described in the USACE environmental review documents. The Project would require a MNDNR Dam Safety Permit, which would require specific studies and potential mitigation or conditions for approval. Approval of a permit would be dependent on the potential hazards to health, safety, and welfare of the public and the environment including probably future development of the area downstream or upstream of a dam.

6.1.18.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

The MNDNR Dam Safety permit would require approval by the MNDNR. An application would be submitted to the MNDNR along with a number of studies and analyses. These studies and analyses could include a dam breach analysis, geotechnical and slope stability analyses, structural analyses, hydrologic and hydraulic modeling, operation and maintenance plan, and structural review by the MNDNR. See section 3.15 for more detail on Minnesota Rules and Statutes pertaining the application process, how the permitting process relates to environmental review, and permit decision criteria for a Dam Safety Permit.

6.1.18.4 Additional Mitigation Needs

Section 3.15.3 provides a discussion for each of the required studies and analyses. It is anticipated the USACE and non-Federal sponsor would comply with the requirements for the MNDNR Dam Safety permit, including any permit conditions and long-term maintenance and recordkeeping.

Much of the content reviewed and included in the EIS pertaining to the design considerations of the Project and potential environmental impacts would go toward meeting the preliminary report requirements as part of the Dam Safety Permit application. However, to date no formal permit application has been submitted by the Diversion Authority. It is also noted that Project designs are still underway. It is possible that already completed studies may need to be redone or revised or additional studies may be necessary to meet application requirements.

6.1.19 Socioeconomics

Section 3.16 provides a discussion on the potential impacts to socioeconomics in the project area. Impacts to socioeconomics include those that can be quantified such as loss incurred from flood events or those that can only be qualified such as the emotional responses to a flood event or mitigation approach (e.g., property buyouts and relocations).

6.1.19.1 Summary of Proposed Mitigation and Monitoring

Mitigation proposed for socioeconomics impacts are primarily related to impacts from flood inundation to insurable structures and undeveloped lands. FEMA and the USACE have completed a Coordination Plan to address Project mitigation, floodplain management, and floodplain map revisions, including FEMA CLOMR requirements. This is detailed above in the table under FEMA CLOMR and subsection 6.2.2 FEMA Regulations and the CLOMR Process as well as in Section 3.16 Socioeconomics.

In addition to mitigation established through the Coordination Plan, the Diversion Authority has developed a Draft Ag Impacts Mitigation Plan (January 2015) to address impacts to agricultural lands, including organic farms. The mitigation may include flowage easements, voluntary acquisitions, supplement crop insurance or other compensation for impacted agricultural land.

For undeveloped lands within the FEMA revision reach (outside of the staging area) and outside of the FEMA revision reach that would still be impacted by Project actions, the USACE has proposed that a takings analysis on a case-by-case basis would be performed to determine mitigation needs. Flowage easements would only be obtained where the taking analysis determines impacts rise to the level of takings under the Fifth Amendment of the U.S. Constitution. A takings analysis approach would also be completed for structures that would be impacted outside of the FEMA revision reach.

The Project includes the construction of community ring levees for the communities of Oxbow/Hickson/Bakke and Comstock. These communities are those that contain the highest population base within the unprotected area. The ring levees would provide protection to these communities during Project operation.

6.1.19.2 Evaluation of Proposed Mitigation and Monitoring

Evaluation of the proposed mitigation and monitoring measures associated with impacts to insurable structures, floodplain designations, and floodplain mitigation was discussed in Section 6.2.2 FEMA CLOMR. The majority of the property buyouts involving structures would occur in the staging area. Property buyouts would also occur for construction of the diversion channel and associate embankment system. Buyouts associated with diversion channel construction are anticipated to be primarily land acquisition using right-of-way and easements.

Flowage easements would be purchased with the intent that undeveloped land would remain feasible to farm. The value of the flowage easement would be determined on an individual property basis by independent appraisal based on a number of factors, including flood depth, duration, frequency of additional flooding, and highest and best use of property.

According to the FFREIS, USDA RMA has indicated the purchase of crop insurance in the staging areas could still be obtained, however flood impacts resulting from the Project may not be covered. Mitigation has not been proposed by the USACE to supplement the potential impact on uninsured crops. However, Project operation changes presented during the Supplemental EA reduced operation frequency to a level that may eliminate or greatly reduce Project operation during the growing season and therefore impacts from flooding to planted crops.

Structural and non-structural mitigation that would be considered following any takings analysis completed would be similar to mitigation proposed as part of the Coordination Plan and could include flowage easements, relocation, buyouts, ring levees, dry flood proofing, and structural elevation.

6.1.19.3 Evaluation Conclusions, Recommendations, and Other Considerations or Requirements

Mitigation has not been proposed for the socioeconomic impact to the community and or individual property owners that may result from proposed mitigation such as forced relations, buyouts, and new flood inundation.

Mitigation considerations should be made for organic farms. This could include flowage easements, voluntary acquisitions or relocations, supplemental crop insurance or other compensation for impacted agricultural land, as currently being considered by the Diversion Authority.

Flowage easements would provide compensation to individual landowners. It is uncertain what the appraised value would be for each property, and therefore the value of the flowage easement, and whether a flowage easement would reduce the entire economic impact to the landowner. There is additional uncertainty of whether organic certification would influence the value of the property, and therefore, the value of the flowage easement required by USACE. Land ownership may also be a factor for implementation of mitigation for organic farms.

Federal crop insurance would apply if a crop can be planted before the established late planting dates. Federal crop insurance would apply to crops which can be planted prior to the established late planting dates. However, mitigation for landowners that do not receive flowage easements has not been proposed. Landowners would have the option of purchasing crop insurance with the anticipation their crop would be covered during operation of the Project. It is uncertain whether crop insurance would cover the economic cost to the landowner if flooding occurs and is related to Project operation.

6.1.19.4 Additional Mitigation Needs

The Diversion Authority is evaluating voluntary acquisitions, supplemental crop insurance or other compensation for impacted agricultural land and organic farms. These potential mitigation measures should continue to be considered.

The Diversion Authority contracted with NDSU to determine the additional risk to agricultural producers in the staging area. Information from this study could be used to create supplemental crop insurance risk policies, which could provide coverage for damages caused by Project operations on planted crops (summer impacts), funded through the O&M program for the Project. Supplemental crop insurance risk policies may be beneficial for the agricultural land in the project area that would be inundated by the Project.

7.0 Consultation and Coordination

7.1 AGENCY COORDINATION

State and federal agencies have participated in the preparation of this DEIS. MEPA provides guidance for agencies to evaluate potential environmental and socioeconomic impacts from the Project and alternatives. Agency representatives relied on the framework developed in MEPA for completing the EIS process. Following is a list of the agencies involved.

7.1.1 Minnesota Department of Natural Resources

The MNDNR is the RGU for implementation of MEPA for the Project. Preparation of the DEIS involved several divisions of the MNDNR including Ecological and Water Resources, and Fish and Wildlife. MNDNR managed the EIS process which included review and approval of work plans, analyses, impact assessments, and technical reports/memoranda, and collaborated with the USACE and the Diversion Authority.

7.1.2 U.S. Army Corps of Engineers

The USACE is working with the Diversion Authority to design and construct the Project. USACE is also a collaborative partner with MNDNR in the implementation of MEPA. The USACE participated in regular correspondence and worked collaboratively in the preparation of the DEIS. The USACE completed the FFREIS and a Supplemental EA and assisted in gathering information for this DEIS. USACE data and information was used as applicable.

7.1.3 Diversion Authority

The project proposer is the Flood Diversion Board of Authority (Diversion Authority). The Diversion Authority and its members worked with the USACE on the FM Metro Flood Risk Management Feasibility Study to develop the Project. The Diversion Authority was a collaborative partner and provided data and information used in this DEIS.

7.2 PUBLIC INVOLVEMENT

Public notification, opportunities for the public to obtain information, and public commenting on the Project began during the project scoping process and the preparation of the scoping environmental assessment worksheet (SEAW). In April 2013, the MNDNR prepared a SEAW and a DSDD to provide information about the Project, identify potentially significant environmental impacts, determine what issues and alternatives would be addressed in the DEIS, and determine the level of analysis required for the DEIS. A 30-day public comment period occurred from April 15, 2013 to May 15, 2013. The comments received were considered in making revisions to the DSDD prior to the agencies issuing the FSDD.

Table 7.1 Public Meetings

Date	Location	Description
May 15, 2013	Moorhead, MN	Public meeting (SEAW) with open house format followed by formal presentation and comment period
August X, 2015*	Moorhead, MN	Public meeting DEIS

*Approximate Date

The DEIS will be published and circulated in accordance with the rules and requirements of Minnesota Rules (EQB Rules) 4410, MEPA requirements. The DEIS will be distributed to allow for a 30-day comment period to satisfy MEPA requirements. Written comments will be accepted during the public comment period.

A public meeting will be held to present information on the DEIS, answer questions, and provide a forum for public comments. Comments received are taken into account in assessing project impacts and potential mitigation for the FEIS. Responses to substantive comments received will be prepared and included in the FEIS.

8.0 List of Preparers

Name and Affiliation	EIS Responsibility and Qualifications
Minnesota Department of Natural Resources	
Jill Townley	Project Manager B.E.D. University of Minnesota—Twin Cities, Landscape Architecture M.U.R.P University of Minnesota—Humphrey Institute, Urban and Regional Planning, emphasis in Environmental Planning 9 years experience in project management and planning
Kate Frantz	Environmental Review Planning Director B.S. University of Minnesota—Twin Cities in Environmental Science, Emphasis in Soil and Wetland Sciences 8 years environmental permitting and planning experience
Melissa Doperalski	Natural Resource and Regulatory Technical Consultant B.S. University of Wisconsin – Stevens Point / Wildlife and Conservation Biology; M.S. University of Wisconsin – Stevens Point / Natural Resources and Landscape Ecology 17 years in natural resources and regulatory review
Nathan Kestner	DNR Regional Environmental Assessment Ecologist B.S. Environmental Studies – St. Cloud State University 15 years of professional experience
Ian Chisholm	Supervisor – Stream Habitat Program, Division of Ecological and Water Resources B.S. University of Wisconsin – Stevens Point; M.S. University of Wyoming, Laramie, WY 26 years experience in river assessment and research, and water management
Luther Aadland	River Scientist B.A. Concordia College-Moorhead, MN; M.S. North Dakota State University; Ph.D. University of North Dakota 28 years experience in river research and restoration
Dave Friedl	Clean Water Legacy Specialist B.S. University of Minnesota St. Paul-Fisheries Management 29 years in Fisheries Management, 7 years in stream research and clean water issues
Jamison Wendel	Red River Fisheries Biologist B.S. North Dakota State University; M.S. University of North Dakota 16 years experience in fisheries management

Name and Affiliation	EIS Responsibility and Qualifications
Suzanne Jiwani	Floodplain Mapping Engineer B.S. University of Minnesota, Twin Cities, Civil Engineering; M.S. Colorado State University, Fort Collins, Civil Engineering (Water Resource Engineering) 39 years experience in field, 14 years at current position in DNR
Jim Solstad	Hydrologist B.S. University of Minnesota, Civil Engineering 35 years professional experience, hydrologic and hydraulic analyses
Jason Boyle	State Dam Safety Engineer B.S. University of North Dakota, Civil Engineering; Master of Engineering University of North Dakota, Environmental/Water Resources 15 years experience in dam safety
Emily Siira	Area Hydrologist B.S. South Dakota State University, Environmental Management, Chemistry Minor 10 years experience in water resource management
Lisa Joyal	Endangered Species Review Coordinator B.S. University of Montana, Wildlife Biology; B.S. University Montana, Zoology;M.S. University of Maine, Orono, Wildlife Ecology 15 years in wildlife biology, 10 years in environmental review
Laura Van Riper	Terrestrial Invasive Species Coordinator B.A. Gustavus Adolphus College, Biology; Ph.D. University of Minnesota – Twin Cities, Ecology 10 years professional experience in invasive species ecology and management
Neil Haugerud	River Ecologist B.A. Gustavus Adolphus College, Biology; M.S. South Dakota State University, Wildlife and Fisheries Sciences 12 years experience in river research and restoration
Mary Presnail	Floodplain Hydrologist B.S. University of Minnesota, Environmental Science Policy and Management; M.S. University of Minnesota, Natural Resource Science and Management 3 years experience in hydrology
Don Schultz	Area Wildlife Manager B.S. University of Minnesota, Wildlife Management; M.S. University of Minnesota, Wildlife Management 30 years as DNR Wildlife Manager
U.S. Army Corps of Engineers	

Name and Affiliation	EIS Responsibility and Qualifications
Craig Evans	Planner, Chief Plan Formulation Section M.A. Hamline University, Public Administration; B.C.E. University of MN, Twin Cities, Civil Engineering 28 years professional experience
Jonathon Sobiech	Biologist M.S. St. Mary's University of Minnesota, Natural Resource Analysis; B.S. University of Minnesota, Recreation and Resource Management and Forestry 13 years professional experience
Elliott L. Stefanik	Biologist, Chief, Environmental Planning Section M.S. University of Wisconsin La Crosse, Biology (emphasis in Fisheries); B.S. University of Wisconsin Platteville, Biology (emphasis in Field Biology) 18 years professional experience (15.5 yrs with USACE)
Virginia Gnabasik	Cultural Resources/Archaeologist M.A. Eastern New Mexico University, Anthropology/Archaeology; B.A. University of Wisconsin-Milwaukee, Anthropology 34 years professional experience
Diversion Authority	
John Glatzmaier	Project Manager CH2M Hill B.S. and M.S. Civil Engineering, B.S. Computer Science 15 years experience in civil engineering 8 years experience in construction
Gregg Theilman	Senior Project Manager Houston Moore Group B.S. Civil Engineering 25 years experience in civil engineering
Mark Bittner	Director of Engineering City of Fargo B.S. Civil Engineering UND (1973) 42 years experience in civil engineering
Robert Zimmerman	City Engineer City of Moorhead B.S. and M.S. Civil Engineering, Ph.D. Engineering 25 years experience in civil engineering
Jeremy Cook	Senior Economist HDR Engineering M.A. Economics, B.A. Economics 13 years experience in economics
Kyle Volk	GIS Coordinator Houston Moore Group B.S. Civil Engineering

Name and Affiliation	EIS Responsibility and Qualifications
	10 years experience in civil engineering
Matt Metzger	Civil Engineer Barr Engineering B.S. Civil Engineering 11 years experience in civil engineering
Erik Nelson	GIS Technician Houston Moore Group BS Geography/GIS 7 years experience in GIS
Wenck Associates, Inc.	
Peter Miller	Principal Oversight B.S. Natural Resources and Environmental Studies 20 years in project management and wetland science
Amy Denz	Project Manager B.S. Natural Resource Management 17 years in natural resource and environmental science, 9 years in environmental review
Chris Meehan	Water Resources Coordinator MCE, University of Minnesota BSCE, University of Minnesota 13 years in water resource engineering
Jeff Madejczyk	Fisheries Biologist B.S. Ecology; M.S. Fisheries Biology 17 years in fisheries biology, 8 years environmental review
Joel Toso	Hydrologist and Water Resources Engineer PhD (Hydraulics), MSCE (Hydrology), BSCE Professional Engineer (MN), Professional Hydrologist (AIH) 29 years in water resources engineering
Lucius Jonett	Water Resources Scientist and Landscape Designer B.S. Electrical Engineering; Masters in Landscape Architecture and Graduate Certificate in Stream Restoration 3 years in stream and ravine stabilization, 3 years in TMDL work and environmental review
Byrce Cruey	Professional Engineer (PE), Certified Floodplain Manager (CFM) B.S. Environmental Resource Engineering 8 years in related field
Brandon Gebhart	Water Resources Engineer Professional Engineer – Civil (Wyoming) B.S. Civil Engineering 20 years in Civil Engineering

Name and Affiliation	EIS Responsibility and Qualifications
Alicia Dowdy	Environmental Scientist B.S. Plant Biology; B.S. Ecology, Evolution, and Behavior 5 years environmental review, 5 years in natural resource management
Suresh Hettiarachchi	

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