Mississippi River

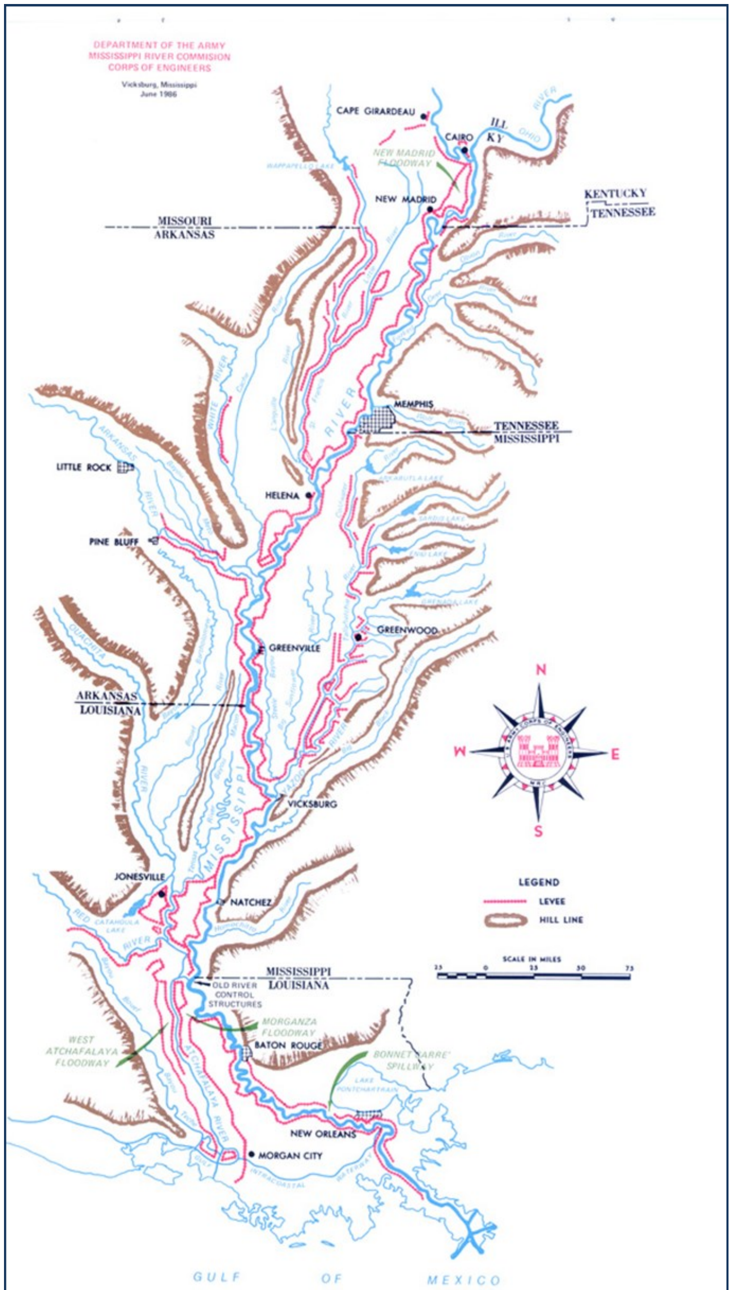

Figure 1. The Mississippi River and Tributaries Project. Floodways are circled in red. (US Army Corps of Engineers)

In 2011 the lower Mississippi River carried the greatest volume of floodwaters ever recorded, exceeding the historic flood of 1927. In that earlier flood, considered the most destructive river flood in the history of the United States, levees were breached or overtopped in 145 locations, 70,000 km^2 were inundated, and 700,000 people were displaced for weeks to months. Officially hundreds of people died but more likely thousands of rural residents were killed (Barry 1997).

The flood exposed two primary limitations to river and floodplain management of the time. First, flood management relied excessively on levees (the “levees-only” approach) which presumed that nearly the entire floodplain could be disconnected from river floods. Second, floodplain and river management was uncoordinated.

In response to the flood, the U.S. Army Corps of Engineers developed the Mississippi Rivers and Tributaries Project (MR&T). The MR&T coordinated levee placement and design, dam development and operations, floodplain management and navigation for the lower Mississippi River basin, including several major tributaries (U.S. Army Corps of Engineers 2008).

In addition to replacing a piecemeal approach to river management with a comprehensive system approach, the MR&T also moved floodplain management away from the “levees only” approach and included floodplain storage and conveyance as critical components of flood-risk management. Four floodways were designated, portions of the historic floodplain that would reconnect to the river and convey floodwaters during the highest floods (Figure 1). Additionally, four “backwater” or “natural storage” areas exist at the gaps in the levees at major tributaries (St. Francis, Yazoo, White and Red rivers). During very large floods, these floodways and backwater storage areas become reconnected to the river and store or convey a considerable proportion of the total flow, thus reducing river stage and stress on levees elsewhere in the system. For example, for the “project design flood” (the maximum flood with a reasonable probability of occurring), the New Madrid floodway is designed to convey nearly ¼ of the flow and, near the Gulf of Mexico, the channel itself is designed to carry approximately 40% with 60% of the flow moving through floodways, primarily the Morganza Floodway in the Atchafalaya Basin (U.S. Army Corps of Engineers 2008).

The 2011 flood was the largest that the MR&T has confronted, with a larger volume than the 1927 flood. The system managed the flood without a single levee breach or death and three of the floodways were activated simultaneously for the first time since it was built. The dramatically different outcomes of the floods of 1927 and 2011 emphasize the effectiveness of both system-scale approaches to river management and the value of hydrologically connected floodplains, as use of the floodways was essential to reducing flood risk for riverside cities such as Cairo, Illinois, and Baton Rouge and New Orleans in Louisiana. Thus, the MR&T also illustrates an example of integrating "green" infrastructure (floodways and backwater areas) with engineered infrastructure (dams and levees), although much of the green infrastructure is comprised of heavily modified floodplain surfaces.

In addition to providing more effective flood management, the system-scale approach to water-management infrastructure in the MR&T provides the opportunity for greater environmental sustainability for the lower Mississippi. During the most recent flood, allowing large volumes of water to be stored and conveyed through the backwater areas and floodways—essentially portions of the historic floodplain—likely provided greater environmental benefits than would have been achieved through pre-1927 uncoordinated and "levees only" flood management. The floodways provided foraging habitat for fish and birds (D. Thomas, Illinois Natural History Survey, *personal communication*) and this may contribute to large recruitment classes of fish populations who benefited from floodplain spawning and rearing, based on results from the 1993 flood in the upper Mississippi (Gutreuter et al. 1999)**.**

However, the MR&T was designed essentially only for flood control and navigation and, reflecting the values and scientific knowledge of the time, did not strive to promote river-floodplain integrity. Additionally, the Mississippi Basin has experienced three historic floods in less than 20 years and forecasts suggest that flood magnitudes may increase with climate change (Kundzewicz et al. 2008). River managers may need to analyze whether the current floodways and backwater areas provide for sufficient floodwater storage and conveyance to maintain the integrity of the MR&T. Thus, the MR&T could be reassessed and redesigned, both to ensure that it can maintain acceptable flood risks and to pursue a broader range of river-floodplain benefits, reflecting current scientific understanding and societal values and expectations.

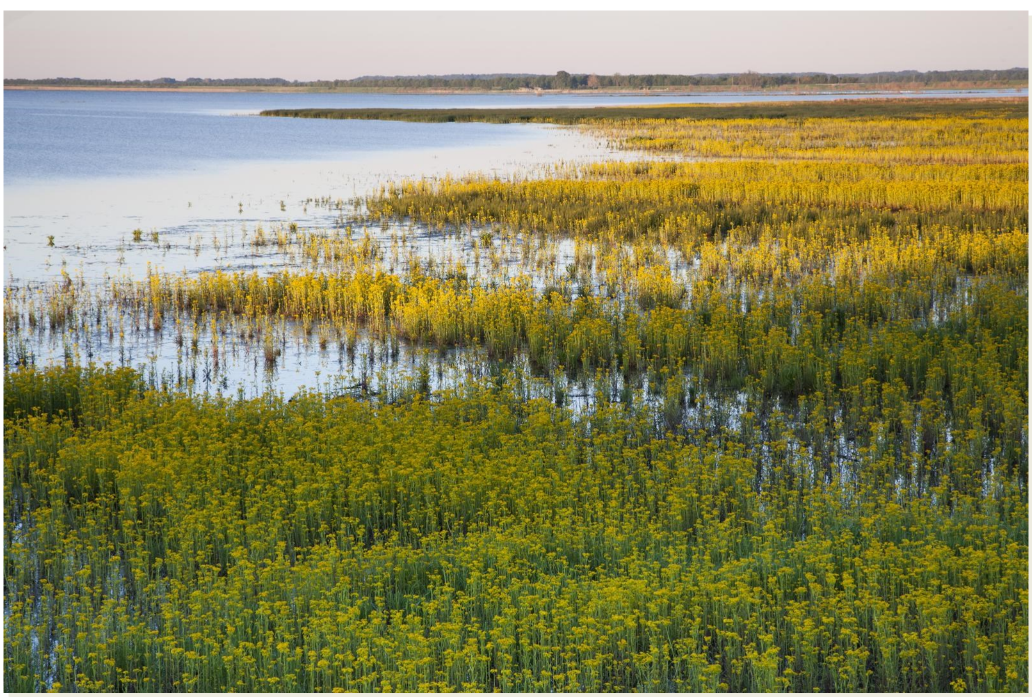

Figure 2. The Nature Conservancy's Emiquon Preserve within the Upper Mississippi River system. It is one of the largest floodplain restoration projects in the Midwest. © Todd Winters

References—Mississippi River case study

Barry, J. M. 1997. *Rising tide: the great Mississippi flood of 1927 and how it changed America*. Touchstone, New York.

Gutreuter, S., A. D. Bartels, K. Irons, and M. B. Sandheinrich. 1999. Evaluation of the flood-pulse concept based on statistical models of growth of selected fishes of the Upper Mississippi River system. *Can. J. Fish. Aquat. Sci.* 56:2282-2291.

Kundzewicz, Z. W., and coauthors. 2008. The implications of projected climate change for freshwater resources and their management. *Hydrological Sciences Journal-Journal Des Sciences Hydrologiques* 53(1):3-10.

U.S. Army Corps of Engineers. 2008. *The Mississippi River & Tributaries Project: designing the project flood.*