

Emergency Relief Program Resilience Case Study – Iowa

Erosion Control for Flood-Prone Roadways

On March 12, 2019, the State of Iowa and other parts of the Midwest experienced a disastrous weather event that brought heavy rains and higher than average temperatures to the area. This weather caused rapid snow melt within the Missouri River system and exacerbated the water levels of the Missouri River and other local river systems in Mills County, Iowa. These high-water levels caused the levee system located where the Platte River connects with the Missouri River to overtop and fail. Floodwaters from the failed levee combined with more flood water from the north and overtopped U.S. Highway 34 (US 34) on its east-west section. US 34, a 4-lane divided highway, is a major connector to the State of Nebraska for freight movement and is one of the limited options to cross the Missouri River; the closest alternate route is 12 miles away.

The flood destroyed a 3.5-mile section of US 34. The full roadway cross section was damaged in parts, and floodwaters eroded the foreslope, causing the pavement to break and undermine both the roadway and the embankment. Additionally, granular entrances were washed out, and pipes were displaced or damaged. The roadway was closed to traffic for several months, resulting in a 30-mile detour.

Immediately following the event, the Iowa Department of Transportation (Iowa DOT) began emergency repairs to restore essential traffic to US 34. By May 2019, the site was repaired by replacing existing roadway sections, restoring the embankment, and adjusting and replacing displaced and damaged pipes. The restoration-in-kind emergency repairs, which cost \$6.8 million, were funded with Federal Highway Administration (FHWA) Emergency Relief (ER) Funds.



Figure 2: Damaged section of US 34 exhibiting cracked pavement, washed out embankment, and displacement of the roadway. Source: FHWA

Project Snapshot



Figure 1: Shows the damage to the roadway embankment and shoulder (US 34). Source: FHWA

Location: Mills County, Iowa

Date of ER Event: March 2019

Nature of Event: Flooding

Assets Impacted: US 34 (from mile marker 0.55 to 3.65): full roadway cross section and pipes

Cost of Resilience Improvements: \$2.3 million dollars

Type of Improvement: Betterment; Concrete block matting system

Economic Justification: Benefit-cost ratio of 1.07

Lead agency: Iowa Department of Transportation

Other agencies involved: Federal Highway Administration, Iowa Division and U.S. Army Corps of Engineers

Resilience Features to Protect Against Future Flooding

Because the area along US 34 is prone to flooding, the Iowa DOT also began assessing the options for a betterment to improve the long-term resilience of the roadway to future events. At first, the Iowa DOT considered installing riprap along the roadway; however, the State wanted to strengthen the roadway and implement a more dynamic design to move with the slope to stabilize the roadway in the event of future flooding. Iowa DOT chose a tied concrete block matting system that anchors to the ground and can contour to the shape of the foreslope, thus adjusting to the best position to protect the roadway from undermining. This solution was chosen based on a successful application of this same system at another highway location within the State. The particular system chosen—which has a life span of 50 years—allows vegetation to grow on top of it and requires no additional maintenance.

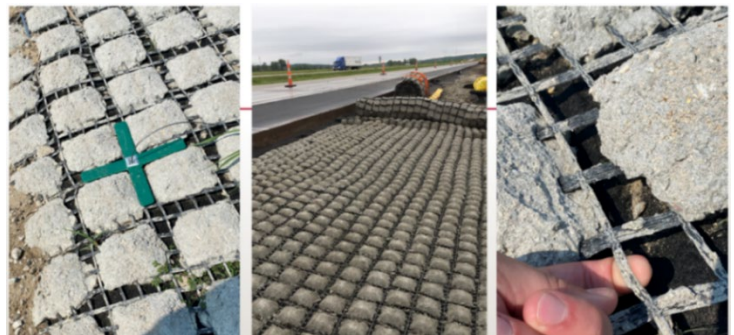


Figure 3: Closeup showcasing the makeup of the tied concrete block matting system. Zoomed out view of the placement of the material along US 34. Source: FHWA

The Iowa DOT evaluated the cost effectiveness of installing the tied concrete block matting system to weigh the cost of the betterment against the risk of eligible recurring damage and the cost of future repairs, as directly related to the FHWA ER Program. The Iowa DOT examined past ER events in the area to gather information on flooding trends. In addition, the agency used guidance and information from FHWA's [Hydraulic Engineering Circular No. 17, 2nd Edition](#) and the Iowa DOT's design manuals to understand the current frequency and intensity relationship of flooding in the area and to inform projections of future flooding events. The Iowa DOT used hydraulic data and modeling to determine what water levels could cause similar damage in the future. Iowa DOT staff analysis concluded that a 100-year event would cause similar damage. Furthermore, the Iowa DOT used the probability equation (with variables of the material's life span and cost) to determine if the cost of the solution would benefit the FHWA ER program. Iowa DOT calculated a benefit/cost ratio of 1.07, which showed that the cost of the betterment was economically justified and would save the FHWA ER Program money in the long run. As a result, in April 2021, FHWA determined that the betterment was eligible for funding under the FHWA ER Program, and the Iowa DOT completed installation of the tied concrete block matting system along 2.25 miles of US 34 later that year.

Challenges and Lessons Learned

The Iowa DOT developed an economic justification for FHWA ER funding. Through ongoing communication and coordination, they agreed upon an approach, which relied on hydraulic data, to assess the frequency of future flooding events. The analysis was consistent with the Iowa DOT's design manual, which had been revised in recent years to require interstates and bridges to accommodate a 200-year event. In addition, to account for the fact that minor damage may still occur even once the betterment is in place, the FHWA Iowa Division Office and the Iowa DOT worked out a cost of \$200,000 to assume as an additional cost in damage as part of the benefit/cost calculation. While this lowered the benefit/cost ratio, the FHWA Iowa Division Office believes this approach appropriately captured potential costs to the agency from future flooding events.

Key Takeaways

Iowa DOT's previous extensive hydraulic study of the area and proactive approach to updating State design standards to account for a changing climate provided the agency a strong foundation to identify and assess the cost effectiveness of resilience features to protect important assets from future flooding. While developing the economic justification for the betterment proposal was challenging, the Iowa DOT worked with the FHWA Iowa Division Office to identify an approach so that proposed resilience improvements consider a changing environment and are defensible in terms of reducing future ER eligible damage.

Contact Information

Andrew Zimmerman, Area Engineer and ER Coordinator
FHWA Iowa Division
andrew.zimmerman@dot.gov
515-233-7334

Disclaimer: Except for the statutes and regulations cited, the contents of this document do not have the force and effect of law and are not meant to bind the States or the public in any way. This document is intended only to provide information regarding existing requirements under the law or agency policies.