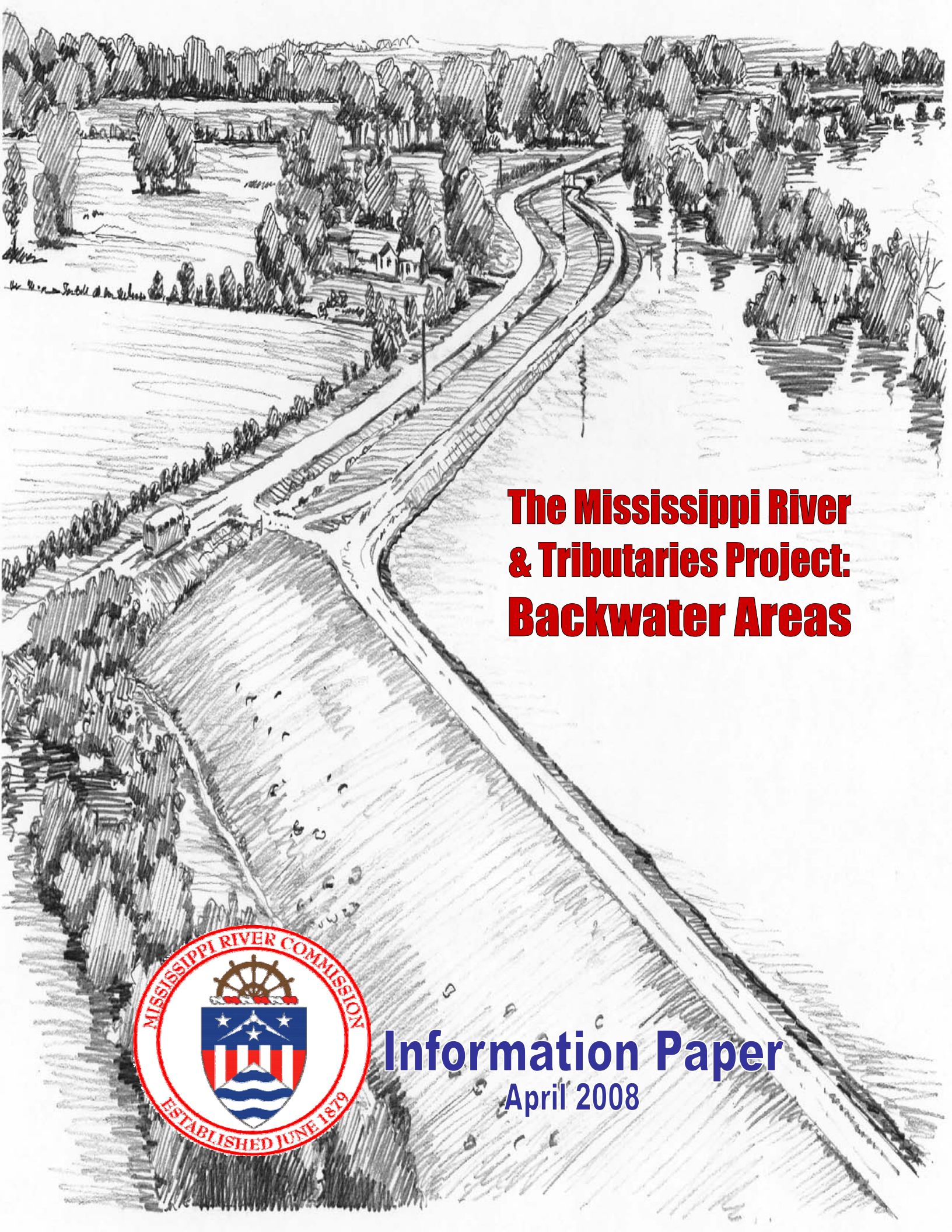

The Mississippi River & Tributaries Project: Backwater Areas

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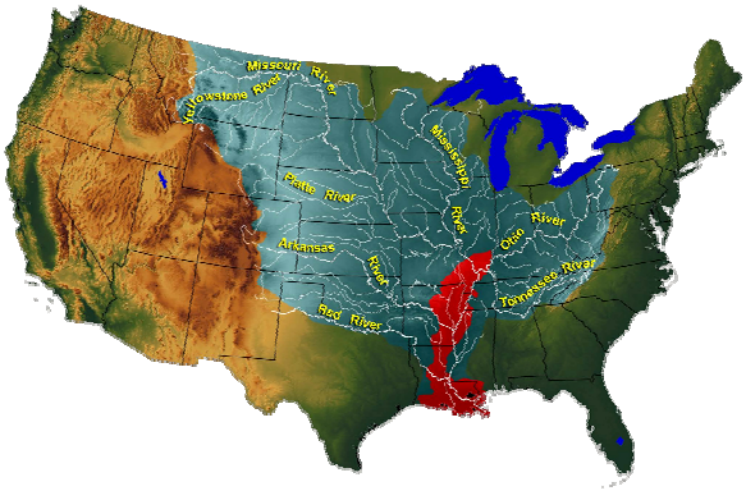
The Mississippi River & Tributaries Project

Backwater Areas

The Mississippi River & Tributaries (MR&T) project was authorized by the 1928 Flood Control Act. Following the devastating 1927 flood, the nation was galvanized in its support for a comprehensive and unified system of public works within the lower Mississippi Valley that would provide enhanced protection from floods while maintaining a mutually compatible and efficient Mississippi River channel for navigation. Administered by the Mississippi River Commission under the supervision of the Office of the Chief of Engineers, the resultant MR&T project employs a variety of engineering techniques, including an extensive levee system to prevent disastrous overflows on developed alluvial lands; floodways to safely divert excess flows past critical reaches so that the levee system will not be unduly stressed; channel improvements and stabilization features to protect the integrity of flood control measures and to ensure proper alignment and depth of the navigation channel; and tributary basin improvements, to include levees, headwater reservoirs, and pumping stations, that maximize the benefits realized on the main stem by expanding flood protection coverage and improving drainage into adjacent areas within the alluvial valley.



Since its initiation, the MR&T program has brought an unprecedented degree of flood protection to the approximate four million people living in the 35,000 square-mile project area within the lower Mississippi Valley. The nation has contributed nearly $13 billion toward the planning, construction, operation, and maintenance of the project. To date the nation has received a 24 to 1 return on that investment, including $306 billion in flood damages prevented. Such astounding figures place the MR&T project among the most successful and cost-effective public works projects in the history of the United States.

History of Backwater Areas in the Alluvial Valley

Backwater areas are the necessary result of gaps left in the main-stem Mississippi River levee system at the mouths of major tributaries that empty into the river. During large flood events, floodwaters from the Mississippi River back into the gaps and/or block discharges from the

tributary streams. The MR&T flood control plan is augmented by four backwater areas located at the mouths of the St. Francis, White, Yazoo and Red rivers. Significant portions of the upper limits of these backwater areas are protected by main-stem levees from overflows from the Mississippi River. The lower portions of these areas must serve as natural storage areas during floods approaching the project design flood. The backwater areas are placed into operation by natural overtopping of the protection levees at the appropriate time to reduce project flood peak discharges and associated flood stages. When flood stages on the Mississippi River or its tributaries subside, floodwaters from within the backwater areas are evacuated through floodgates. *(For more information on the project design flood and how the MR&T project conveys the project design flood, please see "Mississippi River & Tributaries Project: Understanding the Project Design Flood.)*

Prior to the early construction of the levee system, the backwater areas were no different than most lands comprising the alluvial valley. They flooded when the Mississippi River overflowed its natural alluvial banks or backed its floodwaters into the tributary streams. During more severe flood events, the natural banks of the Mississippi River upstream of the junction with the tributary were overtopped and the upstream area became a part of the river's distributary overbank flow area. Eventually distributary overbank flows would course into the lower or backwater areas before returning to the Mississippi's main channel. Throughout the flood events, the low elevation of the backwater areas caused these lands to be inundated at a comparably deeper depth for a longer time period than the higher elevation lands elsewhere behind the levee system.

As the levee system was extended further and further upriver with higher and stronger levees during the 19th century, the confinement of Mississippi River floodwaters protected lands upriver from the backwater areas from overbank flows. But depending on the height of the confined floodwaters and the discharge of tributary rivers, Mississippi River floods continued to back up through the gaps in the levees at the mouths of the tributaries, blocking the outflow of the streams. In this regard, the backwater areas functioned as natural tributary reservoirs in a relatively flat region where structural reservoirs were deemed difficult, if not impossible, to construct at that time.

Historically, the Mississippi River Commission recognized the importance of maintaining the natural storage capacities of the backwater areas as a benefit for flood control. The low-lying lands stored vast quantities of floodwaters thereby lowering flood stages on the main river by reducing the peak flows downstream of the backwater areas. After adoption of the 1928 Act, calls for improving conditions in the backwater areas gained momentum and, while holding the position that the backwater areas could never be fully redeemed from flooding, the Mississippi River Commission eventually conceded that the more valuable portions could receive substantial protection during floods provided nothing hampered the natural reservoir effect of the areas during floods approaching project design flood elevations.

The backwater areas have played a crucial role in the development of the MR&T project. Congress first showed a willingness to accept the responsibility of partially protecting the backwater areas through the 1936 Overton Act. That act authorized improvements toward the protection of a portion of the White River backwater area. Five years later, Congress authorized extensive improvements to partially protect the Red River and Yazoo backwater areas. Those improvements, particularly in the Yazoo backwater area, were key components of a political compromise that ended a decade-long legal battle concerning the implementation of floodways in the MR&T project that had left a great portion of the Mississippi River delta in Arkansas and Louisiana vulnerable to devastating floods. *(For more information on the legal and political struggle over the reality of implementing floodways in the early development of the project, please see "Mississippi River & Tributaries Project: The Floodway Battle.")*

MR&T Backwater Areas

St. Francis River Backwater Area

The 1928 Flood Control Act authorized extensive improvements to the main stem Mississippi River levee flanking the St. Francis front, but it did not address the problems of headwater and backwater flooding within the St. Francis drainage basin. In 1930, the Mississippi River Commission submitted plans to improve conditions in the backwater area developed by the St. Francis Levee District of Arkansas. This project was not recommended because it was found to be unjustifiable from an economic standpoint. The 1936 Overton Act authorized basin improvements in the form of the Wappapello reservoir, floodways down to St. Francis Bay, and numerous drainage ditches to control headwater flooding in the St. Francis River basin. Those improvements, however, only impacted the areas above the backwater limit of the Mississippi River.

Prior to the completion of those improvements, the 1937 flood struck the lower valley. Floodwaters inundated more than 1.3 million acres of land comprising productive agricultural areas and several small towns in the St. Francis River basin, with roughly half of the inundation attributable to headwater flooding from Ozark highlands runoff and half from Mississippi River backwater flooding. The improvements authorized by the Overton Act would have alleviated much of the headwater flooding in the upper two-thirds of the basin, but would not have spared nearly 760,000 acres of the backwater area from flooding. As improvements to control the headwater flooding progressed, the Mississippi River Commission began developing plans to provide partial protection for the backwater area.

The 1950 Flood Control Act authorized a plan submitted in 1948 by the Mississippi River Commission to provide extensive levee and drainage improvements geared toward protecting more than 500,000 acres of the lower basin from headwater flooding and backwater flooding up

to the backwater stages experienced during the 1937 flood. Flood control efforts emanating from that authorization included the enlargement and relocation of the channels of the St. Francis River, St. Francis Bay and the Straight Slough ditch, as well as the construction of several intercepting drainage ditches. To provide protection from the St. Francis River floods, the plan necessitated extending the Steep Gut floodway (St. Francis floodway) from the vicinity of the St. Francis Lake to the mouth of the L'Anguille River near Marianna, Arkansas, by constructing a levee along the eastern side of a depression bounded by Crowley's Ridge on the west. The levee, completed in the 1960s, was raised to three feet below the MR&T project flood flowline and one-half foot above the 1937 stages experienced in the backwater area.

A fuseplug levee, constructed three feet lower than the project flood flowline, extends nearly 10 miles from the levee to a junction with the frontline Mississippi River levee near White Hall, Arkansas. The backwater area is placed into operation by overtopping of the fuseplug levee at a time sufficient to reduce extreme crests on the Mississippi River when stages start to approach project design flood elevations. The backwater area, however, is protected against all St. Francis headwater flooding.

The 1950 act also authorized a pumping plant. Completed in 1977, the W.G. Huxtable pumping plant is the largest freshwater storm runoff plant in the world with a pumping capacity of 12,500 cfs. It is designed to prevent the Mississippi River from backing up into the St. Francis River and to remove runoff impounded within the backwater area by the levees flanking the Mississippi and St. Francis rivers. During the construction of the plant, the channel of the St. Francis River was actually relocated to flow directly into the plant and empty into the Mississippi River through the plant gates. The gates are closed when the elevation of the Mississippi River approaches 177 feet above sea level or exceeds the elevation of the St. Francis River. Under such conditions, the pumps are placed into operation until the level of the St. Francis River drops below an elevation of 175 feet above sea level. During the 1983 flood, the pumping station operated for 182 consecutive days.

White River Backwater Area

Congress first authorized the partial protection of 227 square miles of the White River backwater area through the 1936 Overton Act. The act provided for a nearly 40-mile-long backwater levee that stretches from the frontline levee at Laconia Circle and extends along the east side of the White River until it reconnects with the frontline levee near Old Town, Arkansas. The concept for the backwater levee originated in a plan developed by the Mississippi River Commission in 1925 to protect the area from all but the largest of White River floods and backwater flooding from the Mississippi River. Initial construction of the backwater levee commenced in 1938 to provide an interim grade that offered quick and substantial protection of the area. This phase of work included the construction of two fuseplug sections to assure controlled points of entry for excess water from larger floods into the protected backwater area.

The levee reached the interim grade in 1940 and was completed to full grade and section in 1960.

The Overton Act also provided for drainage structures that were designed to permit the drainage of impounded runoff within the backwater area to the White and Mississippi rivers. The floodgate at the Little Island Bayou drains to the White River, and the floodgate at Deep Bayou drains into the Mississippi River. Both drainage structures were completed in 1940. The 1958 Flood Control Act further modified the project to protect the White River backwater area by authorizing a pumping station to be constructed adjacent to the Little Island Bayou outlet structure. Completed in 1965, the pumping station, dedicated as the Graham Burk pumping station, has a pumping capacity of 1,500 cfs and is used to evacuate impounded runoff when stages on the White River do not permit gravity drainage. The 1958 act also modified the operation of the Little Island Bayou structure to provide for controlled stages in the ponding area for the benefit of fish and wildlife management within the enclosed backwater area.

The backwater area is placed into operation by overtopping of the fuseplug levees at the appropriate time to reduce extreme crests on the White and Mississippi rivers when stages on those rivers start to approach project design flood elevations. In these rare instances, the backwater areas remain inundated until after passage of the Mississippi River peak flood crest. When stages on the Mississippi and White rivers begin to subside, floodwaters from within the backwater areas will be able to flow out through Little Island Bayou floodgates. The Deep Bayou floodgates and culvert operate in a similar fashion when flood stages on the Mississippi River subside.

Yazoo Backwater Area

The partial protection of the Yazoo backwater area from Mississippi River floods was a crucial factor in the passage of the 1941 Flood Control Act that, along with modifications proposed in the 1936 Overton Act and the 1936 and 1938 flood control acts, ended a decade-long legal and political battle concerning the abandonment of the Eudora floodway as a component of the MR&T project. The delays in constructing the floodway had left a great portion of the Mississippi River delta in Arkansas, Louisiana and Mississippi vulnerable to further devastating floods. The abandonment of the floodway, though, made it necessary to confine the project design flood between higher and stronger levees along the Mississippi River, which in turn meant additional backwater flooding in the lower Yazoo basin. *(For more information on the historical context of the Yazoo backwater in settling the floodway dispute, please see "Mississippi River & Tributaries Project: Authorization of the Yazoo Backwater Area Improvements.")*

The 1941 Act authorized a plan developed by the Mississippi River Commission that provided for protection of 634,000 acres of the backwater area from all but the project design flood on the Mississippi River. This was to be accomplished by the construction of a backwater levee

extending from the existing Mississippi River levee along the west bank of the Yazoo River to Yazoo City, where the levee would connect with the levee authorized under the 1936 Overton Act to control headwater floods. Recognizing that such a levee would impound runoff from the tributaries that traversed the backwater area, the commission recommended evacuation of the impounded water, when river conditions permitted, by a drainage structure at the Little Sunflower River and a combination of structures and pumping plants at the mouths of the Big Sunflower River, Deer Creek and Steele Bayou. When stages on the Mississippi and Yazoo rivers were too high to allow for gravity drainage, the water could be pumped out by pumping stations at three locations with a total discharge capacity of 14,000 cfs--Big Sunflower River (11,000 cfs), Deer Creek (700 cfs) and Steele Bayou (2,300 cfs).

Following a comprehensive review of the MR&T project in 1959, the Mississippi River Commission recommended changes to the plan after noting that channel improvements in the Mississippi River and reservoirs and associated works in the upper basin had reduced the frequency and duration of flooding in the backwater area. The plan called for replacing the previously authorized pumping stations at the Big Sunflower River, Deer Creek and Steele Bayou with improved gravity drainage structures and a 20-mile long and 200-foot wide channel connecting the Sunflower River and Steel Bayou ponding areas to the outlets at the Little Sunflower and Steele Bayou floodgates. The Chief of Engineers concurred with the recommendations, but stated his opinion to the Secretary of the Army and Congress that the pumping stations might still be warranted and could be implemented under existing authorizations in the future.

The 1965 Flood Control Act authorized the proposed modifications and construction of the project quickened. In 1969 the Steele Bayou drainage structure, which has a capacity to discharge 19,000 cfs from the ponding area to the Yazoo River, was completed. In 1975, the drainage structure at Little Sunflower River capable of discharging 8,000 cfs was completed. By 1978 the backwater levee along the west bank of the Yazoo River reached its final grade elevation of two feet below the 1956 project design flood flowline. That same year, the channel connecting the ponding areas was completed. The backwater area had experienced major flooding during the 1973, 1974 and 1975 events. Corps of Engineers planning and hydrologic analyses had shown that when river stages along the Mississippi rose during those flood events to elevations higher than the water levels on the protected side of the levee, the floodgates at Little Sunflower and Steele Bayou had to be closed to prevent backwater flooding. Serious flooding would still result, even though at reduced levels from what would have been experienced prior to the completion of the backwater levees. The 1979 flood confirmed those findings as severe interior flooding of the backwater area was experienced. In this event, with the floodgates closed, the rainfall and runoff from within the protected area became impounded behind the levee, though the flood level was lower than it would have been without the backwater levees and floodgates.

In 1982, the Corps of Engineers initiated a reevaluation study of the economic feasibility of the pumping station features authorized under the 1941 Act. The recommended plan stemming from that study called for a 17,500 cfs capacity pumping station at Steele Bayou with pumping initiated at an interior water elevation of 80 feet above sea level during the growing season and an elevation of 85 feet above sea level from December 1 through March 1 of each year. This plan was altered during the review by the Office of Management and Budget, prompting another round of studies. In September 2000, the Corps of Engineers released a draft feasibility report and supplemental environmental impact statement for the Yazoo backwater area. The new recommended plan included a 14,000 cfs capacity pumping station with pumping initiated at any time of the year when surface elevations at Steele Bayou reach 87 feet above sea level. This plan provided for the reestablishment of forest on 62,500 acres of open land below the pump on/off one-year frequency elevation of 87 feet above sea level at the Steele Bayou Structure and 104.4 feet above sea level at Little Callao with a modified operation of the Steele Bayou structure to maintain levels between 70 and 73 feet above sea level during low water periods. The final Yazoo backwater reformulation report and supplemental environmental impact statement will be released in 2007.

Red River Backwater Area

Under the original MR&T flood control plan adopted by the 1928 Act, the Red River backwater area was subject to flooding by and functioned as a storage area for excess flows from the Mississippi, Red, Ouachita, Boeuf and Tensas rivers. During the project design flood, the area also was to receive the additional discharges from the Boeuf and Eudora floodways. The low-lying backwater area would act as a natural reservoir, storing those discharges and excess flows. Project flood flows in the Red River backwater area would ultimately be conveyed downstream through the West Atchafalaya floodway and the Atchafalaya River. Plans to eliminate the Boeuf and Eudora floodways from the MR&T project, combined with improvements made to increase the carrying capacity of the Atchafalaya River during the 1930s, opened the door for partial protection of the Red River backwater area.

The 1941 Act authorized a plan developed by the Mississippi River Commission to protect a 373,000-acre portion of the backwater area known as the Tensas-Cocodrie area. The commission plan called for raising the frontline Mississippi River levee from Deer Park, Louisiana, to Black Hawk, Louisiana, to the full 1941 grade. Backwater protection for the area necessitated the construction of a 93-mile long levee extending from Black Hawk westward along the east bank of the Red River to its junction with the Black River, then northward along the east banks of the Black and Tensas rivers, and reconnecting with the frontline levee just above Lake St. John. The backwater levee was completed in 1954. The lower 38 miles of the backwater levee serve as the fuseplug entrance into the backwater area during project flood conditions and were constructed at heights ranging from three to four feet below the Mississippi River levee grade at Red River Landing. The plan also provided for a floodgate at the mouth of

Bayou Cocodrie to evacuate runoff impounded by the backwater levee to the Red River. The floodgate was completed in 1952.

Following a comprehensive review of the MR&T project in 1959, the Mississippi River Commission recommended additional improvements to the Red River backwater area. Modifications to the Tensas-Cocodrie area included 22 miles of channel enlargement in Bayou Cocodrie and a 4,000 cfs pumping plant to be constructed adjacent to the existing floodgate and drainage structures at the mouth of the bayou. The commission also proposed protecting additional areas within the larger Red River backwater area with loop levees, interior drainage structures and channel improvements. These areas included the 102,000-acre Larto Lake to Jonesville area, the 73,000-acre Sicily Island area, the 54,000-acre Bushley Creek area, and the 37,800-acre area designated as the "Below Red River Area." The 1965 Flood Control Act authorized the commission's proposals.

Construction of the 64 miles of protection levees for the Larto Lake to Jonesville area commenced in the early 1970's. The plan for channel improvements and the pumping station at Bayou Cocodrie in the Tensas-Cocodrie area, however, faced stiff resistance from environmental interests. The proposed channel improvements extended through an area of scarce bottomland hardwood and the pumping plant was to be constructed within the Red River Wildlife Management Area. To alleviate the opposition's concerns, the Corps of Engineers devised a plan to divert runoff from Bayou Cocodrie through a connecting cutoff channel to Wild Cow Bayou. From there, the revised plan provided for a new location outside of the wildlife area for the pumping plant and an additional floodgate and associated drainage structures that would evacuate runoff into the Black River. The Corps of Engineers completed the diversion channel in 1978. The drainage structures and 4,000 cfs capacity Tensas-Cocodrie pumping plant were completed in 1984 and 1987, respectively.

Construction of the Sicily Island area improvements did not commence until 1980 with the 56 miles of Sicily Island levee being completed in phases between 1984 and 1993. Construction of the project's two pumping stations, one with a capacity of 300 cfs and the other with a capacity of 750 cfs, along with all channel improvements was completed by 2002. The improvements authorized at Bushley Creek and below Red River were not constructed after further studies indicated that they were no longer economically justified. Both projects have been placed in an inactive status.

Worlds 3rd Largest Watershed

Drainage basin for 41% of the United States