Vital Currents in America's Heartland:

A History of the North Central Division, U.S. Army Corps of Engineers, 1867–1997

William F. Willingham

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FOREWORD

When I began this history of the former North Central Division (NCD) of the Corps of Engineers almost ten years ago now, I had no idea it would take so long to get into print. I completed the research and writing in 2001, but by then the last elements of the NCD no longer existed. Downsizing and reorganization of the Corps in the late 1990s had led to the NCD's closure and to its district elements' move into the newly formed Lakes and Rivers Division (LRD), headquartered in Cincinnati, Ohio. Publication of the NCD history had to await the evaluation of historians in the Corps' Office of History in Washington, D.C. Fortunately, they believed the NCD story was noteworthy and should be made accessible to members of the Corps and to an interested lay public.

As I hope the following narrative makes abundantly clear, the NCD played an important role in the history of the Corps during the twentieth century. Sitting astride the Nation's heartland, the NCD civil works mission encompassed navigation improvements on the Upper Mississippi River, as well as on the Great Lakes. As directed by the NCD commander and staff, the St. Paul, Chicago, Detroit, and Buffalo districts built and operated such major projects as the locks on the Upper Mississippi and its tributaries, the St. Lawrence Seaway, and various navigation facilities on the Great Lakes. In the last half of the twentieth century, the NCD engaged in significant environmental initiatives in the Great Lakes and Mississippi River drainage areas. Innovative efforts to safely dispose of dredged material in the Great Lakes and to enhance environmental conditions on the Mississippi for fish and wildlife represented events worth recording and making available for future study. Above all, contextualizing the basic history of the NCD allows us to better understand its larger meaning and importance for the Corps' and the Nation's history.

I would like to thank Carol Champ, Executive Assistant to the Division Commander, and Dean Eitel, a long-time division senior civilian executive, who oversaw the closing of the NCD. Both were strong supporters of the project to write this division history and greatly facilitated my research. Without their help, I doubt it would have been possible to complete this work.

William R. Willingham
Portland, Oregon

In late 2007, LRD Commander Brig. Gen. Bruce A. Berwick remarked that the NCD history had languished "on the shelf" long enough and urged its completion and publication. The Louisville District took charge of monitoring a contract with Historical Research Associates, Inc., in Seattle, Washington, to edit and index Bill Willingham's original manuscript and to prepare the book for printing. Throughout this process, certain individuals have been very helpful, both at LRD, and at its districts. Lashawn Sykes at the division has prodded the staff there to search their files for pertinent information. John Kangas and Joe Svirbely have offered numerous helpful comments. At the districts, the Public Affairs Offices have proven helpful by providing essential information from their files and records .

Heather Lee Miller, Leigh Cutler, and Dawn Vogel of HRA have kept the project on schedule and provided a final publication of the highest quality. Finally, the Corps' Office of History staff, especially John Lonnquest and Matthew Pearcy, has helped guide this project to completion.

To all of these we offer our sincere thanks.

Charles E. Parrish, Historian
Louisville District

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INTRODUCTION
Regional Setting and Organizational Description of the North Central Division

The U.S. Army Corps of Engineers has been at work in the Great Lakes and Upper Mississippi Valley region almost since the Corps' founding. Permanently established by Congress in 1802, the Corps of Engineers helped explore and survey the region and prepare its military fortifications. Beginning in the 1820s, the U.S. Army engineers applied the science of engineering to improve the region's waterways and harbors. Topographical engineers carried out the earliest U.S. Army explorations in the inland frontier of the Old Northwest. These engineers were under the command of the Chief of Engineers until 1838, when Congress established a separate Corps of Topographical Engineers. Until the Civil War, the Topographical Engineers carried out most of the congressionally authorized internal improvements in the Great Lakes region.[1]

Major Stephen H. Long, a topographical engineer, explored the area of the Illinois and Upper Mississippi rivers in 1816 and 1817. In 1818, Long led a well-equipped scientific expedition from Pittsburgh to the Rocky Mountains. While Long was exploring the Northwest beyond the Great Lakes, Captain David Douglass of the Corps of Engineers carried out two explorations and surveys focused on the Great Lakes. In 1819, he served on the commission to survey the international boundary between Niagara and Detroit. The following year, he accompanied, as a topographer, an expedition from Detroit to the Upper Mississippi River via Lakes Huron and Superior. In 1823, Major Long once again entered the Upper Mississippi region, scientifically exploring and surveying the areas of present-day Minnesota and North Dakota. The published results of the early Army engineer reconnaissance of the Great Lakes and Upper Mississippi River provided the first scientific knowledge and mapping of the area. Wide dissemination of this information helped speed the settlement and development of the region.

Figure 1. Major Stephen H. Long. One of the first engineers to recommend improvement of the Chicago harbor and a canal between the Chicago and Illinois rivers to connect Lake Michigan and the Mississippi River. (Artist: Charles Wilson Peale, 1819. Courtesy of the Army Engineer.)

Before the advent of the railroad in the mid-nineteenth century, the U.S. Army relied largely on waterway transport for moving troops and supplies. The early Army engineer explorations provided a familiarity with the water passages of the Great Lakes region that supported the Army's efforts to pacify and defend the territory following the War of 1812. This waterways expertise, and the fact that Army engineers were the nation's only formally trained engineers, led Congress to assign the work of federal internal improvements to the Corps of Engineers when it initiated such activity in 1824.

Taking an expansive view of its constitutional powers, Congress recognized that navigation improvements contributed directly to national defense by strengthening U.S. Army logistics and indirectly by encouraging commerce and national economic development. The Corps began its work of improving inland navigation with the passage of the General Survey Act in April 1824. This measure authorized Army engineers to conduct surveys for roads and canals important to national commerce, defense, and transportation of the mail. Congress quickly followed this measure with the passage, also in

1824, of an appropriation to improve navigation on the Ohio and Lower Mississippi rivers. Under this law, the president ordered the Army engineers to remove obstructions that impeded river transportation, such as snags and sandbars. These undertakings marked the initiation of the Corps' civil works mission.

The first chapter of this history of the North Central Division (NCD) describes and analyzes the water resources development work of the

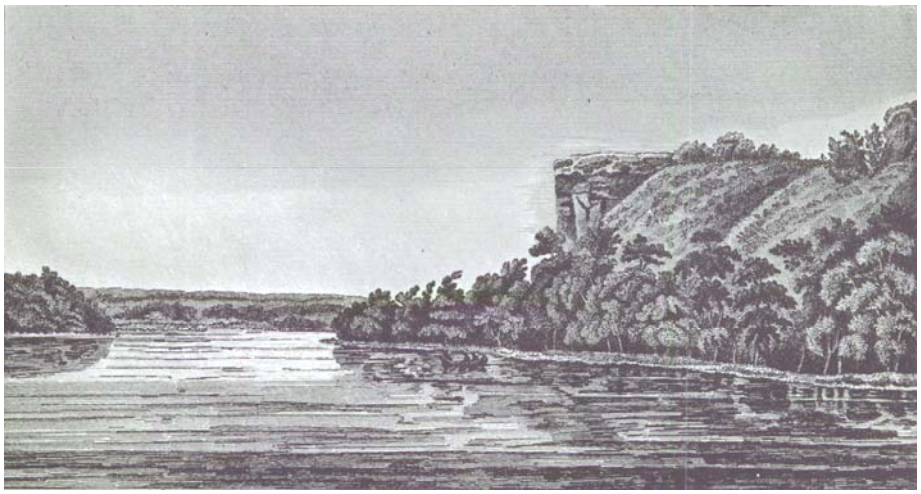


Figure 2. "The Maiden's Rock on the Mississippi River." One of several illustrations provided by landscape artist Samual Seymour for William H. Keating's published narrative of Major Stephen Long's 1823 journey.

nineteenth- and early twentieth-century Army engineers in the Great Lakes region. It also briefly examines the predecessor divisions that oversaw the projects carried out by Corps' districts as they improved the region's rivers and harbors. Subsequent chapters focus on the important aspects of the water resources activities carried out by the NCD from its establishment in 1954 until its closure in 1997.

The NCD had responsibility for water resources development in all or parts of twelve midwestern states. That area included the Great Lakes basin, the Upper Mississippi River valley, and the watershed of the Souris-Red-Rainy rivers in northern Minnesota and North Dakota. Commonly called the "heartland of America," the area embraced by NCD boundaries covered 428,000 square miles, or 11 percent of the total area of the United States. In 1990, 40 million people—20 percent of the U.S. population—lived in the region and five of the nation's thirteen largest cities could be found there. Because of its location, the NCD, through its commander, represented the United States on several U.S.-Canadian international boards concerned with boundary water issues between the two countries.

Regional Descriptions

The Great Lakes region comprises 299,000 square miles, 95,000 of them water. The region covers all or parts of eight states, with 4,000 miles of mainland shoreline. The Great Lakes region was created by glaciations, the most recent period occurring within the last 10,000 years. The configuration of the five Great Lakes, with their outlets and current lake levels, stabilized about 3,000 years ago. The ongoing processes of stream and shoreline erosion have only slightly changed the original topography set in the Ice Age.[2]

During the Pleistocene or Ice Age, a continental ice cap several thousand feet thick spread southward, covering what is now the Great Lakes region. It deepened preglacial valleys by scouring and filled others by deposits, creating the five lake basins. Then, as the climate warmed and the ice front receded northward, water ponded between the ice and the exposed glacial deposits. This process created lake bodies with ever-higher water levels and overflow outlets across present watershed divides. As the ice receded, the levels of the lakes changed repeatedly as new, lower outlets appeared. Present-day shorelines record these past changes in the glacial lakes in such features as the perched wave-cut cliffs of Mackinac Island; the lake-deposited clay flats of Chicago; the variable stratified sands overlying the bluffs along the shore of Lakes Erie, Huron, and Michigan; and the many sand-dune formations found around the lakes. As one of the youngest natural features in North America, the Great Lakes remain a dynamic, evolving system.

The Great Lakes hold an estimated 6 quadrillion gallons of water, and thus it takes enormous quantities of water to cause even small changes in lake levels. In comparison, unlike the range of flows found in large rivers, the flow rates in the lakes' outlet rivers show little fluctuation. The average annual precipitation for the entire region is 32 inches, and the average annual temperatures range from 39 degrees on Lake Superior to 48.7 degrees on Lake Erie.

The Great Lakes sit at different elevations, advancing like a series of steps to the Atlantic Ocean. The five individual lakes are connected by channels, forming one system. The St. Marys River is a sixty-mile waterway between Lakes Superior and Huron. The elevation drop is twenty-three feet. The Straits of Mackinac link Lake Michigan and Lake Huron, forming one lake hydraulically, with lake levels rising and falling together. The St. Clair and Detroit rivers, together with Lake St. Clair, comprise an eighty-nine-mile-long connection between Lakes Huron and Erie. The fall between the two lakes is eight feet. Lake Erie is connected to Lake Ontario by the thirty-five-mile-long Niagara River. The drop at this point in the waterway system is a dramatic 325 feet, with most of it occurring at Niagara Falls. From Lake Ontario, water flows into the St. Lawrence River and on to the Atlantic Ocean.

The Upper Mississippi River region encompasses an area extending 700 miles from the Canadian border on the north to the mouth of the Ohio River on the south, and 500 miles from the Indiana border on the east to South Dakota on the west. The region encompasses 189,000 square miles and parts of eight states. Lakes and streams cover some 5,000 square miles. Once an area of primeval forest and grasslands, now over two-thirds of the region's 184,000 square miles of land are used for agricultural purposes. In 1990, the population of the region stood at 21.5 million.

The character of the Mississippi River and its valley undergoes many striking changes between the river's source and the point where the Ohio River joins it. From its beginning at Lake Itasca in Minnesota, the Mississippi meanders north for eighty miles to Lake Bemidji. After leaving Lake Bemidji, it flows east for 100 miles through swamps, lakes, and pine forests before heading south. Its flow becomes swifter and its banks higher. At St. Anthony Falls, Minnesota, the Mississippi River forms the boundary between the cities of Minneapolis and St. Paul. The first major tributary of the Mississippi, the Minnesota River, joins at the Twin Cities. From this point, the Mississippi passes through an 856-mile section, consisting of high bluffs, rolling hills, and wild wetlands. This reach contains more than 500 forested islands.

As it passes south, the Mississippi forms the state line between Minnesota and Wisconsin, then Iowa and Wisconsin. The St. Croix and Wisconsin rivers enter the Mississippi along this stretch. The Mississippi River forms the entire eastern boundary of Iowa and the western line of Illinois. Several major rivers join the Mississippi in this reach, including the Rock, Illinois, Des Moines, and Kaskaskia rivers. After a journey of almost 1,400 miles, the Mississippi River reaches its juncture with the Ohio River at Cairo, Illinois. Although the river continues southward on its way to the Gulf of Mexico, this point marks the end of the Upper Mississippi River region.

The Souris River, Red River of the North, and the Rainy River basins form the Souris-Red-Rainy region along the northern boundaries of North Dakota and Minnesota. This region covers approximately 60,000 square miles. The topography of the area includes rolling prairie, upland hills, flat valley plains, swamplands, and rugged hills interspersed with lakes and streams. Annual precipitation varies from 14 inches in the west to 28 inches in the east, adequate for farming during normal years. Periodic severe droughts occur in the western portion of the region. The area's population is slightly under 1 million and largely rural.

The Corps' Organizational Structure

From its inception in September 1954, the NCD supervised five Army engineer districts. Each district had its own distinct history stretching back into the early nineteenth century.

Originally, the districts were called "engineer offices" and had been established by the Chief of Engineers to oversee congressionally authorized civil works projects in a given area. The Corps of Engineers began harbor improvements on Lake Erie in 1824, with the earliest work on Buffalo harbor starting in 1826. The Chief of Engineers established a permanent engineer office at Buffalo in 1869. The Army engineers undertook road and harbor improvements in Michigan in the 1820s and initiated a general survey of all the Great Lakes in 1841. Detroit became the home of a permanent engineer office in 1866. In 1830, the Army engineers commenced a survey for a water route between Lake Michigan and the Illinois River and began developing a plan for improving the harbor at Chicago. The Chief of Engineers formally established the Chicago Engineer Office in 1870. In 1866, the Corps of Engineers set up an engineer office at Rock Island, Illinois, to begin navigation improvements on the Upper Mississippi River. That same year, the Corps also created an engineer office in St. Paul, Minnesota, to conduct surveys of the Upper Mississippi and its tributaries.

Today, the Buffalo District covers a 35,000-square-mile area and encompasses the northern third of the state of Ohio; two counties in the northwesternmost part of Pennsylvania; and upper New York State bordering the St. Lawrence River and Lake Ontario. Its major responsibilities include flood control, beach erosion projects, and fourteen commercial harbors.

The Chicago District, covering a 5,000-square-mile urban area, encompasses a cluster of counties bordering Lake Michigan, including Cook, Lake, McHenry, Kane, DuPage, and Will in Illinois; and Lake, Porter, and a portion of La Porte counties in Indiana.

The Detroit District covers 138,000 square miles, including the state of Michigan; portions of Indiana, Minnesota, and Wisconsin; and the U.S. waters of Lakes Superior, Huron, and St. Clair. The Detroit District also oversees a small portion of western Lake Erie and most of Lake Michigan. Its focus has been on maintaining over 100 harbors; 94 miles of navigation structures, including locks at Sault St. Marie; and over 600 miles of navigation channels between Lakes Superior and Huron, Lakes Huron and Michigan, and Lakes Huron and Erie.[3]

Located on both sides of the Mississippi River, the Rock Island District embraces a 78,318-square-mile area containing the eastern two-thirds of Iowa, the upper one-third of Illinois, southern Wisconsin, the northeastern corner of Missouri, and two small areas in southern Minnesota. The district is responsible for 314 miles of the Mississippi River, 268 miles of the Illinois Waterway System (IWS), three Iowa flood control reservoirs, and all of the streams that drain into those water systems. Major projects encompass twenty-two locks and eighteen dams, the Upper Mississippi River System Environmental Management (UMRSEM) program, and fifty-four recreation areas.

The St. Paul District has charge of a 151,000-square-mile area that includes most of Minnesota, the western two-thirds of Wisconsin, the northeastern half of North Dakota, and a small section of northeastern South Dakota and northern Iowa. The district's main focus is on the operation and maintenance of the nine-foot navigation project on the Mississippi River, operation of the flood-control and Mississippi River Headwaters reservoirs and recreation areas, and the UMRSEM program.[4]

The five districts, in their civil works capacities, provided planning, engineering, construction, operations and maintenance, real-estate, regulatory, and various support functions as the operating arms of the Corps of Engineers. Beginning in 1888, the engineer offices, or districts, were grouped into divisions for administrative purposes. Although possessing similar internal organizational structures, each district had distinctive qualities and responsibilities. District boundaries, moreover, changed through time. For example, in 1979, the boundaries of the Chicago District shrank, as those of Rock Island expanded, to reflect the

Corps' transfer of the responsibility for the IWS from the former to the latter district.

During its existence from 1954 to 1997, the NCD served as the chief link between higher headquarters, the Office of the Chief of Engineers (OCE), and the five districts in the division command. The division office reviewed and approved district civil and military work, allocated resources within the division to maintain a balance of workload and personnel, provided technical guidance, and represented the Corps' interests on various regional and international boards and commissions.

Until 1990, the division office was structured functionally like its districts, with divisions for planning, engineering, construction, operations, and real estate. It also had various support offices for resource management, legal, personnel, information and logistics management, public affairs, safety, and other activities. These functional organizations vertically coordinated with the similar administrative structure at the districts and higher headquarters of the Corps. As the Corps' workload changed qualitatively and quantitatively over time, the administrative organization evolved to reflect those changes. In 1990, the Chief of Engineers changed the nomenclature of the internal organization so that divisions and offices at Corps' divisions became directorates.

During the last half of the twentieth century, a division typically was commanded by a brigadier or major general, assisted by two military deputies, one for civil works and another for military responsibilities. The division executive office also included a civilian executive assistant and other special assistants. The military commanders usually served three-year tours. The rest of a division staff consisted of career civilian professionals and support personnel. In support of its civil works mission, the division's last budget (FY1996) totaled $377 million. The operations and maintenance portion of the budget was $215 million, 57 percent of the total. In addition, its military funding for activities related to the Defense Environmental Remediation Program–Formerly Used Defense Sites (DERP-FUDS) program came to $7.7 million and other military support funds stood at $4.9 million.

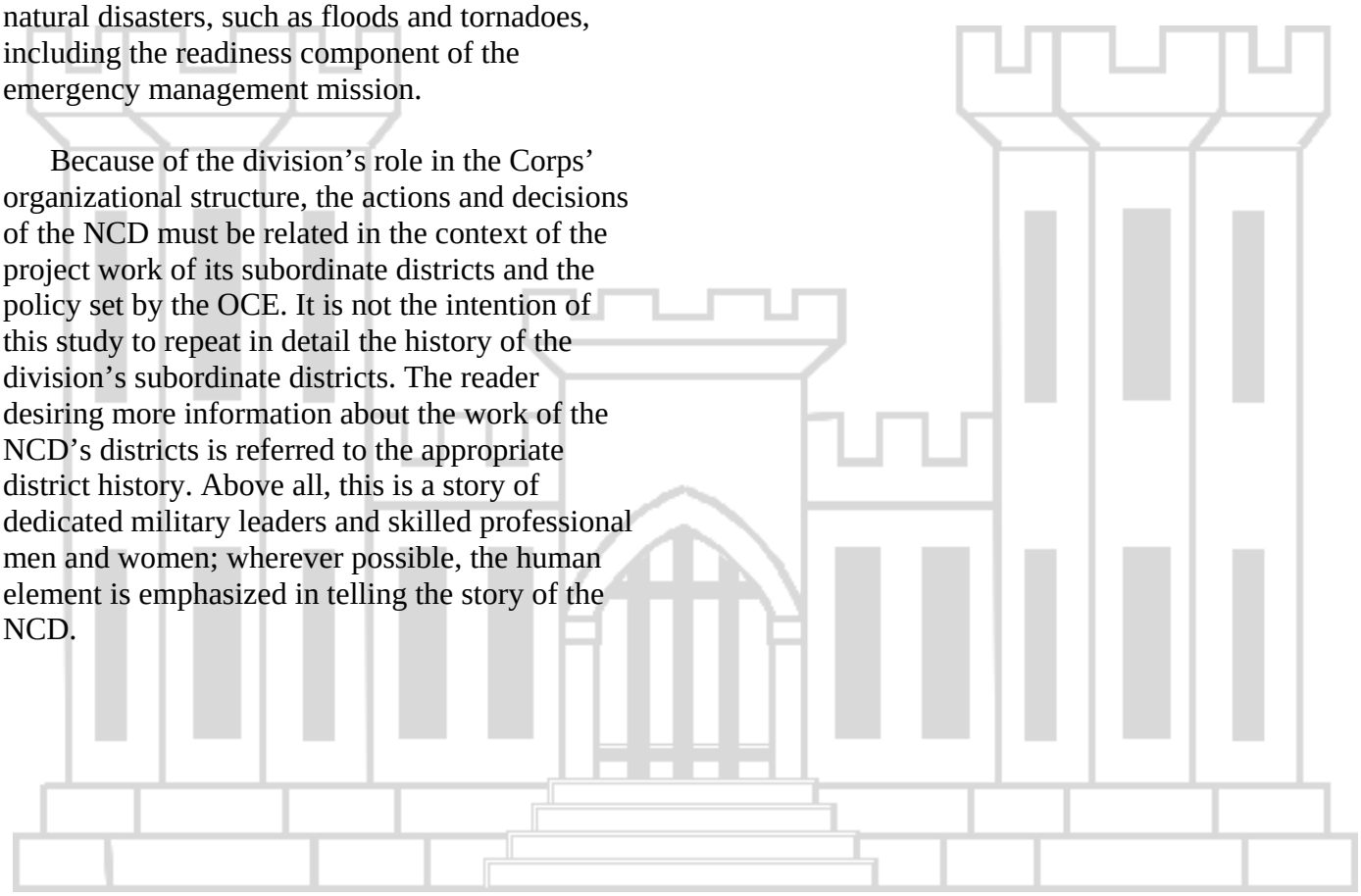
As part of the Corps' attempt to reorganize in the 1990s, under the pressure of declining budgets and reduced workload, the agency cut the number of divisions from eleven to eight The NCD was one of those divisions eliminated in 1997. As a result, its Upper Mississippi River districts became part of the new Mississippi Valley Division, headquartered in Vicksburg, Mississippi, while its Great Lakes districts merged into the new Great Lakes and Ohio River Division (LRD), headquartered in Cincinnati, Ohio, and maintaining a small presence in Chicago through its Great Lakes Regional Office.

In the early 1990s, the Corps also refocused the division mission into four areas: Command and Control, Regional Interface, Program Management, and Quality Assurance. Prior to this change, the NCD reviewed the myriad general planning studies, design memoranda, real-estate reports, contract specifications, operational studies, programming and fiscal data, and other reports produced by its five districts, and made recommendations based on those documents to the OCE. The Division Engineer and his staff routinely visited the districts and project offices for inspections and supervisory purposes.[5] In addition, special visits were required during extraordinary events, such as floods and other natural disasters. One key responsibility of division engineers was to inform the Chief of Engineers how specific regional and local conditions should be taken into account in forming and implementing policy and programs. In the case of the NCD, its mission had been to represent the unique demands of commerce and navigation on the Great Lakes and Upper Mississippi River, in the nation's heartland.

In relating the story of the NCD between 1954 and 1997, this study focuses broadly on the division's executive management and program oversight of the districts and highlights the division's unique involvement in international commissions and boards involved with navigation

and environmental concerns of the Great Lakes. It looks closely at the operational and environmental issues concerning the maintenance of navigation on the Upper Mississippi River and the Great Lakes. In particular, dredging and dredged material disposal matters and navigation season extension receive close attention. This history also includes a discussion of the limited military support mission of the NCD and its support for the United States Postal Service (USPS) construction program in the early 1970s. Finally, this study discusses briefly the NCD's response to natural disasters, such as floods and tornadoes, including the readiness component of the emergency management mission.

Because of the division's role in the Corps' organizational structure, the actions and decisions of the NCD must be related in the context of the project work of its subordinate districts and the policy set by the OCE. It is not the intention of this study to repeat in detail the history of the division's subordinate districts. The reader desiring more information about the work of the NCD's districts is referred to the appropriate district history. Above all, this is a story of dedicated military leaders and skilled professional men and women; wherever possible, the human element is emphasized in telling the story of the NCD.



CHAPTER I
Early Great Lakes Navigation Improvements and Establishment of the North Central Division

Early Great Lakes Harbor Improvements

Beginning in the early 1820s, the federal government encouraged the settlement of the Great Lakes region by subsidizing the improvement of transportation routes. In 1824, Congress appropriated $20,000 to deepen the channel leading into the harbor at Erie, Pennsylvania. Over the next sixteen years, a steady stream of federal money flowed to projects for improving harbors on the Great Lakes. Congressmen favoring strict construction of the Constitution, however, opposed federal expenditures for internal improvements. By 1840, the opponents of federally subsidized internal improvements prevailed in Congress and such spending was greatly curtailed until after the Civil War.[1]

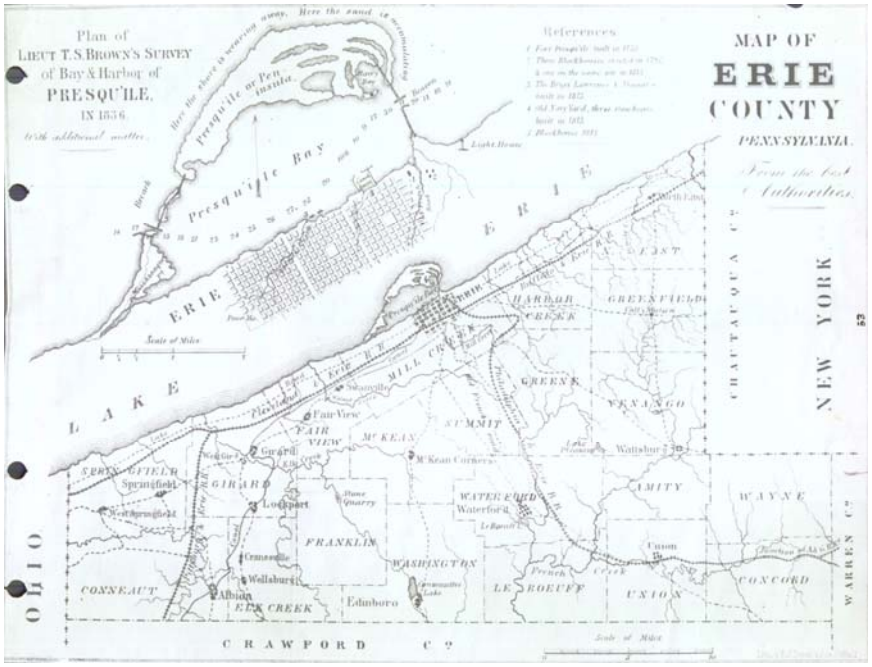


Figure 3. Army engineer survey plan of Presque Isle Bay and Erie harbor, Pennsylvania, 1836. The east bay entrance has already been improved by Army engineers; at the west end of the bay, a breach has been closed in the peninsula's narrow neck. (NCD Files)

Officers of the U.S. Army Corps of Engineers had responsibility for overseeing the federal lake-harbor improvements between 1824 and 1838. In 1838, Congress established an independent Corps of Topographical Engineers and gave it authority to conduct most internal improvements, especially canal, road, river, and harbor surveys. In 1863, Congress rejoined the Topographical Engineers to the older Corps of Engineers, which had concentrated mainly on constructing military fortifications and some civil works improvements.

Prior to the Civil War, one of the Corps' major accomplishments on the Great Lakes involved improving the Chicago harbor. Beginning in 1832, the Corps sought to clear the sandbar at the mouth of the Chicago River and to build piers for a harbor there. To complement this effort, the state of Illinois, with a federal subsidy, dug the Illinois and Michigan Canal to connect the Great Lakes with the Mississippi River. Constructed between 1836 and 1848, the canal began at the head of navigation on the south branch of the Chicago River and extended for 100 miles southwesterly to the Illinois River, which then drained into the Mississippi. The Chicago harbor served as the eastern terminus of this vital commercial waterway. In spite of uncertain funding and environmental and political problems, the Army engineers built port facilities that eventually allowed Chicago to dominate the trade of the West. By 1854, commerce through the Great Lakes at Chicago exceeded that at New Orleans.

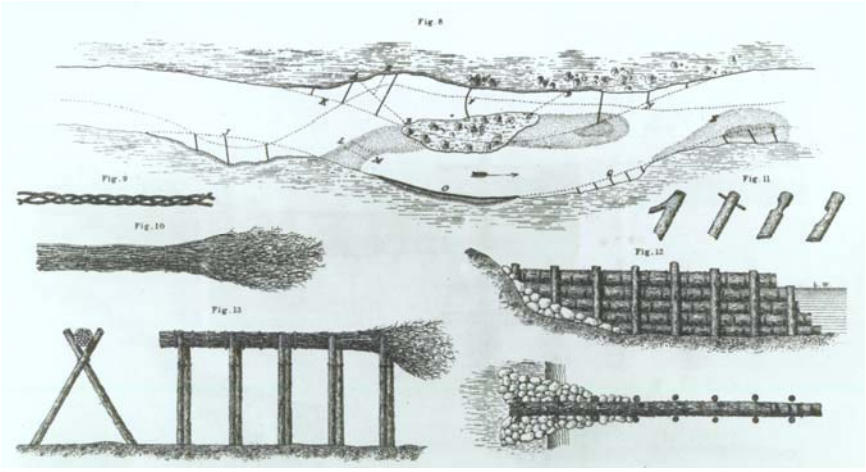


Figure 4. Typical plans for closing dikes or dams, which trained the river to deepen a navigation channel. (NCD Files)

Early harbor improvements consisted of channel deepening by constructing parallel piers from just upstream of a river's mouth into the deep water of a lake. The piers, usually 200 feet apart, directed the river's flow to wash away sand in the channel between the piers. To provide a breakwater, so that lake vessels could enter a harbor in rough weather, engineers extended one of the parallel piers beyond the other. To accommodate ever-larger vessels, the piers were built farther into deep water to provide greater harbor depth. The extension of the piers, however, lessened the scouring effectiveness of river freshets.

Engineers used wood in most harbor improvements. But, as early as 1835, masonry was employed in pier work at Buffalo. In 1839, the engineers tried concrete instead of timbers as a foundation for a new masonry pier. Concrete construction proved more costly than wood and required specialized skill, which was not always available. Until large wooden timbers became scarce and more costly to acquire, at the end of the century, wood remained the main material for constructing harbor improvements for navigation.

Typically, the wooden piers consisted of a series of timber or log cribs about twenty or thirty feet square. The heavy timber or logs were held together with iron bolts and strengthened with cross beams. Constructed onshore, the cribs were floated into position in the channel, filled with stones, and sunk to the lake bottom. Once a line of cribs had been placed, workers then built a superstructure of sawed timber over them to a height of six or seven feet above the water level. The builders then filled the superstructure with small stones and planked over it to form a deck. While underwater timber cribs lasted indefinitely, superstructures exposed to rugged weather required frequent repair.

Army engineers also had responsibility for other navigation improvements on the Great Lakes, such as beacons and lighthouses. By 1837, sixteen lake harbors had such structures, which the Treasury Department operated. The Lake Survey, another congressionally assigned duty of the Corps, began in the pre–Civil War era. Although the Army engineers had made surveys on the Great Lakes since 1817, in order to prepare accurate charts for navigation, the first systematic survey of the lakes began with a $15,000 appropriation from Congress in 1841. The survey was assigned to the Topographic Corps, and when they were merged with the Corps of Engineers

Figure 5. Buffalo harbor, 1829. Buffalo's voluminous commerce with the West began in the 1830s, when settlements in Ohio began to ship their wheat and corn eastward. (Library of Congress)

in 1863, it became the responsibility of the latter agency. The mission eventually expanded to include surveying the navigable waters of the New York State canal system, Lake Champlain, and Lake of the Woods. The Corps completed the survey of Lakes Michigan and Superior in 1874, Lake Ontario in 1875, and Lake Erie in 1877. The Lake Survey issued its final survey report in 1882, but the increased number and size of lake vessels soon required updated charts. The work of the Lake Survey continued into the late twentieth century. The survey was headquartered first in Buffalo and later at Detroit.

Federal assistance for navigation improvements on the Great Lakes led to increased commerce and demands for further improvements. The value of lake trade increased from $4 million to over $60 million between 1835 and 1846. In response to heavy lobbying by Great Lakes commercial interests during this period, Congress appropriated funds in 1844 to carry out work at twenty harbors. These monies enabled the Army engineers to make repairs, complete unfinished work, or modestly extend existing projects, but they did not permit more ambitious improvements necessary for permanent protection of lake commerce. Another eight years passed before Congress again funded lake harbor projects. The 1852 river and harbor appropriation of $2.25 million—while the largest of its kind in the antebellum period—was spread among so many projects that it allowed only the most urgent repairs and maintenance of existing works, and only a few new undertakings.

Figure 6. West Breakwater, Cleveland harbor, 1905. Showing timber superstructure in a state of decay before it was improved with concrete. (*Transactions of the American Society of Civil Engineers*, 54A)

Figure 7. East pier at Ashtabula harbor, Ohio, 1859. Showing timber construction used on early harbor works and an example of the beacons constructed by Army engineers for the Treasury Department. (Canal Park Museum)

Between 1853 and 1861, Democratic presidents, opposed to federally sponsored internal improvements, vetoed river and harbor bills intended to ameliorate conditions for lake navigation. Lacking federal support, local interests tried to improve areas such as St. Clair Flats, connecting Lake Huron with Lake Erie, and St. Marys River, connecting Lake Superior with Lake Huron. In 1856, Congress overrode President Franklin Pierce's veto to appropriate money for these two projects.

The Army engineers, first under the Corps of Engineers and, after 1838, under the Topographic Bureau, also constructed military roads throughout the Great Lakes region. Since these roads were chiefly intended to serve the

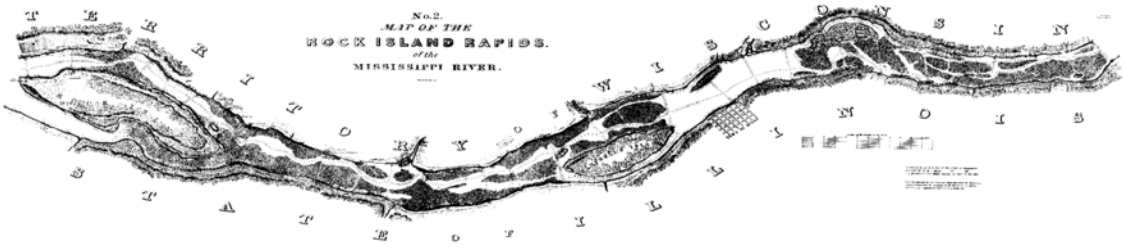


Figure 8. Map of Rock Island Rapids in 1837 by Lieutenant Robert E. Lee. He recommended improving the rapids by cutting off the rock projections. (NCD Files)

U.S. Army in its role of providing national defense and were constructed on federal or Indian lands in the territories, constitutional questions concerning federal internal improvements did not arise. Federal road efforts ended when a territory became a state. Of course, these highways also served civilian purposes, such as assisting in the flow of mail, commerce, and people.

The federal role in improving the rivers of the Old Northwest, like harbor improvements, again raised constitutional issues. Between 1819 and 1839, Congress authorized over $1 million for surveys and improvements on the Mississippi and Ohio rivers. Most of this money was spent outside the area encompassed by the boundaries of the NCD. Army engineers under Lieutenant Robert E. Lee, however, conducted surveys, designed plans, and carried out improvements at the Rock Island and Des Moines rapids on the Upper Mississippi River between 1837 and 1839. Appropriations for western rivers came in fits and starts. In 1852, funds became available for projects on the Illinois River at Dubuque, Iowa, and at the Rock Island and Des Moines rapids.

The most significant river work from the 1852 appropriation occurred at the Rock Island and Des Moines rapids. Drawing on the $100,000 provided by Congress, a young topographical engineer, Lieutenant Gouverneur K. Warren, thoroughly surveyed both rapids in 1853 and 1854. Lieutenant Warren estimated that 89,000 cubic yards of stone would have to be removed at the lower rapids to create a channel 4 feet deep and 200 feet wide. A comparable channel through the

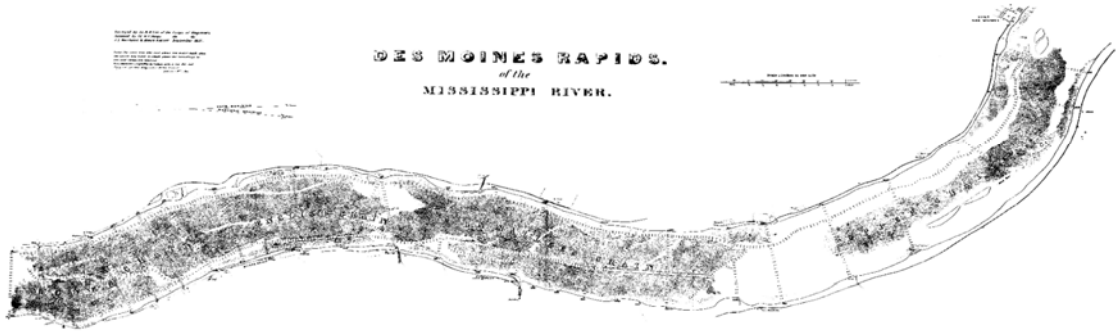


Figure 9. Map of Des Moines Rapids in 1837 by Lieutenant Robert E. Lee. (NCD Files)

upper rapids would require removing 12,000 cubic yards, according to Warren's calculations.

Work began in 1854 at both rapids and continued fitfully until 1860. Annual high water and primitive equipment slowed progress. In 1856, Congress appropriated an additional $200,000 for work on the Des Moines Rapids. A railroad bridge completed across the Mississippi at Rock Island in 1856 proved a worse obstruction to river traffic than the rapids themselves. Steamboat interests claimed that the bridge unlawfully obstructed navigation and brought suit to have it removed. In fact, the bridge reflected the developing struggle between the railroads, representing an emerging east-west trade axis, and river transportation, based on the existing north-south pattern of commerce. Increasingly, grain and other produce from the Old Northwest went east by way of the Great Lakes and the Erie

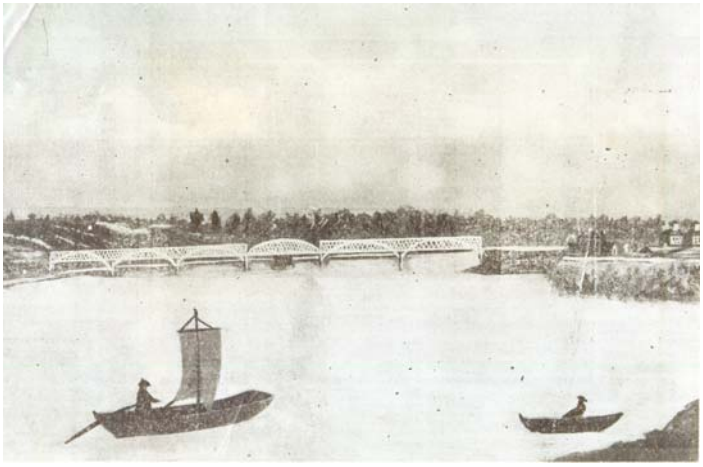


Figure 10. Bridge across the Mississippi River, between Rock Island, Illinois, and Davenport, Iowa, circa 1856. The first such structure across the wide river. (Rock Island Arsenal Ordnance Department)

Canal. By 1856, ship tonnage on the Great Lakes exceeded the tonnage of all vessels operated on western rivers. In 1820, western produce accounted for 58 percent of the value of goods arriving at New Orleans, while in 1860, such shipments fell to 23 percent of the port city's river-borne revenue. Clearly, the emerging railroad network reinforced the lake trade route to the East.

The Civil War delayed further work on civil projects by either the Corps of Engineers or the Topographical Engineers. Colonel James Graham, a topographical engineer with responsibility for the Great Lakes harbor improvements and the Lake Survey, had no funds for accomplishing any work. He could only observe and report on the advancing decay of existing harbor works. In 1863, he requested $4.5 million to carry out much-needed repairs, pointing out that no money had been available for such work since 1852. Finally, in June 1864, Congress appropriated $250,000 for repair of lake harbors. The Corps assigned the work to Colonel Thomas J. Cram and two other engineer officers. But only a small amount was spent before the end of the war. As Colonel Cram noted, in some locations, "scarcely anything [was] left to repair or preserve . . . while from others much of the old work had to be removed before anything new could be commenced."[2]

During the war, both groups of engineers were employed building military fortifications, field works, batteries, and transportation improvements. In 1863, Congress merged the Corps of Topographical Engineers into the Corps of Engineers to create a more efficient organization. Of course, the topographers brought with them a knowledge of and commitment to civil works, such as road building, river and harbor improvements, and surveys of the Great Lakes. This expertise would prove highly valuable in the postwar years, as Congress embarked on a major program of developing the nation's infrastructure.

The outcome of the Civil War also resolved the issue of federal authority under the Constitution to engage in internal improvements. The postwar federal government, under the control of the Republican Party, actively funded improvements to the nation's rivers and harbors. After the Civil War, the Corps regularly assigned engineer officers to the congressionally authorized civil works projects within what became the NCD's boundaries. The Corps maintained offices at Rock Island and St. Paul on the Upper Mississippi River and at Duluth, Milwaukee,

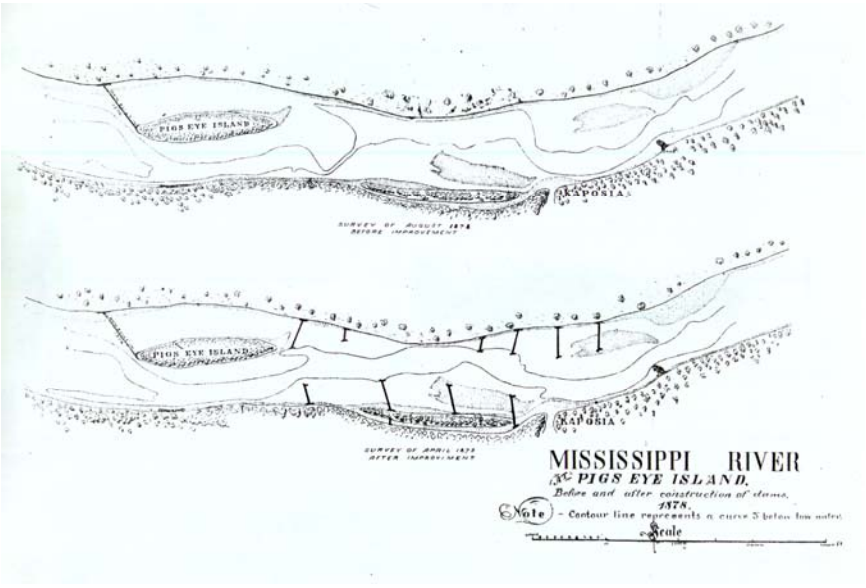


Figure 11. Mississippi River at Pig's Eye Island, circa 1878. Showing the initial construction of wing and closing dams on the Upper Mississippi River, which took place at Pig's Eye Island below St. Paul, Minnesota. (NCD Files)

Chicago, Grand Rapids, Detroit, Cleveland, and Buffalo on the Great Lakes.

The Corps' Growing Civil Works Program

Before the Civil War, there were thirty-six federal harbor projects and two connecting channel projects on the Great Lakes. On the Upper Mississippi River, federal projects existed to improve the Rock Island and Des Moines rapids, conduct some channel improvements, and carry out a harbor project at Dubuque, Iowa. The congressionally authorized project for the Upper Mississippi in 1866 called for a four-foot-deep channel; in 1878, Congress increased the authorized depth to four and one-half feet. By the 1880s, the number of federal projects on the Great Lakes had expanded to nearly eighty and to over thirty on the Upper Mississippi River.

Congress's habit of placing civil works projects, widely distributed geographically, in omnibus river and harbor bills assured such legislation broad support. Supporters of federal waterway improvements justified them as a way to effectively regulate what they considered discriminatory and extortionate railroad rates. A growing antagonism to the power of railroads over transportation costs had led to the belief that railroads should be forced to compete with federal waterways. This view held that the mere threat of competition from waterways would force railroads to cut their rates and improve service. Left unstated was the question of whether federally subsidized water projects could be economically justified in their own right.

The rapidly expanding civil works program of the Corps led to charges of waste and inefficiency in the annual river and harbor bills. President Chester A. Arthur vetoed the $18 million River and Harbor Act of 1882 as wasteful "pork barrel," containing strictly local projects unconnected to the common defense, general welfare, or interstate commerce. Congress attempted reform in 1884 by directing that before it would approve costly surveys of proposed waterway improvements, Army engineers would have to make a preliminary examination to determine if a river or harbor was worthy of improvement. The Army engineer had to produce a report for Congress, showing whether the actual and prospective commerce of a locality would justify an improvement. As Army engineer Captain Ernest Ruffner wrote in 1885, "The whole river and harbor question is now simply a business matter, and depends entirely upon the amount of money which can be so invested, and the best way to invest it." To Captain Ruffner, a fair evaluation of the Corps' river and harbor work need only "consider if the results commercially justified the expenditure."[3]

With the rapid expansion of the civil works program and the growing apprehension in Congress about unworthy projects, the Chief of Engineers became concerned with his ability to manage the program effectively. The program had grown from 49 projects and 26 surveys at a cost of $3.7 million in 1866, to one with 371 projects and 135 surveys costing $18.7 million in 1882. Many of these projects, such as jetties, canals, and channel and harbor deepening, required years to construct and continued maintenance thereafter. To provide the level of support needed, Corps'

field offices, known initially as engineer offices, became permanent assignments at locations convenient for efficient prosecution of the various works. Ultimately, the engineer offices became designated as district offices. By 1900, over thirty engineer offices with a permanent staff of professionals and technicians existed around the nation.[4]

Until 1888, the engineer officers in charge of the far-flung field offices reported directly to the Chief of Engineers in Washington, D.C. The Chief could not possibly give his full attention to the myriad civil and military projects assigned to his engineer officers, let alone annually visit the widely scattered works, as he was required to do by regulation. In response to the increased workload of civil works projects and pressure for organizational change from both Congress and the U.S. Army high command, the Chief of Engineers established in 1888 a new reporting structure for the Corps' field offices. He grouped existing engineer offices within certain geographic boundaries into five divisions, with a supervising Division Engineer in charge of each division.[5]

The new Division Engineer, originally the senior engineer officer in a region, now served as a middle manager, reviewing and supervising the work of subordinate Corps officers and implementing policy set by the Chief of Engineers. Initially, the Chief of Engineers' orders made the Division Engineers responsible for the "care and oversight" of the public works of the Corps' offices within their divisions. Later revision of the orders charged Division Engineers with seeing that the engineering works were executed "economically, efficiently, and in conformity with the law and regulations." The Chief's 1889 regulations ordered Division Engineers to supervise their subordinates' works-in-progress; inspect them once a year; and, as appropriate, counsel, advise, or direct engineer officers in matters related to engineering plans and construction of their projects. Reports and returns connected with all phases of subordinate officers' engineering projects had to pass through the Division Engineer. Division Engineers had to submit to the Chief of Engineers regular reports on the condition of each work under their general supervision, along with recommendations about prosecution of the project. The reports required endorsement, with substantive comments, by the Division Engineer. Clearly, as historian Leland R. Johnson has noted, "the creation of Engineer Divisions to advise, inspect, and monitor the activities of Districts therefore served very real management objectives."[6]

Division Engineers carried heavy workloads, because they continued serving as engineer officers with project responsibilities of their own. A division office was simply a room with a clerk adjacent to the Division Engineer's regular engineer office. Since, by regulation, a Division Engineer did not supervise engineer officers above the rank of major, such officers reported directly to the Chief of Engineers. Division Engineers also had other engineering responsibilities, such as serving on ad hoc engineering boards or special surveys. Under the 1888 regulation establishing the division structure, the Corps' projects within the geographical area of the future NCD were divided between the Northeast Division, under Colonel Henry Abbot, and the Northwest Division, under Colonel Orlando Poe. Colonel Abbot's responsibilities included supervising engineer officers with river and harbor projects on Lakes Erie and Ontario, while Colonel Poe had charge of

Figure 12. Steamboat *Walk-in-the-Water*, 1820. Shown at Detroit, which was unique among early lake harbors located on the Detroit River for its ample depth. (Library of Congress)

the engineer officers with projects on the remaining Great Lakes and Upper Mississippi River.

Division offices moved with Division Engineers, who might or might not reside in the region for which they had responsibility. Since Colonel Poe also had direct responsibility for projects supervised out of the Detroit Engineer Office, the division office also was located in that city for a time. Between 1895 and 1901, the Northwest Division office moved with the succeeding Division Engineers to New York and then Green Bay, Wisconsin. Finally, when Colonel Oswald Ernst became Northwest Division Engineer in 1901, he established his office in Chicago. The division office remained in Chicago until the reorganization of 1929.

In response to increased workloads and congressional pressure to establish a review board for civil works projects independent of the Chief of Engineers, the Corps made further organizational changes in 1901. It increased the number of divisions from five to eight and strengthened their oversight responsibilities. The Corps' projects within the boundaries of the future NCD came under three separate divisions: Northwest, Eastern, and Central. In 1902, Congress recognized the enhanced organizational importance of Division Engineers by establishing a board for the review of Corps' projects composed chiefly of Division Engineers. This body, called the Board of Engineers for Rivers and Harbors, examined proposed project costs, benefits, and necessity.

The Chief of Engineers made further administrative changes in the organizational structure of divisions in 1908. That year, the Chief of Engineers created a Lakes Division, headquartered at Buffalo, New York. This office consolidated the Great Lakes projects formerly scattered among three divisions. The Upper Mississippi River projects under the Rock Island and St. Paul engineer offices, along with one of the two Chicago offices of the Corps, were assigned to the new Western Division, which replaced the Northwest Division. The other Chicago engineer office, with responsibility for lake and harbor matters, came under the direction of the Lakes Division. The Western Division Engineer maintained his office in Chicago.

Another important change in the Corps' organization occurred in 1908. Until that time, specific civil works projects were assigned to an engineer officer, who in turn located his office geographically convenient to his work. Increasingly in the last half of the nineteenth century, as projects became more complex and required years to complete and then permanently operate and maintain, the focus shifted to the projects of a given geographic area as distinct from the engineer officer in charge of those works. The term *district*, used as a designation for a group of projects in a given geographic area, gradually came into informal use to reflect this shift in emphasis. Formal recognition of this distinction took place in 1908, when the Corps' *Annual Reports* began to list civil works projects under district headings. Finally, starting with the 1913

Figure 13. Excavation for the Weitzel Lock chamber at St. Marys Falls, 1876. It was 515 feet long, 80 feet wide, and 17 feet deep over its sill. (Michigan State Archives)

Annual Report, the Corps described districts in terms of geographic boundaries, rather than by just a list of their projects.[7]

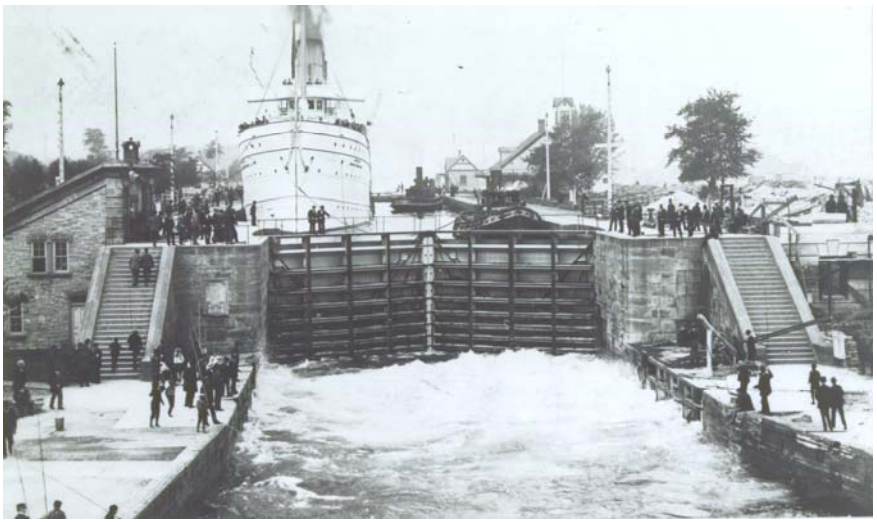


Figure 14. Steamer *Northwest* in the Weitzel Lock, 1890. (Michigan State Archives)

The next major reorganization of the Corps' field structure (discussed in greater detail below) occurred in 1929. President Herbert Hoover, himself a civil engineer, desired that the Corps' divisions and districts be aligned by river basin boundaries. As a result, the Chief of Engineers established eight divisions nationwide. Districts on the Great Lakes were grouped into the Great Lakes Division and those districts on the Upper Mississippi River were placed in the Upper Mississippi Valley Division. At this time, the Chicago District was split in two, with the First Chicago District having responsibility for the Illinois River, IWS, and the Sanitary District of Chicago; while the Second Chicago District had charge of lake harbors and channels. During World War II, the Corps temporarily aligned divisions along the same boundaries as the U.S. Army Service Commands to provide better support for military construction. After the war, the boundaries were once again aligned with watersheds. In 1954, the Corps reorganized yet again. This time the Chief of Engineers pulled together the Great Lakes districts and the two Upper Mississippi River districts to form the NCD.

Figure 15. Poe Lock construction, September 1894. (NCD Files)

Connecting Channel Improvements, 1867–1920

While the Great Lakes provided sufficient width and depth to serve as vast waterways of commerce, the narrow and often shallow waterways connecting the lakes proved major obstructions to the full use of the lakes for navigational purposes. This was certainly the case with the St. Marys River that connected Lake Superior and Lake Huron; with the Straits of Mackinac that joined Lake Michigan and Lake Huron; with the St. Clair River, Lake St. Clair, and Detroit River that united Lake Huron and Lake Erie; and with the Welland Canal that linked Lake Erie and Lake Ontario.[8]

In the early years of the nineteenth century, the Corps' and others' efforts to improve the short connecting stretches of waterways often failed to keep pace with explosive growth in the volume of lake commerce and in the size of vessels operating on the lakes. For example, before the Civil War, the Corps had deepened the two-and-one-half-mile-long St. Clair Flats channel to a width of 230 feet and a depth of 15 feet. After the war, Congress appropriated funds to

improve the deteriorated channel by shortening it one mile and widening it to 300 feet. In addition, the Corps deepened the channel to sixteen feet by 1875 and eighteen feet in 1892. It also added a second channel in 1906. That year, the passage accommodated 60.5 million tons of freight valued at almost $630 million.

A similar expansion of the water route between Lake Superior and Lake Huron proved necessary. By 1870, neither the canal built by the state of Michigan at Sault Ste. Marie in 1855 nor the channel in the St. Marys River was adequate to the size of the vessels using them. Congress responded in 1870 by authorizing a new lock on the St. Marys Falls Canal and improvement of the St. Marys River.

The new federal canal replaced the old state canal in 1881, at a cost of $2 million. The new canal measured 270 feet wide and 16 feet deep; the lock was 515 feet long, 80 feet wide, and 17 feet deep. Ship traffic and the size of vessels, however, had increased so quickly during the lengthy construction period that the new lock, called Weitzel Lock, was barely adequate to the demands of commerce. Further channel improvement also became necessary in order to serve steadily growing commerce. In 1883, 4,000 vessels carried 1.8 million tons of freight through the Soo Canal; ten years later, 12,000 ships passed with 10 million tons of cargo. The Corps built a second lock, called Poe Lock, which opened in 1896, after nine years of construction. In 1892, Congress authorized a Corps' project to increase the size of the entire St. Marys' channel to 300 feet wide and 20 feet deep. The Corps completed work on the project in 1897.

Figure 16. Gates in Poe Lock, July 1896. (NCD Files)

After the turn of the twentieth century, it became clear that two additional locks of larger dimensions were required at Sault Ste. Marie. Work on a new lock began in 1906, and Congress authorized a second one in 1912. The Corps completed the new locks in 1913 and 1919, respectively. No further expansion occurred until the 1930s.

Great Lakes Harbor Improvements, 1867–1920

Except for lighthouse construction along the shores of Lake Superior, the federal government undertook no navigation improvement on that lake until 1867. That year, Congress appropriated funds for improving four Lake Superior harbors. The growing importance of trade on the Great Lakes was apparent in the fact that as early as 1872, Great Lakes commerce accounted for 40 percent of the U.S. shipping tonnage. In the 1880s, additional Lake Superior harbors gained federal assistance, the most important being at Duluth, Minnesota-Superior, Wisconsin. The Corps had projects underway to increase the depth at these harbors from thirteen feet in 1873, to sixteen feet in 1881, and finally, to twenty feet in 1896.[9]

On Lake Michigan, the Corps improved twenty-eight harbors during the 1800s. Many of these lost commerce in the twentieth century and received only minor federal attention by 1916. Most of the Corps' efforts focused on Chicago, which, following the Civil War, emerged not only as the rail center of the United States but also the focus of lake shipping. Not even the great fire of 1871 could slow the remarkable growth of Chicago. Until the 1890s, federal improvements at

Figure 17. Marquette harbor schooners on the Great Lakes ice blockade, June 1873. (Photo by B. F. Childs, Minnesota Historical Society)

Chicago concentrated on harbor entrance piers and breakwaters, while local government and private interests developed the city's inner harbor. Commerce in the Chicago harbor peaked at nearly 11 million tons in 1889.

In the 1890s, shipping began shifting south as industry relocated away from the city's business district to less congested sites along the Calumet River. The city converted the part of the lakefront basin in the old inner harbor to parkland. Congress did appropriate funds in 1894 for the Corps to improve the lower sections of the Chicago River to establish a sixteen-foot-deep navigation channel. Subsequent projects established a twenty-one-foot depth in the Chicago River. The Corps also provided a breakwater for the new Municipal Pier, completed north of the entrance to the Chicago River in 1917.

Improvements to the Calumet harbor began in 1879, when Congress appropriated funds to establish a harbor of refuge. The Corps also created and maintained a sixteen-foot channel 3.5 miles up the Calumet River from the lake. It increased the depth of the channel to twenty feet in 1899. In 1915, the Corps completed a breakwater for the Calumet harbor, providing a safe, 300-foot-wide entrance to the river. The Corps built four additional harbor projects around the south shore of Lake Michigan in the late nineteenth and early twentieth centuries.

The Corps developed other harbors on the western shore of Lake Michigan for the shipment of bulk commodities, such as lumber, grain, and iron ore, in great quantities. The Corps provided improvements that, over time, deepened navigation channels from twelve to twenty feet. The Army engineers employed a standard approach in harbor improvement that consisted of constructing two parallel timber piers out into the lake and dredging between them. Gradually, concrete replaced timber in the construction and repair of harbor works. The Corps also improved sixteen harbors on the eastern shore of Lake Michigan, originally constructed by lumber interests. After the Civil War, Congress authorized the Corps to improve all of these eastern Lake Michigan harbors. Peak usage by the lumber trade occurred in the 1880s or early 1890s,

Figure 18. Chicago from Schiller Street north side to 12th Street south side, 1868. (Chicago Historical Society)

but after that time, other types of manufacturing developed that depended on raw materials brought in by water.

Between 1866 and 1916, the federal government improved thirteen harbors along Lake Huron. Also originally built for shipping lumber, most of these harbors declined as the timber gave out. They then became used chiefly for recreational boating. The exceptions were harbors constructed at the mouths of the Rouge and Saginaw rivers. The Corps improved both of these waterways to support their expanding use for commercial navigation. Freight on the Rouge River increased from 194,000 tons in 1888 to 1,415,000 tons by 1916. The Saginaw River supported a large lumber industry in the late nineteenth century, and the Corps improved the navigation channel from twelve feet in 1867 to sixteen feet by 1915. Although the lumber industry declined after 1890, other manufacturing that depended upon the import of raw materials took its place.

Figure 20. Rubble-mound south entrance arm breakwater at Buffalo harbor, N.Y., circa 1912. (NCD Files)

After the completion of the Erie Canal, Lake Erie carried the largest volume of trade of all the Great Lakes. Even after the railroads arrived, ports such as Buffalo thrived as the main transfer points of east-west trade. For example, iron and copper ore arrived by boat from points west and were transferred to rail for shipment east, while coal brought by rail from points east was switched to ships for transit westward. Buffalo and other

Figure 19. Cleveland coal docks, circa 1890. (NCD Files)

Lake Erie ports also became major manufacturing centers in their own right, milling grain and making steel and other finished products from iron and copper ore. By 1916, commerce on Lake Erie exceeded 100 million tons, while tonnage on Lake Superior stood at 80 million and that on Lake Michigan had reached only 43.5 million. Lake Erie had six of the ten busiest Great Lakes harbors in 1916.

Before the Civil War, the Army engineers had begun improving Lake Erie ports by constructing parallel piers into the lake at the mouth of a river. This work by the engineers created harbors along lower reaches of such rivers. After 1866, Corps' projects emphasized building breakwaters constructed of stone-filled timber cribs that expanded lakefront harbors for ever-larger vessels. The Corps or local interests maintained these enlarged harbors by dredging. Depths in major Lake Erie harbors corresponded to those in Great Lakes connecting channels. Depths advanced from twelve feet in the 1870s to twenty-one feet or more by 1916. The major Lake Erie ports with Corps' improvements were Buffalo, Cleveland, Ashtabula, Conneaut, Toledo, and Lorain. Also, between 1905 and 1914, the Corps built a ship canal and lock on the Niagara River, connecting Buffalo and Tonawanda. In 1916, 2 million tons of freight passed though this ship channel.

Oswego Harbor served as the main harbor on Lake Ontario. By 1870, Oswego had developed

into a large flour-milling center. Congress appropriated funds to improve this harbor, and the Corps carried out a project between 1870 and 1882 for a breakwater that enlarged the harbor's area. Dependent upon the Canadian Welland Canal, which charged a toll, Oswego was at a disadvantage to Lake Erie ports. After 1883, when New York State removed the tolls from the Erie Canal, Oswego's growth stagnated. In addition, the Welland Canal could not pass vessels exceeding a fourteen-foot draft, thus confining Oswego's trade to smaller ships. The Corps also carried out navigation improvements at Charlotte Harbor and Great and Little Sodus bays on Lake Ontario. These locations had a thriving coal export trade.

The Corps' navigation improvements benefiting Great Lakes trade had dramatic effects. Between 1889—the first time officials gathered systematic trade statistics—and 1916, major growth in traffic and tonnage occurred. In 1889, 2,737 vessels transported 25.3 million tons of freight; while in 1916, 2,856 ships carried 125.4 million tons—an increase of almost 400 percent. The combined gross weight of vessels increased from 920,294 to 2,737,491 tons, and the average tonnage of a steam vessel increased from 192 tons in 1889 to 898 tons in 1916. Lake vessels, moreover, advanced in speed as well as size, and because of their greater speed, steam vessels moved more cargo in one year than could a sailing ship. As a result, between 1889 and 1916, steam vessels increased from 1,467 to 1,837, while sailing ships decreased from 962 to 162. The Corps accommodated the increased volume and efficiency of lake commerce by providing for ease and certainty of navigation on the Great Lakes. It constructed safe and commodious harbors and built and maintained adequate connecting channels between the lakes.

Figure 21. Major General Edward Markham, Chief of Engineers, October 1933–October 1937.

The Corps in the Great Lakes Region, 1920–1954

During the 1920s, the Corps continued its work on the Upper Mississippi and Great Lakes with little change. It completed previously authorized projects and continued regular maintenance on all its existing work. While Congress authorized few new undertakings, the Corps pressed ahead on the Upper Mississippi River six-foot channel project and constructed a new lock and dam near Hastings, Minnesota. Congress approved a nine-foot channel for the Illinois River in 1927, but work did not begin until after 1930, when the courts established a maximum draw-off from Lake Michigan at Chicago. The Corps completed the project in 1940, and traffic grew from 1.3 million tons of freight in 1929 to 3.4 million in 1940. Congress authorized no new major channel deepening projects for the Great Lakes, but did permit the Corps to widen the Detroit and St. Marys rivers in places where traffic was restricted by existing conditions. The Corps focused on the maintenance dredging of existing harbor improvements. The NCD predecessor organizations—the Lakes Division and the Northwestern Division—continued to oversee the civil works projects of the region.

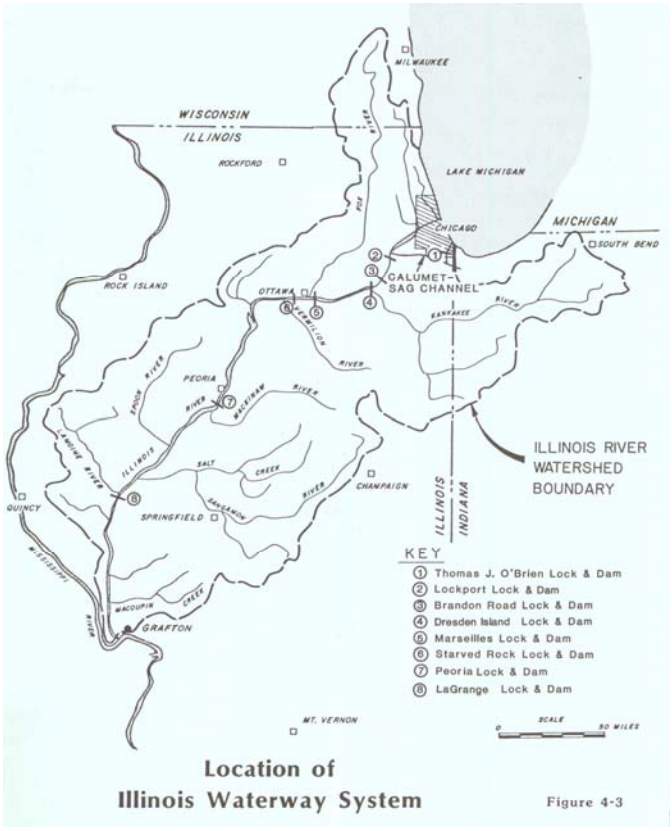


Figure 22. Illinois Waterway System, 1981. (Great Lakes Division)

In the late 1920s, Congress began to change its view of the federal role in flood control. In response to the disastrous 1927 flood in the Mississippi River basin, Congress authorized the Corps to study the nation's rivers for coordinated development of their navigation, waterpower, and flood control potential. The resulting Corps' reports, called "308" surveys because their authorizing legislation came in House Document 308 of the 69th Congress, provided the beginning of comprehensive federal river basin planning and the basis for many emergency relief projects during the Depression.[10]

As noted above, President Hoover, at the end of the 1920s, directed a reorganization of the Corps' civil works structure. For long-term efficiency and economy, Hoover thought that the Corps' divisions and districts should be aligned along river basin boundaries. For the more immediate term, he wanted to focus its attention on the project to canalize the Upper Mississippi with locks and dams. Since the Corps had completed the canalization of the lower Ohio River in 1929, Hoover felt the Corps should now devote its full efforts to the Upper Mississippi channel project. Accordingly, the president's hand-picked Chief of Engineers, Major General Lytle Brown, restructured the Corps into eight divisions along river basin boundaries: the districts on the Great Lakes were grouped into the Great Lakes Division and those districts on the Upper Mississippi, combined with the Ohio River districts, were placed in the Upper Mississippi Valley Division. The Upper Mississippi Valley Division, headquartered in St. Louis, became a super-division, absorbing the old Central and Western divisions. The new division had responsibility for all Corps' work north of Cairo, Illinois, from the Appalachians to the Rockies. The Great Lakes Division, headquartered in Cleveland, had charge of all the Great Lakes harbors and connecting channels. In 1942, the Corps moved the Great Lakes Division headquarters from Cleveland to Chicago.[11]

The River and Harbor Act of 1930 provided for several enhancements to existing civil works projects under the two new divisions. The act authorized the Corps to deepen sections of the Great Lakes connecting channels for twenty-four-foot navigation and approved the nine-foot channel project on the Upper Mississippi River. The act also extended federal control over the entire length of the Illinois River from Lake Michigan to the Mississippi River. To achieve the authorized nine-foot channel, the Corps constructed two locks and movable dams on the Illinois River and one lock and dam on the Mississippi at Alton, Illinois. In addition, the Corps made improvements to the Calumet-Sag Channel connecting the IWS with Lake Michigan south of Chicago at the Calumet harbor.[12]

Under President Franklin D. Roosevelt, the Corps used Public Works Administration funds to complete the deepening of the Great Lakes connecting channels and to maintain Great Lakes harbors. Depression-era emergency funds also enabled the Corps to deepen the major harbors to the same depths as the connecting channels where necessary. The River and Harbor Act of 1930 had

authorized a navigation channel of twenty-four feet; the Corps achieved this depth by 1936. During the early years of the Depression, lake traffic dropped sharply, reaching a low of 41.6 million tons of bulk cargo in 1932. By 1939, however, bulk freight on the lakes reached a new record of 145.2 million tons. In 1940, 213 vessels with twenty-three-foot drafts operated on the lakes. Newer and larger ships, if fully loaded, could not pass through the locks at Sault Ste. Marie. Such shipping growth renewed calls for a new lock at that location.

Figure 23. Peoria Lock and Dam, Illinois Waterway System, August 4, 1939. The wickets are in the raised position. (Chicago Aerial Survey Company)

During World War II, the civil works projects of the Corps were cut back unless they contributed to wartime emergency needs. In 1941, Congress transferred all U.S. Army construction from the Quartermaster Corps to the Corps of Engineers. All of the Great Lakes Division and Upper Mississippi Valley Division districts participated in the wartime construction program, which involved building plants for producing war material, setting up troop camps and hospitals, constructing Air Corps airfields, and building transportation facilities, such as docks, warehouses, and loading operations. The Great Lakes Division districts placed $518 million in construction contracts. In addition, the Corps' districts on the Great Lakes had responsibility for procuring approximately $1 billion in engineering supplies and equipment for the military effort. As a wartime measure, Congress authorized the expedited construction of a new lock at Sault Ste. Marie to replace the Weitzel Lock. The new lock, completed on schedule in July 1943, measured 800 feet long, 80 feet wide, and 30 feet deep.

In the decade after World War II, the Corps' nationwide civil works program was heavily weighted to large, multiple-purpose projects. As the Chief of Engineers, Major General Samuel Sturgis noted in a 1953 memo to the Secretary of the Army, "The Federal program for navigation and flood control improvements has gradually become a program of large multiple-use improvements concentrated in a decreasing number of areas. The smaller navigation and flood control improvements have largely disappeared from the program." This situation grew out of the increased demand for hydroelectric power, especially in the Pacific Northwest. Under President Dwight D. Eisenhower, moreover, the Bureau of the Budget policy of "no new starts" accentuated the trend. In 1953, over 60 percent of the civil works construction appropriation focused on multiple-purpose projects, of which 75 percent went for construction work in the Pacific Northwest and Missouri River basin alone.[13]

General Sturgis felt that the current policy of concentrating the public works program in a few large projects in a limited geographic range was undesirable because it tended "to squeeze out of the program many small projects which are needed and well-justified economically and which would be widely distributed over the country." Instead, he proposed broadening the Corps' civil works program to include more small, economically justified flood control and navigation projects, along with the multiple-use reservoirs. His suggested program of small projects would cost $20 to $30 million over five or six years, and "since they could be completed rapidly, the budget and Congress would not become involved in large continuing appropriations." Sturgis supported a national

public works project and was pleased with the results of this project.[14]

Rapid growth in postwar waterborne commerce on the Upper Mississippi River in the late 1940s led to interest in further work on that navigation channel. During the war, the Upper Mississippi supported between 2 and 3 million tons of freight annually. By 1947, freight tonnage was over 8 million and by 1954, 22 million. The nine-foot channel project, completed in 1940, proved vital in accommodating the growth in river traffic. The last element of the nine-foot channel project, the extension around St. Anthony Falls, progressed slowly after World War II. The project, authorized in 1937, was designed to enable modern barges and towboats to ascend the falls and pass into the center of Minneapolis. The Corps did not complete the project until the late 1950s, after the creation of the NCD.

Another Upper Mississippi River project that got underway just before the creation of the NCD was the improvement of the lock at Keokuk, Iowa. At that location, Lock #19, built in 1913, had become a bottleneck to river commerce by the 1950s. It had a useable length of only 358 feet, while most other locks on the Upper Mississippi were 600 feet long. In 1953, Congress authorized construction of a new lock that would be 1,200 feet long and 110 feet wide. The Rock Island District completed it in 1957. On the Great Lakes, no new major Corps' projects emerged before work got underway on the St. Lawrence Seaway. The Great Lakes districts concentrated on maintaining existing harbor and connecting channel depths.

During the Korean Conflict, the Corps' Great Lakes and Upper Mississippi River districts performed vital support roles for the military effort. Efficient operation of the ship canals at Sault Ste. Marie and the IWS assured the vital supply of iron ore and sufficient shipping to carry it. The Rock Island District oversaw expansion of the Rock Island Arsenal and the Savanna Ordnance Depot. The Chicago District's real estate division acquired lands for expanding Scott Air Force Base and O'Hare Field. Several Great Lakes districts handled $314.6 million in procurement of heavy construction equipment for the military during the war. Finally, the Lake Survey performed extensive mapping services for the U.S. Air Force and Army.

The wartime role of the Great Lakes Division was primarily supervisory, with operating missions assigned to the districts. After the war, the Chief of Engineers asked his division engineers to indicate whether, in the future, military support activities should be centralized at the division level or remain decentralized at the district level. Great Lakes Division Engineer Colonel Wendell P. Trower favored decentralization because he thought that military construction engineering experience enhanced the capabilities of the Corps during emergencies. It also provided more opportunity for recruitment and training of young engineers at the district level where they could be assigned to all phases of the work in both office and field. Colonel Trower pointed out that combining civil and military functions in one staff achieved great efficiency. If these functions were separate, Colonel Trower informed the Chief of Engineers, he would need 140 people to do what now required only 110. Division-wide, 582 out of 1,016 employees performed both civil and military work, and Colonel Trower calculated that he would need an additional 167 personnel if the functions were not joined. Above all, he noted, the civil works mission kept intact an engineering organization that a peacetime army construction program could not support.[15]

The Establishment of the North Central Division

The new administration of President Eisenhower announced early in 1953 that it would focus on budget reduction and economy in all government operations. The Corps of Engineers was not exempt from this edict. In a memo to Chief of Engineers General Sturgis, Under Secretary of the Army Earl Johnson ordered the Corps to examine its field structure and determine "the number of districts and divisions which could be reduced and what realignment of responsibilities would be required

for more efficient operations." As Sturgis's staff began its analysis of the Corps' field structure, Sturgis became concerned about the response of local interests to the closure of districts and divisions. He ordered his staff to get more information on the potential local reaction from his division engineers. He also instructed his staff to counter local objections to closures through a carefully drafted public relations plan that focused "on savings, workload assignment, organizational and operational efficiency by general and specific illustrations." Above all, Sturgis wanted the proposed reorganization to be based on civil works requirements, because he believed military spending was too uncertain. Finally, any plan put forward should "emphasize the changes in transportation and communications that make a greater geographical spread of control possible."[16]

At the time of the reorganization review of 1953, the Corps' structure included thirteen divisions and forty-seven district offices. On July 31, 1953, acting Chief of Engineers Major General B. L. Robinson presented a preliminary reorganization plan to Under Secretary Johnson that called for eliminating one division and downgrading six district offices to area office status. He emphasized that the field realignments were based on "anticipated workloads for military functions and civil works; manageability of these workloads in various combinations; economy and efficiency of operation; geographic factors; retention of a balanced engineering force capable of rapid expansion; and phasing" of the recommended reductions. He warned that the proposed realignments were predicated on reduced military and civil works programs and on "the assumption that no emergency develops and that no new districts will have to be opened for unforeseen projects of major scope." Robinson assured Under Secretary Johnson that "the technical supervision of work in progress will not be reduced; [and that] in fact, consolidations will permit the retention of balanced engineering staffs not otherwise possible." Robinson estimated that the cutback would eliminate 460 employees and save $2 million in salaries. Reduced operating costs would equal $50,000 annually.[17]

General Robinson warned Under Secretary Johnson to expect a "violent political reaction to the realignment of field offices." He urged that the Chief of Engineers be allowed to brief the affected congressional delegations and that local interests be given an opportunity to be heard before a final reorganization plan was announced. He attached a suggested public relations plan and press release for initiating the process. At the heart of the Chief of Engineers' reorganization plan was the proposal to consolidate the Upper Mississippi Valley Division and Great Lakes Division into a "Midwestern Division" headquartered in Chicago. In addition, in recognition of reduced workloads, he wanted to combine the Chicago, Duluth, and Milwaukee districts into one district located at Chicago. Area offices would be retained in Duluth and Milwaukee.[18]

The Under Secretary of the Army did not respond immediately to the Chief of Engineers' reorganization plan, and on September 30, General Robinson requested authority to proceed with the establishment of a Midwestern Division. He also proposed delaying the other recommended field changes pending further studies. Evidently, the Chief of Engineers was having second thoughts about closing offices. He now, according to Robinson, "believed that some consolidations of functions and activities between offices involved will produce savings in personnel without the necessity for abolishing offices." General Sturgis requested that he be allowed to postpone any further consolidations until he could rework his earlier plan. In late October, after further consideration, Sturgis changed his mind again and resubmitted his original recommendation to the Under Secretary. Under Secretary Johnson then recommended approval of the proposed Corps' reorganization plan, but Secretary of the Army Robert Stevens did not respond.[19]

When General Sturgis met with Secretary Stevens on the reorganization issue in December, Stevens was evasive. In the meantime, Secretary Stevens had been on the receiving end of complaints from the powerful Congressman

Figure 24. Colonel Delbert B. Freeman, Division Engineer, Upper Mississippi Valley Division, June 1952–August 1954.

Mendel Rivers (D–SC) about the possible closure of the Charleston District office. Congressman Rivers threatened to use his power in the Committee on the Armed Services to transfer the Corps' dredging functions at naval bases to the U.S. Navy if the Corps closed the Charleston District. Secretary Stevens assured Rivers that no decision had been reached on the possible closure of the Charleston District. On January 7, 1954, Secretary Stevens asked Sturgis to once again review his reorganization plan and come up with new recommendations.[20]

By April 1954, General Sturgis realized that political concerns represented the major obstacle in the Corps' reorganization. He wrote Assistant Secretary of the Army George Roderick that "it is now clear to me that the political factor just will not permit the Secretary or me to order at one time the realignments set forth in my plan of 31 July." Sturgis admitted that the consolidation of divisions and districts "must be gradual and phased." He planned to use his division engineers to overcome local opposition and when "the Division Engineer reports that such a position has been attained, I shall issue the order for closing out the District." Sturgis's immediate goal remained the closing of the Upper Mississippi Valley Division and transferring part of its work to the Great Lakes Division and part to the Lower Mississippi Valley Division. He stated, "I shall give the Division Engineer of the Upper Mississippi Valley Division the task of selling the proposed close-out of his Division to the local interests and the political authorities in the area."[21]

Finally, on May 28, 1954, General Sturgis made it clear in a meeting with the secretary of the Army's staff that he would proceed with closing the Upper Mississippi Valley Division, unless the secretary of the Army directed him otherwise. No one at the meeting raised any objections, and Sturgis immediately ordered his staff to work with the Upper Mississippi Valley Division in preparing a detailed plan for carrying out the closure in ninety days. Initially, all of the existing districts in the division would remain standing, but Sturgis's plan envisioned eventually abolishing the Milwaukee and Duluth districts.[22]

On June 30, 1954, General Sturgis issued General Orders No. 7, which decreed the abolishment of the Upper Mississippi Valley Division and the conversion of the Great Lakes Division into the NCD, headquartered in Chicago. Effective September 1, 1954, the Rock Island and St. Paul districts were transferred to the jurisdiction of the new NCD, and the St. Louis District was made part of the Lower Mississippi Valley Division. The Chief of Engineers ordered the affected division engineers to "make such arrangements as may be necessary to effect the transfer of civilian personnel, records and funds and the transfer or disposal of property."[23]

Colonel Delbert B. Freeman, the Upper Mississippi Valley Division Engineer, had the task of winning over local interests and political authorities to the division's closure. Apparently, the task went smoothly, as Freeman reported on July 8, 1954, "the merger of UMVD with LMVD and GLD is progressing generally according to schedule." St. Louis interests did not object very

strenuously to the closure of the Upper Mississippi Valley Division, because only fifty-five jobs were involved and the city retained the St. Louis District office containing 800 employees. Freeman took pains to court the local newspapers, and they refrained from editorial comment on the division closure. The only difficulty, Freeman reported, involved a potential delay in the movement of the new division into expanded quarters in Chicago. Colonel Trower, the Great Lakes Division Engineer, however, informed Headquarters that the approximately twenty-two employees transferring to the Great Lakes Division were high graded, and he feared that this would disrupt morale and careers in his new organization. Ultimately, only eighteen former Upper Mississippi Valley Division employees joined the new NCD.[24]

In his monthly report to the Chief of Engineers, Colonel Trower wrote on August 6, "all of our plans for taking over the Rock Island and St. Paul Districts have been completed." A month later, on September 4, Trower informed General Sturgis that "on 1 September we launched the new North Central Division," and added, "we were fortunate in securing the transfer of some excellent people from the UMVD." While the Corps succeeded in establishing the new NCD fairly smoothly and rapidly—once the Chief of Engineers decided to proceed—the closing of district offices in the new division proved more difficult.[25]

Colonel Trower quietly began planning for abolishing the Milwaukee and Duluth district offices and changing their status to that of field offices after receiving instructions from General Robinson on June 25, 1954. Robinson informed Trower that he should "start detailed planning so that the interested Congressmen can be approached by . . . 1 December 1954. This should be sufficiently long after the UMVD–GLD merger to permit you to handle both in an orderly fashion." On September 28, 1954, Trower supplied a consolidation plan to Robinson, and Robinson gave his approval on October 7, 1954. Both men used personal rather than official correspondence to avoid premature disclosure of the plan to shutter districts. General Sturgis had decided early in the operation that only those who needed the information in carrying out the closure plan would be informed of it.[26]

Plans for abolishing the Milwaukee and Duluth districts called for dividing their territories among other districts. The civil works boundaries of the Chicago District were extended to include all of the Milwaukee District west of Lake Michigan from Peninsula Point south to the Illinois state line. The civil works boundaries of the Detroit District were enlarged to embrace the part of the Milwaukee District in Upper Michigan, all of the Milwaukee District area in the Lower Peninsula of Michigan, and that portion of the Duluth District lying east of Au Train Bay on Lake Superior. The civil works boundaries of the St. Paul District would be enhanced to include all of the Duluth District except that portion assigned to Detroit. An estimated $270,000 in annual operating costs would be saved by the consolidation.[27]

Colonel Trower held conferences with those most keenly concerned to reveal the details of his plan. His first step involved conferring with members of Congress representing the area within the Duluth and Milwaukee districts to explain why the closeouts were necessary. Immediately following these meetings, Trower consulted with local interests. Meanwhile, on November 30, 1954, General Sturgis personally instructed Trower to begin preliminary planning for yet another consolidation, that of the Rock Island and St. Paul districts. After some thought on the matter, Trower objected in a letter on January 12, 1955. He stated to Sturgis his "conviction, that the North Central Division should have a year to shakedown after the merging of the two divisions and the Milwaukee-Duluth-Chicago consolidation, and to give time for further study of the problems that would be involved in combining the two districts." Sturgis approved a delay in the consolidation, and the Corps eventually discarded the proposal.[28]

In comparison, phasing out the Milwaukee and Duluth districts proceeded on schedule.

Colonel Trower informed General Sturgis that he intended to go to Washington, D.C., January 17, 1955, and personally notify the senators and congressmen concerned. "I think we would only be kidding ourselves if we did not admit that some opposition would be manifested," he wrote the Chief of Engineers on January 12. He added:

> The increased interest in harbor development which has been generated by virtue of the St. Lawrence Seaway and the improvement of the connecting channels will focus more than the usual amount of public attention on any changes in Great Lakes districts. The very acute rivalry which has developed between the ports of Milwaukee and Chicago may also be a contributing factor. It may be hard to explain to the public why the Corps of Engineers is abolishing two lake districts on the eve of an anticipated renaissance in lake commerce.

"True," wrote Sturgis in a marginal note on Trower's letter. Sturgis also agreed with Trower's concluding remark, "that the consolidation should be made even though considerable opposition should develop."[29]

On May 1, 1955, the carefully planned consolidation took place. No other major change in the NCD's civil works organization occurred for fifteen years. In 1970, the Lake Survey, which had existed since the early 1840s under the direction of the Army engineers, was closed. As part of a government-wide reorganization of scientific offices, the charting and research functions of the Lake Survey were transferred to the newly established National Oceanic and Atmospheric Administration. The Detroit District took over the personnel and functions involved in the lake-level forecasting and measurement of river flows. The Coastal Engineering Research Center of the Corps inherited the Shore Process Branch that had handled the Great Lakes coastal research.[30]

Colonel Trower remained the NCD Engineer for nine months after the division was organized. He would have preferred to stay on and oversee construction of the U.S. portion of the St. Lawrence Seaway, but U.S. Army regulations called for mandatory retirement of colonels who were five years in grade and had more than thirty years of service. The Chief of Engineers was concerned about the retirement policy, because he was about to lose 50 percent of his division and district engineers. On such a vitally important and complex project as the St. Lawrence Seaway, he would lose both Trower at the NCD and Colonel Philip Garges, Buffalo District Engineer. The St. Lawrence Seaway, General Sturgis wrote the secretary of the Army on March 23, 1954, was not simply a construction project but "intimately related technically to the Great Lakes Levels Survey, and the Inter-Connecting Channels Survey." Experienced engineers, he argued, were needed to oversee the work and, "these men, as engineers, are at the very peak of their competency." General Sturgis successfully persuaded the Army Chief of Staff to delay Trower's retirement, but the reprieve was only temporary. Col. Trower retired in June 1955.[31]

For over 125 years, Army engineers had been actively developing the navigation potential of the Great Lakes and the Upper Mississippi River. The new NCD inherited a large river and harbor program from its predecessor organizations, and it had a great responsibility to carry on successfully the work of the past. At mid-twentieth century, it was about to embark on major new work in the region, involving the St. Lawrence Seaway and continued improvements to the Upper Mississippi River navigation channel. In addition, it would undertake new challenges concerning regional environmental issues. Elaboration and evaluation of these matters are the subjects covered in the succeeding chapters of this study.

CHAPTER II
Early Projects of the North Central Division to Circa 1960

By the time Colonel Wendell P. Trower left the NCD on June 6, 1955, any disruptions accompanying the headquarters' move and organizational changes long since had been surmounted. The new Division Engineer, Brigadier General Paul D. Berrigan, wrote Major General Samuel Sturgis on July 5, 1955, "I am gradually getting used to the new problems of the North Central Division. Wendell [Trower] did such a good job of solving them that he left me only a few that were beyond his control." The Chief of Engineers replied to Gen. Berrigan, "Needless to say, it gives me great confidence to have you there as Division Engineer with three of our most important projects: the St. Lawrence, the Inter-Connecting Channels, and Cal-Sag."[1]

The new NCD exhibited marked continuity of personnel, organizational structure, and responsibilities with its predecessor, the Great Lakes Division. In June 1955, NCD headquarters staff consisted of 180 personnel who assisted and advised the Division Engineer in carrying out his civil and military works responsibilities. As noted above, the major civil workload involved review and oversight of engineering studies; design, construction, and operation of river, harbor, and flood control structures; and other district-specific projects. In addition, the Corps enforced laws relating to civil works activities, such as granting permits involving navigable U.S. waters; disposing of or altering obstructive wrecks and bridges; issuing navigation controls; and establishing harbor lines. The Corps also collected and published data on waterborne commerce in the Great Lakes Division through its Regional Statistics Office (RSO). Organizationally an element of the Division Engineer's technical staff, the RSO was located at the Detroit District until October 14, 1954, when it was moved to Chicago and physically made a part of the division headquarters' office.[2]

The NCD's military mission in 1955 included oversight of preliminary cost estimates and design and supervision of construction, along with acquisition, management, and disposal of real estate for the U.S. Army and Air Force. At that time, the division also had authority for the design and construction of Veterans Administration hospitals. In addition, the NCD provided administrative support to the Snow, Permafrost, and Ice Research Establishment (SPIRE), which moved from the St. Paul District to Wilmette, Illinois, in 1951. Once it had moved, the Chief of Engineers ordered the Great Lakes Division to provide SPIRE with services such as facilities, personnel, communications, and funding. The Great Lakes Division assigned these responsibilities to the Chicago District. This arrangement continued under the NCD until SPIRE was renamed the U.S. Army Cold Regions Research and Engineering Laboratory (CRREL) in January 1961, and moved soon thereafter to Hanover, New Hampshire.

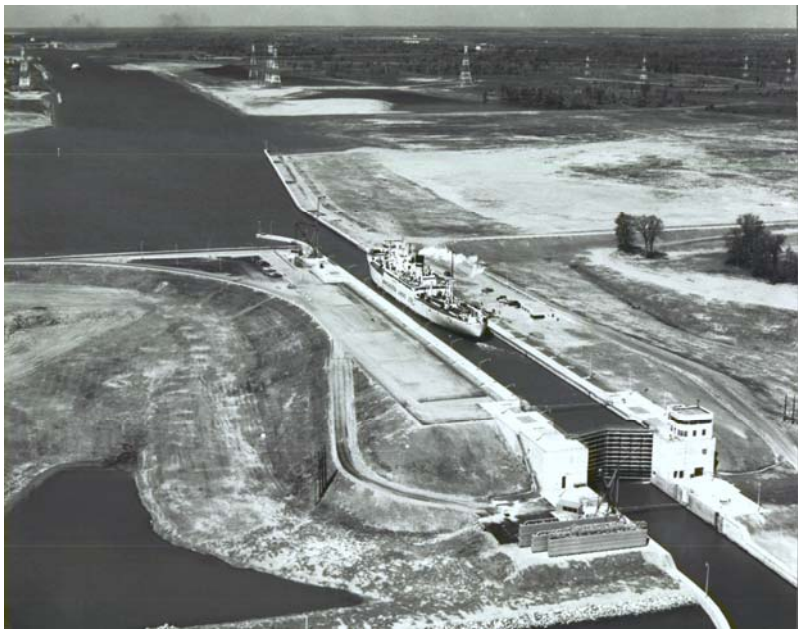


Figure 25. Snell Lock, St. Lawrence Seaway. Constructed by Buffalo District. (New York District)

Generally speaking, the districts served as the operating elements of the division. The NCD's

six districts (including the Lake Survey) employed 4,100 personnel in 1955. The districts functioned within stable territorial boundaries, except for the Lake Survey, which had responsibility across district lines for hydrographic surveys required for the preparation of navigation charts covering the Great Lakes, Lake Champlain, New York canals, and Minnesota-Ontario border lakes. The Lake Survey, in addition to studying the hydraulics and hydrology of the Great Lakes, forecasted lake levels and provided other data to navigation interests. In 1959, one Army engineer noted that with the completion of the St. Lawrence Seaway and the extension of oceangoing commerce to mid-America, "the Lake Survey is looking forward to an expanded program of more comprehensive charting and engineering services."[3]

The Division Engineer's staff supported the district offices in a number of ways. Through staff review of district reconnaissance studies and design memoranda, and field inspections of work in progress, the division ensured district conformance with Corps regulations and policies covering planning, designing, and constructing civil works projects. The division developed dredging and maintenance practices that applied division-wide and directed interchange of physical plant materials, funds, and personnel between districts. It also reviewed operating procedures of the districts and initiated division-wide adoption of improved administrative and business practices.

In spite of having an expanded geographic area of responsibility, in comparison with the former Great Lakes Division, NCD staff size, with one exception, did not show commensurate growth. The exception was the engineering division. In June 1953, the Great Lakes Division had thirty-four personnel assigned to its engineering division. The chief of the Great Lakes engineering division, Edwin Nelson, was the ranking civilian employee and top engineering advisor to the Division Engineer. In June 1953, Nelson now performed the same role for the NCD Engineer; however, he now had a staff of seventy-

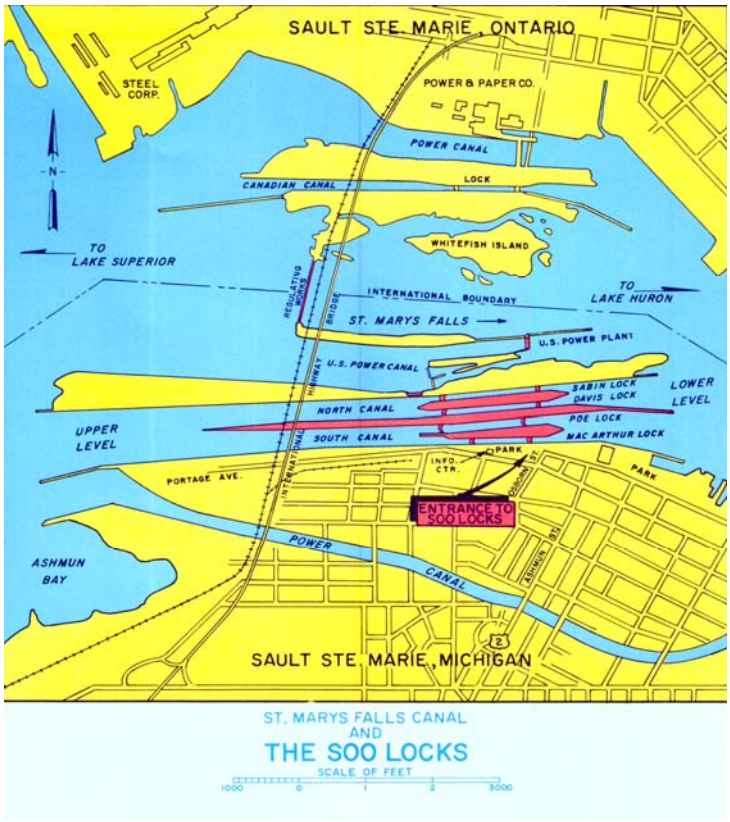


Figure 26. St. Marys Falls Canal and the Soo Locks. (NCD Files)

four. In addition, the engineering division expanded from five branches—program development, planning and reports, technical engineering, soils and materials, and geology—to nine by adding hydraulics, conservation, military, and services branches. The services branch consisted of clerks, stenographers, and typists.

The origin of new branches also demonstrated how new division elements originated, either at the direction of higher headquarters or at the division's own initiative. For example, the NCD engineering division's program development branch was the outgrowth of a directive from the OCE. In September 1952, the Chief of Engineers ordered each division to improve its programming and budgeting procedures for civil works. The Great Lakes Division responded by establishing a programming branch within the engineering division in July 1953. Among the responsibilities of the programming branch (later the program development branch) was the preparation and assembly of data necessary to prepare the Division Engineer for testimony before the House

Figure 27. Lock construction on St. Lawrence Seaway. (NCD Files)

and Senate Appropriations committees in support of budget estimates.

The hydraulics and conservation branches, conversely, represented deviations from standard division organization and resulted from the NCD's own initiative. The NCD needed a hydraulics branch, it said, because of the scope and magnitude of several major studies in progress on Great Lakes hydraulics problems. In 1954, the NCD requested OCE approval to set up a hydraulics branch. In recognition of emerging environmental concerns on the Upper Mississippi River, the conservation branch had been transferred to the NCD from the Upper Mississippi Valley Division. A single specialist, Gordon Hanson, who had pioneered the effort to bring conservation and biological considerations to standard engineering and operations practices, staffed it. Hanson's responsibilities at the NCD included coordination with conservation interests and collaboration with the operations and real-estate divisions in matters relating to public use and administration of Corps' projects lands and waters. Eventually, Hanson became chief of the NCD's environmental resources branch.

On his own initiative, instead of in response to a directive from headquarters, the Division Engineer established a military branch in the engineering division to facilitate the coordination of planning, programming, funding, and control of military projects for the U.S. Army and Air Force. Prior to its creation in the engineering division, there had been a military branch in the operations division and responsibilities for many military construction matters had been split between the divisions, resulting in duplicated efforts.

In contrast to the engineering division, the operations division was not expanded after the Great Lakes–Upper Mississippi Valley Division merger in 1954. In 1953, the Great Lakes Division operations division, under John Borrowman, consisted of civil works and military branches with a total of thirteen employees. In June 1955, the NCD's operations division, with Borrowman still in charge, consisted of a maintenance and operations branch and a construction branch, still with only thirteen people. In response to new orders and regulations from the OCE, the NCD reorganized its operations division in September 1955. At that time, the NCD broke its construction branch into three sections: one for civil works projects, including general construction and the St. Lawrence Seaway; one for U.S. Air Force projects; and one for U.S. Army projects.

The St. Lawrence Seaway Project

After World War II, the explosive growth of Great Lakes shipping led to a renewed interest in developing an outlet from the lakes directly to the Atlantic Ocean via the St. Lawrence River. Prior to that time, many mid-continental commercial interests believed that an Atlantic connection provided by the Erie Canal and the Hudson River and by the many railroads serving the region adequately met their needs. An alternative route to the Atlantic through Lake

Ontario and the St. Lawrence River was thought to benefit Canada more than it would the United States. Railroads, fearing a loss of traffic, and East Coast and Gulf ports, fearing cheaper competition, vigorously fought the St. Lawrence Seaway Project. Private power companies also opposed the public power features of the proposed seaway project. The project, however, never completely died.[4]

In spite of opposition, other developments encouraged seaway advocates. The 1909 Boundary Waters Treaty between the United States and Canada established a permanent Canadian-American body, the International Joint Commission (IJC), with jurisdiction over boundary-water issues. The commission quickly demonstrated that the two countries could work together efficiently and harmoniously. Pressure continued to mount for improving navigation on the St. Lawrence River. The First World War demonstrated that the eastern railroads were inadequate to the nation's transportation requirements in an emergency and revealed the need for expanded electrical generating capacity. Seaway advocates argued that both needs could be met by developing the navigation and power potential of the St. Lawrence River.

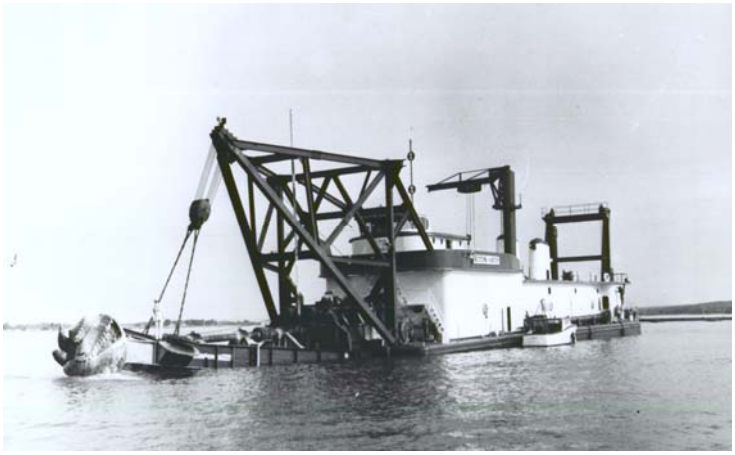


Figure 28. Connecting channel deepening. (NCD Files)

In 1919, Congress agreed to a joint study with Canada to investigate improving the St. Lawrence River between Lake Ontario and Montreal. The resulting report by the Corps and Canadian experts recommended joint development of the river's hydropower and navigation potential. Subsequent studies led to a Canadian-U.S. agreement in 1941 to build hydropower dams and construct a deepwater navigation channel. Congress, because of the wartime emergency, failed to implement the agreement. Planning, however, continued on the proposed project, much of it carried out by the Corps. From the 1920s to the 1950s, commercial and shipping interests in the Great Lakes area lobbied for the St. Lawrence Seaway Project through the Great Lakes–St. Lawrence Association. Finally, when it appeared that Canada was prepared to build the navigation project entirely within its territory, Congress authorized the joint project in 1954.

The Corps had the major role in planning, design, and construction of the St. Lawrence Seaway Project. It did so, ultimately, as the agent of a public corporation, the St. Lawrence Seaway Development Corporation, which had overall responsibility for the project. The complicated undertaking had several navigation and power components, detailed in "St. Lawrence River Project, Final Report, 1942," from the Corps. This document served as the basis for subsequent planning and construction of the seaway. To improve navigation on the international waterway, the United States built two locks and the Canadians built four. In addition, the project required constructing ship channels in the International Rapids and Lachine sections of the St. Lawrence River, extensive dredging, and hydropower facilities. The latter element involved a joint effort by New York State and Ontario. The powerhouse sat across the north channel of the St. Lawrence River and required the construction of a powerhouse and spillway dam. A control dam to regulate the outflow of Lake Ontario was built in the vicinity of Iroquois Point. The entire project, completed in 1959, cost the United States $431 million and Canada $640 million.

When President Dwight D. Eisenhower signed the St. Lawrence Seaway Act in May 1954, the

Corps eagerly anticipated its role in constructing the U.S. portion of the project. The Buffalo District, expecting to receive a major assignment, had already prepared a detailed study of the organization it would need to complete the seaway project. Colonel Trower wrote the Chief of Engineers in January 1954,

> The task of making this study of an organization to construct the St. Lawrence Seaway has generated a considerable amount of enthusiasm, both in the Buffalo District and the Division office. The thought that at long last the Seaway may become a reality and that the Buffalo District and Great Lakes Division in all probability will be assigned responsibility for its construction is heartening.

On May 10, 1954, Trower again assured the Chief of Engineers that the Buffalo District stood ready for any assignment related to the St. Lawrence Seaway Project. Trower felt confident that "the advanced planning which we have done here since the first of the year will pay big dividends. We can, I am sure, live up to any of the commitments which have been made relative to starting construction, progress, and completion."[5]

The NCD and its predecessor, the Great Lakes Division, played key parts in General Sturgis's effort to secure the Corps' role in the seaway project and then to ensure the success of the Corps' construction effort. In the early stages of the Corps' maneuvering to involve itself in the project, Sturgis relied on Great Lakes Division Engineer Colonel Trower to provide him information about those in the Great Lakes region opposed to giving the Corps control of seaway construction. In particular, Sturgis was concerned about N. R. Danielian, head of the Great Lakes–St. Lawrence Association, the seaway project's chief lobbying group. Danielian did not want the Buffalo District to acquire the planning and construction assignment for the project and resented that the Corps did not defer to him in conducting all of its Great Lakes activities. Sturgis heartily detested Danielian, telling him in person "he was a damn fool." At Sturgis's behest, Trower successfully outmaneuvered Danielian and neutralized his ability to work against Corps interests in the Great Lakes and on the seaway project in particular. Trower accomplished this by personally convincing powerful members of the Great Lakes–St. Lawrence Association executive board to restrain Danielian.[6]

With Danielian under control, Colonel Trower concentrated on making sure the division, especially the Buffalo District, was ready to take on the St. Lawrence assignment. In June 1953, after receiving responsibility for any future role the Corps might have for the seaway project, Trower and his staff developed the organization and procedures for constructing the navigation works of the proposed St. Lawrence project. In early 1954, as Congress entered its final deliberations on the project, the Corps had already completed its initial planning for the undertaking. In fact, Trower submitted the Buffalo District's final plan on January 11, 1954. General Sturgis gave his approval to the overall plan in February 1954, and ordered Colonel Trower to develop

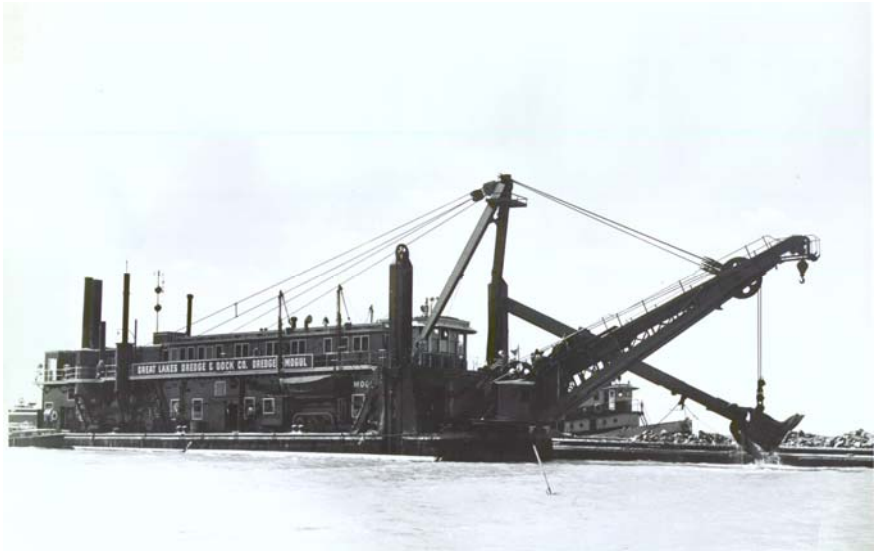


Figure 29. Drill boat and the giant dipper-type dredge *Mogul*. (Detroit District)

even more detailed studies and plans. As it turned out, this advanced planning saved time later and allowed for the project's on-schedule completion.[7]

Even though Congress approved the St. Lawrence project in May 1954, the Corps did not officially receive its work assignment until September 1954. While the Chief's staff nervously awaited word about its role, Colonel Trower kept busy refining the seaway planning. On August 6, 1954, he informed General Sturgis, "We have already begun subsurface explorations and other field work and are engaged now in recruiting the Engineering Division of the Buffalo District up to the strength required to complete the [seaway project's] design."[8]

A month later, Colonel Trower confidently asserted that the new NCD was in a strong position to carry out its St. Lawrence responsibilities, since the division had been "fortunate in securing the transfer of some excellent people from Upper Mississippi Valley Division." Indeed, within three weeks of the establishment of the NCD, on September 17, 1954, the St. Lawrence Seaway Development Corporation designated the Corps as its design and construction agent for the project. By November 1954, Trower announced that the Corps was ready to advertise for bids on the project's initial phase. By the end of 1954, the division had reviewed most of the basic planning, contained in eight Buffalo District design memorandums.[9]

The Corps' lead role in the St. Lawrence Seaway Project was not a foregone conclusion, and the Chief of Engineers had to maneuver adroitly in Congress and within the Eisenhower administration to secure the job for the Corps. At the time, the Corps felt besieged on several fronts. The Hoover Commission, looking into government reorganization, considered reducing the Corps' role in civil works projects. The U.S. Air Force was threatening to stop using the Corps for its military construction needs. Another challenge came with the Eisenhower administration's desire to cut federal spending, which raised the possibility of fewer Corps civil works projects. A further complication for the Corps' continued dominance of federal navigation projects appeared with Congress's creation of a public corporation to finance and build the St. Lawrence Seaway Project.

General Sturgis was determined that if such public corporations were to become the wave of the future in federal civil works projects, the Corps should, at the very least, keep its traditional role as primary construction agent. Even though the Corps had misgivings about the use of a semipublic development corporation to build the seaway project, an anxious Sturgis lobbied hard to get the actual construction job. Once the Corps got the assignment, it realized that only its best work would ensure future jobs with public corporations. As it turned out, the St. Lawrence Seaway proved a good lesson in the more complicated political and bureaucratic arena in which the Corps would work in the future. As William Becker observed in his history of the St. Lawrence Seaway Project,

> The Engineers found itself [*sic*] in a "negotiated" environment. That is, the Corps had to develop the bureaucratic means of dealing with a number of agencies, while keeping as intact as possible traditional procedures of design, contracting, and inspection. The project was the first of many which would require the Engineers to collaborate fully with multiple federal and state agencies, a mode of operation that was to become more common with the growing federal interest in environmental issues.[10]

The St. Lawrence Seaway Development Corporation named the Corps its agent for design and construction, with authority to supervise field construction to assure compliance with all contracts. The corporation retained general oversight and direction of the Corps. The actual implementation of the working relationship proved complex. Corps personnel were not used to being in a subordinate role, while staff of the new corporate entity had never before had such

responsibility. Nevertheless, the two agencies soon established an informal coordination process that satisfied all parties and kept the project on track. Both the Corps and corporation were anxious to avoid delays, for fear their critics would charge them with inefficiency or incompetence. Upon completion of each phase of the project, the finished portions transferred to the corporation for operation and maintenance.

Figure 30. St. Marys Falls Canal, Sault Ste. Marie, Michigan, August 11, 1966. View west. (Detroit District)

For their part, the Buffalo District and the NCD hammered out an efficient working relationship for getting the actual work done. The Buffalo District handled engineering and design, plans and specifications, real estate, relocation, contract administration, project scheduling, and construction superintendence. The division provided overall engineering and design review and coordination with all Canadian and New York State agencies involved in the project.

Corps work on the St. Lawrence Seaway Project occurred primarily in two portions of the St. Lawrence River, the International Rapids section and Thousand Islands reach. Work on the International Rapids involved complicated lock and canal construction and extensive channel dredging. Before dredging could be done, the Corps had to conduct comprehensive model tests to determine the extent of work necessary to ensure suitable flow conditions. Dredging at the Long Sault Canal site, which contained the Eisenhower and Snell locks, also depended on railroad and highway relocations and construction of a bridge connecting the mainland to Cornwall Island. Channel enlargement in the Thousand Islands section proved less difficult than elsewhere in the project. Here, the Corps had to remove rock and overburden in twenty-four miles of shoals. All Corps work had to be coordinated with channel deepening and lock and canal work done by the Canadian Seaway Authority and with the power authorities of New York and Ontario, who had responsibility for building the project's hydropower elements.

Colonel Trower had been involved in the international negotiations regulating Lake Ontario's water levels. This issue now proved contentious for the seaway project because it affected the St. Lawrence power and navigation improvements and shore property owners' rights. The power and navigation interests wanted higher lake levels to increase power benefits and reduce the need for additional excavation to deepen ship channels, while landowners wanted lower levels to cut shore losses. The lake regulation issue was still unresolved by the time Trower retired and General Berrigan became the commander of the NCD in July 1955. In the meantime, the Buffalo District moved ahead with awarding excavation contracts for the Long Sault Canal and the two locks.[11]

The Corps tenaciously followed its established contracting process and fended off all attempts by the St. Lawrence Seaway Development Corporation to assert more control over construction. In other matters, such as public relations, the Corps willingly deferred to the corporation. As General Sturgis put it, the Corps had "a vital, though subordinate, public relations interest" to the corporation. Therefore, if any

public relations problem arose that could not be resolved at the district level, the Division Engineer was to report it promptly to the Chief of Engineers.[12]

Contractors excavating for the St. Lawrence canal and locks found the work difficult because soil conditions often proved worse than originally anticipated and labor costs were high. Schedules were tight and losses suffered by early contractors made others reluctant to bid on later contracts. As General Berrigan recalled in 1980, the canal excavating difficulties were most vexing.

> The material to be excavated turned out to be very difficult to handle. This is prehistoric glacier country and the valleys are full of boulders plus marine clay. The marine clay plus the rounded gravel worked like marbles and cup grease. It stuck to the buckets and it stuck to the dump trucks. It worked best in the below zero weather when the frozen lumps fell out of the dump trucks. In the summer they used backhoes in the spoil area to unload the trucks.

Figure 31. Soo Locks. Looking east showing construction of new second lock. (NCD Files)

Contractors had agreed to do the excavation work at the rate of seventy-five cents per cubic yard. Berrigan believed it might have cost them over a dollar. He thought that the contractors initially bid low on the seaway work because it was a "prestige job and the competition was fierce."[13]

The Eisenhower and Snell locks also represented large construction undertakings, requiring over 1 million cubic yards of cement. As constructed, they measured 860 feet long, 80 feet wide, and 30 feet deep over their sills at low water. Work in the Thousand Island section, where the river ranged from one to four miles wide and contained rocky shoals and tortuous channels, consisted of excavating shoals and widening and deepening channels. Downstream, below the Snell Lock near Cornwall Island, an additional 12 million cubic yards of dredged material was removed to produce a channel 400 to 500 feet wide with adequate depth for twenty-seven-foot navigation. Since private dredging firms refused to take on the work at an acceptable price, the Corps was forced to do the dredging itself, using government equipment and hired labor. The Corps' dredging proved a great success. The effort kept the entire project on schedule, and Corps costs were $1.00 less per cubic yard than the Buffalo District had originally estimated.

At the NCD, Borrowman, chief of operations, had primary responsibility for obtaining plant equipment used for dredging on the St. Lawrence Seaway Project. His efforts resulted in several million dollars in savings. The Corps' efficiency in accomplishing the seaway project was striking. The Army engineers had completed in three and one-half years what had originally been designed to take six. One spokesman for the Corps proudly noted, "No other project demanded so much from the Engineers in so short a time as the Seaway Program."[14]

Connecting Channels and Harbor Deepening

The St. Lawrence Seaway Act made no provisions for deepening the channels connecting the upper lakes. Colonel Trower, while still in command of the Great Lakes Division, pointed to the changing characteristics of the lakes' bulk cargo fleet. In March 1953, he told General Sturgis that:

> Recent vessels added to the fleet, with drafts of 24 to 26 feet, have in general been much larger than those of the existing fleet. At lower lake stages these larger boats will not be able to load to maximum draft. Consequently, the Lake Carriers are asking for a review report on the connecting channels to consider a 27 foot minimum depth.

At the close of the 1953 shipping season, Trower further added, the total commerce at Sault Ste. Marie exceeded 128 million tons, 8 million tons more than the previous record established in 1942. Also, in 1953, the Public Works committees of the Senate and the House responded to concern about Great Lakes connecting channel depths by asking the Corps of Engineers to look into the advisability and costs of providing connecting channel depths of at least twenty-seven feet, a depth commensurate with that being considered for the St. Lawrence Seaway. The Great Lakes Division Engineer assigned the study to the Detroit District.[15]

At the beginning of the connecting channels study, navigational depths of 22.5 feet existed in down-bound channels to accommodate loaded deep-draft ore carriers moving from Lake Superior to destinations on Lakes Michigan and Erie. Up-bound channels provided 18.5 feet in depth. The two systems of channels were separated in two places, one along a thirteen-mile stretch of the lower St. Marys River and the other on a seven-mile reach of the lower Detroit River. In places where both up- and down-bound traffic used the same channel, a 22.5-foot navigational depth existed. In the course of its study, the Detroit District projected prospective commerce on the lakes and concluded that the connecting channels should be deepened to twenty-five feet. The Detroit District study demonstrated that such a depth would result in saving nearly $10 million in annual transportation costs for iron ore, stone, and grain. Deepening the connecting channels could be justified without reference to seaway potentials.

The proposed project involved deepening and widening the entire 167 miles of navigation channels connecting Lakes Superior, Huron, and Erie. Channel depths were to range from 27 to 30 feet and widths from 330 to 1,200 feet. In addition, to assure safe passage between Lakes Huron and Michigan, a shoal covering a 4,000 by 1,250 foot area would be removed between Mackinac and Round islands. Borrowman, chief of the NCD's operations division, initiated test dredging procedures at various channel sites that helped reduce project costs by cutting the quantities of dredged materials needing removal. Even so, the project called for removal of an estimated 44 million cubic yards of earth and enough rock to fill a number of 2.5 cubic yard capacity dump trucks that, if placed bumper to bumper, would more than encircle the earth.

The Corps estimated the project's cost at about $135.9 million, with annual maintenance set at $200,000. Great Lakes states' governors responded enthusiastically to the channel-deepening proposal and most urged speedy authorization. Congress voted for the project and President Eisenhower approved the measure in March 1956. General Berrigan assigned the project to Detroit District Engineer Colonel Peter Hyzer. Besides the usual engineering issues, Hyzer also had to schedule the work to interfere as little as possible with the bulk shipment of critically important iron ore and still get the job done within the allotted six years. Hyzer also encountered other problems, such as the limited availability of highly specialized equipment needed to perform the work and the unwillingness of contractors, after their costly experience with excavation work on the St. Lawrence project, to bid on the project. Berrigan found it necessary to assist Hyzer on the latter issue.

"When it was getting close to the time for the bids on the first connecting channel job," General Berrigan recalled in 1980, "I discovered that none of the Seaway contractors had any plans to bid it. I wrote them that it was not a job with any unknowns . . . [but still] I got negative answers from everyone." At the time, however, Berrigan was determined to secure competition for the first contract that involved excavating the upper six miles of the up-bound channel on the lower Detroit River. It required removing nine feet of solid rock to increase the depth of the 300-foot-wide channel from twenty-one to thirty feet. Berrigan made new personal appeals to contractors known to the Corps and eventually obtained a promise for a courtesy bid from Marine Operators, a joint venture. The company, reluctant to take on the project, deliberately bid high, or so it supposed. On opening of the bids, Marine Operators' offer of $16 million came in $6 million less than the offer of the only other bidder. Marine Operators started work in May 1957, using special, highly efficient drilling and dredging equipment. Berrigan believed that Marine Operators made a $10 million profit on the job.[16]

For the second phase of the project, which involved the up-bound channel of the lower St. Marys River, competition proved stiff between bidders and the margin of profit less. Ultimately, three contractors excavated approximately 3 million cubic yards of material over thirteen miles of channel. The contractors used hydraulic dredges, whose pipelines carried the excavated material to a designated dump area. In addition to the work of these private contractors, the Corps itself carried out other connecting channel work, using hired labor and government equipment. The U.S. hopper dredge *General Markham* dredged the east outer channel below the mouth of the Detroit River on Lake Erie. Corps dredge *Paraiso* performed the work at the head of the Detroit River until summer 1958, when it went east to work on the St. Lawrence Seaway Project. At the time, the *Paraiso* was the largest dipper dredge in the world. Equipped with a fifteen-cubic-yard bucket capable of dredging to fifty feet deep, it was originally built in 1913 for maintenance work on the Panama Canal. Work on the connecting channels continued until 1962, when the Corps attained authorized project depths.

Just as commercial interests of the Great Lakes region pushed for deepening the connecting channels after World War II, so too did they request the deepening of selected Great Lakes harbors. As early as 1940, the Great Lakes Division submitted cost estimates to headquarters for harbor-deepening projects. Depths ranging from twenty-seven to thirty-five feet were considered, with costs increasing rapidly for the greater depths. For example, in 1948, the Corps estimated that they could deepen ten representative lake harbors to twenty-seven feet for $9 million, while thirty-five feet would cost $82.5 million.

The construction of the St. Lawrence Seaway increased the cry for Great Lakes harbor-deepening projects, and Congress responded in 1956 by asking the Board of Engineers for Rivers and Harbors to review previous reports and make recommendations for possible improvements of lake harbors. The Chief of Engineers initiated new studies of deepening harbors to accommodate deep-draft vessels, assigning overall responsibility for the work to the NCD. The Division Engineer, in turn, requested reports on individual harbors from each of the lake districts. The district reports were designed to show which of the fifty-seven federally improved harbors having eighteen-foot or greater project depths should receive further work. The project planning branch of the division's engineering division had responsibility for managing the study. In all, the division reviewed thirty-seven interim reports on specific harbors and five commodity studies before issuing their final report in 1966. As a result of the interim studies, Congress, between 1960 and 1965, authorized the Corps to improve thirty Great Lakes harbors and to construct one new harbor.

In addition to the deepening of major commercial harbors, the Corps also improved small-boat harbors on the Great Lakes. Between 1954 and 1970, the Army engineers improved

twenty-three such harbors. The division role in the construction of small-boat harbors on the lakes included researching the best design approaches, often using hydraulic models, and then applying them to Great Lakes conditions. Since coastal engineering workloads fluctuated widely in the districts, it was not always possible for them to maintain the necessary skills for carrying out the work. The division had to take the lead in the design process and provide close supervision and consultation of the districts' work.

Figure 32. Poe Lock removal in progress. (NCD Files)

The New Poe Lock

During World War II, shipping interests urged replacing the old Poe Lock with a lock the same 800-foot length as the MacArthur Lock but with a width of 100 instead of 80 feet and depth of 32 instead of 30 feet. Congress authorized such a project in 1946, but did not fund it. Only preliminary planning had been completed on the project by the time the NCD was established, and Congress did not make funds available for detailed planning for a new lock at Sault Ste. Marie until 1958.[17]

During the 1950s, large deep-draft vessels carried increasing quantities of lake cargo, but only the MacArthur Lock could accommodate these ships when fully loaded. By 1954, 51 percent of the total freight had to go through the MacArthur Lock, because both the Canadian lock and the Poe Lock were too narrow and shallow. The Davis and Sabin locks handled the remainder of the Great Lakes fleet. The MacArthur Lock, however, was straining to accommodate vessels up to 730 feet long, the maximum length that could fit in the lock using special procedures.

Studies carried out by the Corps in the late 1950s showed that a lock 1,000 feet long, 100 feet wide, and 32 feet deep would serve the needs of lake commerce. Congress provided the funds for detailed planning and the Corps' Buffalo District was assigned the design job. In 1960, the Detroit District received responsibility for constructing the new lock. In early 1961, work had barely begun on the cofferdams and demolition of the old Poe Lock when ship owners expressed concern that the new ships they were planning to construct, which would be up to 950 feet long and 95 feet wide, would barely fit in the new lock. In response to these concerns, the Corps agreed to redesign the lock, even though it would mean a construction delay of twelve to fifteen months. Much of the delay involved relocating and extending the cofferdams used during lock construction. The new Poe Lock, finished in 1968, was 1,200 feet long and 110 feet wide.

The Calumet-Sag Project

The Calumet-Sag extension to the Illinois Waterway System (IWS), started in November 1955, by the Chicago District, was, as General Sturgis pointed out to General Berrigan, a high-profile project. The Corps' project called for improving 36.2 miles of channels between the industrial area on Lake Calumet near the southern boundary of Chicago and the IWS, which linked the Great Lakes with the Mississippi River. The work would excavate a channel 225 feet wide and 9 feet deep to accommodate commerce that had

Figure 33. Junction of Sag Channel with main sanitary canal before widening, 1954. (NCD Files)

increased from 43,270 tons in 1935 to 3.7 million tons in 1954. Congress's approval of the project confirmed Colonel Trower's judgment in February 1954 that the development of Lake Calumet as an industrial terminal would "give great impetus to demand for early initiation of the Calumet-Sag project."[18]

While the project's intent was not controversial, differences arose over who should pay the cost of replacing, removing, or altering twenty-five railroad bridges and forty highway bridges that existed within the project area.

Figure 34. Junction of Sag Channel with main sanitary canal after widening, 1962. Note two new bridges constructed as part of the Calumet-Sag Channel improvement. (Chicago District)

Existing law allowed the federal government to pay for changes to the railroad bridges but not the highway bridges; still, local interests demanded that the federal government pick up the cost for the highway bridges on the same basis as was applied to the railroad bridges. Such a reallocation of highway bridge costs amounted to an increase in the federal first cost of $40 million and a like reduction in local interests' outlays. While Colonel Trower urged supporting the locals' position, others in the Corps' hierarchy initially opposed his view. After further consideration of the matter, however, the Corps recommended in 1956 that the federal government pay for highway bridge modifications, arguing that benefits from the project were national in scope and that local interests had spent large sums for previous work on the project. Congress concurred in 1958. With that change, projected federal costs for the $188 million Calumet-Sag project came to $171 million, with locals responsible for the remainder. Ultimately, the Chicago District spent $106 million and completed most of the navigation project by the late 1970s, with portions deferred in 1972 and 1973 for further study. These studies ultimately determined that further work was not economically justified.[19]

International Issues

In their capacity of providing technical support to the IJC, the Division Engineers of the Great Lakes Division and the NCD were involved with the controversy over the diversion of water from Niagara River for hydropower generation. At issue was the effect of such diversions on the natural beauty of Niagara Falls. The Niagara Diversion Treaty of 1950 allowed additional water diversion from the falls, while requiring further studies of the rate of erosion affecting the Horseshoe Falls section to determine ways to prevent further deterioration of the scenery. In March 1953, Colonel Trower reported to General Sturgis that "the report of the International Niagara Falls Engineering Board on the Preservation and Enhancement of Niagara Falls has been completed and is scheduled for submission to the International Joint Commission . . . . This report recommends the remedial works required to preserve and enhance the beauty of the

Falls under conditions which will prevail with the additional diversions permitted under the 1950 treaty."[20]

In May 1953, the IJC approved the project the Buffalo District and engineers from the Hydro-Electric Power Commission of Ontario had devised, and preliminary construction began later that year. The Buffalo District oversaw the U.S. portion of the project, which involved excavation and fill off the western tip of Goat Island. The entire project took four years to complete at a cost of $12.5 million. Additional studies of measures to preserve and enhance the scenic beauty of Niagara Falls were undertaken in the 1960s.[21]

In 1953, the Chief of Engineers clarified that the Great Lakes Division Engineer would represent the United States on all international boards of control for Lakes Superior and Ontario and for Niagara Falls. His participation would assure full coordination of the international aspects of matters these boards considered, since the Great Lakes Division Engineer had jurisdiction over the entire Great Lakes drainage area. The work of these boards took on added visibility in 1953 because unusually high lake levels in the previous year, accompanied by a stormy winter, had caused severe wave and flood damage to shore properties. Those affected looked to the control boards for solutions to their problems.

Based on preliminary studies, Congress authorized the Corps to determine if a plan could be developed for the regulation of the lake levels in the interest of power, navigation, and the reduction of shore property damage. As Colonel Trower noted to General Sturgis in March 1953, such a study "is quite involved and will require a considerable period of time to complete." By June 1953, Trower reported that the lake regulation study was well underway and receiving excellent cooperation from the lake states and federal agencies involved. He also observed that "because of the importance of Great Lakes shipping, the vast power potential in the natural storage of the lakes, and the highly developed shores, this is one of the most important studies yet assigned to this Division." The issue of lake levels continued to be a problem throughout the entire history of the NCD.[22]

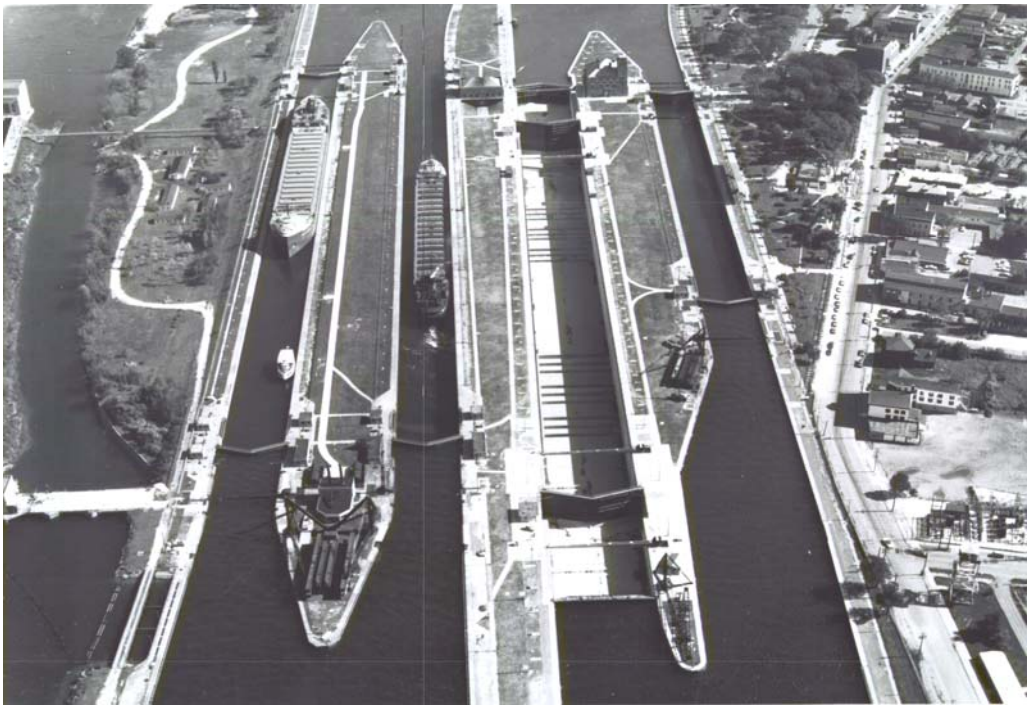


Figure 35. St. Marys Falls Canal, Sault Ste. Marie, Michigan, September 30, 1968. Aerial view looking east, showing New Poe Lock in unwatered condition. (Detroit District)

Military Construction and Support Work for Others

In 1959, headquarters staff of the Corps performed an analysis of the NCD's workload during its first five years. The study reported that between 1955 and 1959, the division had maintained a steady workload, averaging nearly $150 million per year. During that period, military obligations accounted for 56 percent and civil works 44 percent of the workload. The study projected that over the next five years, the NCD program would stay flat or decline only modestly, with the civil works portion increasing to 65 percent of the total effort. During the 1955 to 1959 period, the division overhead rate had averaged 3.3 percent, or about .3 percent higher than the target. For the five-year period, the NCD's personnel strength averaged 4,076.

The study also found that the five districts—with the exception of the Buffalo District—were generally operating on an economical basis individually, with good overhead rates and balanced workloads. The Buffalo District, however, had experienced a sharp workload decline from 1957 to 1959, and was projected to have further reductions through 1964. Buffalo also had unfavorable overhead rates. The study recommended that the Division Engineer "conduct a full study inquiring into possible adjustments that may be made in the Buffalo District and submit a plan as to course of action to be taken." Options included converting the district to an area office, restricting it solely to an operations and maintenance mission, or bolstering its workload.[23]

Between 1954 and 1970, the NCD had a military construction program, that the Chicago and Detroit districts largely carried out. The military construction work in the Great Lakes region focused on installation facilities and Cold War projects, such as building Nike guided missile bases placed around major metropolitan centers in the Midwest during the 1950s. The Corps developed standardized plans for all buildings and structures built at Nike missile bases. Ultimately, the Chicago District constructed twenty-three Nike installations in the Chicago defense area alone. Over time, the Corps also carried out efforts to upgrade these missile facilities, converting some to Hercules missiles. At one point during the upgrade effort, Chief of Engineers Lieutenant General W. K. Wilson told the NCD Engineer, "I cannot over-emphasize the importance of meeting the required completion dates of NIKE-HERCULES improvements . . . at the various defense areas in your division." General Wilson also added that he was "happy" that NCD Engineer Brigadier General Thomas D. Rodgers was "personally following these projects."[24]

In addition to larger construction jobs such as Nike bases and hospitals, the Chicago and Detroit districts accomplished many smaller projects at U.S. Army and Air Force installations. These undertakings included construction or renovation of military storage buildings, barracks, officers' quarters, and family housing. Division engineers held their district engineers strictly accountable for meeting the needs of their military customers. For example, in the early 1960s, General Rodgers informed Chief of Engineers Lieutenant General

Figure 36. Calumet-Sag Channel before improvements, 1955. Typical fixed bridge with limited clearance of fourteen feet at low water. (NCD Files)

E. C. Itschner that "to insure that District Engineers take a personal and active interest in military supply matters[,] I am requiring those DE's with military supply functions to personally visit factories and supply sources on a monthly schedule." The Chief of Engineers replied that Rodgers's action was "in complete accord with the emphasis I have placed upon improving procurement functions." A few months later, Acting Chief of Engineers Major General Keith Barney wrote to the NCD Engineer, reinforcing headquarters' concern with Corps management of its supply responsibility: "There is no substitute for command attention to the supply mission which is becoming increasingly complex and critical." By the late 1960s, however, the NCD military construction workload had declined substantially; in 1970, it was transferred to the Missouri River Division located in Omaha, Nebraska.[25]

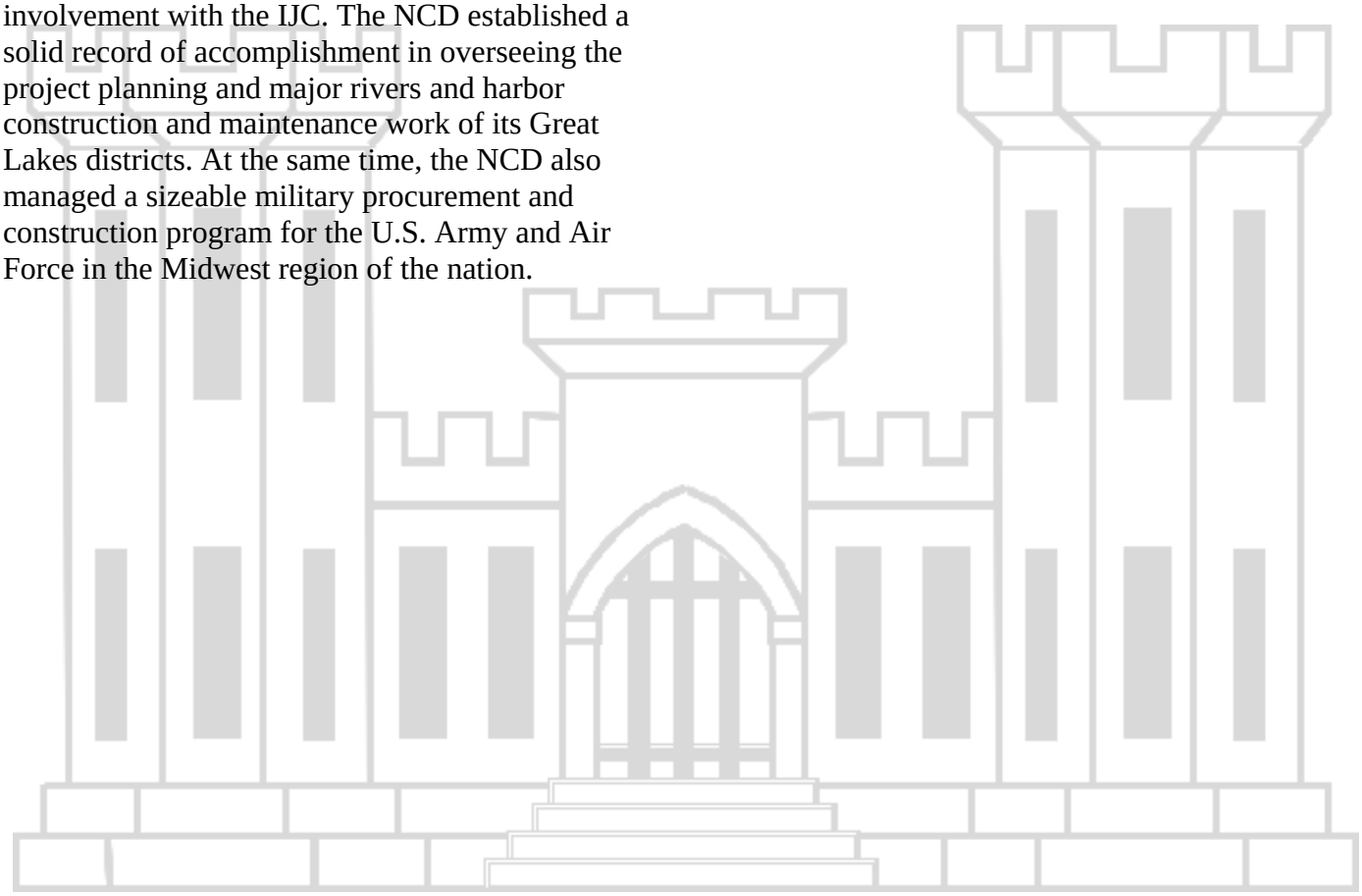
The NCD had a role in the Corps' involvement in the U.S. Postal Service's (USPS) early 1970s attempt to upgrade its facilities. By the late 1960s, the USPS realized that its postal operation was facing a general breakdown. It had failed to modernize its buildings and equipment and could no longer keep up with processing the rapidly increasing volume of mail. To overcome these problems, the USPS was reorganized as a public corporation and a massive program of facilities modernization was undertaken. The heart of the plan involved the concept of the Bulk Mail System. The postal plan called for the construction of a large number of plants located on the periphery of urban areas, near interstate highways and major airports. The postal authorities intended these bulk plants to use the latest computerized mechanization and other high-speed mail handling equipment to process high volumes of mail.[26]

Realizing that they lacked the necessary organization or expertise to carry out such an ambitious construction program, the new USPS sought the assistance of the Corps of Engineers. After receiving necessary approval from the Secretary of Defense in October 1970, the Corps agreed to take over major post office design and construction and real estate responsibilities for the USPS. The Corps' vast construction experience and decentralized organization made it ideally suited to carry out such a national program. Over the next three years, the Corps oversaw the design and construction of mail facilities across the country.

Corps divisions assumed a major support role in the postal construction program, serving as liaison with USPS regional headquarters, and assigning and overseeing districts' postal construction work. The Corps of Engineers' Postal Construction Support Office (CEPCSO) in the OCE ordered division engineers to establish district boundaries for the postal program by coordinating with adjoining divisions to ensure efficient arrangement of responsibilities. In Illinois, for example, the Corps decided that the southern one-third of the state would be under Lower Mississippi Valley Division jurisdiction, while the northern two-thirds would come under the NCD. Division engineers also had to determine district personnel requirements for carrying out the program and arrange for the transfer of USPS personnel into the districts where appropriate. Divisions were not actively involved in the design process, since CEPCSO managed this function.

The NCD had responsibility for constructing three bulk-mail facilities, one at Forest Park, Illinois; one at Allen Park, Michigan; and one at Minneapolis, Minnesota. These were giant facilities. The Allen Park building, for example, covered 7.2 acres, cost $34 million, and housed $10 million worth of equipment. It could handle 216,000 parcels and 62,000 mail sacks in a sixteen-hour day. In addition to bulk-mail facilities, the Chicago, Detroit, and St. Paul districts constructed or modernized a number of smaller post offices within their districts. Corps involvement in the postal program began phasing out in 1973 and was over by 1975. The postal construction program demonstrated the Corps' ability to apply its civil works skills in a nontraditional way.

The new NCD engaged in a significant civil and military construction program during its first fifteen years. The division's involvement in building the St. Lawrence Seaway and the Calumet-Sag projects and oversight of the navigation improvements to Great Lakes' harbors and connecting channels represented traditional yet vital types of Corps' projects. Water resources issues that touched on international relations with Canada, such as lake level fluctuations and construction of the new Poe Lock, also arose during those early years and affected the NCD's involvement with the IJC. The NCD established a solid record of accomplishment in overseeing the project planning and major rivers and harbor construction and maintenance work of its Great Lakes districts. At the same time, the NCD also managed a sizeable military procurement and construction program for the U.S. Army and Air Force in the Midwest region of the nation.



CHAPTER III
Great Lakes Projects, 1960–1997

The initial Great Lakes projects and responsibilities of the new NCD during the 1950s continued as major activities of the division in the 1960s and 1970s. Even as the NCD sought to guide the work focused on such matters as the connecting channels and harbor deepening, management of lake levels, and completion of the Calumet-Sag project, new issues and concerns arose. These new matters included such items as dredged material disposal initiatives and navigation season extension studies. During the 1960s, moreover, the NCD implemented a new project-planning organization and related procedures, and responded to challenges posed by an emerging national environmental consciousness.

Responding to water issues in the Great Lakes basin remained a primary focus of the NCD into the 1990s. In effect, the Great Lakes system represented a giant multiple-purpose project, producing over 820 billion kilowatt hours of hydropower annually; providing navigation links for moving iron ore, coal, and grain; and offering recreation opportunities for 700,000 boats. In addition, many cities used lake water for municipal purposes. Finally, the lakes' coastal wetlands and near-shore areas constituted prime habitat for fish, waterfowl, and mammals. Balancing the Great Lakes system and the needs of its users was no easy task. In particular, the environmental consequences of managing Great Lakes' water proved challenging to the leadership and technical experts of the NCD.

Management of Great Lakes water issues also had an international context. The Boundary Waters Treaty of 1909 between the United States and Canada established broad principles and mechanisms to help resolve issues concerning water quantity and quality along the boundary between the two countries. The treaty set up the International Joint Commission (IJC), a binational organization with three Canadian and three U.S. members, to carry out its provisions. The IJC, in turn, created a number of boards to carry out its work, and the NCD Engineer typically served as the United States' co-chair on several of these entities.

Project Planning

In the final years of President Dwight D. Eisenhower's administration, considerable disagreement over water development policy arose between the Republican president and the Democrat-controlled Congress. President Eisenhower called for restraint in river and harbor legislation and proposed no new water resources projects for fiscal years 1959 and 1960. When a defiant Congress passed a public works bill for 1960 containing an unusually large number of new projects, the president vetoed the measure. Dissatisfied with the president's water resources development policy, the Senate created a select committee in April 1959 to study the nation's public and private water resources needs. In January 1961, the select committee issued a report, which foresaw a coming national water crisis and called upon the executive branch to undertake a number of long-sought reforms in the federal water program.[1]

In particular, the committee recommended a greater emphasis on research and planning, urging preparation of comprehensive plans for the development and management of water and related land resources of the entire nation's major river basins. The committee proposed a cooperative effort involving a number of federal agencies and states. The committee did not perceive preparation of comprehensive or "framework" studies as any diminution of existing federal construction agency programs, but only that the projects of these agencies should fit into the framework of the comprehensive plans.[2]

President John F. Kennedy was receptive to the select committee's recommendations. In July 1961, he requested that Congress implement the recommendations and provided a draft statute on

which to base the necessary legislation. In the draft statute, President Kennedy proposed establishing a Water Resources Council consisting of the secretaries of Agriculture; Army; Interior; and Health, Education, and Welfare. The draft statute called for the council to establish a number of basin commissions to coordinate preparation of comprehensive basin plans.

President Kennedy's proposed legislation, however, did not become law until Congress passed the Water Resources Planning Act in July 1965. In the meantime, the Kennedy administration took a number of other steps to implement recommendations of the Senate select committee. For example, President Kennedy requested the four cabinet-level secretaries who would make up the Water Resources Council to form an ad hoc council to review current water planning policies and recommend necessary changes. The council submitted a report, which the president approved in May 1962, setting new standards for proposing and evaluating water resources projects. These standards encouraged project adoption by setting the discount rate used in establishing project cost at 3.5 percent and encouraging plans consistent with a yearly national economic growth rate of 4.5 percent. The Senate subsequently published the council's plans as Senate Document 97 of the 87th Congress.[3]

In June 1962, the Bureau of the Budget ordered the ad hoc council to submit plans intended for undertaking comprehensive water development studies for all major river basins by 1970. In response, the ad hoc council submitted a program for eighteen framework studies. To implement the studies, the council proposed interagency coordinating committees, modeled after the Corps' multi-agency planning effort for the Delaware and Potomac river basins. The planning work of the ad hoc council laid the foundation for water resources studies carried out in the second half of the decade. In addition, Congress passed the Water Resources Research Act of 1964. A section of this act required the president to improve interagency coordination of water resources research.[4]

The Corps of Engineers took note of the push within Congress and the White House to reform water resources planning. As early as 1961, NCD Engineer Brigadier General Thomas D. Rodgers asked his staff to consider ways to implement comprehensive studies for river basins within the division's geographic region. In August, Rodgers met in Washington, D.C., with Chief of Engineers Lieutenant General Walter K. Wilson to discuss the Corps' role in comprehensive studies. Based on his initial conversation with the Chief, Rodgers went on to formulate a proposal, in September 1962, that the NCD engineering division's planning and reports branch—the branch responsible for comprehensive planning—be redesignated the project development branch or the project formulation branch, titles that better reflected the character and level of professional responsibility of the assigned personnel.[5]

The Chief of Engineers agreed with General Rodgers concerning the need to improve the stature and prestige of the Corps' planning work, but he clearly had something more drastic than a change of name in mind. The Bureau of the Budget had recently been critical of the Corps' planning efforts and had questioned the ability of the Corps to develop the comprehensive river basin plans President Kennedy had requested. After discussing the full range of river basin planning proposals with his division engineers, General Wilson ordered that henceforth, "our principal objectives are to establish an organization which will have high level status and be exclusively concerned with river basin planning." As a first step, Wilson ordered that basin planning branches should be established within the civil works division of each division's engineering offices. The chiefs of the basin planning branches would be the key basin planning officers in division offices.[6]

In March 1963, NCD management had drawn up outlines of the new organization for comprehensive basin planning, and by midyear, the basin planning branch was in operation alongside the existing project planning branch. A civil engineer, James King, formerly assistant chief of the engineering division's planning and

reports branch, was promoted to fill the dual position of branch chief for river basin planning and assistant to the chief of the engineering division. King's new responsibilities included the supervision of three sections: the Upper Mississippi River basin, economics, and basin planning units. He and his staff oversaw districts' basin planning study efforts, particularly when it called for coordination with other federal agencies and with state and local entities.

By June 1963, the NCD had initiated five comprehensive, interdisciplinary, interagency river basin studies. Four of the studies encompassed smaller but more detailed investigations of the St. Lawrence, Fox, St. Joseph, and Genesee river basins. The fifth effort was a broad look at the entire Upper Mississippi River basin. The Corps had undertaken the biggest basin study—the Upper Mississippi River Comprehensive Basin study—in response to a resolution adopted in May 1962 by the Senate Committee on Public Works. The NCD Engineer chaired the study coordinating committee, made up of representatives from the Departments of Agriculture; Health, Education, and Welfare; Interior; Commerce; the Federal Power Commission; and the Corps of Engineers. States represented on the coordinating committee were Wisconsin, Illinois, Indiana, Iowa, Minnesota, Missouri, and South Dakota. At the working level, eight committees, each responsible for a specific subject matter, were each chaired by a representative of the agency having primary responsibility for that resource. The NCD provided the chairman for the coordinating committee, and in addition, had charge of the Plan Formulation Task Group, Economics Advisory Committee, and Flood Control–Navigation Advisory Committee. The comprehensive study, including a main report and seventeen volumes, was published in 1972.[7]

The study provided a framework for development and management of water and related land resources of the Upper Mississippi River basin in both the short and long term. It tried to balance environmental quality against national and regional economic development and to identify programs and costs to accomplish the recommended plan over the period from 1980 to 2020. The report also recommended further detailed studies for specific projects, periodic updates of the basic framework plan, and establishment of a federal-state commission to oversee continued studies and coordinate implementation of adopted program elements. At the behest of several state governors, President Richard M. Nixon created the Upper Mississippi River Basin Commission (UMRBC) in 1972 by executive order and directed it to prepare a comprehensive master plan for management of the Upper Mississippi River system. The commission had members from ten major federal resource agencies and the governors of each state in the Upper Mississippi River basin.[8]

Following passage of the Water Resources Planning Act in 1965, the Chief of Engineers decided to take additional steps to increase the stature and competence of basin planning within the Corps. In March 1966, the Chief ordered all division offices to establish separate planning divisions within their organizations. In response, NCD Engineer Brigadier General Roy T. Dodge forwarded his proposal to the Office of the Chief of Engineers (OCE) in April 1966. Dodge emphasized that he needed additional funds and personnel to establish the proposed planning division. He reported that eight new positions would be required in FY1967 and three more in FY1968. Dodge wrote that "there are other staffing requirements in this Division Office which are unfilled due to space limitations" and "some of these are more critical and more urgent than those listed" in the planning division proposal. The Chief of Engineers, however, proved unyielding and set May 31, 1966, as the target date for starting up planning divisions at the division level throughout the Corps.[9]

In May 1966, the NCD established a planning division with five branches—plan formulation, regional planning, policy and long-range planning, economics, and environmental resources—while reducing its engineering division by four branches—basin planning, project planning, conservation-recreation, and

program development. Except for the program development branch, which became the program development office, reporting directly to the Division Engineer, the reorganization simply transferred personnel and equipment from the abolished engineering division branches to the new planning division organization.

The Corps' internal reorganization of its field planning structure reflected what was happening throughout the federal water resources development establishment. As Chief of Engineers Lieutenant General William F. Cassidy wrote in October 1966,

> Every public official, military or civilian, in the water-resources field must take a new look at his work. Every agency is taking a new look at its mission. Several conditions are responsible for this. From the postwar population increase, with its crowding and growing suburbs, its litter and pollution, many problems of natural resource management have suddenly emerged. . . . Also, a number of serious emergencies occurred in which catastrophic flooding and catastrophic droughts have existed virtually side by side. These things and others have triggered the movement for a large-scale revision and overhaul of policies and relationships at all levels on natural resource questions.

The piecemeal approach to water resources development would no longer suffice, and Congress, in passing the Water Resources Planning Act of 1965, sought a coordinated effort to assess national water policies and needs on a regional basis.[10]

The Corps had an especially large part in the new planning initiative, since it was involved in fifteen river-basin studies and five major interagency regional "framework" studies in the mid 1960s. In addition, it had a backlog of several hundred regular project studies underway. Many of the single-project studies had to be coordinated with basin-wide investigations. As General Cassidy noted, "This constitutes a bewildering variety of planning activities going on simultaneously, often in the same areas, and a considerable amount of organization and experience will be required to bring them together into a smoothly functioning planning program."[11]

In part, General Cassidy believed that the Corps' new division planning organization, highlighting long-range and environmental planning, should help strengthen the agency's ability to cooperate with others in achieving balanced water resources development. However, as he put it, "the many interests taking part in this vital planning represent a great variety of needs and views. In the turbulence of this period, the possibilities for divergence and conflict are endless. To avoid such pitfalls and bring all elements together is a tremendous challenge to leadership at all levels." Above all, he asserted, the Corps pledged to undertake "all the manifold planning and development tasks . . . in a spirit that will search for common viewpoints and common goals."[12]

The NCD shouldered much of the Corps' load of river basin studies in the late 1960s. The Upper Mississippi River Comprehensive Basin study was already far along in 1967 when the Corps initiated a similar study for the Great Lakes. Although NCD planning personnel had become quite experienced in interdisciplinary, interagency studies, their role in the Great Lakes undertaking differed from that of the Upper Mississippi River Comprehensive Basin study because much control of the planning process rested with the newly established Water Resources Council. Under the Water Resources Planning Act of 1965, the council, with approval of the president, had authority to create and oversee interstate, intergovernmental river basin planning commissions. In practice, the council focused its efforts on coordinating resource agency planning and reconciling interagency differences, and Congress retained final authority over water projects.[13]

After its creation in 1967, the newly formed Great Lakes Basin Commission spent several months getting organized. Division Engineer Brigadier General Robert M. Tarbox expressed his exasperation to the Chief of Engineers at the loss of time. According to Tarbox, nothing had been accomplished after six commission meetings: "Perhaps I am impatient, but I feel that the Commission could make greater progress if efforts were concentrated on moving ahead on developing a framework plan." Instead, he reported, "we have gotten diverted by such activities as a task force to develop and recommend a coordinated plan . . . to solve possible massive die-off of ale wives in 1968." At Tarbox's urging, a committee was eventually appointed that, under guidance of NCD personnel, developed a procedure for starting the Great Lakes basin framework plan.[14]

The Corps struggled to keep river basin commissions as coordinating bodies only, a point that General Tarbox had in guidelines given to St. Paul District Engineer Colonel Richard Hesse. Hesse represented the Corps on the Souris-Red-Rainy Rivers Basins Commission when the chairman of that body was pressuring members to identify areas and problems for more detailed studies, concurrently with work on the framework study. Tarbox advised Hesse to "hold out for concentration of effort on the framework study," stating that the more detailed studies underway in the Corps "have been authorized, directed, and funded by the Congress for study by the Corps." Tarbox added, "We have no intention of recommending to Congress that authority or funds be transferred to the Commission." Tarbox had the full support of the Chief of Engineers in this position.[15]

The NCD's relationship with the river basin commissions remained a concern of General Tarbox's in 1969. By that time, five of the division's six districts were working with basin commissions and the sixth, Rock Island, soon became involved. Tarbox wrote the Chief of Engineers that he believed the river basin commissions were "here to stay," and that free and open participation in commission meetings paid off because "the members of the Great Lakes Basin Commission fully accept and appreciate the expertise and capabilities of the Corps." But Tarbox feared "that we are going to be in conflict between the desires of the commission and the policies and procedures and laws under which we operate." In particular, Tarbox thought that the Great Lakes Basin Commission staff was "trying to gain more authority and to gain control of the activities of the members." Although Tarbox's concerns may have been justified, the difficulties he perceived never developed. The Corps' position that the commissions should remain strictly planning and coordinating bodies prevailed.[16]

After the Souris-Red-Rainy Rivers Basins Commission issued its framework study in 1973, the commission merged with the UMRBC. The Great Lakes Basin Commission finished its framework study in 1977. As a consequence of President Ronald Reagan's emphasis on economy in government, all basin commissions were terminated on September 30, 1981, except the

Figure 37. Hydraulic Pipeline Dredge. (NCD Files)

UMRBC, which operated until the end of 1981. The next chapter discusses NCD work with the UMRBC during the 1970s.[17]

Connecting Channels and Harbors

During the 1960s, NCD districts expended considerable effort on operation and maintenance of Great Lakes navigation channels and harbors. The undertaking involved 1,144 miles of navigation channels, 115 commercial and recreational harbors with 90 miles of breakwater piers and revetments, 62 locks, 45 dams, 750 miles of flood control levees, and 90 local flood control projects. The Corps annually dredged and disposed of almost 10 million cubic yards of material. To carry out dredging, the NCD operated a floating fleet consisting of four hopper, two dipper, and two pipeline dredges; many derrick and crane barges; and numerous towboats. The NCD's construction and operations division had overall management of the dredging program.[18]

Figure 38. Hopper dredge. (NCD Files)

For decades, the Corps deposited materials dredged from connecting channels and lake harbors in designated deep areas of the lakes. It proved an economical way to dispose of materials and did not interfere with navigation. By the mid-1960s, however, widespread public concern about water pollution had focused attention on the Corps' disposal of dredged material in the Great Lakes. Years of discharging untreated municipal and industrial waste in the region's waters had caused severe pollution along the highly developed metropolitan strip extending along the lower shores of Lakes Michigan, Erie, and Ontario. When the Corps dredged navigation channels and harbors and disposed of contaminated material in the lakes, it added to the perceived pollution problem.[19]

In July 1965, General Dodge reported to General Cassidy that it was apparent "that public attitudes toward pollution are becoming more critical and we must reevaluate our procedures and policies on industrial waste, spoil disposal and domestic waste from government activities." Dodge further warned the Chief, "should we be required to discontinue our long-standing practice of disposing of dredged material in dumping grounds in the lakes, our costs would be materially increased." Cassidy replied, "You are quite correct in concluding that the public is becoming increasingly insistent that pollution of the Nation's water be stopped," and asked Dodge for suggestions on how the Corps' might strengthen its efforts at pollution control. In response, Dodge initiated studies of the feasibility of alternative disposal practices for the most critical lake harbors. The Corps also considered temporary measures to accommodate dredged materials until it could come up with other long-range disposal options.[20]

While these studies were underway, General Dodge clarified the Corps' position on dumping dredged materials in the open lakes. Speaking before the Vice-President's Conference on Water Pollution in the Great Lakes States on September 16, 1965, he stated, "We are acutely aware of the problem, sensitive to the criticism, and are deeply concerned. We are anxious to take remedial

measures and join with industry and all levels of government in vigorous efforts to improve and preserve the quality of the Great Lakes." While Dodge looked to the ultimate goal of preventing pollution by finding alternate means for disposing of dredged materials, he emphasized the immediate need for maintenance dredging because the Great Lakes harbors and connecting channels served as vital elements in the national economy. Years later, Dodge wryly recalled the predicament the Corps faced over the dredging disposal issue:

> All of a sudden I was quite a villain for polluting the lakes. We first tried to make the point that we're not polluting the lakes. We're just moving the pollution from one point to another in the lakes and we were not adding to it, just changing it around, but that argument got nowhere. There was much pressure, and the media came down anytime we would be dumping spoil to take pictures of this polluted material being dumped in the lake, without regard to the argument that we took it out of the lake in the first place. It quickly became apparent that we were no longer going to be able to follow that practice and something had to be done.[21]

By the end of September 1966, Corps' headquarters was reviewing the division's alternative disposal studies before submitting them to the Bureau of the Budget for funding. At that time, the Chief of Engineers wrote to General Dodge: "We are faced with a difficult problem [dredged disposal] and should pursue every possible action to meet the demand for corrective measures where necessary." The Corps suggested constructing diked disposal areas to hold dredged material and then let water filter out. The Bureau of the Budget, however, decided that before the Corps requested funds for construction of diked disposal areas, it should further study alternatives in cooperation with the Federal Water Pollution Control Administration (FWPCA) and other agencies.[22]

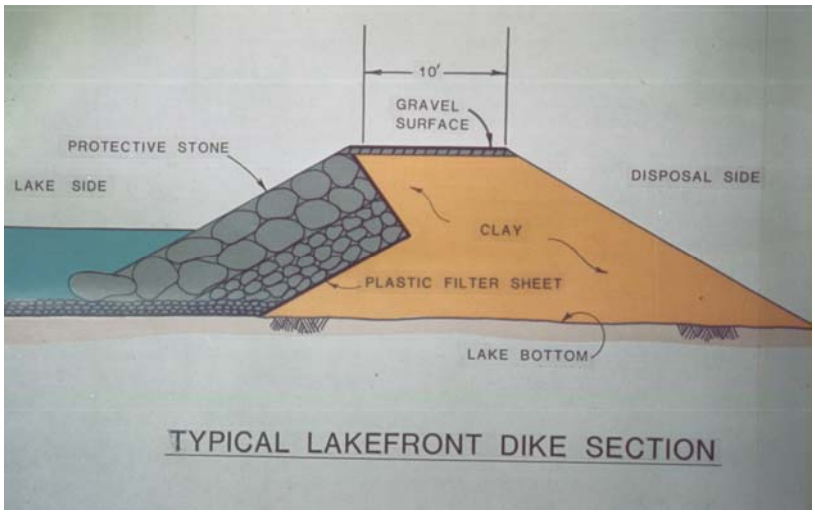


Figure 39. Confined disposal facility (CDF) dikes. These are generally trapezoidal in section with sufficient top width for maintenance vehicles. Armor stone is provided in areas subject to wave attack. Upland CDFs are simply vegetated for erosion control. Dikes are constructed to prevent seepage and escape of contaminants into the environment. To this end, impervious dike cores can be employed, or the CDF can be lined with an enduring material that accomplishes the same purpose. (NCD Files)

Figure 40. Confined disposal facilities. (NCD Files)

Figure 41. Kenosha confined disposal facility. (NCD Files)

The study, called the "Pilot Program for Determining Alternate Methods of Disposal of Polluted Dredgings," was assigned to the Buffalo District under the NCD's close supervision. The study included thirty-five sites identified as polluted by the FWPCA and looked at a variety of disposal alternatives, including several innovative treatment technologies. Its prime objective, General Dodge noted, was "to determine the effectiveness and acceptability of along-shore diked disposal areas which, in most instances, would be the most economical alternative to open-lake disposal." As part of the pilot program, the Corps constructed and operated the first confined disposal facilities on the Great Lakes.[23]

In February 1969, General Tarbox, NCD Engineer since September 1967, reported to the Four-State Enforcement Conference on Lake Michigan Pollution on the pilot program's findings. The study found that each harbor was unique in its type of pollutants, their source, the practicality of controlling such pollution, and availability of alternate disposal sites. Although it had not been possible to measure the effects of polluted dredged material on lake water quality, Tarbox reported that it must be presumed the effect was undesirable.[24]

The pilot program demonstrated that although diked disposal averaged three and one-half times the cost of open lake disposal, it still represented the least costly and most effective way of handling pollutants associated with dredging in the lakes. In 1968, the Corps estimated that it would cost $65.5 million initially and $8.5 million annually to place dredged materials from thirty-five polluted harbors on the Great Lakes into diked disposal areas. Anticipating congressional action and funding during the first half of 1970, Detroit District personnel met FWPCA representatives, state officials, and local interests to plan for operations under a proposed law authorizing diked enclosures near polluted dredging sites. While local interests expressed unhappiness about cost-sharing provisions of proposed legislation, they did support the Corps' decision to avoid dumping polluted dredged material into the lakes while waiting for the anticipated legislation.[25]

In December 1970, President Nixon signed legislation authorizing the Corps to construct, operate, and maintain contained dredged material disposal facilities (Public Law 91–611, section 123). The law called for the Corps to construct disposal areas capable of holding ten years of

Figure 42. Buffalo confined disposal facility at Times Beach. (NCD Files)

dredged material at areas where, in the judgment of the Environmental Protection Agency (EPA), they were most urgently needed. Under the law, a local sponsor had to provide the land required for disposal sites. The sponsor also had to contribute 25 percent of construction costs. The latter requirement could be waived by the secretary of the Army, provided the EPA administrator certified that the area involved and its industrial concerns were participating in an approved plan for wastewater treatment.[26]

The selection and construction of diked disposal sites proceeded slowly because of difficulty in obtaining assurances for the local contribution toward construction costs. Most localities delayed making a financial commitment to the program, hoping to receive a waiver from the EPA. The EPA, in turn, proved reluctant to grant waivers from the local cooperation requirement until they were satisfied that localities were not in violation of water quality standards. In congressional testimony in March 1972, NCD Engineer Major General Ernest Graves expressed the Corps' frustration over long delays in the diked disposal program. In response to the committee chairman's questions about the program and its local cooperation element, Graves responded that the EPA had identified seventy-six harbors with polluted bottom sediments requiring contained disposal (at a cost of $167 million), but that only one community had gotten a waiver. The chairman then observed, "This is a very costly program and I hope that the localities will cooperate." Graves assured him that the Corps was "pressing EPA to make its decision because once it issues its decision, then the issue is put squarely to the local communities. As long as the decision on the EPA approval is pending, it is natural for the local community to delay."[27]

Figure 43. At Clinton River, Michigan, attempts were made to maximize beneficial uses of dredge material in ways such as marsh reclamation, recreational uses, wildlife enhancement, and marina development. (NCD Files)

The delay in carrying out the diked disposal program also had a negative impact on the NCD's Great Lakes maintenance dredging. The Corps normally dredged over 10 million cubic yards per year, but concern over the effect of polluted dredge material on lake environments greatly limited dredging to about 7 million cubic yards annually. The backlog from not dredging in polluted lake harbors reached 12 million cubic yards of material by 1974. In July 1974, NCD Engineer Brigadier General Walter O. Bachus expressed his concern to the Chief of Engineers that because of the deferred dredging, "several of our channel and harbor projects risk becoming seriously shoaled if water levels drop in a short time." Only high lake levels at that time kept the situation from reaching a navigation crisis.[28]

The effort to find a solution to dredged material disposal in the Great Lakes also became a test of the Corps' ability to include public parties in its water resources planning process. As early as 1969, General Tarbox had queried the Chief of Engineers: "We say we want to get the public in on the selection of alternatives. Do we really mean this? Is it possible to do so? Has anyone really done so? If so, how do we accomplish this?" The need to consult the public in the

selection of alternatives for confined disposal of dredged material, coupled with requirements of the National Environmental Policy Act (NEPA) of 1969, led the NCD and its districts to develop improved methods of public involvement. Special training for techniques for enhancing public participation began for Corps planning and public affairs personnel in 1971; by the mid-1970s, Corps regulations incorporated detailed procedures for designing and implementing a program for public involvement in all water resources planning.[29]

The NCD districts at Detroit, Chicago, and Buffalo worked on the cutting edge of public involvement in water resources issues as they sought to create diked disposal sites and deal with other navigation and regulatory matters on the Great Lakes. Fortunately, disposal of dredged material from connecting channels required no local cooperation, and NCD districts moved quickly to find environmentally acceptable solutions to annual maintenance dredging on such channels. The NCD's major problem in keeping the diked disposal facilities construction program on track involved sufficient funding. For example, NCD Engineer Brigadier General Robert L. Moore noted to the Chief of Engineers in February 1976 that seven contained disposal facilities would be under construction that year but "funds requested in the President's budget for FY1977 are insufficient to continue the construction at these sites for completion on a timely basis."[30]

The diked disposal construction program continued into the 1980s. Since the 1960s, the Corps had constructed forty confined disposal facilities around the Great Lakes, most at full federal expense. Of the total constructed, fourteen were built on land and twenty-six were fashioned as in-water facilities. The in-water sites averaged 112 acres in size, whereas upland locations averaged only 35 acres. The amount of dredged material placed in Great Lakes confined disposal facilities averaged 2 million cubic yards a year. As the program reached maturity, concern shifted to what to do as existing confined disposal facilities started to fill up. Congress recognized the problem and in 1988 authorized the use of disposal facilities constructed under legislation passed in 1970 beyond their original ten-year life span.

Public Law 91–611, which authorized construction of diked disposal facilities to contain polluted dredged materials on the Great Lakes, also established the Dredged Material Research Program (DMRP). The DMRP implemented a five-year plan to examine environmental effects of dredging and disposal. Conducted between 1973 and 1978 by the Corps' Waterways Experiment Station, the research program cost $32.8 million. The Corps carried out about one-third of the studies in-house, while assigning the remainder to universities, private research laboratories, and other federal agencies. In all, over 250 individual studies were carried out under the research program.[31]

The general objective of the research program was to provide definitive information on the environmental impact of dredging and disposal operations and to develop "technically satisfactory, environmentally compatible, and economically feasible dredging and disposal alternatives." Specific program goals included establishing the water quality effects of open-water, land, and wetland disposal; improving the effectiveness and acceptance of confined land disposal where appropriate; testing and evaluating concepts of wetland and upland habitat development using dredged material; and developing and testing the use of dredged material as a productive natural resource.

The major conclusion of the DMRP was that no single disposal alternative was suitable for a region or a group of projects and no approach could be categorically dismissed. Each project required evaluation on a case-by-case basis and in the context of long-range regional planning that considered possible interactions among projects. The studies demonstrated that in open-water disposal, unless dredged material was highly contaminated, physical impacts were likely to be of greater potential consequence than chemical or biological impacts. Serious short-term water

quality effects were not likely unless the disposal site was geochemically dissimilar to the dredging site. Similarly, adverse biological effects were unlikely because of the resiliency of most organisms. Turbidity, except during times of fish migrations and spawning activities, was more of an aesthetic problem rather than a biological one. Finally, the studies showed that while confined dredged disposal on land or in shallow water next to land could offer increased environmental protection, it was not inherently better than open-water disposal. For example, soil biochemical conditions in diked containment areas sometimes could enhance rather than retard contaminant release.

The DMRP concluded, "If a confined disposal site is to be effective from an environmental protection standpoint, it must be efficient in retaining a high percentage of the finer soil particles, for it is the clays and silts that carry the contaminants." If the confined disposal site operated efficiently, then effluents should be essentially nontoxic. The DMRP developed guidance for designing, constructing, and operating confined disposal areas to achieve maximum effective capacity and satisfactory effluent quality. Moreover, several DMRP field test and demonstration projects established the viability of using dredged material to develop both wetland and upland wildlife habitats in a variety of environmental situations. The DMRP made this information available in a series of engineer manuals for Corps' district use. After the completion of the DMRP, the Corps conducted a number of other research programs dealing with dredging and dredged material management. Staff at the NCD served as key experts in the Corps' national and regional dredging program, coordinating studies and providing oversight of the Corps' Great Lakes dredging responsibilities.

The NCD also took the lead within the Corps in finding beneficial uses for nonpolluted dredged material. As General Bachus wrote in 1975, "There may very well be many places where

Figure 44. Niagara Falls, N.Y., 1882. (Library of Congress)

conventional and economical dredge placement methods (open water and bank deposits) may still be appropriate." He noted that in the Great Lakes and Upper Mississippi River basins, the Corps had created artificial wetlands and islands that benefited fish and wildlife. The Corps had enhanced recreation opportunities by creating artificial beaches or nourishing existing beaches. It had also used dredged material for shoreline protection and landfills. Bachus noted that while such beneficial uses of dredged material had higher initial costs, the long-term asset value of the new creation made it a good investment. Finally, Bachus observed that an "obvious advantage in using dredged material in these beneficial ways is that the Corps of Engineers would receive stronger support of its dredging operations, even . . . among its most extreme critics."[32]

American Falls at Niagara Falls, New York

In the mid-1960s, city officials in Niagara Falls, New York, and others launched a campaign to win federal support for a program to remove rock debris from the base of the American Falls portion of Niagara Falls. The debris represented an accumulation of rock that had tumbled down the falls in a number of slides over the years. By 1965, the pile of debris reached halfway up the 181-foot cataract. Some observers thought the debris unsightly and feared that if such slides were to continue, the falls would eventually disintegrate into a series of rapids. In response to public pressure, the Buffalo District undertook a series of studies to test the strength of the rock making up the falls and to determine if removal of the debris pile was feasible.[33]

Because the studies focused on a high-profile issue garnering considerable press coverage, the NCD monitored the progress of the Buffalo District's American Falls investigations closely. The division wanted to ensure that the Corps received favorable recognition for its efforts to protect the falls. As General Dodge pointed out to the Chief of Engineers,

> Because of the intensity of the world-wide public interest in Niagara Falls, the remedial study offers the Corps of Engineers a unique opportunity to demonstrate its interest in preserving natural beauty and in responding to the interests of the general public. From a public relations standpoint, such favorable press coverage can enhance the reputation of the Corps of Engineers and can be expected to offset criticism the Corps has suffered on some other projects.[34]

General Tarbox, Dodge's successor as the NCD Engineer, continued the division's focus on the American Falls issue. Tarbox served as the U.S. Chairman of the American Falls International Board, a special committee of the IJC. The board, Tarbox reported to the Chief of Engineers, "recommended diverting the flow from the American Falls for several months to permit examination of the condition of the rocks, including rock mechanics studies. . . . In the absence of any opposition to the board proposal, I have directed the Buffalo District to proceed with planning and the expectation that approval of both governments will be forthcoming."[35]

The plan called for completely dewatering the American Falls so that a detailed erosion study could be undertaken between April and December 1969. Once Canadian agreement to the project was secured, the Corps proceeded with building a steel and earthen cofferdam to completely turn off the falls. The Corps accomplished the dewatering of the falls in June 1969, and geologists then studied cores removed from boring probes that reached through the eighty-foot top layer of resistant dolomite rock into the sixty-foot layer of softer shale below. These and other studies involving Corps and Canadian experts determined that natural erosion and recession would indeed wear the falls away, but that the process would take twenty centuries to complete. Public interest in the Corps' American Falls studies remained high, and the Chief of Engineers, aware of this concern, asked to "have maximum information on progress and status [of the falls project] at all times."[36]

Corps experts concluded that it was feasible to remove talus collected at the base of American Falls and structurally to retard or prevent further erosion, but that stabilizing the falls would cost $26 million and disrupt natural processes. The American Falls International Board, after careful consideration of the scientific studies and opinions expressed in public hearings, concluded that the natural process of erosion and recession should not be interrupted and that the rock debris should not be removed. The board urged that guiding policy "should be to accept the process of change as a dynamic part of the natural condition of the Falls." The board's final report eloquently stated the dilemma surrounding preservation and enhancement of the falls:

> Stabilizing the American Falls means stopping the natural process of erosion. To stop this process would be to deny to future generations the anticipation and the spectacle of continuing movement and change brought about by geologic forces and the action of water on the rock formations. From this point of view, it may seem quite wrong to make the Falls static and unnatural, like an artificial waterfall in a garden or park, however grand the scale. Not to stabilize the rock and to allow erosion and rockfalls to continue may have a higher potential for a continuing dynamic public experience.

The Canadian and American governments accepted the recommendations of the board and nature has been allowed to take its course.[37]

Lake Regulation and the International Joint Commission

Other IJC matters, such as lake-level control, required a great deal of personal attention from the NCD Engineer. In his first three months at the NCD in 1964, General Dodge attended four meetings of the various international control boards. Dodge commented to the Chief of Engineers that since the meetings were held in the United States, "I acted as Chairman and thereby got my feet wet in a hurry." In addition to the International Niagara Committee, the NCD Engineer shared with a Canadian counterpart joint chairmanship of the International Niagara Board of Control; the International St. Lawrence River

Figure 45. American Falls before dewatering, November 1967. (NCD Files)

Figure 46. American Falls after dewatering, June 1969. (NCD Files)

Figure 47. International Great Lakes Diversions and Consumptive Uses Study. (NCD Files)

Board of Control; the Lake Superior Board of Control; a Great Lakes Study Group Steering Committee; and, after 1965, the International Great Lakes Levels Board.[38]

The Division Engineer's chairmanship of the U.S. section of the International Great Lakes Levels Board evolved out of his other national and international responsibilities. In 1952, Congress directed the Corps' Great Lakes Division to study Great Lakes water levels. This action grew out of a general public concern about widespread damage to shore property during high lake levels in 1951 and 1952. The NCD had inherited this study and was approaching its end in 1964 when General Dodge assumed command of the division.[39]

In his first quarterly report to the Chief of Engineers, General Dodge noted that the low water level on the lakes was one of the most serious problems facing the division: "There have been many meetings of political leaders on both sides of the border to discuss the problem and a great clamor for something to be done." Fifteen years later, Dodge remembered the dilemma he faced. "When I first arrived [at the NCD,] the Great Lakes were at their lowest level in history and low levels in the Great Lakes means the harbors are not deep enough to take full draft ships." The navigation interest, he recalled, "would like you to hold as much water back as possible to keep the harbor levels up." On the other hand, "the hydro-power people want you to have as much flow as possible for generation of electricity." By 1964, no one appeared satisfied with lake-level regulation, and there was much pressure, Dodge later remembered, to see what could be done about it.[40]

In July 1964, General Dodge believed that as a result of the pressure to do something about controlling lake levels, the IJC would be directed to study the problem. "Undoubtedly," he told the

Chief of Engineers, "a major part of this effort will fall to NCD." Dodge was right on both counts. On October 7, 1964, the governments of Canada and the United States ordered the IJC to study the feasibility of further regulating the Great Lakes to reduce extreme high and low levels. To carry out the study, the IJC established an International Great Lakes Levels Board in December 1964. Dodge served as U.S. co-chairman of the board. The IJC's lake-level study superseded the existing congressionally directed study the NCD had been carrying out.[41]

Figure 48. Great Lakes–St. Lawrence River Shoreline subject to erosion. (NCD Files)

Lake levels on the Great Lakes resulted from the interaction of natural and artificial factors affecting the water supply and discharge to and from the system. Natural elements included precipitation, inflows from an upper lake and runoff from surrounding land, evaporation from the water surface, and outflows to the next lower lake. Other natural phenomena affecting water levels included ice in connecting channels, changes in barometric pressure, wind-induced waves, minor tides, and crustal movement. Artificial factors at work consisted of regulation of outflows of Lakes Superior and Ontario, diversion of water into and out of the basin, dredging in connecting channels, and consumptive use.

Lake levels on the Great Lakes fell into three categories: long-term, seasonal, and short-term. Long-term lake-level fluctuations stemmed from the relationship between storage volume of the lakes and outflow capacity of connecting and draining rivers. Connecting rivers had a small capacity compared to the large storage volumes of the lakes. Prolonged periods of abnormal precipitation, either low or high, caused water levels and flows to vary significantly above or below their long-term averages. Seasonal fluctuations of Great Lakes levels reflected the annual hydrologic cycle of rain, snow, and evaporation. Water levels rose in summer and dropped in winter. These seasonal changes were reflected in long-term average lake levels. Dramatic, short-term variations in water levels resulted from strong winds, sharp differences in barometric pressure, or ice jams on outlet channels. The whole system was a natural reservoir of remarkable efficiency and stability. Because of the Great Lakes' vast area and limited outflows, high water tended to remain in the lakes, escaping only slowly, while a low-water situation took time to build up

Figure 49. Great Lakes–St. Lawrence River Shoreline subject to flooding. (NCD Files)

to average. Normally, the Great Lakes system coped with huge water-supply variations while maintaining water-level fluctuations of one to two feet in any given year.

The study noted three general categories of interests affected by lake-level variations. One group consisted of property interests, including owners of public and private lands and developments along the shore, such as recreation areas, port and marina facilities, industry, municipal works, and fish and wildlife habitat. Shore interests generally desired lake regulation to reduce the range of lake-level variation, preferring neither very high nor very low water. Navigation interests comprised a second group, and high lake levels best served them. During the 1964 navigation season, when the levels of Lakes Michigan and Huron stood about one foot below low-water datum, available channel depths were correspondingly lower, and the cargo-carrying capacity of the Great Lakes fleet was materially reduced. In contrast, a third group, hydroelectric interests, suffered when lake-water flows were held back to benefit navigation. During the low lake levels of 1964, regulators reduced the flow in the Niagara River to about two-thirds of its long-term average; and power production suffered accordingly. Power interests preferred a fairly wide range of levels in order to have enough water storage to operate their turbines efficiently at different times of the year.

Over time, both the Americans and Canadians had attempted to regulate the Great Lakes' levels. The outflow from Lake Superior had been controlled since 1921, when the Corps and a Canadian power company constructed compensating works to use some of the outflow for power generation. Construction of navigation and power facilities on the St. Lawrence River in 1958 provided for moderate regulation of the range of stages on Lake Ontario without harming downstream interests. Up to the time of the 1964 study of Great Lakes water levels, except for on Lake Ontario, attempts to regulate levels and flows of the lakes had little effect in comparison to natural variations stemming from the supply of

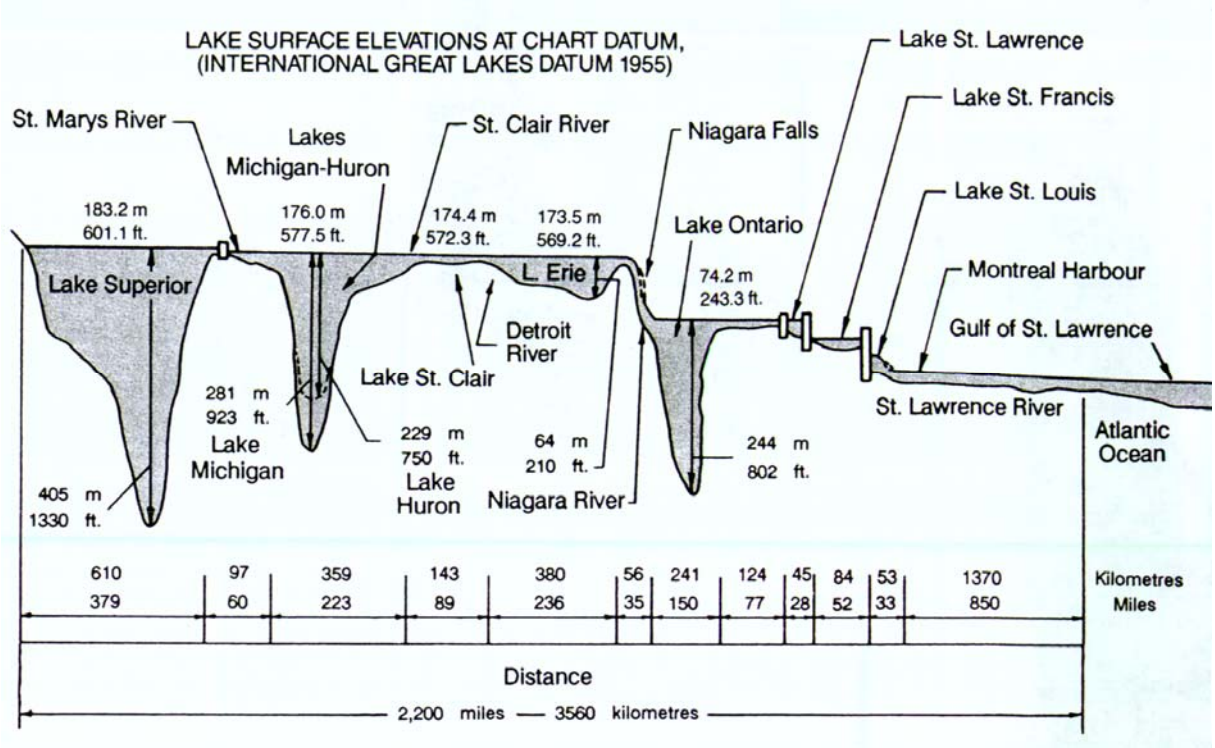


Figure 50. Profile of the Great Lakes–St. Lawrence River System, 1985. (NCD Files)

water received as rain and snow. The 1964 study sought to determine whether it was practicable to improve the regulation of the Great Lakes and their connecting waters for the widest public benefit.

The study, begun in 1964 and completed in 1973, looked at a range of options. Ironically, the project started just as the Great Lakes experienced historically low levels and reached completion while water levels attained historic highs. During the early stages of the study, General Cassidy urged General Dodge to keep the public informed about the lake-level work of the Corps. Cassidy told Dodge, "This is a good time to educate the public on the significance of high water levels and the economic and esthetic impacts of periodic lake fluctuations. The public should know of the continuing studies being conducted by the Corps and IJC to develop plans of action for use in meeting current and long range situations created by high and low water."[42]

The study findings, issued in December 1973, reported, "To the extent that the lakes already possess a high degree of natural regulation and are artificially regulated by means of the works at the outlets of Lake Superior and Lake Ontario, only small improvements are practicable without costly regulatory works and remedial measures." The study further indicated that minor modifications to the existing regulatory plan for Lake Superior could yield small long-term average annual net benefits at minimal cost, but major structural works were not considered cost effective. Indeed, the study concluded, "The most promising measures for minimizing future damages to shore property interests are strict land use zoning and structural setback requirements."[43]

The study also recommended slight adjustments to existing regulation of Lake Superior to take into consideration the levels of Lakes Superior, Michigan, and Huron. It also recommended further examination of alternatives for regulating Lake Erie and improving the regulation of Lake Ontario. In a follow-on report issued in 1976, the IJC lamented that the investigation of regulating Great Lakes water levels had taken so long and suggested that additional studies, especially concerning the environmental effects of regulation, seemed necessary. The IJC study that focused on regulation of Lake Erie was not completed until 1981. The Lake Erie study concluded that economic losses would far outweigh any benefits from Lake Erie regulation. The study recommended lakeshore management practices as a means of reducing flood and erosion damages along the Lake Erie shoreline and called for a public information program to educate the public about various natural and man-made factors affecting Great Lakes water levels.

In response to heavy shoreline damage caused by historically high water levels, combined with severe lake storms in 1973, the IJC ordered its two lake boards of control to deviate from established regulation plans to reduce damage to riparian areas. The record lake levels of 1973 revealed that the key to better regulation was timely storage or release of water supplies. Finally, because the ability to accomplish improved timing of regulation depended on better hydrologic forecasting, the IJC recommended that Canada and the United States cooperate in improving meteorological and hydrologic networks for the Great Lakes basin.

Out of concern for effects on lake levels of existing and potential diversions of water into, out of, or within the Great Lakes basin, the IJC established another study board in 1977 under the NCD Engineer's chairmanship. After lengthy examination of the issue, the study board issued a report in 1981 that concluded that diversions within the Great Lakes basin were not an economical or environmentally acceptable means of reducing extreme high or low lake levels. It recommended, however, that all diversions and consumptive uses be monitored periodically and their effects analyzed.

In response to century-high lake levels in the 1980s and resulting shoreline damage in the millions of dollars, the Canadian and U.S. governments directed the IJC in August 1986, "to examine and report upon methods of alleviating

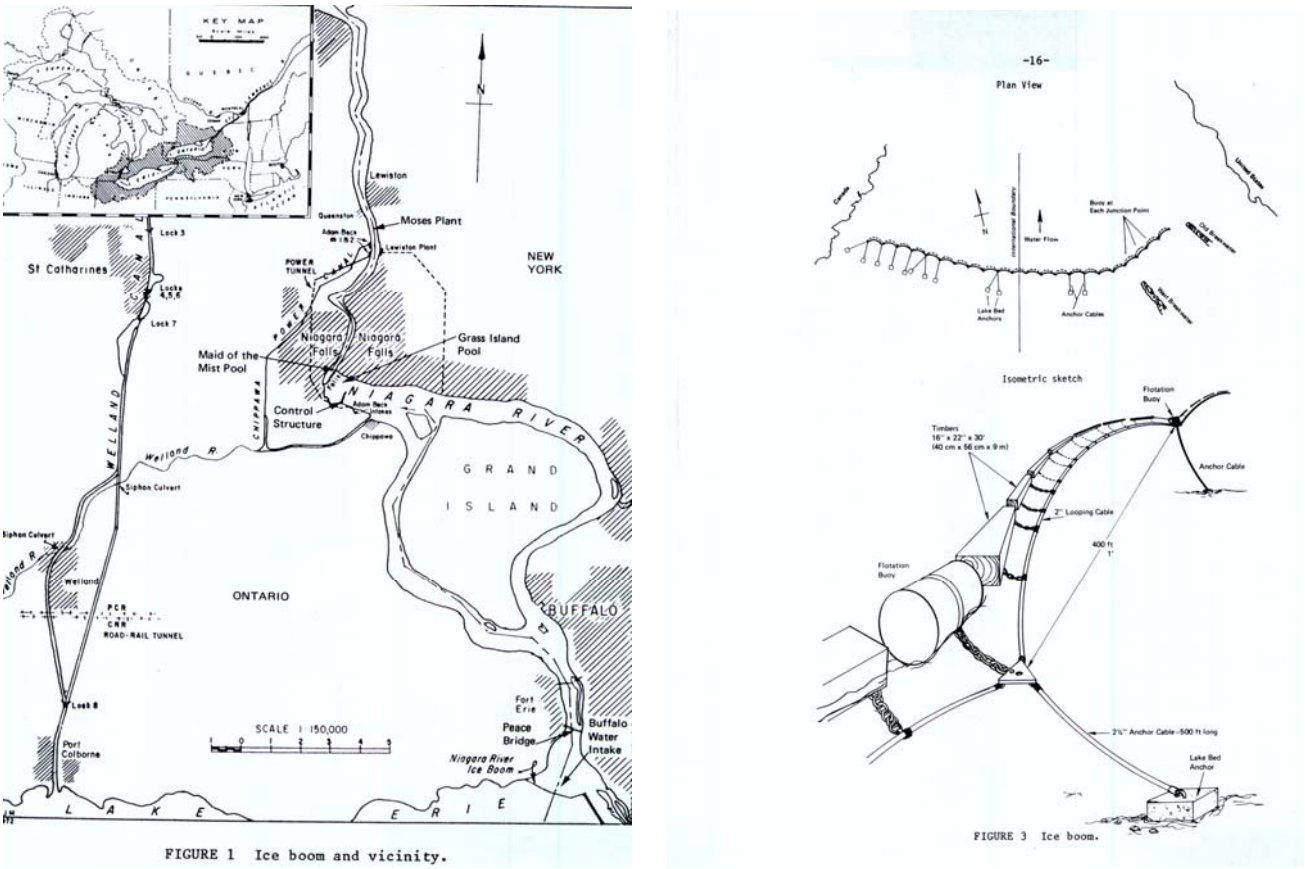


Figure 51. Ice boom (NCD Files)

the adverse consequences of fluctuating water levels in the Great Lakes–St. Lawrence River Basin." Resisting pressure to produce only short-term responses to the effects of high water levels on riparian landowners, the IJC realized that a more holistic, long-term strategy was necessary. The Commission decided that a successful approach to the problem of Great Lakes water management required a greatly expanded analysis of ecological concerns to avoid undesired side effects from recommended solutions.[44]

Above all, the IJC recognized that the public needed broad education about causes and consequences of water level fluctuations. Clearly, fluctuations affected different interests in different ways. For example, high levels sometimes eroded shoreline areas, while low levels hampered recreation and hydroelectric production. Finally, the IJC identified a need for comprehensive and coherent agreement on how benefits and costs of government actions should be distributed and shared. To achieve these goals, the IJC charged its project study team with developing a long-term approach, which recognized that "given the unknown fluctuations in the natural system, the multiple jurisdictions, the diverse stakeholders' interests, the process of accommodation is diverse and complex."[45]

Phase 1 of the study focused on developing a set of principles to guide future decision making; a strategy for effective government action; and a method for evaluating measures for specific, local solutions in a broad and systemic context. Acutely aware that previous reports on regulating Great Lakes levels had not had much influence, study participants were determined that their work would "be more than an updated version of earlier studies." Indeed, the authors of the report to the IJC argued "that the primary contribution of this first phase of the study has been to redefine the basic questions and tasks which need to be addressed if our two nations are to find workable ways of managing the issues associated with

fluctuating water levels and flows in the system."[46]

To perform the analysis of existing physical, economic, and environmental situations; identify critical issues; develop and evaluate possible solutions; and formulate recommendations for future actions, the IJC established a project management team with five subordinate study groups. The commission also appointed an executive director, Kenneth Murdock of the NCD, to administer the complicated binational study process. All study groups had co-chairs, one of which was usually a division chief from the NCD. Division Engineer Brigadier General Theodore Vander Els served as co-chair of the Project Management Team, which answered to the IJC. In order to meet the report deadline of May 1989, the Project Management Team decided to phase the undertaking, with phase 1 to be completed by the initial deadline and phase 2 scheduled for delivery in 1991. Phase 1 contained a characterization of the problem, an inventory of measures, and the development of an evaluation framework. Phase 2 refined the databases and provided an evaluation of selected measures dealing with lake-level fluctuations. Broad public participation was a key element of both phases of the study.

The ecosystem approach of the study, which took into account the full range of components making up both natural and human interactions in the Great Lakes basin, produced several recommendations for organizing a long-term decision-making and implementation process. The study quickly rejected as politically, economically, and environmentally unacceptable any attempt at full regulation of the Great Lakes water regime through engineering or structural solutions alone. Rather, the study report stressed that combinations of measures of all types would need to be pursued. Above all, the study recommended against undertaking any major public works without full consideration of possible environmental consequences. It also urged an educational effort to better inform the general public and special interests about both natural processes and impacts of human intervention in the Great Lakes basin. The study also faulted the federal governments of Canada and the United States for not better articulating Great Lakes water policies and goals. It was left for phase 2 to evaluate the list of recommended measures developed in phase 1.

Phase 2 of the study of the Great Lakes' fluctuating water levels resulted in several follow-on and in-depth investigations that involved NCD personnel. These efforts culminated in a March 1993 report by the Levels Reference Study Board, co-chaired by NCD Engineer Brigadier General Jude W. P. Patin and E. Tony Wagner of Environment Canada. This major report, which cost $6 million, focused on listing forty-two practical actions that governments could take to deal with the adverse consequence of fluctuating water levels. The report also recommended a set of guiding principles for future decisions to enhance coordinating system-wide water management. Finally, the study board recommended several emergency preparedness actions for immediate adoption and put forward several long-term comprehensive land-use and shoreline management measures. After six years of intense study, the report authors felt they had distilled "the best available knowledge about many aspects of the Great Lakes–St. Lawrence River Basin, and [produced] a set of recommendations that reflects the collective wisdom of the study team and the interested public." In addition, the study board stated, "The recommendations not only outline practical actions for the near- and long-term, they show Governments how to ensure continued success in their application by improving the mechanisms for implementation."[47]

The value of the Levels Reference Study was its comprehensiveness. Since 1964, the IJC had conducted four major studies of changing water levels in the Great Lakes. While previous studies had concentrated upon ways to regulate water levels and flows, this study examined a range of potential solutions to water level problems. These included land-based measures, lake-regulating actions, and changes in government policies. The study also employed a system-wide, holistic

context to look at human and environmental perspectives on possible solutions.

Based on the work of phases 1 and 2 study efforts, the IJC issued its final recommendations to the Canadian and U.S. governments in December 1993. The IJC recommendations closely followed those issued by its previous study boards. It did not propose building additional dams and control works to regulate levels and flows. Instead, it urged governments to promote comprehensive and coordinated land-use and shoreline management measures to reduce flooding and erosion losses. The IJC also suggested improved data gathering and analysis of flood and erosion damages and of environmental factors affecting water supplies. Other key recommendations emphasized improved forecasting abilities and emergency preparedness plans and sought long-term monitoring and evaluation of the effects of water level fluctuations on wetlands. Brigadier General Russell L. Fuhrman, NCD Engineer at the time the IJC was assembling its final recommendations, confidently predicted that they would bring needed changes to water management on the Great Lakes, but that such adjustments would take place over a long time: "There will be changes [as a result of the IJC studies], all of them good. But it's a very, very deliberate process just to make sure that we're not caving in to what may be the whim of the moment but do what makes sense in the long term."[48]

By the early 1990s, numerous Corps' studies dealing with the problem of lake-level fluctuations clearly indicated the limits of what the Corps or other federal and Canadian agencies could do about the situation. In fact, a broad assessment of environmental conditions of the Great Lakes published in 1990 for the Conservation Foundation of Washington, D.C., succinctly summed up the matter: "Many of those affected by varying lake levels have blamed 'nature' for their problems and want to see more human control. Yet human ability to manage lake levels is limited. . . . It has been the lack of recognition and unwillingness to adapt to natural conditions on the part of human society that has caused the problem, not 'nature.'" Specific measures to affect system-wide water-level fluctuations on the Great Lakes appeared futile.[49]

Dealing with issues surrounding lake-level fluctuations and other Great Lakes matters involving the IJC consumed an inordinate amount of the NCD Engineer's time. For example, General Moore noted to the Chief of Engineers in May 1976 that his work on the IJC boards had increased significantly: "This involves answering complaints, providing technical information and participating in workshops, public meetings, congressional hearings and news media appearances." NCD Engineer Brigadier General Scott B. Smith reported in a speech to the IJC that for FY1981 the division spent $2 million and twenty-four man-years in support of various IJC activities. Scott added, "I believe that the Corps is the best agency to provide support to the IJC in water resources matters." General Fuhrman, NCD Engineer in the early 1990s, found working with the IJC boards a challenging process because it was "a very, very bureaucratic operation, and in order to achieve something on the Board, you have to have 100 percent consensus." Fuhrman was proud of the fact that during his tenure as the NCD Engineer and as a member of several IJC boards, "we have been able to reach consensus on every issue."[50]

Navigation Season Extension

In addition to concerns about lake levels and dredged disposal, General Dodge also had to respond to shipping and port interests' pressing desire to extend the navigation season on the Great Lakes. Dodge reported to the Chief of Engineers in October 1964 that he would attend a one-day conference in Cleveland called by the Council of Lake Erie Ports "to discuss the possibility, practicability, and commercial advantage of lengthening the navigation season on the lower Great Lakes and the St. Lawrence Seaway." Great Lakes shipping interests also pushed their agenda in Congress, and in 1965, it responded by authorizing a study to determine the preliminary engineering and economic feasibility of extending the navigation season.[51]

Based on the Corps' favorable assessment of the technical feasibility of extending the navigation season, in 1970, Congress authorized a second, more in-depth assessment of winter navigation on the Great Lakes (the Winter Navigation Program). First, the study should determine the economic justification, engineering practicability, and environmental and social impacts of an extended season, as well as the extent of federal participation in any recommended plan of improvement. Secondly, the Corps was directed to conduct a three-year demonstration program to establish the practicability of extending the season. Finally, Congress ordered the Maritime Administration to identify the means to provide reasonable insurance rates for shippers and vessels engaged in waterborne commerce in extended season operations.

A number of other federal agencies cooperated with the Corps on the study, such as the Federal Power Commission, Great Lakes Basin Commission, Great Lakes Commission, and the Atomic Energy Commission. The IJC acted in an observer status. Winter navigation affected two types of traffic: inter–Great Lakes traffic and Great Lakes–to–ocean traffic. To accomplish the study of these elements of winter navigation, planners established seven working groups under a Winter Navigation Board, a multiagency organization made up of senior officials of the federal and nonfederal agencies involved. The NCD Engineer served as chairman of the board, and the Detroit District had responsibility for key elements of the demonstration program. Although Congress stipulated that the results of the winter navigation program study be reported no later than July 1974, the success of the initial work led Congress to extend the study until December 1976.

Ice was the major obstacle to winter navigation, and work groups focused on different aspects of the problem. While icebreakers could open passages for vessels, methods to control the floating ice had to be developed. For example, in the St. Lawrence Seaway, the chief problem centered on ice-control techniques to prevent ice jams, assure uninterrupted river flow for hydroelectric power production, and avoid flooding. Another problem involved the need to develop a winter navigation system, since the buoys normally used for navigation had to be removed prior to ice formation to prevent their being damaged or dragged off-station and rendered useless for navigation. The study also had to develop ways of forecasting ice conditions, design structures to withstand ice, consider human factors such as crew safety and survival equipment for vessel crews, and evaluate potential environmental impact of these activities.

Over the course of the demonstration program, various work groups found workable solutions to most issues studied. They tested new or improved methods for facilitating year-round commercial shipping and showed that the concept of navigation season extension was economically justified. In the process, the work groups came up with some novel solutions to unique winter navigation problems. One situation receiving special attention involved ships navigating through locks and passages blocked by ice booms, used to assure winter hydroelectric production. To overcome the difficulty ice buildup caused in gate recesses and on lock walls, the engineers successfully installed bubbler systems that reduced ice formation. They also designed an experimental gate for installation in ice booms both to accommodate navigation and to retain the boom's desirable features.

Bubbler systems proved valuable in a number of ice situations. These devices were based on the natural phenomenon that lake and river water was warmer at the bottom in winter than it was at the surface. When air bubbles were released from the bottom, they tended to bring warmer water upward, thus reducing or eliminating ice over a specified area. Air bubblers, which pass compressed air through nozzled tubing on the bottom, proved successful at Duluth harbor and in the Lime Island section of the St. Marys River. A bubbler system and other measures also helped alleviate another difficult problem in St. Marys River caused by extending the navigation season.

Under normal winter conditions, ice bridges form and break up naturally, permitting transportation across them to and from inhabited islands in the St. Marys River. Residents of these islands depended on the ice bridges for access to the mainland. When ice bridges were broken to support conventional navigation, transportation by that link became unavailable. Ice floe buildup on ferry slips eliminated that route as well. The practical solutions to the problem of drift ice disrupting island-to-shore transportation included using an air boat; employing a Coast Guard ice-breaker; installing a bubbler system to reduce ice buildup on ferry slips; and installing an engine-driven propeller on a barge moored upstream of the ferry slip to circulate water into the slip, which flushed out ice and prevented drift ice from entering.

The three-year demonstration program indicated that extending the navigation season would have little effect on the environment. The operation of the Lime Island bubbler system had no adverse effect, and in fact, the addition of oxygen was considered a beneficial effect. On the other hand, ice breaking and navigation interfered with the St. Marys River transportation system. The study found seventeen improvements or additions to existing methods that, if intensively operated, would achieve extended season navigation, whether to January 31, February 28, or year-round. Based on these findings, Congress authorized further studies to establish a recommended plan for a federally supported navigation season extension program.

To assure that the recommended program would be acceptable to a broad spectrum of public interests, study managers held a series of public meetings to gauge opinion on extending winter navigation on the Great Lakes. Views expressed at these public meetings fell into several categories. Initially, those opposed to navigation season extension based their position on general environmental or seamen safety concerns, the fear of structural damage to docks or pilings, or on anticipated ice problems in the operation of hydroelectric facilities. Most interested groups agreed to go along with the program if their particular concerns were addressed. The Corps showed great awareness of the potential environmental problems in extending the navigation season.

As General Moore noted in a speech to an industry association in Chicago, the Corps understood that "one vital aspect of consideration of approval of a winter navigation extension program throughout the St. Lawrence Seaway area is the consideration of environmental quality. . . . We propose to address [this] to the fullest possible extent. Not only have we looked at the environmental concerns of fish and wildlife but also at the human element, addressing the impact upon people and their way of life on the Great Lakes and in the area of the St. Lawrence Seaway." Based on the early success of the demonstration program, Congress continued it throughout the remainder of the decade. The program focused in particular on ice control and management devices and on testing the effectiveness and environmental impacts of all of the various measures under consideration.[52]

In 1979, NCD Engineer Major General Richard L. Harris recommended that Congress approve a federal program for year-round navigation on the upper Great Lakes and up to ten-month navigation on Lake Ontario and the St. Lawrence River. Further extension of the program would require the cooperation of Canada, so Harris recommended that a joint U.S.-Canadian board be established to work out necessary agreements. The recommended plan would have required a federal investment of $442 million (1979 dollars) with average annual benefits of $205 million and average annual costs of $52 million over a fifty-year period. The plan would result in a favorable 4-to-1 benefit-to-cost ratio. Congress failed to act on the recommendation at that time, but the Corps continued various environmental studies during the 1980s related to winter navigation. The new studies, carried out by the Detroit District under the Corps' existing operational programs, focused on the effects of extended season navigation on fish and wildlife. When the Corps issued the final Record of Decision on the environmental studies in 1990, it

concluded that there were no significant environmental impacts on connecting channels or from the Soo Lock's operation if shipping continued through February 15.

The Michigan Department of Natural Resources, however, remained unconvinced by the Corps' studies and opposed extending the navigation season. The full implementation of the extended season navigation program continued as a controversial issue. In 1993, the Corps gained approval from the Michigan Department of Natural Resources for a navigation closing date of January 15 and an opening date of March 25 by committing to a three- to five-year study on lake herring and whitefish spawning and on emergent wetlands in the St. Marys River. If the study found significant environmental impacts, the Corps promised to take appropriate action to minimize or mitigate adverse effects. The last action of the NCD command on navigation season extension occurred in September 1994, when the Division Engineer signed a Record of Decision setting the annual opening date at March 25.

Addressing Great Lakes navigation requirements from the 1960s to the 1990s required the NCD to adapt constantly to new challenges. Traditional dredging to maintain harbors and connecting channels encountered urgent environmental concerns over lake pollution stemming from disposal of dredged material. Changing lake levels from naturally fluctuating water supply caused harmful shoreline erosion to property owners and adversely affected navigation interests and hydropower production. Attempts to extend the navigation season through the winter months led to intensive study of the negative effects of such navigation on ice formation and breakup. To further complicate matters, the NCD had to deal with these issues in the context of heightened public environmental concerns. In meeting these challenges, the NCD developed new planning and study tools, learned to accommodate diverse constituencies, and adapted to working within regional and international commissions.

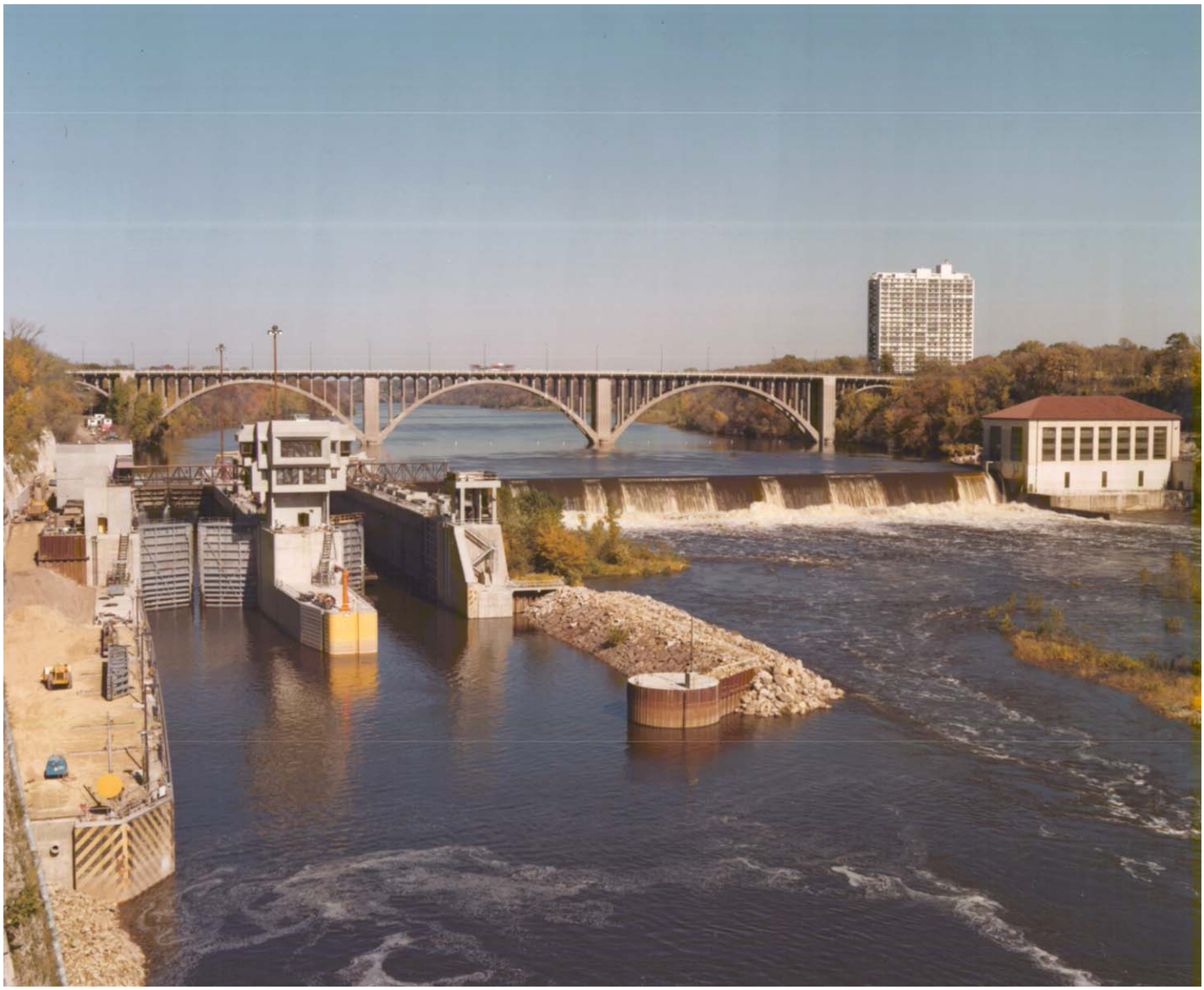


Figure 52. Locks and Dam No. 1 on the Upper Mississippi River. (St. Paul District)

CHAPTER IV
Upper Mississippi River Projects, 1960–1997

During the 1960s and 1970s, the Corps' traditional water resources activities involving construction and operation and maintenance of navigation, flood control, and hydropower structures became more complex as a result of new concerns over the environmental impacts of such undertakings. The advent of National Environmental Policy Act (NEPA) and its requirements for environmental impact statements (EIS), implementation of the Federal Water Pollution Control and Clean Water acts, and greater public input in water resources decision making all contributed to a new context for Corps projects. The Corps struggled to adjust to this new playing field in water resources development. Nowhere was this struggle more evident than in the controversies generated by heightened environmental scrutiny of the Corps' Upper Mississippi River mission to provide navigation and flood control.

Compounding the environmental problems the Corps faced on the Upper Mississippi River—and on the Great Lakes as well—was the fact that the NCD suffered from weak leadership in the late 1960s. In an interview conducted in 1985, Lieutenant General Ernest Graves reflected that when he assumed command in 1970, he quickly found that the "Division didn't have a sense of direction[,] . . . [it] was wandering. They were studying the daylights out of things, but they were never reaching a conclusion." At the conclusion of a command inspection conducted shortly after Graves assumed command of the NCD, Major General Frank Koisch, director of civil works, confirmed Graves's assessment, bluntly telling him "that it was the worst division in the Corps of Engineers."[1]

General Graves approached this management crisis by replacing the top civilian leadership at the division and making district engineers more accountable for results. He focused great effort on improving study processes and shortening the time it took to complete reports. Given funding and staffing levels, "Our goal," he later noted, "was to have no more than six studies per district. There had been two to three times that number in some cases." Since the NCD had five districts, the division had to oversee thirty active studies at any given time. Graves felt "that was more than enough in terms of our involvement from the division level. . . . It got to the point that I really did not know what the 30 studies were that we were supposed to be pushing. I could call the district engineers to account." Graves's management reforms proved essential to accomplishing the equally challenging goal of integrating new environmental requirements into the Corps' traditional project planning process. The specific problems the Corps had to deal with on the Upper Mississippi River stemmed from its navigation mission.[2]

Navigation on the Upper Mississippi River

Since 1930, the focus of Corps efforts on the Upper Mississippi had been the completion and maintenance of the nine-foot channel navigation project. The project had also included establishing a nine-foot channel on the Illinois River. By 1940, the Corps completed the nine-foot channel project on the Upper Mississippi between Minneapolis, Minnesota, and Alton, Illinois, by constructing twenty-six locks and dams. The Corps subsequently added three more locks and dams between 1940 and 1964.[3]

Beyond operating and maintaining locks and dams, the Corps carried out annual dredging to maintain the nine-foot channel on the 556.5 miles of the Upper Mississippi River. Of that distance, the upper 242.5 miles were in the St. Paul District, while the Rock Island District had responsibility for the remainder. In addition to maintaining the nine-foot channel on the river's main stem, the Corps also sustained that depth on the lower 14.7 miles of the Minnesota River, the lower 25.5 miles of the St. Croix River, and 1.4 miles on the lower Black River.

Figure 53. U.S. Army Corps of Engineers dredge *William A. Thompson* at work on the Upper Mississippi River. (St. Paul District)

The Corps found that it had to dredge to a depth of thirteen feet in channel areas subject to shoaling in order to assure safe passage of vessels drawing nine feet of water. Although navigation needed only eleven feet of depth, the Corps normally dredged two additional feet as an economy measure, since increased depth allowed a longer time lapse before the operation needed repeating. Usually, engineers maintained channels to a width of 300 feet, but widened river bends to as much as 550 feet to allow room for maneuvering large barge tows. Each year in the spring, as high water began to recede, crews made channel soundings to determine areas requiring detailed surveys to provide the data that established each season's dredging requirements.

The Corps performed its dredging either with a self-propelled hydraulic dredge, the *William A. Thompson*, or with derrick boat 767, later named the *Hauser*. The *Thompson* began operating on the Upper Mississippi River in 1938. During the 1960s and 1970s, the dredge removed 3 million cubic yards annually. The *Hauser*, which began service in 1941, typically dredged 250,000 cubic yards per season.

The nine-foot channel's benefits to commercial navigation quickly became evident. Between 1940 and 1962, river freight moving from Guttenberg, Iowa, and Minneapolis, Minnesota, increased from 1 million tons to over 8 million tons. By 1970, for example, nearly 15.5 million tons were shipped over this stretch of river annually. The growth in tonnage largely stemmed from increases in down-bound shipments of grain and up-bound shipments of coal.

Flood Control on the Upper Mississippi River

In addition to maintaining the nine-foot channel navigation project, the Corps also focused its Upper Mississippi River efforts on flood control. On occasion during the late nineteenth century, Congress had directed a reluctant Corps to rebuild privately constructed levees that were eroding and in danger of failing. Congress justified this levee work on the basis that it helped improve navigation. Based on this rationale, the Corps completed the fifty-mile-long Warsaw to Quincy, Illinois, levee in 1896, and the thirty-five-mile-long Flint Creek, Iowa, levee in 1900, but Army engineers objected that protecting or building levees compromised navigation works on the river. They pointed out that levees designed for high-water flows scoured and placed river sediment differently than channel constriction works designed for low flows.[4]

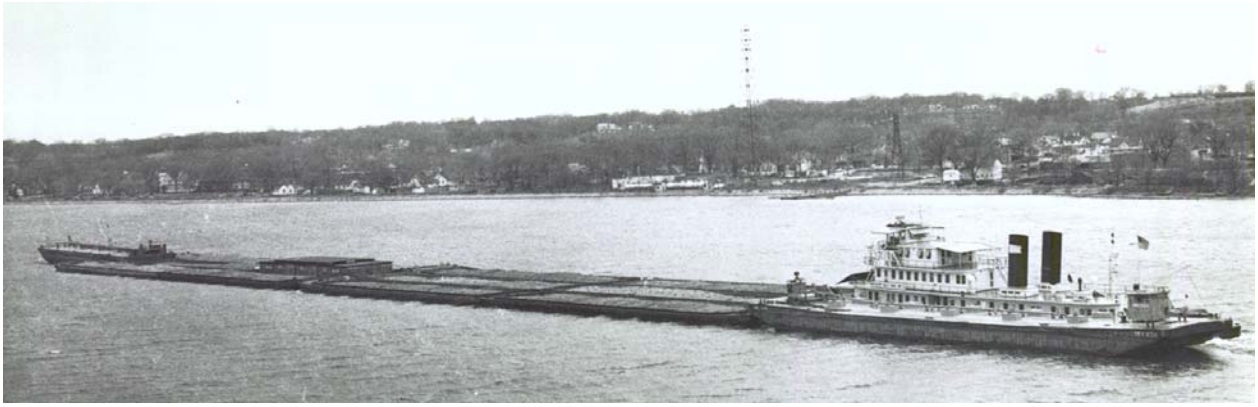


Figure 54. Towboat *Ernest T. Weir*, November 1953. Down bound in Pool No. 15 with fourteen barges and 15,000 tons of grain. (Rock Island District)

In the early twentieth century, local interests continued to build levees and claim more of the river's floodplain. Congress, responding to agricultural interests along the Mississippi River, passed the Flood Control Act of 1917, allowing the Corps to work on levees from Louisiana to Rock Island, Illinois. As historian John Anfinson has noted,

> This act, more so than the 1936 Flood Control Act, marks the formal beginning of the Corps involvement in flood control on the upper and middle Mississippi. Through this act, the federal government assumed an official role in securing the Mississippi's floodplains for agriculture and gave the Corps a new mission for managing the middle and upper Mississippi River.

In 1928, Congress added to the Corps' flood control workload, ordering the Corps to fortify eleven levees, enclosing over 260,000 acres of floodplain.[5]

In 1936, Congress passed the first national flood control legislation. In this law and the subsequent Flood Control Act of 1938, Congress greatly broadened the Corps' role in flood control on the Mississippi River. For the Upper Mississippi, the acts focused Corps energies on raising and enlarging existing agricultural levees. Under these flood control acts, the Corps fortified most of the levee systems in Missouri and Illinois belonging to the Mississippi River and its tributaries. The flood control acts of the 1930s also authorized four flood control reservoirs for the upper main stem's tributaries. These structures were located in Iowa, Illinois, and Minnesota. Combined with the Corps' navigation mission, its flood control responsibilities extended and deepened the agency's management role on the Mississippi River. This role focused on structural solutions to flooding and navigation concerns; neither Congress nor the Corps showed much interest in nonstructural alternatives to floodplain management for reducing flood damage.[6]

Figure 55. Flooding at Joliet, Illinois, 1902. (NCD Files)

After World War II, Congress again authorized the Corps to build or reinforce flood protection structures on the Upper Mississippi River, although much of this new work was directed at urban centers rather than agricultural lands. By 1960, the Corps had constructed most of the levee projects protecting agricultural land, and flood control works for urban centers were just getting underway. Only after 1960 would Americans begin to question their continued expansion onto floodplains and almost total reliance on structural solutions to flood damage. Heightened awareness of the environmental effects of relying on the structural approach, along with severe floods that occurred between 1965 and 1993, shook America's confidence in and reliance on flood control structures. However, one hundred years of steady expansion onto Mississippi Valley floodplains proved difficult to overcome.

Although a section of the Flood Control Act of 1938 allowed the use of nonstructural approaches, such as abandoning floodplains, Congress and the Corps continued to focus on structural flood control. Most state governments, moreover, opposed floodplain restrictions, such as zoning and land acquisitions, as too costly to bear without federal assistance. Finally, in the late 1950s, the Corps recognized that structures alone would not solve the flood damage problem and began to consider seriously the benefits of floodplain regulation. In the Flood Control Act of 1960, Congress granted the Corps' request to assemble and disseminate data on floods and flood damages to state and local governments. In the late 1960s and early 1970s, the federal government took further steps to encourage consideration of floodplain restrictions and nonstructural flood control. Still, structural measures remained the favored approach through the 1980s.

Periodic severe floods on the Upper Mississippi River between 1965 and 1993 called into question the unthinking commitment to purely structural remedies for the damages suffered. Floods on the Upper Mississippi resulted from a combination of ground saturated by autumn rains, deep frost, heavy snow cover, and rapid melting, accompanied by spring rains. These factors together, for example, caused the record Upper Mississippi River flood of 1965, which caused damages of $120 million and inundated 3 million acres of farmland and over 170 communities. The flood displaced more than 100,000 people, and sixteen lost their lives. As bad as the flood damages were, they would have been worse had it not been for the Corps' existing flood control projects. They prevented an estimated $300 million in losses, while the Corps' emergency flood protection work prevented an additional $35 million in damages.[7]

To many observers at the time, the 1965 flood demonstrated the value of flood protection and increased the demand in many communities along the Mississippi River for additional Corps flood-control measures. North Central Division Engineer Brigadier General Roy T. Dodge wrote Chief of Engineers Lieutenant General William F. Cassidy in July 1965, "As might be expected[,] the floods have aroused new interest in studies and dormant projects." Dodge added that "because of the amount by which the 1965 flood exceeded previous floods, we are reevaluating the degree of protection afforded . . . and considering necessary modifications[, and we] have concluded that projects under construction in South St. Paul and Winona, Minnesota, should be modified."[8]

As a result of the 1965 flood experience, both the St. Paul and Rock Island districts recommended congressional funding to improve existing levees and to speed completion of flood-control reservoirs previously authorized for tributaries of the Upper Mississippi River. This included levee projects along the Mississippi River in Minnesota, Iowa, and Illinois, and reservoirs on tributaries in Wisconsin and Iowa. Congress funded most of these requests, and the Corps finished the projects by 1970.

In 1969, communities and farms along the Upper Mississippi River once again experienced damaging floods. In September and October 1968, heavy precipitation thoroughly saturated soils

throughout the Upper Mississippi River basin. Record or near-record snowfall followed. In January, the Corps conducted surveys to determine the snow's water content. From these surveys, it became apparent that serious flooding was a strong possibility. Corps hydrologists observed that not only was the water content of the snow pack extremely high but natural ponding areas also were full and winter streams were flowing at 2.5 times their normal volume. Division Engineer Brigadier General Robert M. Tarbox wrote the Chief of Engineers in February about elevated public concern over the flooding on the Upper Mississippi River. He reported that he had directed emergency operations centers to activate in the St. Paul and Rock Island districts.[9]

Figure 56. Operation Foresight flood emergency levee built at Rock Island, Illinois, in advance of 1969 spring flood on Mississippi River. There was not enough room on the river side of the building for the emergency levee, so it was built right through the middle of the building in background. (NCD Files)

The NCD actively oversaw district flood-fighting operations in the field. The division authorized aggressive use of Corps authority for flood emergency preparation and flood fighting under Public Law 99, which authorized the Corps to supplement individual and local community flood-fighting efforts. The law, however, limited Corps assistance to temporary, protective, and preventive measures designed to meet an imminent flood threat. Before the Corps could assist, it also had to have local assurance that all lands, easements, and rights-of-way would be provided and that the local entity would hold and save the United States free from damage claims resulting from the emergency work. Finally, local authorities had to agree to maintain the work after its completion.

Following coordination with local and state authorities, Corps districts quickly initiated flood-fighting efforts. Within ten days, fifty contracts had been awarded to assist thirty communities in the construction of over 150 miles of emergency levees. The Corps also issued 237 rental contracts for 3,500 pieces of equipment. In addition, the districts furnished over 9 million sandbags and other supplies worth $760,000. At the height of the flood fight, the division fielded 32 Army officers and 230 of its civilian employees. When the floods finally crested, they proved the second highest on record in the Upper Mississippi River basin. The Corps estimated that the $8 million spent in emergency measures prevented more than $150 million in damages.[10]

According to General Tarbox, the key to the operation's success was deployment of district employees to area offices in the field. Engineers assigned to these offices worked from twelve to twenty hours a day, seven days a week, rendering technical assistance, negotiating contracts, and supervising the flood-fight work. In May, when Tarbox briefed the Chief of Engineers on the emergency flood fight, he noted that "the time elapsed between start of study and start of construction was a matter of days, instead of the ten years normally required." The flood fight, Tarbox asserted, demonstrated what the Corps could do

when its manpower and facilities were mobilized for an emergency and when the normal restraints to direct action were relaxed.[11]

During the 1970s, the new emphasis on environmental concerns greatly influenced the NCD's approach to flood control on the Upper Mississippi basin. In August 1970, the Corps issued new regulations mandating that all flood damage-reduction alternatives should be considered without prejudice. If appropriate, all nonstructural project plans should be included in planning recommendations. Next, Section 73 of the Water Resources Act of 1974 mandated federal agency consideration of nonstructural alternatives when reviewing any project involving flood protection. By 1975, the Corps was looking seriously at nontraditional ways to achieve flood damage reduction. Chief of Engineers Lieutenant General William G. Gribble wrote to NCD Engineer General Walter O. Bachus that "structural solutions are acceptable only after non-structural solutions have been fully explored and found unacceptable." The NCD's experience with a controversial dam on the Kickapoo River near LaFarge, Wisconsin, reinforced a willingness to look at nonstructural solutions to flood problems.[12]

After a Corps' study of flood problems in the Kickapoo River valley, Congress authorized the Corps in 1962 to build a flood-control dam that would also provide recreation opportunities. Just as the Corps began construction in the early 1970s, environmentalists began to question the dam's effects on water quality and on wild and scenic values. To make matters worse, the Corps experienced serious cost overruns on the project and faced assertions that it had overstated the recreational benefits of the dam. In response to broad criticism from Wisconsin state officials and environmental groups, the Corps stopped all work on the project in April 1975. At that time, the project was approximately 36 percent complete, with $14.8 million expended on construction and land acquisition. General Bachus admitted to the Chief of Engineers, "If I had to do it from scratch, I believe I'd look pretty hard at this project. It has taught me a lot about 'reading between the lines' on EIS evaluations. We must learn to listen better." In 1976, Congress refused to fund further construction on the LaFarge Dam, and the Corps later recommended deauthorization of the project.[13]

Figure 57. Lake LaFarge. (St. Paul District)

While the Corps struggled with the environmental concerns of the LaFarge Lake flood-control project, it turned to nonstructural alternatives to solve flood-damage problems at Prairie du Chien, Wisconsin. Given the unavoidable adverse environmental impact of dams, levees, and channel improvements, it was not surprising the Corps took a new interest in nonstructural flood control alternatives. By 1975, the NCD routinely urged districts to identify nonstructural alternatives in their project planning. In doing so, the division was following the lead of Chief of Engineers Lieutenant General

John W. Morris. Testifying before congressional committees in the spring of 1977, Morris emphasized, "We now look at nonstructural options as the most desirable solution to flood problems since they are usually least disruptive to the natural environment." President Jimmy Carter went even further in April 1977, stating that "alternatives, especially nonstructural or small-scale solutions to specific problems, such as floods, should always be investigated as substitutes for expensive and damaging projects which often do not provide effective solutions anyway."[14]

The Prairie du Chien project emerged in Corps planning when traditional structural alternatives proved unfeasible. In 1971, the St. Paul District submitted a report proposing nonstructural solutions, including evacuation of 128 residences and 2 businesses and flood-proofing for structures located on the floodplain fringe. Displaced residents would be relocated outside the floodplain. Cost sharing for the $2.3 million project required a 20 percent nonfederal contribution; the federal government covered the remainder of project costs. Congress authorized the project in 1974, and the Corps worked closely with local officials to win the support of floodplain residents for relocation.[15]

To gain public acceptance for the relocation plan, the Corps and local officials created a citizens' advisory committee. Division Engineer Brigadier General Robert L. Moore became personally involved in the process. He wrote the Chief of Engineers in May 1976, "The advice of the CAC [citizens' advisory committee] has been particularly helpful in reexamining . . . the criteria . . . for determining the eligibility of residential structures for flood-proofing and those areas in the floodplain which should be subject to mandatory evacuation. This and similar issues are being resolved jointly through combining our technical expertise with the local knowledge of the citizens of Prairie du Chien."[16]

The St. Paul District finally completed the Prairie du Chien project in 1983. Senator William Proxmire (D–WI) summed up the feelings of many concerning the planning process:

> I am delighted that the Corps of Engineers and the City of Prairie du Chien have worked closely together to develop a nonstructural alternative to the impoundment of a free-flowing river to prevent future flood losses. Because of its innovative approach, this project is one of the relatively few Federal flood control programs that has drawn absolutely no opposition from environmental groups.

In Washington, the Chief of Engineers concurred about the positive results of the Prairie du Chien planning process: "Your experience," he wrote General Moore at the NCD, "should give us some knowledge that will be of value nation-wide in implementing similar projects."[17]

The biggest flood that the NCD had to deal with occurred in 1993, an unusual hydrometeorological event that was distinctive from all other recorded floods in terms of its size, severity, damage, and season in which it occurred. Devastating the Midwest, the flooding of the Mississippi and Missouri rivers resulted in forty-seven deaths, made 74,000 people homeless, and caused between $15 and $20 billion in damage. Navigation on the Mississippi ceased for fifty-two days and 20 million acres of farmland were inundated for weeks during the growing season.[18]

Typically, floods in the upper Midwest take place in the spring, but this one extended throughout the summer in both the Mississippi and Missouri river basins. Unusual meteorological conditions in the Upper Mississippi River valley during summer 1993 produced four times the normal amount of rainfall. Ground already soaked by heavy winter snow and abnormally heavy spring rain was unable to absorb additional moisture. The flood was unique in its geographic extent as well as in its duration. It affected a large portion of the upper Midwest, and was the greatest flood ever observed in some locations. Large sections of five Corps districts were

affected. The major impact stemmed from floodwaters eroding banks and channels along the Mississippi River, causing many levees to fail.

While the media reported on the obvious—levees overtopped and rampaging floodwaters—little coverage showed flood-control projects preventing damage. In fact, a post-flood study by the NCD reported that all structures designed for an event of the magnitude of the 1993 flood performed well, preventing an additional $19 billion in damages. Reservoirs accounted for $11 billion in damage prevention, while levees provided for $8 billion in losses avoided. Most nonurban levees on the Upper Mississippi and Missouri rivers were nonfederal, agricultural levees, and those overtopped because they had not been designed to offer protection for a flood event of the magnitude of the one occurring in 1993.

The unusual nature of the extreme summer rainfall of 1993 prevented the Corps from conducting extensive emergency advance measures to deal with the flood. Instead, Corps districts, under Public Law 84–99, provided emergency flood and post-flood response activities to save lives and protect improved property. Each Corps district activated its emergency operations centers under the ultimate supervision of the NCD emergency operations chief and sent engineers to provide technical assistance in defending levees, conducting sandbagging operations, and monitoring flood-protection works. The Corps also supplied 430 badly needed water pumps and hundreds of thousands of gallons of potable water to communities throughout the flood-stricken area. In addition, the NCD used about 10 million sandbags and issued 2 million square feet of plastic sheeting in its portion of the flood fight. At the peak period, 815 Corps employees were deployed to the field for the emergency response. Corps personnel also coordinated closely with the Federal Emergency Management Agency (FEMA) and the Bureau of Reclamation in the flood-fight response effort.

The Corps' largest flood-recovery efforts involved repairing damaged levees in the Midwest. Of the 543 damaged levees needing emergency repairs, 270 were rejected as being ineligible for Corps assistance, mostly because they did not meet Corps' technical standards. Levee repairs carried out by the Corps cost an estimated $97.5 million and involved the work of 1,000 Corps employees.

Extensive damage to some communities led to reassessing the best method of future flood-damage reduction. Existing federal floodplain management policy came in for major reconsideration, with nonstructural approaches once again being examined. James Witt, FEMA's director in the aftermath of the 1993 flood, announced that "acquisition, elevation, or relocation of flood damaged structures" would be his agency's priority during the recovery effort. As a result, more than 10,000 buildings were torn down or relocated, and five towns attempted complete relocation, with varying degrees of success. For its part, the Corps vowed to reevaluate its floodplain management policies. The authors of the Corps' post-flood report noted the "possibilities for returning some of the floodplains to their natural state—particularly to wetlands—will be studied in future Corps' floodplain assessments."[19]

In fact, Congress wasted no time in ordering the Corps to undertake a comprehensive assessment of flood-control and floodplain management of the Upper Mississippi and Lower Missouri river areas flooded in 1993. Congress adopted legislation authorizing the floodplain management study in November 1993, and the Corps assigned oversight of the task to the NCD on December 14, 1993. The division had responsibility for coordinating the work of five Corps' districts and outside agencies participating in the undertaking. In his tasking order, Major General Stanley Genega, director of civil works, told the NCD Engineer to have his proposed plan of implementation ready and to hold the initial In-Progress Review for the study within thirty days. Genega also stated that given the time and funding resources available for the study, it should "be accomplished on a broad and conceptual basis, using a system approach to

floodplain management (of which, flood control is only one aspect thereof)."[20]

In carrying out the study, the NCD-assembled team compared impacts of a wide array of policies, programs, and flood-damage reduction measures involved in the Midwest Flood of 1993. In particular, the study evaluated potential impacts of changes in flood insurance programs, state and local floodplain regulations, flood hazard mitigation and disaster assistance, wetland restoration, and agricultural support policies, in addition to traditional structural approaches such as reservoirs and levees. Corps study managers used sophisticated systematic computer modeling in impact analysis of structural and nonstructural alternatives to flood reduction.

The more significant findings of the study included the following items: (1) Corps reservoir and urban levees and floodwalls performed as designed and prevented significant damages. (2) If all agricultural levees had been raised and strengthened, urban flooding would have been greater. (3) Restoration of floodplain wetlands would have little impact on floods the magnitude of the 1993 event, and restoration of upland wetlands, while reducing localized flooding, would have little effect on main-stem flooding for an event the size of the 1993 flood. (4) To achieve better floodplain management and appropriate responsibility for flood damages, more extensive reliance on nonstructural policies, such as local floodplain zoning ordinances, flood insurance, and public education, and more emphasis on flood-hazard mitigation, including acquisition, flood-proofing, and raising flood-prone structures would be beneficial.

Not surprisingly, the study found that better adherence to existing policies, such as good maintenance of levee systems and state and local land-use regulations would be a valuable first step for better floodplain management. The study also observed that, from a hydraulic evaluation perspective, no single alternative provided beneficial flood-damage results throughout the entire system. The study, as one reviewer noted, "validates the view that while structural flood control measures are an important part of an overall floodplain management program, they have limitations[,] and floodplains are best managed through a combination of structural and non-structural measures that fully recognize the inherent risk of occupying flood hazard areas."[21]

Channel Maintenance on the Upper Mississippi River

Just as the Corps' dredging program on the Great Lakes came under criticism in the 1960s and 1970s, so too did its dredging activities on the Upper Mississippi River. Fish and wildlife conservationists became alarmed at the sedimentation of backwater and side channels caused by the nine-foot channel project on the Upper Mississippi. The navigation dams had created a series of pools that acted as sediment traps, which reduced the river's ability to maintain backwater areas or create new ones and adversely affected fish and wildlife habitat. Maintenance dredging exacerbated the problem by disposing dredged material in sensitive wetlands or along shore lands, which closed off environmentally valuable backwaters and side channels.

The passage of NEPA in 1969, and subsequent environmental legislation, gave environmentalists leverage in how water resources development would proceed during the 1970s and 1980s. Corps leaders set about incorporating a new environmental emphasis in the Corps' policy and work ethic. Division Engineer Brigadier General William W. Watkins, Jr., quickly captured the new tone established by the Corps' headquarters. Speaking to the Chicago Region Federal Executive Board in April 1970, Watkins declared that the Corps would not choose between those who sought to preserve our resources and those who tried to develop them; rather, "The Corps of Engineers' position . . . is that both views have too much merit for either to be allowed to obliterate the other; that a truly responsive agency must be responsive to both."[22]

Preparation of an EIS, as required by NEPA, for any federal action affecting the environment had a major impact on the Upper Mississippi River dredging program. The decision by the

newly created Council on Environmental Quality that an EIS must be prepared not only for new projects but also for completed ones and for project maintenance as well, swamped the Corps with a huge backlog of impact statements. This backlog took years to clean up and slowed the preparation of EISs for new work. EIS preparation had a major impact on the Corps' study program. As General Graves later noted, "You had to integrate the Corps study effort with the environmental impact statement. It was a struggle to build this interface."[23]

While Corps districts had chief responsibility for preparing EISs, divisions had to review them for technical accuracy and policy compliance. In April 1974, General Bachus notified the Chief of Engineers that the EIS backlog was compromising the division's ability to complete project planning. To rectify this situation, Bachus placed EIS completion and simplification on his list of top-ten "management by objectives" priorities and appointed a single EIS program manager at the division level with "total responsibility and accountability for meeting processing milestones."[24]

General Bachus assigned management of the EIS program to the environmental resources branch within the NCD's planning division. Planners quickly introduced two innovative procedures that succeeded in speeding up EIS completion. Prior to April 1974, districts forwarded EIS drafts to the NCD as they were completed, usually after the project study reports they commented upon. After April 1974, division planners required that EIS completion be linked to the study report submission date. The second change involved internal division procedures. Instead of each NCD element commenting on the entire EIS, the environmental resources branch broke the EIS into segments for review by appropriate organizational units. As a result of the revised review process, Bachus reported to the Chief of Engineers in January 1975 that the NCD had eliminated the backlog of EISs on continuing projects started prior to passage of NEPA. By the middle of 1975, NCD's districts had also reduced their EIS backlog to manageable proportions.[25]

Between 1970 and 1976, the Corps modified 320 projects nationwide to meet new environmental standards. Projects or studies carried out in the NCD accounted for sixty-seven of the total number of projects modified. Not all of the projects, however, could be altered to meet the new environmental standards. During the same period, the Corps abandoned or delayed eighty-seven projects as a result of NEPA and other factors; fourteen were within the NCD. The Corps delayed or abandoned about one-half of the projects on its own initiative, while the remainder were stopped at the request of states or the Environmental Protection Agency (EPA). Costs and environmental concerns proved equally important in all of those abandoned or delayed projects. In a briefing for the Chief of Engineers, General Moore noted in August 1976, "We in North Central Division have pushed environmental concern and enhancement in all of our activities. We are closely monitoring our environmental impact statement productivity and quality. This is an ever-increasing workload and a drain on our people, but we are trying to stay ahead." The pressure to meet the new

Figure 58. Shore end of the discharge pipe of the dredge *William A. Thompson*. Dredge material is being discharged into a spoil area along the right bank of the Mississippi River, downstream from Buffalo, Iowa, in September 1966. (Rock Island District)

environmental standards weighed especially heavily on the Corps' maintenance dredging on the Upper Mississippi River.[26]

In June 1973, while the *Thompson* routinely dredged the nine-foot channel in the Mississippi River near LaCrosse, Wisconsin, the state of Wisconsin won a temporary injunction in Federal District Court against the Corps, stopping further work. Later in the month, the Corps moved the *Thompson* to another site along the Wisconsin shore. Again the state went to court, this time unsuccessfully. In September, the Wisconsin Attorney General filed suit in Federal District Court at Madison, Wisconsin, seeking to ban further deposition of dredged material in the Mississippi River until the Corps filed an EIS. The state claimed that the Corps' dredged disposal practices caused grave environmental damage by placing material where it could reenter the river or enter backwaters and destroy fish habitat. Since the dredging season was over for 1973 and further work would not resume until the following spring, Wisconsin did not press for an immediate hearing.[27]

Wisconsin's challenge to the Corps typified the attitude of various agencies, states, and environmental groups to disposal sites and methods involved in the Corps' nine-foot channel maintenance. Environmental critics claimed that the Corps placed dredged material in valuable fish and wildlife habitat, in areas blocking water flow to such habitat, or in places from which it eventually eroded into the habitat. These critics also claimed that any disposal of dredged material in the floodplain affected fish, wildlife, and water quality. Prior to these claims, the Corps had removed some 9 million cubic yards of sand and silt annually from the Upper Mississippi River during the 1960s.[28]

In March 1974, a federal district judge granted an injunction on the basis that the dredged disposal practices of the Corps violated Wisconsin law and caused significant environmental damage. Both the St. Paul and Rock Island districts raced to complete their dredging maintenance EISs. At the NCD, General Graves looked forward to a completed draft EIS from the St. Paul District in February 1974 and to one from the Rock Island District in March that year. In December 1973, Graves wrote the Chief of Engineers of his concerns: "The [St. Paul District] EIS will leave us vulnerable to suits in violation of NEPA inasmuch as the pipeline dredge *Thompson* is scheduled to dredge in the St. Paul District in April, May and June." Graves hoped to be in compliance with NEPA "by the time the *Thompson* begins dredging in Rock Island District in July." The St. Paul District filed its EIS in April 1974, and the injunction was lifted.[29]

At a meeting of the newly created Upper Mississippi River Basin Commission (UMRBC) in November 1973, state representatives on the commission introduced a resolution in favor of establishing a commission task force to examine Mississippi River maintenance dredging. The task force was not formed until early 1974, but Graves kept the Chief of Engineers informed on the matter. "Our approach," he said, concerning the task force on maintenance dredging, "is to exchange information freely and to participate as actively as resources allow in seeking solutions." State representatives, Graves explained, were strongly oriented toward reducing adverse effects on wetland and fish habitat, "even at significant cost." Divisions among state commission members existed only over how willing they were to disrupt maintenance dredging while seeking a long-term solution to the environmental problems. Graves urged a "rational approach" that allowed maintenance dredging to continue in ways least damaging to the environment, while new equipment and practices were developed to lessen environmental harm.[30]

Environmental impact statements completed by the St. Paul and Rock Island districts in the early months of 1974 confirmed that Corps dredging practices had an adverse effect on the natural environment. The studies found that dredging and disposed dredged material damaged backwaters, marshes, and sloughs, and suggested some alternatives to the existing operation and maintenance program. These findings, along with growing congressional and public interest in

Upper Mississippi River management problems, called for decisive action from the Corps. Yet very little scientific information was available on the complex interactions of the river and man's impacts on it.[31]

In response to questions the EIS raised about Corps dredging practices, General Bachus and the regional director of the U.S. Fish and Wildlife Service set up a joint team to work out a long-range management strategy for the Mississippi River's multiple uses. The team, established in September 1974, soon joined forces with the UMRBC's Dredged Spoil Practices Committee. The expanded partnership, known as the Great River Environmental Action Team (GREAT), sought to develop an environmentally and economically balanced dredging program for the Upper Mississippi River.[32]

The GREAT team at first concentrated its studies on the Mississippi River from the head of navigation at Minneapolis to Lock and Dam Number 10 at Guttenberg, Iowa. In 1976, Congress authorized expansion of the program, and GREAT studies were organized on other sections of the Upper Mississippi River. The original GREAT, operating north of Guttenberg, became GREAT I; GREAT II examined the river between Guttenberg and Saverton, Missouri; and GREAT III concentrated on that part of the Upper Mississippi River not included in the NCD. The stated goal of the GREAT I and II teams was that "total resource management plans require interdisciplinary planning to address the broad range of complex issues involved including economic, environmental, and social consequences of plan implementation." In reality, funding limitations forced the teams to focus on channel maintenance.[33]

General Moore was typical of a succession of NCD Engineers in his strong support for GREAT. He promised the Chief of Engineers in February 1976 "to continue [the] priority effort on this study [GREAT] and to maintain intense public involvement in workshops and work group activities." He wrote of the "tremendous" public response the program received and ventured that

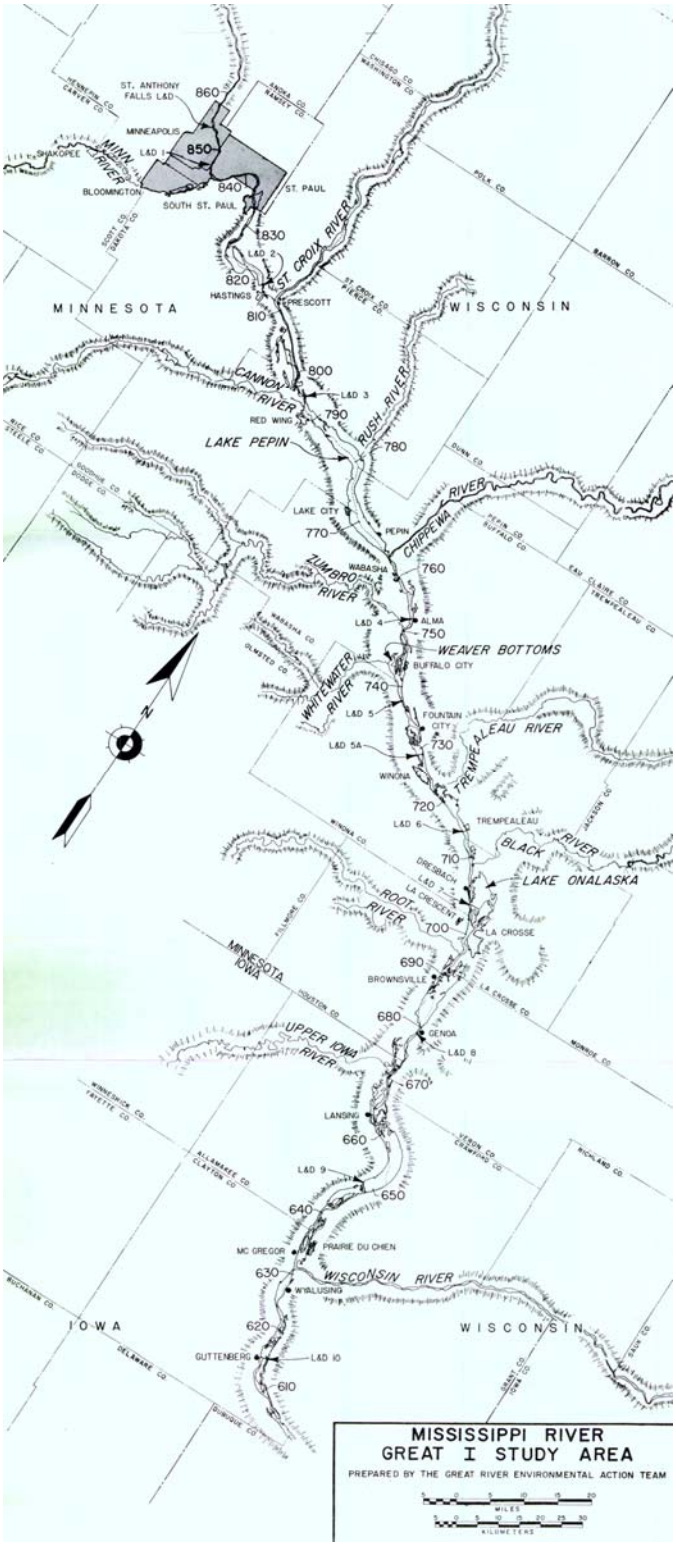


Figure 59. Mississippi River GREAT I Study Area. (NCD Files)

"the culmination of our efforts will find an improved quality of life for the citizens of the Upper Mississippi Valley." Moore felt committed to GREAT because it provided a forum for better understanding and a closer working relationship

among state and federal agencies. At the same time, he looked for concrete results in return for the high investment of operation and maintenance funds in the study. Among other things, he wanted to make certain that GREAT findings were incorporated into the operations and maintenance program as quickly as possible. Moore found that overseeing the maintenance-dredging program was a continual challenge. Prior to the dredging season, each disposal site had to be coordinated with appropriate state agencies and the GREAT study team. As he explained to the Chief of Engineers in May 1976, "We are walking a tight rope and I'll do my best to maintain a balance. It is a continual 'give and take' situation."[34]

Changes to meet environmental needs had to be balanced against safety requirements of tugs and tows using the nine-foot channel. One way to reduce the adverse impact of dredging involved lowering the annual volume of sand removed from the channel. Channel maintenance became a question of how little dredging the Corps could do and still fulfill its obligation to provide a nine-foot navigation channel. In 1975, the Corps selected certain stretches of rivers for experimental reduced-depth dredging.

Throughout the period of study, the St. Paul and Rock Island districts completed much less dredging than they had previously. For example, in 1970, the St. Paul District removed 2.2 million cubic yards of material from the river above Guttenberg; between 1975 and 1979, the district dredged 600,000 cubic yards annually from the river's same reach. The story was similar in the GREAT II area of the Rock Island District. In both cases, the Corps found that reduced-depth dredging in selected areas had no adverse effects on navigation. The Corps also discovered that reducing dredging depths helped offset the increased costs of finding beneficial uses for the dredged materials.[35]

Improved federal-state agency relations fostered by the GREAT studies received a new test when Section 404(T) of the Clean Water Act of 1977 authorized states to regulate the Corps' dredging discharge in those portions of navigable waters within a particular state. Until the Clean Water Act, dredging practices could be applied uniformly throughout the Upper Mississippi River. After the act, different practices had to be applied not only on different stretches of the river but sometimes also on different sides of the river channel. In theory, the Corps could use emergency authority for whatever dredging it deemed necessary, and its ultimate authority over dredging remained unchanged. In practice, however, the Corps was obligated to acquire state permits for all routine dredging.[36]

While the Clean Water Act of 1977 appeared to increase the likelihood of friction between the states and the Corps over dredging and disposal practices, relations between the entities actually had improved by the late 1970s. Progress on the GREAT studies made this possible. In 1974, both Wisconsin and Minnesota challenged the Corps' dredging practices in court. By the time the GREAT studies were completed in 1980, both the states and the Corps had made concessions to reach a basic agreement on the future of nine-foot channel dredging.

As the GREAT studies progressed between 1974 and 1980, state departments of transportation played larger roles in study deliberations. They regarded navigation as an integral part of state transportation networks and viewed dredging less critically than the environmental agencies, which alone represented the state at the beginning of the studies. The Corps, moreover, had clearly demonstrated by 1980 its willingness to adopt less environmentally threatening dredging and disposal practices. The St. Paul and Rock Island districts, with NCD guidance, incorporated the GREAT recommendations into their dredging programs by the early 1980s.[37]

Most participating agencies agreed with the GREAT studies' conclusions and recommendations. The U.S. Department of Transportation, however, disapproved of the GREAT I report. Captain J. G. Glasgow of the U.S. Coast Guard, a GREAT I team member who represented the department, argued "the channel

maintenance plan does not consider all the alternatives available. It was assumed from the outset that a reduced-depth dredging program would be initiated without properly analyzing the impacts on navigation." The Coast Guard held that reduced-depth dredging would adversely affect navigation and efficiency of barge operations. Glasgow asserted, "This program has a direct adverse effect on navigation safety and is more costly." The NCD responded to Coast Guard criticism of GREAT by asserting that dredging would be reduced only where there would be negligible impacts on navigation safety and where such action would not increase dredging frequency. In 1982, the NCD entered into a joint study with the Coast Guard in an effort to resolve their concerns.[38]

GREAT was not the only Upper Mississippi River study carried out in the late 1970s. Congress approved a second study in the Inland Waterways Authorization Act of 1978, which also authorized construction of a new lock and dam at Alton, Illinois, two miles below existing Lock and Dam Number 26 on the Mississippi River, and established an inland waterways user tax. Section 101 of the legislation instructed the UMRBC to prepare a comprehensive master plan for the management of the Upper Mississippi River system. In particular, the master plan was to identify economic, recreational, and environmental objectives of the Upper Mississippi River system, recommend guidelines to achieve objectives, and include legislative proposals for implementing recommendations.[39]

The UMRBC assigned development of the master plan to the GREAT River Study Committee on which the NCD served as a member. A master plan task force with a representative of NCD's planning division developed the plan of study, which involved a number of economic studies relating to the navigation system. The navigation elements included water carrying capacity; effect on railroads; and costs, environmental effects, and benefits of various navigation improvements. Finally, the master plan was to examine the need and environmental effects of a second lock at Alton. The NCD had responsibility for conducting cost-benefit and environmental studies of the proposed new lock at Alton and for carrying out an assessment of dredged material disposal outside the floodplain. The NCD assigned the latter study to the Rock Island District.[40]

In its master plan report, the UMRBC recommended a four-point navigation improvement program. First, it urged that the Corps should be authorized to engineer, design, and construct a second lock chamber 600 feet long at Lock and Dam Number 26. Second, in view of the environmental studies already carried out in the master plan, the commission also recommended that Congress exempt construction of this second navigation lock from the necessity of an EIS. Third, the report recommended that the Corps implement a program of nonstructural and minor structural enhancements to the nine-foot channel system to improve its performance and realize the full benefits of the additional lock chamber at Lock and Dam Number 26. Finally, the commission recommended continuing the collection of data on the operation and economics of the Upper Mississippi River basin navigation system.

Besides the four-point navigation improvement program, the commission recommended a ten-year environmental program, which, under the direction of the Department of the Interior, would rehabilitate and enhance natural habitat. To enhance the recreational opportunities of the Upper Mississippi River system, the commission urged Congress to implement a program of recreational projects and to authorize an assessment of the economic benefits of recreational activities. The commission also found that it was not necessary to dispose of dredged material outside the floodplain and that the Corps should continue its current disposal practices while searching for productive uses of dredged material.[41]

After President Ronald Reagan ordered the UMRBC to disband in December 1981, the commission recommended that the states of Minnesota, Wisconsin, Iowa, Missouri, and

Illinois establish a cooperative organization to work with federal agencies on implementing the master plan. In response to this proposal, the five states approved the articles for the Upper Mississippi River Basin Association (UMRBA), which went into operation in January 1982.[42]

During the 1980s, the UMRBA attempted to support legislation authorizing projects and programs the master plan had recommended. It also developed implementation strategies to supplement the recommendations. The Corps tried to do its part by implementing those elements related to navigation under existing authorities and budgets. In an interim report issued in February 1985, the UMRBA admitted that while "progress had been made toward the implementation of recommendations in the Master Plan, . . . in most cases the progress has been in planning and research activities that refine the original recommendation or implementation strategy and not in actual project or program development." Without congressional authorization and funding, the interim report stated, progress was limited.[43]

The Corps, without congressional authority to build a second lock at Lock and Dam Number 26 and large appropriations for rehabilitation measures, could do little to increase shipping capacity or improve the river environment on the Upper Mississippi River. The Corps did carry out habitat improvements along the river in a piecemeal fashion, but fell far short of the comprehensive approach sought by the UMRBA. The greatest environmental gains came from the Corps' revised dredged-material disposal practices, which both reduced dredged quantities and expanded the productive uses of disposed material. Dredged disposal procedures were those developed chiefly under the GREAT studies during the 1970s. The results of reduced dredging occurred most dramatically in the St. Paul District. Prior to 1974, the district annually dredged 1.5 million cubic yards of material. By 1983, it had cut the amount to 740,000 cubic yards. The St. Paul and Rock Island districts also continued developing programs to make dredged material available for various beneficial uses.[44]

Corps commitment to environmental enhancement of the Upper Mississippi River took a new turn in the late 1980s. The connection between the Corps' nine-foot navigation project and the river's fish and wildlife resources was explicitly recognized in the 1985 Supplemental Appropriations Act and Section 1103 of the Water Resources Development Act of 1986 (WRDA). These measures authorized constructing a second lock at Lock and Dam Number 26 and implementing a variety of environmental initiatives on the Upper Mississippi River.

Section 1103 of the WRDA provided both a framework and statutory direction for managing the Upper Mississippi environment "to ensure the co-ordinated development and enhancement of the Upper Mississippi River" and declared Congress's intent "to recognize . . . [the Upper Mississippi River] system as a nationally significant ecosystem and nationally significant commercial navigation system." In addition, the legislation specifically directed the Corps "to monitor traffic movements on the system[,] to verify the need for river rehabilitation and environmental enhancement and protection," and to develop a long-term resource monitoring program. The Corps, in cooperation with the U.S. Geological Survey, combined the resource-monitoring program with a computerized inventory and analysis system to further enhance management of the river system. Finally, the act authorized $124 million for habitat rehabilitation and enhancement projects and $61 million for long-term resource monitoring. Congress authorized recreation projects but left them unfunded.[45]

The Corps assigned the NCD the lead for implementing the plan, known as the Environmental Management Program (EMP). Tom Hempfling, in the planning division of the NCD, served as the overall manager for the Corps' role in the EMP until the Corps' reorganization of 1996 closed the NCD. The early years of the EMP proved challenging for the Corps. On the one hand, the WRDA authorization for the EMP was similar to other Corps project authorizations. It established the program components without defining them in detail,

leaving implementation to the Corps' discretion and guidance. On the other hand, the EMP was unlike typical Corps projects in which reconnaissance and feasibility studies preceded construction authorization. The EMP had no prior Corps planning documents, only the broad conceptual master plan the UMRBC had prepared. The NCD and Corps headquarters struggled in the early years of the EMP to adapt traditional Corps planning processes to EMP project's needs.[46]

As a complex and high-profile undertaking, the Office of the Chief of Engineers (OCE) and the Office of the Assistant Secretary of the Army for Civil Works (ASACW) closely monitored the EMP. They provided specific guidance to the NCD on the format and content of all projects recommended for selection. Initially, as Chief of Engineers Lieutenant General Henry Hatch told NCD Commander Brigadier General Theodore Vander Els,

> We at HQUSACE [Headquarters U.S. Army Corps of Engineers] had envisioned operating the EMP much the way we do our Continuing Authorities Program. That is, we would approve the projects themselves, and the Assistant Secretary's office would approve their inclusion in our overall construction program based on a fact sheet. In the case of the EMP, however, the Assistant Secretary had reserved for himself the authority to review and approve the projects. During this review, any subject pertaining to the project was open for question and discussion.[47]

Later in the program's operation, the ASACW delegated some of his authority over the program to the Chief of Engineers. He directed the NCD to submit fact sheets describing each proposed project passing initial district and division screening to headquarters in Washington, and ordered headquarters to give concept approval before a project could proceed to general design and a detailed project report by a district. After review by the NCD EMP manager, a recommended detailed project report was forwarded to headquarters for further review and approval. Headquarters' review and approval process usually took five months. Cost-shared projects required additional processing. The NCD staff worked strenuously to move projects along and restrain costs. Early in the program, the NCD assembled a task force to recommend guidance for preparing habitat project fact sheets and reports and for evaluating completed projects.

While the Corps was accountable for management and execution of the EMP, its efforts had to reflect Congress's directive that the EMP operate as a partnership, consisting of the Corps, the five basin states, and the Department of the Interior. In addition, the authorizing legislation designated the UMRBA as the "caretaker" of the master plan for managing the Upper Mississippi River system. Major EMP policy and budgetary issues had to be addressed in that forum. The Corps pledged to involve the UMRBA in the decision process and to use it as the main entity for bringing all parties together for program development and implementation.

Drawing on the sedimentation studies done in the 1970s under the GREAT program and the comprehensive master plan of the UMRBA, the Corps' districts—under guidance from the NCD—worked with various state natural resources agencies and the federal Fish and Wildlife Service (FWS) to develop projects for habitat rehabilitation. An interdisciplinary team of biologists and engineers from Corps districts carefully developed and screened each project to find just the right alternative that optimized habitat benefits and costs.

The Corps developed three types of habitat projects to deal with sedimentation problems: dredging, levee or dike construction, and island creation. The Corps used dredging to restore side channel and backwater areas affected by sedimentation. Levee construction, in conjunction with water level control facilities, provided feeding areas for migrating waterfowl. To fight windblown waves that increased suspended

sedimentation, the Corps created islands in large expanses of open water. The islands inhibited the windblown sedimentation and provided nesting places for waterfowl and aquatic nursery habitats in the riprap protecting the islands.

The Corps worked with the FWS to carry out long-term resource monitoring. The data provided information for improving dredged material placement and reuse and in revising design criteria for habitat projects. Long-term monitoring also looked at environmental impacts of navigation, such as the effects on fish spawning habitat. The EMP gained new respect for the Corps of Engineers and its environmental mission from many in the environmental community who once had been highly critical of the Corps.

As NCD Engineer Brigadier General Jude W. P. Patin noted in 1991,

> something big has been happening on the Upper Mississippi River, where conservation and environmental interests had previously regarded the Army Corps of Engineers as 'the enemy' and commercial navigation as a primary cause of the river's degradation. The Upper Mississippi River System Environmental Management Program has gained support for the Corps of Engineers and its environmental mission from those who often found themselves in conflict with the Corps.

Patin reported privately to the Chief of Engineers, "the NCD is proud of its role and commitment to imaginative environmental initiatives . . . [and] building on the Division's success with the Upper Mississippi Management Program, we are strengthening our partnerships with other Federal, state, and local agencies to broaden our involvement and continue the current momentum in quality environmental programs." By 1997, the EMP had completed twenty-three habitat projects, while construction continued on twelve and design proceeded on another seven.[48]

In 1997, as Corps restructuring led to the closure of the NCD and transfer of responsibility for the EMP to the new Mississippi Valley Division, the Rock Island District issued a report to Congress evaluating the EMP. This study assessed the results of the EMP and made recommendations about whether to renew its authorization when it expired in 2002. In general, the report found that the EMP had been very successful in developing and implementing projects to understand the ecology of the Upper Mississippi River system. The report also noted that the EMP had succeeded in sustaining significant fish and wildlife resources through habitat rehabilitation and enhancement projects. The EMP's long-term resource monitoring program had increased the effective management of the regulated river system through systematic data gathering and analysis and the application of applied research to habitat restoration.

When it assessed specific projects, the report found that through FY1998, Congress had appropriated $177 million for the EMP components. In addition, the FWS had expended $1.3 million on EMP coordination and projects, and the five basin states had spent another $10.5 million in support of the EMP. When all authorized habitat projects (as of 1997) were completed, over 97,000 acres of aquatic, wetland, and floodplain habitat would have been restored, protected, or enhanced. From its evaluation, the report concluded that the EMP strengthened partnerships among many river constituencies, and that "the EMP is fundamental to successful comprehensive management of the [Upper Mississippi River] system."[49]

The Rock Island program review and evaluation of the EMP recommended that Congress reauthorize the program for an additional fifteen years at an annual funding level of $33.17 million. Of the total amount, habitat rehabilitation and enhancement projects would get $22.75 million and long-term resource monitoring would receive $10.42 million. During the 1990s, Congress had funded the EMP at $19.5 million annually. The report also recommended a requirement for program reports to Congress

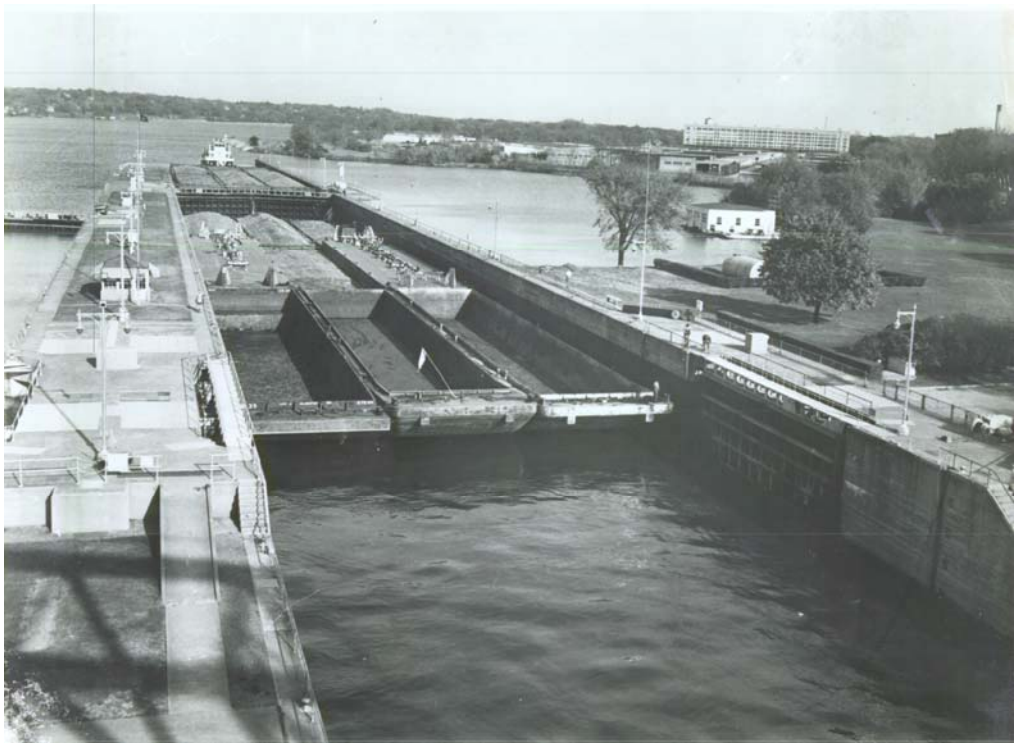


Figure 60. Towboat *Truax*, November 1953. Down bound from St. Paul, Minnesota, to St. Louis, Missouri, locking through Lock No. 15 with largest shipment of grain—12,000 tons, five barges of corn, and five of oats. (Rock Island District)

every six years. Finally, the report recommended several minor management adjustments and increased levels of public involvement in program planning and implementation. In passing, the report also pointed out that the EMP should be considered "a model program applicable to other river systems and water resources." In transmitting the report to the secretary of the Army, Lieutenant General Joe Ballard stated that "the results achieved by the EMP to date, combined with the potential for strengthening the State-Federal Partnership, constitute sufficient basis for extending the EMP, subject to significant changes, beyond its current expiration date of 2002." The success of the EMP represented one of the signal accomplishments of the NCD in its final years.[50]

In spite of heightened environmental concerns, navigation improvements supporting river commerce remained a focus of the NCD mission on the Upper Mississippi River. The increase in Upper Mississippi River commerce, which began with the completion of the nine-foot channel in the late 1930s, continued steadily into the 1990s. In 1939, 2.4 million tons of freight moved between Minneapolis and the mouth of the Missouri River, while in 1978, the total had grown to 79.3 million tons of grain, petroleum, coal, and other commodities over the same reach of the river. In 1995, shippers transported approximately 126.3 million tons of cargo on the Upper Mississippi River system's commercially navigable miles of river.

Steady growth in river commerce stemmed from the barge's cost advantage over competing rail and land transportation of bulk commodities. At the NCD, the economics branch of the planning division monitored commercial navigation trends and collected data in support of the division's planning efforts, especially for studies assessing the need to build larger lock chambers to accommodate ever-increasing traffic. The NCD served as the central point for collecting data gathered by the districts at their navigation locks.

By the 1990s, certain Upper Mississippi River locks experienced major backups, safety problems, and environmental damage while tows awaited lockage. In 1993, the NCD initiated a six-

year feasibility study to identify and assess the need for navigation capacity improvements and also included environmental studies, assessing potential impacts to fish and wildlife from any capacity expansion. At the time the Upper Mississippi and Illinois Navigation Study started, NCD Engineer Brigadier General Russell L. Fuhrman declared that there would be "a good balance of environmental and engineering going into that study." He went on to note that the feasibility study was "going to be a great challenge because we're dealing with a very, very complicated ecosystem and very, very complicated transportation system." This system-wide study, projected to cost $36 million, was not completed before the division's closure in 1997.[51]

Regulatory Program

In addition to the environmentally induced changes in traditional Corps navigation and flood-control programs, environmental concerns also affected other Corps responsibilities. One such program involved the Corps' regulatory responsibilities in the nation's waters. Until the 1970s, the Corps' regulatory program acted to protect navigable waters from obstructions or refuse inhibiting navigation. Persons seeking to build structures or dump refuse in navigable waters had to get a permit from the Corps first. Gradually, court decisions expanded the definition of refuse to include pollutants; and, by the early 1970s, the Corps was overseeing a permit program that regulated the discharge of pollutants into not just navigable water but all of the nation's water. Finally, in 1972, Section 404 of the Federal Water Pollution Control Act amendments authorized the Corps to issue or deny permits for the discharge of dredged or fill material into U.S. waters, following guidelines established by the EPA.

Nationwide, the Corps was overwhelmed with thousands of permit applications from industrial concerns and developers. With limited funds and personnel, the Corps in general and the NCD in particular made slow progress in eliminating the backlog of permit applications. The Chief of Engineers was aware of the problem and wrote to General Bachus in August 1974, that Bachus "and other Division Engineers will have to make funds available from within your Divisions . . . . Because all Divisions have large requirements for funds for this purpose[,] we are not able to meet these requirements."[52]

Bachus's successors at the NCD continued to struggle with the enlarged regulatory program throughout the 1970s. A program to phase in the permits required by expansion of jurisdiction helped, and development of general or regional permits for entire categories of work that would have only minor effects on the environment also alleviated the immediate crisis. Still, in February 1976, General Moore complained to the Chief of Engineers that "as the phased program for implementing Section 404 expands in jurisdiction, the shortage in personnel to adequately administer and manage the program will become more critical." Three months later, Moore noted that while general permits helped one part of the permit program problem, they did not, however, "relieve in any respect the magnitude of surveillance that is imposed by the greatly increased areas of jurisdiction." The Chief of Engineers responded that he fully appreciated the additional manpower demands required to implement the Section 404 program and could "only reemphasize the policy of pursuing a reasonable enforcement program as we move into these new areas."[53]

During the 1980s, the Corps emphasized regulatory reforms designed to improve administration of the permits program. Management of the regulatory program was complicated by the fact that Corps district boundaries followed water basins, not political divisions. In seeking permits, individuals in some states had to deal with more than one district office. After careful study of the matter and coordination with the states and Corps districts and divisions involved, NCD Engineer Brigadier General Scott B. Smith requested the Chief of Engineers to approve a boundary realignment between the NCD and Missouri River Division. The proposed realignment affected all regulatory functions except Section 404 permits. The regulatory activities of the St. Paul District in

North Dakota were transferred to the Omaha District, while regulatory jurisdiction of the Kansas City and Omaha districts in Iowa were transferred to the Rock Island District. Headquarters approved the transfer in February 1982, which in effect brought all of North Dakota and most of Iowa under single district regulatory jurisdiction, except for Section 404 permits. The division was also proud that it had the first state in the nation, Michigan, able to assume responsibility within its boundaries for the Section 404 program. This delegation of federal regulatory authority to a state occurred in 1984.[54]

The environmental challenges of the 1970s and 1980s greatly affected the NCD program for navigation and flood control on the Upper Mississippi River. The division responded to the new era by attempting to accommodate this environmental sensitivity while accomplishing its traditional responsibilities for operation and maintenance of the nine-foot navigation channel and for flood-damage prevention. The Corps demonstrated a greater willingness to involve the public in its decision making and increased cooperation with state and regional governmental bodies in finding more environmentally sensitive ways to conduct its dredging operations and to experiment with nonstructural approaches to flood-damage reduction.

The NCD played a key role in the various river basin commissions that addressed regional environmental issues. General Graves, NCD Engineer in the early 1970s, later remarked that he felt Corps participation on the UMRBC was "a good way to interact" with other federal resource agencies in solving environmental issues. Graves added, "I probably spent more time on all these interagency things while I was division engineer than I spent on the command of the division." Above all, the division joined in major scientific data gathering and analytical studies, such as GREAT and EMP, which provided information allowing more environmentally friendly projects and operation and maintenance activities.[55]

CHAPTER V
Organizational History and Miscellaneous Work, 1980–1997

During the past twenty-five years, the Army Corps of Engineers has undergone great changes and adjustments. While the civil and military workload has fluctuated widely during this period, the long-term trend for both missions has been downward. Although the reasons differed for each mission, the outcome was similar—reduced workload. Toward the end of the period, the Corps responded by implementing a major reorganization that led to closure of the NCD.

For the Corps as a whole, the era of large-scale water resources development projects had ended by the early 1980s. In FY1984, the Corps for the first time saw its civil works operations and maintenance expenditures exceed its construction outlays. The NCD did not escape this transition. As NCD Engineer Brigadier General Jerome B. Hilmes noted to Chief of Engineers Lieutenant General Joseph K. Bratton in August 1983, "NCD is a mature division and moving more towards O&M vis-à-vis new construction." The future of civil works appeared uncertain until passage of the Water Resources Development Act of 1986 (WRDA). This measure made possible a steady flow of small-scale water projects, funded in part through cost-sharing provisions.[1]

The Corps' military program experienced similar fluctuations during the 1980s and 1990s. Military buildup under the Reagan administration in the early 1980s caused a major expansion of work for the Corps, while the end of the Cold War after 1989 led to an equally sharp contraction. New types of military programs, such as the Base Realignment and Closure (BRAC) projects, produced some work, and innovative efforts embraced in the concept of "support for others" helped smooth the transition from high to lower levels of military construction contracts. Adjusting to both short- and long-term fluctuations and programmatic shifts in workload caused significant adjustments in the size of the Corps' workforce and organization at district and division levels. The Corps had to alter its business practices and become a leaner organization at the same time. While the Corps' reorganization in the 1990s can be considered revolutionary, the agency had experienced evolutionary change throughout the past twenty-five years in response to economic, technological, and environmental concerns. The NCD and its component districts are a case in point.

Reorganization in the 1970s and 1980s

Evolutionary organizational changes brought on by environmental concerns in the early 1970s resulted in modest manpower growth, while technology in the field of data processing allowed functional realignments accompanied by small personnel reductions across the NCD. In particular, the impact of the National Environmental Policy Act (NEPA) and other environmental and cultural resources responsibilities increased the NCD environmental resources branch from one Full-Time Equivalent employee (FTE) in 1970 to five by 1977. Also, during the 1970s, technical advances in automated data-processing and accounting systems led to realignment and centralization of finance functions at the NCD in 1970. The new Automated Data Processing Center (ADP) had a mission to provide guidance for NCD districts and data processing for both the division and the Chicago District. By absorbing a district function, the division appeared to be running counter to the Corps' traditional decentralization policy. In this case, however, higher headquarters had decreed that in the interest of economy and efficiency, administrative support functions would be consolidated at the division level. Similar motives led to consolidation during the 1970s of finance and accounting activities, with audit and internal review functions located at division level. Once again, personnel positions were transferred from the Chicago District to the division to accomplish this consolidation. The NCD worked hard at better integrating its finance, accounting, and ADP operations, and at streamlining reporting requirements.[2]

Both division planning and engineering functions experienced realignments during the 1970s. Multipurpose planning, especially in Great River Environmental Action Team (GREAT) studies, led to the creation of a special studies branch, which operated from 1973 until 1980. Also during the 1970s, the NCD's engineering division carried out a series of internal reorganizations at the direction of the Office of the Chief of Engineers (OCE). The division abolished its hydraulics branch and established a water control center to better coordinate reservoir operations. The NCD was slow to make this OCE-mandated change, and was one of the last Corps divisions to do so, finally setting up a reservoir control center—which it called a water control center—in May 1971. This office coordinated and managed all water-regulation activities associated with the Great Lakes, rivers, and reservoirs within the division on a systems basis. The objective of the water control center was to optimize operations for flood control, shoreline erosion, navigation, power production, and water quality. In addition, the center provided coastal engineering analysis for division review of survey reports and other studies. The division continued to reorganize this office throughout the 1970s, transferring marine hydraulics several times between the water control center and the coastal engineering and hydraulics design branch. Eventually, the function stayed in the water control center.[3]

Another internal realignment at the NCD in the early 1980s involved the enhanced role of emergency planning and preparedness. This function achieved a heightened role in the division organization as a result of the Corps' designation as a Major Army Command (MACOM) in June 1979. Major command status did not change the traditional relationship of the Corps to congressional military and public works committees or to the executive branch, but it emphasized and clarified Corps functions and relationships within the Army. "An established engineer command," the Corps announced, "should lead to increased readiness and facilitate the rapid transition from peacetime to wartime engineer support during mobilization."[4]

While neither the NCD mission nor the routine operations changed as a result of the Corps' new MACOM status, it did add "Commander" to the Division Engineer's title and increased the NCD role in Army mobilization exercises. At the beginning of the 1980s, preparedness for mobilization emerged as a national priority; and the military aspect of the Corps' dual civil and military missions took on a new emphasis, for which General Bratton set the tone: "Our civil works organization is a great national resource as a strategic reserve for wartime construction. We must firmly protect this emergency and mobilization capability."[5]

The NCD readily embraced this new concern for emergency mobilization capability. Division Engineer Brigadier General Scott B. Smith told a Corps-wide conference on emergency management in July 1981, "The Army of the 80s has 'preparedness' as its mission. We're part of that Army. The Reagan administration has made it clear that building the Nation's defense capabilities is one of its top priorities. Our role in this buildup is to plan our response—our course of action—to a national emergency."[6]

In response to an OCE directive, in May 1980, the NCD established an emergency management office, consisting initially of a chief, two civil engineers, and a clerk. The OCE authorized three to four emergency operations positions at each NCD district and five for division headquarters. The personnel spaces for establishing the emergency management program came at the expense of other offices at the very time that these established offices were experiencing reductions from budget cuts. The fact that the OCE would authorize new positions while cutting others demonstrated the heightened priority placed on national emergency mobilization as a MACOM function. During the early 1980s, as General Smith noted to Deputy Chief of Engineers Major General Elvin R. Heiberg III, the NCD "continued to push mobilization planning and preparedness." His successor, Brigadier General Hilmes, also emphasized developing mobilization readiness for responding to natural and national emergencies.[7]

In the late 1970s, the Corps was concerned that its field organization was not effectively in balance with its changing workload and new priorities. In particular, the downward trend in design and construction concurrent with an increase in planning and operations and maintenance activities severely stressed the Corps' organizational structure. As early as January 1976, NCD Engineer Brigadier General Robert L. Moore, admitted in a briefing to an OCE Command Inspection Team that because of its declining program "we feel strongly that Chicago District is prime for reduction. The question is to what level."[8]

In June 1977, the Chief of Engineers ordered the Corps' Engineer Studies Group to examine the issue of balancing workload with available personnel at the district level. In addition, at the direction of the OCE, the NCD looked at a major reorganization of its districts as early as 1977. After a quick study, General Moore and his staff proposed a plan for transferring areas of responsibilities from one district to another, closing a district, and shifting a district from one division to another. Under this plan, the St. Paul District would transfer its workload in the Upper Peninsula of Michigan to the Detroit District, while Detroit would transfer its responsibilities in Ohio to the Buffalo District. The advantages of the reorganization included a decrease in the number of districts involved in work for the states of Ohio and Michigan, a small savings in personnel (five FTEs), and minimal political opposition, since the plan had been informally discussed with state officials.[9]

Other parts of the reorganization strategy were potentially more controversial. The plan called for the abolition of the Chicago and Rock Island districts and the transfer of their workloads to the St. Louis and St. Paul districts, with the St. Louis District being transferred to the NCD. An alternative approach, if the St. Louis District stayed in the Lower Mississippi Valley Division, would have abolished only the Chicago District and divided its responsibilities between the Rock Island and Detroit districts. At this time, the Chicago District was vulnerable because it had the lowest civil works workload in the NCD and the entire Corps. Ultimately, General Moore, recognizing that political pressures might prevent carrying out the full measure of changes he was recommending, only asked permission to redistribute certain workloads among the St. Paul, Detroit, and Buffalo districts. The Chief of Engineers permitted Moore to proceed with the limited part of his plan, but thought it prudent to delay for further study the rest of the proposed reorganization.[10]

During 1978 and early 1979, the NCD carried out an intensive realignment study "designed to improve performance and customer satisfaction; provide an improved capability to support changing priorities and workloads; better balance the workforce to current and projected work; and better employ professional assets by moving to centers of expertise for comparable technical needs." The NCD study assumed the "possible disestablishment" of Rock Island and Chicago districts and the "tailoring" of the Buffalo District. It also once again looked at the transfer of the St. Louis District to NCD. In June 1979, NCD Engineer Major General Richard L. Harris recommended closing the Chicago District and transferring St. Louis to the NCD. Public reaction to these moves proved highly negative and the Corps ultimately decided to make only limited changes in NCD organization. In June 1980, the division trimmed the Chicago District by reducing its area of responsibility. The district lost all of its Lake Michigan mission and functions and responsibilities in Indiana to the Detroit District. All of Chicago's Illinois Waterway System (IWS) functions were reassigned to the Rock Island District. The reorganized Chicago District's mission now focused on metropolitan Chicago's water resource issues within the counties of McHenry, Lake, Kane, DuPage, Will, and Cook.[11]

Despite brand-new realignments within the NCD, new mandates under the Reagan administration in 1981 necessitated further organizational changes. In its effort to reduce the size of the federal government, the administration's Office of Management and Budget ordered the Corps to make cuts in its civil

works program. In September, the Corps was told to reduce staff nationally from 28,235 to 25,240 by the end of FY1982—a 10.6 percent reduction. Although higher headquarters and the divisions took some of the cuts, the bulk of downsizing came at the district level. The NCD's portion of the reductions amounted to 280 spaces. For the longer term at the NCD, cuts of 2 percent were set for FY1983 through FY1986.[12]

Realignment studies undertaken by the division office showed that the NCD headquarters and four of the five districts could take personnel reductions without adversely affecting mission. The situation in the Chicago District, however, precluded such an approach. As General Smith put it, "Chicago District . . . in its present geographical configuration and with its present organization, cannot absorb 'salami slice' space cuts throughout its structure." The solution imposed on the Chicago District required personnel cuts and a reduction of certain functions, making it a "streamlined" district while the other districts in the NCD remained fully functioning. The Chicago District retained its existing technical capability but lost its finance and accounting function to division headquarters and certain other administrative support responsibilities to the Rock Island District. In all, the Chicago District lost sixty-nine spaces, a 35 percent reduction. For the next several years, the NCD expended considerable effort in managing further realignments and reductions at districts under its control.[13]

Adopting Project Management

In 1986, WRDA, the first omnibus civil works projects authorization since 1976, caused significant changes in the way the Corps operated. The legislation directed the Corps to implement greater cost sharing with nonfederal sponsors and to expedite the planning process for civil works projects. It also contained new requirements for intergovernmental cooperation, local sponsorships, and financing inland navigation and harbor maintenance and construction. For the first time, cost sharing was imposed on all flood-control projects, with local sponsors required to pay at least 25 percent of all project costs. The legislation also established two trust funds based on user's fees to support inland waterway construction and rehabilitation and for harbor maintenance. Recognizing that the Corps would have to change its project-planning and management procedures to implement WRDA, Chief of Engineers Lieutenant General Heiberg and his senior leaders initiated a major review of Corps' business functions in 1987. This review took on heightened importance when, at the beginning of 1988, Assistant Secretary of the Army for Civil Works (ASACW) Robert Page directed the Corps to revise its management system.[14]

Traditionally, a district worked on a civil works project by passing it from one functional area—planning, engineering, construction, and operations—to the next as it progressed from concept through completion. Typically, each functional area assigned a different manager to the project, with no single person responsible for delivery time or cost control. This approach to project management proved time-consuming and expensive. In contrast to the Corps' method, the private sector employed one person—the project manager—to oversee all project costs and schedules throughout the life of the undertaking. The system emphasized teamwork above loyalty to a functional specialty and stressed cost controls and timeliness throughout the life of the project.[15]

In July 1988, the Corps adopted the project management concept and issued an engineering circular to guide implementation. Each district was to designate a civilian as a deputy district engineer for project management (DDE [PM]) and to assign a project manager for each large civil works project. An Office of Project Management was to provide technical advice to the DDE (PM). Chiefs of functional areas retained responsibility for providing functional products, including schedules, budgets, and manpower requirements necessary to accomplish their assigned work. The new project managers had responsibility for overall project schedule, cost, and coordination, and reported directly to the DDE (PM). Corps headquarters ordered that no

additional personnel positions be created to achieve the new structure.[16]

Over the next four years, senior leaders at headquarters and division and district offices struggled to implement the new project management system. The process was not smooth. Functional elements (stovepipes) and their chiefs did not want to give up authority or personnel to a project manager or civilian DDE. Each district tended to interpret and implement guidance differently. Although frustrated, Chief of Engineers Lieutenant General Henry Hatch pushed ahead with determination, clarifying that the DDE (PM) had equal rank with chiefs of engineering and construction. He also restructured Corps headquarters to emphasize higher echelon commitment to the project management system. The key change at headquarters involved the establishment of two program directorates—civil works and military programs—in July 1989. While each directorate had its own engineering and construction division, civil works contained divisions of project management, programs, and policy and planning. Military programs had a project management and an environmental restoration division. In the field, each district and division combined programs and project management offices. By 1990, project managers existed at every level of the Corps. In effect, this new organization had its own stovepipe.[17]

To support the project management initiative, the Corps pushed the automation and linking of reporting, budgeting, and scheduling requirements with project managers' data networks. One goal of these efforts was to reduce the time it took to design and construct a civil works project, which could run to twenty years under the old planning approach. As Bory Steinberg, chief of the civil works project management division at the Corps' headquarters, noted in July 1990, such a time-lapse was "totally unacceptable in an era of cost sharing and partnership with non-federal sponsors." One way of reducing project planning and execution time involved cutting the study and review effort. The goal aimed to achieve planning and design of a project in seven years. In addition, the Corps was committed to constructing all projects according to costs and schedules set in cost-sharing agreements with local sponsors. The Corps recognized that the key element in the new planning process was accountability and hoped a successful project management system would achieve that goal.[18]

Between 1990 and the end of his term as Chief of Engineers in 1992, General Hatch continued to fine-tune the implementation of program and project management and tried to overcome residual resistance to the new way of doing business. In March 1991, the Corps issued a regulation for project management. It established a project team, led by the project manager, which included technical personnel from the functional elements. Field surveys conducted by headquarters continued to reveal resistance to the new approach to project management. Field personnel complained about conflicting headquarters guidance, complicated reporting requirements, and micromanagement. Nevertheless, the new system gradually took hold, as new leaders emerged in district and division offices that embraced project management as the way to do Corps business.[19]

The NCD, along with the rest of the Corps, began implementing project management in July 1988. According to Dean Eitel, head of the division's environmental resources branch at that time, there was "a lot of confusion" over roles and responsibilities in the early days of instituting project management. Some of the biggest problems arose at the district level, especially when people who became heads of project management had reputations for being unfriendly to environmental issues. Bing Chin, chief of the division's program development office when project management was implemented, also thought there was a lot of resistance to the new approach, particularly at the districts. Chin was skeptical that project management was necessary because he thought the current system under the programs office provided sufficient control over budgets and schedules. Chin felt the guidance from headquarters was often unclear, making the process of setting up project management even more difficult. Nevertheless, he worked hard to

help implement the new system, especially at the district level.[20]

In 1990, NCD Engineer Brigadier General Jude W. P. Patin, unhappy with the pace of implementing project management within the NCD, reassigned Larry Hiipakka from his job as Assistant Chief of Engineering to that of Acting Director of Programs and Project Management. His mission was to speed the implementation process at both the district and division level. One of the first things Hiipakka did involved bringing together district and division senior staff to hammer out a consensus document, setting out a process for fully implementing the project management system. Called the South Clark Street Agreement (named for the location of division headquarters at the time), it established what districts would do to establish the program and how division staff would work together with the districts to make it happen.[21]

As proved the case throughout the Corps, traditional district and division office chiefs did not want to lose leadership of studies and projects or cede power to the new DDE (PM) at the district level and to the director of programs and project management at division command. "And that," as Hiipakka observed, "was the most difficult thing to accomplish, that transition of authority." Fortunately for Hiipakka, he had firm backing from several division commanders during the crucial time of implementation.[22]

Hiipakka also found that it took time to develop good project managers because of the broad base of technical, managerial, business, and interpersonal skills required by the position. Hiipakka felt that adoption of project management would enable the Corps to cut in half the time it took to move a project from the feasibility phase to project authorization and prevent significant cost growth over the life of a project. Most important, from the standpoint of congressional expectations, project management would allow the Corps to cut down the amount of unobligated and unexpended annual carryover of civil works project funds.[23]

The NCD also played an important role in the effort to automate cost accounting and scheduling for upward reporting by project managers. The five NCD districts successfully piloted the development of a fully automated reporting of district project executive summaries in 1990. The system, subsequently adopted Corps-wide, provided the capability to access current project data and gave early warning of potential problems concerning cost and schedules. This, in turn, strengthened a project manager's ability to develop accurate baseline cost estimates and schedules, and then manage them.[24]

The Chicago Tunnel Flood

In the early 1990s, the NCD and Chicago District had to respond to a major urban disaster in the city of Chicago. On April 13, 1992, a long-forgotten underground freight tunnel system collapsed under the Chicago River near the Kinzie Street Bridge. Built in the early 1900s to serve buildings in downtown Chicago's famed Loop, the tunnel system consisted of fifty miles of crisscrossing passageways, twenty feet beneath the riverbed. A portion of the old tunnel running under the river had been breached accidentally, and the Chicago River flowed into the underground passageways, quickly flooding the city's subway system and the basements of over ninety buildings. The water entered most basements through incompletely sealed old access doors and utility conduits.[25]

As soon as city officials discovered the problem in the early morning hours of the thirteenth, they ordered evacuation of the downtown area and shut down the main power grid serving the Loop to prevent overloading the electrical system. Within a few hours of the discovery of the flooding, Mayor Richard M. Daley—realizing that the situation was too much for the city to handle—requested assistance from the Chicago District. Chicago District Engineer Lieutenant Colonel Randall Inouye immediately responded by activating an emergency operations center (EOC) and sending geotechnical, structural, and hydraulic engineers and emergency management specialists to help the beleaguered city. In the meantime, city officials hired a

construction company to plug the breach, but workers had only limited success in stemming the flow of water into the tunnel system. Within forty-eight hours, at the city's request, state and federal authorities declared the Loop a disaster area and provided assistance.

Federal Emergency Management Agency (FEMA) officials met with division and Chicago District personnel to coordinate assistance efforts. Division Engineer Brigadier General Russell L. Fuhrman ordered the Chicago District to expand its EOC activities and prepared to call in additional personnel with tunnel experience from throughout the Corps. Eventually, forty-three Corps personnel from outside Chicago assisted with the flood fight. In addition, the NCD coordinated all public affairs activities for the Corps during the emergency, which attracted intense media attention.

By April 19, the contractor had partially sealed the tunnel system on both sides of the river, stopping most of the flow into the system. On that same day, FEMA formally gave the Chicago District the job of completing the plugging of the tunnel hole and dewatering the entire system. The Corps assumed responsibility for all engineering work, and General Fuhrman issued a Corps-wide call for more hydraulic engineers to assist in the design tasks involved in draining the water out of the tunnels.

The Corps' team of engineers quickly developed a computer model of the tunnel system to help plan a dewatering process that would minimize possible foundation settlement and prevent structural damage to the flooded basements. As General Fuhrman explained, "The water is exerting a tremendous pressure on the walls of the tunnel and the building foundations. If you take it [the water] out too quickly, the walls could cave in." Over 150 Corps personnel oversaw the controlled drawdown in a round-the-clock operation. By May 7, the contractor, Case International, had dewatered most of the tunnel system, with only the river crossing locations remaining flooded. On May 22, all tunnel areas had been pumped out and turned over to the city for periodic maintenance pumping. The pumping had removed an estimated 250 million gallons of water. Under the Corps' emergency contracts, the Kenny Construction Company built three permanent concrete bulkheads to ensure that the concrete plugs on each side of the river at the Kinzie Bridge location held. As the water level receded, engineers and hazardous waste specialists determined if buildings were structurally and environmentally safe, allowing owners to begin damage repairs and cleanup of the flood's mess.[26]

In all, the Chicago District expended more than $10 million in the Chicago Tunnel flood effort and used over 11,000 man-hours from about 200 personnel representing eleven districts and three division offices. Eitel, then NCD Resource Management Director, later noted that General Fuhrman made a conscious decision to let the Chicago District commander lead the flood fight with a minimum of division oversight. "Too often," Eitel observed, "you can find Division commanders saying, 'Oh, I had a chance to impress everyone.' But General Fuhrman did not do that." Eitel went on to say that Fuhrman "felt that it really was the district's show and for that reason stepped back." According to Hiipakka, however, division technical staff played an important role behind the scenes in supporting the Chicago District's flood fight.[27]

General Fuhrman later recalled that the Chicago flood fight "was a very intense operation with a lot of media coverage, but it was also very easy to control because . . . we could go straight to FEMA and get what we wanted or coordinate what we wanted," without having to go through higher levels of Corps' bureaucracy. Fuhrman's handling of the Chicago flood fight may have registered favorably at Corps headquarters, for on August 23, 1992, the Chief of Engineers ordered him to Florida to oversee the Hurricane Andrew recovery effort. In that task, Fuhrman directed a team of 600 civilian Corps employees and almost 3,500 contractors, expending $200 million in contract funds.[28]

Unlike the Chicago emergency undertaking, the Hurricane Andrew recovery operation required Fuhrman to work within a totally different command structure. In contrast to his relative independence in Chicago, the Florida effort placed Fuhrman's engineering management responsibilities within the layers of a presidential task force, the state's emergency forces, and a Department of Defense task force. Fuhrman found the Hurricane Andrew recovery effort an exciting challenge. He also took several key managers from the NCD office to Florida to assist him. In both the Chicago and Florida emergency situations, Fuhrman felt the Corps responded appropriately and successfully.[29]

Reorganization in the 1990s

Throughout the 1980s, the Corps attempted to accommodate declining fiscal resources, reduced manpower allocations, and changing technical and policy requirements through management improvements, organizational adjustments, and other efficiency measures. By the late 1980s, however, Corps leadership realized that simply changing business practices or ordering across-the-board manpower reductions would not keep the organization viable. Declining military workload in response to the end of the Cold War reinforced the message contained in the congressionally mandated cost-sharing features of WRDA. The Corps had to reevaluate its mission, goals, and structure and become more cost effective. Simply making changes in project management procedures would not suffice. Corps leadership also recognized that in addition to a shrinking workload, the organization suffered from high overhead costs and a loss of technical expertise. It had, moreover, been undergoing, over the previous twenty years, a transformation from a predominantly design and construction program to one more heavily weighted toward operation, maintenance, and environmental concerns.

In response to a congressional directive in the Energy and Water Development Appropriations Act for fiscal years 1990 and 1991, the Corps formed a study group to identify the most effective means for reorganizing the agency. Under Department of the Army guidance, the Corps set up a study group of division and district personnel, the so-called Bayley Task Force. This study group identified several criteria for reorganization plan development, including cost effectiveness, flexibility, competence enhancement, and management efficiency. Using these objectives, the Bayley Task Force defined six alternative structures for future Corps' organization and mission requirements:

1. No change—base case
2. Realignment—change district and division boundaries to better balance workloads and reduce offices
3. Regionalization—consolidation of most district technical and administrative functions at centers under division command and control
4. Decentralization—a power-down alternative with fewer division offices providing only general guidance and limited technical review
5. Eliminate divisions—reduce number of division offices, adding additional responsibilities to both districts and headquarters
6. Combination—combine the most desirable features of realignment and regionalization[30]

The final plan actually drew from each of these approaches, calling for realignment of division and district offices and consolidation of certain advisory and administrative functions under division command. Most sensitive politically, the plan recommended reducing the number of divisions from ten to six and the number of districts from thirty-five to twenty-two. The NCD was one of those recommended for closure. The Chicago, Detroit, Rock Island, and St. Paul districts would close and the remaining Great Lakes district (Buffalo) would report to a new division office headquartered in Cincinnati. The estimated cost to implement the plan was $266 million with annual cost savings estimated at $112 million. Most of the savings would come

from reduced personnel costs, as the plan would eliminate 2,600 positions.

As the Bayley Task Force completed its report, the Corps' top leadership tried to insulate the Corps of Engineers' reorganization from politics by including the plan in the larger BRAC process. Begun in 1990, BRAC tried to identify and recommend military installations to be closed or realigned, free from congressional interference. The plan coming out of the Bayley Task Force effort—initially included in the BRAC reorganization of July 1991—caused an uproar in all locations identified for closure or realignment. Congress, responding to political pressure, did not feel that the BRAC process was appropriate for evaluating the civil works component of the Corps and passed the "Nunn Amendment" in November 1991, withdrawing the Corps from BRAC. Congress also ordered the Department of Defense, in the Energy and Water Appropriations Bill, not to spend funds to close any district or division office.

In February 1992, the Corps responded to these congressional directives by creating two more study groups to review the case for reorganization and to develop a plan that could win congressional approval. Corps leadership recognized that it needed to do a better job of educating Congress on the necessity of reorganization, since it would not be part of the BRAC process. The new reorganization study groups consisted of a headquarters Reorganization Office assisted by a Field Advisory Committee (FAC) and a task force under Brigadier General Albert J. Genetti, Jr. The FAC was charged with developing site-selection criteria for the various types of organizations that comprised the proposed plan. These included divisions, districts, and technical and administrative centers. As the reorganization study got underway, Corps leadership committed itself to involving all field elements of the organization in the FAC process. General Hatch stated that he wanted "the perspective of all divisions and districts to be represented in the design of the new Corps."[31]

The Genetti Task Force had responsibility for drawing up the proposed organizational structure. In July 1992, Genetti's group suggested reducing the number of divisions from eleven to six and basing district management on the concept of fifteen technical centers and ten military construction centers. The technical centers were designed to provide greater concentrations of planning, design, and review expertise, while two districts per division would have responsibility for all military work. Finally, five administrative centers would provide regional human resources, audiovisual, technical library, and audit functions. The decision on which districts and divisions to close or realign would depend upon the application of the site-selection criteria to the existing structure of the Corps. The site-selection criteria included such items as current office site, cost of living, educational opportunities, transportation hub access, labor and office space availability, number of current personnel, and geographic distribution of workload.

While the Genetti Task Force recommended a major reorganization of the Corps, it did not name the divisions or districts targeted for either realignment or closure. That element of the reorganization process caused high anxiety among Corps employees throughout the organization. North Central Division employees had been shocked by the BRAC reorganization plan since it called for closing the NCD office and moving it to Cincinnati. Now they were just as concerned with the process unfolding through the new reorganization effort. Division employees responded by issuing a white paper on "Why a Corps of Engineers Office should be in Chicago, Illinois," hoping that this would sway the final plan scheduled for submission to the Secretary of Defense in November 1992.[32]

The white paper conceded that the Corps was going to reorganize its division structure, but tried to show the positive attributes that made Chicago a logical location for the Midwest regional office of the agency. The paper argued that in most measures of quality of life, Chicago was superior to Cincinnati—the feared first choice of the reorganization planners. Marshalling an

impressive number of studies and statistics, the white paper went on to attempt to demonstrate that as a transportation hub, federal regional center, labor market and financial center, efficient operational center, and cost-of-doing-business locale, Chicago was second to none in the nation's heartland. The authors of the white paper concluded by stating, "Chicago is the premier world-class city which should be retained as the location of the Corps of Engineers midwest division office." Congress further complicated the process when, on September 24, 1992, it funded Corps' reorganization planning while specifically ordering the agency not to close any district offices. Finally, on November 19, 1992, Chief of Engineers Lieutenant General Arthur E. Williams and ASACW Nancy Dorn held a joint news conference to announce the final reorganization strategy.[33]

The November 1992 reorganization plan proposed closing five division offices and significantly modifying the responsibilities and workload of all thirty-eight districts. The Corps sought to close division offices in Chicago, New York, San Francisco, Dallas, and Omaha. A realigned and enlarged NCD, with headquarters located in Cincinnati, would have included the twelve districts that made up the former NCD, Missouri, and Ohio River divisions. In addition to reducing the number of divisions, the plan also altered their responsibilities. The remaining divisions lost their technical and policy review functions, which were now assumed by a Washington Level Review Center at headquarters. Management oversight, ensuring district-level program execution, and providing regional interface with other federal and nonfederal agencies became chief missions at the division level. The overall plan was based on considerations of cost effectiveness, flexibility, competence enhancement, and management efficiency. The 1992 reorganization plan would result in eliminating 2,600 full-time positions and in projected annual savings of $115 million. The Corps estimated implementation costs at $215 million with a 1.7 year payback time.

Once again, Corps employees and their supporters in the divisions proposed for closure and realignment brought political pressure to bear in Congress. Responding to congressional concerns, President Bill Clinton, in January 1993, instructed the Secretary of Defense to review the 1992 reorganization process. The president also ordered Vice President Al Gore to examine the Corps as part of a sweeping review of federal government management practices, called the "National Performance Review." Clearly, the 1992 plan for reorganization was dead. For the next several years, the Corps' reorganization process became part of the "Reinventing Government" initiative and was heavily influenced by the congressional budget cutting pushed by the Republican-controlled House of Representatives, which had been elected in November 1994. This incremental approach to reorganization produced a reduction of approximately 1,770 FTE employees (about 6 percent) between fiscal years 1990 and 1995. The struggle to consolidate functions and downsize (or "rightsize") its workforce proved a painful process for the Corps.

In June 1993, as General Fuhrman prepared to leave command of the NCD, he expressed frustration with the pace of reorganization: "Anybody that studies reorganizations will tell you the only way they're successful is to do them fast. Get it over with and then get on with your business. Otherwise there's just too much trauma." Fuhrman stated that from the announcement of the NCD's closure, he had "pushed hard right away . . . to focus on the personnel piece and make sure all of the 180 employees I had in this Division had every opportunity available to them to stay with the Corps or to go elsewhere." Within a few months, Fuhrman's aggressive personnel actions had reduced the division workforce by 20 percent. But with reorganization then placed on hold, he found it difficult "to maintain our mission with that reduced number of folks." As Fuhrman noted in summer 1993, "Frustration [among the workforce] is high out there because nobody knows what their future is and hopefully[,] we'll get some direction from the Department of the

Army and the Department of Defense here in the near term so that we can get on with business." The employees of the NCD had now entered a period of prolonged uncertainty.[34]

In May 1994, the Corps commenced the new effort to reorganize, or restructure, as the agency's leadership preferred to call the process. As a first step, in June 1994, the Corps' top echelon convened a restructuring workshop to seek ideas on how the Corps could function more efficiently. A broad-based group, the participants included representatives from the headquarters and the field, as well as Corps' project sponsors and partners. Congressional staffers came as observers. Acting ASACW Dr. John Zirschky urged the attendees to "focus on what the organization does, not where it is done" in coming up with a new approach to restructuring the Corps. In delivering his keynote address to the workshop, Under Secretary of the Army Joe R. Reeder urged that participants "focus on getting better, on becoming the premier modern engineering business entity in the world." In his remarks, General Williams candidly stated, "We have been through a period of frustration and uncertainty because of projected reorganizations, hiring freezes, high grade ceilings, changes in workloads and personnel reductions . . . . We have 40,000 civilians in the Corps who have been on a bungee cord. We now have an opportunity to move forward."[35]

The workshop addressed such tough issues as the future role and mission of the Corps, definitions of technical and policy review and the level at which they should occur, and implementation of the new Civil Works Standard Organization Structure. After intensive debate, the workshop produced a draft statement of revised roles and missions for comment throughout the Corps. Based on the new roles and mission matrix, divisions would have four responsibilities: command and control, quality assurance, program management, and regional interface. Districts would focus on project management, customer service, and operations functions. The Corps had no choice but to proceed with restructuring because it faced a mandated 12 percent staff reduction by FY1999—a total of 4,500 positions. By June 6, 1994, the agency had eliminated only 747 positions, and those had been achieved on a voluntary basis.[36]

The process of restructuring the Corps advanced on a piecemeal basis, without a grand, overarching plan. Initially, the effort to improve organizational effectiveness and efficiency concentrated at headquarters and division levels. During 1994, for example, new technical review procedures removed divisions from the process and instead focused reviews at the district level. The Corps also revised, during 1994 and 1995, many of its business processes, including the continuing authorities program, the feasibility study process, and the operations and maintenance performance measurement system. The overall objective continued to be delivering quality products and better customer service at less cost. Still, restructuring proved painful because of continuing pressure to downsize. By August 1995, the Corps had taken roughly 1,800 of the 4,500 reductions required by 1999. Maintaining viable engineering and technical expertise in a retrenching organization proved a continuing challenge. Restructuring the Corps, it was clear, would not be a one-time event.[37]

The next phase of the Corps' restructuring occurred at the district level. The approach required developing Corps-wide guidelines and then allowing division commanders to ensure that all specific district-restructuring actions complied with the guidelines. Because of congressional opposition, no district would close, and all districts would continue to maintain core engineering, planning, operations, and construction capability. The level of competency, however, in each function would not necessarily be uniform across districts. The guidelines encouraged consolidation of non-engineering support functions. All changes were to be consistent with better business practices and customer services. The goal, according to the guidelines, was not to "do more with less," but "to identify how to accomplish the realistically projected workload in an era of declining resources." After gathering comments from the

field, customers, and congressional elements, the Corps issued guidance so that district restructuring could begin in spring 1996.[38]

At the same time as district reorganization was moving slowly ahead in 1996 and 1997, the Corps was developing and implementing a revised division-restructuring plan. A provision of the 1996 Energy and Water Development Appropriations Act (Public Law 104–46, passed in November 1995) directed the Corps to come up with a plan to reduce the number of division offices within the Corps to no less than six and no more than eight, with each division responsible for at least four district offices. Public Law 104–46 further directed the Corps to begin implementing the division office plan by August 1996 and complete it no later than October 1997. During spring 1996, the Corps devised a plan that took into account "geographic considerations and the relative relation of District missions within a watershed." In June 1996, Secretary of the Army Togo West, Jr., approved a division-restructuring plan, which closed division offices in Honolulu, Chicago, and Waltham, Massachusetts, but maintained a token presence in cities where offices were to be shut. The division plan would eliminate about 175 positions and save the government an estimated $4 to $6 million per year.[39]

The initial plan to close the NCD would have reassigned the five districts formerly reporting to the division to the new Upper Mississippi and Missouri Valley Division (UM&MVD) and the Great Lakes and Ohio River Division (LRD). The Chicago, Buffalo, and Detroit districts would transfer to OR&GLD, while the Rock Island and St. Paul districts would move to UM&MVD. In the September 1996 appropriations bill (Public Law 104–206), Congress gave the Corps further guidance to the effect that it should postpone implementation of the division-restructuring plan until April 1, 1997. Throughout 1996, the Illinois congressional delegation and Illinois governor James Edgar tried to prevent the closure of the NCD. Six Midwestern senators wrote in June 1996 that "the Corps of Engineers has not conducted a careful review in reaching its decision to close the NCD office, nor has the Corps worked through potential problems that might arise from its restructuring plan." Because of what they considered unanswered questions concerning closure of the NCD, the senators bluntly stated, "This is not responsible federal policy, and we therefore remain unconvinced that closing the NCD is justified."[40]

In opposition to the closure of the NCD, Governor Edgar noted, "Based on pure geography and demography, there is not a more appropriate location for an office to oversee Great Lakes and Upper Mississippi River activities than Chicago." The governor, moreover, was concerned that programs such as the Upper Mississippi River Environmental Management Program, the Upper Mississippi River–Illinois Waterway Navigation Study, and a memorandum of understanding on lake diversion at Chicago would all be harmed by closing the division office.[41]

The drawn-out division-restructuring process that seemed to assure the closure of the NCD played havoc with the morale of division employees in Chicago. Eitel, who had been at the NCD since 1973, and was then serving as chief of resource management, observed that the uncertainty of the situation set the workforce against management. "There was lots of consternation and just animosity between management and labor," he noted. "People spent their time around the water cooler . . . [and] there was paralysis in doing work." In looking back on the division-restructuring process, Eitel thought that minds at headquarters had developed a negative perception of Chicago and saw its management style as stagnant, whereas they perceived Cincinnati as having a more aggressive leadership approach over time.[42]

Whatever the reasons, the decision to close the NCD and the headquarters office in Chicago required a transition process to help employees slated to lose their jobs. According to Eitel, who had been placed in charge of the transition team, Colonel James R. Van Epps, the last NCD Engineer, told him to "do whatever you think is needed to take care of our people." Eitel arranged

for out-placement services, job fairs, and sessions on coping with stress—"lots of things to kind of help them over this as best we could." Still, the end was not easy to accept, and those few who were to remain in the Great Lakes Regional Office in the old NCD headquarters to deal with Great Lakes issues for the new LRD were uncertain of their future under the division office in Cincinnati.[43]

and a small regional office in Omaha. That decision led to aligning the Corps' districts in the Mississippi River basin into the Mississippi Valley Division and to combining the Ohio River and Great Lakes districts into the OR&GLD.[44]

The Chief of Engineers felt that this particular organization best met the requirements of law, supported the Corps' mission, and minimized personnel and workload impacts. Above all,

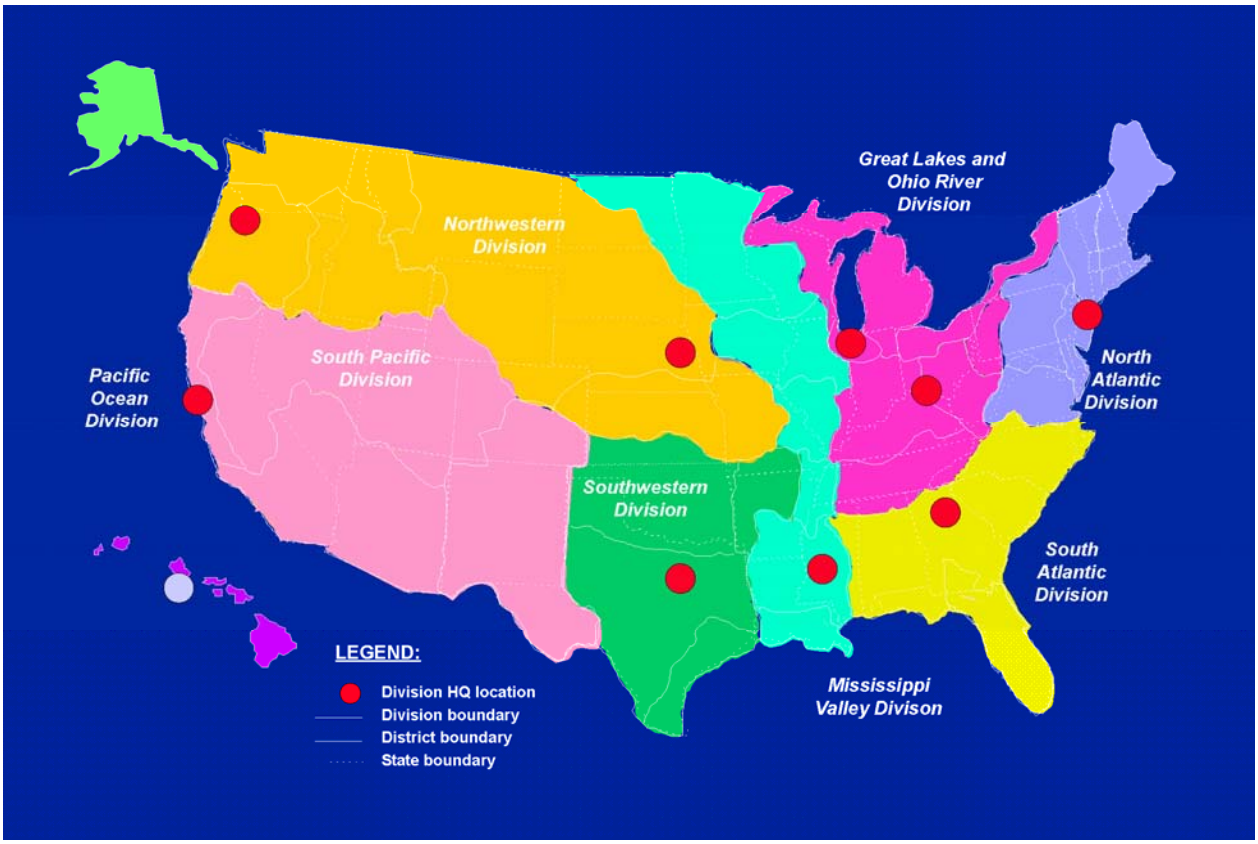


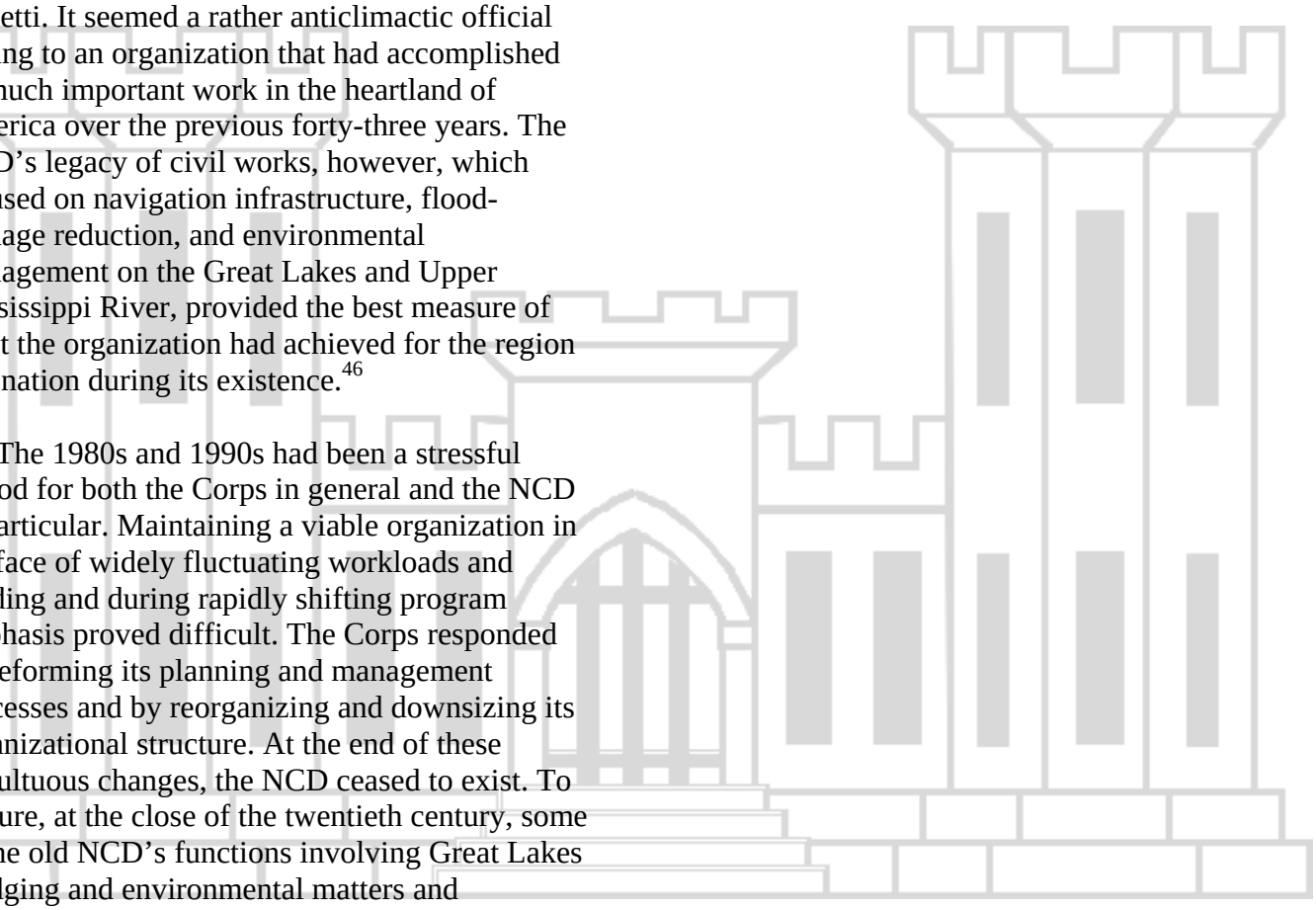
Figure 61. Map of reorganized Corps divisions. (Pittsburgh District)

Late in the operation, a further complication arose in the division-restructuring process that affected future relationships among those who remained in Chicago and those who moved to Cincinnati. At one point, the St. Paul and Rock Island districts of the NCD were going to be merged with the St. Louis District of the Lower Mississippi Valley Division and the Kansas City and Omaha districts of the Missouri River Division to form the UM&MVD. Instead, in January 1997, higher headquarters decided to merge the Missouri River Division with the North Pacific Division, creating the Northwestern Division, with headquarters in Portland, Oregon,

Corps leadership made a calculated judgment that its revised reorganization structure accurately reflected the reality of politics in Congress and therefore was best able to overcome the "roadblocks to past restructuring efforts." As ASACW H. Martin Lancaster said on releasing the revised division-restructuring plan, "There was some concern in Congress with our previous plan as to whether we could effectively coordinate the regional issues." The Corps argued that combining the NCD and the Ohio River Division under a single Division Commander provided the geographic balance and regional interface that addressed congressional concerns.[45]

Through the final round of the reorganization, NCD staff, according to Hiipakka, strived to maintain its professionalism and commitment to the work at hand "because of their personal devotion to the success of the Corps of Engineers as an agency." Finally, Hiipakka noted, "we worked with the other Divisions to have a smooth hand-off of our responsibilities to them." The NCD's end finally came on May 15, 1997, at a deactivation ceremony held at the Harold Washington Public Library and presided over by Deputy Chief of Engineers Major General Genetti. It seemed a rather anticlimactic official ending to an organization that had accomplished so much important work in the heartland of America over the previous forty-three years. The NCD's legacy of civil works, however, which focused on navigation infrastructure, flood-damage reduction, and environmental management on the Great Lakes and Upper Mississippi River, provided the best measure of what the organization had achieved for the region and nation during its existence.[46]

The 1980s and 1990s had been a stressful period for both the Corps in general and the NCD in particular. Maintaining a viable organization in the face of widely fluctuating workloads and funding and during rapidly shifting program emphasis proved difficult. The Corps responded by reforming its planning and management processes and by reorganizing and downsizing its organizational structure. At the end of these tumultuous changes, the NCD ceased to exist. To be sure, at the close of the twentieth century, some of the old NCD's functions involving Great Lakes dredging and environmental matters and International Joint Commission responsibilities continued in Chicago under the direction of a small liaison staff at the Great Lakes Regional Office, which was collocated with the Chicago District. This tiny remnant of the former NCD sought to accomplish the Great Lakes-focused responsibilities of the new LRD located in Cincinnati. For the future, the organizational command and control and the regional interface for water resources issues on the Great Lakes and Upper Mississippi River would be the responsibility of the Corps of Engineers' divisions headquartered at Cincinnati and Vicksburg.



EPILOGUE

Throughout its history, the North Central Division primarily focused on the water resources needs of the Great Lakes. The entire Great Lakes region is a massive presence, with a water surface area of 95,000 square miles and a drainage basin of 300,000 square miles, covering eight states and two Canadian provinces. The Great Lakes hold 20 percent of the world's fresh water supply and almost 95 percent of the United States' fresh surface water. The lakes' 11,200 miles of shoreline also serve as prime feeding and rearing habitat for large numbers of fish, waterfowl, and mammals. Over 29 million United States residents lived in the basin during the NCD's existence.[1]

Above all, the economic impact of the Great Lakes was unmistakable, with the system serving as the nation's fourth seacoast. In the 1990s, annual waterborne commerce averaged 175 million tons and recreational boating functioned as a major industry. To service Great Lakes navigational needs, NCD districts operated and maintained 134 harbors, containing one-third of the nation's breakwaters and jetties. Moreover, NCD districts annually dredged 4 million cubic yards of material from these harbors, placing much of it in twenty-seven confined disposal facilities. The connecting waterways of the Great Lakes also supplied large quantities of hydropower. Plants located on the St. Marys, Niagara, and St. Lawrence rivers annually produced 800 billion kilowatt-hours of electricity.

Under the International Boundary Waters Treaty of 1909, the United States and Canada worked together to treat the Great Lakes and St. Lawrence River as a single system because of the natural interconnection of the waterways. Outflows from Lakes Superior and Ontario were regulated to improve navigation and hydropower production and to lessen shoreline flooding and erosion problems. NCD Engineers chaired various International Joint Commission (IJC) study boards and sat on commissions charged with restoring and protecting Great Lakes water quality. This activity in support of the IJC comprised a major responsibility of every NCD Engineer.

The other major NCD water resources focus involved the Upper Mississippi River and Illinois Waterway System. This effort required the maintenance and rehabilitation of the Upper Mississippi River nine-foot channel project and its twenty-nine locks and dams, as well as eight locks and dams on the Illinois River. Shippers moved almost 130 million tons of commercial cargo on the Upper Mississippi and Illinois rivers during the mid-1990s. The St. Paul and Rock Island districts maintained 885 miles of navigable waterways, annually dredging 1.7 million cubic yards of material. To ensure coordinated development and enhancement of the Upper Mississippi River system, the NCD carried out an innovative environmental management program. This program sought to improve fish and wildlife habitat and provide long-term resource monitoring for more informed management practices.

At the end of its existence, the NCD operated and maintained a total of seventy-two commercial shipping channels and harbors, forty-two commercial locks, and sixteen flood-control reservoirs. It also managed over 250,000 acres of land and 680,000 acres of water for recreational purposes. Additionally, it had responsibility for issuing permits under the Clean Water Act and other authorities involving construction in or filling of navigable waterways or wetland areas. This total water resources program required an annual expenditure of almost $300 million and a division-wide staff of approximately 2,900.

Throughout its existence, the NCD's main workload dealt with the operations, maintenance, and rehabilitation of the existing navigation infrastructure. Most of the Corps' navigation responsibilities, consisting of locks and dams together with harbor and connecting channel facilities, had been constructed long before the

NCD was established. Chief exceptions to the emphasis on infrastructure involved such construction activities as the St. Lawrence Seaway project, the Calumet-Sag project, the confined disposal program, miscellaneous military construction during the 1950s and 1960s, and the short-lived postal construction program. Of course, the NCD also engaged in major planning studies in support of the IJC and various environmental issues related to navigation on the Great Lakes and the Upper Mississippi River. The Great River Environmental Action Team (GREAT) studies, Environmental Management Program, Flood-Plain Management Assessment for the Upper Mississippi River and numerous lake-level examinations, navigation season extension investigations, and dredged material disposal studies for the Great Lakes constitute significant examples of the NCD's planning effort over time. Finally, the NCD also had responsibility for a number of small flood-control projects and provided emergency flood assistance to local communities as needed.

The NCD budget reflected the heavy emphasis over time on the operations and maintenance portion of its civil works mission:

DECADE	AVERAGE ANNUAL TOTAL APPROPRIATION	AVERAGE ANNUAL OPERATIONS AND MAINTENANCE APPROPRIATION	OPERATIONS AND MAINTENANCE % OF TOTAL
1970s	$147,608,000	$ 87,692,000	59%
1980s	$228,100,000	$156,182,000	69%
1990s	$296,526,000	$196,861,000	66%

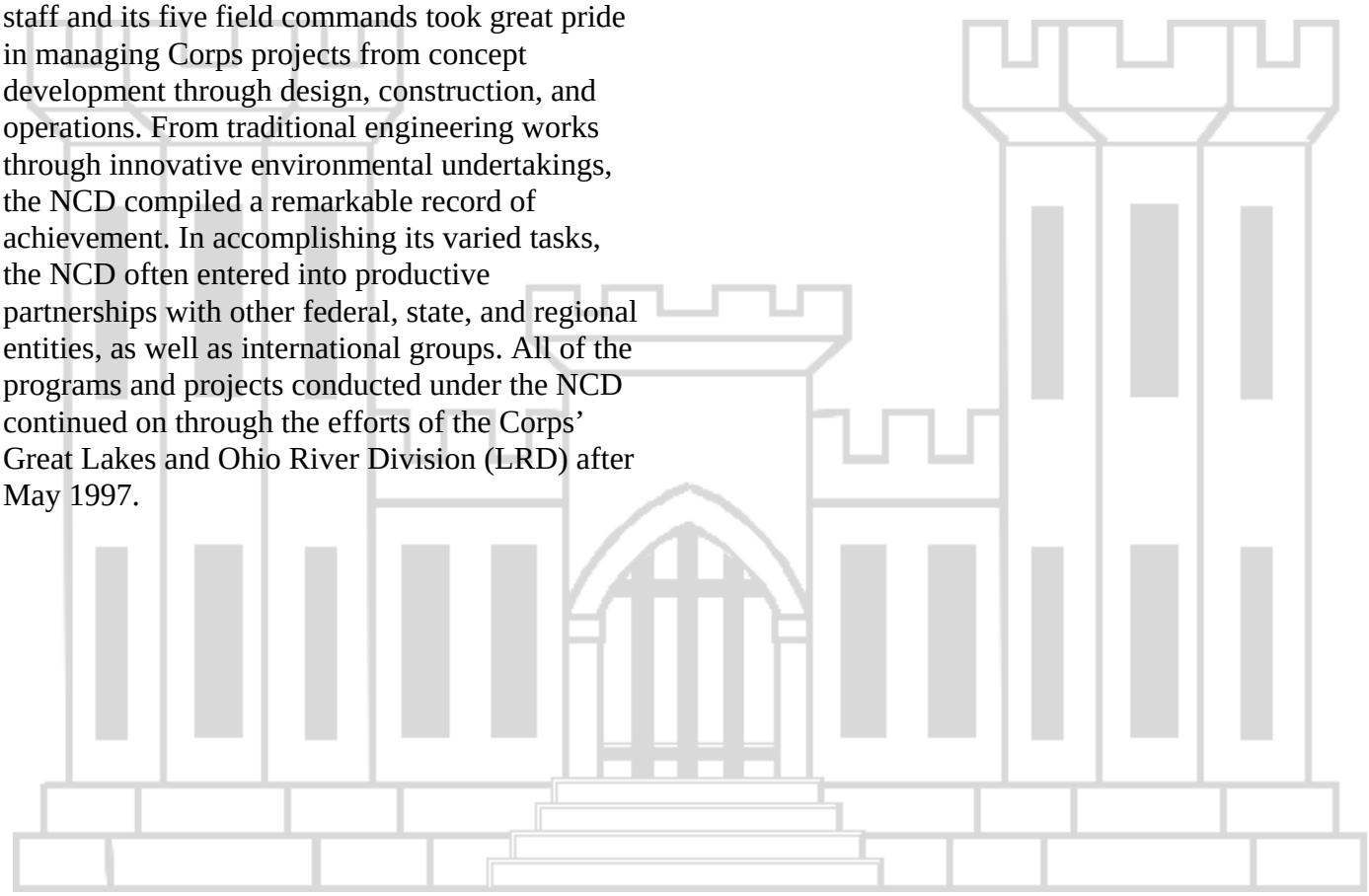
In addition, during the 1980s, the NCD annually spent on average another $23 million over and above its operations and maintenance budget for major rehabilitation, targeting its aging navigation infrastructure. Between 1978 and 1997, the NCD expended approximately $362.9 million on its major rehabilitation program.[2]

The NCD's environmental undertakings grew ever more diverse during its last decade of operation. For instance, the division became involved in the cleanup of formerly used defense sites, known as FUDS. This program began in 1985 and covered the states of Illinois, Wisconsin, Michigan, and Minnesota. While the Chicago, Detroit, and St. Paul districts performed the actual site assessments, the division provided overall coordination and resource management for the program. The NCD coordination role, carried out by Robert Worda as project manager, required report reviews, determinations of site eligibility, and contract payments. Over a ten-year period, approximately 700 sites across four states were evaluated under the FUDS program.[3]

During the NCD's final years, it also committed to an increasing number of partnerships with other governmental agencies throughout the division's geographic area of responsibility. In addition to an active support role for IJC undertakings, the NCD provided emergency operations support to the Federal Emergency Management Agency when natural disasters struck, such as floods. The division had a long-standing relationship with the Environmental Protection Agency, involving Section 404 permitting actions, dredging matters, and other regional environmental issues. Navigation concerns related to the Great Lakes and the Upper Mississippi River also led to partnerships with U.S. Fish and Wildlife and the U.S. Geological Survey, and with the St. Lawrence Seaway Development Corporation on issues involving the St. Lawrence Seaway. The NCD also acted in concert with the Great Lakes Commission, the Council of Great Lakes Governors, and the Upper Mississippi River Basin Association on a broad variety of regional economic and natural resources issues. All of these cooperative engagements by the NCD demonstrated its

ongoing commitment to the well-being of the Great Lakes and Upper Mississippi River region.

The civil works mission of the NCD was vital to the heartland of the United States. The navigational infrastructure consisting of waterways and harbors built, operated, and maintained by the NCD provided the bloodstream for an important economic area. The professional men and women of the NCD were dedicated to the efficient and effective execution of the Corps' mission in the heartland. The NCD headquarters staff and its five field commands took great pride in managing Corps projects from concept development through design, construction, and operations. From traditional engineering works through innovative environmental undertakings, the NCD compiled a remarkable record of achievement. In accomplishing its varied tasks, the NCD often entered into productive partnerships with other federal, state, and regional entities, as well as international groups. All of the programs and projects conducted under the NCD continued on through the efforts of the Corps' Great Lakes and Ohio River Division (LRD) after May 1997.



North Central Division

Division Engineers

IMAGE NOT AVAILABLE

COL Wendell P. Trower
May 1951–June 1955

BG P.D. Berrigan
June 1955–July 1957

MG Louis J. Rumaggi
July 1957–June 1959

IMAGE NOT AVAILABLE

COL Harry O. Fischer
July 1959–August 1960

North Central Division

Division Engineers

CONTINUED

BG Thomas D. Rogers
August 1960–April 1963

BG William C. Gribble, Jr.
May 1963–November 1963

IMAGE NOT AVAILABLE

COL Jeff W. Boucher (Acting)
November 1963–March 1964

BG Roy T. Dodge
April 1964–September 1967

North Central Division

Division Engineers

CONTINUED

BG Robert M. Tarbox
October 1967–June 1969

BG William W. Watkins, Jr.
July 1969–August 1970

MG Ernest Graves
December 1970–December 1973

BG Walter Bachus
January 1974–July 1975

North Central Division

Division Engineers

CONTINUED

BG Robert L. Moore
July 1975–February 1978

MG Richard L. Harris
July 1978–November 1980

BG Scott B. Smith
December 1980–July 1983

BG Jerome Hilmes
July 1983–August 1985

North Central Division

Division Engineers

CONTINUED

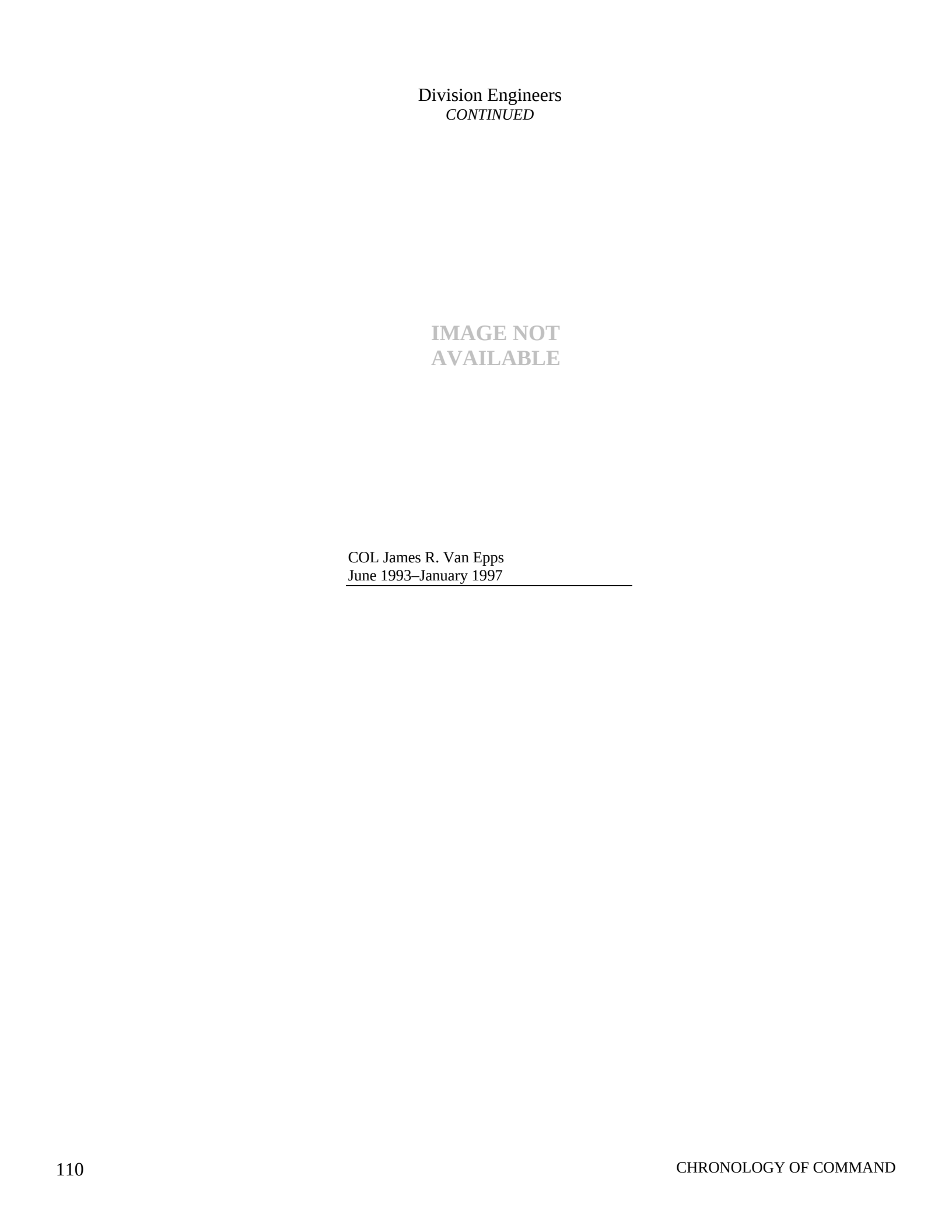
BG Joseph Pratt
August 1985–August 1987

BG Theodore Vander Els
August 1987–October 1989

BG Jude W. Patin
October 1989–February 1992

BG Russell Fuhrman
February 1992–June 1993

North Central Division



COL James R. Van Epps
June 1993–January 1997

LIST OF ACRONYMS

ADP	Automated Data Processing Center
ASACW	Assistant Secretary of the Army for Civil Works
BRAC	Base Realignment and Closure
CDF	confined disposal facility
CEPCSP	Corps of Engineers' Postal Construction Support Office
CRREL	Cold Regions Research and Engineering Laboratory
DDE (PM)	deputy district engineer for project management
DERP-FUDS	Defense Environmental Remediation Program–Formerly Used Defense Sites
DMRP	Dredged Material Research Program
EIS	environmental impact statements
EMP	Environmental Management Program
EOC	emergency operations center
EPA	Environmental Protection Agency
FAC	Field Advisory Committee
FEMA	Federal Emergency Management Agency
FWPCA	Federal Water Pollution Control Administration
FTE	Full-Time Equivalent
FWS	Fish and Wildlife Service
GREAT	Great River Environmental Action Team
IJC	International Joint Committee
IWS	Illinois Waterway System
LRD	Great Lakes and Ohio River Division
MACOM	Major Army Command
NCD	North Central Division
NEPA	National Environmental Policy Act
OCE	Office of the Chief of Engineers
RSO	Regional Statistics Office
SPIRE	Snow, Permafrost, and Ice Research Establishment
UMRBA	Upper Mississippi River Basin Association
UMRBC	Upper Mississippi River Basin Commission
UMRSEM	Upper Mississippi River System Environmental Management
UM&MVD	Upper Mississippi and Missouri Valley Division
USPS	United States Postal Service
WRDA	Water Resources Development Act of 1986

NOTES

Introduction

1. Background on the formation and early years of the Corps of Engineers and the Corps of Topographical Engineers can be found in U.S. Army Corps of Engineers (USACE), Office of History (Office of History), *The History of the U.S. Army Corps of Engineers* (Washington, DC: GPO, 1998), 1–49; Todd Shallat, *Structures in the Stream: Water, Science, and the Rise of the U.S. Army Corps of Engineers* (Austin: University of Texas Press, 1994); Frank Schubert, *Vanguard of Expansion: Army Engineers in the Trans-Mississippi West, 1819–1879* (Washington, DC: GPO, 1980), vii–xii, 1–17; and Frank Schubert, ed., *The Nation Builders: A Sesquicentennial History of the Corps of Topographical Engineers* (Washington, DC: GPO, 1988).

2. Regional descriptions are based on Detroit District and Great Lakes Commission, *Living with the Lakes* (Detroit, MI, 1999); USACE, *Water Resources Development in Illinois, 1995* (Chicago, IL, 1995), 7–26; USACE, *Water Resources Development in Michigan, 1995* (Detroit, MI, 1995), 27–29; USACE, *Water Resources Development in Minnesota, 1993* (Chicago, IL, 1993), 15–18, 61; and USACE, *Water Resources Development in Wisconsin, 1995* (Chicago, IL, 1995), 15–18, 27, 57, 67, 85.

3. Information on the size and responsibilities of the districts comprising the NCD in the mid-1990s was taken from NCD, "Information Paper on NCD Headquarters, Chicago, Illinois," September 1995, NCD Public Affairs Office, Historical File, Great Lakes Regional Office (HF, GLRO).

4. Ibid.

5. Male pronouns are used exclusively to refer to the Division Engineer (and later the Chief of Engineers) in large part because a woman never occupied either of these two positions in the NCD.

Chapter I

1. Material in this chapter on Corps water resources development activities in the Great Lakes and Upper Mississippi River valley region is based on John Larson, *History of Great Lakes Navigation*, NWS–83–4 (Washington, DC: Institute for Water Resources, 1983), 1–68; Nuala Drescher and James Martin-Diaz, *Engineers for the Public Good: A History of the Buffalo District, U.S. Army Corps of Engineers* (Washington, DC: GPO, 1982), 1–235; John Larson, *Essayons: A History of the Detroit District, U.S. Army Corps of Engineers, 1841 and Forward* (Detroit: Army Engineer District, Detroit, 1995), 3–234; John Larson, *Those Army Engineers: A History of the Chicago District, U.S. Army Corps of Engineers* (Chicago: Army Engineer District, Chicago, 1980), 3–232; Roald Tweet, *A History of the Rock Island District, Corps of Engineers* (Rock Island, IL: Army Engineer District, 1975); Raymond Merritt, *Creativity, Conflict, and Controversy* (Washington, DC: GPO, 1979); Arthur Woodford, *Charting the Inland Seas: A History of the Lake Survey* (Detroit: U.S. Army Engineer District, Detroit, 1991); Leland Johnson, *The Ohio River Division, U.S. Army Corps of Engineers: The History of a Central Command* (Cincinnati, OH: U.S. Army Engineer Division, 1992), 31–66; Office of History, *History of the U.S. Army Corps of Engineers*, 29–56; Ernest Ruffner, *The Practice of the Improvement of the Non-Tidal Rivers of the United States* (Quincy, IL: Cadogan & Hatcher, 1885), 3–18, 87–118, 173–195; Betsy Mendelsohn, "Chicago Harbor before the Civil War,"

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2. Quoted in Larson, *Those Army Engineers*, 98–99.

3. Ruffner, *Practice of Improvement*, 7.

4. Program statistics are from Janet McDonnell, "An Administrative and Organizational History of the U.S. Army Corps of Engineers, 1865–1902," unpublished manuscript, Office of History, 5–6.

5. Discussion of the establishment of divisions is based on Ibid., 80–86; Merritt, *Creativity, Conflict, and Controversy*, 56–57; and Johnson, *Central Command*, 31–46. Johnson traces the origins of Corps divisions back to 1884 and provides the most complete discussion of the beginnings of divisions currently available.

6. Johnson, *Ohio River Division*, 33. The first quotation in the paragraph refers to the 1888 regulations; the second, to the 1901 regulations.

7. See, for example, USACE, *Annual Reports of the Chief of Engineers*, 1892, 1893, 1907, 1908, 1913, and 1915. See also, Merritt, *Creativity, Conflict, and Controversy*, 56–57; and McDonnell, "An Administrative and Organizational History," 80–81.

8. This section is based on Larson, *Essayons*, and Larson, *History of Great Lakes Navigation*.

9. This section is based on Larson, *Essayons*; Larson, *History of Great Lakes Navigation*; and Drescher, *Engineers and the Public Good*.

10. Office of History, *History of the Army Corps of Engineers,* 51.

11. Johnson, *Ohio River Division*, 115–119.

12. W. C. Weeks, "The Illinois Waterway," *Military Engineer* (May–June 1932): 229–235.

13. Gen. Sturgis to Sec. of Army, 3 July 1953, Box 42, Samuel D. Sturgis Papers, Office of History Research Collections (OHRC); and Office of History, *History of the Army Corps of Engineers*, 54.

14. Ibid.

15. Col. Trower to Gen. Sturgis, 10 October 1953, Box 42, Sturgis Papers. See also, Robert Stevens to Sec. of Defense, Re: Indispensability to National Defense of the Civil Works Function of the Corps of Engineers, 3 November 1953, Box 42, Sturgis Papers.

16. Earl Johnson to Chief of Engineers, Re: Review of Engineer Civil Functions, 24 February 1953, Box 44; Chief of Engineers to Executive Officer, memorandum, 8 June 1953, Box 61; and Earl Johnson to Gen. Sturgis, Re: Review of the Corps of Engineers Field Organization, 18 June 1953, Box 44, all in Sturgis Papers.

17. Gen. Robinson to Earl Johnson, Re: Review of Engineer Field Structure, 31 July 1953, Box 44, Sturgis Papers.

18. Ibid.

19. Gen. Robinson to Earl Johnson, Re: Review of Engineer Field Structure, 30 September 1953; Gen. Robinson to Gen. Sturgis, Re: District and Division Reorganization Plans, 20 October 1953; Earl Johnson to Gen. Robinson, Re: Review of Engineer Field Structure, 20 October 1953; Earl Johnson to Sec. Stevens, Re: Review of Engineer Field Structure, 20 October 1953; and Gen. Sturgis to Sec. of Army, Re: Reorganization of the Field Structure of the Corps of Engineers., n.d., all in Box 44, Sturgis Papers.

20. Gen. Sturgis, "Meeting with Secretary of the Army," memorandum, 1 December 1953; Mendel Rivers to Robert Stevens, 9 November 1953; and Robert Stevens to Mendel Rivers, n.d., all in Box 44; and Robert Stevens to Chief of Engineers, Re: Review of Engineer Field Structure, 7 January 1954; and Gen. Sturgis to George Roderick, Re: Review of Engineer Field Structure, 19 April 1054, both in Boxes 44 and 60, all in Sturgis Papers.

21. Gen. Sturgis and George Roderick, Re: Review of Engineer Field Structure, 19 April 1954, Boxes 44 and 60, Sturgis Papers.

22. Gen. Sturgis, "UMVD–GLD Consolidation," memorandum, 29 May 1954, Box 44, Sturgis Papers. As recorded in his memo, Sturgis emphasized two points to the secretary's staff: "The presentation was not a request to reorganize but information to them, and the Chief of Engineers had traditionally made organizational changes he saw fit from time to time as necessary for efficient operations and I assumed that this authority continued."

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24. Daily Log: Civil Works, 10 June 1954, Box 45; Col. Freeman to Gen. Sturgis, 8 July 1954, Box 54; Diary, Executive Office, 7 July 1954, Box 43; and Col. Ghelardi to Gen. Sturgis, 6 August 1954, Box 54, all in Sturgis Papers.

25. Col. Trower to Gen. Sturgis, 6 August 1954; Col. Trower to Gen. Sturgis, 4 September 1954; and Col. Ghelardi to Gen. Sturgis, 3 September 1954, all in Box 54, Sturgis Papers.

26. Gen. Robinson to Col. Trower, 25 June, 7 October 1954, Box 44, Sturgis Papers.

27. Col. Trower to Gen. Sturgis, 2 November 1954, Box 54, Sturgis Papers.

28. Col. Trower to Gen. Sturgis, 12 January 1955, Box 54, Sturgis Papers.

29. Ibid.

30. Woodford, *Charting the Inland Seas*, 185–188.

31. Gen. Sturgis to Sec. of Army, 23 March 1954, Box 44, Sturgis Papers.

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3. Maj. Ira Hunt, Jr., "The Lake Survey and the Great Lakes," *Military Engineer* (May–June 1959): 184–186.

4. Material on the Corps' role in building the St. Lawrence Seaway comes from William Becker, *From the Atlantic to the Great Lakes: A History of the U.S. Army Corps of Engineers and the St. Lawrence Seaway* (Washington, DC: GPO, 1984), 1–105; Drescher and Martin-Diaz, *Engineers for the Public Good*, 268–277; Maj. Gen. Bernard Robinson, "The St. Lawrence Seaway Project," *Military Engineer* (July–August 1954): 245–248; Loren Olmstead, "Progress on the St. Lawrence Seaway," *Military Engineer* (January–February 1957): 1–4; and Maj. James Neil, "The Fourth Seacoast," *Military Engineer* (November–December 1965): 383–386.

5. Col. Trower to Gen. Sturgis, 8 January 1954; and Col. Trower to Gen. Sturgis, 10 May 1954, both in Box 54, Sturgis Papers.

6. Gen. Robinson to Gen. Sturgis, "Visit of Dr. Danielian," memorandum, 9 December 1953; Gen. Sturgis to Col. Trower, 11 December 1953; Col. Trower to Gen. Sturgis, 21

December 1953; Col. Trower to Gen. Sturgis, 8 February 1954; and Col. Trower to Gen. Sturgis, 2 June 1954, all in Box 54, Sturgis Papers; and Becker, *From the Atlantic to the Great Lakes*, 32–33.

7. Col. Trower to Gen. Sturgis, 8 January 1954, Box 54; Col. Trower to Gen. Sturgis, 11 January 1954, Box 184; Gen. Robinson to Col. Trower, 15 February 1954, Box 184; Gen. Itschner to Col. Trower, 2 March 1954, Box 184; and Col. Trower to Gen. Sturgis, 10 May 1954, Box 54, all in Sturgis Papers.

8. Col. Trower to Gen. Sturgis, 6 August 1954, Box 54, Sturgis Papers.

9. Col. Trower to Gen. Sturgis, 4 September 1954; and Col. Trower to Gen. Sturgis, 2 November 1954, both in Box 54, Sturgis Papers.

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11. Col. Trower to Gen. Sturgis, 11 and 29 April 1954; and Col. Berrigan to Gen. Sturgis, 5 July 1954, both in Box 54, Sturgis Papers.

12. Gen. Sturgis to Col. Berrigan, 28 September 1955, Box 54, Sturgis Papers.

13. Brigadier General Paul D. Berrigan, interview by John Greenwood, 19 November 1980, transcript, OHRC, 392, see also 389–391.

14. Quoted in Drescher and Martin-Diaz, *Engineers for the Public Good*, 277.

15. Col. Trower to Gen. Sturgis, 9 March 1953, Box 54, Sturgis Papers; and Berrigan, interview, 391. For background on connecting channels and harbor deepening, see Larson, *Essayons*, 200–209, and Larson, *History of the Great Lakes Navigation*, 69–73.

16. Berrigan, interview, 392–394.

17. Background on the new Poe Lock is from Larson, *Essayons*, 201, 210–213, Larson, *History of the Great Lakes Navigation*, 73–74; and C. A. Aune, "The Soo Locks," *Military Engineer* (January–February 1966): 34–37.

18. U.S. Congress, House of Representatives, *Illinois Waterway and Grand Calumet River, Ill. and Ind. (Calumet-Sag, Navigation Project)*, House Doc., 45, 85th Cong., 1st sess., 1–24; Col. Trower to Gen. Sturgis, 8 February 1954, Box 54, Sturgis Papers; Larson, *Those Army Engineers*, 225–231; and Lt. Col. H. J. St. Clair, "Cal-Sag—A Vital Link," *Military Engineer* (January–February 1958): 46–49.

19. Gen. Itschner to Gen. Sturgis, "Calumet-Sag Channel," memorandum, 25 March 1954; Gen. Itschner to Gen. Sturgis, "Local Cooperation in the Calumet-Sag Project," memorandum, 23 June 1954; and Col. Trower to Gen. Sturgis, 10 May 1954, all in Box 54, Sturgis Papers; Berrigan, interview, 390–391; and USACE, *Water Resources Development in Illinois 1995*, 52–53.

20. For background on the Niagara Falls issues, see Drescher and Martin-Diaz, *Engineering for the Public Good*, 257–258; and Col. Trower to Gen. Sturgis, 9 March 1953, Box 54, Sturgis Papers.

21. Col. Trower to Gen. Sturgis, 4 September 1954; and Col. Trower to Gen. Sturgis, 2 November 1954, both in Box 54, Sturgis Papers.

22. Col. Trower to Gen. Sturgis, 9 March 1953; Col. Trower to Gen. Sturgis, 8 June 1953; Col. Trower to Gen. Sturgis, 10 December 1954; Col. Trower to Gen. Sturgis, 29 April 1955; and Col. Berrigan to Gen. Sturgis, 5 July 1955, all in Box 54, Sturgis Papers.

23. "NCD Workload, Civil Works," General Files, Box 55, OHRC.

24. Larson, *Those Army Engineers*, 261–267, Larson, *Essayons*, 246–247; Christina M. Carlson and Robert Lyon, *Last Line of Defense: Nike Missile Sites in Illinois* (Denver, CO; National Park Service, 1996), 5–77; Lieut. Gen. W. K. Wilson to Brig. Gen. T. D. Rodgers, 22

August 1961, Civil Works, Periodic Letters, 1960–1962, Box 11, OHRC; and William Baldwin, "Military Construction Organization in the Field, 1947–1989," unpublished manuscript, Office of History.

25. Brig. Gen. Rodgers to Lieut. Gen. Itschner, 30 December 1960; Itschner to Rodgers, 13 January 1961; Rodgers to Itschner, 2 February 1961; and Gen. Barney to Gen. Rodgers, 20 April 1961, all in Civil Works, Periodic Letters, 1960–1962, Box 11, OHRC; Larson, *Those Army Engineers*, 261–267, and Larson, *Essayons*, 246–247.

26. Discussion of the postal construction program is based on Dennis S. Lavery, "The Postal Support Effort in the Corps of Engineers," unpublished manuscript, Military Files, XV–3–4; and Corps of Engineers Postal Construction Support Office to Division Engineers, Re: Post Office Design, Construction, and Real Estate Responsibilities at the Regional Headquarters Level, 28 May 1971, Military Files, XV–3–5, both at OHRC; Larson, *Those Army Engineers*, 267, and Larson, *Essayons*, 248.

Chapter III

1. Beatrice H. Holmes, *A History of Federal Water Resources Programs and Policies, 1961–1970*, Miscellaneous Publication No. 1379 (Washington, DC: U.S. Department of Agriculture, Economics, Statistics, and Cooperatives Service, 1979), 37–42.

2. Ibid., 40–42.

3. Ibid., 42–46; and James Moore and Dorothy Moore, *The Army Corps of Engineers and the Evolution of Federal Flood Plain Management Policy* (Boulder, CO: University of Colorado, 1989), 56–57.

4. Holmes, *Water Resources Programs and Policies*, 42–46; and Moore and Moore, *Federal Flood Plain Management Policy*, 57–58.

5. Discussion of the NCD's move into river-basin planning in the 1960s is based on Larson, "Engineers and Public Servants," 1983, 3–4–46 to 3–4–51.

6. Quotation in Larson, "Engineers and Public Servants," 3–4–46B.

7. Upper Mississippi River Comprehensive Basin Study Coordinating Committee, "Upper Mississippi River Comprehensive Basin Study, Main Report" (1972).

8. Merritt, *Creativity, Conflict, and Controversy*, 117, and Raymond H. Merritt, *The Corps, the Environment, and the Upper Mississippi River Basin* (Washington, DC: GPO, 1984), 93.

9. Quotation in Larson, "Engineers and Public Servants," 3–4–46C; and Moore and Moore, *Federal Flood Plain Management Policy*, 83–85.

10. Lt. Gen. William Cassidy, "A New Look at Water-Resources Development," *Military Engineer* (September–October 1966): 323–325, quotation on 323; and Moore and Moore, *Federal Flood Plain Management Policy*, 58.

11. Cassidy, "A New Look at Water-Resources Development," 342.

12. Ibid., 325.

13. Holmes, *History of Federal Water Resources Programs*, 43, 119–121; and Moore and Moore, *Federal Flood Plain Management Policy*, 58.

14. Quotation in Larson, "Engineers and Public Servants," 3–4–48.

15. Quotation in ibid., 3–4–49.

16. Quotation in ibid.

17. Ibid., 3–4–49A.

18. Gen. T. Rogers to Gen. Itschner, 30 December 1960, Civil Works, Periodic Letters, 1960–1962, Box 11, OHRC.

19. Terence Kehoe, *Cleaning Up the Great Lakes: From Cooperation to Confrontation* (Dekalb, IL.: Northern Illinois University Press, 1997), 3–13; January Miller, *Confined Disposal Facilities on the Great Lakes* (Chicago, IL: U.S. Army Engineer Division, North Central, 1993), 1; Martin Reuss, *Shaping Environmental Awareness: The United States Army Corps of Engineers Environmental Advisory Board, 1970–1980* (Washington, DC: GPO, 1983), 3–6; Theodora Colborn et al., *Great Lakes, Great Legacy?* (Washington, DC: The Conservation Foundation and the Institute for Research on Public Policy, 1990), xxiv–xxix; and Holmes, *History of Federal Water Resources Programs*, 137–139.

20. Gen. Dodge to Gen. Cassidy, 12 July 1965; Gen. Cassidy to Gen. Dodge, 5 August 1965; Gen. Dodge to Gen. Cassidy, 3 November 1965; and Gen. Dodge to Gen. Cassidy, 6 September 1966, all in Civil Works, Periodic Letters, 1963–1965, Box 11, OHRC.

21. Gen. Roy T. Dodge, statement (Chicago, IL, Engineer Division, 16 September 1966), cited in Larson, "Engineers and Public Servants," 3–4–20; and Brigadier General Roy T. Dodge, interview by Lynn Simms, 26 February 1982, transcript, OHRC, 103.

22. Gen. Cassidy to Gen. Dodge, 30 September 1966, Civil Works, Periodic Letters, 1966–1967, Box 11, OHRC; and Miller, *Confined Disposal Facilities*, 1–2.

23. Miller, *Confined Disposal Facilities*, 1–2; and Gen. Dodge to Gen. Cassidy, 27 February 1967, Civil Works, Periodic Letters, 1966–1967, Box 11, OHRC. See also Gen. Dodge to Gen. Cassidy, 25 May, 24 August 1967; and Gen. Tarbox to Gen. Cassidy, 1 December 1967, all in Civil Works, Periodic Letters, 1966–1967, Box 11, OHRC.

24. Larson, *Essayons*, 250, 21; Miller, *Confined Disposal Facilities*, 1–2; Brigadier General Robert Tarbox, interview by Carroll Pursell, 1 August 1983, transcript, OHRC, 75–77.

25. Larson, *Essayons*, 251.

26. Ibid.; and Miller, *Confined Disposal Facilities*, 2.

27. U.S. Congress, House of Representatives, *Hearings before a Subcommittee on Appropriations*, 92nd Cong., 2nd sess., 14 March 1972, 1384–85.

28. Larson, *Those Army Engineers*, 275–277, quotation on 276; Larson, *Essayons*, 287–294.

29. Quotation in Larson, *Those Army Engineers*, 278.

30. Larson, *Essayons*, 253–260, 287–294; Drescher and Martin-Diaz, *Engineers for the Public Good*, 280–288; Larson, *Those Army Engineers*, 278–279; Gen. Moore to Gen Gribble, 27 February 1976; and Gen. Moore to Gen. Gribble, 28 May 1976, both in General Files, Periodic Letters, Box 55, OHRC.

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34. Gen. Tarbox to Gen. Cassidy, 28 November 1966; and Gen. Tarbox to Gen. Cassidy, 23 February 1966, both in Civil Works, Periodic Letters, 1966–1967, Box 11, OHRC.

35. Gen. Tarbox to Gen. Cassidy, 1 December 1967, Civil Works, Periodic Letters, 1966–1967, Box 11, OHRC; and Tarbox, interview, 79–80.

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37. American Falls International Board, "Preservation and Enhancement of the American Falls," 2, 34.

38. Gen. Dodge to Gen. Wilson, 16 July 1964, Civil Works, Periodic Letters, 1963–1965, Box 11, OHRC.

39. International Joint Commission (IJC), "Interim Report on the Regulation of Great Lakes Levels," July 1968, 9–10; NCD, "Summary Report: Great Lakes Shoreland Damage Study," February 1979, 2; NCD, "Water Levels of the Great Lakes, Report on Lake Regulation: Main Report," December 1965, 1–4, 57; and Gen. William Gribble to Gen. Wilson, 28 August 1963, Civil Works, Periodic Letters, 1963–1965, Box 11, OHRC.

40. Ibid.; and Dodge, interview, 99–100.

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42. Gen Cassidy to Gen. Dodge, 22 June 1967, Civil Works, Periodic Letters, 1966–1967, Box 11, OHRC.

43. IGLWLB, "Regulation of Great Lakes Water Levels," December 1973, 4–5.

44. Project Management Team, "Living with the Lakes," July 1989, 1.

45. Ibid., 2.

46. Ibid., ii.

47. LRSB, "Levels Reference Study," 31 March 1993, v.

48. Brig. Gen. Russell L. Fuhrman, end of tour interview by John Anfinson, 7 June 1993, draft copy in author's possession.

49. Colborn et al., *Great Lakes, Great Legacy?* quotation on xxvii, see also 109–110.

50. Gen. Moore to Gen. Gribble, 28 May 1976, General Files, Periodic Letters, Box 55, OHRC; NCD, "Corps of Engineers Involvement in International Joint Commission Board Activities," 30 September 1981, HF, GLRO; and Fuhrman, interview, 13.

51. Gen. Dodge to Gen. Wilson, 9 October 1964, Civil Works, Periodic Letters, 1963–1965, Box 11, OHRC. Discussion of navigation season extension is based on John Hanna, "Extending the Great Lakes Navigation Season," *Military Engineer* (September–October 1974):

309–311; Detroit District, “Interim Report: Great Lakes–St. Lawrence Seaway Interim Report on Navigation Season Extension,” July 1974, 1–90, Detroit District, “Final Environmental Statement, Fiscal Year 1977, Navigation Season Extension Demonstration Program,” September 1976, Detroit District, “Supplement to Operations and Maintenance, Environmental Impact Statement of the Federal Facilities at Sault Ste. Marie, Michigan, Addressing Limited Season Operation Extension,” July 1979, Detroit District, “Final Survey Study for Great Lakes and St. Lawrence Seaway Navigation Season Extension,” vol. 1 (August 1979), Detroit District, “Draft EIS, Supplement II to the Final Environmental Impact Statement, Operations, Maintenance, and Minor Improvements of the Federal Facilities at Sault Ste. Marie, Michigan,” July 1977, Detroit District, “Operation of the Lock Facilities to 31 January +/- 2 Weeks,” March 1988; and Larson, *Essayons*, 262–270, 322–337.

52. Gen. Robert L. Moore, presentation to the Chicago Association of Commerce and Industry, 10 December 1975, NCD Public Affairs Files, HF, GLRO; see also Gen. Moore to Gen. Gribble, 27 February 1976; and Gen. Moore to Gen. Morris, 1 September 1976, both in General Files, Periodic Letters, Box 55, OHRC; and Gen. Robert L. Moore, presentation to the IJC, 27 July 1976, NCD Public Affairs Files, HF, GLRO. Gen. Ernest Graves, who was NCD Engineer when the navigation season extension program started, had a more cynical take on the matter. In a 1985 interview, he commented that navigation season extension could never overcome environmental and power company opposition and so the judgment was made to keep the operation alive as a study: “The conclusion was that if they could think of reasons to go on studying it, they could think of reasons to go on passing ships, because the experimental work to pass the ships was allowing them to do what they wanted to do. They were going to have a perpetual study which would be doing the same things that the project would do. They would be allowed to do these things without an authorized project. If you said, ‘All right, the study is finished, now we want it to be authorized,’ they wouldn’t ever get it authorized, and then they wouldn’t be able to do it any more.” Gen. Ernest Graves, interview in Frank N. Schubert, *Engineer Memoirs: Lieutenant General Ernest Graves* (Alexandria, VA: USACE, 1997), 138–139.

Chapter IV

1. Schubert, *Engineer Memoirs*, 130, 132.

2. Ibid., 132–135, 144–146, 150–151. When Gen. Robert Moore became NCD Commander, he apparently discovered that drift had once again set in. He reported to the Chief of Engineers that he had reinstituted Gen. Graves’s system that tied district engineers to program execution. See remarks in “Briefing given by BG Robert Moore at the visit of Chief of Engineers,” 5 August 1976, HF, GLRO.

3. Material on the construction, operation, and maintenance of the Corps’ nine-foot channel project comes from William O’Brien, Mary Rathbun, and Patrick O’Bannon, *Gateways to Commerce* (Denver, CO: National Park Service, 1992), 11–134; John Anfinson, “The Upper and Middle Mississippi River History, 1866–1993,” in USACE, “Floodplain Management Assessment” (St. Paul, MN: U.S. Army Engineer District, St. Paul, May 1995), 1–18, John Anfinson, *Commerce and Conservation on the Upper Mississippi River* (St. Paul, MN: U.S. Army Engineer District, St. Paul, 1993); Merritt, *The Corps, the Environment, and the Upper Mississippi River Basin*, 1–97, Merritt, *Creativity, Conflict, and Controversy*, 187–208, 417–420; and Tweet, *History of Rock Island District*, 255–282.

4. Anfinson, "Upper and Middle Mississippi River History," 4–5. For background on the Corps' flood-control responsibilities in general, see Joseph Arnold, *The Evolution of the 1936 Flood Control Act* (Fort Belvoir, VA: USACE, 1988), 1–100; and Moore and Moore, *Federal Flood Plain Management Policy*, 1–136.

5. Anfinson, "Upper and Middle Mississippi River History," quotation on 6. Congress was also responding to flood-control problems on California's Sacramento River when it passed the 1917 measure.

6. Ibid., 6–7.

7. Merritt, *Creativity, Conflict, and Controversy*, 348–352; and Tweet, *History of the Rock Island District*, 317–323.

8. Gen. Dodge to Gen. Cassidy, 12 July 1965, Civil Works Periodic Letters, 1963–1965, Box 11, OHRC.

9. Gen. Tarbox to Gen. Cassidy, 28 February 1969, cited in Larson, "Engineers and Public Servants," 3–4–39.

10. Merritt, *Creativity, Conflict, and Controversy*, 352–353.

11. Gen. Tarbox to Gen. Cassidy, cited in Larson, "Engineers and Public Servants," 3–4–41.

12. Quotation in Larson, "Engineers and Public Servants," 3–5–41; and Moore and Moore, *Federal Flood Plain Management*, 95–98, 108.

13. Ibid., 3–5–41; Merritt, *The Corps, the Environment, and the Upper Mississippi River Basin*, 73–78.

14. Quotation in Larson, "Engineers and Public Servants," 3–5–52.

15. Merritt, *The Corps, the Environment, and the Upper Mississippi River Basin*, 79–81; and Moore and Moore, *Federal Flood Plain Management*, 124–126.

16. Gen. Moore to Gen. Gribble, 28 May 1976, General Files, Periodic Letters, Box 55, OHRC.

17. Sen. William Proxmire quoted in Merritt, *The Corps, the Environment, and the Upper Mississippi River Basin*, 81; and Gen. Gribble to Gen. Moore, 2 July 1976, General Files, Periodic Letters, Box 55, OHRC.

18. This account of the 1993 flood is based on NCD, "The Great Flood of 1993, Post-Flood Report, Upper Mississippi River and Lower Missouri River Basins: Main Report," September 1994; Lower Mississippi Valley Division, "Impacts of the Great Flood of 1993, Upper Mississippi River and Lower Missouri River Basins," July 1996; USACE, Civil Works–Emergency Operations, "Information Paper, Midwest Flood of 1993," November 1993; USACE, Civil Works, Emergency Operations, to Office of Management and Budget, "Levee Rehabilitation Policy as authorized by Public Law 84–99," memorandum, 22 July 1993; Col. Richard W. Craig, "The '93 Flood Redux: The North Central Division," *Military Engineer* (March–April 1994): 4–5; and Alan Mairson, "The Great Flood of 1993," *National Geographic* 185 (January 1994): 42–81.

19. Leslie Allen, "Seeking Higher Ground," *Preservation* 52 (July–August 2000): 38–43, 93, quotation on 39; and NCD, "Great Flood of 1993," 59.

20. USACE, "Floodplain Management Assessment of the Upper Mississippi River and Lower Missouri Rivers and Tributaries," June 1995, quotation in att. 2–4.

21. Ibid., 7.

22. Gen. Watkins's remarks cited in Larson, "Engineers and Public Servants," 3–5–4. For the change in the Corps' thinking about environmental matters, see Reuss, *Shaping Environmental Awareness*, 1–6.

23. Schubert, *Engineer Memoirs*, 134.

24. Quoted in Larson, "Engineers and Public Servants," 3–5–6.

25. Ibid., 3–5–7.

26. OCE, "Effects of NEPA on Corps Studies and Projects (Civil Works): 1970 through 1976," January 1977; and briefing given by Gen. Moore to Chief of Engineers, August 1976, HF, GLRO.

27. Merritt, *The Corps, the Environment, and the Upper Mississippi River Basin*, 69–70.

28. Ibid., 68.

29. Ibid., 70; and Gen. Graves quoted in Larson, "Engineers and Public Servants," 3–5–9/3–5–10.

30. Gen. Graves quoted in Larson, "Engineers and Public Servants,"3–5–10.

31. Merritt, *The Corps, the Environment, and the Upper Mississippi River Basin*, 70, 94.

32. Ibid., 72, 94–97

33. Ibid., 96; Upper Mississippi River Basin Commission, "GREAT, A Study of the Upper Mississippi River" (St. Paul, MN: U.S. Army Engineer District, St. Paul, 1980), 1: ii–6; Gen. Moore to Gen. Gribble, 27 February, 28 May, 1 September 1976, General Files, Periodic Letters, Box 55, OHRC; and Tweet, *History of the Rock Island District*, 340–341.

34. Gen. Moore to Gen. Gribble, 27 February, 28 May 1976, General Files, Periodic Letters, Box 55, OHRC.

35. Merritt, *The Corps, the Environment, and the Upper Mississippi River Basin*, 72, 96; Tweet, *History of the Rock Island District*, 336; and Gen. Moore to Gen. Gribble, 27 February 1976, General Files, Periodic Letters, Box 55, OHRC.

36. Merritt, *The Corps, the Environment, and the Upper Mississippi River Basin*, 70–71.

37. Ibid., 96–97; and Tweet, *History of the Rock Island District*, 340–342.

38. Quoted in Larson, "Engineers and Public Servants," 3–5–16; and NCD, "Information Paper: GREAT Studies," 6 January 1982.

39. Upper Mississippi River Basin Commission (UMRBC), "Comprehensive Master Plan for the Management of the Upper Mississippi River System," January 1982, 1–3. See also Martin Reuss, *Reshaping National Water Politics: The Emergence of the Water Resources Development Act of 1986* (Ft. Belvoir, VA: U.S. Army Corps of Engineers Institute for Water Resources, 1991), 52–57.

40. UMRBC, "Comprehensive Master Plan," 5, 39–141.

41. Ibid., 157–169.

42. Ibid., iii, 171–175.

43. Upper Mississippi River Basin Association, St. Paul, MN, "Comprehensive Master Plan for the Management of the Upper Mississippi River System, Implementation Status Report," February 1985, xi.

44. Ibid., 35–40.

45. Water Resources Development Act of 1986 (PL 99–662), sec. 1103.

46. Discussion of the EMP is derived from John Doyle, Jr., and William Horn, Memorandum of Agreement between the Department of the Army and the Department of the Interior for Implementation of the Upper Mississippi River System Environmental Management Program, August–September 1987, HF, GLRO; NCD, "Upper Mississippi River System

Environmental Management Program, Sixth Annual Addendum," May 1991; Brig. Gen. Jude Patin and Thomas E. Hempfling, "Environmental Management of the Mississippi: A Model Partnership," *Military Engineer* (March–April 1991): 9–11; Rock Island District, "Report to Congress: An Evaluation of the Upper Mississippi River System Environmental Management Program," December 1997; Fuhrman, interview; and Lieut. Gen. Joe N. Ballard to Sec. of the Army, Re: Modification of Authority for the Upper Mississippi River System—Environmental Management Program, 3 February 1999, HF, GLRO.

47. Gen. Hatch to Gen. Vander Els, 30 May 1989, General Files, Periodic Letters, 113b, OHRC.

48. Patin and Hempfling, "A Model Partnership," 11; Gen. Patin to USACE Commander, 2 March 1990, General Files, Periodic Letters, Box 113b, OHRC; and Col. James Van Epps, "Status Report on the Civil Works Activities in the North Central Division, Fiscal Year 1998," 21 March 1997, 5, HF, GLRO.

49. Rock Island District, "Report to Congress," December 1997, ii.

50. Ibid.; and Ballard to Sec. of Army, 3 February 1999.

51. Fuhrman, interview.

52. Quotation in Larson, "Engineers and Servants," 3–5–57 to 3–5–58.

53. Gen. Moore to Gen. Gribble, 27 February, 28 May 1976; Gen. Morris to Gen. Moore, 2 July 1976; and Gen. Moore to Gen. Morris, 1 September 1976, all in General Files, Periodic Letters, Box 55, OHRC.

54. Larson, "Engineers and Servants," 3–5–63; and Gen. Jerome Hilmes to Gen. Bratton, 6 July 1984, 4 February 1985, General Files, Periodic Letters, Box 113b, OHRC.

55. Schubert, *Engineer Memoirs*, 136.

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1. Gen. Hilmes to Gen. Bratton, 12 August 1983, Civil Works, Periodic Letters, 1982–1984, Box 11, OHRC.

2. Dean Eitel, interview by William F. Willingham, 21 Sept. 2000, tapes in HF, GLRO; and Larson, "Engineers and Public Servants," 3–6–3 to 3–6–6.

3. Eitel, interview; and Larson, "Engineers and Public Servants," 3–6–6 to 3–6–9.

4. *Engineer Update* (Washington, DC), July 1979; and Maj. Gen. E. R. Heiberg to Division Engineers, Re: Establishing An Emergency Management Program, 17 April 1980, HF, GLRO.

5. Lt. Gen. Joseph Bratton, "1982: Challenges for the 1980s," white paper, OCE, May 1982, OHRC, 1, 11.

6. Brig. Gen. Scott Smith, remarks at the Conference of Emergency Management, 21 July 1981, HF, GLRO.

7. Maj. Gen. Richard Harris to District Engineers, Re: Establishing an Emergency Management Program, 16 May 1980, HF, GLRO; Brig. Gen. Scott Smith to Maj. Gen. Elvin Heiberg, 13 August 1982; Brig. Gen. Hilmes to Lieut. Gen. Bratton, 13 February, 6 July 1984; and Brig. Gen. Hilmes to Lieut. Gen. Heiberg, 4 February 1985, all in General Files, Periodic Letters, OHRC.

8. Brig. Gen. Robert Moore, briefing given at NCD Office to OCE Command Inspection Team, 13 January 1976, HF, GLRO.

9. Brig. Gen. Robert Moore to Lieut. Gen. John Morris, 7 November 1977; and Lieut. Gen. John Morris to Brig. Gen. Robert Moore, 25 November 1977, both in HF, GLRO.

10. Ibid.

11. NCD, "Executive Summary to NCD Realignment Study," 25 May 1979, and NCD "Realignment Fact Sheet," 24 October 1979, both in HF, GLRO; Larson, *Those Army Engineers*, 289–290, and Larson, *Those Army Engineers*, ii, 8–9.

12. "Army Corps of Engineers Announces Reorganization and Reduction of Civil Works Activities," news release and fact sheet, 18 September 1981; and NCD, "North Central Division Engineer Announces Realignments and Manpower Reductions of Corps of Engineers Field Offices," 18 September 1981, both in HF, GLRO.

13. Eitel, interview; Brig. Gen. Scott Smith, briefing paper, 2 August 1981, HF, GLRO; Larson, *Those Army Engineers*, ii, 8–9; Brig. Gen. Scott Smith to Maj. Gen. Elvin Heiberg, 13 August 1982; and Brig. Gen. Jerome to Lieut. Gen. Bratton, 13 February 1984, both in Civil Works, Periodic Letters, OHRC.

14. Reuss, *Reshaping National Water Politics*, 1–2, 80–92, 145–146, 187–199.

15. Donita Moorhus and Gregory Graves, "The Limits of Vision: A History of the United States Army Corps of Engineers, 1988–1992," unpublished manuscript, August 1998, Office of History, 17–18.

16. Ibid., 20–22.

17. Ibid., 23–25.

18. Bory Steinberg, "Project Management: The New Emphasis at the Corps," *Military Engineer* (July 1990): 60–64, quotation on 62.

19. Moorhus and Graves, "Limits of Vision," 25–30; and Mike Welsh, *A Mission in the Desert: Albuquerque District, 1935–1985* (Albuquerque, NM: U.S. Army Engineer District, Albuquerque, 1985), 34–35.

20. Eitel, interview; and Bing Chin, interview by William F. Willingham, 21 September 2000, tapes in HF, GLRO.

21. Larry Hiipakka, interview by William F. Willingham, 29 October 2000, tapes in HF, GLRO.

22. Steinberg, "Project Management," 62.

23. Discussion of the Chicago Tunnel Flood is based on Larson, *Those Army Engineers*, ii, 96–101; Chicago District, "After-Action Report for the Great Chicago Tunnel Flood Spring 1992," 28 May 1993; NCD, "Public Affairs After-Action Report, Chicago Loop Flood," n.d., both in HF, GLRO; Capt. Michael C. Gladbach, "Dewatering the Great Chicago Flood," *Engineer Officer Bulletin* (January 1993): 3–4; "The Great Chicago Flood," *Soldiers* (July 1992): 6–7; Eitel and Hiipakka, interviews; and Fuhrman, interview.

24. Quotation in Larson, *Those Army Engineers*, ii, 98.

25. Eitel and Hiipakka, interviews.

26. Fuhrman, interview. See also Hiipakka, interview.

27. Fuhrman, interview.

28. Discussion of Corps reorganization is based on Moorhus and Graves, "Limits of Vision," 30–45; Welsh, *Albuquerque District, 1935–1985*, 34–38; and USACE, "Reorganization Study" (Headquarters, Washington, DC, 1991); USACE, "Reorganization Plan" (Headquarters, Washington, DC, 1992); and U.S. Army Corps, "The Reorganization Wrap-up," 1, no. 1 (19 November 1992), all in HF, GLRO.

29. Lieut. Gen. Henry Hatch, "Corps Reorganization," memorandum, 28 January 1992, HF, GLRO.

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35. John Zirschy, Acting Assistant Secretary of the Army (Civil Works), and Lieut. Gen. Arthur Williams, Chief of Engineers, to USACE, “District Restructuring,” memorandum, 23 August 1995; U.S. Army News Release, 1 September 1995, No. 95–49; and Maj. Gen. Stanley Genega to Commanders, Major Subordinate Commands; Directors, Laboratories, Headquarters, Staff Principals, “Directorate of Civil Works Restructuring,” memorandum, 7 April 1994, all in HF, GLRO.

36. Zirschy and Williams, memorandum, quotation from attachment, dated 23 August 1995.

37. Public Law 104–46, 13 November 1995; and USACE, News Release, No. 96–03, 7 Feb 1996; and U.S. Army, News Release, 6 June 1996, both in HF, GLRO.

38. “Delegation Tries to Halt an Army Retreat,” *Chicago Tribune*, 24 March 1996, sec. 4, p. 2; and Gov. Jim Edgar to Sec. of the Army Togo West, Jr., 22 November 1996; Rep. Sidney R. Yates to Togo West, 1 July 1996; and Senators Carol Braun, Paul Wellstone, Paul Simon, Carl Levin, and John Glenn to Sen. J. Bennet Johnston, 28 June 1996, all in HF, GLRO.

39. Gov. Edgar to Togo West, 22 November 1996, HF, GLRO.

40. Eitel, interview.

41. Ibid.; and Hiipakka, interview.

42. Eitel and Hiipaaka, interviews; and Col. Eric T. Mogren, “Briefing: U.S. Army Corps of Engineers Restructuring,” January 1997; and “Upper Mississippi and Missouri Valley Division Implementation Plan for Division Restructuring,” 1 July 1996, both in HF, GLRO.

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44. Hiipakka, interview; and Great Lakes and Ohio River Division, “U.S. Army Corps of Engineers Host Retirement and Inactivation Ceremony,” news release, No. 97–05, 9 May 1997, HF, GLRO.

Epilogue

1. Statistical material is contained in various NCD command briefing documents in the NCD Public Affairs Office records, HF, GLRO.

2. Budget information is based on the published testimony of the NCD Commanders before the Energy and Water Development Subcommittee of the House of Representatives’ Committee on Appropriations, 1967–1997, 90th–104th Congress.

3. Robert Worda, interview by William F. Willingham, 29 October 2000, tapes in HF, GLRO.

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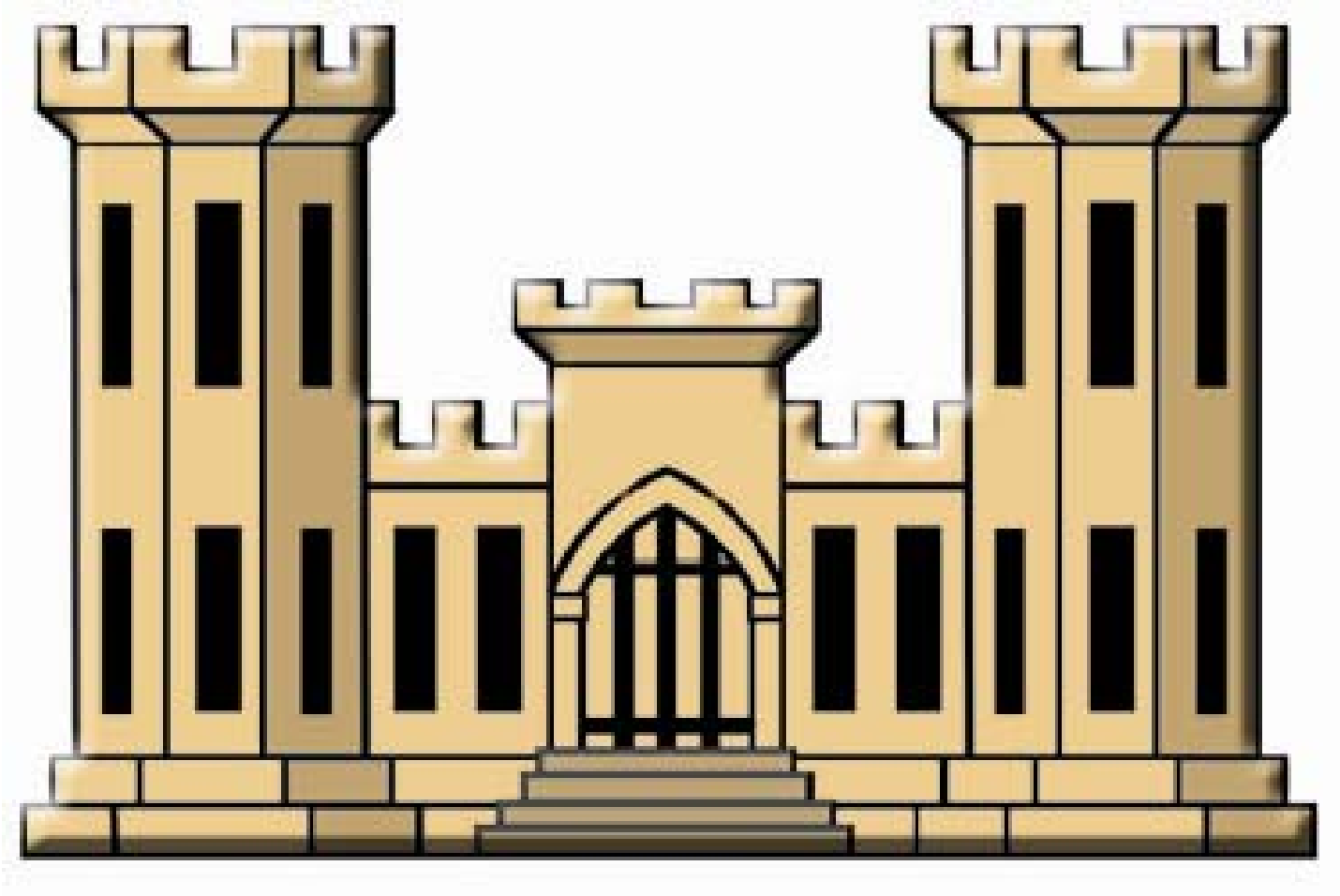

On cover:
(Background) *Snell Lock, St. Lawrence Seaway. Constructed by Buffalo District. (New York District);* (Inset) *Flooding at Joliet, Illinois, 1902. (NCD Files)*