

4TH STREET SOUTH LEVEE FLOOD PROTECTION AND DESIGN FARGO, NORTH DAKOTA



Background

In 2014, FEMA was in the process of updating the Flood Insurance Rate Map (FIRM). With this update, Fargo's 4th Street Levee was designated as a Provisionally Accredited Levee (PAL). For certification, the City was required to provide supporting documentation to ensure levees complied with 44 CFR Section 65.10 of the National Flood Insurance Program (NFIP).

The Project

The City of Fargo retained Houston Engineering, Inc. (HEI) to develop a final certification report to submit for FEMA accreditation; however, during the certification process, riverbank stability concerns were identified in the 4th Street Levee corridor and the levee couldn't be certified as it was.

HEI began a levee/floodwall design to modify and stabilize the existing levee. Due to necessary setbacks from the river, property acquisitions were required which divided the project into

two phases. The project required extensive coordination with the Fargo Water Treatment Plant (WTP) as much of the system's vital components needed to penetrate the levee.

Phase 1 included:

- 265 feet of earthen levee
- 210 feet of floodwall
- Storm sewer lift station with two 8,000 gpm pumps and a
- 46-inch outfall
- 11' x 11' valve box for the reverse osmosis discharge line
- 400 feet of 48-inch jack/bore of WTP overflow pipe
- 4th Street road raise
- Improved river access for US Geological Survey

Phase 2 of the project addressed additional stability concerns by unloading the river bank and closing the line of protection with a floodwall adjacent to a nearby condominium.

Phase 2 consisted of:

- 730 feet of floodwall
- Storm sewer gatewell

HEI is now in the process of assisting the City to help the flood protection become re-certified by FEMA.

The project required extensive coordination with the Fargo WTP as much of the system's vital components needed to penetrate the levee. ■



State Outstanding Design Award
ND Society of Professional Engineers

Engineering Excellence Award
Category G - Water Resources

ACEC

AMERICAN COUNCIL OF ENGINEERING COMPANIES
of North Dakota



» Location

Fargo, North Dakota

» Client

City of Fargo

» Contact

Jody Bertrand
Engineering Department
701.241.1548

» Client Benefits

- Levee protects approximately 75 structures from flooding.
- Residents remain out of floodplain and won't be required to pay flood insurance.
- New levee provides a more stable line of protection for the City.
- Access has been improved for operation and maintenance processes.
- Lift station was constructed to a higher river stage, has more discharge capacity, is safer for operation and maintenance, and provides a more secure closure mechanism than the previous lift station.
- Floodwall designed to match water treatment plant.

MICKELSON FIELD AREA COMPREHENSIVE PLAN

FARGO, NORTH DAKOTA



Background

The Mickelson Field area generally involves the neighborhoods between 8th Avenue and 11th Avenue North in Fargo, which is in direct proximity to the Red River. During the 1997, 2009, 2010, and 2011 spring floods, this area had to be protected using emergency flood control measures to prevent property damage in the adjacent neighborhoods.

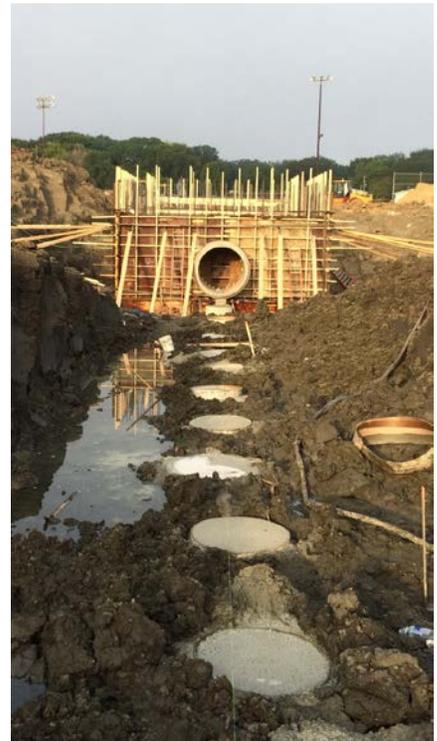
The Project

To eliminate the extensive emergency protection efforts for the homes surrounding the Mickelson Field area, the City of Fargo enlisted the services of Houston Engineering, Inc. (HEI) to develop a comprehensive flood protection solution for this neighborhood.

The resultant project had to balance the need for providing permanent flood protection for the area while preserving the natural beauty and aesthetic value of the neighborhood.

The final project consisted of a 1,500-foot-long earthen levee which has average height of 20 feet. In addition, several internal drainage structures and an internal drainage pond were installed to control local drainage on the dry side of the protection. **A new 20,000-gpm lift station was constructed to provide added protection to the area's storm sewer system, and several other storm mains were modified.**

To enhance the aesthetic and public recreational benefits of the neighborhood, a vegetation restoration plan was also developed. ■



» Location

Fargo, North Dakota

» Client

City of Fargo

» Contact

Nathan Boerboom, PE
Storm Sewer Utility Division Engineer
701.476.6743

» Client Benefits

- Eliminated the need for future temporary flood protection measures in this neighborhood.
- Improved storm sewer system capacities during non-river flooding events.
- Approximately 1,500 feet of permanent flood protection designed based on US Army Corps of Engineers and FEMA standards.

HARWOOD/RIVER DRIVE PERMANENT FLOOD PROTECTION FARGO, NORTH DAKOTA



Background

Following the 2009 and 2010 spring flood events of the Red River, the City of Fargo started an aggressive effort to reduce the dependency on temporary/emergency flood protection efforts.

The City trusted Houston Engineering, Inc. (HEI) to develop, plan, design, and oversee construction of the permanent flood protection for the Harwood/River Drive neighborhood.

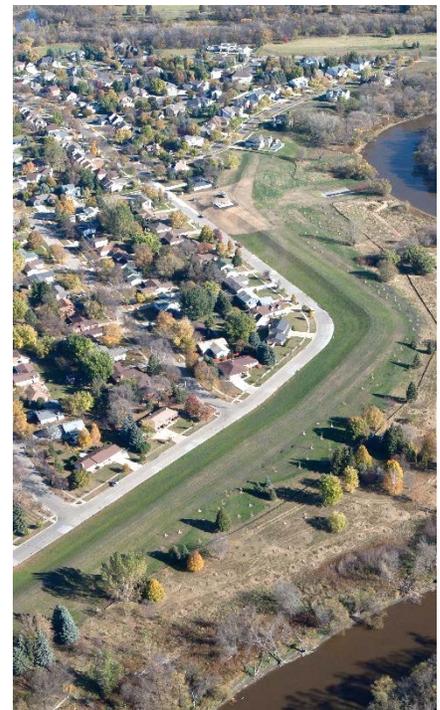
The Project

HEI replaced or modified the existing temporary levees, creating permanent earthen levees with a greatly expanded reach to protect the neighborhood. This expansion vastly reduced the need for temporary levees and sandbags in the event of a serious flood event, saving the City time and money.

The City bought many homes in the area to create space for the new permanent levees. Where homes were not bought, the levee design aimed to minimize impacts to homeowners' property and, in some cases, incorporated decorative retaining walls to help enhance the aesthetics of the area while still providing adequate protection.

To avoid internal flooding of the neighborhood, HEI designed a new 20,060 gpm lift station for the area as well as a new outfall into the Red River.

Construction was completed in the summer of 2015 at an estimated cost of \$3.4 million. ■



» Location

Fargo, North Dakota

» Client

City of Fargo

» Contact

Nathan Boerboom, PE
Storm Sewer Utility Division Engineer
701.476.6743

» Client Benefits

- Reduced reliance on temporary flood protection measures, decreasing costs and improving reaction times during major flood events.
- Incorporated aesthetic elements to enhance the neighborhood.
- Designed and constructed a new lift station and outfall into the Red River.

2ND STREET/DOWNTOWN RECONSTRUCTION FLOOD MANAGEMENT PROJECT FARGO, NORTH DAKOTA



Background

Emergency action was needed for flood protection implementation along 2nd Street in Fargo when the river stage was forecasted to rise above 31 feet. To protect this area, 2nd Street was forced to remain closed and protected with emergency clay levees. Since 1969, Fargo experienced major spring flooding several times, requiring emergency levee construction along 2nd Street 13 times. Each time resulted in substantial implementation, inspection, and cleanup costs.

The Project

As part of the Houston-Moore Group (HMG), Houston Engineering, Inc. (HEI) led the development of several options to help reduce flood risk in the Fargo downtown area along 2nd Street North. All options provided the same level of protection, but presented different opportunities for defining the river corridor by including:

- Enhanced public space options
- Area for future redevelopment with flood protection
- Methods to maintain various levels of connectivity to the river
- Final designs for floodwalls, gateway structures, utilities, and street reconstruction

The 2nd Street/Downtown Reconstruction project included realigning 2nd Street to the west to accommodate construction of a floodwall varying in height up to 15 feet. The floodwall alignment included the acquisition of several commercial properties, including the Park East Apartments, to remove that area from the proposed floodplain. This space allowed for the construction of an earthen levee.

HEI was responsible for preliminary plan development, including:

- Topographic surveys
- Public and private utility relocation
- Hydraulic impacts
- Coordinating geotechnical exploration

HEI oversaw construction for this \$40-million project, which was substantially completed in 2017. ■



Engineering Excellence Award
Category G-Water Resources

ACEC

AMERICAN COUNCIL OF ENGINEERING COMPANIES
of North Dakota

» Location

Fargo, North Dakota

» Client

Flood Diversion Board of Authority/
City of Fargo

» Contact

Nathan Boerboom, PE, CFM
Division Engineer
701.476.6743

» Client Benefits

- Flood protection for the Downtown Central Business District.
- Recreational and aesthetic enhancements along the river corridor.
- Incorporation of future redevelopment activities in the adjacent areas.
- Construction of or improvements to floodwall, retaining wall, underground utilities, and roadways.
- Created 3D animated videos to assist with public involvement.

COMPREHENSIVE FLOOD MITIGATION IMPROVEMENTS MOORHEAD, MINNESOTA



Background

For decades, the City of Moorhead has maintained a highly detailed Emergency Flood Operations Plan, which includes actions required to activate flood mitigation infrastructure and emergency measures. Over time, the City had incrementally constructed flood mitigation improvements based on lessons learned with each new flood.

However, the floods of 2009, 2010, and 2011 showed a need for a more comprehensive flood mitigation program. Floods had become more frequent and severe, and in 2009 alone, the City deployed 9 miles of sandbag levees, 9 miles of clay levees, and 61 emergency auxiliary pumps. The need for more permanent protection was apparent.

The Project

The City crafted a comprehensive flood mitigation strategy aimed at

reducing flood risks for residents. The City initiated the first phases of the comprehensive project immediately following the 2009 flood crest. This project developed incrementally and received modifications/expansions following the 2010 and 2011 floods.

During implementation of the project, the City experienced three major flood events in 2010, 2011, and 2013. With each completed phase of the project, the City's reliance on emergency measures was significantly reduced (see table at top right).

In all, \$105 million in funding was acquired to construct the comprehensive flood protection throughout Moorhead.

Houston Engineering, Inc. (HEI) assisted the City with design and other services for more than 50% of all permanent flood control work undertaken as part of this effort. ■

EMERGENCY MEASURES SUMMARY

River Stage (ft)	2009 Conditions			Current Conditions		
	Levees (miles)	Sandbags (millions)	Deploy Time (days)	Levees (miles)	Sandbags (millions)	Deploy Time (days)
38	0.7	0.67	3	0	0.01	0.5
41	4.0	2.85	7	1.2	0.20	2
42.5	9.0	4.1	10	2.1	0.35	3.5

MAJOR PROJECT COMPONENTS

Levees & Floodwalls (miles)	12.1
Removable Floodwall Closures	3
Stormwater Pump Stations	19
Stormwater Gates	78
Sanitary Sewer Pumping Stations	5
Voluntary Property Acquisitions	247
Project Easements Acquired	67

» Location

Moorhead, Minnesota

» Client

City of Moorhead

» Contact

Dr. Bob Zimmerman, PE
City Engineer
218.299.5390

» Client Benefits

- Significantly reduced the City's reliance on emergency flood protection measures, dramatically reducing deployment times.
- Implementation of closure structures keeps traffic flowing on high-volume roadways during non-flood times.

DESIGN AND CONSTRUCTION OF PUMP STATIONS MINOT, NORTH DAKOTA



Background

The catastrophic Mouse (Souris) River flood event of 2011 caused historic damage to property and infrastructure in the City of Minot. In its aftermath, the City of Minot, the Souris River Joint Board, and others have worked with Houston Engineering, Inc. (HEI) and other project partners to put in place new infrastructure that would protect the City during floods, major storms, and more.

This undertaking has included the design and construction of new and significant pump stations.

The Project

Water Treatment Plant (8th Avenue Pump Station and Mouse River Pump Station)

The aftermath of the 2011 flood revealed devastating damage to the vast majority of the City of Minot's water supply wells, and the Minot

Water Treatment Plant (WTP) needed permanent flood protection to prevent wastewater contamination. This flood protection, which included the 8th Avenue and Mouse River pump stations, reduced the flood risk to the WTP's potable water storage and high service pumping station. These facilities provide the sole source of potable water for the City of Minot and the Minot Air Force Base.

Broadway Pump Station

The Broadway Pump Station services an area 640 acres in size just north of the river. This pump station, at full capacity, can discharge 190,000 gpm.

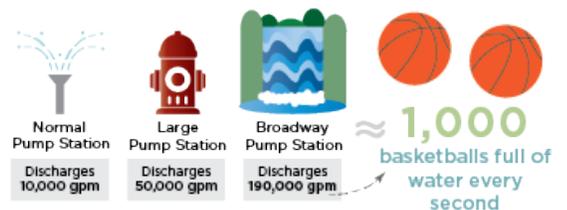
As part of the design phase for this pump station, a physical, scale-model was created at the St. Anthony Falls Laboratory at the University of Minnesota in the Twin Cities. This model was used to simulate the hydraulic conveyance of the pump station.

The Broadway Pump Station will ensure internal drainage in its area north of the river and, on the dry side of the flood protection, will be sufficient enough to avoid internal flooding.

4th Avenue Northeast Pump Station

As part of the ongoing efforts throughout Minot, HEI is designing the 4th Avenue Northeast Pump Station as well as a retention pond located east of downtown to protect northeast Minot. The pump station is anticipated to have a capacity of 30,000 gpm. ■

Broadway Pump Station



» Location

Minot, North Dakota

» Client

City of Minot
Souris River Joint Board

» Contact

Dan Jonasson
Public Works Director
701.857.4140

» Client Benefits

- New pump stations provide adequate internal drainage throughout Minot to prevent flooding during heavy precipitation events.
- The Broadway Pump Station discharges 190,000 gpm at full capacity.
- The Minot WTP project consisted of the 18,000-gpm 8th Avenue Pump Station to draw down stormwater and the 9,000-gpm Mouse River Pump Station to pull water from the river to treat in times of emergency.