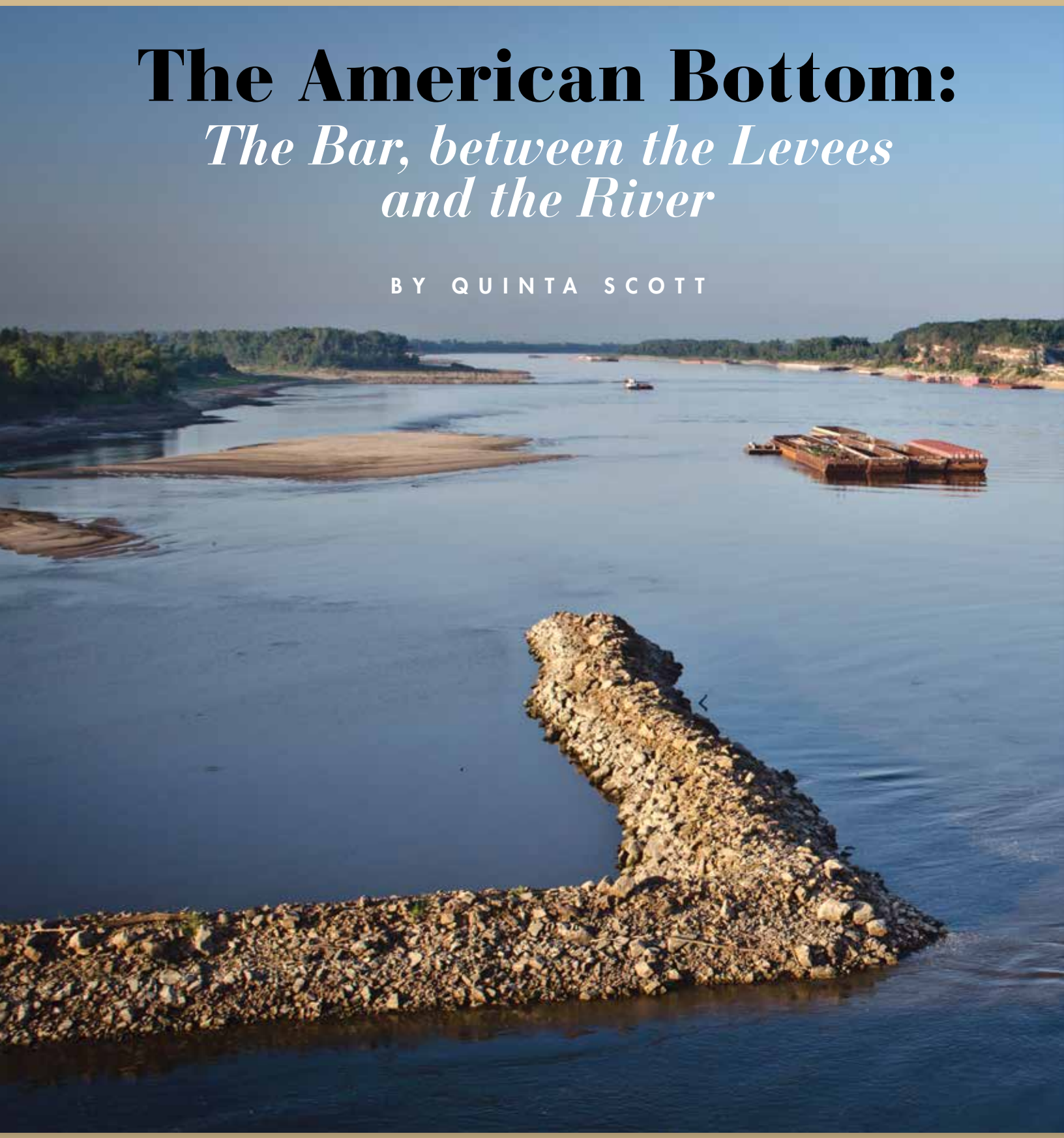
The American Bottom:

The Bar, between the Levees and the River

BY QUINTA SCOTT



Mississippi River at downstream of the Jefferson Barracks Bridge

"The fences built from the bank into the water eventually caught sand and timber began to grow. Filled land on the riverside of the levee is referred to as "bar ground." – Raymond Ripplemeyer, 1966.[1]

An island finds its start as a sandbar. Cottonwood takes root. If the trees and bar are not washed away in a flood, the trees catch mud and it settles. Black willow (*Salix nigra*) takes root. The trees prevent the next flood from washing away the island and catch more mud and debris. The island grows, always catching more sediment and drift until it becomes a timber island. So it goes until the island reaches the level of the floodplain and can support a hardwood forest.[2]

This is the third in a series of articles on the American Bottom. The first concerned information regarding the bluffs that mark the valley wall and the hill prairies that top them. The second covered information about the floodplain and the challenge of draining and farming wet ground that is protected by levees. Now, this analysis will examine the lands between the levees and the river's edge. The people who farm this land call it "the bar" because much of it started out as a sandbar that evolved into an island becoming attached to the mainland.

Once again as one crosses the Jefferson Barracks Bridge between St. Louis County, Missouri, and Monroe County, Illinois, it is possible to see that underneath this streams the Mississippi River, supporting a nine-foot deep navigation channel along the Missouri bank for barge traffic. One cannot see the channel training structures from the eastbound traffic lane, but they exist, deflecting the current at their ends, keeping navigation moving. Ahead one can see the heavily wooded Illinois bank where the black willows (*Salix nigra*) at the river's edge progress to cottonwoods (*Populus deltoids*) to hardwoods at the interior. This was once part of Horsetail Bar, a sandbar that occupied the Jefferson Barracks reach and caused many navigational difficulties. A dense willow forest marks the silted-in side channel between the old sandbar and the farm field beyond it. Depending on the level of the river, sometimes the chute is wet, other times dry. A forest anchors the bank and gives way to fields of wheat, corn, or soybeans. Finally comes the borrow pit, the source of soil for the adjacent levee. Depending on the level of the river, sometimes the pit is filled with water; other times this is not the case. An attached island, silted-in side channel, forest, field, borrow pit, and levee: these are the elements of the "the bar." Officially, people who study the bar know it as the "batture lands."

Then there are the elements of the river itself: the navigation channel-fast water, islands, the side channels with slow and quiet water, the wetted edge, and the terrestrial or mainland. The navigation channel speaks for itself. Islands provide resting, feeding, and breeding places for waterfowl and protect wildlife from humans or other predators. The quiet water in the side channels is essential to fish, which rest, breed, and feed in them. The wetted edge, where nutrients leach from the land into the aquatic environment, goes from wet to dry and back again as the river rises and falls.

Once again, one can turn right on Sand Bank Road in Columbia and take it to Bluff Road, then follow Bluff to Bottom Road which leads to Levee Road. In order to bike the levee, the best route is to stick to Levee Road, which is public and paved. The levee road is privately owned by the levee districts in areas where there is gravel, with big signs posted to indicate this. No paved roads crisscross "the bar." The farm roads that do so are private. Some farmers do not care if people explore their fields; others care very much and it is impossible to know who is who until an indignant farmer runs someone off his property. There are, however, public places on "the bar" that can be explored: Meissner Island, a division of the Middle Mississippi River National Wildlife Refuge; Fort Chartres Island and Chute, managed by the Illinois Department of Natural Resources; and the Kaskaskia Confluence Trail and bottomland forest, managed by the U.S. Army Corps of Engineers. Explorers will not get to the Mississippi itself until arriving at the mouth of the Kaskaskia River.

South of Alton, Illinois, the modern Mississippi is an open river, unencumbered by dams. Since 1872, the Corps of Engineers has managed the Middle Mississippi south of St. Louis for navigation. Channel training devices—often called fences, hurdles, dikes, wing dams, wing dikes, or jetties—all serve the same purposes: to scour a reliable navigation channel, create new land and a new bank, and narrow the river. When set on the convex side of a bend they divert the river's erosive power to the navigation channel and the opposite concave bank, where "mattresses" (19th century term) or revetments keep the river from eroding the bank. In 1872, the engineers designed the "hurdles" (19th century term) to scour a 4-foot channel, and in 1881 an 8-foot channel, then a 9-foot channel, all measured by the low water reference point, an arbitrary number used to set the flood gauge at St. Louis at zero. In 1881, the Corps began building closing dams that set across side channels to prevent the river from adopting a side channel as its main channel. Sediment washing off the floodplain silted in the side channels, damaged habitat for fish and migrating waterfowl, and fused islands to the mainland, thus forming "the bar." By 2000, only 23 severely degraded side channels remained in the Middle Mississippi between the Missouri and Ohio Rivers whereas none had existed in 1881. All were the creation of the process of building out the bank and narrowing the river.[3]

When Congress passed the 1986 Water Resources Development Act, it included the Upper Mississippi Management Act that declared the Upper River to be a nationally significant ecosystem as well as a critical navigation system. The Corps of Engineers, the U.S. Fish and Wildlife Service, and the Departments of Natural Resources of the states bordering the river initiated the Upper Mississippi Environmental Management Program to restore ecosystems in the river wherever it did not interfere with navigation.[4]

Hence, in the wake of the flood of 1993, engineers from the Applied Engineering Center of the St. Louis District, who understood how the river moves sediment, and biologists from the U.S. Fish and Wildlife Service, the Illinois DNR, and the Missouri Department of Conservation, who understood fish, worked together to develop tools to modify existing dikes and closing dams and manage the Middle Mississippi for both fish and navigation.

If the engineers were not able to remove closing dams across side channels, they could notch them and allow water to flow through them. They could set hard points, mini-wing dikes, in chutes and force water to scour deep holes in them without the buildup of sediment. They could force the river to flow around chevron dikes, shaped like a "C," to create side channels along the bank without disrupting navigation in the main channel. When a flooded river spills over a chevron dike, it scours deep holes inside the "C," which serve as places for fish to wait out the winter. Should the river need dredging, the dredged sediment could be placed in front of the chevron and create an island. The biologists found that the new dikes increased the diversity and numbers of micro-invertebrates—fish food. In turn, the fish increased their numbers and diversity.[5]

At the turn of the century these same organizations formed the Middle Mississippi Partnership to "restore and enhance the natural resources of the corridor" between the bluffs from the Missouri to the Ohio River, using "public and private resource management compatible with economic development, private lands conservation, and education." One goal was to restore aquatic habitat in the remaining side channels and, where possible, create new ones.

Accomplishing any restoration project on the Middle Mississippi is dependent on the willingness of private owners to be engaged and on the availability of funds from the Federal treasury. Proposals are priorities for the agencies working on the river, which they would focus on more if they could and the funds were available.

Fort Chartres Lock and Levee

Levees follow levees: the farmers in Monroe and Randolph Counties formed their levee and drainage districts in the early 1880s at the same time the Corps of Engineers was building closing dams across the chutes between the islands and the east bank of the Mississippi, but still before the islands fused to the floodplain. These farmers constructed their levees close to the east banks of the side chutes.

The 1883 Wilson and Wenkel Levee and Drainage District levee started at the Monroe County line and ran behind the Carroll Island slough. Directly south, the Columbia Levee and Drainage District ran its 1882 levee along the bank of the river where it passed behind Beard and Foster Islands to Fountain Creek, the southern limit of the district. Here, a "potato levee" turned west along the creek and ran to the bluff. The Harrisonville and Ivy Landing levee ran from Fountain Creek, down the bank of the Mississippi, passing in back of Lucas Bar and Calico Island to Ivy Landing. The Stringtown Levee and Drainage District began at Kidd, Illinois, in back of Salt Lake Towhead and followed the bank through Penitentiary Point ending at the head of Isle de Duclos, old Fort Chartres Island. The #5 Levee and Drainage District Levee picked up from there and extended down the bank of Fort Chartres Slough ending at the foot of the island. Subsequent levees followed the same configuration, including the federal levees, built in the late 1940s. They did so because the easements were in place and had been for decades. From looking at the Upper Mississippi River Navigation maps one can see the levees run around the old islands and bars, which have long since been welded to the mainland.[6]

Old Carroll Island: Levee and Borrow Pit

When Congress passed the Flood Control Act of 1936, the legislators made it the job of the Corps of Engineers to build flood protection across the nation. In 1947, the Corps of Engineers began construction of levees, designed to hold flood levels of up to 47 feet, along the American Bottom from Alton to the mouth of the Kaskaskia River. The soil for the levees came from borrow pits on the bar ground.

How deep engineers made the borrow pits varied according to the depth of the available clay in an undulating ridge and swale landscape. Before digging, engineers used borings to measure the depth of the impervious clay that would go into the levee. They stopped digging before they ran out of clay so that no sand or silt constituted the outer slopes of the embankment.[7]
In the 65 years since the construction of the levees, the river has washed in 2 or 3 inches of mud every time it has flooded. During the flood of 2011, many fish, mostly Asian carp, swam into the bar ground and the field just east of the Jefferson Barracks Bridge. The receding flood corralled the fish in the shallow borrow pit, the lowest point in the field. There they became easy pickings for wading birds, egrets, and herons. When the egrets and herons left, the seagulls moved in. When the borrow pit completely dried out, the raccoons arrived. The following summer the farmer who tills this field planted soybeans in the borrow pit.

The Bar: Soybean Field

After the Corps of Engineers began building "fences" or hurdles to deepen the navigation channel in 1872, and began closing side channels to prevent the river from adapting side channels as its main channel in 1881, sediment washing off the fields filled the side channels and fused the islands to the mainland. Farmers began cultivating the new land and called it "the bar ground" or "the bar." When sand collected behind the wing dikes, the resulting sandbars followed the same process: sandbar to timber island to mainland. Farmers harvested the cottonwood and sent it down river to box factories, saved some to weave into mattresses for revetments to protect the riverbank, and began cultivating the cleared fields.[8]

To say that "the bar" is an inter-related element of the bottoms as a whole is inaccurate. Without the protection of the levees the farmers who till "the bar" cannot be guaranteed a good crop year after year. In good years they harvest bumper crops of corn and soybeans; in bad years they watch the river reclaim their land for flood

storage. They plant very little wheat because "once it goes under water, it's done for." Generally, farmers can get their corn and soybeans planted by the beginning of June after spring flooding has receded. In years of heavy summer flooding, they may be able to plant soybeans in August and expect to harvest the crop in the fall. More often, the river takes the land in those years. In a drought, the sandy ground does not hold the water and the crops dry out.[9]

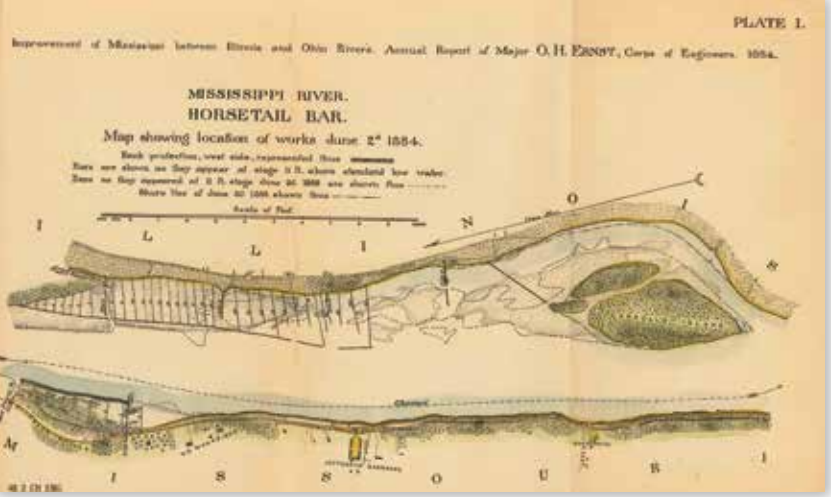
Between 2007 and 2011, farmers on "the bar" had two good years. In 2007 they were able to harvest everything they planted: wheat, corn, soybeans, and double-cropped soybeans, planted after the wheat was harvested. 2009 was also a relatively successful year, with only a few acres being too wet to plant. The other years during this period, including 2008, 2010, and 2011, were complete losses.[10]

Anatomy of a Hurdle or Wooden Dike: Foot of Jefferson Barracks Chute

As the Middle Mississippi meanders, it moves water and sediment downstream. It erodes sediment from the concave side of its bends and deposits it on the convex side, forming point bars. The main channel, the navigation channel, changes constantly as the bends migrate downstream. To create a deep, reliable navigation channel, the Corps of Engineers projects dikes into the stream from the convex banks of the river and armors the concave cut banks with revetments to stop their erosion. With the dikes in place, the river scours a deeper navigation channel and deposits all that moving sediment on the upstream side of the dikes, creating an artificial sandbar. A small, open area of water pools on the downstream side.

Between 1872 and 1879, the Corps experimented with stone dikes, but abandoned them in favor of permeable wooden hurdles when stone dikes proved difficult to maintain. After 1879, engineers drove two or three rows of timber piles, logs as long as 65 feet, into the riverbed and tied them together in clumps. They filled the spaces between the rows with fresh cut willows 30 feet long and not more than 4 inches in diameter. The tops of the piles rose 20 feet above low water. The upstream side of the pile rose 25 feet in order to catch drift—big trees eroded from the bank—that could rip the structure apart. Cypress and white oak were the timber of choice, but cottonwood, hickory, pecan, or sycamore would also do.

By directing the current away from the convex bank, the engineers encouraged the river to erode the concave bank. To stop that process, they wove together layers of live timber into mattresses 3 to 5 feet thick to create revetments, set them on the bank at or below low water, and anchored them with very heavy stones. The engineers also used mattresses to protect the dikes from erosion at the bank line.



Jefferson Barracks Reach, 1888

In 1872, when the Corps of Engineers began the process of scouring a 4-foot navigation channel south of St. Louis Harbor, the first place they attacked was the wide, shallow reach south of River des Peres and out in front of Jefferson Barracks. There, Horsetail Bar, eroded sediment spilling out of the river on the west and eroding from Cahokia Chute on the east, filled much of the navigation channel clear south to the head of Carroll's Island. Engineers, examining the river in August 1873, could find no well-defined channel. The river was "diffused over the broad sandy bottom" and divided in three parts: the channel followed the west bank south of the River des Peres, crossed over the gravel head of Horsetail Bar where the river was too shallow to accommodate a steamboat at low water, and continued south along the east bank to the head of Carroll's Island, where the channel deepened. The main channel threaded the rocky Missouri bank and "the high sand of Horsetail Island." In 1873 and 1874, the Corps of Engineers built a set of five wing dikes, one on the west bank at the mouth of the River des Peres and four on the east, with the dikes set perpendicular to each other in order to force the river into a narrow navigation channel. The engineers placed the fifth at the head of Carroll Slough in order to divert water away from the chute. By doing so, they allowed the river to erode portions of Horsetail Bar and deepen the channel.

By mid-1880, the Corps of Engineers had spent $395,450.91, and a reliable eight-foot channel in the Jefferson Barracks reach was still not a sure thing. The engineers expected it to be "an object of care for an uncertain number of years." By 1887, however, the engineers were pleased with the progress at Horsetail Bar: "the growth of the new banks has continued in a satisfactory manner, the area on which willows are growing being largely increased. The lowest depth of the water in channel reported during the year was 10.5 feet."[11]

Jefferson Barracks Dike Field

Even after the engineers completed their training works to erode Horsetail Bar, the sandbar continued to bedevil navigation. The Jefferson Barracks Reach continued to be wide and shallow and require frequent attention from the engineers. In 1992, the Corps of Engineers once again attacked it and constructed a field of five L-dikes with trails from the Illinois bank. However, they continued to have to dredge the reach to maintain the navigation channel. After they extended and raised the dikes in 2006, the dredging stopped until the summer of 2012 when the drought-plagued river ran very low.

The construction of the Jefferson Barracks dike field created a stretch of river where few fish swim. There were few deep holes and no slow-moving side channels around sandbars in which the fish could rest, feed, and breed. The sandbars there were high and dry most of the time. Vegetation took root, covered them, and washed away only in very big floods. The engineers notched each dike in one to three places to allow water to flow through and open a quiet side channel for fish along the true bank and as well as an isolated sandbar for breeding least terns, an endangered bird. What resulted were small pools on the downstream side of the notches.

In 2001, engineers in the Hydrologic and Hydraulics Branch of the Applied River Engineering Center of the St. Louis District of the Corps built a scale table model of the dike field, using an aerial photograph. They studied alternatives for scouring a new side channel along the east bank to create aquatic depth and diversity for fish, creating an island between the side channel and the navigation channel for nesting terns, and maintaining a reliable navigation channel. Some of their attempts included raising the dikes, widening and narrowing the notches, increasing and decreasing the number of notches in each dike, increasing and decreasing the height of the notches, as well as subtracting and adding dikes to the field. They tested each configuration, only one of which worked. The engineers would remove a small dike from the field, which allowed the notches to create a continuous side channel between five and ten feet deep at low water for fish and a nicely isolated, 190-acre island for the endangered Least Terns.

The proposed work—raising the dikes in the field, notching the existing dikes at the bank, adding new rootless dikes (that is, dikes not anchored to the bank but starting several hundred feed out from the bank), artificially dredging the new side channel—was never done. The EPA examined the project, found the sandbar contaminated by chemicals spewed into the river from a chemical plant upstream, and stopped the project until the contaminants could be cleaned up.[13]

Anatomy of a Stone Dike—Jefferson Barracks Dike Field

The St. Louis District of the Corps continued to use wooden hurdles into the 1950's, but did occasionally use rock dikes as early as 1872. Today, the engineers build stone dikes 10 to 18 feet above low water, projected straight out from the bank. An L-dike has a trail to reinforce the scour. Occasionally, engineers will build a sloped dike or a stepped dike. In every case, the width at the crest measures at least 5 feet, but closer to 10. Any dike less than 6 feet wide can fall victim to an ice flow, which will shear off its top. The angle of repose of the type of stone used determines the slope of the dike. As the end of the dike deflects the current to the navigation channel, the river scours under the dike, and rock falls into the stream, armors the scour hole, and prevents further loss to the stream end of the dike. Generally, engineers build the dike perpendicular to the bank. Tilting the dike upstream results in the end being battered. Angling it downstream results in the downstream bank being battered and the possibility of being blown out. Engineers space the dikes to create the most effective scour of the channel. Spacing them too far apart may lead to the river meandering between them. Spacing them too closely is too expensive. To anchor the dike to the bank, excavators dig a trench, fill it with rock, and extend the dike into the bank. To further protect the bankhead, they will always pave the bank on the downstream side, and occasionally on the upstream side.[12]

New Carroll Island: Jefferson Barracks Chute, Upstream

In 1881, "a strong draught of water towards the chute east of Carroll's, hindering the bank building process at the downstream portion of the Horsetail Reach, and causing an enlargement of the chute referred to."—Major O. H. Ernst, Corps of Engineers, 1883

Looking at the 1817 map of the Mississippi, one would think that not much has changed in the last 195 years. At Old Carroll Island, a healthy chute ran along its east bank but was a little further upstream. The Carroll Island seen on today's map is a creature of channel training devices the Corps of Engineers installed in the Horsetail Reach after 1873. By 1866, Carroll Island had split into two islands, and within the next 15 years the two islands had begun to fuse into one.

In 1874, when the Corps of Engineers completed the hurdles to build out the east bank, scour a reliable channel in the Horsetail Bar (Jefferson Barracks) Reach, and remove Horsetail Bar as an impediment to navigation, they built the fifth and last dike across the slough that ran behind Carroll Island. Seven years later, water rushing down the chute behind Carroll Island threatened to enlarge the side channel. In 1883, the engineers constructed a sixth hurdle, 2,450 feet long and 1,500 feet below the fifth hurdle, which extended from the Illinois bank to the head of Carroll Island, had the "desired effect of causing heavy deposits in the vicinity," and closed the chute behind the island. Never would the Mississippi try to adopt the chute behind Carroll Island as its primary channel.

The chute filled with sediment, and Carroll Island became bar ground. At a later date, the Corps of Engineers extended a series of wing dikes from the west bank of Carroll Island. The dikes caught sand behind them and created a new Carroll Island over time. When the river was up, Jefferson Barracks Chute flowed behind it. When the river was down, as in the summer of 2012, flow through the chute broke into a series of ponds north of Palmer Creek.[14]

Jefferson Barracks Chute: Old Wooden Hurdle and New Notched Dike

Even though sand, backing up behind broken down wooden hurdles, plugs Jefferson Barracks Chute at its head and its foot, and even though it is shallow in normal years, fish can access the chute all year long. There may be no deep holes in which fish can ride out the winter, but it is a good place for nesting and rearing the young.

To restore Jefferson Barracks Chute, the Middle Mississippi Partnership would increase the amount of water flowing through the chute and limit the amount of sediment entering the chute. Notching the closing dam at the head and foot of the chute allows water to flow through and prevents the buildup of sediment. This process also creates a variety of deep and shallow habitats, which attract catfish, white bass, freshwater drum, crappie, smallmouth bass, buffalo, sauger, paddlefish, and bluegill. Hard points, mini-dikes, would create more deep scour holes without any buildup of sediment, and catfish love them. Finally, selective areas of the chute could be dredged and the dredge used to build and ridge and swale landscape. Trees would be planted on the higher, dried ridges.[15]

Forest along Palmer Creek and Jefferson Barracks Chute

There are more than 94,000 acres in the American Bottom, and agriculture dominates throughout. Before European settlement, 47,344 acres of forest covered 50 percent of the bottoms. By 1989, coverage was reduced to 11 percent. Since 2000, the region has recovered 2,174 acres of forest. In 1989, wetlands covered 212 acres but increased by 2,205 acres by 2000 as places like Kidd Lake Marsh Natural Area expanded and private duck clubs, like Chartres Duck Club, converted agricultural lands back to wetlands.[16]

According to the 1890 maps of the area, willows (*Salix nigra*) anchored sandy Carroll Island and the low lands in the floodplain, while an elm (*Ulmus Americana*), ash (*Fraxinus pennsylvanica*), oak (*Quercus spp*), and hackberry (*Celtis occidentalis*) forest grew on higher, drier land in the floodplain. The composition of the forests on other islands and floodplain was similar. In 2012, silver maple (*Acer saccharinum*), mulberry (*Morus rubra*), and oak (*Quercus spp*) grew in the woods along Palmer Creek and at the edge of Jefferson Barracks Chute.

Because farming the bar is so tenuous, many farmers choose to leave their fields in forest, particularly along the river and side channels. Also, because farming is so tenuous, the bar ground offers extensive opportunity for reforestation either through natural regeneration of trees or by planning selected bottomland hardwoods, generally nut producing trees, food for wildlife.[17]

Half of the 1,000 acres of bar ground next to Jefferson Barracks Chute is in forest. If this land and much of the forested land bordering the Middle Mississippi could be put in public trust, restoration managers could rebuild a ridge and swale landscape, planting trees on the ridges and allowing natural processes to create swales, wet habitat for micro-invertebrates and the reptiles and amphibians that feed on them.[18]

Asian Carp and Paddle Fish

While shopping the fish counters in St. Louis supermarkets, one would never know the Middle Mississippi River is teeming with a huge variety of native fish including: sturgeon (shovelnose, lake, and pallid), mooneye, paddlefish, shad, American eel, catfish (channel and flathead), gar, buffalo (bigmouth and smallmouth), bass (white, largemouth, and smallmouth), crappie, bluegill, sauger, walleye, and Asian carp.

Asian carps, silver carp or bigheaded carp, are invasive species, indigenous to India and China. In 1973, fish farmers imported and stocked carp to control phytoplankton, algae, in their catfish ponds. The phytoplankton are microscopic plants—food for larval fish, native mussels, and zooplankton (microscopic animals)—that drift in the well-lit surface of a lake. Within a few years, six state, federal, and private fish hatcheries were raising carp. By the end of the decade, municipal sewage lagoons were stocking the fish. By 1980, they had escaped into the nation's rivers and lakes where they reproduced and increased their range exponentially throughout the Mississippi River Basin.

The carp scoop plankton from the surface of the water, competing with native fish that rely on plankton for food such as the gizzard shad, bigmouth buffalo, and paddlefish. Ironically, a fish that was introduced to control algae led to the production of more algae. The carp feed on algae but then excrete nitrogen and phosphorous nutrients, which produce more algae. Because they also feed on zooplankton, they reduce the number and size of plankton that would feed on algae; hence more algae and less oxygen in the waterways. Silver carp swim in schools, just below the surface of the water, and when disturbed, jump. This can occur when noisy outboard motors upset them, making them leap into boats, often damaging them, while shocking boaters, and leaving behind slime, scales, and feces.

It took until 2007 for the U.S. Fish and Wildlife Service to declare the carp a foreign invader under the Lacey Act. The Lacey Act, passed in 1900, directed the Secretary of the Interior to collect information about the breeding habits of game birds and their preservation. The act as originally written has been amended several times, and by the beginning of the 21st century it governed the regulation of invasive species.[19]

In China, Asian carp is a delicacy, served in expensive restaurants, but the pollution of Chinese rivers has made them unsafe to eat. Therein exists an opportunity for Illinois's commercial anglers. The Illinois Department of Commerce has invested $2 million in a carp processing plant in Grafton that will ship 35 million pounds of carp to China over the next three years where the fish will be sold as "Upper Mississippi wild-caught carp."[20]

Illinois officials would also like to see the carp minced and served in food pantries and soup kitchens, but the patrons tend to find it unpleasant. The question is whether the actual flavor of the fish or the popular idea of it having an unpleasant taste is driving this resistance. Chefs in Baton Rouge, Louisiana, and Chicago, Illinois, have begun to experiment with recipes. The Illinois Department of Natural Resources would like to change the image of the fish in order to change its appeal to American taste buds. However, DNR personnel have yet to figure out the most efficient way to process the highly bony fish. One suggestion is to mince it and serve it as fried carp cakes. Another idea is to fillet the meat and serve it grilled, poached, or seared, accompanied by a nice Chardonnay. Still more approaches include canning it and using it as a meat substitute, as well as renaming it – Chilean Sea Bass used to be called the Patagonian Toothfish. The fish was renamed, people grew to love it, and it was overfished in a very short period of time.[21]

The chances of overfishing Asian Carp are remote, as they have very high reproduction rates: the female produces 1.9-2.2 million eggs a year. Even if only one to three percent reached adulthood, those rates still would produce abundant amounts of fish whose only potential natural predator is humans if solutions can be found to confront repudiation of its taste and for difficulty in methods of preparing the fish.[22]

Beard's Island: Chevron Dikes, River Mile 163.5

In January 1881, the Corps of Engineers decided to connect the head of Beard's Island, a timber island, to the east bank, which would build out the Illinois shore and reduce the width of the river.[23] In June 1882, "water was making such headway down the chute behind Beard's Island that it was decided to cut it off by the construction of a hurdle line." The engineers ran the hurdle from the willow-covered towhead above Beard's Island to a point on the Illinois shore 2,000 feet upstream. When heavy current washed out the first piles, workers start a second hurdle line 850 feet long and 300 feet south of the towhead in hopes of closing the chute as soon as possible. No sooner had they driven piles into the sand when "the piles driven caught the refuge brush from the mattress barge above, and water commenced shoaling immediately both above and below the line." By 1901, Beard's Island was fully integrated into the bar ground and had been divided into fields.[24]

This reach, between Carroll Island and Beard's Island and their adjacent chutes, once offered waterfowl and fish quiet resting, nesting, and feeding places. At the beginning of the 21st century, it was straight, safe, and boring. Fish could find little shallow, quiet, off-channel habitat, though some mussels could be found. Nor could fish find deep holes in which to wait out winter. Between river miles 168 and 156.6, 51 stone dikes had contracted the river into an efficient navigation channel. Only Atwood Chute at river miles 160.8-161.7, running along the Illinois bank, remained connected to the main channel.

In 2008, the Middle Mississippi River Partners began studying ways to increase aquatic habitat in the reach once occupied by Beard's Island, while maintaining the navigation channel. As they had at the Jefferson Barracks Dike Field, the engineers at the Applied River Engineering Center built a scale model of the reach, using an aerial photograph. They removed existing dikes, extended dikes, notched dikes, and built chevron dikes and settled on two alternatives, one at Beard's Island and a second at the mouth of the Meramec River near Kimmswick.

At the edge of Beard's Island, between river miles 163 and 162.1, the engineers trimmed an existing dike, built a chevron dike, trimmed a second dike, inserted three chevron dikes, trimmed a third dike, and built a new dike, all in that order. In the model adding four chevron dikes another result was the creation of two sandbars surrounded by side channels; trimming the three existing dikes allowed the river to scour holes and add diversity to the new side channels. The Corps built the dikes in February and March 2010 and came back and made repairs to them after the flood of 2011. In theory, the new side channel habitat should attract channel catfish, sunfish, paddlefish, whitefish, and a variety of buffalo fish, but during the very low water season of 2012, the engineers could not return to the project to ascertain its success.[25]

Middle Mississippi River National Wildlife Refuge: Meissner Island, Lucas Slough,

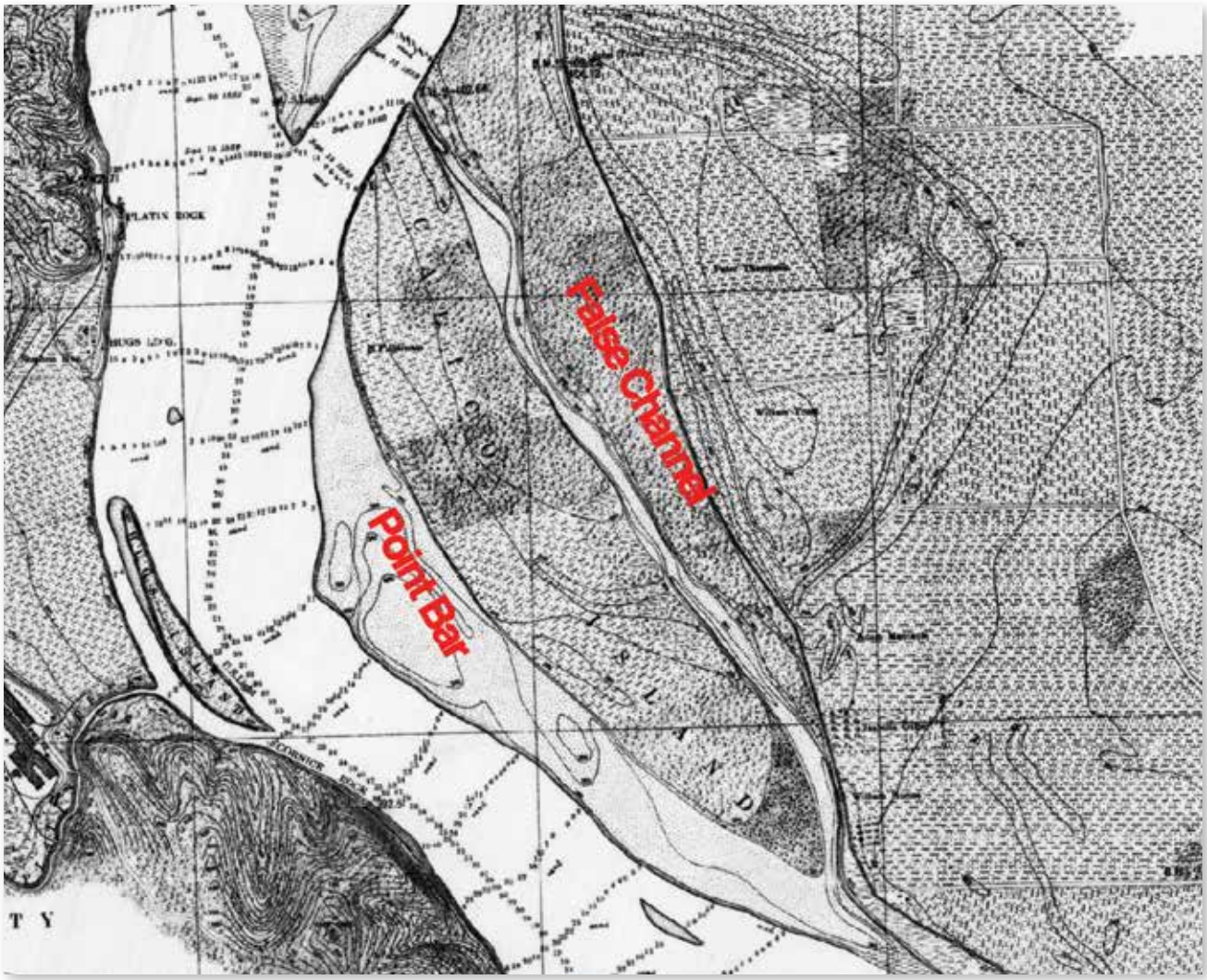
In 1880, the Columbia Levee District ran its levee along Lucas Slough in back of Foster Island. At Harrisonville Landing at the foot of Foster Island, the width of the river varied between 4,400 feet and 6,000 feet, which at the time was too wide. To narrow the river, build out the Illinois bank, and create a reliable navigation channel, the Corps of Engineers closed off the chute in back of Foster Island at its head in 1889. At the same time, the engineers built six hurdles to the south of the landing to "concentrate the water at Lucas Crossing," eradicate Lucas Bar, and contract the river between the foot of Foster Island and the head of Calico Island. By 1893, Foster Island had been renamed after its owner, George Meissner, and had become attached to the bank at its head. The Corps added a series of 13 short hurdles in 1895 and scheduled additional hurdles in 1899 to assure that the Mississippi at Harrisonville Landing would be no more than 2,500 feet wide.

Today, Lucas Slough is an intermittent wet location in the bar. When the river is up, ground water fills the slough. Otherwise, it depends on rainwater. Even in the months after the flood of 2011, which kept the slough wet for most of the summer, it had already dried out by the turn of the year.

In the immediate wake of the flood of 1993, Congress authorized the U.S. Fish and Wildlife Service to expand the Mark Twain National Wildlife Refuge Complex (which manages refuges between the Iowa River and the Ohio River) and to purchase up to 11,400 acres from willing sellers, farmers who had tired of cultivating frequently flooded lands. In 1997, after Congress authorized the Mark Twain complex to expand the refuge by 60,000 acres, the Fish and Wildlife Service put together a "wish list" of 56,000 acres, 14,758 of them south of St. Louis, which included all of the islands and side channels and much of the bar.

In 2000, the U.S. Fish and Wildlife Service created the Middle Mississippi River National Wildlife Refuge between St. Louis, Missouri, and Cairo, Illinois, a region where there are few public lands. By 2005, the service had purchased 4,300 acres on four islands for the refuge with the aim of managing them as a forest corridor and reconnecting their side channels to the river. They included Harlow Island (Missouri), Wilkinson Island (Illinois), Beaver Island (Missouri), and the tiny (78 acres) Meissner Island on "the bar."

The Fish and Wildlife Service is allowing the farm fields on Meissner Island to regenerate naturally into a forest of silver maple (*Acer saccharinum*), willow (*Salix nigra*), and cottonwood (*Populus deltoids*). Additionally, the service has planted mast or nut-producing trees, oaks (*Quercus spp*), and hackberries (*Celtis occidentalis*), food for wildlife. Archers and small game hunters can come in during their respective seasons, but they must follow state hunting regulations.[26]



Calico Island, False Channel and Point Bar, 1890

In 1817, Calico Island was a collection of sandbars in the middle of the Mississippi, which coalesced into one large island over the next 50 years. By 1881, so much sediment had filled Calico Chute that it had become a sandy slough, and the island was well on its way to becoming bar ground. In 1889, when the Corps of Engineers directed the series of six hurdles against Lucas Bar between the foot of Foster Island and the head of Calico Island, the designers also wanted "to close the false channel behind Calico Island," a sandy slough, which filled during times of flood, but that was otherwise dry. By 1891, the current south of Lucas Bar had changed and was eroding the head of Calico Island. To protect the island, the engineers built a mattress or revetment 4,000 feet long and 120 feet wide, sunk it over the eroded portion of the bank, and weighed it down with rocks.[27]

On the west side of the island, the Mississippi was depositing a sandy point bar, possibly from sediment eroded from Lucas Bar, just to the north. This point bar developed into the Calico Island well known today. By 1931, the Corps of Engineers had extended dikes across the bar. Within 18 years, trees took root on the point bar, and a chute was developing along its east side. By 1981, new Calico Island had developed into a timber island, with a distinct chute running along its east bank. Dikes along its west bank directed the river's current to the navigation channel along the Missouri bank. It is clear from aerial photographs taken in 2002 and 2011 that sometimes Calico Chute was open and water flowed through it but sometimes did not.[28]

The Bar—Old Calico Island: Wetland Reserve Program

In 2006, William Ziebold wanted a place to hunt and, therefore, placed 47 acres on the bar into the Wetlands Reserve Program. Ziebold's 47 acres bridged the "false channel behind Calico Island," now a low sandy swale, which once separated old Calico Island from the mainland. Willows (*Salix nigra*) took root on the ridges; grasses and forbs took root in the swale.

In 1985, Congress acknowledged that 73 percent of the nation's landscape was privately owned. If Americans were going to sustain a healthy wildlife population, they would have to establish private and public partnerships in order to restore landscapes. First, the lawmakers created the Conservation Reserve Program in 1985 to protect highly erodible land, and second, established the Wetlands Reserve Program in 1990 to protect wetlands. The Natural Resources Conservation Service administers both and provides technical and financial assistance to encourage landowners to take highly erodible lands out of production and restore them for fish and wildlife.

When Ziebold tried to turn the swale into a duck pond, he learned just how difficult the process of restoring a wetland can be. When the river was up, the swale filled with seep water. When the river was down, it dried out. He hoped he could dam the swale, line its bottom with clay, and turn "the false channel" into a pond that would hold water. Then, he realized that a flooded Mississippi would wash through the bar, flush out the clay, and he would have to start over again. When the Applied River Engineering Center looked at restoration plans for old Calico Island, the engineers also tried to return water to the false channel.[29]

Hard Points Calico Chute—2012

At river mile 148, the Mississippi threads between the tall bluff on the Missouri bank and Calico Island on the Illinois bank. Calico Chute runs between the island and the bank of the river.

When a group of biologists from the U.S. Fish and Wildlife Service, the Illinois Department of Natural Resources, the Missouri Department of Conservation, and engineers from the Applied River Engineering Center formed their coalition to restore riverine habitat to side channels of the Mississippi, they found Calico Chute in fairly good shape. Its width varied between 125 and 250 feet with an average of 200 feet. When the river ran low, its average depth of the channel was about nine feet, but there were places where it was as deep as 21 feet, and places existed where it was almost dry, leaving its sandy bottom exposed. Old, broken wooden pile dikes marked the head and the foot of the chute. On its right bank, Calico Island supported a dense 250-acre forest. This was not the case on its left bank, where farmers had stripped the forest from 500 acres of floodplain for farm fields in 1991. The collaborators built a table-sized model on which they could test their ideas for restoring habitat to Calico Chute and others in the Middle Mississippi.

Little needed to be done to restore diversity to the depth; the engineers inserted hard points constructed of rock, wood, or both at high energy areas along the chute to create deep scour holes for fish. They dredged where they did not want sand to exist and added sand where they did, enlarging the sandbar at the foot of the island. Using sand dredged from the channel, they created ridges on the banks and anchored them with trees. Wherever possible, they allowed water to flow through the chute and create a ridge and swale landscape. Finally, to reduce the amount of silt washing off the adjacent fields and into the chute, they reforested the denuded left bank with a riparian buffer of trees and shrubs at least a hundred feet deep.

The drought of 2012 followed the flood of 2011. The flood scoured a hole in the east bank of Calico Chute, whereas the drought built out the point bar on the east bank, leaving the hard points, designed to scour holes for fish, stranded in sand. When the Corps of Engineers brought in a barge to rebuild the east bank of Calico Chute, rocks fell from the barge and into the chute.[30]

Fort de Chartres Powder Magazine and the Fort Chartres Reach

A series of graphics at the Fort de Chartres museum tells the story of the fort's precarious relationship with the Mississippi. When the French completed the second Fort de Chartres, a wood palisade structure, in 1725 on the east bank of the Mississippi, an island divided the Mississippi into two roughly equal channels. The main channel flowed along the west bank, but within 30 years the main channel had migrated to the east bank. The French built a third Fort de Chartres, this time in stone and further inland, in 1756. In 1763, the French ceded Louisiana to the English. After the British took possession of the fort in 1765 and renamed it Fort Cavendish, the east channel had widened considerably, and a small island hugged the west bank. By 1772, the river was causing major erosion to the east bank, endangering the fort. The English abandoned the fort. A year later a flooded Mississippi took possession of Fort de Chartres' south wall and bastion. The remaining buildings fell into ruin as locals carted off the stones for their own structures, leaving only the powder magazine. The State of Illinois acquired the fort in 1913, restored the powder magazine in 1917, and rebuilt the main gate in the 1920s, as well as the Guards' House in 1936. The Illinois Historic Preservation agency, created in 1986, reconstructed the walls on the original foundations in 1989.[31]

A 1797 map locates the ruins of the fort along the chute of Isle de Duclos, owned by the Duclos family, which settled on the site of Old Fort Chartres (possibly the first fort) in 1742. An 1817 map locates the ruins of the fort not far from the end of what is known today as Fort Chartres slough, Isle de Declos chute. In 1866, the chute still carried water around the island, but by 1881 the island had ceased to exist. By 1890, parts of what is called Fort Chartres Island, Isles de Duclos, had been turned over to farm fields, but much of it remained in forest, treed in hackberry (*Celtis occidentalis*), elm (*Ulmus Americana*), and oak (*Quercus spp*).[32]

Isle de Duclos: Old Fort Chartres Chute, River Mile 132

Those considered to be history buffs likely know Fort de Chartres for the reconstructed eighteenth-century French fort. Hunters, anglers, trappers, hikers, and birders instead know Isle de Duclos Island and Fort Chartres Island for their woods, fields, and wetlands. The Illinois Historic Preservation Agency owns 1,219 acres, including the grounds of the fort and the region between the levee and the river. The Illinois Department of Natural Resources manages old Fort Chartres Island, once Isle de Duclos and now bar ground, and new Fort Chartres Island and Chute, created by the Corps of Engineers' stone dikes and closing dams for a total of 782 acres. Much of it, 570 acres, is in timber. The agencies lease out 150 acres for farming and water in the two chutes accounts for 52 acres.

Hunters come to Fort Chartre Island for deer, turkey, fox, coyote, and skunk. Small game hunters and trappers come for raccoon, opossum, rabbit, squirrel, quail, and dove. The DNR allows hunters to bring in portable tree stands and leave them overnight, but they are not allowed to nail, screw, or wire stands to trees. Only primitive, muzzle-loaded firearms or bows and arrows are allowed. Duck hunters can haul in boat blinds for teal and other waterfowl and use modern shotguns. Birders come for snipe, rail, woodcock, migrating waterfowl, and other birds.[33]

The Fort de Chartres and Ivy Landing Drainage ran its Onemile Race Creek ditch from Fults Creek ditch at the bluff line, across farm fields to the Fort de Chartres lock, and into the old side channel between Isle de Duclos and the mainland. Other small ditches drain through other locks and into the slough. The district closes these locks when the river floods the bar ground but keeps it open otherwise. Water trickling through the lock keeps the side channel flowing most of the time.

In 2005, the Applied River Engineering Center made a study of the geomorphology of the Middle Mississippi River and developed a blueprint for the restoration of old side channels, sloughs, oxbows, wetlands, and borrow pits. Any restoration proposal is couched in terms of what the agencies working on the river would do if possible and the funds were available. As for the old slough behind Isle de Duclos, the engineers enlarged it and left it connected to the river at its southern end at river mile 132.5.[34]

Anatomy of a Dike-created Island and Chute

At Isle de Duclos, the engineers built wing dams that directed the navigation channel to the Missouri side of the river and directed the river's sediment behind the wing dams, creating, first, a sand bar, then a willow island, and finally a timber island that reached the level of the mainland. The Fort de Chartres side channel ran between the Timber Island and old Fort de Chartres Island.

In 2000, scientists with the U.S. Geological Survey at the Upper Midwest Environmental Sciences Center's Long Term Resource Monitoring Center studied aerial photographs of Chartres Island and Chute to understand the evolution of the island and the deterioration of the chute. This was a part of a larger study of the state of side channels in the Middle Mississippi, which included a 2012 study by fish biologist Dr. Thomas Keevin and Erin Marks Guntren at the St. Louis District of the Corps of Engineers.

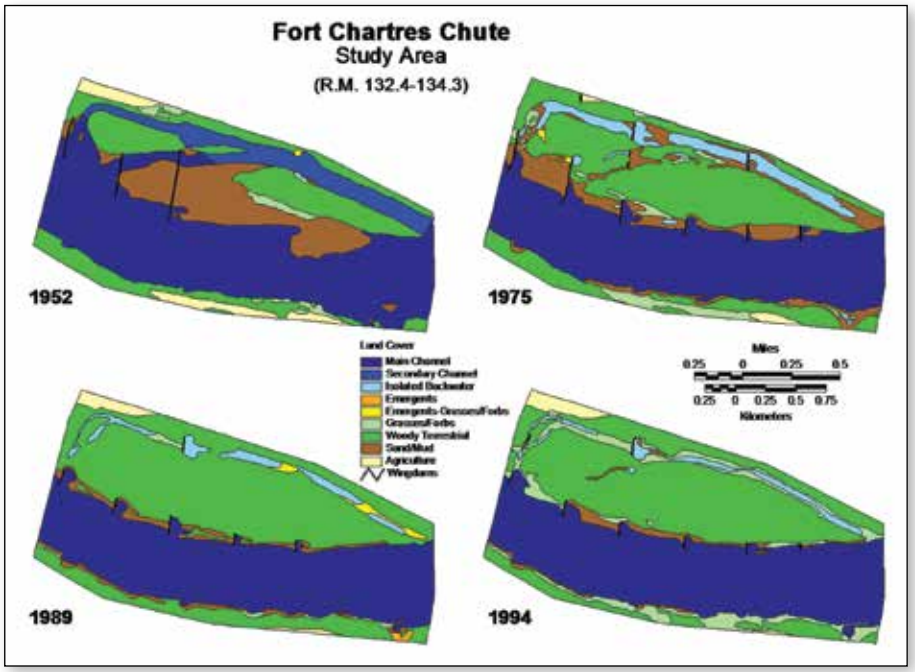
Keevin and Guntren's earliest aerial image of Fort Chartres Island, taken in 1931, shows sand had begun to accumulate behind a series of four wing dikes jutting out from the east bank of the river, forming two sandbars. Pooling in front of the dikes has delivered water to a side channel that runs between the bank and the bars, and forest has taken root at the head of each.

By 1950, the U.S.G.S. scientists measured a 101-acre side channel that separated three forested islands surrounded by sand and mud from the main land. A smaller secondary channel ran between them and joined the larger channel. Three wing dikes—one sprung from the main land at the head of the side channel, a second sprung from the mid-section of the island at the head of the side channel and blocked the head of the smaller channel, and a third long dike sprung from the foot of the same island—crossed both the smaller channel and the larger island, and extended out into the river.

Over the next 20 years, the wing dikes collected mud, eliminated the small secondary channel, and welded the three islands into one forested island. In 1975, the Corps constructed two closing dams across the remaining side channel. Mud and sand plugged both ends of the channel, reducing its size to 67 acres and isolating aquatic habitat. Additionally, engineers ran several dikes along the west side of the island and into the river. They caught more mud and sand and built a larger island. According to Keevin and Guntren's 1981 aerial, sand plugged both the head of Fort Chartres Chute and its foot, but water, pouring over the center closing dam, created a plunge pool that could be as deep as 10 feet at low water. By 1989, the large side channel had been reduced to a series of pools totaling 33 acres, and a 535-acre forest covered the island. The small secondary channel had disappeared. However, when hiking the island, it is viewed as a depression in the landscape.

Then the flood of 1993 occurred, which washed away 73 acres of forest which were replaced by grass and forbs. Not even the flood could open the side channel. Only 23 acres of aquatic habitat remained, where a healthy side channel once ran between the east bank and the three small islands in 1950.

Finally, silt began clogging the side channel, filling it with vegetation. However, floods, like those of 1993, 2008, and 2011, can scour the sediment and vegetation from the channel and return water to it temporarily at least. [35]



Fort Chartre Island Chute: Plunge Pool, 2008

The Fort Chartres side channel is one of 23 remaining on the Mississippi River. The St. Louis District and the Illinois Department of Natural Resources have made plans to restore the channel for the benefit of the pallid sturgeon, an endangered fish. But for the two scour holes, the chute dries out when the river reaches 10 feet on the St. Louis gauge. The engineers introduced more water into the side channel by notching in the closing dams to allow water to flow through. They dredged sediment from it and installed hard points, mini-dikes that scoured deep holes for the fish. Engineers used the dredge to form sandbars in the chute and build ridges on which to plant trees and reforest the banks.

The plunge pool, ten feet deep at low water and at the middle of Fort Chartres Chute, retains water even when the rest of the chute dries out. It is a place that fish can swim to as water in the chute dries up. Three years prior to restoration and in the three years following, the Corps and the DNR inventoried which fish were swimming in particular areas. They measured the water quality in the chute, including levels of dissolved oxygen, temperature, turbidity (muddiness), pH levels, and the rate at which water flows through it. Finally, and most importantly, they determined when and how well the chute was connected to the river, so that fish could enter and exit.

So much of what the Corps of Engineers and the Illinois DNR would like to do in terms of restoration on the Middle Mississippi is dependent on funding. All plans for Fort Chartres Chute have been on hold until funds become available.[36]

Chartre Island Snake

While the closing dams may complicate habitat in Fort Chartres Chute, the center dam allows a hiker to cross the chute and hike the island. Unfortunately, the trail allows the hiker to reach the river's edge where wing dikes are building still more land on the west bank of the island. Even through the focus of restoration at Fort Chartres Island is on its adjacent chute, restoration managers would like to document and map the trees in the forest canopy and the shrubs in its understory as well as the grasses and forbs in the sand areas before and after the construction work in the chute.[37]

A Small Tow Exits the Kaskaskia River at its Confluence with the Mississippi and the End of the Kaskaskia Confluence Trail

At the confluence of these two rivers, history meets environmental stewardship. This is where, on April 18, 1881, the Mississippi jumped its bank, picked up a shallow ditch called "The Narrows" on the peninsula between the Mississippi and Kaskaskia, flowed to the Kaskaskia, and took over its narrow channel. On the left bank of the Mississippi and at the opposite the end of the Confluence Trail is Fort Kaskaskia State Park. On the right bank, on the Missouri side, is the Beaver Island Division of the Middle Mississippi River National Wildlife Refuge.

The Mississippi River makes a sharp, 70-degree turn around Beaver Island. A series of 16 dikes scour the navigation channel around the bend. Stone riprap armors the bank on the Illinois side, opposite Beaver Island. Clear around the bend lays Kaskaskia Island and the remnants of the Village of Kaskaskia, founded by the French in 1703. Across the Mississippi and overlooking the confluence and Kaskaskia Island is Fort Kaskaskia State Park.

In 2004, Ducks Unlimited donated Beaver Island to the Middle Mississippi River National Wildlife Refuge. This 245-acre island hosts a mature cottonwood forest. The cobble and gravel bed of the active side channel around the island offers native fish—including the endangered pallid sturgeon—quiet spawning habitat.

The French built the first Fort Kaskaskia in 1734 and rebuilt it in 1759 as a small fort or earthen redoubt set atop a bluff on the opposite bank of the Kaskaskia and overlooking the village. After the French abandoned the fort in 1763 and turned Louisiana over to the British, villagers from Kaskaskia destroyed much of the fort to keep it from falling into British hands. When they arrived in 1766, the British found only the earthworks remaining and built Fort Gage in the village of Kaskaskia. During the American Revolution, General George Rogers Clark arrived at Kaskaskia in 1778 and took Fort Gage and Fort Kaskaskia.[38]

Finally, two highly familiar missions of the U.S. Army Corps of Engineers occurred: flood risk management (levee specification) and navigation (the 9-foot navigation channel). Most are not familiar with its other two missions: environmental stewardship (notched dikes, chevron dikes, restored side channels) and recreation. The Kaskaskia Confluence Trail fulfills these last objectives. In May 2010, the Department of the Interior added the trail to its list of National Recreation Trails.[39]

The trail is a part of the larger Kaskaskia River Project, which serves two Corps missions: navigation and recreation. In 1962, Congress authorized the Kaskaskia Navigation Project, which channeled and straightened 40 miles of the Kaskaskia River from its confluence with the Mississippi to Fayetteville, Illinois. To maintain the 9-foot navigation channel, the Corps built a lock and dam just short of the confluence. The project included large reservoirs, Carlyle Lake and Lake Shelbyville, for both flood control and recreation. Additionally, the Corps turned many of the cutoff bends in the river into recreational areas with campgrounds. The Corps and the Illinois Department of Natural Resources stock the river to increase the populations of bass, bluegill, crappie, catfish, and walleye.[40]

The American Bottom from the mouth of the Missouri to the confluence with the Kaskaskia River has 100 miles of Mississippi River shoreline. Only at the end of the Kaskaskia Confluence Trail can the public gain access to the river. The hike to the confluence is short, just .4 miles, but there are plenty of opportunities to wander through the bottomland forest, treed in black willow (*Salix nigra*), cottonwood (*Populus deltoids*), and silver maple (*Acer saccharinum*). This is a paved, wheelchair accessible trail to the Mississippi River, one that can be biked or jogged. If one is fortunate, and the rivers are up, there might be an opportunity to startle a Great Blue Heron (a very shy bird) at its fishing hole in a low swale in the landscape. It will respond with a squawk, rise up, and glide off into the woods. If the rivers are in flood, the trail is inaccessible, and the woods provide fine fishing for the bird. Human anglers fish from the banks hoping to reel in catfish, largemouth bass, crappie, bluegill, white bass, walleye, or even an Asian carp. Hunters are also allowed to access designated areas during deer season.

NOTES

[1] Raymond Ripplemeyer, quoted in Helen Rogland Klein, *Arrowheads to Aerojets* (Valmeyer, Ill.: Myron Roever Associates, 1967), 96.

[2] Quinta Scott, *The Mississippi* (Columbia: University of Missouri Press, 2009), 10.

[3] DeWitt C. Jones and James W. Skelly, "Regulation of the Middle Mississippi River," in *The Military Engineer*, Journal of the Society of American Military Engineers, Volume XIII, No. 69, May-June 1921, 197-204; U.S. Army Corps of Engineers, St. Louis District, *Draft Herculaneum Side Channel Restoration Project Implementation Report*, Last updated, August 5, 2010, http://www.mvs.usace.army.mil/pm/herculaneaum/Main%20Report.pdf.

[4] Scott, *The Mississippi*, 55-56.

[5] U.S. Army Corps of Engineers, St. Louis District, Rivers Project Master Plan, Section 4, Regional Description and Factors Influencing Development, 4-28-4-32, http://www.mvs.usace.army.mil/rivers/Master_Plan_Files/Text/Section%2004%20Regional%20Description%20and%20Factors%20Influencing%20Devel.pdf

[6] House Documents, 63rd Congress, 2nd Session, December 1. 1913-October 24, 1914, Vol. 22, Washington D.C.: U.S. Government Printing Office, 1914, 17-19; Eugene L. Harman, Assistant Engineer, Report to the Mississippi River Commission, St. Louis, Missouri, November 5, 1913, in House Documents, 63rd Congress, 2nd Session, December 1. 1913-October 24, 1914, Vol. 22, Washington D.C.: U.S. Government Printing Office, 1914, 17-19; Conversation with Doris and Robert Ripplemeyer, July 30, 2012.

[7] Rodney Linker, Luhr Brothers Engineering, "How deep were the borrow pits," email reply, August 15, 2012.

[8] Ripplemeyer,"Rivers and Levees, 1966," 96-97.

[9] Conversation with Delbert Wittenauer, July 2, 2012; conversation with Ronald Niebruegge, July 3, 2012; conversation with Gary Stumpf, July 25, 2012.

[10] Conversations with Roland Niebruegge, July 9-11, 2012. Niebruegge was kind enough to review his crop records for the years 2007-2011. From his figures I generalized yields for the rest of "the bar."

[11] Capt. Charles J. Allen, Report to Col. J. H. Simpson, "Examination and Survey of the Mississippi River from the Missouri River to the Ohio River," Annual Report of the Chief of Engineers to the Secretary of War for the Year 1873, Washington, D.C.: U.S. Government Printing Office, 1873, 469-76; Charles True, Report to Col., J. H. Simpson, Corps of Engineers, U.S.A., Annual Report to the Secretary of War for the Year 1874, Washington, D.C.: U.S. Government Printing Office, 1874, 336-337; Frederick J. Dobney, The River Engineers on the Middle Mississippi: A History of the St. Louis District, U.S. Army Corps of Engineers, St. Louis, 1977, 56, 61, http://www.mvs.usace.army.mil/pa/River_Engineers_on_the_Middle_Mississippi.pdf; Col. J. H. Simpson and Capt. O. H. Ernst, Corps of Engineers, "Improvement of the Mississippi River Between the Mouths of the Illinois and Ohio River," Annual Report of the Secretary of War for the Year 1880, Vol. II, Part 1, Washington, D.C.: U.S. Government Printing Office, 1880, 159; "Report of Major O. H. Ernst, Corps of Engineers, upon the Improvement of the Mississippi River between the Mouths of the Illinois and Ohio River," Annual Report of the Chief of Engineers, U.S. Army to the Secretary of War for the Year 1887, Part IV, Washington, D.C.: U.S. Government Printing Office, 1887, 2722.

[12] DeWitt C. Jones and James W. Skelly, Regulation of the Middle Mississippi River, in *The Military Engineer*, Journal of the Society of American Military Engineers, Volume XIII, No. 69, May-June 1921, 197-204; Bruce McCartney, Chair, and Tom Pokrefke, Editor, "Inland Navigation Channel Training Works," Task Committee of the Waterways Committee of the Coasts, Oceans, Ports, and Rivers Institute (COPRI) American Society of Civil Engineers, Chapter 5, 36-52, http://www.engr.colostate.edu/~pierre/ce_old/classes/ce717/MOP%20Inland_Navigation_ASCE%20FINAL%20DRAFT.pdf.

[13] Dawn M. Smith, David C. Gordon, Aron M. Rhoads, Robert D. Davinroy, "Sedimentation Study of the Middle Mississippi River at Jefferson Barracks, River Miles 176.0 to 166.0, Hydraulic Micro Investigation, " U.S. Army Corps of Engineers, St. Louis District, Hydrologic and Hydraulics Branch, Applied Engineering Center, November 2001, http://www.mvs.usace.army.mil/eng-con/expertise/arec/Model%20Study%20Report%20PDFs/JB%20Bridge%20CD/JB-BridgeReport.pdf; Telephone conversation with Mike Rogers, U.S. Army Corps of Engineers, St. Louis District, River Engineering, November 7, 2007; Telephone conversation with Dawn Lamm, July 13, 2012.

[14] E. D. Libby, Assistant Engineer to Major O. H. Ernst, Corps of Engineers, "Primary Hurdle—Carroll's Island," Annual Report of the Chief of Engineers to the Secretary of War for the Year 1883, Part II, Washington, D.C.: U.S. Government Printing Office, 1883, 1215; Major O. H. Ernst to Brig. Gen H. G. Wright, "Improvement of the Mississippi River Between the Illinois and Ohio River," in Annual Report of the Chief of Engineers to the Secretary of War for the Year 1883, Part II, Washington, D.C.: U.S. Government Printing Office, 1883, 1178; Edward J. Brauer, et al., "Geomorphology Study of the Middle Mississippi River,: U.S. Army Corps of Engineers, St. Louis District, December 2001, Plates 8-12 for the years 1817, 1866, 1881, 1928, 2003,http://www.mvs.usace.army.mil/arec/documents/Geomorphology/GeomorphologyStudyofTheMiddleMississippiRiver.pdf.

[15] Middle Mississippi River Partnership, The Middle

Mississippi River Regional Corridor Reach Reports, American Bottom, Ecoregion 1: Middle Mississippi River, 1A-19-1A-25, http://www.swircd.org/mmrp/Reach%201%20Appendices.pdf

[16] Middle Mississippi River Partnership, The Middle Mississippi River Regional Corridor Reach Reports, American Bottom, Ecoregion 1: Middle Mississippi River, ER1-3-ER1-4, http://www.swircd.org/mmrp/American%20Bottom%20Ecoregion%201.pdf.

[17] U.S. Geological Survey, Upper Midwest Environmental Sciences Center, 1890s Map Plates—Georeferenced Images of Maps Produced by the Mississippi River Commission, http://www.umesc.usgs.gov/data_library/umesc_metadata/maps_quads_figs/umesc_1890s_mrc_map_mosaics.html#Distribution_Information; Edward J. Brauer, et al., "Geomorphology Study of the Middle Mississippi River,: U.S. Army Corps of Engineers, St. Louis District, December 2005, 40, http://www.mvs.usace.army.mil/arec/documents/Geomorphology/GeomorphologyStudyofTheMiddleMississippiRiver.pdf

[18] The Middle Mississippi Regional Corridor Reach Reports, "Subarea 1-2 Beards/Carroll Islands," 1A-19-1A-25, http://www.swircd.org/mmrp/Reach%201%20Appendices.pdf; U.S. Army Corps of Engineers, St. Louis District, Rivers Project Master Plan, 2001, Section IV, "Notched Closure Structures," 4-30, 4-50-4-53, http://www.mvs.usace.army.mil/rivers/Master_Plan_Files/Text/Section%2004%20Regional%20Description%20and%20Factors%20Influencing%20Devel.pdf; Bill Boyd and Mary Grapperhaus, Illinois Department of Natural Resources, Division of Fisheries, Fishing the Middle Mississippi, June 1995, l, http://www.ifishillinois.org/profiles/rivers&creeks/Mississippi/Mid%20Miss%20River%20Fishing%20Guide.pdf.

[19] "Senate action against Asian carp lauded as vital for fight," *Toledo Blade*, November 22, 2010, http://www.toledoblade.com/local/2010/11/22/Senate-action-against-Asian-carp-lauded-as-vital-for-fight.html.

[20] Allen Allington, "Asian Carp & The Great Lakes: Investing in Carp," Ann Arbor, Michigan Radio, September 14, 2012.

[21] Sophia Tareen, "Asian Carp Anti-Hunger Program Launches in Illinois," http://www.huffingtonpost.com/2011/09/22/asian-carp-antihunger-pro_n_975647.html; "Our View: Asian Carp Fight Should Focus on Where the Fish Are," *Rockford Register Star*, http://www.rrstar.com/carousel/x219195571/Our-View-Asian-carp-fight-should-focus-on-where-fish-are.

[22] Tip of the Mitt Watershed Council, "Asian Carp," http://www.watershedcouncil.org/learn/aquatic%20invasive%20species/asian-carp.

[23] Major O. H. Ernst to Brig. Gen. H. G Wright, Chief of Engineers, "Improvement of the Mississippi River between the Illinois and Ohio Rivers," in Annual Report of the Chief of Engineers to the Secretary of War for the Year 1883, Part II, Washington, D.C.: U.S. Government Printing Office, 1883, 1180

[24] Report of John O. Holman, Assistant Engineer, July 7, 1883, Annual Report of the Chief of Engineers to the Secretary of War for the Year 1883, Part II, Washington, D.C.: U.S. Government Printing Office, 1883, 1224; *Standard Atlas of Monroe County, Illinois* (Chicago: George A. Ogle and Co., 1901), 14, in *Combined Atlases of Monroe County, 1875, 1901, and 1916*.

[25] Edward J. Brauer, David C. Gordon, Edward H. Riiff, and Robert D. Davinroy, "Cliff Cave-Kimmswick Hydraulic Sediment Response Study, Upper Mississippi River Miles 168.0-156.6, Applied River Engineering Center, St. Louis District, Corps of Engineers, September 2006, http://www.mvs.usace.army.mil/arec/documents/HSRModels/M41_CliffCaveKimmswick.pdf; Lamm, Dawn M., Email, September 21, 2012; Rivers Project Master Plan, 4-50.

[26] Michael T. Rodgers, Dawn M. Lamm, Edward H. Riiff, and Robert D. Davinroy, Sedimentation Study of the Middle Mississippi River at Herculaneum, Missouri, River Miles 156.3-149.7, St. Louis District, U.S. Army Corps of Engineers, Final Report-June 2003, http://www.mvs.usace.army.mil/arec/documents/HSRModels/M28_Herculaneum.pdf; Annual Report of the Chief of Engineers to the Secretary of War for the Year 1894, Part III, Washington, D.C.: U.S. Government Printing Office, 1894, 1590; Capt., Edward Burr, Corps of Engineers, Report dated August 31, 1900, Annual Reports of the War Department for the Fiscal Year Ended June 30, 1901, Report of the Chief of Engineers, Part 3, Washington, D.C.: U.S. Government Printing Office, 1901; St. Louis District, Corps of Engineers, Project Implementation Report with Integrated Environmental Assessment, Navigation and Ecosystem Sustainablity Program, Herculaneum Side Channel Restoration, http://www.mvs.usace.army.mil/pm/herculaneaum/Main%20Report.pdf; Scott, *The Mississippi*, 64; U.S. Fish and Wildlife Service, Middle Mississippi National Wildlife Refuge, Meissner Island Division, http://www.fws.gov/Midwest/MiddleMississippiRiver/Meissner_Island.html.

[27] Maj. A. M. Miller and Col. C. B. Comstock, Annual Report of the Chief of Engineers to the Secretary of War for the Year 1890, Part I, Washington, D.C.: U.S. Government Printing Office, 1890, 204; D. M. Currie, Assistant Engineer, Report to Major A. M. Miller, Report of Mr. John O. Holman, Superintendent to Major Miller, in Annual Report of the Chief of Engineers to the Secretary of War for the Year 1892, Washington, D.C.: 1892, 1719-1723.

[28] Email, Dr. Thomas M. Keevin, U.S. Army Corps of Engineers, St. Louis District, September 12, 2012; Study of Calico Chute, using map dated 1890, and aerial photographs dated 1931, 1949, 2002, and 2011, prepared by Erin Marks Guntren.

[29] Scott, *The Mississippi,* 47; Conversation with William Ziebold, September 15, 2012; Geomorphology Study of the Middle Mississippi River, Plate 19, http://www.mvs.usace.army.mil/arec/documents/Geomorphology/GeomorphologyStudyofTheMiddleMississippiRiver.pdf

[30] U.S. Fish and Wildlife Service, and the U.S. Army Corps of Engineers, St. Louis District, "Middle Mississippi River Side Channels: A Habitat Rehabilitation and Conservation Initiative, n.d., 17; Conversation with Dawn Lamm, Applied River Engineering Center, St. Louis District, July 19, 2012.

[31] Illinois Historic Preservation Agency, Fort de Chartres, http://www.illinoishistory.gov/hs/fort_de_chartres.htm.

[32] The DeClue Family Website, "A brief synopsis of the Early Duclos Family in America," http://www.declue.org/DeClue_history/Early_Duclos_Family_History_in_America.htm; Prairie du Rocher Chamber of Commerce, Historic Information, Maps, 1797 Area Map of Prairie du Rocher, http://www.visitprairiedurocher.com/history/maps/pdr_area_map_1797.html

[33] Illinois Department of Natural Resources, Fort de Chartres Hunter Fact Sheet-Illinois Historic Preservation Agency, http://dnr.state.il.us/lands/landmgt/hunter_fact_sheet/r4hfs/fdc.htm.

[34] Geomorphology Study of the Middle Mississippi River, Plate 25, http://www.mvs.usace.army.mil/arec/documents/Geomorphology/GeomorphologyStudyofTheMiddleMississippiRiver.pdf.

[35] Charles Theiling, Mary R. Craig, Kenneth B. Lubinski, "Side Channel Sedimentation and Land Cover Change in the Middle Mississippi River Reach of the Upper Mississippi River System," La Crosse, Wisconsin: U.S. Geological Survey, Upper Midwest Environmental Sciences Center, Long Term Monitoring Program, August 2000, 86-89.

[36] U.S. Army Corps of Engineers, Rock Island District, Upper Mississippi River Restoration-Environmental Management Program, Unimpounded River, Reaches 9-10, Middle Mississippi River, http://www.mvr.usace.army.mil/EMP/Documents/Appendix%20C-1.pdf; The Middle Mississippi River Regional Corridor Reach Reports, Fort du Chartres Island, 2A-35, http://www.swircd.org/mmrp/Reach%202%20Appendices.pdf.

[37] The Middle Mississippi River Regional Corridor Reach Reports, Fort du Chartres Island, 2A-35, http://www.swircd.org/mmrp/Reach%202%20Appendices.pdf.

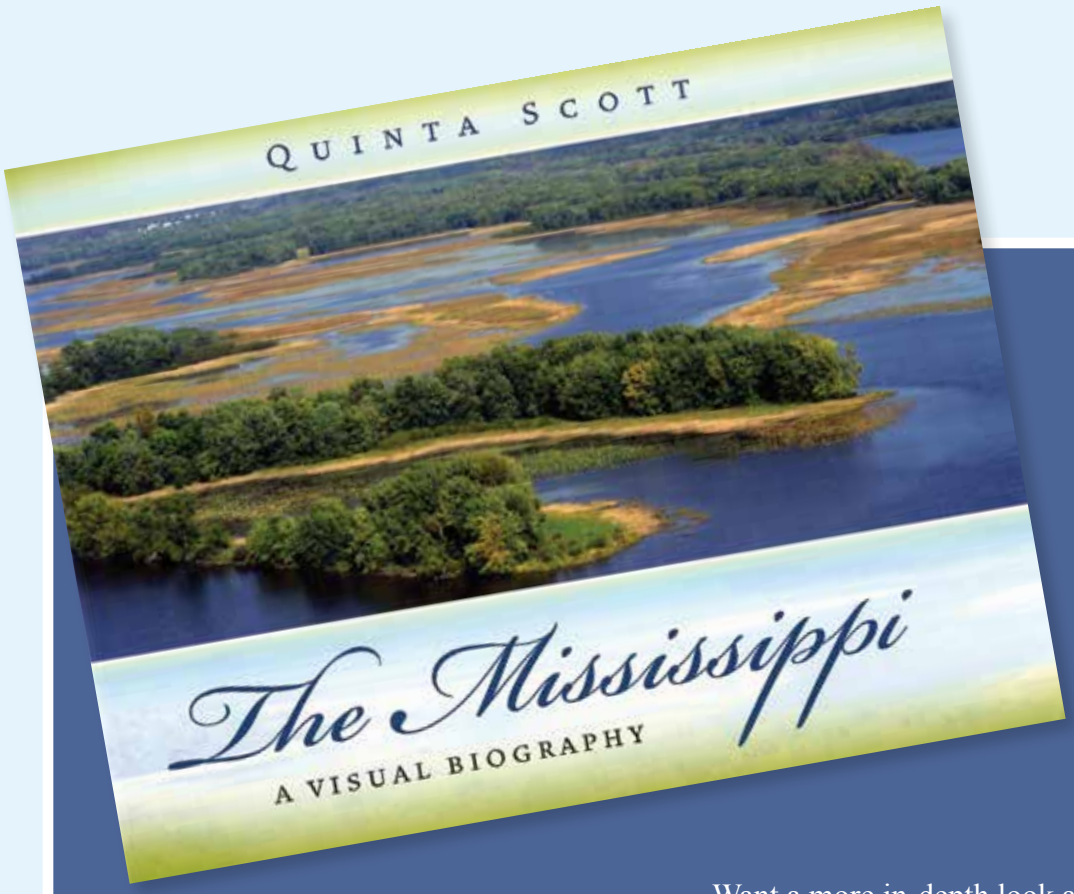
[38] J. H. Burnham, "Destruction of Kaskaskia by the Mississippi River," in *Transactions of the Illinois State Historical Society for the Year 1914*, Springfield: Illinois Historical Society, 1914, 95-112; Timothy J. Lauth, U.S. Army Corps of Engineers, St. Louis District, Hyrologic and Hydraulics Branch, Hydraulic Design Section, "Stone Dike Alterations project Report, Middle Mississippi River, Miles 201-0, (UMRS-EMP) Environmental Management Program," http://www.mvs.usace.army.mil/arec/documents/Stone%20Dike%20Alteration/Stone%20Dike%20Alteration%20Report%20Update%206-6-11.pdf; U.S. Fish and Wildlife Service, Middle Mississippi River National Wildlife Refuge, "Beaver Island Division," http://www.fws.gov/uploadedFiles/MiddleMissBrochure.pdf; Illinois Historic Preservation Agency, "Fort Kaskaskia," http://www.illinoishistory.gov/hs/fort_kaskaskia.htm.

[39] National Recreation Trails, Kaskaskia River Confluence Trail, Illinois, http://www.americantrails.org/nationalrecreationtrails/trailNRT/Kaskaskia-Confluence-USACE-IL.html; U.S. Department of the Interior, Press Release, Designation of 31 New National Recreation Trails in 15 States, http://www.doi.gov/news/pressreleases/Salazar-Announces-31-New-National-Recreation-Trails-in-15-States.cfm.

[40] U.S. Army Corps of Engineers, St. Louis District, Kaskaskia River Project, http://www.mvs.usace.army.mil/Kaskaskia/wildlife.html.

Who helped: Because most of the bar ground is in private hands, I have had to depend on the owners of the lands along Jefferson Barracks and Calico Chutes for permission to go there. Ronald Niebruegge took me across his fields and out to Calico Chute. Because the river was so low, we were able to cross the chute to the Calico Island. He also introduced me to the term "the bar," which sent me off onto a whole new line of research. Gary Stumpf allowed me to cross his fields to the edge of the Jefferson Barracks Chute; Rodney Linker served as my guide. Rodney—who is vice-president of Luhr Brothers, an engineering firm that does work on the river, building dikes and levees—also helped me understand the concept of the Low Water Reference Point and how it applied to the Flood of 1993. He also sent me his take on how levees are built. You will find his name scattered throughout the footnotes of these articles. Robert and Doris Ripplemeyer toured their farm in the bottoms with me and gave me insight into the language of that special place.

Claude Strausser, retired chief of the Hydrologic and Hydraulic Branch of the St. Louis District, helped me understand the flood of 1993 and the release of floodwater from the American Bottom at Prairie du Rocher. Dr. Thomas M. Keevin, a fish biologist at the St. Louis District of the Corps of Engineers, supplied me with the maps he produced with Erin Marks Guntren, detailing the state of Jefferson Barracks, Calico, and Fort Chartres Chutes between 1890 and 2002. Dawn Lamm, an engineer the Applied River Engineering Center at the St. Louis District, answered any and all questions I had about side channels, the Jefferson Barracks Dike Field, and the chevron dikes at Beard Island. Kenneth S. Lubinski of the U.S. Geological Survey-Upper Midwest Environmental Sciences Center supplied me with the Fort Chartres graphic and his report on Side Channel Sedimentation. Larry Robinson, a cartographer at the Sciences Center, sent me .pdf and .jpg files of the 1890 maps created by the Mississippi River Commission.



Want a more in-depth look at this topic? You can acquire Quinta Scott's new book, The Mississippi: A Visual Biography, from either Amazon at

http://www.amazon.com/Mississippi-Visual-Biography-Quinta-Scott/dp/0826218407/ref=sr_1_1?s=books&ie=UTF8&qid=1320087304&sr=1-1

or from the University of Missouri Press by calling 1-800-621-8476, or on line at

http://press.umsystem.edu/product/Mississippi,1255.aspx