

BIRDS POINT-NEW MADRID FLOODWAY

The Birds Point-New Madrid floodway is designed to prevent the MR&T project design flood from exceeding the design elevation on the Mississippi River levees in the vicinity of the confluence of the Mississippi and Ohio rivers. The floodway not only protects Cairo, Ill., but also 2.5 million acres of land in Missouri, Arkansas, Kentucky and Tennessee. The floodway is bounded on the east by the 56-mile-long frontline MR&T levee that generally runs along the Mississippi River between Birds Point, Mo., and New Madrid, Mo. On the west, the floodway boundary is defined by 36-mile-long setback levee. The frontline and setback levees end without connecting near New Madrid, leaving a 1,500-foot gap that serves as an outlet for interior drainage. This gap also permits backwater flooding in the lower portion of the floodway. The area within the floodway comprises approximately 133,000 acres.

The frontline levee includes three crevasse sites (upper, middle and lower) that introduce floodwaters into the floodway upon activation. The 11-mile long upper crevasse site consists of approximately 8.5 miles of fuseplug levee standing two feet lower than the frontline levee. The fuseplug levee is lower than surrounding levees because it is designed to overtop to relieve pressure on the nearby levees in the system. The remaining 2.5 miles of the upper crevasse site are constructed to the same height as the frontline levee, but they contain imbedded polyethylene pipes that can be filled by pumping liquid blasting through pre-emplaced access wells installed in the levee.

Upon activation, the liquid blasting agent is exploded to remove approximately seven feet from the top of the levee to allow floodwaters to enter the floodway. The middle crevasse site is a 5,500-foot-long section of levee that also contains imbedded pipes and is activated in similar fashion to the upper crevasse site.



This site is used to both introduce floodwaters upon floodway activation and to drain the floodway after the flood crest passes. The 5-mile-long lower crevasse consists of approximately 3.5 miles of lowered fuseplug levee for overtopping and 1.5 miles of raised

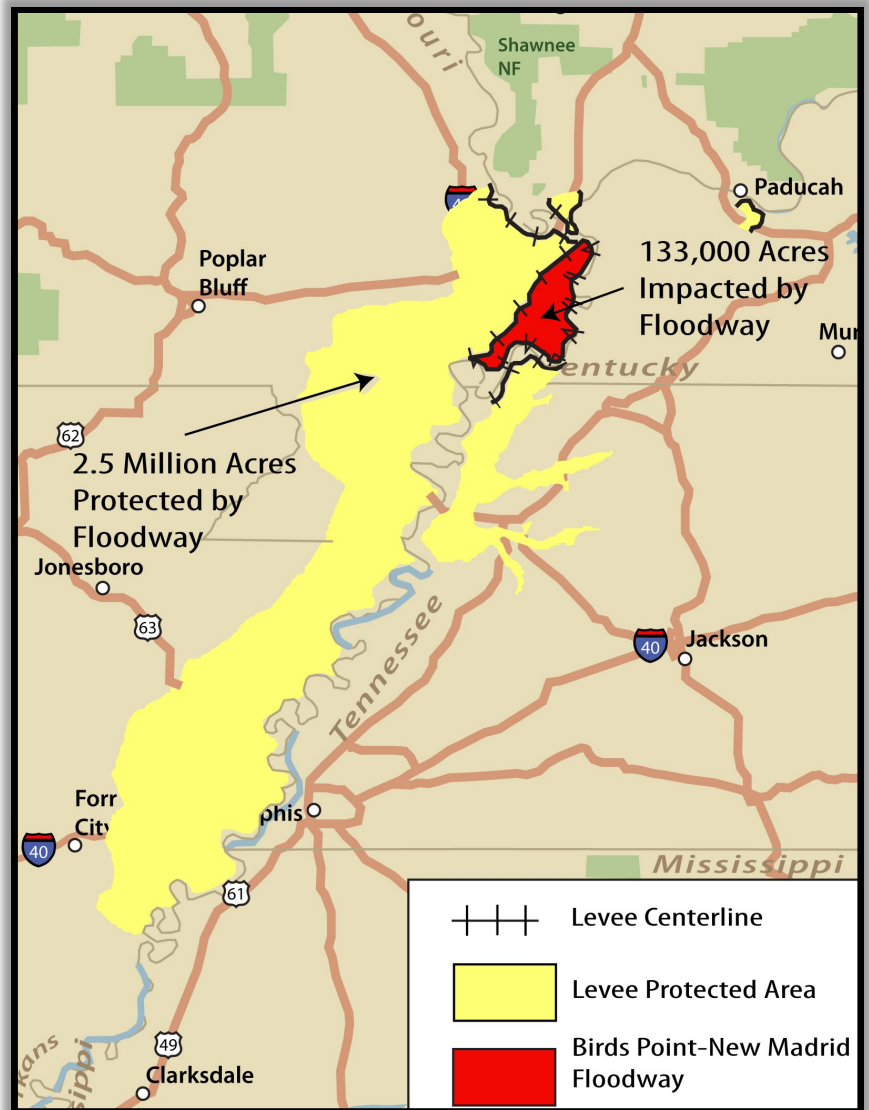
sections of levee that are imbedded with pipes. The lower crevasse site also acts as an inflow and outflow location.

Under project design flood conditions, the floodway can pass up to 550,000 cfs from the Mississippi River and provide up to 7 feet of stage lowering in the vicinity of Cairo, with smaller reductions above Cairo and through the floodway reach. Because timely operation of the floodway is critical to ensure it performs as designed, the operations plan includes a timeline with trigger stages for preparation of the inflow crevasse. According to the tenets of the plan, preparations for artificial crevassing should be completed by the time the river stage reaches 60 feet at the Cairo gage.

The operational plan allows for the leeway to activate the floodway when stages reach at least 58 feet on the Cairo gage, if warranted by the conditions of the MR&T levee system in the vicinity. The operation of the floodway is directed by the president of the Mississippi River Commission after consultation with the Chief of Engineers.

History of the Floodway

The Birds Point-New Madrid floodway proved controversial almost from its conceptualization prior to the 1928 Flood Control Act. In the aftermath of the devastating 1927 flood, President Calvin Coolidge instructed the Mississippi River Commission and the Corps of Engineers to develop comprehensive plans to prevent a similar tragedy from happening again. The resultant commission plan, with an estimated cost of a then-staggering \$882 million, recommended the inclusion of four floodways to allow room



for the river to expand and to relieve pressure on surrounding levees in the system. The proposed floodways, however, were all situated below the mouth of the Arkansas River. From Cape Girardeau, Mo., to the mouth of the Arkansas River, the commission recommended stronger and higher levees that would be set back from the existing levee system at places where the confined channel was too narrow to handle the maximum probable flood. To provide protection for Cairo, at that time a lavish and bustling river town with a population exceeding 15,000, the commission recommended raising the level of levee protection to 70.4 feet on the Cairo gage.

The plan submitted by Maj. Gen. Edgar Jadwin, the Chief of Engineers, differed from the commission plan in a number of respects and had an estimated cost of only \$296 million—a number that was well-received by the fiscal conservatism of the Coolidge administration. One of the more noticeable engineering differences involved Jadwin's proposal for the construction of the Birds Point-New Madrid floodway, which he believed was less expensive and less dangerous than the commission recommendation for higher and stronger levees to protect Cairo. The initial floodway operations plan did not rely on explosive detonation. Instead, the plan called for the existing Mississippi River levee between Birds Point and New Madrid to remain in place, but approximately 10 miles were to be cut down or degraded by 3 feet. The height of the degraded levee would correspond to a gage reading of 55 feet on the Cairo gage. This cut-down section of levee represented the fuseplug – a levee designed to overtop and crevasse as a means of triggering the activation of the floodway. The setback levee to the west was intended to confine the floodwaters introduced into the floodway. By Jadwin's estimation, the floodway would undergo operation approximately once every ten years.

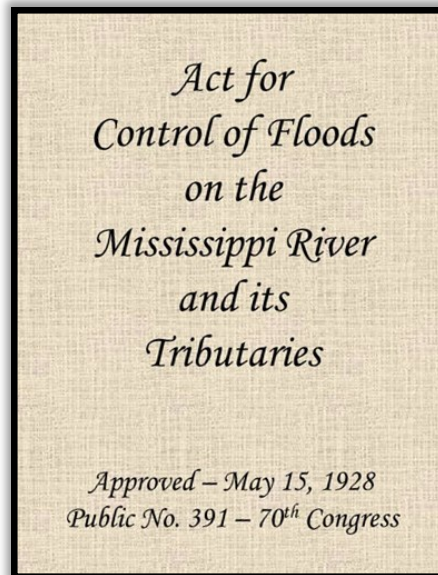
A review of the transcripts of the hearings held by the House Committee on Flood Control reveals that many residents from within the alluvial valley favored the Mississippi River

Commission plan over the Jadwin plan. Obviously, interests in southeast Missouri who owned land within Jadwin's proposed Birds

Point-New Madrid floodway were among those who favored the commission plan. The inclusion of floodways in the general flood protection scheme marked a necessary turnaround in the engineering policy practiced prior to the 1927 flood. The flood had forced that change, but even in the wake of its widespread devastation a controversy emerged over the reality of actually implementing the floodways. Residents within the floodways were ill-prepared for that reality, which assured that private land once protected by levees would now be subject to inundation to reduce flood stages elsewhere in the valley.

Under the Jadwin plan, the Birds Point-New Madrid floodway was designed to do just that. Opposition to the floodway was best expressed by Missouri congressman Dewey Short when he proclaimed to the House Committee on Flood Control that his constituents "do not want to see southeast Missouri made the dumping ground to protect Cairo, much as we love Cairo."

The 1928 Flood Control Act ultimately adopted the engineering features of the Jadwin plan. On December 11, 1928, Coolidge approved the federal acquisition of land and flowage rights—a one-time indemnity paid landowners to flood their land during the operation of the floodway. The president also authorized the purchase of a



strip of land immediately adjacent to the fuseplug levee at a price capped at two times the 1928 assessed value of the land, but stipulated that the fuseplug levee could not be constructed until at least 50 percent of the flowage rights had been secured.

Construction was scheduled to commence in the summer of 1929, but George W. Kirk, who owned land in the floodway, filed a lawsuit seeking an injunction to stop the awarding of contracts. In the lawsuit (*Kirk v Good*), Kirk maintained that because of the floodway, he would be unable to sell his property or use it as security to obtain loans. Judge Charles B. Davis of the Federal District Court of Missouri denied the injunction on the grounds that the damages Kirk would sustain would be “mere consequential damages such as the construction of any major public work is likely to entail.” If damages were to be realized through the operation of the floodway, the landowner had “complete and adequate remedy” for compensation under the provisions of the 1928 Flood Control Act.

Following the dismissal of the case, construction of the setback levee commenced October 21, 1929, as did improvements to



**1937 levee
blast**

carry the drainage intercepted by that levee. This work was completed by the end of October 1932. For all intents and purposes, the floodway was operational. The only remaining work involved degrading the fuseplug levee to a height corresponding to 55 feet on the Cairo gage. The levee had not been degraded because the federal government had reached agreement

to purchase only 44 percent of the necessary flowage easements within the floodway. By 1936, the Corps of Engineers had obtained approximately 77 percent of the flowage rights, surpassing the mandated 50 percent necessary to degrade the fuseplug levee. A federal judge, however, threatened to issue an injunction if the Corps of Engineers attempted to degrade the levee prior to obtaining all flowage easements. It was not until January 1942—fourteen years after the passage of the 1928 Flood Control Act—that the federal government completed



the acquisition of flowage rights on the necessary 106,858 acres within the floodway at a total cost of \$2,385,546 or approximately \$22 per acre.

The Great Flood of 1937 along the Ohio and Mississippi valleys provided the first significant test for the Birds Point-New Madrid floodway. The flood emanated from the Ohio River and reached a record maximum discharge of 1,850,000 cfs at Cairo. While the Mississippi River above Cairo was at a low stage, the combined flows surpassed the highest flood stages ever experienced between Cairo and Helena, Ark. As the flood stage exceeded 56 feet on the Cairo gage January 23, Brig. Gen. Harley Ferguson, the president of the Mississippi River Commission, approved the operation of the floodway. The following day, the Memphis District dispatched Major R.D. Burdick to oversee the activation of the floodway.

The Corps of Engineers intended for the floodway to activate when the river, after exceeding 55 feet on the Cairo gage, would overtop and naturally crevasse the fuseplug section of the frontline. However, the fuseplug section still had not been degraded by the necessary 3 feet because of the federal court's threat of an injunction. Moreover, the frontline levee was one of the strongest in the system, leading Burdick and his team of engineers to fear that it would act as a spillway and not crevasse quickly enough to lower stages at Cairo before the river overtopped the floodwall there. Consequently, with floodwater already spilling over the frontline levee through groupings of natural crevasses near river mile 18 and river mile 30, personnel from the Memphis District attempted to breach the levee with picks and shovels. These efforts failed to produce the desired result. On January 24, preparations were made to open the levee with dynamite placed into freshly augured holes. The following day, Burdick's team detonated the explosives, opening two sections of the levee aggregating 120 feet in width and sending

1937 flood aftermath



about 30,000 cfs of floodwaters coursing through the floodway. By January 27, the crevasses had an aggregate length of only 1,000 feet, well short of the intended 10-mile long fuseplug site envisioned under the Jadwin plan. As such Burdick estimated that the floodway discharge only reached 150,000 cfs of the 550,000 cfs design capacity.

After the artificial crevasses were executed, Burdick noted that the stage at Cairo fell only about 4.5 inches, from 58.7 feet to 58.3 feet, before resuming its ascent as the Ohio River crest had not yet reached Cairo. On February 3, the river crested on the Cairo gage at 59.5 feet. By that time, the length of the crevasses had grown to 9,200 and passed, by the commission's estimation, approximately 450,000 cfs. Despite the flawed activation, Burdick concluded that the floodway reduced the crest at Cairo by 3.5 feet.

By May 1937, the commission had closed all the openings in the frontline levee with an interim levee and restored the levee to its former section and grade with the exception of crevasses at the lower end of the floodway. In spite of heavy damage to buildings in the floodway, the inhabitants moved back after the



1937 flood and planters were able to yield an excellent crop during the 1937 growing season. By 1938, the levee was restored to its former section and grade.

The operation of the floodway demonstrated the reality of the engineering plan which had, up to that point, only existed on paper. Maj. Gen. Edward Markham, the Chief of Engineers, highlighted the difficult reality of floodway activation when he wrote to Congress, "I am now of the opinion that no plan is satisfactory which is based upon deliberately turning floodwaters upon homes and property of people, even though the right to do so may have

been paid for in advance." In the decades following the 1937 flood, the Corps of Engineers and Mississippi River Commission initiated reservoir projects and levee modifications that raised the level of protection in the confluence area and reduced the frequency of operation of the Birds Point-New Madrid floodway. The flood control acts of 1938, 1944 and 1946 authorized dozens of reservoirs in the Missouri, Upper Mississippi and Ohio basins that, once constructed, played a significant role in managing floodwater throughout

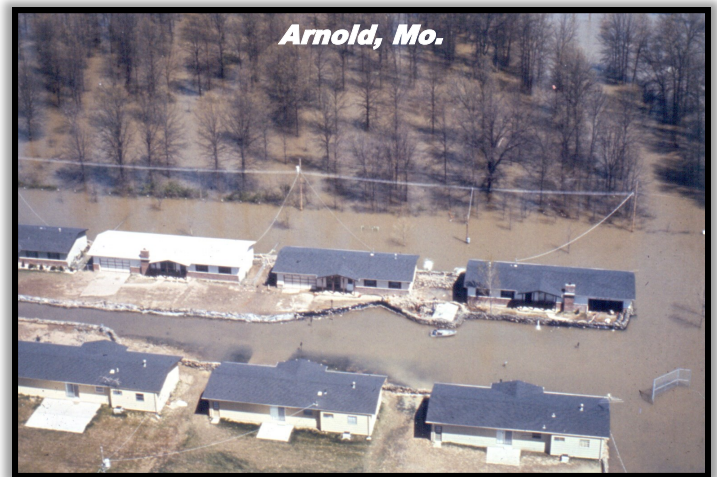


the drainage basins above the confluence area. Perhaps the most important of these reservoirs were Kentucky Lake on the Tennessee River and Lake Barkley on the Cumberland River. Though the two reservoirs are not features of the MR&T project, both are operated to reduce flood stages to safeguard the levee system in the vicinity of Cairo and to reduce the frequency of operation of the floodway. By the late 1950s, the Mississippi River Commission estimated that the reservoirs in the greater Mississippi drainage basin, once completed, would reduce the expected frequency of operation to once every 17 years.

The 1965 Flood Control Act authorized a plan by the Mississippi River Commission to raise the frontline levee at the floodway to a grade corresponding to 62 feet on the Cairo gage and the fuseplug sections to a grade corresponding to 60 feet. The levee improvements enhanced the level of protection within the floodway by reducing the expected frequency of its operation to once every 80 years. While the floodway would not be placed into operation by overtopping until a flood stage of 60 feet was predicted, the act stipulated that the Mississippi River Commission, if necessary, maintained the right to operate the floodway through artificial crevasses at the fuseplug sections or elsewhere on the frontline levee when stages reached 58 feet on the Cairo gage and a stage higher than 60 feet was predicted.

Following the passage of the 1965 Act, the Mississippi River Commission further modified the plan for operating the Birds Point-New Madrid floodway. The new plan raised the fuseplug sections to a height corresponding to 60.5 feet on the Cairo gage, raised the frontline levee to 62.5 feet and raised the setback levee to a height of 65.5 feet. The plan called for the operation of the floodway through explosives detonation only at the upper fuseplug section when stages reached 58 feet at Cairo with a forecast of stages to exceed 60 feet.

1973 flood



These changes necessitated a round of modified easement acquisition that conformed to the new plan of operation and reserved for the federal government the right to operate the floodway by artificial crevassing. The easement also reserved to the owners the right to compensation if operation of the floodway resulted in “excessive deposits of sand and gravel” upon the land.

Following the floods of 1973, 1975 and 1979, all of which raised the specter of activation, the Mississippi River Commission revised its operational plan further after concluding that the activation of the floodway would be more safe and effective if artificial crevasses, including the use of explosives, were not limited to the upper fuseplug section.

The new plan of operation included artificial crevasses at four locations along the frontline levee: two at the upper fuseplug section, one at the lower fuseplug section and one in the frontline levee opposite Hickman, Ky. To assure the artificial crevasses came at the precise time to protect against the project design flood, the commission made provisions for the use of explosives if necessary.

The Mississippi River Commission and the Corps of Engineers, though, soon realized that neither possessed sufficient property rights to enable personnel to access the levee to place explosive materials as prescribed in the modified plan. The original and modified easements obtained under the authority of the 1928 and 1965 flood control acts covered only those lands between the landside toe of the frontline levee and the riverside toe of the setback levee. The easements did not extend to and Barkley lakes. Although the floodway was not operated, the district court’s injunction remained intact. The federal government appealed the case to the 8th U.S. Circuit Court of Appeals. On April 15, 1984, the appellate court reversed the district court’s decision by finding that the plan to operate the floodway was not

1983 flood at Cairo, Ill.



“arbitrary, capricious or an abuse of discretion.” The court also questioned Wangelin’s authority to review the case at all by finding that the decision to operate the floodway “is one committed to agency discretion by law...and is unreviewable.” Lastly, the court ruled that the district court had erred in instructing the federal government to deposit the \$10.4 million as compensation.

After the flood, the Mississippi River Commission tweaked the operational plan again in 1986 in an effort to reduce preparatory actions and to delay the operation of the floodway until later in the project design flood curve. Elements of the plan included raising 2.5 miles of the upper fuseplug section and 1.5 miles of the lower fuseplug, and imbedding the raised sections with polyethylene pipe that could be filled with blasting agent in less than a day. The explosives could also be removed safely in the event that river stages did not necessitate the operation of the floodway. The timetable for the new operational plan was based on the river elevations projected in the design hydrograph for floods approaching the project design flood. When stages reached 56 feet on the Cairo gage, a tow with the

components for the blasting agent and necessary equipment would depart the Ensley Engineer Yard. Preparation of the inflow crevasse would begin when stages reached 59 feet and would be completed by the time the river reached 60 feet. Artificial crevassing of the levee would commence upon the command of the Mississippi River Commission president prior to river stages reaching 61 feet on the Cairo gage with additional stage increases forecasted. It must be noted that under the operating plan, the federal government reserved the right to activate the floodway when stages reached or exceeded 58 feet on the Cairo gage.

Despite the increase in the level of protection and the reduced frequency of operation brought about by reservoir construction, residents within the floodway pushed for its outright abandonment. In 1987, Missouri congressman William Emerson prodded the House Committee on Public Works and Transportation to pass a resolution that directed the Corps of Engineers to determine feasible alternatives to operating the floodway. This resulted in a 1990 reconnaissance study that investigated several alternatives to include purchasing the land within the floodway; constructing permanent auxiliary channels in the floodway to confine floodwaters diverted into the area, rather than allow them to overflow the entire floodway; realigning and setting back the frontline levee at five locations



2011 flood - Mississippi River levee between Baton Rouge and New Orleans, La.

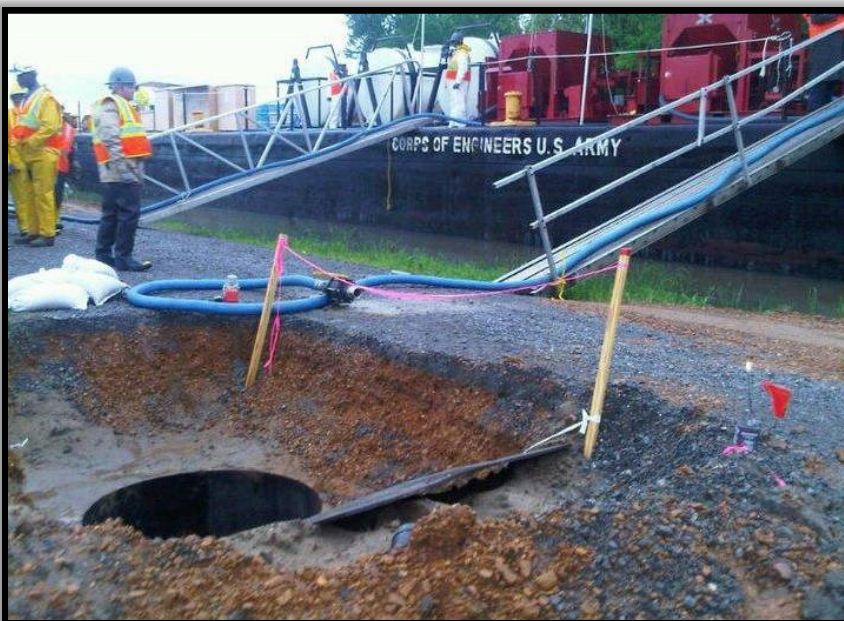
to provide a wider floodplain; executing a cutoff at Bessie Bend to increase the slope and lower flood stages upstream of the bend throughout the floodway reach; and a plan of natural overtopping of the frontline levee. The study concluded that several of the alternatives were feasible from an engineering viewpoint, but were not justified economically. The study further concluded that the plan of natural overtopping of the frontline levee without artificial crevasses would serve as an alternative to the 1986 plan of operation and would provide a higher level of protection for the lands within the floodway. This alternative would require raising the upper fuseplug section to height corresponding to 64.5 feet on the Cairo gage, while leaving the elevation of the lower fuseplug section unchanged.

The reconnaissance study served as the basis for an engineering review of the potential impacts the natural overtopping plan would have on the levees along both banks of the



2011 flood - ?????

Mississippi and Ohio rivers. Published in 1991 by the Memphis District, in coordination with the Louisville District, the engineering review determined that the implementation of the modified plan required improvements to existing levees and floodwalls and alterations to existing pumping stations and culverts in both districts at a cost of \$140 million—\$100 million in the Memphis District and \$40 million in the Louisville District. In April 1992, the Mississippi River Commission endorsed the modified plan and requested that the district furnish copies to local and congressional interests because the



2011 flood - preparing to load levee pipes with liquid blasting agent.

implementation of the plan would require congressional authorization. Through 2011 such congressional authorization had not been secured, and the 1986 plan of operation remained in effect.

In the spring of 2011, the lower Mississippi River experienced record-setting flood stages that ultimately prompted the second ever activation of the Birds Point -New Madrid floodway. On April 25, the stage at Cairo reached 55 feet with a forecasted crest stage of 60 feet. Maj. Gen. Michael Walsh, president of the Mississippi River Commission, directed the Memphis District to begin preparing the floodway in the event that rising river stages necessitating filling the pipes in the frontline levee with liquid blasting agent. The following day, the state of Missouri filed a temporary restraining order with the federal courts. The plaintiffs argued that floodwaters passing



2011 flood - loading levee pipes with liquid blasting agent.

through the floodway would cause pollutants to enter Missouri's waters, violating Missouri's Clean Water Act, and also that using explosives to activate the floodway represented an arbitrary and capricious action. Judge Stephen Limbaugh denied the order on the grounds that the U.S. Court of Appeals' decision after the 1983 flood had already established that the Corps of Engineers' right to activate the floodway is authorized by Congress and unreviewable and, moreover, activation would not violate the Missouri Clean Water Act. The appellate courts and the U.S. Supreme Court upheld the decision.



2011 flood - blast for middle crevasse at Birds Point-New Madrid floodway

As work crews prepared the floodway for possible pumping operations, water control managers in the Ohio basin reduced releases from Kentucky and Barkley lakes to slow the rate of rise at Cairo. With the forecasted crest stabilized at 60.5 feet (just inches below the activation trigger point under the operations plan) and with the region experiencing several consecutive days with no rainfall, Walsh delayed issuing orders to commence pumping operations even though the stage at Cairo climbed above 59 feet and a massive sand boil had developed near the city's floodwall. Unfortunately, heavy rains returned on the evening of April 30.



2011 flood - upper levee crevasse.

The river quickly established a new record stage on the Cairo gage, surpassing the old record set in 1937. At around 3 p.m. May 1, as the river hit 60 feet at Cairo and the National Weather Service issued a new forecast crest of 61.5 feet, Walsh issued the order to commence pumping operations, although he still held out hope that activation would not be necessary. Heavy lightning, however, prevented the work crews from accessing the levee and pumping the liquid blasting agent. Finally in the early

morning hours of May 2 as the Cairo gage reach nearly 61 feet (forecast crest of 63 feet for May 5), the lightning abated and work crews began pumping operations.

As pumping operations commenced, the floodway preparation task force experienced several problems, including a bad mixing unit on one the two barges and a spur levee that denied the barges access to a portion of the upper inflow crevasse site. Facing time constraints and a rising river, the task force, at the request of Maj. Gen. Walsh, developed and implemented an accelerated operations plan that called for preparing only 9,000 feet of the

levee with explosives, rather than the 11,100 feet prescribed in the operations plan. At approximately 10 p.m. May 2, Maj. Gen. Walsh issued the order to activate the floodway. The Cairo gage read 61.72 feet. Within an hour the river at the Cairo gage, which had been rising one-half of an inch per hour, dropped by one-half of a foot. By May 5, when the forecasted river crest was to reach 63 feet on the Cairo gage, the gage read 59.65 feet, approximately 3.5 feet lower than projected. After the floodway was activated, the task force had to quickly

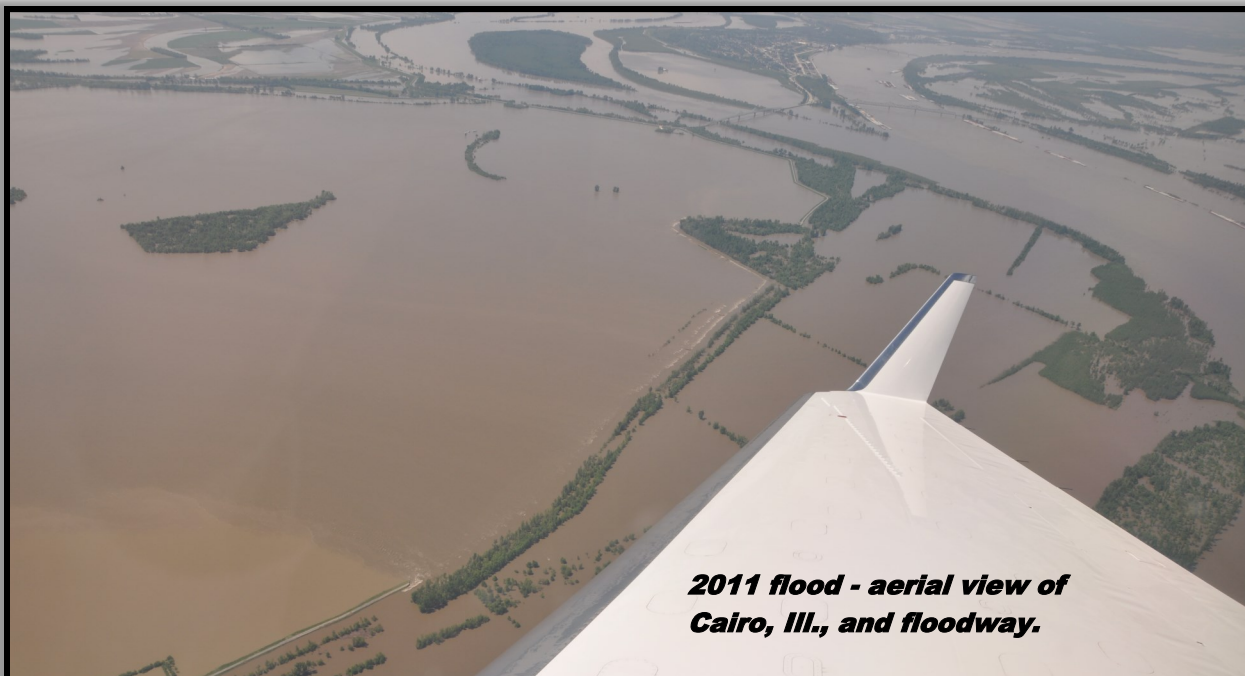
move to the lower end of the floodway to open the lower inflow/outflow crevasse. The crevasse was opened by May 3, but because of a perceived limited supply of liquid blasting agent, only five of the six lines were filled and the levee was only partially opened. On May 5, the middle inflow/outflow crevasse site was opened, but because the task force had to use an alternative explosive that was not as effective, only 500 feet of the designed 5,500 feet were opened during the initial activation.

Although the floodway succeeded in significantly reducing stages, the operation did not go according to the operations plan. For instance, actual loading of the pipes imbedded in the inflow crevasse did not begin until the stage at Cairo had surpassed 60 feet, the level at which loading was intended to be completed. In addition, the order to activate was not given until after the Cairo gage exceed 61 feet by more than 8 inches. Furthermore, the accelerated plan resulted in the intentional crevassing of only a portion of the upper crevasse site. Consequently, the floodway was able to pass just over 400,000 cfs rather than the full design flow of 550,000 cfs.

In the aftermath of the floodway's activation, the timely reconstruction of the three crevasse sites was essential for farmers to proceed with planting during the 2011 growing season. While it would take nearly a year-and-a-half to return the levee at the upper crevasse site to 62.5 feet, residents wanted a temporary levee to provide adequate protection so that farming operations could safely resume. By mid-June 2011, work began closing all three of the crevasses, repairing scour holes and

constructing the levees to a target elevation of 51 feet. The initial work was limited in scope and intended to provide adequate protection for the 2011 growing season and to provide a stable platform for future system restore operations. By November 2012, all three crevasse sites were completed to full width and a height of 55 feet. By early January 2013, both the middle and upper crevasse sites had been fully restored and provided a level of protection equivalent to 62.5 feet on the Cairo gage, and the lower crevasse had been restored to a height equivalent to 58 feet. The restoration of the lower crevasse to a height equivalent to 62.5 feet on the Cairo gage was completed in the summer of 2014.

In the aftermath of the 2011 flood, the Corps of Engineers tweaked the floodway operation plan to incorporate the lessons learned during the most recent activation. The revised plan addressed the use of an alternate commercial explosive and more clearly detailed the decision criteria and trigger points for activation. The updated plan also addressed post-operation reconstruction plans.



**2011 flood - aerial view of
Cairo, Ill., and floodway.**