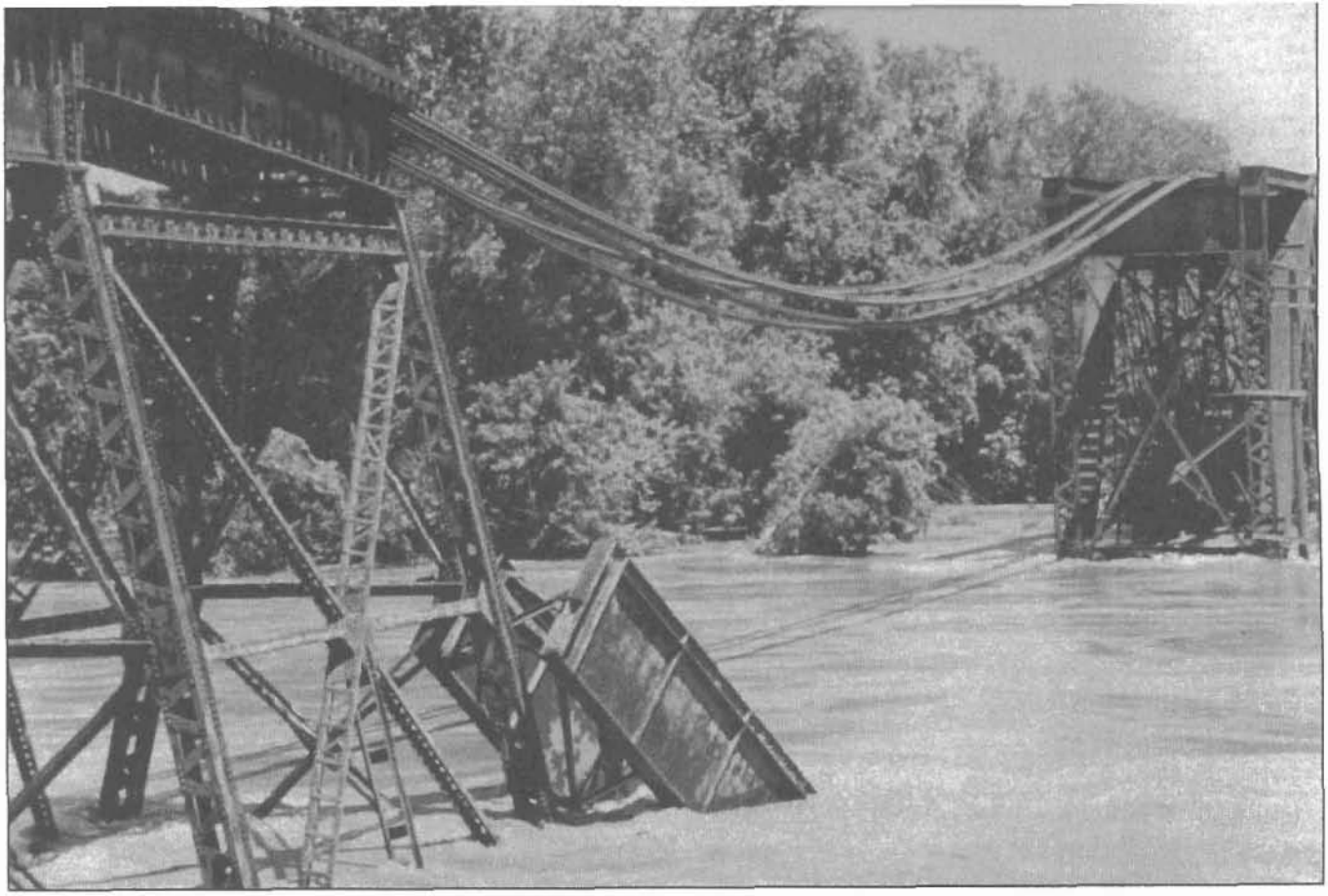


The Corps' Response to the Great Flood of 1993

This article is an edited version of LTG Williams' statement before the Subcommittee on Investigations and Oversight, House Committee on Public Works and Transportation, October 28, 1993.

Flooding in 1993 of the Upper Mississippi and Lower Missouri River Basins was the most devastating flood in our nation's history. Nine states: North Dakota, South Dakota, Minnesota, Wisconsin, Iowa, Nebraska, Illinois, Kansas, and Missouri, received the brunt of nature's onslaught.

The great flood of 1993 was a rare event, which many hope will not be repeated in their lives. Expected to occur only once every 100 to 125 years (which equates to a 0.8 percent to 1.0 percent chance of occurrence), the flow of water down the Mississippi River to St. Louis peaked at 1.1 million cubic feet per second. At locations in the upper Mississippi River, flooding approached a 500-year flood. Pappillion, Nebraska, received an inch of rain in only six minutes; at Fargo, North Dakota, the Red River rose four feet in just six hours. Uncommon events such as these quickly became commonplace throughout the midwest.

This flood event left an unforgettable mark on the people and the land. Not only was the flood characterized by its record peak levels, but also by its sheer volume and duration. The volume of runoff produced by incessant and protracted rains dwarfed that produced by the previous record flood of 1844. At St. Louis, the Mississippi River remained above flood stage for more than three months.

This article describes the Corps of Engineer's role in this epic flood, summarizes the damages and relief efforts, and identifies lessons learned during the recovery process.

The Corps Role in the Region

The U.S. Army Corps of Engineers constructed and operates a vast flood-control infrastructure on tributary rivers in the Upper Mississippi

By Lieutenant General Arthur E. Williams

River Basin. This system consists of 72 dam and reservoir projects, more than 200 levees, floodwalls, pumping plants and diversion structures. Additionally, other federal agencies and numerous nonfederal public and private interests have built thousands of flood control structures throughout the basin. Some of these flood control structures are eligible for Corps assistance during flood disasters.

Each reservoir in the system has a water control plan that specifies how water will be stored and released under a variety of hydrologic conditions in its watershed. Under flood conditions, reservoirs impound and later release floodwaters in a controlled manner to lessen the impact downstream. By August 1, 1993, reservoirs in the midwest were at their peak storage—almost 20 million acre-feet of floodwater. Once a flood crest has passed, operating plans call for the release of stored floodwaters as quickly as possible without further impacts to the flooding downstream. It is important to rapidly return each reservoir to its normal pool level so storage space is available to capture the next flood. The Corps operations in the spring of 1993 were no different in this regard.

Federal navigation projects in the Upper Mississippi River Basin are vitally important to our nation's economy. Upstream from St. Louis, there are 34 locks at 29 sites along 854 navigable miles of the Mississippi River. Along the 753 miles of navigation on the Missouri River, there are no locks. The Illinois River has nine locks along its 327-mile system, and the Kaskaskia River has one lock on its 30-mile length. Navigation on these flood-swollen rivers was essentially stopped from June through August 1993 because of dangerous channel conditions. Navigation industry losses exceeded $300 million. As an example of the impact on navigation, approximately 8 million tons of cargo normally pass through Lock 27 near St. Louis during the month of July. The total tonnage for July 1993 was zero. Other locks within the system above St. Louis reported similar impacts.

Damages

The great flood of 1993 earned the dubious distinction as the flood of record. Unlike a hurricane or earthquake, where the disaster strikes quickly, the 1993 flood sustained its relentless attack from the spring through the summer, leaving 50 people dead in its wake. It inflicted more than $20 billion in damages. Communities witnessed the destruction and damage to 72,000 homes. Water inundated 20 million acres of agricultural land, destroying $1.5 billion of soybeans in Illinois and $1.0 billion of corn in Iowa.

The Corps' flood control infrastructure, including flood control reservoirs, levees, walls, and other structures, performed extremely well during the crisis; they prevented billions of dollars in damages. For example, of the 230 levees constructed by the federal government, only 38 were overtopped and two breached, compared with an 80 percent rate of overtopping and breaching of private levees. Since the flood, the Corps has begun spending an estimated $250 million to make repairs to both federal and nonfederal levees.



Photo this page: At Sny Island, Illinois, a dozer clears dredged material from the riverbank.

Photo opposite page: A railroad bridge at Glasgow, Missouri, succumbs to rising water. Floodwaters ravaged the midwest from spring through late summer 1993.

Flood waters moved large quantities of sediment into the navigation channels, causing additional damage. Estimates are that $11 million worth of dredging will be needed to restore these navigation channels.

Recreation areas were also affected. The Corps temporarily closed more than 100 recreation areas, either fully or partially. Shower buildings and comfort stations were severely damaged, roads and areas around boat ramps and swimming beaches were eroded, and campsites were destroyed. These recreation areas suffered damages amounting to about $11 million.

Relief Efforts

The Corps operates under two basic emergency authorities that allow it to prepare for and respond to disasters. These authorities are the Flood Control and Coastal Emergency Act (Public Law 84-99, as amended) and the Robert T. Stafford Disaster and Emergency Assistance Act (Public Law 93-288, as amended). Public Law 84-99 permits the Chief of Engineers to undertake activities that include flood response and rehabilitation of flood control works. Under the Stafford Act, the Federal Emergency Management Agency (FEMA) developed a contingency plan for a holistic federal response called the Federal Response Plan. This plan calls on 26 federal departments and agencies and the American Red Cross to execute coordinated disaster relief and recovery operations. Specifically, it allows FEMA to assign public works and engineering missions to the Corps. The intent of both the Stafford Act and Public Law 84-99 is for the federal government to assist states, not to take over and direct disaster relief operations.

Under the authority of Public Law 84-99, the Corps assists state and local agencies with planning, flood fighting, and the rehabilitation of eligible flood control structures. The Corps maintains supplies such as sand bags and pumps for use in flood fights. If these stocks are depleted, each district emergency operation center has on file lists of sources where supplies and equipment can be quickly procured. As early as June 1993 the Corps began to distribute what would eventually exceed 31 million sand bags and loaned 430 pumps to aid local communities. In some instances the Corps contracted with private construction firms to reinforce levees. This emergency work amounted to about $25 million. Our professional engineers also assisted local governments by providing technical advice. By working closely with the levee districts, local and state officials, and other federal agencies, the Corps maximized its effectiveness during the response phase.

Once FEMA activated the Federal Response Plan on July 11, 1993, the Corps executed FEMA-directed missions. The Environmental Protection Agency, U.S. Public Health Service, Departments of Transportation, Agriculture, and Interior, and the General Services Administration provided valuable support to the Corps mission assignments. The Corps provided damage surveys, generators, and portable toilets; installed culverts; and supplied potable water. A significant water supply mission involved the transportation and storage of potable water to Des Moines, Iowa, when that city's water treatment plant was flooded. The recovery phase of the mission included technical assistance to rehabilitate the plant and restore the water supply to approximately 250,000 people. The cost of these FEMA missions amounted to more than $20 million.

Throughout this flood emergency, the Corps coordinated relief operations with several federal agencies—the U.S. Coast Guard (USCG), the U.S. Geological Survey (USGS), the Bureau of Reclamation (BOR), the National Weather Service (NWS), the Soil Conservation Service (SCS), and the Federal Emergency Management Agency (FEMA). Of particular note, the Corps called on the USGS to make additional flow measurements at key river locations for use in making water control decisions. Because of the close working relationship between the Corps and USCG, navigation issues and safety concerns were quickly addressed and disseminated to the public. Engineers from the BOR supplemented Corps damage survey teams so that damages were rapidly quantified. A triumvirate of the Corps, SCS, and FEMA coordinated federal policies regarding levee rehabilitation and developed joint management teams at the disaster field offices established by FEMA. In late August, representatives from the U.S. Fish and Wildlife Service (USFWLS) and the Environmental Protection Agency (EPA) were added to these interagency teams to evaluate nonstructural alternatives to levee repairs where appropriate. Contractors, soldiers and private citizens emerged to lend their valued support. All partners contributed their personnel, expertise, and professionalism. This team effort expedited relief operations and alleviated the suffering of those affected.

Especially productive were the efforts to bring back navigation to the Upper Mississippi River Basin without creating additional damages to, or threatening the stability of, weakened levees. The possibility that the wakes caused by barge traffic would further damage levees alarmed local officials. On July 19, the Corps met with the River Industry Executive Task Force and the Coast Guard to develop a plan for restoring navigation. The plan included a test tow protocol for opening the waterways. The plan of operation included a navigation traffic control center for direction, monitoring,

information exchange, and public announcements. The test tow protocol required that three tows descend the Illinois and Mississippi Rivers to determine if wave action would cause additional stress to the levees. Levee district representatives rode the three tows to see first-hand the effects of commercial traffic. We commend the navigation industry for this cooperative effort. The River Industry Executive Task Force exemplifies what government and industry can accomplish in cooperative approaches to problem solving.



Volunteers fill sandbags at Roshenport, Missouri. The Corps provided more than 31 million sandbags to the midwest to hold back flood waters.

The flood fight demanded a massive commitment of Corps personnel. When the call went out for assistance, more than 1,000 Corps team members came forward and volunteered for duty in the affected areas. They deployed to the three Corps divisions (North Central, Missouri River, and Lower Mississippi Valley) and their subordinate districts (St. Paul, Rock Island, Omaha, Kansas City, St. Louis, and Memphis). Our volunteers brought that indomitable credo "The Corps Cares." Armed with their professional skills and concern for their fellow citizens, the volunteers worked tirelessly to help mitigate the damage. Throughout the remainder of 1994, between 200 and 500 deployed personnel will finalize levee rehabilitation. Once again, Corps personnel have proven to be our organization's greatest asset.

As the magnitude of the flood grew, I directed the establishment of a coordinating office to oversee the flood fight. Known as the Deputy Director of Civil Works (Forward), the office activated August 4, 1993 in St. Louis. The Forward Office, headed by MG Albert Genetti, Commander of the Ohio River Division, developed a strategic management plan for implementing recovery operations. It provided a regional setting to ensure Headquarters USACE policies were reviewed, interpreted, and applied uniformly. The office also became a one-stop shopping center from which to coordinate all public affairs and to provide liaison with congressional, state, and local interests. On September 17, having set recovery policies and procedures in place, the office closed.

As the floodwaters finally receded during October and November, the Corps began in earnest to rehabilitate more than 200 damaged federal and eligible nonfederal levees. Districts identified 38 levees where immediate and provisional measures could be provided to reduce the risk of further damage. The Corps expedited initial repairs to those levees, with final repairs to follow in 1994 for the remaining eligible levees. All initial repairs will be completed prior to the spring of 1994, when the annual thaw may again threaten to send floodwaters south to the Gulf of Mexico. The first 38 levees entered the Corps' Fast Track Levee Rehabilitation Program. This program typifies the creative solutions the Corps team developed to solve immediate threats to life and property. Design, contracting, and construction teams sped temporary repairs to these levees so that a minimum 20-year level of protection would be in place before the possibility of spring flooding.

Corps contractors will restore many of the more than 200 eligible levees scheduled for final repairs to their predisaster condition; however, more than half of the final repairs will not be completed until late 1994. Thus, the Corps will be fully engaged in rehabilitating levees for more than a year after the great flood of 1993 struck the region.

The Corps' Levee Rehabilitation Program is analogous to an insurance policy that promotes levee integrity and financially protects public levee sponsors. Active program sponsors comply with engineering and maintenance standards that ensure reliable protection against floods. In return, when an eligible levee is damaged by a flood, the Corps funds 80 percent of the repair cost. This program benefits public sponsors and minimizes the destruction caused by floods.

In the aftermath of the 1993 flood, the Corps received more than 500 requests for levee rehabilitation. About 300 of these requests were rejected because levee sponsors had previously elected not to

enroll in the Corps program, or because the levees were in an unsatisfactory state of maintenance prior to the flood. These levee sponsors had no Corps "insurance policy." Levee sponsors enrolled in the Corps program spend thousands of dollars each year to maintain the integrity of their levees. Their steadfastness to sound engineering and maintenance resulted in Corps assistance after the 1993 flood—often exceeding $1 million per levee.

Lessons Learned

Some significant lessons learned from the great flood of 1993 follow. The list is incomplete because the task to repair damaged eligible levees will not be finished until late 1994, and we expect more lessons will be learned.

- The Deputy Director of Civil Works (Forward) in St. Louis was a success. Not only was the office able to coordinate implementation of policy, but it was a "one stop" information office that elected officials and members of the public could contact for specific information. The Public Affairs Office released information that affected the entire area to both the news media and the public. Thus, the responsiveness and credibility of the Corps increased with those most affected by impacts of the flood.
- On the engineering front, the Corps recognized the need for a better computer model to simulate the flows of the Mississippi and Missouri Rivers and their tributaries. The computer model will be used to determine impacts of flooding on facilities and water control plans. We are already involved in developing that model and will coordinate with the National Weather Service in its development.
- The automation of data dissemination among the Corps headquarters, divisions, and districts requires improvement to take advantage of current technology. As a result of this flood, we have identified the need to develop a better means for the exchange of water data between federal agencies on a real-time basis.
- The 1993 flood showed that Corps flood control projects, including reservoirs and levees, worked as designed and withstood the test of this flood. The water control plans for the reservoirs helped guide Corps decisions during these unprecedented conditions.
- The emergency operations centers at Corps headquarters, divisions, and districts functioned very well during the crisis. They provided timely responses to needs throughout the affected area.
- The River Industry Executive Task Force worked extremely well and illustrated the benefits of government and industry cooperation.
- The Corps' volunteer program was also a great success. It provided a pool of more than 1,000 individuals who were willing to go to the stricken area and join in the flood fight.
- As a result of the 1993 flood, many sponsors of public levees now realize the value of the Corps' levee rehabilitation program. If more sponsors join our program, more levees will be better maintained and better able to protect life and property.
- Our federal partners are a great force multiplier. Each organization has unique capabilities and dedicated professionals who contributed to the Corps successes. Teamwork provided the most effective relief possible.

The Future

In anticipation of spring flooding during March and April 1994, the Corps has developed an action plan. Routine planning activities include the identification of emergency contractors and borrow sites, and pre-positioning of sand bags and pumps. Additionally, the Corps will continue to educate the public, especially state and local governments, in flood fighting techniques and Corps assistance programs. In cooperation with the National Weather Service, we will assist in forecasting flood-vulnerable areas by estimating rainfall amounts, soil moisture content, and water content of the snow cover. The Corps stands ready against potential spring flooding.

Chaired by the White House, an interagency committee is analyzing floodplain management policies. The goal is to formulate coordinated and coherent interagency policies toward floodplain management that optimizes and balances uses of the floodplains. State and local participation in this effort are crucial. The committee has the difficult, but important, task of balancing the legitimate uses of navigation, flood control, water supply, recreation, industry and economic development, agriculture, environmental preservation, and habitat restoration. It will examine the whole ecosystem, while keeping in mind that 260 million humans are also part of that system. All committee members share a common hope—that the magnitude of the devastation caused by the great flood of 1993 never revisits the midwest. Whatever the decisions resulting from this effort, the Corps will be intimately involved in implementing them.

ESSAYONS!

Lieutenant General Williams is the 48th Chief of Engineers. He previously served as U.S. Army Corps of Engineers Director of Civil Works, Pacific Ocean Division Commander, Lower Mississippi Valley Division Commander, Sacramento District Commander, and 44th Engineer Battalion Commander. He is a graduate of the Naval War College and holds a masters degree in civil engineering from Stanford University. LTG Williams is a registered Professional Engineer in Minnesota.

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Letter to the Editor

Reference Bosnia: Engineer Planning for Operations Other Than War, By Major David R. Brown, *ENGINEER* magazine, November 1993.

The feature article referenced was an interesting introduction to the engineer specific concerns in OOTW. In an arena which includes numerous vital topics, the author succeeds in providing thought-provoking opinions. The "Mine/Countermine Operations" portion of the article was undoubtedly intended to cause appropriate self-reflection in the combat engineer community and units concerning their proficiency in countermine operations. Instead, the misplaced emphasis of the article may only have destroyed soldier confidence in a good piece of equipment, the currently fielded AN/PSS-12 mine detector.

The mine danger to our soldiers is very real. Antitank and antipersonnel mines are among the most lethal munitions on the battlefield, even though much of the world mine stockpile may NOT be very "high-tech." There is not presently any fielded means of stand-off detection to allow our soldiers to locate camouflaged or concealed mines without exposing themselves to serious injury or death. There also is no non-metallic mine detector fielded or presently available to U.S. forces.

The key to our detection "deficiency" was correctly identified by the author: TRAINING. In fact, proper training is so crucial that the lead sentence in the Mine/Countermine part should more correctly read "Many soldiers have little confidence in their ability to detect any mines with any equipment currently fielded." Despite such valid concerns, however, documented recent field use on live-armed mines in Southwest Asia by civilian contractors and in Bosnia by allied peace-keeping forces indicates unreservedly that trained operators using the AN/PSS-12 successfully detected the majority of all AP mines, even those touted as "non-metallic." This was possible because even non-metallic mines generally have at least a metal firing pin which can be detected by a well-trained operator using the AN/PSS-12. The confidence level has nothing to do with the extremely capable AN/PSS-12 detector, and everything to do with the frequency and realism of the detector training conducted.

An article featuring the successful use of the AN/PSS-12 is being written and will be submitted for publication in a future edition of *ENGINEER*.

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Letters to the editor are welcome. They should be addressed to: Editor, ENGINEER Professional Bulletin, ATTN: ATSE-T-PD-EB, Fort Leonard Wood, MO 65473-6650.