THE FALLS CITY ENGINEERS

A HISTORY OF THE
LOUISVILLE DISTRICT
CORPS OF ENGINEERS
UNITED STATES ARMY
1970—1983

Leland R. Johnson

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE **1984**	2. REPORT TYPE	3. DATES COVERED **00-00-1984 to 00-00-1984**
4. TITLE AND SUBTITLE **A History of the Louisville District, Corps of Engineers, United States Army, 1970-1983**		5a. CONTRACT NUMBER 5b. GRANT NUMBER 5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)		5d. PROJECT NUMBER 5e. TASK NUMBER 5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **U.S. Army Corps of Engineers,Louisville District,PO Box 59,Loisville,KY,40201**		8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)		10. SPONSOR/MONITOR'S ACRONYM(S) 11. SPONSOR/MONITOR'S REPORT NUMBER(S)
12. DISTRIBUTION/AVAILABILITY STATEMENT **Approved for public release; distribution unlimited**		
13. SUPPLEMENTARY NOTES		
14. ABSTRACT		
15. SUBJECT TERMS		

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**359**	

Standard Form 298 (Rev. 8-98)
Prescribed by ANSI Std Z39-18

LOUISVILLE
CIVIL WORKS S

000531

DISTRICT
JPPORT AREA

**Refer to Inside Back cover for Military Support Area map.

THE FALLS CITY ENGINEERS

A HISTORY OF THE

LOUISVILLE DISTRICT, CORPS OF ENGINEERS

UNITED STATES ARMY

1970 – 1983

Leland R. Johnson

1984

United States Army Engineer District

Louisville, Kentucky

Library of Congress Cataloging in Publication Data

Johnson, Leland R.
A history of the Louisville District, Corps of Engineers, United States Army, 1970-1983.

Bibliography: p.
Includes index.
1. United States. Army. Corps of Engineers. Louisville District—History—20th century. 2. Ohio River Valley—Public works—History—20th century. I. Title.
UG24.K4J636 1984 358'.22'0976944 84-24462

FOREWORD

In his foreword to the history of the Louisville Engineer District, *The Falls City Engineers*, Major General Charles J. Fiala, the District Engineer in 1974, declared the first two centuries of Army Engineer activities in the Ohio Valley had been marked by high adventure, sometimes humorous and always turbulent. The recent history of the Louisville Engineer District has been no less challenging and interesting, and this update of the District history seeks to relate that recent history, to describe the significant changes which have occurred in the District as an institution, and to outline contributions made by the District to regional and national development.

As one of the first histories of Corps of Engineers field installations to be published, the 1975 history of the Louisville District attracted considerable attention. It became a university class text; it served as a reliable reference source of information about the history of the District and the Corps in general for internal elements of the Corps, for interested scholars, and for the public throughout the United States. It is expected that this description of the work and accomplishments of the Louisville District during recent years will serve essentially the same purposes.

Starting with a year of crises in 1970, when the Louisville District lost its military construction and real estate mission in direct support of the Army and Air Force and when it began its program and administrative realignment in response to the national environmental movement, this update reviews the difficulties besetting the District during the 1970s, aptly called the "decade of the environment," and details the strenuous efforts of the District to revise its civil works program in compliance with environmental legislation and other policy directives from Congress and from the several national administrations which successively directed the executive branch of the federal government after 1970. It describes the vigorous civil works construction activities of the District during a period when it completed four massive navigation modernization structures on the Ohio River and eight multiple purpose dams and lakes on tributary streams within the lower Ohio River basin along with many smaller though not less important civil works projects.

During the fourteen years under review, 1970—1983, the District responded to a broad spectrum of emergencies, not only to regional flooding, tornadoes, blizzards, and other natural or manmade disasters but also to a series of national crises requiring swift, effective action by the District to meet the needs of Americans for energy conservation, wastewater management, dam safety inspections, defense mobilization preparedness, and other exigencies as they arose. By furnishing a wide array of support services for the Army and Air Force, the Federal Emergency Management Administration, the Environmental Protection Agency, and other agencies of federal government the Louisville District earned a reputation as the "Federal Engineers," ready and able to expedite practically any sort of construction and engineering challenge. And the extensive engineering and construction expertise within the District combined with the broad experience it secured as a support service for other agencies during the 1970s maintained the readiness of the District for its renewed role in the national defense effort of the 1980s, which apparently would be marked as the "decade of defense."

While this update of the District's

history emphasizes its mission performance and accomplishments as an institution during the decade of the environment and the decade of defense along with its contributions to regional and national development, like the earlier history of the District, it also recounts the influence upon and the reaction to the operations of the District by the American public whom it serves. It devotes some attention to the dedicated services of the women and men in the District who wrestle with the daily problems and crises as they arise and who often give of themselves beyond the call of duty to assure the missions of the District are successfully completed. It is regrettable that each of those individual efforts cannot be related within this volume, but they have not gone unnoticed and their results are fully apparent in the accomplishments of the District. The record of those individual and team efforts and of the achievements of the District in service to the public during recent years gives us ample grounds for our optimism about the future of the District as a responsive human institution during the waning years of the twentieth century.

DWAYNE G. LEE
Colonel, Corps of Engineers
District Engineer and Commander
Louisville, Kentucky

CONTENTS

Written under the auspices of the Louisville Engineer District, this update of the installation history began under the direction of Colonel Charles E. Eastburn and was completed under the administration of Colonel Dwayne G. Lee. Under the terms of his assignment, the author's purpose has been to relate the activities of the Louisville District since 1970 against a general background of changing federal water resource and defense policies and of the regional development of the Ohio River basin. Because the installation history published in 1975 reviewed two centuries of Army Engineer activities within the boundaries of the modern Louisville District, its treatment of individual projects, of the District's internal organization and functioning, and of more recent history was scanty. Writing this update allowed the author to more fully treat those subjects; and to develop a more cohesive narrative he chose to begin the update with the events of 1970, a year of transition and turmoil for the Louisville District. Because of renewed interest in navigation on the Kentucky River, growing out of the District's proposal in 1980 to cease the operation of some of the locks, the author also, by direction of the District, prepared a brief account of the construction history of the locks and dams on the Kentucky which is printed as an appendix to this update. Though largely based upon the District's internal records, this study is entirely the work of the author, and the choice of material, its organization and interpretation, is solely his responsibility.

In one sense, the fourteen years in the District's history, 1970 through 1983, reviewed in this study seem a short time, amounting only to about five thousand days. But considering that experiences of each of the some one thousand employees of the District differed from those of all other personnel during each of the fourteen years, this volume could be viewed as a summation of District personnel's experiences during fourteen thousand different years. To produce a volume of manageable length, it became necessary to omit mention of many individuals and their contributions to the District's history. To the personnel thus slighted, the author offers his apology for the neglect. As philosopher Phil J. Blood once observed: "Where history is concerned, every truth is somebody's fiction."

Because interests of the general reader, as well as those of District personnel, have been taken as a basis for the selection and treatment of the information presented, many discussions of technical subjects have deliberately been simplified to avoid obscurantism for the sake of technical accuracy. For more accurate and fuller treatment of technical subjects, readers should consult sources listed in the notes and bibliography. Many figures in the text have been rounded off and are historical rather than current; consequently, readers again should consult the sources and update the figures before using them for other purposes. Readers should keep in mind that the author by training is a historian, not an engineer or technician, and his understanding of technical subjects therefore is limited.

Still, intense effort has been made to assure the accuracy of information selected for presentation, not only by the author but also by members of the District's Historical Review Committee, who located and made available materials casting light on various facets of the District's recent history and who searched the manuscript for discrepancies which escaped the author's attention. The author gratefully acknowledges the assistance of that distin-

guished panel, ably chaired by Mary R. Best and composed of Frederick R. Huelson, Martin K. Pedigo, Charlotte P. Nation, Douglas S. Blunk, Vivian J. Collins, and Charles E. Parrish. Special thanks are due to Mr. Parrish, the District historian who assisted with research, guided the author on tours of the District, and supplied unfailing editorial support; to Ray Haynes who edited the manuscript; to Mary R. Best who guided the production of this update from start to finish; to Martin Reuss of the Historical Division, Office of the Chief of Engineers, who reviewed the manuscript; to Michael P. Musick who for many years has served as the author's guide to Record Group 77 in the National Archives; to Jane Cordery who set the type; Dave Duggins and Mike Lush who did the book's layout and design; and to Charles A. Schumann, Dorothy McCraw, and Martin K. Pedigo who maintained an exhaustive newspaper clipping collection which proved invaluable to the research of this update. Without assistance of those friends, the task of the author would have been difficult if not impossible. He must also express his gratitude to District personnel who took time from busy schedules to answer questions and contribute to the education of a historian.

Leland R. Johnson
January 1, 1984

Established on March 15, 1886, the Louisville District of the Corps of Engineers, United States Army, in 1983 had a dual mission: supporting the armed services for national defense and directing a broad water resource development program mandated by Congress. For the Army and Air Force it managed real estate, provided engineering services, performed construction, and prepared for military mobilization in five states: Kentucky, Indiana, Ohio, Illinois, and Michigan. As directed by Congress, it managed federal water resource development in most of the states of Indiana and Kentucky, eastern Illinois, southwestern Ohio, and a small part of northern Tennessee, a 75,550 square-mile area comparable in size to all six New England states plus New Jersey and Delaware. Its area of civil works jurisdiction could best be described as the Lower Ohio River basin, meaning the lower 542 miles of the Ohio River and all of its tributaries except the Cumberland and Tennessee rivers which were the responsibility of the Nashville Engineer District.

Though its continuous existence as a permanent Engineer field operating agency began in 1886, its historical roots tap more deeply into the past. An Engineer suboffice opened at Louisville in 1867, and before the Civil War Captain Henry M. Shreve and Major Stephen H. Long headed the Office of Western River Improvements headquartered at Louisville from 1826 to 1856. Army Engineers had worked at Louisville while on military and topographic mapping missions even before 1826, however, and Lieutenant Thomas Hutchins, a British and American Army Engineer, mapped the Falls of the Ohio at Louisville in 1766, four years before Daniel Boone settled in Kentucky and twelve years before George Rogers Clark founded Louisville.[1]

Congress and General George Washington created the Corps of Engineers during the American Revolution to provide combat and construction support for the Continental Army. Combat engineering and military construction remained the principal functions of the Corps until Congress in 1824 made it also responsible for improving Ohio and Mississippi River navigation. The Ohio was the first river improved for navigation by the Corps of Engineers, commencing in 1824 with clearance of its channel and construction of the first federal navigation dam near Henderson, Kentucky. Aimed at establishing a minimum depth of thirty-six inches for navigation, the channel clearance project on the Ohio continued throughout the 19th century. An Engineer suboffice opened at Louisville in 1867 to build the first federal navigation locks in the canal bypassing the Falls of the Ohio, and Congress during the years after the Civil War acquired the state-constructed lock and dam systems on the Kentucky and Green rivers and approved federal navigation projects on the Wabash River and other tributaries of the lower Ohio, projects which were assigned to the Engineer "District" office established at Louisville in 1886. From the turn of the century to 1929, the Louisville District completed a chain of locks and wicket dams on the lower Ohio to create a nine-foot minimum depth for navigation, and in 1954 the District began replacing those old dams with navigation modernization structures providing a more generous capacity for increasing river traffic. By 1970 the District had most of its assigned navigation modernization structures completed or under construction.[2]

Congress in 1936 expanded the civil works mission of the Corps to include the achievement of a measure of flood control, and that monumental task in the lower Ohio River basin became the responsibility of the Louisville District. The District laid initial plans to accomplish that goal through two programs: the construction of dams and reservoirs on tributaries of the Ohio to hold some of the runoff that caused flooding, and the construction of levees and floodwalls, called local protection projects, to keep flooding out of cities and off of farmlands. After 1944 Congress broadened the flood control mission, providing for the design of reservoirs to furnish not only flood protection but also water supply, recreation, and other features thought desirable. The Louisville District therefore built multipurpose projects instead of dams and reservoirs for flood control alone, completing its first lake projects about 1952 at Cagles Mill in central Indiana and on the West Fork of Mill Creek near Cincinnati, Ohio. The District had completed twelve multipurpose dams and reservoirs by 1970 and had eight more under construction or in the advanced planning stages.[3]

After military construction in support of the Army and the Air Force (Army Air Corps) was transferred from the Army Quartermaster Corps to the Corps of Engineers in 1940 and 1941, the Louisville District designed and built airfields, troop cantonments, hospitals, ordnance plants, and a wide variety of other facilities for the Army and Air Force and also administered real estate for those two branches of the armed services. It mobilized the industrial resources and the construction industry of the lower Ohio River basin for the support of national defense during the Second World War, the Korean War, and to a lesser extent during the war in Southeast Asia. From 1961 to 1970, the District was responsible for military construction and real estate throughout the Ohio River basin from Pittsburgh to Cairo. But in 1970 the District's military mission was transferred to other Districts, not to return until 1981.[4]

As part of the Army, the chain of authority over the District's military and civil works missions has been relatively straightforward. The District Engineer, along with officers commanding the Engineer Districts at Nashville, Huntington, and Pittsburgh, reported through the Ohio River Division Engineer at Cincinnati, Ohio, directly to the Chief of Engineers in Washington, DC. In Washington, the command flow passed from the Chief of Engineers to the Secretary of the Army, who had an assistant designated for civil works, and on to the Secretary of Defense and the President. The Armed Services committees of Congress authorized military construction and real estate projects, while the Public Works committees did the same for civil works projects. Both missions were funded through the Appropriations committees. The approved programs for both missions were incorporated into the President's budget submitted to Congress each fiscal year, which ended on the last day of September in each calendar year (on the last day of June before 1976 when the date was changed). Except for small standing appropriations available during flood emergencies and the like, Congress retained very tight reins on all expenditures by the Corps of Engineers.[5]

The Chief of Engineers in Washington, DC., commanded "troops" who chiefly were the civilian career specialists of the Divisions and the Districts. That also was true of the Louisville District Engineer, or District Commander, who in 1982 commanded 1,161 fulltime civilian employees and seven Engineer officers, about half stationed at the District office in Louisville and the remainder at the various field offices scattered throughout the District to handle on-site real estate and construction problems and to operate locks and dams and manage the lakes completed by the District. The few Engineer officers rotated in and out of the District to secure practical experience with military construction and civil works in addition to training they received at Army schools and as staff officers and troop commanders. The younger officers ranked from lieutenant to lieutenant colonel and the District Engineer held the rank of colonel. The Division Engineers were either brigadier or major generals and the Chief of Engineers was a lieutenant general.[6]

The District Engineer at Louisville as elsewhere commonly served three years before transfer to other duties, a policy aimed at providing more officers with the experience and also at preserving the freedom of the officers from local influences. For many years, District Engineers have been the only unbonded contracting officers in the federal government, meaning that it has not been necessary to purchase insurance against their misuse of public funds, and the legend that only one District Engineer in all American history has ever defrauded the government is very near the truth. Forty-four officers and one civilian have served as Louisville District Engineer since 1886, the sole civilian being William H. McAlpine who commanded the District during the First World War when practically every officer had troop commands or military staff assignments.[7]

In the executive, or "front" office, the District Engineer had the assistance of a deputy, usually a major or a lieutenant colonel, a civilian executive assistant, and a small staff for the supervision of District activities and missions. He spent much of his time conducting public meetings, conferring with members of Congress and political representatives, and discussing policies and problems with other federal agencies and higher authorities in addition to routine supervision of District functions. The latter was seldom routine after 1970, however, for it seemed some sort of crisis was constantly in progress, ranging from directing emergency operations after natural disasters to handling environmental controversies or dealing with sudden changes in District missions. In the few remaining slack periods, the District Engineers usually were "targeting" some internal problems, often related to the constant pressure from higher authorities to accomplish more work with fewer personnel.[8]

The number of civilians employed by the District during the 1960s had averaged between 1100 and 1200 personnel. With the loss of the military real estate and construction mission in 1970 the number began to dwindle and by 1980 it was less than 900, a twenty-five percent reduction during the decade; the number climbed back toward 1200 after the military mission returned to the District in 1981. That workforce was organized by function, with project planners in the planning division, those who designed projects in the engineering division, construction supervisors in the construction division, and those who operated the completed locks, dams, and lakes in the operations division. Personnel handling contract awards were in the supply and procurement division and personnel who acquired lands for projects were in a real estate division. In addition, there were offices, loosely referred to as the support services, responsible for personnel matters, litigation, budget and accounting, safety concerns, administrative services, and various other functions. The internal divisions of the District were also organized by function, subdivided into branches and subordinate sections. The entire system, of course, rested upon the individuals and teams who actually performed the work.[9]

The civil works program of the District had become increasingly complicated during the 1960s especially in the planning and engineering of its flood control and multipurpose lakes. In the Water Supply Act of 1958, Congress allowed the addition of water supply storage to flood control reservoirs provided that state or local governments were willing to pay the costs of such storage, and in the 1965 Water Projects Recreation Act Congress required that state or local governments bear half the costs of project recreation features. Those cost-sharing stipulations required that the Corps of Engineers work closely with state and local interests during the planning for multiple purpose, or "multipurpose," projects as opposed to reservoir projects for the flood control purpose alone which were funded entirely by Congress. Efforts proceeded during the 1960s to improve federal, state, and local collaboration for water resource development through the initiation of elaborate comprehensive studies such as those for the Ohio River basin, Wabash River basin, and Southwestern Ohio in the Louisville District, and also through formation of river basin commissions which had both federal and state funding for cooperative planning studies.[10]

The comprehensive water resource studies went on at a fast pace during the 1960s, resulting in the authorization by Congress of a large number of multipurpose projects throughout the District, and the District constructed them at an equally rapid rate. It was referred to as the "dam a year" program, and the District did complete a new dam on the average of every eighteen months. Before 1966 there was little public opposition to the program; there seemed a common sense of community interest in the achievement of a measure of flood control in the Ohio River basin and elsewhere as a great national goal, and people seemed to take pride in the dams as magnificent engineering achievements, much as they hailed flights of the space shuttle during the early 1980s.[11]

The increasing number of dams and lakes and the expanded land acquisition required at each to serve multiple project purposes brewed major public opposition to the program during the late 1960s, however, especially from landowners who were forced to sell their lands at the sites of the dams and lakes. In 1968, when the District was participating in President Lyndon B. Johnson's campaign on behalf of the redevelopment of Appalachia through studies of the value of water resource projects as a boost to regional economic revitalization, at a public meeting concerning a proposed lake on the North Fork of the Kentucky River near Kingdom Come, the District Engineer encountered five hundred angry people, most of them opposed to the lake. "I think they've found a way to fight poverty;" quipped a local sheriff, "they're going to drown us all out."[12]

Through long experience, the District had come to expect landowners in the upstream "take" area of lake projects to line up against spokesmen from the downstream interests who would benefit from increased flood protection, but during the late 1960s it encountered a new form of opposition. The irate landowners found allies in representatives of the national ecology and environmental preservation elements of the American conservation movement who were campaigning to reduce the scope of the water resource development program or at least to make it more responsive to public concerns about environmental degradation. Environmentalists marshaled support for the landowners' opposition to water resource projects even in the downstream cities which stood to gain from the flood control, water supply, and recreation features offered by the projects.

Public criticism of the Corps of Engineers and of the federal water resource development efforts grew clamorous during the late 1960s, and in 1969 Supreme Court Justice William O. Douglas pinned the label "public enemy" on the image of the Corps. Embodying the military, the bureaucracy, and developmental technology in a single institution, the Corps made a convenient target for social activists of the 1960s. Opponents to water resource projects pictured Corps personnel as bland, unemotional, and uncaring "bureaucrats," ever ready to sacrifice people and their environment for technological development. One critic, for instance, took the Director of Civil Works for the Corps to task because in an internal memorandum to his staff he had directed them to use "believe" instead of "feel" in correspondence, the critic thereby inferring the Director had no "feelings." Similar criticism was directed at personnel of the Louisville District, as indicated by one description of a public meeting conducted by the District:

> The Colonel from the Corps of Engineers was surrounded, as most Colonels usually are, with stiff, fixed accessories in the form of pokerfaced men representing the Planning Division, Real Estate Division, Road Relocations Division, and Public Affairs Division. These "little lieutenants" assisted the Colonel in keeping the confusing figures rolling out to the crowd.[13]

Such an impression might easily prevail at a public meeting where the District Engineer and his staff had to supply the most precise information available and to preserve a uniformly courteous demeanor to project proponents and especially to opponents to encourage all to express their opinions. Yet, to those acquainted with the staff members mentioned and with the other executive leadership of the District about 1969 the adjectives "stiff" and "fixed," or bland and uncaring seem oddly inappropriate, for the staff members had uniquely vigorous personalities. Fred Morgan, the chief of real estate division who retired in 1973, has aptly been described as the "consummate diplomat." William Leegan, the chief of planning division, was selected Alumnus of the Year by the University of Kentucky in 1973. Robert H. Hayes, the chief of engineering division, earned the George W. Goethals Medal in 1974 for his engineering expertise. Then there was the very lively John R. "Jack" Bleidt, the chief of operations division with the foghorn voice of a steamboat captain, and Richard H. Russell, the chief of construction division who practiced management by confrontation, deliberately starting arguments to cut to the root of things. They were not bland or stiff personalities at all; in fact, their volatile personalities might indicate that the route to top level management within the Louisville District lay in "making waves."[14]

Nor were the colonels who served as Louisville District Engineer aptly described as "fixed" characters. Colonel Robert R. Wessels, District Engineer from 1966 to 1969, had been captured during the Battle of the Bulge in 1944 and often joked that he had been the first American soldier to cross the Rhine--as prisoner of war. As deputy to District Engineer John L. Persons in 1950, Wessels had directed the floodfight which saved Vincennes, Indiana, on the Wabash from disaster; and in 1966

LOUISVILLE DISTRICT

DISTRICT ENGINEER

COLONEL R. R. WESSELS

EXECUTIVE ASST

A. F. HUBER

DEPUTY DISTRICT ENGR

MAJOR R. H. RYAN

SECURITY

L. R. THOMPSON

ADP CENTER

H. L. FERGUSON

TECH. LIAISON

J. E. V. WAGNER

SAFETY

A. G. BAILEY

PERSONNEL

H. H. RINKEL

COUNSEL

H. A. DELOACH

ADM. SERVICES

J. A. MITCHELL

PROGRAMS

W. H. SCHULZ

COMPTROLLER

W. I. STONE

ENGINEERING

R. H. HAYES

CONSTRUCTION

R. H. RUSSELL

REAL ESTATE

FRED MORGAN

SUPPLY

C. M. KNOSP

OPERATIONS

J. R. BLEIDT

Louisville District executives in 1969 included colorful and outstanding personnel.

1969

he and Richard H. Russell of the construction division had earned Army commendations by saving from drowning a couple who somehow had landed their car in the Blue River. After leaving Louisville in 1969, Wessels served in Vietnam and then became director of a space shuttle construction office in Alabama. His successors as District Engineer, six of them from 1969 to 1983, were equally capable and colorful individuals.[15]

It was even rumored that Colonel Wessels and the District staff had a sense of humor. At a 1969 farewell party for Wessels at the Kentucky Hotel in Louisville, "Jack" Bleidt of the operations division recited a bit of doggerel which might substantiate that rumor and perhaps also hold some nostalgic interest for District personnel and others who knew the people mentioned:

Wouldn't it be nice if:

Colonel Wessels would light Monroe Crull's cigar.
Carl Flener predicted no more floods this year.
Fred Morgan bought all the real estate before we finished a project.
We found that Charles Rager bought a lot on a Corps reservoir.
Abe Harrison drilled a hole in the right place.
Dick Russell repaired the right levee.
You could catch Fred Huber working.
David Stayer lost his 1909 electrical catalogs.
Bob Johnson signed your pay check for $1,000,000.
You could catch Wally Stone not playing golf.
Someone could get Bill Schulz excited.
Harry DeLoach would say the same thing twice.
Howard Rinkel said hire anyone you wanted.
All the radios worked all of the time.
The Louisville Repair Station didn't charge "friendship prices" for all the work they do.
The computer actually saved you work.
You could catch Bill Leegan not on the phone.
You could catch Allan Baily running a red light.
You could catch Herschel St. Ledger not grinning.
Or Roy Karlen saying "Yes."
You heard C. V. Edwards lost his guide specs.
Steve Sullivan finished design on a building before it was obsolete.
Charlie Knosp actually bought what you ordered.
Jim Mitchell approved $20/day per diem.
Vince Wagner forgot and did the work himself.
Art Mills had to eat fallout shelter rations for a week.[16]

Practically all people mentioned in the list had retired or left the Louisville District by 1983, meaning that within a fourteen-year period the executive leadership of the District had a nearly complete turnover; and that was characteristic of the District as an institution: someone within the chain of command of the District was constantly being replaced with resulting changes in emphases and directions. A nearly complete sweep at the top occurred during 1969 in addition to the change in District Engineers. Richard M. Nixon succeeded Lyndon B. Johnson as President, with consequent changes in the Secretaries of Defense and Army, and Lieutenant

General William F. Cassidy ended his tour as Chief of Engineers, noting as he left that the field of water resource development was going through an upheaval with "inevitable confusion and concern." His successor, Lieutenant General Frederick J. Clarke, was to preside over a considerable reshuffling of the Corps, a realignment of its military construction responsibilities and a system overhaul to respond to its many critics, leading the Engineers into what was to become known as the "decade of the environment."[17]

The Louisville District office also enjoyed a clean sweep at the bottom in 1969, for in July its personnel began their exodus from the old offices in the 830 West Broadway Building in Louisville to the new Federal Building between Sixth and Seventh Streets. The confusion and concern involved in moving all office equipment and files, of creating a new telephone system, and of providing keys to new offices made life somewhat hazardous in 1969 for James A. Mitchell, Sue Sharpe, and James Brown of the District's administrative services office, and even for the District's computer, which rolled off a moving truck in the middle of Broadway in downtown Louisville and received a traffic ticket. "Let the computer fall where it may," quipped Wallace I. Stone, proving even the District comptroller had a sense of humor. And the ability to meet challenging situations with some sardonic humor may have had more than merely minor value in those days, when District personnel read frequent descriptions of themselves in the papers as representatives of a "public enemy" and when they had to respond to the series of crises that beset the District during 1970.[18]

LOUISVILLE DISTRICT ENGINEERS
1969—1984

Col. John T. Rhett, Jr.
08-25-69 — 08-10-72

Col. Charles J. Fiala
08-11-72 — 01-09-75

Col. James N. Ellis
01-10-75 — 08-14-77

Col. Thomas P. Nack
08-15-77 — 08-14-80

Col. Charles E. Eastburn
08-15-80 — 07-28-83

Col. Dwayne G. Lee
07-29-83 —

CHAPTER I: YEAR OF CRISES: 1970

The first Earth Day of April 22, 1970, proved a "happening" never to be forgotten, a nationwide rally heightening public awareness of the perils of pollution, of asphyxiating air, of rivers that caught fire, of bulldozers roaming the earth seeking trees and streams to devour. Crowds of students donned gasmasks and conducted mock funerals for automobiles in vivid protest of diminishing air quality. At a Louisville school, students jammed a gymnasium to overflowing, graphically portraying the teeming future of an overpopulated earth. Uncounted editorials lambasted environmental deterioration, and at rallies held at some fifteen hundred colleges and ten thousand schools across the nation speakers predicted ecological doom.[1]

Earth Day of 1970 demonstrated beyond a doubt that the budding environmental movement had genuine grassroots support throughout the nation, especially among the oncoming generation. It clearly indicated that Americans demanded a stop to further degradation of their environment and even a reversal of the damages already done by a technological society. Political leaders took notice. So did the Army Corps of Engineers and its Louisville District.

President Theodore Roosevelt, Gifford Pinchot, and other conservationists of the early 20th century had urged that better management of natural resources become a national goal. The thought of those "utilitarian" conservationists had emphasized the wise use of natural resources: the creation of national forests to preserve and manage dwindling timber resources, the establishment of national parks to preserve scenic recreational resources for the use of all Americans, and the storage of water behind dams for use instead of letting it waste in recurrent and devastating flooding. By Congressional mandate and executive order, the aims of those conservationists had been institutionalized through the assignment of work designed to achieve those aims to professionals in various agencies of government, to the Soil Conservation Service, the Bureau of Reclamation, the National Park Service, the U. S. Forest Service, the Tennessee Valley Authority, and the Army Corps of Engineers at the federal level. By 1970 the Army Engineers had been hard at work nearly a half century in the fields of resource development that were their special province: the construction of locks and dams for improved navigation and the construction of dams, levees, and channel modifications to contain flooding and also to supply water for manifold uses by the American people.[2]

But there had been another element of the conservation movement, founded by naturalist John Muir in the Far West, which contended that management and use of natural resources amounted to exploitation and destruction and argued that at least some of those resources should be preserved in an undisturbed condition. To that element of the conservation movement, which came to be popularly known as the "environmentalists," even the word "development" was anathema; hence, they cringed each time representatives of the Corps of Engineers or other federal agencies spoke of water resource development. Those heirs of John Muir were the chief organizers and popular leaders of the first Earth Day rallies in 1970.[3]

"A classic controversy in the resource field is that between those who seek to preserve our resources and those who seek to develop them," observed the Chief of Engineers a few days before the 1970 Earth Day celebrations. "Some believe that future generations will be better served not by development construction but by preservation of the remaining natural environment. The developers believe that a very vigorous development construction effort in both the public and private sectors is needed to keep abreast of the tremendously accelerating material needs of our proliferating descendants."[4]

Personnel of the Corps of Engineers and its District at Louisville deplored pollution and degradation of the environment, of water quality in particular, as strongly as any environmentalist; yet, the public criticism of their work in the fields of water resource development stung. "I can't honestly say we haven't been suffering under all the criticism," admitted Lieutenant General Frederick J. Clarke, the Chief of Engineers. To him, it seemed the Corps had been placed in the "rather unfair position of being blamed for presenting a bill by people who have forgotten that they ate the dinner."[5]

Perceptive Army Engineers recognized even before Earth Day that the environmental movement was more than a transient fad and that a redirection of Corps programs was in order if it hoped to continue to serve the public in the field of water resource development. Even before the first Earth Day, Congress had written some of the goals of the environmental movement into law, especially in the National Environmental Policy Act which became effective on January 1, 1970, and which required all federal agencies to prepare environmental impact statements for projects and actions significantly affecting the human environment. That landmark legislation and the response to it by the Corps of Engineers produced major changes in the civil works program of the Engineers and in the organization through which they administered that program.

At the national level, President Richard M. Nixon created a Council on Environmental Quality to advise him concerning implementation of the National Environmental Policy Act, and he directed the Army Engineers to use their existing authority under Section 13 ("Refuse Act") of the Rivers and Harbors Act of 1899 to enforce more stringent water quality standards pending the formation of the Environmental Protection Agency. Three weeks before the first Earth Day, the Chief of Engineers established his own Environmental Advisory Board and began rewriting Corps policies to comply with both the lettter and spirit of the National

Brig. Gen. Willard Roper, Ohio River Division Engineer in 1970, approved the formation of a Planning Division within the Louisville District. He had served as Louisville District Engineer, 1963-66.

Environmental Policy Act and subsequent related legislation. One month before Earth Day, Major General Willard Roper, the Ohio River Division Engineer who had earlier served as the District Engineer at Louisville, penned an informal directive to Colonel John Rhett at Louisville that amounted to no less than a call to arms:

> I know you recognize that some change of direction is required if we are to maintain our leadership in providing projects that are planned, designed and constructed to serve the needs of the people. The rapidly increasing national concern for deterioration of environmental quality (including ecological diversity) brings our role in relation to the environment into sharp and critical focus. Also I'm certain you recognize that goals of environmental quality lack precise definition but nevertheless reflect a strong sense of national value. Because of this imprecision it is evident that we can modify the traditional engineering values of our staffs only by positive leadership and action.
>
> I suggest that you personally review the past practices relative to project planning, design and construction impact upon environmental quality and maintain a critical evaluation of your criteria, standards and procedures with a view toward developing fully responsive staff action in all District elements. If funding is inadequate to accomplish this objective, project or study estimates should be increased accordingly. If interdisciplinary staffing is inadequate, I suggest immediate recruiting to obtain the expertise needed. Please indicate a summary of actions taken or proposed in your next quarterly letter.[6]

Planning Division Established

After warning General Roper to expect a "fairly healthy increase" in the District's budget to fund the new efforts, Colonel Rhett began employing foresters, recreation planners, landscape architects, biologists, and other professionals to staff the District's environmental resources branch and other program elements; he effectively doubled during 1970 the District's capability for environmental analysis. He also took personal interest in a study then underway of separating the District's planning requirements from those for technical engineering functions and of establishing a planning division, representing a major departure in civil works administration because no District in America then had a separate planning division.[7]

While the District's study of planning functions had direct connection with the reaction of the Engineers to the National Environmental Policy Act, its roots lay in a 1965 study in Washington of the civil works program which had recommended that Engineer field installations add economists and professionals other than engineers to their planning staffs and that there should be a "better placement of the planning function in the organization." Planning requirements in Engineer Districts had mushroomed after the Second World War, chiefly as result of the conversion of Engineer dam and lake projects from single-purpose flood control projects to multipurpose projects and as result of the initiation of comprehensive river basin studies, called parent studies, of varying water resource needs in such areas as the Wabash River basin. Both multipurpose and comprehensive planning required studies much broader in scope than engineering alone, and both necessitated extensive coordination with many federal and state agencies in addition to frequent meetings with the concerned public. By 1970, planning functions in active Engineer Districts had begun to rival technical design and engineering functions in magnitude.[8]

Individual project plans before 1970 had included general policy planning, project economics, and technical engineering data as a unit in the general design memoranda for presentation to Congress, and when

Congress determined that a particular project should not be undertaken the technical engineering sections of general design memoranda were wasted effort. It seemed more efficient to divide design memoranda into two phases, the first for plan formulation to select the most suitable general project plan and the second to provide technical engineering data and detailed project design; thus, the phase two technical engineering work would not be done until after general project plans had been approved by higher authorities. It also seemed apparent that so long as planning functions were included within engineering divisions of the Districts, they would remain subordinate to technical engineering, with few opportunities for promotion available for general planners unless they transferred to the design and technical engineering elements of Districts, and such transfers ordinarily were out of the question for biologists, foresters, and other planning specialists in professional fields outside technical engineering.[9]

William E. Leegan, first Chief of Planning Division at the Louisville District in 1970, subsequently served as Chief of the Engineering Division also.

The Ohio River Division at Cincinnati had established a planning division within its own organization on May 31, 1966, and in early 1970 Major General Willard Roper, the Division Engineer, advised Colonel Rhett that, in view of the increasing complexities of planning and the additional burdens imposed on planning by the National Environmental Policy Act, he would support the formation of a planning division within the Louisville District, which would thereby become one of the first Districts in the nation to have such an administrative element. The District's planning division, with William E. Leegan as its first chief, began operations officially on September 13, 1970, with fifty-eight personnel organized into six branches: plan formulation for preauthorization studies, comprehensive studies, and initial public contacts; project planning for detailed studies of individual projects; economics for development of benefit to cost ratio justifications; environmental resources for necessary environmental and social impact studies; services for inhouse support requirements; and floodplain management specializing in nonstructural means of achieving flood protection.[10]

The planning division at its formation was immersed in several ongoing studies. It participated in completion of the Ohio River Basin Comprehensive Survey, long-range plans for meeting the future water resource needs of the people living in the 205,000 square-mile basin, which were forwarded to Washington for review in 1970; and it had primary responsibility for preparing the Wabash River Basin Comprehensive Study, a long-range study completed in 1971 after ten years of effort. Also

Louisville District Planning Division Staff, September 1975. From left to right, top row: Glen Milburn, Bill Zurschmiede, John Jurgensen, Rich Powers, Mike Holley, John Ridge, Don Fields, Cletis Waggahoff, Terry Siemsen, Jim Loper, Tom Sweet; 2nd row: Dave Owens, Bill Ebbs, Don Reid, Jim Duck, Bill Crocker, Dick Schwab, Richard Hartke, A. Thomas, Chuck Lockman, Keith Hoss, Neil Tyler, Bill Stodghill, Faye Cunningham, Bob Woodyard; 3rd row: Carl Neff, Jerry Benson, Carter Sexton, Mark Amon, Charley Doyle, Marguerite Stevenson, Margaret Heyn, Fred Bennett, Larry Montgomery, Marty Keller; 4th row: Bill Sauter, John Kessler, Charley Hawley, Charley Curtan, Jerry Parsons, Kitty Cinnamond, Sylvia Lyda, Hanna Roederer, Carolyn Degener, Louise Stine, Dennis Kamper; 5th row: Rachel Doane, Dottie Dooley, Betty Griffin, Betty Sexton, Bill Leegan, Russell Whistler, Pat Jones, Carol Lankford, Melodye Thompson, Becky Twombly, RoseAnn Mandia; front row: John Lambert, Bob Reeves, Susan Hoag, Mary Pat Dries, Jim Biggs, Frank Christ, Dave French, Chuck Parrish; missing: Carlos Spink, Danny Evans, Harvey King, Carolyn Kays, George Woodard, Harry Ross, Bob Ledford, Hugh Ward, Ken Letson, Brock Henderson, Ray Hamilton, and Gordon Trainor.

in progress in 1970 was a growing program of nonstructural flood protection studies; that is, studies of the means of providing flood protection without the construction of dams or levees. Since 1966 the District had been providing floodplain management information studies to local communities at their request to help those communities deal with some of their flooding hazards, and in 1970 the District finished its first flood insurance study--at Aurora, Indiana-- in cooperation with the Department of Housing and Urban Development. The study helped establish a basis for setting premiums on federally subsidized insurance against flood damages.[11]

Planning the features of new multipurpose projects, studying nonstructural flood protection, coordinating comprehensive studies, and meeting the requirements mandated by the National Environmental Policy Act required herculean efforts from the staff of the District's new planning division; yet, the most voluminous planning burdens emanated from several highly controversial projects which the District had under study in 1970. Projects like the proposed dams on the Red River in Kentucky and on Big Walnut Creek in Indiana generated a vast volume of correspondence with the public, of coordination efforts with state and federal agencies, and of meetings with both opponents and proponents of the specific projects.

The proposed Big Walnut Dam and Lake located on a subtributary of the Wabash River near Greencastle, Indiana, probably was the "hottest" of the controversial projects under study in Indiana in 1970. Recommended in an interim report of the Wabash River Basin Comprehensive Study and authorized by Congress in 1968, Big Walnut was to be a multipurpose lake for flood control, recreation, fish and wildlife, and water supply, but heated debate had erupted because it threatened to inundate an unusual stand of timber and a blue heron rookery. To consider alternate sites for the dam that would save the timber and the rookery, the District formed a task force headed by William Leegan, the new chief of the planning division, that first met on December 17, 1970. During 1971, while the task force study was underway, the Big Walnut controversy, or "flap" as it was known in the slang of the time, waned, and when the task force in early 1972 recommended an alternate site for the dam its recommendation received qualified support from the environmentalists who had opposed the original site. Yet, the Big Walnut Dam still had an uncertain future, it became the subject of renewed controversy after 1972, and that dispute will be reviewed in a subsequent chapter.[12]

The Red River Controversy

Of several perplexing projects on the District's agenda in 1970, the proposed dam and lake at the lower end of the spectacular arch-adorned Red River gorge in Powell County, Kentucky, was the classic, pitting water conservation against wilderness preservation, a downstream majority wanting flood protection and water supply against an upstream minority desiring to avoid selling their homes to make way for the project, and an alliance of environmentalists opposed to the advocates of water resource development in general and to the Red River project in particular because they thought it unnecessary and a threat to the scenic gorge environment. The Red River controversy unleashed a wide array of public passions, replete with marches on the state capital and in the Red River gorge, acrimonious testimony before

Congress, shoving matches at public meetings, and the famous accusation by Supreme Court Justice William O. Douglas that the Corps of Engineers was a "public enemy."

The controversy had an innocuous origin, growing out of planning studies of water conservation needs in central Kentucky that proposed building a multipurpose dam across the Red River upstream of Stanton and Clay City to reduce flooding at those towns and points downstream and to improve water supply and recreation opportunities in the Kentucky River basin. The Louisville District conducted its first public meeting on the project in 1954, and in 1962 Secretary of Army Elvis Stahr, Jr., recommended the project to Congress. After Congress approved the project, the District conducted the post-authorization meeting at Stanton in 1963; it was attended by only ninety-five people and there were no complaints about the project except from some of the families who would be forced to sell their land that would be inundated by the lake.[13]

The name Red River generated some initial confusion outside the project area, there being several Red Rivers in other parts of the nation and a second Red River

Carved by an erosion and weathering process causing softer strata of limestone and shale to break away, Sky Bridge is one of eighteen major natural rock arches in the Red River Gorge Geological Area of Eastern Kentucky. Photo courtesy of Kentucky Department of Travel Development, Frankfort, Kentucky.

in Kentucky (which flowed through Simpson and Logan counties on its way to the Cumberland River). According to columnist Joe Creason, the Red River which dashed out of its gorge in Wolfe, Menifee, and Powell counties and flowed into the Kentucky River received its name from the carmine tint its waters sometimes bore as a result of eroding iron ore outcroppings. Unlike the other Red Rivers, the tributary of the Kentucky had carved out a precipitous niche in the edge of Appalachia, the economically depressed region which received national attention during the 1960s.[14]

Though included in Appalachia, the Red River valley had twice experienced economic booms. Its iron ore had been profitably worked in the early 19th century and shipped down the Red and Kentucky Rivers to markets, and late in the 19th century the lumber industry had denuded much of the valley of its virgin timber. The U. S. Forest Service had begun purchasing land in 1932 in the upper Red River valley and gorge to become part of its Cumberland (later Daniel Boone) National Forest, planning to revegetate denuded lands and to manage the valley's natural resources. Small farms and light industry along the lower Red River supported a sparse population during the mid-20th century and protected residents from some of the more serious economic difficulties that afflicted other mountain areas in Appalachia.[15]

During the early 1960's, some Kentuckians thought water resource development a potential key to the revival of the regional economy of Appalachia. Author Harry Caudill in his *Night Comes to the Cumberlands* in 1963 proposed the creation of a public corporation similar to the Tennessee Valley Authority to build lakes in Appalachia for flood control, water supply, and recreation, and he asserted the mountain region of Kentucky could best serve the nation by being submerged by multipurpose lakes. The influential Louisville *Courier-Journal* was also supportive of water resource development in Kentucky before 1966.[16]

"The dams, channels and floodwalls built by the Engineers in Eastern Kentucky have been blessings of untold value," wrote the editors of *The Courier-Journal* in a 1965 editorial that criticized the Engineers for working too slowly and urged them to speed up the water resource development program to help Appalachia "overcome its economic lag and develop the full potential of its scenic terrain." Concerned about the need of central Kentucky for additional water supply, the editors of the *Courier-Journal* also urged state government to cooperate with the Engineers to have water supply storage added to the proposed project on Red River. It was in that cordial atmosphere that the Louisville District in 1966 prepared to begin purchasing land needed for construction of the Red River Dam.[17]

Before 1966 the Red River gorge was an isolated haven of refuge, visited chiefly by nearby residents, by professors interested in the gorge's stunning geologic formations and interesting botanical life, and by a few people enjoying the gorge's scenic beauty. The Mountain Parkway, a state tollroad, opened easier access to the Red River gorge for the motoring public from Lexington, Louisville, Cincinnati and other urban areas about 1966, bringing an increasing number of visitors to the gorge to see the arches and other natural features and also beginning the development of Clay City and communities near the gorge as commuter suburbs for people employed in the larger towns. The improved access provided by the tollroad and the resulting increased visitation to the gorge made the public more appreciative of its remarkable natural bridges and at the same time more familiar with the proposed location of the Red River Dam.[18]

Support for the budding environmental movement in Kentucky also developed in 1966. A Kentucky chapter of the Sierra Club, the followers of John Muir's philosophy, formed that year. At about the same time, the publishers and editors of the Louisville *Courier-Journal* reconsidered the newspaper's position on water resource development in general and the Red River project in particular. On September 28, 1966, a *Courier-Journal* editorial dropped a bombshell on the Corps of Engineers:

> Barring an unlikely attack of common sense, a massive dam built by the Engineers will flood the gorge and cover parts of Menifee, Wolfe, and Powell counties within the next four years. Congress has already voted the money to begin the project. The region is so remote and so thinly populated that few people know or care about the project. Only a few people in nearby towns and some assorted conservationists have complained, and when the Engineers get the chance to build a dam such complaints bounce off like raindrops.[19]

The Red River controversy actually began at a public meeting in Stanton on August 16, 1967, when Fred Morgan, chief of real estate for the District, told the crowd the purchase of land for the project would begin early in 1968 and the dam might be completed as early as 1972. Representatives of the Sierra Club read their protests against the dam into the record of that meeting and afterwards enlisted the assistance of the club's national organization for a last-ditch fight to stop the project. After that meeting, H. B. Farmer and other property owners to be relocated by the project formed a "Save Our Red River" organization to oppose the project, and proponents of the dam, headed by Dwight L. Pendleton and Nellie Meadows of Clay City, established the "Red River Valley Flood Control Association" to support plans for the lake. In a note to the Division Engineer, Colonel Robert R. Wessels, the Louisville District Engineer, warned: "The protests originated by the Sierra Club concerning the flooding of Red River Gorge by this project have continued to grow, and at this time appear to threaten a storm of major proportions, probably spreading to the national arena.[20]

The storm struck on November 18, 1967, when William O. Douglas, Supreme Court Justice and leader of the Sierra Club, hiked through Red River gorge at the head of several hundred protestors, while proponents of the dam lined nearby roads displaying their support for the dam. Douglas's entourage included representatives of the media who elevated his hike and the Red River project into the national limelight. "This is one of the great wonders of America," Douglas was quoted as saying of the gorge: "It's a place we hope can be saved and we're going to keep it wild, beautiful, untamed, and untouched for future generations."[21]

At a Sierra Club banquet in Lexington that evening, Justice Douglas warned the crowd not to look to Washington for help because "beaucratic values do not take into consideration all the values of civilization, just the engineer's values." In his speech, he labeled the Corps of Engineers a "public enemy" and the draft of that speech evidently formed the nucleus of a scathing indictment of the Corps he subsequently published in *Playboy* magazine.[22]

Picturing the Corps of Engineers as the villain, Justice Douglas converted the Red River gorge issue into a *cause célèbre* for the burgeoning environmental movement of that era. The ensuing controversy spawned hundreds of newspaper stories, magazine spreads, protest songs and marches, petitions and litigation, and not a few fist fights. Few subjects in modern Kentucky history, other than basketball and politics, have generated such public dissension as that which attended the Red River affray.

The opinions of farmers, poets, housewives, businessmen, and political leaders concerning the Red River project were widely printed and broadcast, and one reporter questioned the Louisville District Engineer. Colonel Wessels said Congress had authorized the project in 1962 on the basis of a Corps estimate that it would return $1.90 in flood control, water supply, water quality, and recreation benefits for every dollar invested, a 1.9 to 1 benefit to cost (b:c) ratio considered very satisfactory, and also pointed out that the District had encountered no substantial opposition to the project until after Congress had funded its construction. Noting that the Corps was bound by complex regulations in calculating a project's benefits and costs, he promised that in the future the District would consult with "naturalists and conservationists before getting into other projects."[23]

Four days after the Douglas hike through the gorge, Colonel Wessels and his staff met in Frankfort with Governor Edward "Ned" Breathitt and representatives of the local chapters of the Sierra Club and Audubon Society. Project opponents wanted land acquisition for the

Justice William O. Douglas visited the Red River Gorge on November 18, 1967, to focus public attention on the site. Courtesy, Lexington *Herald-Leader*.

dam deferred pending completion of studies of other sites for the dam which might be less destructive to the natural features of the gorge. Wessels and the Governor agreed that a new look at project planning was in order, and shortly thereafter William Leegan of the District toured the gorge with the director of the National Forest Service which had charge of much of the land in the project area. Leegan learned the Forest Service was interested in moving the site of the dam farther downstream to take the summer recreation pool of the lake out of the gorge. When Secretary of Interior Stewart Udall, who headed the Water Resources Council in Washington, flew into Kentucky in early 1968, he requested the Louisville District to make a "quick reconnaissance study" of a site for the Red River Dam located about 5.8 miles downstream of the authorized site.[24]

The District immediately began the study Udall requested, and because of growing national concern about the project Lieutenant General William F. Cassidy, Chief of Engineers, along with the Chief of the Forest Service and other federal executives, toured the gorge and inspected the proposed sites for the dam. Finished on March 15, 1968, the reconnaissance study concluded that construction of the dam at a new downstream site would cost nearly $3 million more than at the original site, would produce lesser benefits, and would delay project completion at least a year, but it would move the lake out of the gorge except at times when it became necessary to hold floodwater temporarily to protect Stanton, Clay City, and downstream communities. Secretary Udall firmly declared he wanted the dam built at the downstream site or not at all, and in July Congress directed the Corps to review project planning to preserve the Red River gorge "to the maximum extent feasible.[25]

While the District was conducting its project review in 1968, a procession of distinguished visitors paraded through the gorge pronouncing their opinions on the merits of the gorge and the project. One was former Secretary of the Army Elvis Stahr, who had become president of the National Audubon Society. Stahr had recommended the project to Congress in 1962, but after seeing the gorge in 1968 he retracted his earlier support and asked the Governor of Kentucky to lend his support to the campaign to have the dam moved downriver. Though advocates of the project in Powell and Menifee counties protested the added costs and delay resulting from a change of sites would scuttle the project permanently, Louie Nunn, the newly elected Governor, on February 25, 1969, requested the dam be constructed at the new downstream site; and when Senator John Sherman Cooper lent his influential suport to the Governor's request the Chief of Engineers on May 7 approved the change.[26]

The decision to move the dam downstream, taking the summer pool of the lake out of the gorge, promised an end to the controversy, for it seemed a compromise satisfactory to the environmentalists. "The Sierra Club will not try to block construction of the dam at the alternate site as long as its present leadership is in power," commented the District's public affairs officer. "They may feel it shouldn't be built but they also tell me," he added, "we made a commitment and a compromise and we will not go back on our word that we would accept the alternate plan."[27]

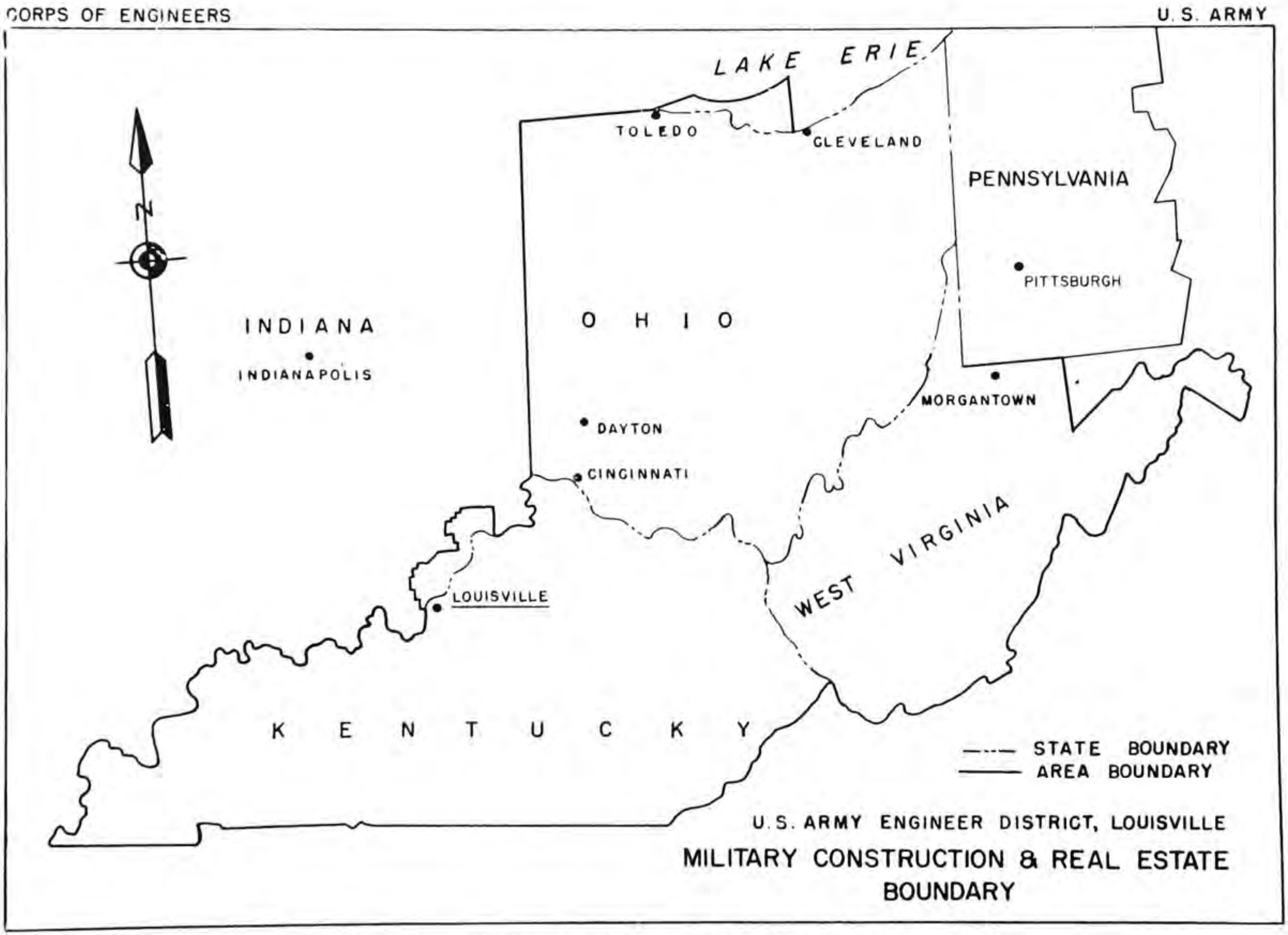
Project redesign, a major undertaking, proceeded with all possible speed in the District's planning and engineering divisions, but the National Environmental

Policy Act on January 1, 1970, required that an environmental impact statement be prepared and a dispute also erupted during 1970 concerning the summer recreation pool level of the lake. The District preferred a summer pool at elevation 710 feet above mean sea level to develop optimum storage for water supply, while environmentalists urged the adoption of a lower level at 700 feet to get the lake farther away from the gorge. To secure an independent opinion, the District contracted for analysis of the project effects at various levels with a firm from Massachusetts specializing in ecological sciences. When that study was completed, the District Engineer recommended the summer pool of the lake be held at elevation 703 feet, which provided less water supply than the Engineers thought desirable but which minimized the lake's effects on botanical life in the gorge. Governor Louie Nunn approved that lake level as a further concession to environmental concerns on April 14, 1971, commenting that the level selected would protect the gorge's unique environmental features and scenic areas and still provide flood protection and vital water supply for decades to come.[28]

By chance, on the day the Governor announced his decision on the lake level the Chief of Enginers also sent a strong message to the Ohio River Division Engineer directing him to be sure that public participation in planning for Engineer projects included representatives of environmental organizations, that planning gave full consideration to project impacts upon the environment, and that all types of alternatives to proposed projects were thoroughly investigated. The Division Engineer passed the Chief's message along to Colonel John Rhett at Louisville, directing him to assemble all personnel in the planning division and key personnel from other divisions to make it plain to them that Corps policy was "to give full consideration to environmental and conservation matters and to include the public in our planning process at an early date."[29]

The District at the time was wrestling with preparation of its environmental impact statement for the Red River project, which was one of the first such statements written in the District. It was proving an extremely difficult task, for even at elevation 703 feet the lake would cause environmental damages in the lower gorge area, especially during major floods about every fifty years when the Red River Dam would store as much as fifty-six additional feet of water in the lake to protect Stanton and Clay City from flooding. The extent of damage done to the fragile plant life on the floor of the gorge would depend upon how long it was necessary to hold back the floodwater. District Engineer John Rhett expected the Red River Environmental Impact Statement to be exceptionally thorough, but he did not expect it to rekindle the Red River controversy, nor did local leaders of environmental organizations think it would create much of a stir. "The politicians have gone on to other things," observed John Franson of the Audubon Society, and "the citizens have a feeling that the issue is settled." Thus began a truce that was to last two years while the District's planning division worked out the intricate details of the Environmental Impact Statement.[30]

Formation of the planning division, implementation of the National Environmental Policy Act, and the Red River controversy were sufficient in themselves to make 1970 a memorable year; yet, several other events made 1970 a year of turmoil for the Louisville District. The District's



Louisville District Military Construction and Real Estate Area in 1970.

Construction of runway extension at Standiford Field, Louisville, Kentucky, under Corps contract, June 17, 1965.

regulatory responsibilities began an expansion in 1970 when the President requested the Corps to use its authority under Section 13 of the 1899 Rivers and Harbors Act to enforce water quality standards pending formation of the Environmental Protection Agency. The Uniform Relocation Assistance and Real Property Acquisition Policies Act (Muskie Bill) of 1970, offering additional benefits to people relocated because of federal project construction, substantially altered procedures in the District's real estate division. And the Flood Control Act of 1970 contained a real "sleeper," the requirement in Section 221 that local and state governments sharing costs of water resource projects enter into binding agreements promising to do their share. Section 221 was to become a hindrance to state participation in water resource projects and a subject of litigation because some state constitutions forbade state general assemblies from obligating future sessions of the general assemblies for the expenditure of funds. The greatest source of turmoil in the District by far, however, was the transfer of military construction and real estate missions out of the District.

The Loss of Military Construction

The Louisville District by 1970 had about thirty years of experience as construction and real estate manager for the Army and Air Force in parts of the states of Illinois, Indiana, Kentucky, and Ohio.

For the Air Force, it had built Baer and George airfields in Indiana and Illinois, Standiford and Bowman fields in Louisville, and some elaborate facilities at Gentile, Lockbourne, Youngstown, and Wright-Patterson air bases in Ohio. Construction of many of those airfields had begun during the Second World War, and some had continued in service as Air Force installations while others had formed the nucleus of municipal airports after their use by the Air Force was discontinued. Its service to the Army had included building troop cantonments and related facilities at Forts Knox and Campbell and Camp Breckinridge in Kentucky, Fort Benjamin Harrison and Camps Scott and Atterbury in Indiana, and the construction of ordnance plants at sites throughout the Ohio River basin. In addition, the District acquired real estate and built specialized structures for the Jeffersonville Quartermaster Depot, Jefferson Proving Grounds, Nichols General Hospital in Louisville, and even at Plum Brook Research Station, a National Aeronautics and Space Administration installation. District personnel had taken great pride in their direct support to the armed forces, and it was quite a shock to them when military functions were transferred out of the District in 1970, leaving the District and the entire Ohio River Division with civil works functions only.[31]

Much of the military engineering and construction had been repetitive, for standardized designs of barracks and other structures had been used for reasons of economy and speed of construction; yet, at

Interior of chapel construction at Fort Knox under Louisville District contract, April 26, 1967.

other times, military projects had required some highly esoteric design and construction methods. While civil works construction often proceeded at what seemed a geologic pace, with perhaps a quarter century elapsing between project conception and completion, military real estate acquisition and construction as often as not was done "under the gun" with the Army and Air Force demanding that facilities the size of small cities be constructed and ready for use within ninety days. Military authorities, moreover, often required changes in project design after construction had begun, generating extremely complicated contract administration difficulties. There once was a military project within the Ohio River Division at which project design was modified some 1,300 times while it was being built. Sudden switches in Department of Defense requirements also disrupted the District's military construction activities, as happened, for instance, in 1965 when the Defense Department terminated six large military projects in the District, thereby wasting a large amount of design work already completed. "It's a rather wildly fluctuating workload," said the Chief of Engineers in comment on the military mission, "it jumps around all over the country and does call continually for shifting of our people and the spaces [jobs] out in the field."[32]

The wildly fluctuating character of the military mission was well illustrated by the rise and fall of the workload in the Louisville District from 1940 to 1970. In 1940 and 1941 when Army and Air Force (then Army Air Corps) construction was transferred from the Quartermaster Corps to the Corps of Engineers, the Louisville District along with all other Engineer Districts was thrown into total mobilization for the Second World War, stopping most of its civil works projects to concentrate upon building airfields, cantonments, and ordnance plants for training and arming the troops bound for Europe and the Pacific. After 1945 the workload sharply decreased and the District's real estate division disposed of many installations declared surplus at the war's end. The military work increased during partial mobilization for the Korean War, then tapered downwards during the late 1950's. The District's military workload mushroomed in 1961, not for mobilization but as result of a reorganization whereby all military construction within the Ohio River Division was consolidated at the Louisville District. In 1961 the District was at work for the Army and Air Force at some sixty-nine sites from Pittsburgh west to the Mississippi, but the scope of the mission was diminishing and by 1964 the number of military jobs in progress was less than half that of 1961.[33]

The declining workload of the early 1960's drove the District's administrative overhead on its military projects up to about 7.5 percent of the work completed in 1964, and with a further decline expected the District began a reduction-in-force, laying off employees to reduce its overhead percentage. That reduction was in progress when yet another change of course occurred in 1966 with beginning of the Southeast Asia Support Program to train and arm troops bound for Vietnam. For the Louisville District, the Vietnam effort meant urgent work to rehabilitate and construct facilities at the Blue Grass Army Depot near Lexington, a tank plant at Cleveland, and at Forts Knox and Campbell. At Fort Campbell, for instance, the District got an order on April 11, 1966, for about $10 million worth of emergency construction, chiefly consisting of the renovation of old barracks, the erection of sixteen new "prefab" buildings, and the construction of training facilities including a hand-to-hand combat course, all to be ready for initial use by June 1. The District completed its design work for the $10 million project within a month, negotiated its first cost-plus-fixed-fee contract in many years for the work, and, by staying on the job through the Memorial Day weekend, had the first buildings ready for use by arriving recruits on schedule.[34]

After the flurry of construction in support of the soldiers headed for Southeast Asia waned, another decline in workload set in and by 1970 the District's military work was concentrated at Ravenna Ordnance Plant, Fort Knox, Wright-Patterson Air Force Base, and a few Army Reserve Centers such as those at Louisville and at Zanesville, Ohio. The work at Fort Knox consisted chiefly of standard barracks and classroom buildings and tank repair and maintenance structures, but at Wright-Patterson Air Force Base, in addition to warehouses, libraries, and a chapel, the District had underway some extremely complex and exotic structures. The toxic hazards laboratory, avionics laboratory, optics science laboratory, and nuclear engineering test facility were of a type never before constructed, and each presented unique design and construction challenges. Perhaps the most interesting challenge was construction of a structure to house sonic equipment designed to destroy aircraft components with sound waves, a building that would not itself be destroyed by sonic vibrations. "Continuing problems of great variety are constantly being faced and solved," said the Ohio River Division Engineer in comment on the work at Wright-Patterson, but "these have not halted or significantly delayed the work--a fact which reflects favorably upon the District Engineer and his people."[35]

During the two decades preceding 1970, the Louisville District completed about $130 million worth of military projects, generally to the satisfaction of representatives of the Army and Air Force, and it thus came as something of a surprise to District personnel when the military mission abruptly ended in 1970. As a result of the stand down from Vietnam mandated by the Nixon administration in the 1970 defense budget, the Chief of Engineers was required to reduce costs and layoff about nine hundred employees. He sought to accomplish that by moving military construction and real estate functions from the Louisville and six other Engineer Districts to other Districts. The military projects in Indiana went to the Omaha, Nebraska, Engineer District on March 1, 1970, and the remainder of the Louisville District's military jobs went to the Engineer District at Baltimore, Maryland, by July 1. There were at the time few military projects under construction in Indiana, so the Baltimore District acquired most of the Louisville District's military mission.[36]

The Division Executive Assistant said that Baltimore acquired the military work from both the Louisville and the Norfolk, Virginia, Engineer Districts in 1970 because it was located nearest to First Army headquarters at Fort Meade, Maryland, was within two hundred miles of most First Army installations, and had a modern office building. Perhaps equally significant to the transfer was the $52.9 million worth of civil works projects in progress in Louisville District in 1969, as compared to $21.8 million worth of civil works in the Baltimore District; the transfer of military functions would therefore balance the workload in Baltimore's favor.[37]

During early 1970 the Louisville District rushed final work on several contracts and prepared for a reduction-in-force. Through hard work during long hours, it was able to deliver the contracts in progress and the files to the receiving Districts by July 1, leaving no controversial contract change orders outstanding to worry the Omaha and Baltimore Districts. It was necessary to reduce the number of District personnel by 143 spaces, but because sixty-six employees retired and the remainder either transferred with the military mission to the Omaha or Baltimore Districts, or to other agencies or the District's civil works program, no actual layoffs of personnel proved necessary. Among the retirees was Eugene B. Stokes, who had headed the military branch of the District's engineering division, and among those transferring to civil works was Gordon M. Stevens, the assistant chief for military construction who became resident engineer at Uniontown Dam project on the Ohio River. At the end of the turmoil accompanying the transfer, Colonel John Rhett, the District Engineer, said he believed the reorganization would eventually produce a "higher quality District."[38]

Effective July 1, 1970, the District also lost its last direct connection with military programs when its civil defense support branch closed and transferred to the Ohio River Division at Cincinnati. Formed on the heels of the Berlin Wall and Cuban Missile crises of the early 1960s, the civil defense branch with eight employees headed by Arthur M. Mills had conducted, in collaboration with state and local civil defense agencies, extensive planning for the evacuation of urban areas under nuclear attack and for postattack recovery operations, the most visible of its activities involving selection and marking of fallout shelters for use by survivors of nuclear blasts. With help from temporary employees during summers and from contracting architect-engineer firms, the civil defense branch had inventoried buildings in many cities and towns throughout the District and had selected those most suitable for use as fallout shelters; the buildings thus selected were marked with signs and stocked with food and other survival necessities. When the District's civil defense office closed and Arthur Mills moved to Cincinnati as supervising engineer of a consolidated civil defense program, the Louisville District became again, for the first time since 1939, responsible for only a civil works mission.[39]

The Louisville Engineer District was a much different institution at the end of its year of crises in 1970 than it had been at the first of the year. Practically every element of the District had been altered in some respects by the attrition and changes resulting from the loss of military construction, military real estate, and civil defense missions; it had become a leaner and more focused organization. The formation of the planning division and the accompanying administrative reorganization had refined its approach to its civil works responsibilities, placing it in a better position to meet the requirements of the National Environmental Policy Act, to deal with controversies arising out of such proposed projects as those on Big Walnut Creek and Red River, and to get in step with the environmental movement sweeping the nation at the time of the first Earth Day in 1970. Those radical changes in the District as an institution, though often painful at the time, improved its capabilities for handling its immense civil works program, for by the end of its year of crises the Louisville District had underway three giant navigation modernization locks and dams on the Ohio River, five major flood control impoundments on tributary streams, and the planning for more than a dozen highly controversial multipurpose projects.

While the Louisville District lost its most direct connection with national defense when its military construction and real estate missions transferred in 1970 to other Engineer Districts, it retained an indirect connection to national defense through its immense civil works program designed to supply flood protection for the agricultural and industrial resources of the American heartland and to provide economical waterways transport to assist with development of those resources. The rationale underlying assignment of civil works to the Corps of Engineers in 1824 had been that improved waterway transportation would directly benefit national defense, for at that time there were no railroads, highways, or transportation modes other than waterways capable of moving troops and military supplies economically to the frontiers. American statesmen of 1824 also recognized that improvement of waterways for commercial navigation, assisting national economic development, contributed to national defense indirectly because the very foundation of American military capabilities rested upon a strong and prosperous people. The goals of that original rationale had been amply realized during subsequent military conflicts when inland waterways transported troops and supplies and delivered raw materials needed for the production of armaments. Shipyards along the Ohio River during the Second World War, for instance, had constructed and launched about a thousand small ships that had descended the rivers to enter combat on the high seas.[1]

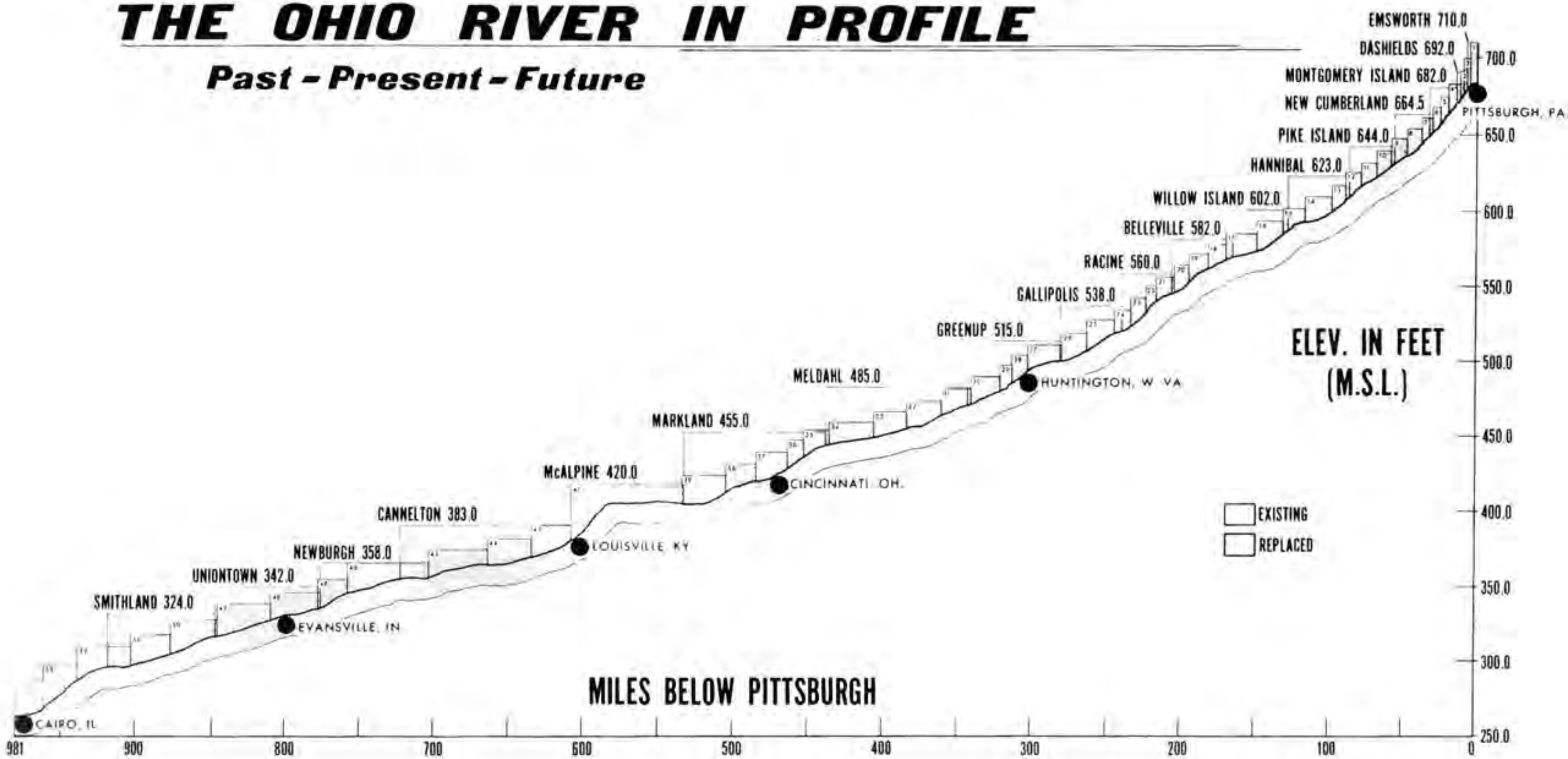
Though railroads, highways, and aircraft had largely supplanted waterways for rapid deployment of the armed forces by 1970, the concept that waterways, by fostering a vigorous and prosperous national economy, could contribute to the ultimate foundation of national defense remained a viable part of the rationale for participation by an element of the Army in civil works projects. "Our national security cannot be measured merely in military strength," commented one recent Chief of Engineers: "It must be based also on the productivity of our fields and factories and the fruitful employment of our people. Contributing to these aims in no small measure is the wise and foresighted policy of developing and expanding our water resources for the utmost good of the country."[2]

The civil works activity of the Louisville Engineer District contributing most directly to national prosperity was the project to improve the navigation of the Ohio River, a logistical artery bisecting the industrial American midland. Though its benefits for national defense were never quantified or considered in project justifications, the improvement of navigation on the Ohio River, allowing its expanded use for the transport of foodstuffs, industrial materials, and energy-related commodities, clearly contributed significantly to American military strength. The District's projects to improve the Ohio for navigation therefore constituted major, albeit unquantified, support for the national defense posture.

In 1970 the District had underway the work assigned it on the Ohio aimed at modernizing 545 of its 981-mile length, more than half of the river. Conceived about 1950, the Ohio River Navigation Modernization project called for the replacement of forty-six old lowlift locks

THE OHIO RIVER IN PROFILE

Past - Present - Future



The Louisville Engineer District became responsible for modernizing Ohio River navigation downstream of Cincinnati, Ohio.

and dams completed in 1929 with nineteen new highlift structures, essentially converting the river from a two-lane highway into a four-lane interstate down which huge tows of barges equivalent in cargo capacity to several trains or hundreds of trucks could surge. For the administration of construction, the Ohio had been divided into three parts, with the Pittsburgh Engineer District in charge of the headwaters, the Huntington Engineer District building on a middle section, and the Louisville District securing the lion's share of the work: the seven giant locks and dams planned to enlarge the artery of waterways commerce from Cincinnati, Ohio, downstream to Cairo, Illinois, where the beautiful Ohio was muddied by the Mississippi. The seven highlift dams for which the Louisville District was responsible would replace seventeen obsolete lowlift locks and dams, from Lock and Dam 35 upstream of Cincinnati to 53 near Cairo.[3]

The modernization plans, as approved on March 11, 1953, called for increasing lockage capacities by building two locks at each new dam, one to be 110 by 600 feet inside the chamber and the other to be 110 by 1200 feet in inside dimensions, ending the need for double lockage—the breaking of tows into two sections to get through the single 600-foot locks at the old dams. Two locks would be required at each new dam, not only to serve growing waterborne commerce but also because the new highlift dams, unlike the old wicket dams, would not have a "navigable pass" through which traffic might move when a lock was closed for repairs. Rather than wooden wickets with an average lift of ten feet at each dam, the new dams would be built of reinforced concrete with large, pivoting metal tainter gates to control pool levels above the dams. Higher dams and increased lock lift at the new structures would allow each to replace two or more old locks and dams, reducing time lost by towboats and barges during lockage and providing longer and deeper pools, essentially converting the Ohio from a relatively narrow and shallow stream into a series of lakes up to 113.9 miles in length that would be useful for commercial, industrial, and recreational purposes.[4]

The Louisville District commenced construction on its assigned section of the Ohio at the upstream end of the District during the 1950s with Markland Locks and Dam serving as a harbor for Cincinnati, followed by McAlpine Locks and Dam for the harbor of Louisville. Locks and Dam would be the proper name for the new structures because each would have two locks instead of one as at the old wicket dams, and McAlpine Locks and Dam would become the only structure on the river with three navigation locks. Smithland Locks and Dam near Paducah, Kentucky, was designed with two 1200-foot locks instead of one 1200-foot lock and one 600-foot lock as at the other modern structures, and was called "the world's largest twin-lock facility."

Construction of Markland Locks and Dam, replacing five old wicket dams and creating a single broad harbor for the port of Cincinnati, commenced in 1956; the locks were completed in 1959 and the dam in 1963. Though not designed for flood control, the Markland project had a multipurpose design, providing a wide channel for commercial navigation, a deep pool useful for recreation and water supply, a place for hydroelectric power production that was subsequently developed under federal license by Public Service Company of Indiana, and piers on the dam that later supported a highway bridge across the river. It should be emphasized that none of the locks and dams on the Ohio had any

The 1200-foot tows could be handled in a single lockage at Markland Locks near Cincinnati. June 5, 1979.

flood control purposes or significant relation to the heights of floods; the Army Engineers achieved their flood protection mission through construction of dams for the purpose on tributaries of the Ohio and through building floodwalls and levees at many urban and rural areas. Development of the potential for hydroelectric power production at the new dams was also noteworthy, for only at Dam 41 at Louisville had that potential been realized at the old locks and dams, where the head, the difference in elevation between the upper and lower pools, was insufficient for economical electric power production.[5]

Unlike Markland, the McAlpine Locks and Dam project at Louisville did not replace several old lowlift dams because Dam 41 at the Falls of the Ohio had been constructed high enough initially to eliminate need for the construction of Dam 40. The work at McAlpine involved converting Dam 41 from a movable wicket structure to a fixed concrete dam; in fact, an innovative bit of engineering left old metal parts of Dam 41 standing in place in the new dam, encased in and serving as economical reinforcement metal for the concrete. The hydroelectric power plant built in 1925 at Dam 41 remained in place and operational and the pool of McAlpine Dam remained at about the same elevation as that of old Dam 41, but was regulated by two sets of tainter gates, segmental gates that arc upward from a fixed trunnion, rather than by movable wickets with flat surfaces formerly in place. The work at McAlpine chiefly consisted of widening the canal leading down to the locks, excavating an adjacent surge basin where the District would moor its fleet of workboats, and constructing a 1200-foot lock alongside the 360-foot lock initially constructed in 1872 and the 600-foot lock built in 1921.[6]

After completing McAlpine Locks and Dam in 1966, the District commenced construction of three new locks and dams at Cannelton, Newburgh, and Uniontown in the middle sector of its assigned river section and downstream of McAlpine during the late 1960's. A traffic jam, however, diverted its attention temporarily to the lowermost section of the river, to old Lock and Dam 52 at Paducah, Kentucky. John R. "Jack" Bleidt, chief of the District's operations division, insisted that traffic on the lower Ohio was increasing at such a pace that improvements there could not await eventual construction of a modernization structure proposed at Mound City—that some expedient measure was required to alleviate traffic congestion at old Lock 52.

Lock 52: Design Award for 1970

Delays to commercial traffic have been extremely costly, not only to towboat and barge owners but also to shippers and to

McAlpine Locks and Dam at the Falls of the Ohio is the only three-lock structure on the river and for many years it had the only hydroelectric power plant using the river flow.

Lock and Dam 52 near Paducah, Kentucky, had a temporary 1200-foot lock added in 1969. In the picture the 600-foot lock is on the left with a boat entering it; the 1200-foot lock with the steel cell walls is at right next to the bank.

the consumers who in the end bore the cost of any increased transportation charges. "Money expended in transportation is practically money wasted," proclaimed the Army Engineer who designed the first lock and dam on the Ohio River in 1874, explaining he meant transportation was a waste because it added nothing to the intrinsic value of the commodities transported. He argued the federal government through constructing locks and dams could reduce the costs of transporting grain, for instance, and thereby lower the price of bread; that is, the central government could contribute to the well-being of its citizens by improving waterways navigation. By the late 1960's, consumers indirectly were paying a high price for traffic congestion at Lock 52 where the average daily waiting time for towboats and barges had climbed from fourteen hours in 1960 to forty-seven hours in 1966.[7]

During the score of years before 1970, the point of greatest traffic density on the Ohio had shifted from the head to the mouth of the Ohio. For more than a century before 1953 the densest traffic on the river had been at its head nearest the coalfields and steel mills of Pittsburgh; heavy shipments of coal from West Virginia shifted the greatest traffic volume downriver to the vicinity of Huntington after

1953; and by the late 1960's the growth of industry and construction of steam electric power plants along the banks of the lower Ohio accompanied by heavy shipment of western Kentucky and southern Illinois coal via waterways had moved the point of greatest traffic ever farther downstream into the Louisville District. Lock 52 was handling not only commerce moving up and down the Ohio but also boats entering and leaving the extensive systems of locks and dams on the Cumberland and Tennessee rivers--both rivers enter the Ohio some eleven miles apart at points not far upstream of Lock 52 at Paducah.[8]

The District's operations division had sought to speed barge traffic through Lock 52 by adopting the "three up, three down" rule, meaning that three tows would lock through headed upstream followed by three downbound, but the lines of waiting tows grew ever longer despite the best efforts of Lockmaster Robert Williamson and his sturdy Lock 52 crew. By 1967 some individual tows had to await lockage at 52 for as long as thirty hours, at an estimated average cost per hour of $200, a cost that in the end was paid by consumers when they purchased bread or paid their electric bills.[9]

At the constant prodding of Jack Bleidt and the operations division, the District's engineering division searched for some "stopgap" means of alleviating congestion at Lock 52, and the situation posed a challenge. The solution had to provide a quick answer to the challenge; it had to be low in cost, for it might be replaced by the modern structure planned at the Mound City site; and the solution selected could not interfere with existing traffic using Lock 52 while construction progressed. A new 1200-foot lock alongside the existing 600-foot lock seemed an obvious answer, because many delays at 52 occurred because tows had to be broken into sections to pass the lock one section at a time and because a new lock could be built alongside the old one without much interference with traffic while under construction. Yet, a new 1200-foot lock of massive concrete of the sort built at projects like Markland and McAlpine would cost perhaps $30 million, could take five or more years to complete, and possibly could interfere with traffic because concrete locks had to be built "in the dry," meaning surrounded by a temporary cofferdam to hold out the river while concrete was poured. The solution: build the lock not of concrete but of the temporary cofferdam.[10]

Cofferdams, usually shortened to simply "coffers" in engineering jargon, have a long and somewhat dishonorable history. Because they were temporary structures, their design was left to contractors who, to hold down costs and maximize profits, often skimped cofferdam construction at 19th century projects and lost one or two to river washouts before investing in one that would properly hold out the river. Some 19th century cofferdams, merely banks of clay and gravel dredged from the river or dug from river banks, were of such inadequate design that the first substantial flood washed them away. The Corps of Engineers, however, revolutionized cofferdam design in 1911 while raising the battleship *Maine* from the floor of Havana harbor where it had rested since its sinking in 1898 sent the United States to war with Spain. Because the wreck lay in deep water, the Corps enclosed it inside a cofferdam composed of circular cells formed by driving interlocking steel sheet-piles into the harbor bottom and filling the cells with sand and gravel; once the cells surrounded the wreck, the area inside the ring of cells was pumped out, exposing the wreck for removal. Circular steel cells first used on the Ohio River in 1926 eventually became standard for river navigation projects. Having sufficient stability to withstand pressures exerted by fifty or more feet of water lapping at the outside of the cofferdams, the cellular coffers permitted continued work inside them for most of each year except during extreme floods. Most navigation modernization projects built on the Ohio after 1950 were constructed inside two cofferdams of steel sheetpiling, one around the site of the locks and a second around the dam section containing the piers and tainter gates.[11]

The principal engineering innovation at Lock 52 on the lower Ohio River involved the use of circular steel cells, not to enclose the locksite while concrete was placed, but actually to serve as walls of the new 1200-foot lock chamber itself. With lines of steel cells forming the walls, the lock could not be filled and emptied through the usual culverts inside concrete lock walls; the design therefore included an open flume down one side of the new lock walls with gates at each end controlling the flow of water through the flume.[12]

Blount Brothers Company received the contract for construction of the temporary 1200-foot lock at Lock 52, and under the supervision of Resident Engineer Barton H. Van Antwerp began excavating a space for the new lock into the riverbank adjacent to the old lock in May 1968. They built the lock chamber with three lines of circular cells, two lines serving as walls of the lock and the third as one side of the flume and also as retaining wall for the riverbank. Steel piling driven in a circle formed each cell and each was filled with sand and capped with concrete. At the ends of the lock chamber, concrete monoliths provided anchorage for holding the lock gates and also the gates controlling flow in and out of the flume. As a further economy, the flume pit was floored with riprap—broken stone—and the lock chamber with precast concrete blocks. The entire job was done by December 1969, meaning the project had required only thirty-eight months from conception of the design to completion at a cost of merely $8.5 million, less than a third of what a standard concrete lock might have cost.[13]

Jack Bleidt and Leonard Vanzant of the operations division were watching on December 6, 1969, when Lockmaster Robert Williamson sent the first boat, the *City of St. Louis* with a fifteen barge tow filling the new lock chamber, through the "temporary" 1200-foot lock. While its austere design had deficiencies which were corrected at a later date, it was recognized by the Chief of Engineers with the National Design Award of 1970 for its "innovative common sense" approach to a unique engineering challenge.[14]

The Construction Division and Modernization

Richard H. "Dick" Russell, who became the seventh chief of construction for the Louisville District in 1966, once commented that he "ran the Ohio River" during the early 1970's, and that was very near the truth because he was directing the almost simultaneous construction of Cannelton, Newburgh, and Uniontown Locks and Dams at that time. He and his construction division staff decided when the new dams would block the river, when the new locks would open, and when the old locks and dams could be closed and blasted out of the channel. Construction division was then, and it remained, the "hardhat" division of the District, equivalent to frontline troops of an Army command, and Richard Russell administered his division like an officer of the line. Except for a small headquarters staff, the bulk of the construction division personnel worked out of small resident engineer offices, often merely trailers, and spent their days wading in mud and breathing dust amongst the roar of heavy equipment at construction sites. Their primary mission was to see to it that contractors performed their work in accordance with contract specifications; that is, used proper materials and methods to get the projects built right and on schedule.[15]

Of all District elements, the construction division bore the greatest brunt of the many changes in District missions that occurred between 1970 and 1983. In the first place, most construction division personnel had to move every few years, following work from one site to another, and they either learned to like constant change or they left the division for other employment. But fortune seemed unkind to the District's construction division in 1970. The abrupt loss of the military construction mission early in the year depleted the division of personnel, and even the remaining personnel assigned to civil works projects were decimated that year when President Richard M. Nixon impounded funding for civil works construction, limiting the amount of funds the Corps could expend during the year to less than its authorized budget and ordering a curtailment of contract awards for new work. The consequent sharp decline in civil works construction drove the District's overhead (supervision and administrative costs) on its workload volume up to 9.18 percent, an entirely unacceptable figure. To reduce that percentage, Colonel John Rhett, the District Engineer, took what he called "extraordinary management actions," abolishing twenty-six jobs in the construction division, leaving job vacancies unfilled, and pushing early retirement. "The impoundment actions of the Office of Management and Budget," complained the Ohio River Division Engineer to the Chief of Engineers, "as well as their actions in funding certain categories of work only until 31 December have made this year a particularly difficult one for scheduling our workload and personnel requirements. I realize that these matters are beyond your control, but such actions make it very difficult to run an efficient organization."[16]

Richard H. Russell, Chief of Construction Division at Louisville District from 1966 to 1975. He subsequently transferred to the Nashville Engineer District to manage construction of the Divide Cut, Tennessee-Tombigbee Waterway.

The cut in District staffing did reduce the overhead percentage; by 1972 it was down to 4.5 percent, half what it had been in 1970. Yet, the improvement involved factors other than personnel reduction. Funding impoundment by Presidential directive, a budgetary control measure struck down by the courts, ended in 1971 and the amount of construction underway in the District and elsewhere immediately increased. By 1972 the District was at the peak of its civil works construction effort, building five major dams for flood control on tributaries and three huge navigation modernization structures on the mainstem of the Ohio. Its workload became so heavy in fact that it sublet considerable of its engineering and design work to other Engineer Districts or to private architect-engineer firms under contract; and the Smithland Locks and Dam on the Ohio River near the mouth of the Cumberland River was temporarily transferred to Nashville Engineer District for construction while the Louisville District concentrated upon the three new locks and dams building on the Ohio between Smithland and Louisville.[17]

Even after viewing the modern locks and dams on the Ohio River at Cannelton, Newburgh, and Uniontown, few laymen recognized what an engineering achievement each of the immense structures represented, for the bulk of each structure was deeply embedded in the riverbottom and submerged by the river. Were one of those locks and dams sitting on dry land, it would be impressive if not awesome, for its size would be equivalent to a ten-story building more than a half mile long, not made as an empty shell like a building but of massive steel-reinforced concrete monoliths. While the engineers who designed and built skyscrapers have earned public recognition for their achievements, few men and women involved in the design and construction of modernization structures on the Ohio River have received any public recognition whatsoever. Yet, the builders of skyscrapers dealt chiefly with wind stresses while the builders of dams had to produce structures that would withstand stresses generated by tons of water constantly in motion. The Ohio River continually forced its way past the dams, crashing over them at the weirs, and churning through the tainter gates, and also trying to get under them or around their abutments at each side. Even after the river had rushed past the dams, unless protective measures were taken, it would cut through everything on the riverbottom down to bedrock and eat its way back upstream to undermine the dams from the rear. Designing dams that would resist such forces has been one of the most challenging tasks in all engineering, and building them an equally demanding feat, especially on the Ohio where the foundation bedrock lay under sixty feet of water and mud.

While construction procedures differed at each site as conditions dictated, the locks and dams at Cannelton, Newburgh, and Uniontown followed a construction pattern developed by the Engineers during many years of experience. As a rule, locks were built first because their construction did not obstruct river traffic, and they were constructed under a contract separate from that for the dam though sometimes by the same contracting firm. The contractor drove a cofferdam around the site of the 1200 and 600-foot locks, excavated mud and materials (overburden) inside the cofferdam to expose bedrock, placed the forms and steel reinforcement (rebar), and poured the concrete under carefully controlled conditions to form massive blocks (monoliths) that would become part of the lock walls. Though the construction of locks can be summarized thus briefly, work at projects such as Cannelton Locks actually was much too complex to describe herein and required years to accomplish.[18]

Modern dams on the Ohio generally were built in two or more phases inside two cofferdams called the Stage 1 and Stage 2 coffers. The Stage I cofferdam contained most or all of the metal tainter gates, and the Stage 2 coffer encircled the last part of the gated section and perhaps part of the fixed weir—the overflow section of the dam without gates that ran from the end of the gated section to the riverbank opposite the locks. Getting cofferdams in place and building them with sufficient stability and strength to withstand "heads" of perhaps sixty feet of water was a major part of the job at the modern dams and often the source of serious troubles experienced during construction. Once the cofferdams were in place and pumped dry, the contractors cleared away river mud and excavated into the bedrock to open a "key trench," a large slot in the bedrock in which the dam foundation was anchored to resist relentless efforts by the river to push the dam downstream. The contractors placed the forms, installed the steel reinforcement, and began pouring concrete to raise the piers one section, or "lift," at a time until the piers of the dam finally towered high above the river.

Once piers were completed, a prestressed concrete service bridge was installed atop the piers on which a crane would run on rails for repair work, and tainter gates were suspended between the piers. Invented in the 19th century by Jeremiah B. Tainter for use in splashing logs down shallow streams to mills, tainter gates had been adapted by engineers for the control of pool levels at waterways projects. Cannelton Dam, for instance, had twelve tainter gates, each 100 feet long and 42 feet high; when closed against the concrete sill at the bottom between two piers, the Cannelton tainter gates held out the river until it rose 42 feet, forming a lake 113.9 miles long from the dam upstream to the base of McAlpine Locks and Dam. Tainter gates could be raised or lowered to control the level of Cannelton pool, but at the approach of a flood were raised out of the river entirely and thus they had no flood control function at all.[18]

Lest this brief summary of construction procedures leave the impression that building one of the modern dams on the Ohio was a simple matter, it should be pointed out that the construction of each required thousands of individual jobs done one at a time and all at a certain precise time on a complex schedule. Building Cannelton, Newburgh, and Uniontown Locks and Dams required about ten years on the average for each structure, and each cost about $100 million. While most of the work at each of the structures was routine, problems were experienced at all, and it was those problems and their solutions which occupied most of the attention of the construction division and other District personnel. Even in 1983, the most vivid memories of veterans of that campaign to modernize the Ohio related to the problems--the floods, the cofferdam failures, and the other spectacular difficulties.[20]

Cannelton Locks and Dam

Located 113.9 miles downstream of McAlpine Locks, Cannelton Locks and Dam replaced Dams 43, 44, and 45 of the old system and created the longest pool on the Ohio River. Construction of the locks began in 1962 and on the dam in 1965, but the work was not completed until 1974--twelve years under construction. The project suffered every sort of nightmare dreamt by waterways engineers, every type of delay, natural and manmade, conceivable; it even caught fire. Amongst District personnel, the ordeal at Cannelton went on so long it became a source of wry humor.[21]

Flooding of cofferdams continually

plagued the Cannelton job and its resident engineer, Arch K. Boyle, throughout the initial construction phase, especially at the Stage 1 cofferdam. When a 1966 flood washed fill materials from inside several steel cells in the cofferdam, it was necessary to repair them and back them up by the construction of more cells. A March 1967 flood removed more fill from some cells, and in November five of the cells, together with their foundation rock, moved a few feet, accompanied by a pronounced humping (uplift) of bedrock inside the cofferdam. After repairs were completed, the river again flooded the cofferdam in May 1968, at which time a runaway barge rammed into one of the cells of the cofferdam and broke it open. The accident might have resulted in considerable damage and further delays to the work except for a stroke of good fortune: the cell struck by the barge had already been reinforced through construction of a second cell behind it after the 1966 flood.[22]

James Nesbitt and Bernard Wethington who succeeded Arch Boyle as the resident engineers at Cannelton had no more luck than Boyle. A 1971 flood took out a coffer cell next to the lock wall and cracks in the finished concrete of the wall appeared. The river had cut through the bottom near the lock wall all the way into bedrock and emergency work was required to protect the site from further scouring. Foundation explorations also indicated weaknesses in the rock strata, making it necessary to redesign the pier foundation as a "battered

The fire at Cannelton Dam on the Ohio River after the barge accident on April 20, 1972.

caisson foundation." On top of those troubles came the disasters of 1972.[23]

Repeated flooding early in 1972 stopped work at Cannelton and also that in progress at the Newburgh and Uniontown projects downstream. In a letter to the Chief of Engineers concerning the flooding, the Ohio River Division Engineer admitted:

> In Louisville major problems continued on all Ohio River projects. Starting with the flooding of Cannelton cofferdam on 28 February, we have been plagued with high water and attendant problems during the entire period. Cannelton has been flooded twice, Uniontown once and Newburgh continues to have minor difficulties. At Newburgh the men were off the job for approximately two weeks during high water, and at Uniontown approximately one month was lost. The full work force has returned to both these jobs, and they are moving well. These events prove we are a long way from taming the Ohio River.[24]

On the morning of April 20, 1972, word came that the Cannelton project and the Ohio River were on fire and indeed they were. Near dawn that morning, the towboat *Thomas W. Hines* with barges of gasoline was approaching Cannelton Locks from upstream when the pilot somehow lost control of the tow. The tow broke apart and some barges and the towboat went through the dam and over the weir section at the Kentucky bank, the towboat smashing stern-first through a temporary construction bridge connecting the dam with the Kentucky shore. One barge wrapped around a pier of the dam and ruptured, releasing flaming gasoline that damaged the dam and floated, still burning, several miles down the Ohio. Rather than risking lives to extinguish the fire in the barge lodged against the pier, it was allowed to burn out, then the District contracted for cleaning the barge to exhaust the last fumes and to remove it with military explosives. Extensive repairs to the burned dam followed: the removal of fire-blackened concrete and steel, and the reconstruction of the damaged areas.[25]

Col. Charles J. Fiala addresses the crowd at the dedication of Cannelton Locks and Dam, November 2, 1974.

After twelve years of protracted construction, the *Belle of Louisville* and a crowd of 2,000 gathered on November 2, 1974, to watch Lockmaster John Woosley open the lock gates, parting a symbolic red, white and blue ribbon, and dedicating the Cannelton project. While addressing that crowd, Colonel Charles J. Fiala, the District Engineer, told them Cannelton Locks and Dam, had without doubt, been the most difficult project ever constructed by the Louisville District. While some District personnel might have disagreed, it seemed an accurate judgment at the time.[26]

Newburgh Locks and Dam

Construction of Newburgh Locks and Dam sixty-eight miles downstream of Cannelton began in 1965; yet, it was completed less than a year after Cannelton. Better progress prevailed at Newburgh in part because cofferdams were not flooded even once; the flat bottomlands on the Kentucky bank there meant floods could spread out with a "flatter" rise. Still, a series of "ulcer breeders" as the contractor called them plagued the Newburgh project. There were jurisdictional strikes amongst the workforce, a strike at a manufacturer which delayed delivery of construction equipment, and loss of a complete section of the concrete mixing plant when a truck carrying it wrecked while on the way to the work site.[27]

Because bedrock lay a hundred feet below the normal river level at Newburgh, the contractor adopted an unusual complex of subcoffers inside the main cofferdam to get the pier foundations in place; that is, the main cofferdam was constructed around the entire site and pumped out (dewatered) and the contractor then built more cofferdams inside the first to get deeper with safety. One subcoffer was built in a unique figure-eight configuration to eliminate the need for internal bracing while placing foundations for piers 9 and 10. Once the rock substrata had been exposed, the apparent weaknesses of the rock resulted in the first use in the Louisville District of prestressed rock anchors to add additional stability to the piers. Actually steel cables of up to 123 feet in length, the rock anchors were installed under very high tension to help tie the piers of the dam into the foundation rock.[28]

As happened at most large construction

Towboat and barge fleet entering Newburgh Locks and Dam on the Ohio River, June 4, 1980.

jobs, several design changes were made while work was underway at Newburgh. One of the larger savings to the government effected through "value engineering" came in 1970 at the Newburgh project when a District team including William M. Gossage, Robert Cody, Howard Boatman, Jack E. Kiper, and Alfred J. Graves recommended a change in the dam design reducing the amount of concrete and pilings needed without loss of strength or safety and saving taxpayers about a million dollars. In 1972 the number of cells in the fixed weir section of the dam was increased from sixteen to eighteen and the direction of the weir altered slightly to secure better foundation conditions and to funnel riverflow toward the gates of the dam for smoother discharge. Another major change occurred in 1973 when a retaining wall of twenty-seven steel cells was placed downstream of the tainter gates to prevent excessive erosion at the base of the dam and expensive maintenance after the dam was finished.[29]

Toward the end of the job the fuel shortages of 1973-1974 troubled the contractor. At one time only enough fuel to operate the equipment six days in one month remained, but the resulting delays were inconsequential, and on July 2, 1975, Lockmaster Earl McCrady locked through the *J. W. Bedford* with nine barges to officially open Newburgh Locks and Dam for business. Despite problems and design changes experienced during the course of construction, Resident Engineer Leo Wilsbacher commented the Newburgh project was one of the smoothest construction jobs he had seen, and no doubt he was correct.[30]

Uniontown Locks and Dam

Perini Corporation as contractor had completed Uniontown Locks, sixty-eight miles downstream of Newburgh, during the 1960's, and on May 20, 1970, the contract for the dam went to the Gust K. Newberg Construction Company. Gordon M. Stevens became resident engineer at Uniontown in 1970 with Norman R. Gilley as his assistant, Samuel Bartlett and Cecil E. Dodson as project geologists, and George Brunner as office engineer.

The District was much concerned about the geology of the Uniontown site, located near the confluence of the Wabash River with the Ohio and at a point where the rivers had deposited some forty-five feet of mud and alluvial materials atop layers of bedrock composed of limestone, coal, clay, and shale strata at varying depths. That concern was well-advised, for upstream at Cannelton a portion of the bedrock had moved during construction, taking a small section of the cofferdam with it.[31]

The rectangular cofferdam at Uniontown Dam on the Ohio before it failed. February 24, 1971.

The contractor began driving a steel cell cofferdam in a rectangular configuration to contain the sites of dam piers 6 through 11 on July 9, 1970. When completed on February 2, 1971, it included twenty-eight steel cells and two permanent weir cells, all filled with river sand and capped with lean concrete. Pumping began on February 6 and the interior of the cofferdam was dry on the 16th. The Ohio was rising at the time and on February 26 it stood at elevation 352 feet, about three feet below the point at which it would have become necessary to deliberately flood the cofferdam to equalize the pressure inside it with that of the river outside.[32]

February 26, 1971, began with the usual Friday morning routines: Resident Engineer Stevens and his assistant Norman Gilley conducted the end-of-the-week safety meeting and prepared their weekly reports; construction inspectors Daniel Riggs and Thomas Bowling walked out atop the cofferdam cells to observe the progress of the work; and some fifty workmen began the dayshift, operating cranes atop the coffer cells to lift materials in and out of the coffered area, working on barges and boats moored alongside the coffer, and at work some sixty feet down at the bottom of the cofferdam. Down "in the hole," one bulldozer shoved muck and loose stone from atop the bedrock while drills ground into the rock. Some drills were cutting out cores to explore the foundation rock and others were cutting "presplit" holes—closely spaced drill holes in a straight line that would help form a smooth side of the ,key trench when the bedrock was blasted out. A few men were attaching markers called "tattletales" at the bottom of the steel cells, which helped engineers with surveying instruments detect any movement or deflection of the cells under pressure of water as the river surged steadily upward outside the cofferdam.[33]

At 9:45 that Friday, David Resenbeck and Doug Oliver, two engineers for the contractor, set their "gun," as they called their transit, atop one of the cells and began "shooting," meaning to check the tattletales in order to detect deflection of the steel cells. Resenbeck later described that moment:

> About that time Doug said, "Wait a minute." He said he thought that his gun had moved; he was looking at cell 17 and it showed movement of two inches, so he thought the gun had moved. He checked the instrument and it was all right, so he checked cell 17 again and it had moved two inches; then he checked cell 23 and it had moved five inches. So he thought, well, there is still something wrong with the gun, so he proceeded to check it again. At that time, after he checked it, everything was still good, but cell 23 had moved a foot or somewhere in that neighborhood. At this time, he kept saying, "It is moving!" But I couldn't visually see it with my eye. About that time I saw Tom Bowling... waving his arms and just about that time it became visible to the eye that it was moving. It is hard to say the rate it was moving, faster than you could walk; you could detect this with your eye. Of course I was concerned with the drillers and the tractor operator down in the hole not being able to hear the warning whistles, so I was kind of watching the driller, and then I noticed the drill turning over and the rock just more or less heaving up.[34]

Standing atop one of the cells that was breaking up, Inspectors Riggs and Bowling shouted the alarm to the workmen, and the crane operators laid on the horns to alert them. As the men down below scrambled for their lives, the cofferdam split open at two points and the four cells between those points began to march upstream, majestically maintaining their side-by-side formation and moving upriver in perfect plumb, straight as a detail of combat engineers on parade. Some of the men scampering across the bottom of the coffered area boarded a platform and were hoisted to safety by a crane. Others reached the two escape towers at the sides which held zig-zag staircases and started the sixty-foot climb to the top of the cells. One of them later remarked: "I don't know how we got up those stairs so fast. We usually have to stop and rest along the way."[35]

Running along the top of the swaying cells, the workmen and inspectors headed for apparent safety and jumped aboard one of the barges moored alongside the cofferdam. Then, as the cells of the dam opened up, the river rushed into the interior of the cofferdam, wrenching one of the barges loose from its mooring and sucking it down into the hole. Realizing even the barges were not safe, the men boarded the Engineer workboat which took them safely to bank; even that was dangerous, for the boat had but a small engine and the water rushing into the coffer could have sucked the entire boatload of men into the chasm.[36]

As soon as it became evident the workmen and inspectors had miraculously escaped uninjured, the resident engineer launched the first of several investigations of the debacle. Differences of opinion concerning the cause of the cofferdam failure developed, but independent consultant Ralph Peck concluded the movement of cells as a unit some seventy feet upstream of their original position, carried along with the underlying slab of rock, indicated the strength of the bedrock was less than anticipated by either the Corps or the contractor. Peck therefore found "the conditions encountered in construction to differ from those which could reasonably have been anticipated by the contractor."[37]

Uniontown cofferdam after it failed. February 27, 1971.

During the following year the contractor removed the failed rock and rebuilt the cofferdam along its original lines, adding gated pipes to flood the cofferdam deliberately at lower elevations. The reconstructed cofferdam eventually withstood the pressures of a flood six feet higher than the elevation at which the first cofferdam had failed. For safety, additional stair towers and a lifeboat were placed in the reconstructed cofferdam.[38]

The District added major changes to project design after the cofferdam failure. No more presplit or line drilling was permitted and blasting the bedrock to open a key trench was ruled out; the trench was opened with electric coal saws. To provide increased security against sliding of the foundation, the District's engineering division added caissons in the foundations of the piers. Large drill rigs cut shafts deep into the bedrock at various angles across the faults, or weaknesses, in the rock.

Workmen wearing harnesses and carrying air hoses then descended into the shafts for final cleaning by hand, followed by Corps geologists and inspectors to see the condition of the rock. Thirty-inch steel pipes lowered into the shafts were filled with concrete; the shafts having water in them were filled with concrete through a pipe, with the seal between the concrete and water inside the pipe maintained through the use of a volleyball. After pipe caissons were completed, construction of the piers of the dam began atop them.[39]

The Uniontown cofferdam failure, which delayed completion of the project about a year and cost some $8.4 million, along with the cofferdam troubles experienced at Cannelton, brought reassessment of construction procedures. Until 1971 the design of cofferdams was a contractor responsibility, but after the failure at Uniontown Lieutenant General Frederick J. Clarke, Chief of Engineers, thought it desirable for the Corps itself to design cofferdams for major projects with the aim of reducing the risks of cofferdam failure. In November 1971, the contract for Willow Island Dam on the Ohio River in Huntington Engineer District became the first for which the Engineers instead of contractors designed the cofferdam.[40]

Perhaps because the Ohio had been canalized by locks and dams since 1929 and most significant alterations to the environment had already taken place, neither Uniontown nor any other Ohio River

Workmen insert steel reinforcement into caissons at Uniontown Dam before the concrete is added; note the varying angles of the caissons. October 16, 1971.

Resident Engineers Conference, Louisville District Construction Division, at Rough River Lake, October 1973. Seated from left: Norman Longworth, Calvin Martin, Bernard Wethington, William Keown, Richard Schleicher, C. J. Walter, Steve Markwell, Paavo Carlson; 2nd row from left: Cecil Dodson, Jack Kiper, Norman Gilley, Arnold Goodaker, Henry Vickers, Dana Greenfield, George Brunner; back row from left: Frederick Meadows, Richard Russell, John Emmerich, Otwa Lee Meetze, Gordon Stevens, James Houchin, Ralph Hill, Carl Wilson.

modernization structure encountered major opposition from the environmental groups who were protesting the District's multipurpose lake projects on streams tributary to the Ohio. Indeed, it was at Uniontown where cooperation between the Corps and environmentalists produced notable benefits. Along the banks upstream of Uniontown Dam were cypress sloughs sheltering thousands of migrating ducks and geese, sloughs which would be flooded periodically by the dam and on which the District planned to purchase flowage easements. Working with the Audubon Society, Colonel John Rhett and the District arranged for outright purchase of the lands rather than easements along the sloughs, with the lands eventually becoming wildlife preserves under license to state agencies. The arrangement added more than 2,000 acres of wildlife preserve to Indiana's Hovey Lake State Game Preserve and about 4,000 acres for similar purposes in the vicnity of Kentucky's Powell Lake, Highland Creek, and Grassy Pond game refuges. "When we get together early in the project," said Colonel Rhett, "as we did this time, we have the best chance of coming up with the best answer."[41]

When the *Sergeant Floyd*, carrying the Corps' 200th anniversary display, parted the symbolic ribbon across Uniontown lock chamber on October 4, 1975, the Louisville District had completed more than a decade of difficult and sometimes harrowing efforts to get Cannelton, Newburgh, and Uniontown Locks and Dams into operation. With completion of the Uniontown project, the District had finished five of the seven new locks and dams assigned it on the Ohio River and had modernized 410 of the 545 miles of river in its section. Downriver, the Nashville Engineer District had started construction of Smithland Locks and Dam in 1971; the Louisville District would finish that job during the late 1970s. The seventh new structure, the proposed Mound City Locks and Dam nearest the mouth of the Ohio, by 1975 had an uncertain future, and the District had begun a restudy of planning on that lowermost river section. The modernization efforts of the District on the lower Ohio during the last years of the "decade of the environment" should be described after discussion of other challenges met by the District during the early 1970s.[42]

The design and construction of a multipurpose dam was among the most complex of all cooperative endeavors. The task required orchestration of all elements of an Engineer District, which had to chime in on schedule, move vigorously through interpretive middle phases, and produce everything that was needed at precise moments during the crescendo of furious construction in the final phases. Serving as conductor, the District Engineer perforce kept all sections of the organization interacting together, for the contributions of all elements were vital to production of a technically correct structure pleasing to two highly critical audiences: the forces of nature and the taxpayers of the United States.

Carrying that parallel perhaps a step too far, the Louisville Engineer District in 1970 had five noteworthy performances underway simultaneously, all located in the eastern sector of the District: Cave Run and Carr Fork dams in southeastern Kentucky, Clarence J. Brown and East Fork (William H. Harsha) dams in southwestern Ohio, and Brookville dam in eastern Indiana. Those five performances were resuming in 1970 after an intermission of about a year resulting from efforts by President Richard M. Nixon to control runaway inflation. His administration had impounded construction funding, requiring that the Corps of Engineers suspend the awarding of contracts for new construction needed to finish its projects. Work had ceased at several dams in the District in 1969 at the end of the first movement, leaving concrete control towers standing alone in the river valleys, ready to function but without dams or lakes to regulate.

When the construction freeze ended in late 1970, the Louisville District had plans and specifications in hand and in short order it awarded contracts that would send the dams inching skyward. Bulldozers, pan scrapers, and roller compactors began roaring at the five dam sites, pushing clay and earth and rock into their proper place for structural development, flattening layer after layer onto each increment, carrying the dams even higher, as far as two hundred feet above the valley floor at the dam on East Fork of the Little Miami River. From 1970 until East Fork (Harsha) Dam, the last of the impoundment quintet, was topped out, the planning, engineering, real estate, supply, and construction sections of the 1,000-person "orchestra" of the Louisville District performed with precision.

One of the most experienced and prolific building organizations in the nation by 1970, the Louisville District had completed twelve major dams and impoundments for flood control and multiple purposes, not including navigation modernization structures on the Ohio or smaller locks and dams on tributary streams. The District had begun constructing dams for flood control in 1946, commencing with Cagles Mill Dam in Indiana and West Fork of Mill Creek Dam near Cincinnati. In the quarter century between 1946 and 1970, the District had completed ten more high dams: Buckhorn, Rough, Nolin, Green, and Barren River dams in Kentucky; and Monroe, Mansfield (Cecil M. Harden), Mississinewa, Salamonie, and Huntington Dams in Indiana. It thus had a dozen successful performances to its credit by 1970, but its public audience was becoming increasingly critical and restless.[1]

With a single exception, the District

The Louisville Engineer District in 1970 had under construction in the eastern sector of the District the five major multipurpose impoundments identified on this map in the large bold print.

had built its multipurpose dams not of reinforced concrete and steel like the modern navigation structures on the Ohio, but of the native soils and rock found in the vicinity of the dams. Building dams of concrete had been popular among engineers early in the 20th century, but it generally proved more economical in the Louisville District to form them with layers of earth and rock, the sole exception being Huntington Dam completed in 1968 at the headwaters of the Wabash River which had a central concrete spillway section controlled by steel tainter gates. Reinforced concrete was used at flood control dams, however, to erect skyscraper-like operating towers located just upstream of the dam embankments and also to form outlet conduits leading under the dams to the stilling basins below; that is, in portions of the structures that would be subject to the thundering, scouring action of water in motion.[2]

Like five symphonies written by the same composer, the five dams the District was building in 1970, though somewhat similar in structural design and construction, were not at all standardized and repetitious productions, for each had distinctive and noteworthy features. Cave Run Dam on the Licking River controlled the runoff of precipitation from 826 square miles of watershed, at least double the size of the areas controlled by each of the other four and larger still than the 58 square-mile area upstream of Carr Fork Dam near Hazard, Kentucky. Four of the five dams exceeded a hundred feet in height, and the Clarence J. Brown Dam at Springfield, Ohio, though only seventy-two feet high, was by far the longest at 6,620 feet in length, or more than a mile of embankment in a unique "L" configuration when viewed from the air. The East Fork (William H. Harsha) Dam in Ohio reached two hundred feet in height and actually was two dams, one across the stream channel of East Fork of the Miami River and the other blocking a low place at one side of the lake. Brookville Dam in eastern Indiana was the average or "typical" dam of the five: it was 2,800 feet long, 181 feet high, and controlled runoff from a 379 square-mile watershed.[3]

The Structural Pattern

Before outlining the unique histories of each of the five dams abuilding in the eastern sector of the District in 1970, a brief summary of the structural pattern followed by Engineers while building the dams should provide some background. That pattern involved an orchestration wherein each District element took the lead during various project stages in the following general order: planning, engineering, real estate, supply and procurement, construction, and operations divisions.

As previously mentioned, a separate planning division was not established within the District until 1970, and the plan formulation, or first phase, studies for each of the five impoundments were therefore performed within the engineering division though in truth essentially by the same personnel who transferred to the new planning division in 1970. During the second phase advanced engineering and design stages, the engineering division converted general conceptual plans for the dams into site specific blueprints and specifications for guidance of the constructors. Under the overall direction of Robert H. Hayes, chief of the engineering division from 1961 to 1972, the technical details for the five projects were hammered out. It was the engineering division's survey branch that mapped the sites of the dams to secure full


1971 photograph in the District's Engineering Division. Left to right: Frank Druml, David Beatty, Col. John T. Rhett, Jr., and Robert Hayes, Chief of the Engineering Division.

knowledge of the terrain and other features in the areas where dams and lakes eventually would rise. The foundations and materials branch, renamed the geotechnical branch in 1977, conducted geologic investigations of soils and subsurface conditions at the dam sites, drilling holes deep beneath the surface to extract core samples of underlying strata to learn what conditions might be encountered. The hydraulic and hydrologic branch collected and analyzed such hydrologic data as precipitation records, streamflow records, and runoff characteristics to help determine what should be the eventual height of the dam, the elevations and size of the spillways, and the dimensions of outlet conduits and other structural features.[4]

While those branches completed their data collection and planning, the relocations branch worked with state highway and county road departments, utility companies, and other agencies with facilities located in the lake areas, drawing up detailed plans for rerouting roads and utility lines around the areas and for removal of other manmade obstacles in the way of the projects. The design branch in the meantime prepared the complex plans and specifications which reduced concepts for the dams to lines, dimensions, and precise figures on paper, complete with instructions for constructors. When the specifications and blueprints were printed and ready for distribution to construction firms interested in placing a bid for the work at

Louisville District Engineering Division personnel, September 1975. Left to right, front row kneeling: John Sanders, Charlie Robinson, C. E. Percy Purcell, Joe Rainbolt, Paul Roberson, Gene Cartee, Mark Weedman, Council Miller, Larry Martin, Perry Daniels; 2nd row: John McGregor, Carl Rose, Cal Wiseman, Coyle Edwards, Bill Edwards, Joe Voll, Catherine Cleare, Betty Sibley, Thelma Weber, Irene Carpenter, Lillian Fleischman, Brenda Sawdy; 3rd row: Tom Yingling, Al Harmon, Archie Ware, Charles Breckenridge, Steve Michel, Bob Lehman, Dave Romaine, Bob Biel, Jay Hagan, Norm Sanders, Jimmy Vandergriff, Leon Abolins, Phil Hasselwander, Pat O'Bryan, Bob Westmeier, Doug Shelton, Ed Pantoja, Tom Riddle, Jim Emly, Tom Martin, Ed Yost, Bob Stadler, Don Robison, Randy Rankin, Joe Keith; 4th row: Richard Pruitt, Darrel Gordon, Bob Mullins, George Herbig, Boyd McClellan, Joe Jarboe, Gordon Whitten, Joe Bube, Dennis Curl, Abe Harrison, John Sirles, Don Basham, Jim Hodge; top row: Kenny Besser, Ed Baldwin, Ted Reverman, Noah Whittle, Jack Skinner, Dave Beatty, "Sarge" Engdahl, Ron Kiser, Jim Mead, Bill Stevens, Earl Hibbs, Mike McConville, Rick Garmom, Bob Weido, Frank DeGott, Kenny Hudston. Top picture from left, front row: Eugene Presley, Bill Kreisle, Herschel St. Ledger, Farrel McDonald, Frank Warden, Margie Wheeler, Jane Cordery, Aileen Barrett, Homer Smith, Noland Kirk, Bill Locker, Ben Kelly; 2nd row: Bill Fowler, Howard McKee, Richard Zirkle, Tom Dickert, Kenny Loyall, Roy Pack, Henry Griffin, Steve Rager, Gerry Hitchcock, Jack Pfeifer, Harry Rankin, Bob Fisher, Sharon Reinhart, Jim Lapsley, Steve Bonn, Danny Holcomb, Darroll Hawkins; top row: Pat Neichter, Charles Fox, Joseph X. Seckinger, Bill Showers, Jim Elliott, Barry Robinson, Craig Meuter, Rick Morgan, Ted Pullen, Charles Dunlevy, Harvey Headley, Al Scalzo.

hand, the engineering division had completed its service as lead element; thereafter it would carefully monitor work at each dam, modifying plans for the projects when necessary.[5]

For a brief moment at the time contracts were awarded, the District's supply and procurement division took the virtuoso lead in the efforts to get construction of the dams underway. It prepared formal contract documents, which together with the plans and specifications comprised the "bid package," and it advertised the work and made the bid package available to all contracting firms interested in undertaking the work. Contractors reviewed the plans, inspected the work sites, and prepared their own cost estimates, submitting their proposals at a definite time set by the supply and procurement division which opened and read the bids publicly at ceremonies called bid openings or "lettings."[6]

The supply and procurement division conducted the contract bidding in accordance with strict legal rules, and bid openings were interesting affairs, especially to those watching the reactions of contractors to the bids as they were read aloud and heard the high bidders mumble: "They can't do it for that!" Supply and procurement division handled contract awards for everything from a $100 million dollar dam down to a historian contracting to produce a book of no less than two hundred pages for a few thousand dollars. Charles M. Knosp, who retired as chief of the supply

Louisville District Procurement and Supply Division personnel, May 1974. Front row from left: James Mackin, Jr., Lois Anne Baum, Mary Bonn Thompson, Ruth Kersey, William Pollard, Robin Benjamin, Sharon Bratcher, Vivian McLaughlin, Wanda West, Faye Riddle; 2nd row from left: Marge Knable, Robert Mulligan, Clyde Lobb, John Dennison, James Rigney, Joseph Theobald, Bill Cheesman, Opal Craig.

and procurement division for the Louisville District in 1970, remarked that in his forty years with the Corps he had awarded contracts for towboats, complete hospitals, glass eyes, and even snuff. In addition to awarding contracts, the supply and procurement division administered most contracts let by the District, but not the building of dams which was in the purview of the District's construction division.[7]

But before hardhats of the construction division and contractors could lift a shovel at the dam sites, the real estate division had to acquire titles to the lands for public use. In fact, before construction contracts were even awarded the District's real estate division had conducted public meetings to explain to landowners the land acquisition procedures and had opened a project office in a community near the dam site to maintain direct contact with them. Real estate negotiators met with each landowner personally, and those often were trying times for both the people who had to sell their land and for Corps negotiators. The negotiators quickly learned to listen patiently to the opinions of the landowners about what was wrong with a project, with income taxes, or with federal management of foreign and domestic affairs before steering the conversation around to the subject at hand: agreeing upon a fair price for the land.[8]

Land acquisition procedures were extremely complicated even before the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970 provided landowners with several additional relocation benefits such as assistance with locating new "safe and sanitary" housing. That act, however, did not alter the essential principle: landowners were guaranteed a payment equal to the "fair market value" of their properties, either through negotiated agreement with the Corps or by the decision of a court. At all five of the major dam projects underway in the Louisville District in 1970 there were disagreements about the fair market value of some properties that made the headlines of local newspapers; yet, the District's real estate division acquired nearly ninety percent of the lands needed amicably, and about half of the ten percent requiring condemnation actions in courts were initiated merely to secure clear titles, not to settle disagreements about price.[9]

The real estate division normally began purchasing lands needed for a project at the site of the dam so its construction could begin. Because building a dam usually took five or more years, the properties to be acquired in the lake area upstream of the dam site would not be inundated by the lake for several years and therefore their acquisition could proceed at a more leisurely pace. Despite dramatic films and books emphasizing the contrary, it was very rare within the Louisville District for a property owner to refuse to relocate so late that the lake was rising, necessitating that a court send law enforcement officials to remove the individuals.[10]

After title to the land at a dam site had been acquired and the construction contract awarded, the District's construction division opened a resident engineer office at the site as contractors with personnel and their equipment arrived. The resident engineer and his staff kept records of work performed by the contractors, counting the number of truck and pan scraper loads of earth moved, measuring the yardage of concrete placed, and even standing at the piledrivers and counting each fall of the hammers. With that sort of information, they regularly estimated the amount of work accomplished by the contractors, and contractors were paid an amount based upon that estimate minus a percentage retained until the work was completed. The resident engineer staff also made certain the contractors were using the materials and methods specified in their contracts.

Near the resident engineer office was a materials laboratory for systematic testing of materials used in the dam. Entering such a laboratory, one would observe engineers apparently making mud pies but actually testing the soils used in embankments for moisture content, density, and plasticity, or other characteristics of interest. If the dam included considerable amounts of concrete in its design, the laboratory might also have a small damp closet where cylinders of concrete cored from the structure were slowly cured and deliberately broken with a hydraulic press to ascertain the strength of the concrete.[11]

At least two contracts were awarded for the construction of each dam, one for the concrete operating tower and outlet conduit and the other for placing the earth and rockfill embankment. The first contractor normally built an access road into the site of the dam if needed, cleared the site of vegetation, and began constructing the control tower for operations that would stand in the lake immediately upstream of the dam. After excavating and placing a sturdy foundation, the contractor built forms for the walls of the tower, hoisted them into place, and began pouring concrete in lifts of ten to fifteen feet until the tower reached perhaps a hundred feet into the air. At the top of the tower were installed steel cable hoists to raise or lower gates over openings near the base of the tower to open or close the entrances to the outlet conduit. From the base of the tower, a concrete conduit, similar to a large pipe or culvert of from eight to fifteen feet in diameter, was placed to run under the future site of the dam embankment to a downstream stilling basin where water from the lake would return to the river channel. Construction of the operating tower, outlet conduit, and related features usually required two or more years, and only after completion of that work was a contract for building the dam embankment awarded.[12]

The contractor for the dam embankment sometimes began with excavating a spillway through a nearby bluff adjacent to the site of the dam. Having a bottom elevation a few feet lower than the crest of the dam, the spillway served as safety valve to prevent overtopping of the embankment during extreme floods filling the lake faster than water could be released through the conduit under the dam. The design of the dams built by the Louisville District was so conservative, however, that none of the spillways had ever been used for passage of floods as of 1983.

Construction of a dam embankment began with placement of a diversion or barrier dam serving a purpose somewhat similar to that of a cofferdam: it kept the work site dry while the foundation of the dam was excavated and treated and the main body of the dam constructed. Diversion dams placed across stream channels blocked their flow and diverted the streams through the outlet conduits; most diversion dams were designed to block stream channels permanently and were so placed that they became the upstream toe of the main body of the dam. Built to a lower elevation than the main body of the dam, diversion dams were designed to protect the work site against floods of relatively short frequency, not against what were called 100-year floods; nor were diversion dams designed to provide any flood control benefits, though that happened on occasion.

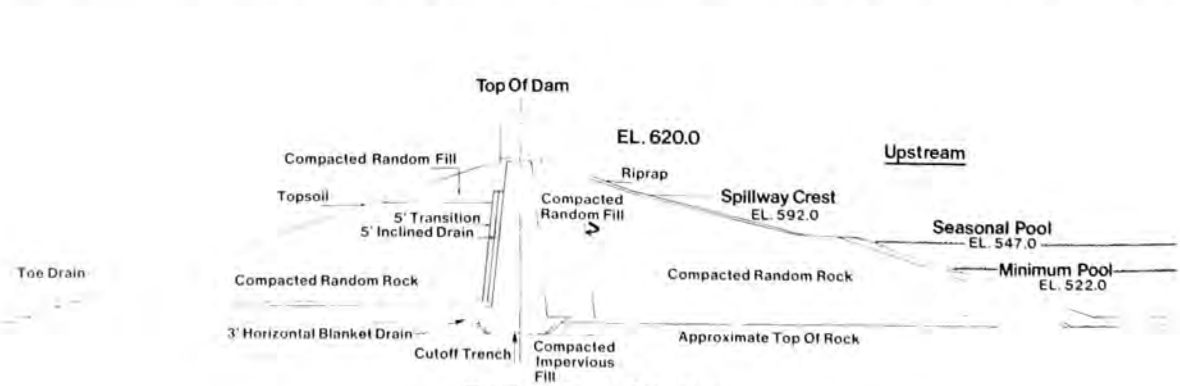
After a diversion dam was in place and

the flow of the river moving through the bottom of the operating tower and the outlet conduit, the contractor cleared the area under the base of the dam down to the foundation and opened a key trench or cutoff to assist in securing the base of the dam against seepage or sliding. If the foundation were bedrock, track drills pounded a line of presplit holes down along the sides of the key trench and the rock between the lines of drill holes was removed with controlled blasting and excavation. The foundation was sealed by pumping through drill holes a cement mixture called "grout" to fill any crevices or weaknesses in the rock. Where the quality of the rock foundation, or of the abutments at each side of the dam, was questionable, enough "grout" was pumped into the foundation and abutments to form a curtain or cutoff wall protecting against seepage through the rock.

When foundation treatment was completed, the contractor placed the central impervious core of a dam, commencing down in the key trench or cutoff. Called the "puddle" by older engineers, the impervious core of the dam was compacted clay rolled into place under controlled moisture and density standards. Once the trench was filled, the contractor continued raising it higher in lifts of a few inches at a time, while at each side of the clay core layers of sand and rock and earth in segregated zones also were placed. Thus the dam slowly rose from the valley one layer or lift of a few inches at a time, dumped onto the proper zone from trucks or pan scrapers, dozed into level layers, and roller compacted to the density specified for each zone of materials.

As work at the dam progressed, contractors also relocated the roads, utility systems, buildings, cemeteries, and most trees from the lake area upstream of the dam, usually rushing near the end of the job to have all structures removed and all roads rerouted before the lake began to fill. The building of boat ramps and other recreation facilities might also be underway around the future shoreline, though that work often waited until a later time when funds became available.

When at last a dam reached its full height--was "topped out"-- and the District made its final inspection, if the work were satisfactory, the contractors then were paid their retained percentage. At a chosen time, usually corresponding to the beginning of spring rains, the gates in the operating tower dropped into place closing the entrances to the outlet conduit and the lake began to rise. The impoundment slowly crept up the side of the new dam at



Typical Dam Section

a designated rate while engineers monitored the performance of the dam as the weight of water began to rest heavy against the embankment. At the end, the District's public affairs office arranged a dedication ceremony to mark project completion and the operations division became responsible for seeing that the project served the purposes for which it was built.[13]

Advance planning, technical engineering and design, real estate acquisition, contract awards, and construction thus were the basic elements the pattern followed at each of the five lake projects under construction in 1970. The pattern was merely the underlying theme, however, for each of the five dams provided variations upon the theme. Each had a unique design to fit local topographic and geologic conditions. Each presented its own special difficulties during various project phases. And each had its own history.

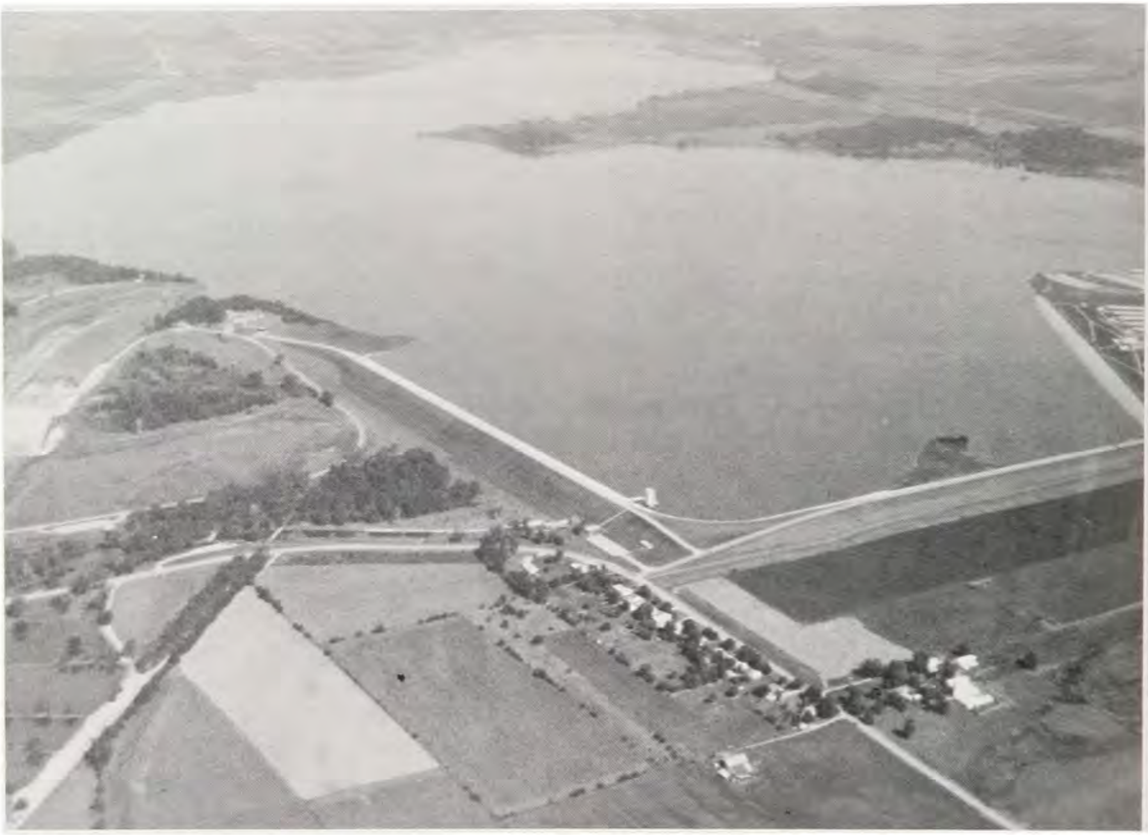
Clarence J. Brown Dam and Reservoir

The Clarence J. Brown project may have been the last reservoir to be constructed by the District. The words "reservoir" and "impoundment," once used as names for projects, had become somewhat archaic by 1970, and names of reservoirs built by the Corps were changed that year to "lakes," a word more closely associated in the vocabulary of the public with recreation. But Clarence J. Brown Reservoir and a few other projects were not included in the change in nomenclature because they had been specifically named "reservoirs" by special acts of Congress. The Clarence J. Brown Dam and Reservoir, first known as Buck Creek Reservoir, was named by Congress in 1967 in honor of Ohio's congressman from Blanchester who ushered authorization and funding legislation for the project through Congress before his death in 1965.[14]

Congress after 1970 immortalized two other of its distinguished members by naming Louisville District projects in their honor. In 1974, Mansfield Dam and Lake in Indiana was named for Cecil M. Harden, a congresswoman who represented the state for years, and in 1980 the project on East Fork of the Little Miami River near Cincinnati was named for Congressman William H. Harsha of Ohio. The Louisville District has become somewhat unusual among Engineer Districts in that it has a lake named for a woman—Congresswoman Harden—and another for a black, the Caesar Creek Lake in Ohio which bears the name of a freed slave who lived during pioneer times along the stream on which the dam was constructed.[15]

Project names, it should be mentioned, generally were selected by the District during early planning phases and most often derived from the name of the stream on which the dam would be located or from a nearby community. Congress approved the names in the project-authorizing legislation at the recommendation of the Chief of Engineers. But no matter what official names were selected, the public sometimes chose its own. Local people often referred to the West Fork of Mill Creek Lake near Cincinnati as Winton Woods lake, the Cagles Mill Lake in Indiana as Cataract lake, and Cecil M. Harden Lake as Raccoon lake.[16]

Clarence J. Brown Dam was at first known as the Buck Creek project because it was located on that stream, a tributary of the Mad River which frequently flooded Springfield, Ohio. The District first studied the project in 1954, and after a 1959 flood heavily damaged the Springfield area local civic leaders like Carl Ultes, Sr., whose business was flooded in 1959, championed



Aerial view of Clarence J. Brown Dam and Reservoir near Springfield, Ohio. Note that the dam has the form of an "L" viewed from the air.

the Buck Creek project. At their urging, Congressman Brown arranged an intensive study of the project, and in 1961 the District recommended a multipurpose dam astride Buck Creek to supply flood protection, improved water quality, and recreation for the Springfield area.[17]

Congress approved the project in 1962 and on October 1, 1966, Ohio Senator Frank J. Lausche broke ground for its construction. Six Industries, Inc., was contractor for the 110-foot high operating tower and the 11-foot diameter outlet conduit. Under supervision of Resident Engineer John Emmerich, the firm built the tower in fifteen foot lifts, assembling forms for the concrete on the ground and hoisting them up the tower with a crane that also handled the concrete bucket during the "pours." The original completion date for the entire project was 1970, but work stopped in 1968 with only the operating tower and conduit completed because the President halted the award of new construction contracts to help control inflation.[18]

After the construction freeze ended in 1970, the District awarded a contract for building the dam and relocating a mainline railroad from the lake area on October 14, 1970, to the Halloway Construction Company. The dam had a twenty-five-foot deep cutoff trench beneath it backfilled with impervious materials extending down into the underlying glacial till. Only seventy-two feet high but more than a mile long, it required the careful placement of some two million cubic yards of fill, one truck or scraper load at a time.[19]

The dam ws completed in three consecutive seasons, the lake impounded during early 1974, and the dedication ceremony scheduled for September 17, 1974. Vice President Gerald R. Ford was to be the chief speaker at the ceremony dedicating the $22 million project, but had to cancel when he became President in August; he sent as substitute Secretary of Interior Rogers C. B. Morton. Though the cost of the project was one hundred percent federal, the Ohio Department of Natural Resources leased and assumed responsibility for operating the recreation facilities at the lake. Working with the Clark County Historical Society, the District helped preserve the David Crabill house, a 19th century brick residence of local historical significance; a barn and smokehouse were later added to the farmstead and plans called for further interpretation of the site.[20]

Brookville Lake

"The Brookville dam and reservoir project," complained Indiana Senator Birch Bayh to President Nixon, "was the result of many years of hope, work and planning. Over the years, without the dam, flooding has taken a drastic toll in lives and property." His complaint related to the stop of construction at Brookville Dam in 1969 as result of the construction contract freeze imposed on civil works projects by the administration.[21]

The Senator was correct. The memorable 1913 flood at Brookville had taken fifteen lives and the homes of more than eight hundred residents. Property damages had been substantially higher during the 1959 flood, and afterwards the Whitewater Valley Flood Control Association had formed to lobby for the Brookville project. Winning support from Congressmen Lee Hamilton and Ralph Harvey and Senators Vance Hartke and Birch Bayh, proponents of the project secured a study appropriation in 1960 and construction funding in 1965, with the State of Indiana agreeing to pay the cost of including water supply as a project feature.[22]

The R. E. Dailey Company and subcontractor J. C. Hood Company began building the operating tower and outlet conduit when ground was broken on December 11, 1965. The Brookville project also required extensive relocations including the villages of Fairfield and Quakertown. The District built a new Fairfield two miles from the site of the old village, but most villagers moved elsewhere and by 1979 only one of the residents of new Fairfield actually had lived in the old village. Quakertown was not rebuilt, but the summer population of the recreation area near its site at lakeside was larger than that of the village ever had been. Drowned by Brookville Lake was the birthplace of James B. Eads, a famous 19th century engineer who had built the bridge bearing his name at St. Louis and had also improved the mouth of the Mississippi River during the 1870s.[23]

When the Nixon administration lifted the freeze on construction contracts in 1970, Resident Engineer C. J. Walters supervised the contractor who began construction of the 181-foot high and half-mile long earth and rockfill dam and completed it in three construction seasons. Impounded in 1974 at the same time the Clarence J. Brown Reservoir was filling, Brookville Lake was dedicated on July 26, 1975, at ceremonies conducted by Indiana

Aerial view of Brookville Dam and Lake in eastern Indiana on the Whitewater River.

Aerial view of Carr Fork Dam and Lake near Hazard, Kentucky. The dam and control tower are in the center of the picture, the outlet and stilling basin on the left, the spillway cut into the rock at the lower right, and a boat launching ramp at right center.

Governor Otis R. Bowen, Senator Vance Hartke, Congressman Lee Hamilton, Brigadier General Wayne S. Nichols of Ohio River Division, and Colonel James N. Ellis of the Louisville District.[24]

The Indiana Department of Natural Resources contracted to operate recreation facilities around Brookville Lake and found the project kept them quite busy. Located not far from the Cincinnati urban area, Brookville Lake had more than a million visitors during its first year of operation. In fact, it reached its predicted ultimate use for recreation in its first season and remained in heavy use each year thereafter.[25]

Carr Fork Dam and Lake

"Located approximately two miles from Sassafras near the Little Dove Church" was the standard set of directions handed people trying to find Carr Fork Lake in the heartland of Appalachia. Actually located on Carr Fork which flows into the North Fork of the Kentucky River a few miles from the progressive community of Hazard, Kentucky, Carr Fork was considered the "pet project" of Seventh District Congressman Carl D. Perkins, whose home was in Hindman not far from the lake. No doubt his ardent advocacy of the project did help move it through committees of Congress, for it was begun at a time when President Lyndon B. Johnson was campaigning for economic rehabilitation of the Appalachian region, and when Congressman Perkins asked Congress in 1964 for funds needed to start construction of the project he declared:

> Maximum progress on flood control projects should spearhead efforts to solve economic problems in the Appalachian area. The constant threat of flood hinders all efforts to revitalize the economy. This request conforms with and implements the President's proposed Appalachian public works program.[26]

Hazard and communities nearby had suffered severely from repeated flooding, especially during the 1957 flood disaster, before Congressman Perkins and Kentucky Governor Edward "Ned" Breathitt broke ground for the Carr Fork project on April 17, 1966, commencing work needed to reduce flooding stages at Hazard. The lake was to fill a very narrow floodplain of the sort for which that part of Kentucky was well known, and relocations involved moving roads, power lines, three schools, six churches, eight cemeteries, and two hundred and seventy-five families. To Kentucky sports fans, the saddest loss was little Carr Creek High School, which with only twenty-four students enrolled had placed second in the 1928 state high school basketball tournament and had won the state championship in 1956. Some of those fans even wanted to name the project Carr Creek Lake to honor the school.[27]

The pattern at the Clarence J. Brown and Brookville projects was repeated at Carr Fork. Resident Engineers O. Lee Meetze and Norman Gilley directed work of the Markwell and Hartz Company which built the operating tower and outlet works from 1966 to 1968, when work stopped because of the construction freeze, leaving the tower standing like a skyscraper alone in the center of Appalachia. When construction resumed, Resident Engineer Paul Ellis directed emplacement of the 130-foot earth and rockfill dam which was topped out on April 24, 1975. The dam controlled the runoff from only a fifty-eight square mile area and impounded a summer pool covering only 710 acres; yet, it contained waters from Defeated and Troublesome Creeks and Deadman Branch which previously, as their names might indicate, had been sources of periodic waves of destruction that had descended upon Hazard.[28]

Cave Run Dam and Lake

Authorized in 1936 to control runoff from 826 square miles of the Licking River basin, the Cave Run project was called at the time of its construction the most controversial dam ever built in Kentucky and it probably earned that distinction. It was one of a pair of dams proposed for the Licking River. The Falmouth project was to be located about sixty miles upstream of the mouth of the river and Cave Run another one hundred and fifteen miles upstream. Landowners opposing both projects organized the Licking Valley Protective Association and were successful in their opposition until 1962. Morehead publisher W. E. Crutcher headed a campaign in support of the Cave Run project, testifying on its behalf before committees of Congress some twenty-eight times; and in 1962 Congressman Carl Perkins and Senator John Sherman Cooper separated the Cave Run project from the more controversial Falmouth project downriver and won funding for Cave Run. Those three and President Adron Doran of Morehead State University broke ground for Cave Run Dam in August 1965, when the Markwell and Hartz Company commenced the construction of an operating tower and outlet conduit that they completed in 1967.[29]

Acquisition of land needed for the Cave Run project proved unusually difficult. The District's real estate project office at Morehead with James M. Dodge in charge had to acquire about 27,000 acres of land for the project and secure easements on another 4,000 acres, and relocations included highways, county roads, utility lines, pipelines and twenty-eight cemeteries containing about two thousand graves. In addition to some acrimonious disputes concerning fair market values of the land acquired, the relocations also became a source of conflict, notably the Zilpo Road controversy that continued nearly a decade.[30]

Original project plans provided that the Zilpo recreation area on the south side of the lake would not have access by road and would be used by hikers and boaters only. Wanting the full economic opportunities of increased tourism, people of Bath and Menifee counties in 1966 urged the construction of more roads along the south lakeshore and a road into the Zilpo recreation area. They won the influential support of Congressman Perkins who asked further study of road plans by the Engineers and the U. S. Forest Service, which would operate the recreation facilities in conjunction with its Daniel Boone National Forest extending into the lake area.[31]

After study of several alternate road systems, a plan providing access to Zilpo recreation area was agreed upon at a meeting with Congressman Perkins in 1971, but the road to Zilpo bisected a pioneer weapons area of the National Forest where sportsmen hunted turkey and wild game with bows and muzzle-loading rifles. The League of Kentucky Sportsmen, fearing that the road would ruin the hunting area, asked in 1972 that it be rerouted to skirt the pioneer weapons area and they received support from Kentucky Senator Marlow Cook. Engineer personnel thought the dilemma ironic, for the District had not planned a road in the first place and had added it only in response to local public demand. "We don't have any particular stake in the road," explained the District's public affairs officer to reporters: "We had a problem about where to build a road and we've recommended a solution to the problem. The road we have recommended will be the cheapest and the least environmentally damaging." Senator Cook disagreed and introduced legislation to stop road construction, but when neither Congress nor the courts enjoined the road its construction began in 1976, ending a decade of argument.[32]

The relocation of some 2,000 graves from the Cave Run lake area proved far less controversial than the Zilpo Road. A. T. McNeeley, the District's chief of cemetery relocations in 1970, explained that, while infringing upon the sanctity of a graveyard to move headstones and human remains was a sensitive issue, the work at Cave Run went well because the Engineers and their contractors abided by precise legal guidelines. Meticulously monitored by Corps inspectors at both disinterment and reinterment sites and with members of families of the deceased present if they wished, all graves were opened by hand and the remains moved that same day to new landscaped and fenced cemeteries where they were placed in the same order they had occupied in the original setting.[33]

Needing a licensed funeral director for the relocation of cemeteries in Rowan County, the District recruited Randolph Richardson of Owingsville who was trained in the requirements of the business by

Corps inspectors. Richardson subsequently pursued the business and by 1979 his firm had about fifteen employees who had relocated some 40,000 graves throughout Kentucky and the South. "This work is strictly regulated and governed by contracting agencies and we have state and federal inspectors," said Richardson, noting that several firms engaged in the business making it very competitive. "We have moved graves of pioneers, Indians and slaves among others," he said, "but the graves of the babies and children are the saddest and most touching. The mortality rate for them was so much higher in early times."[34]

The Razor's Edge at Cave Run

The operating tower and outlet conduit at Cave Run were completed in 1967 and after the construction contract freeze ended in 1970 the Guy M. James Construction Company began building the dam embankment under direction of Resident Engineer Paavo D. Carlson and his assistant Dana G. Greenfield. In the summer of 1971 the contractor started placement of the diversion dam, an earth and rockfill structure eventually to become the upstream toe of the main dam but serving initially to divert the Licking River through the fifteen-foot diameter outlet conduit, keeping the foundation of the main dam dry while it was treated. A rainy June delayed construction of the diversion dam to the extent that it had not reached its full height before torrential rains fell over the Licking River basin during the weekend of July 17 and 18. Because much more water was flowing down the Licking River than could pass through the outlet conduit, the diversion dam began to impound a lake before it was ready to serve that purpose.[35]

On Monday morning, July 19, Dana Greenfield and Lieutenant Thomas L. Hugenberg, an Engineer officer stationed at Cave Run for part of his training, saw the situation becoming critical and warned the District office the water upstream of the diversion dam, even with gates to the conduit wide open, was rising nearly half a foot an hour, making overtopping of the uncompleted diversion a threat. Chief Richard H. Russell and Jack E. Kiper of the construction division along with Colonel John Rhett went to the site where they put the contractor to work with bulldozers, pushing more earth atop the diversion dam in an effort to raise it to its full height before the flood crest arrived.[36]

While that work was in progress, rumor that the dam would fail circulated in nearby communities and Kentucky State Police and civil defense officials evacuated some people from the communities of Salt Lick and Farmers downstream of the dam. By midnight on July 19 the contractor had gained six feet on the rising river and work stopped, the crisis seemingly passed. But the river kept coming up and on Tuesday, July 20, the bulldozers went back onto the dam to spread more earth. The higher the dam went, the less room there was on its crown, and by afternoon its width would accommodate only a single bulldozer at a time, meaning the new earth was being compacted only under the treads of the dozers.[37]

Seeing a crack in the new fill and thinking failure imminent, the bulldozer operators climbed down from their machines and left the dam. Richard H. Russell and the contractor's superintendent strolled out atop the dam and sat down at the crack to discuss the situation. Russell asked the superintendent if he had an operator who would attempt most anything that was asked of him, and when

Cave Run diversion dam being raised for emergency flood service in July 1971. The dark strip is the fresh earth pushed into place to raise the diversion dam; note the two dozers atop the narrow crown of the fill.

the superintendent responded that he did, Russell directed him to have that operator push a layer of earth exactly two and a half inches thick over the crack. Russell later admitted the thickness of the layer was insignificant but doing the work was important for morale. The superintendent instructed the operator, who spread the earth as directed, and soon other operators returned to the dozers and work resumed. The diversion dam went still higher. So did the river.[38]

News of the emergency spread on July 20, and Lieutenant Governor Wendell Ford arrived to establish an emergency office at Morehead. The District's public affairs officer, Martin K. Pedigo, got the word while at Greencastle, Indiana, wrestling with the Big Walnut controversy and he drove at top speed across the District to Morehead to help reporters gather their stories. That evening the entire nation saw on television the dozers pushing new fill into place atop the diversion dam and heard the District Engineer describe the situation.[39]

Loose dirt at the top of the dam began to slough and slide into the river lapping against its side, and operating the dozers became increasingly perilous, with a plunge into the river on one side and long fall down the side of the dam on the other. Russell and the staff stopped work, had one dozer blade earth from the downstream side of the crown over to the side nearest the river and had rock placed on the lower part of the crown to serve as an emergency spillway if the river went over the top; and the workmen began filling and placing sandbags to add additional height to the crest of the dam. At seven that evening, Colonel Rhett notified state authorities the danger of failure was imminent and requested that people downstream of the dam be evacuated; the people moved to refugee centers at Morehead and Owingsville. The situation was, Richard Russell later recalled, the "razor's edge."[40]

When Major General William L. Starnes, Ohio River Division Engineer, came to the dam on July 21 the rate of rise had slowed and the river came at last to a stand at five that afternoon, at a point higher than the crest of the dam had been before emergency work began. Recalling a special membrane called T-17 he had seen used for erosion control in Vietnam, General Starnes ordered enough of the material located to convert the entire side of the dam into a spillway in case more rains came. The District's chief of supply located the membrane through the Army Defense Supply Agency and ordered several truckloads, which as it happened were not needed because the river receded without going over the edge. Emergency efforts had cost $90,000, but the diversion dam had prevented more than $400,000 in flooding damages to downstream communities, thereby compensating in part the inconvenience suffered by people who had to evacuate their homes.[41]

Study of the emergency began immediately after it ended and the District's study committee compiled a list of "lessons learned" subsequently implemented at other projects. It recommended the design of diversion dams and outlet conduits be more conservative in the future to provide greater capacity for containment of freak flash flooding of the sort that caused the Cave Run emergency. It suggested that diversion dams of the future be designed as rockfills where possible with a minimum top width of thirty feet for use during emergencies and that their construction be expedited to reach full design height as quickly as possible. To improve flood forecasting, the committee recommended that more stream gages be installed upstream of dams during their construction. Because communications during the emergency had been hampered by the single telephone line and the low-power radio transmitter available at the resident engineer's trailer at Cave Run, the committee recommended that at future projects the permanent service building and operating radio tower and transmitter be included in initial construction contracts to make those facilities available to the resident engineer staff and also during emergencies.[42]

As national publicity subsided along with the Licking River, construction of the dam resumed. It was topped out early in 1974 and on August 3, 1974, Congressman Carl Perkins presided at the project's dedication ceremony. Fishermen already were using the lake by that date, and the Kentucky Department of Fish and Wildlife Resources built the Minor E. Clark Fish Hatchery at the tailwaters of the dam. The U. S. Forest Service which operated the recreation facilities at Cave Run Lake supplemented facilities built by the Corps with investments of its own, and the lake fast became one of the most popular recreation areas in Kentucky.[43]

Kentucky Congressman Carl D. Perkins addresses the crowd at the Cave Run Lake dedication ceremony, August 3, 1974.

William H. Harsha Dam and Lake

The last of the quintet of dams the Louisville District had under construction in 1970 was on East Fork of the Little Miami River near Cincinnati. Perhaps in part as a result of its location on the fringe of the Cincinnati urban area, the East Fork project became an early target of environmentalists, though their initial opposition may have backfired by stimulating greater public support for the project. Authorized in 1938, there had been little public interest in the project until 1966 when an editor of a newspaper in the vicinity commenced a campaign to stop the project on grounds that it would be an "eyesore." Urging that East Fork be preserved as a free-flowing stream, the editor debated the merits of the project with the Louisville District Engineer at a meeting of environmentalists in Cincinnati in April 1966. Proponents of the project, however, reacted by shifting from passive to active support, and Congress added funds to the 1967 federal budget to initiate construction.[44]

Unlike the four other dams under construction in 1970, the District had not awarded the contract for construction of the operating tower and outlet conduit at East Fork before the construction freeze began in 1969, and work at the dam therefore did not begin until the freeze was lifted in 1970. Resident Engineer John Emmerich succeeded by James E. Houchin

Aerial view of East Fork (William H. Harsha) Dam and Lake, September 28, 1979. The light-colored rectangle on the left is the huge spillway where the rock removed was placed into the dam. A large saddle dam is visible near the top of the picture.

directed the on-site work for the District at East Fork.[45]

The budding environmental movement had bloomed by the time construction began at East Fork, and in June 1971 a "camp in" was conducted at the site to protest the project. The District's public affairs officer attended to explain the project's features to members of the East Fork Preservation Society, Earth Day Society, and Ohio Public Interest Action Group, which represented the alliance of environmentalists and landowners formed to oppose completion of the project. Perhaps the most vocal of all project opponents was Paul McCarty of Bantam, whose home was to be purchased at fair market value for the project. Mr. McCarty brought several suits against the project and ran for Congress against Congressman William H. Harsha. He received support for his efforts from the Ohio Public Interest Action Group affiliated with Ralph Nader's consumer action organization and therefore described in the media as "Nader's Raiders." Representatives of that group told a committee of Congress the Harsha project was "economically unsound and ecologically unwise," and in an aside to a reporter one member remarked: "Boondoggling is to the Corps of Engineers what hair is to barbers; it justifies their existence."[46]

While the controversy over the East Fork project continued in congressional committee, the media, and the courts, the work at the dam went forward during interims between court injunctions. S. J. Groves Company received the contract for building the dam embankment, and after the first delay resulting from litigation the company started building the diversion dam to divert the river away from the foundation of the main body of the dam and had it partially completed in August 1974 when an incident reminiscent of that at Cave Run Dam in 1971 occurred. On August 27 a six-inch rain fell over the East Fork basin, causing flash flooding all along the stream, and, as had happened at Cave Run, the volume of water became too great for the East Fork outlet conduit to pass and the diversion dam began impounding a lake.[47]

When news of the impoundment arrived at the District office on August 29, the chief of the construction division asked Noah Whittle, chief of the hydraulics and hydrology branch of engineering, to forecast the flood crest at the site of the dam. On the basis of that forecast, he instructed the resident engineer to begin raising the crest of the diversion dam to a height a few feet above the predicted flood. Richard H. Russell, chief of construction, along with Lieutenant Colonel John E. Moore, the Deputy District Engineer, and Charles "Chuck" Schumann of the public affairs office, drove from Louisville to the dam for firsthand observation of the situation. By midnight the diversion dam had been

Bulldozers raising the diversion dam at the East Fork Dam construction site, August 29, 1974.

Congressman William H. Harsha spoke at the ceremony renaming East Fork Lake in his honor, July 9, 1982. Seated from left: Brig. Gen. R. S. Kem, Col. Charles E. Eastburn, and Congressman Robert McEwen.

raised to an apparently safe level and, with no more rain forecast, work stopped and the weary men checked into a motel for sleep, leaving a skeleton crew at the dam. At four in the morning they were awakened by a construction inspector pounding on the door with news that a two-inch rain had fallen over the basin during the previous two hours and more flooding was on the way downriver.[48]

Returning to the dam, Russell learned the river was rising two feet each hour and the diversion dam most certainly would be overtopped. He called the District Engineer and secured authority to cut down the dam at one point to confine damages resulting from overtopping to one side of the dam. That work had just begun when the river began trickling over the top at 6:30 a.m. Equipment and workmen left the dam for safety and the resident engineer staff in the contractor's trucks set out driving downstream ahead of the flood to help local police warn people the flood was coming and to see that the area was evacuated. Everyone was safely out of the area before the river cut its way down through the diversion dam, causing a rise of about four feet downstream and flooding homes in the lowlying areas before receding as quickly as it had come.[49]

Repairs to the diversion dam began the

following day, while teams of engineers measured high water marks along the stream and surveyed flood damages, differentiating between the damages that would have occurred naturally as a result of flash flooding and those resulting from the overtopping of the diversion dam. The District accepted responsibility for any damages to property over and above those that would have occurred under natural flooding conditions, and Stephen E. Smith of the District's office of counsel and Willard A. Conner of the real estate division spent much of the following year settling claims made by the property owners.[50]

Litigation by environmentalists and landowners against construction of the East Fork project continued until it was completed, and in spite of an eloquent appeal by Colonel James N. Ellis, the District Engineer, even the city government of Cincinnati sided with the opponents to the project in 1976. The contractor made excellent progress, however, in effect building two dams of nearly equal magnitude at the site. The main dam across the East Fork channel was 1,450 feet long and 200 feet high; the saddle dam across a low place at the side of the lake was 2,600 feet long and 110 feet high. Both were completed by 1977 and the lake was impounded in 1978. By virtue of a 1980 act of Congress, the official name of the project changed from East Fork to William H. Harsha Dam and Lake, honoring the former congressman from Ohio who was able to attend the name-changing ceremony at the dam on July 9, 1982.[51]

Completion of the Harsha project thus sounded the coda for the quintet of impoundments the Louisville District had under construction in 1970. By the time the District had completed the last of those five, its attention had been diverted to other matters. Three other big dams Congress had authorized during the 1960s were funded for construction during the 1970s. And while that trio of dams was under construction the Louisville District also encountered what seemed a continuous string of flood and tornado disasters along with snow and ice emergencies and navigation accidents at its locks and dams.

CHAPTER IV: EMERGENCY OPERATIONS, 1972–1978

Often criticized during the 1970s for its contribution to what mankind was doing to the environment, the Corps found its work better received during emergencies when it sought to alleviate what the environment was doing to mankind. Congress and the President have relied upon the Engineers since 1882 for prompt response to human needs during and after natural and manmade disasters. The Engineers had prominent roles in disaster recovery work following the Johnstown flood of 1889, the San Francisco earthquake of 1906, and many other emergencies, notably floods which became their special province. Engineers with their fleet of workboats rescued and assisted victims of the Ohio and Mississippi River floods of 1882 and 1884, the Shawneetown, Illinois, levee failure of 1898, the 1914 "Dayton" flood in Ohio, and the record floods of 1927, 1936, and 1937 on the Ohio and Mississippi, together with floods of lesser magnitude in other years. It was after the 1937 flood that Louisville and other Engineer Districts began formal emergency preparedness planning and Congress created a contingency fund to permit the Engineers to conduct flood fights and other emergency operations without awaiting approval from higher authorities.[1]

Emergency operations in the Louisville District were directed for years by the chief and assistant chief of the operations division, with the District's security officer, Louis R. Thompson from 1952 to 1965, acting as emergency operations planner, in which capacity he prepared contingency plans for the District's response to floods and natural disasters, foreign attack, and civil disturbances, along with the evacuation of urban areas and postattack and disaster recovery work. After the 1964 Ohio River flood disaster, the District Engineer created an emergency operations center, or "war room," in the District office to serve as nerve center during emergencies, complete with telephone lines, radio communications, situation maps, and space for conferences and briefings, also making Frank G. Jones emergency operations planner and upgrading the position to special assistant to the District Engineer. Kenneth Mathews succeeded Jones in 1973 and in 1977 Norman R. Gilley became the District's emergency operations manager. The emergency operations center was activated at any time the District was alerted for either of the two general categories into which its emergency activities fell: a crisis at one of its own projects or a "major disaster" declared as such by the President.[2]

During operational crises such as a barge lodged against a District navigation dam or threatened overtopping of a levee by a flood, the District had standing authority to respond to the situation to save life and property within certain limits without requesting the approval of higher authority. When a runaway barge rammed into one of the dams and locks in the District, the emergency operations center normally opened for business and, if emergency repairs were needed, the District's troubleshooters, the personnel with floating plant and equipment headquartered at Louisville Repair Station near McAlpine Locks, were dispatched to the scene for urgent work to clear the dam, repair the lockgates, or whatever the situation required. If the crisis happened to demand materials or equipment unavailable within the District, the District Engineer had authority to secure what was needed by contract. At the first threat of major flooding at any point within the District, the emergency operations center opened to coordinate the situation and engineers were sent to the site to investigate, to offer technical assistance to local and state governments, and to conduct floodfights where necessary to save flood control projects and life or property. The District Engineer also had standing authority to undertake floodfights within certain monetary limits without awaiting approval from higher authorities.[3]

The District normally handled floodfights and operational crises independently, with regular situational reports to the Division Engineer and Chief of Engineers, but "major disasters" declared by the President brought the District under direction of a federal disaster assistance coordinating agency. That agency, first established by the Federal Disaster Relief Act of 1950, directed the activities of all federal agencies including the Corps of Engineers during "major disasters" and disbursed federal funds to assist people and communities stricken by a disaster with recovery, usually meaning the removal of debris, restoration of public utilities and facilities, provision of temporary housing and subsistence supplies, and other aid to people as the situation dictated.

Prior to 1950 federal agencies had provided disaster assistance by direction of the President from their own funding and subsequently were reimbursed by act of Congress; the 1950 Disaster Relief Act established continuing funding for disaster assistance to be dispensed by a federal coordinating agency after the President had formally proclaimed the existence of a "major disaster." Because various presidential administrations after 1950 frequently tinkered with the federal disaster assistance program to improve it, the name and procedures of the federal coordinating agency often changed. During the 1970s, for instance, the agency at the start of the decade was the Office of Emergency Preparedness (OEP) headed by George A. Lincoln, an Engineer officer who had served on the Ohio during the 1937 flood; in 1974 the agency became the Federal Disaster Assistance Administration (FDAA) in the Department of Housing and Urban Development; and in 1978 the agency became the Federal Emergency Management Administration (FEMA). After the President declared a "major disaster," the federal coordinating agency generally called upon the Engineers to assess the extent of damages and to prepare damage survey reports and sometimes, depending upon the particular situation, requested the Engineers to remove debris, repair utility systems, and provide temporary housing sites for disaster victims.[4]

From 1972 to 1978 a series of major crises and natural disasters, each with its own unique difficulties, tested the resourcefulness of Louisville District personnel. Before 1972, emergency operations within the District had consisted chiefly of responses to flood situations, the most memorable being the 1957 flood in eastern Kentucky where the District rebuilt many bridges destroyed by flooding and the 1964 Ohio River flood which almost slipped into Louisville past its floodwall system. Other than the 1967 incident at Markland Dam, where runaway barges lodged under tainter gates and threatened loss of the upstream pool before the barges were removed, operational crises in the District had been relatively minor before 1970. That changed during the 1970s when the

District confronted several major crises involving barges carrying toxic chemicals or explosive fuels and hazardous ice conditions. Its long experience with recovery work after flooding disasters was augmented during the 1970s with recovery operations in the aftermath of tornadoes and blizzards. The general pattern will be outlined by a discussion of each of the District's emergency responses.

McAlpine Chlorine Barge, 1972

High water on the Ohio during the spring of 1972 sent many runaway barges into the District's dams on the river, capped by the emergency which developed at McAlpine Dam at Louisville. On Sunday, March 19, the towboat *J. F. Hunter* struck the island at the head of the canal leading to the locks and lost three barges; one sank near McAlpine Dam, another lodged against the power plant, and a third wrapped itself around a pier in the dam. Aboard the third were four gleaming white steel tanks containing 640 tons of liquid chlorine.[5]

Their Sunday interrupted, Lockmaster Willie Morgan and Jack Bleidt and Leonard Vanzant of the operations division assessed the situation, had the crew from the repair station line onto the barge next to the power plant, and had the District towboat *Person* pull it to safety. The partly submerged barge lodged against the pier and pinned in the gatebay by the rushing

Chlorine barge lodged in a tainter gatebay at McAlpine Dam, Louisville, Kentucky, March 30, 1972.

Captain John Beatty's catamaran and salvage equipment used to secure the chlorine barge at McAlpine Dam, March 1972.

river could not be so easily retrieved, and when it became apparent the barge contained a substance that when released into the air would form a deadly cloud of toxic gas, the District opened its emergency operations center, ordered gasmasks from Fort Knox for use by personnel near the barge, and called the Vicksburg Engineer District for advice because that District had handled a chlorine barge emergency on the Mississippi a few years earlier.[6]

The Engineers, Coast Guard, experts from chemical firms, and marine salvage professionals met to discuss the crisis on March 20 with Rear Admiral O. M. Siler of the Coast Guard, the on-site comander. They considered flushing the barge through the dam, attempting to pull the barge with towbats back from the pier, or stabilizing it and pumping out the chlorine before moving it. Selecting the third alternative, the group then divided responsibilities, the Louisville District taking charge of salvage operations. The situation worsened when another barge lodged under another gate of the dam, making it inoperative, and the District Engineer requested the Chief of Engineers to have a combat engineer demolition unit placed on standby to blast a hole in the fixed weir of McAlpine Dam if needed to control any rise in the river that might hamper the salvage operation. Needing equipment to stabilize and hold the barge while it was pumped out, the District contracted with Captain John Beatty of Cincinnati for use of his catamaran rig, made of the hulls of two Navy minesweepers, to slip cables under the barge and pull it up snugly into place.[7]

While the catamaran was on the way to Louisville, at the request of governors of Kentucky and Indiana, the Office of Emergency Preparedness, the President's disaster coordinating agency, authorized application of federal disaster assistance funding to aid in the crisis. It had at first hesitated, for no disaster had occurred; yet, the potential for disaster was real: one tank of the chlorine vented into the air would form a large toxic cloud of gas which the wind could drive directly over Louisville.[8]

Major General William L. Starnes went to McAlpine from the Ohio River Division to be on hand for instant decisions and helped lay plans for the most serious of contingencies. The Pittsburgh Engineer District sent its big derrickboat downstream to assist if needed and four Corps patrol boats were trucked into McAlpine and launched. Through its established contacts with the Army, the District secured gasmasks and trucks with searchlights from Fort Knox, helicopters with gas detection devices from Edgewood Arsenal in Maryland, gasmasks and radios from Lexington Blue Grass Army Depot, and Air Force weather experts to monitor air currents over the barge. An Army hospital train went on standby at New Cumberland Army Depot. Through intensive national media coverage of the crisis, everyone in the Louisville area was alerted to the hazards of the situation, which proved advantageous when evacuation later became necessary.[9]

Plans called for stabilizing the forward end of the barge with cables anchored into the dam piers and by closing the tainter gate of the dam down atop the barge. At risk of life, Louisville Repair Station workmen jumped onto the quivering barge and attached cables to tie it to the dam. They built falsework (crickets) and placed it atop the barge to catch the lower edge of the tainter gate when it descended and also built guards around the domes atop each steel tank. When Captain Beatty maneuvered his workbarges and catamaran rig into place on March 31, the critical period began.[10]

Mayor Frank Burke of Louisville decided to evacuate Portland, the section of Louisville nearest the dam, during the critical period, and 4,266 residents moved out on April 1 without incident, a few going to refugee shelters but most lodging temporarily with friends and relatives. Evacuation remained voluntary on the Indiana bank and about half the residents left New Albany, Clarksville, and Jeffersonville.[11]

On April 1, river traffic near McAlpine ceased and the tainter gate was closed down onto the crickets built atop the barge and secured. Easter Sunday morning, April 2, Captain Beatty eased his catamaran rig downstream to slip cables under the barge while many people watched the events on television from a camera atop the hydroelectric power plant. Chaplains from Fort Knox conducted Easter services at the dam for the Engineers and other personnel in emergency service. The catamaran inched down into place by 9:17 and its winches began slowly rotating, taking up slack in the cables strung under the barge. In minutes that seemed hours to everyone watching, the cables came up beneath the barge, and at 10:56 the cables at last had the barge snugly under control.[12]

The critical period over, people began returning to their homes and Corps personnel jumped back onto the barge to attach pipes to pump the chlorine from the barge to an empty barge alongside. After two days of pumping, the barge was emptied and removed from the gatebay. Potential disaster had been averted and among the sixty Corps personnel who rigged the cables and pipes, performing the hazardous physical work atop and around the barge, there was not a single injury, not even a mashed thumb.[13]

Litigation concerning legal responsibility for the emergency began and continued some six years afterwards, and Congress enacted a Ports and Waterways Safety Act in 1972, assigning the U. S. Coast Guard additional powers to curtail hazards on American waterways, including creation of a traffic control system for the port of Louisville. In a letter written a week after the successful end of the crisis, Louisville Mayor Frank W. Burke paid tribute to the emergency response of the District:

> The people of Louisville and surrounding areas recognize the heroism and excellence of your work. On behalf of everyone involved, may I say congratulations and thank you for a job well done.[14]

Operation BIG STINK, 1974

An operational emergency similar to that of 1972 at McAlpine Dam occurred at Markland Dam on January 15, 1974, when the towboat *Bessie Walker* lost its barge tow and four barges lodged against the dam. Three barges pinned by the current against piers 10 and 11 were the chief concern: one carried salt, another fuel oil, and the third had aboard cylinders of valeraldehyde and propionaldehyde, which were toxic and flammable chemicals used for the preservation of grain and manufacture of synthetic rubber. The latter barge leaked toxic fumes and seemed about to sink.[15]

When Lockmaster Howard Gibson reported the accident, Colonel Charles J. Fiala and his staff went immediately to Markland and opened an emergency office. They learned fumes from the leaking barge were not a threat to life on the order of liquid chlorine--but the smell! A chemical professor described the odor in the most technical manner possible as "closely related to stink bombs, somewhere in between the odor of rancid butter and dirty socks." The countryside for miles around Markland Dam was affected, and there were voluntary evacuations. One of the earliest actions of the District Engineer was to obtain gasmasks and oxygen air packs for workmen at the dam. The major concern, however, was not the smell or toxic effects of the fumes but fire because the chemicals were highly flammable, and the leaking barge was lodged against a barge full of fuel oil.[16]

Troubleshooters from the Louisville Repair Station arrived that night, and during the night drift accumulated against the barge and it sank another foot at its stern. In the morning, Corps diver James "Flipper" Pierce and others jumped aboard the barge to inspect the damages and lash it with nonsparking nylon cables to other barges and to the wall of the nearby powerhouse. "The smell was something like a stinkbug," commented Pierce after leaving the barge.[17]

"A very, very touchy salvage problem," said Colonel Fiala, noting the combination of flammable chemicals leaking into the air, the presence of the fuel oil barge, the rough and flooding river, and the high winds. Deciding the emergency demanded that the Corps remove the barges as quickly as possible, the Colonel awarded a contract to American Commercial Barge Line, which had the powerful towboat *Dell Butcher* in the vicinity, to undertake the delicate task of pulling the barges away from the dam.[18]

The tainter gates of the dam were manipulated to modify flow patterns through the dam and obtain the quietest water possible in the vicinity of the barges; there, the recently installed remote controls for operating the gates paid dividends, for they could be moved without the operators walking along the bridge over the dam and thereby suffering exposure to hazards and smells. Captain N. "Sonny" Ivey took control of the big *Dell Butcher* on the afternoon of the 16th and maneuvered it into position at 4:00 p.m., while the local fire department soaked the barge down with a continuous stream to reduce the potential for flash fire.[19]

With little margin for error, Ivey deftly nosed the *Dell Butcher* down to the barges where the repair station crew secured them to the bow of the towboat. He then reversed the powerful engine, gave it full rudder, and swung the barges with a feather touch away from the dam, grazing the dam with the towboat fenders but holding the barges out. Once away from the cramped maneuvering area, he straightened the barges and took them upstream, leaving only their stink behind at the dam. Within two hours, lockage resumed at Markland and the emergency ended. A. John Columbo, chief of the Louisville Repair Station, said of his workmen who had performed the hazardous work atop the barges: "These are the men who go

Towboat *Dell Butcher* prepares to remove barges lodged against Markland Dam while streams of water spray on the sinking chemical barge. January 16, 1974.

On April 3, 1974, the tornado which splintered its way through Xenia, Ohio, brought the Louisville Engineer District one of its most urgent disaster recovery missions in history.

right in there and do what they have to until it's done. They have never turned down a job."[20]

The Day of a Hundred Tornadoes, 1974

A typically warm and wet April Fools Day in 1974 was marred by a few tornadoes, one hitting Nashville, Tennessee, another striking at tiny Campbellsburg, Kentucky, and the Louisville Engineer District went on the alert. That storm passed without further damages, April 2 proved a pleasant spring day, and on Wednesday, April 3, the District went to work without worries: it was a windy morning with showers forecast. An intense, fast-moving low pressure area surged into the Ohio valley from the west during late morning, however, and the hammering of cold air against warm, wet air spawned tornadoes from Alabama to Michigan, turning that April the third into a day of terror. More than a hundred tornadoes touched down, killing 317 people and injuring 1500; it was the worst storm of tornadoes in the Louisville District since one in 1925 had killed 740 people.[21]

At 2:45 that afternoon, the first tornadoes in the area smashed through Palmyra, Borden, and Madison, Indiana, and the blitzkrieg began. While official weather forecasters watched out their windows, a tornado touched down at Standiford airfield, starting a twelve-mile path of destruction through the Louisville area. At evening, a barrage of twisters splintered their way across the Louisville District, killing eighteen people at Brandenburg, Kentucky, and thirty-six at Xenia, Ohio.[22]

Many District employees watched the tornado swirling through Louisville from windows of the District office or through windshields of their automobiles as they raced the storm for home. Some had no homes when they arrived, the storm having whipped off the roofs and even trees from the lawns. The District's emergency operations center was open by dark as the mobilization began; Corps personnel at Rough River Lake arrived at Brandenburg within thirty minutes of the storm to offer assistance. For early damage assessment, the District contracted for aerial photography of disaster areas the morning after the storm, the pictures proving useful both for Corps' emergency operations and for other agencies involved in the disaster recovery effort. Leave was cancelled and some employees were recalled from vacation for the emergency; not a single person asked to be excused from duty.[23]

President Richard M. Nixon declared a "major disaster" to exist in nine states on April 4, at which time the federal disaster coordinating agency became the lead element of recovery efforts and called upon the Corps and its Louisville District for assistance. Engineers scattered from the office in many directions, some meeting

Aerial view of tornado damages at Xenia, Ohio, April 6, 1974.

with federal coordinating officers in several states and others going directly to the field to begin preparation of damage survey reports describing the type and amount of damages resulting from the storms. More than seventy engineers and technicians visited disaster areas in Kentucky, Indiana, and Ohio to offer assistance. In many communities, the Engineers helped local governments arrange contracts for clearing away the debris; in a few cases they were asked to take full charge of contracting for debris removal.[24]

Debris removal assignments for the District came at the hard-hit communities of Monticello, Madison and Hanover, Indiana, and Xenia and Butler County, Ohio. For that mission the District established disaster field offices at each community. Each office was headed by a resident engineer assisted by an office engineer, a roving project engineer, a contract expert from supply division, a real estate expert to help secure rights-of-entry needed from private property owners, a few clerks, and construction inspectors. To get the work accomplished and to hasten the return of the communities to normal functions, the field offices usually operated seven days a week from dawn to dusk and often after dark.[25]

The field office at Madison opened on April 10, awarded its first contract two days later, and administered eleven contracts for the removal of 153,000 cubic yards of debris within fifty-one days at an average cost of $3.30 per yard, a remarkably low price. The Monticello field office opened April 11 and awarded nine debris removal contracts for the removal in seventy-three days of 101,000 cubic yards of storm debris at an average cost of $3.93 per yard. The job was larger at Xenia, Ohio, which had suffered such losses that President Richard M. Nixon inspected the damages on April 6; eight times as much debris was removed at Xenia than at the two other communities. Forty-nine contractors removed 860,000 cubic yards of debris at an average cost of $2.44 per yard. The low costs for the debris removal resulted from keen competition that developed between the contractors. After a few initial contracts were awarded to local firms to get the job quickly underway, contractors came to the field offices from as far away as Texas, eager to obtain part of the work.[26]

The job was not simply handed over to contractors. The engineers first estimated the amount of debris in designated sections of the disaster area, and supply division personnel quickly prepared bid packages and contract documents for frequent, even daily, bid openings. Before contractors started work, rights-of-entry to private properties had to be secured, and that was done by local officials with the assistance of real estate division personnel. When contractors began moving the debris with bulldozers, picking it up with front-end loaders and piling it into dump trucks, Corps inspectors were on site to see the job was properly done. They had to identify unsafe structures that were to be demolished to prevent mistakes by the contractors. Dump sites had to be carefully chosen, considering hauling distances for the trucks and the future urban development of the communities; and Corps inspectors were at the dump sites to count trucks and estimate the yardage hauled, thereby assuring proper payment to the contractors. That the job was well done was indicated by the fact that there was not a single contract claim at the end of the job in June and merely very minor complaints from property owners. Xenia and the Indiana communities made a surprisingly

Engineer floodwall holds the Ohio River out of town, 1975.

swift recovery from the "Day of a Hundred Tornadoes," and by 1983 very little evidence remained in the towns of the heartbreaking losses they suffered in 1974 except perhaps the absence of great trees that no longer stood in Cherokee Park in Louisville, at Xenia, at Brandenburg, and other places where twisters had touched down.[27]

Because the Louisville District was so large-- 75,550 square miles from northern Indiana to the Tennessee state line-- floods, tornadoes, navigation accidents, or other calamities occurred almost every year during the 1970s at some point within the District. Some disasters affected only a small portion of the District, with damages in one community or a single watershed, and were soon forgotten by the public outside the affected area; but in 1975 there occurred a great Ohio River flood that was largely forgotten by the public by 1983. On April 3, 1975, exactly a year after the Day of a Hundred Tornadoes, the river stage at Cairo, Illinois, where the Ohio meets the Mississippi, climbed to 56.4 feet with a combined flow for both rivers of 1.73 million cubic feet per second, of which the Ohio provided 1.15 million cubic feet. That was the highest river stage at Cairo since 1937 and it equalled the stage of the 1927 flood, the second highest of record.[28]

Why did a flood ranking among the top three of record on the lower Ohio pass with such little public notice and without the mass evacuations, horrendous property damages, and disruption of national life that accompanied the floods of 1927 and 1937? One reason was the many Engineer flood control projects completed since 1937. When the 1975 flood crest passed the Cincinnati and Louisville urban areas, its top few feet had been removed through storage in the flood control reservoirs on tributary streams; hence, the cities suffered some inconvenience as a result of flooding but little property damage. The most serious flooding occurred at the downstream end of the District near Paducah and Cairo, for on that stretch of river the Ohio was swollen from contributions from the Green, Cumberland, and Tennessee River basins where record rains had fallen. The lower Ohio inundated bottomlands miles from its banks, but could not get at Paducah, Cairo, or other communities protected by floodwalls. Hence, the third greatest flood of record at the mouth of the Ohio passed into the hydrologists' record books without leaving much impression upon public memory.[29]

Operation ICE SKATE, 1977

Constant operational emergencies plagued the District during 1976 on the lower Ohio River where four old wicket dams, No. 50 through 53, remained in use. Troubles began on April 27 when a tow accidently rammed into lock gates at Dam 50. The Louisville Repair Station crew went there, removed the damaged gate, and replaced it with a spare gate kept for that purpose. On August 5, a tow ran over wickets at Dam 52, causing the loss of its pool and blocking the river. To move traffic past the dam, the District's operations division manipulated the dams upstream of Dam 52, storing a pool at each dam and releasing the extra water in downstream progression to create an artificial wave on which tows could ride past Dam 52. Repairs to Dam 52 had scarcely been completed when another tow rammed the gates there on August 10. Because the last spare lock gate had been installed at Lock 50 in April, the District had to make emergency repairs to the gates at the site while artificial waves moved traffic past until the repairs were completed.[30]

After the difficult summer of 1976, the crew from the repair station returned to Louisville for Christmas holidays and the usual winter "layup" for maintenance of floating plant and tools. On December 27, however, another towboat rammed into lock gates at Lock 51, forcing the District's troubleshooters back on the river for the repairs. The accident closed the lower Ohio for eight days, holding up about seventy waiting tows of coal, petroleum, and rock salt which were desperately needed upriver where extremely cold weather during a fuel shortage had iced highways and the river.[31]

During January and on into February and March of 1977, the entire Louisville District was chilled by temperatures as low as twenty-six degees below zero and covered by snow up to four feet deep, drifting even higher by winds. For the first time since 1948, the lower Ohio River froze from bank to bank.[32]

Toward the end of January people ice skated on the river, some even crossing it on the ice. Because ice was thin near the center where towboats had broken through, police at Louisville warned people the ice was unsafe but made no arrests. "There's no law against stupidity," commented one policeman. At Cincinnati on January 25, Captain W. A. Boudreaux was ramming the *City of Pittsburgh* upriver through the ice, the first towboat to reach the Queen City in eight days, when he encountered several hundred pedestrians out for a stroll on the Ohio. As it crunched upstream, it was cracking the ice from bank to bank, and the captain warned the walkers away but they ignored him. Fifty feet from the pedestians, he stopped the tow and contacted local police. They seemed stymied by the jurisdictional issue, for the river flowed within Kentucky to a point near the Ohio bank, thus being outside of Cincinnati jurisdiction; yet police at Covington, Kentucky, were not sure where the boundary of their city's jurisdiction crossed the river. From the deck of his boat at the Cincinnati waterfront, Captain John Beatty, owner of the salvage firm which handled the chlorine barge at McAlpine in 1972, tried to talk the strollers off the river out of the way of the towboat, but the people refused to leave. One even asked the captain to see his bill of sale for the Ohio River.[33]

As ice thickened, smaller towboats had difficulty breaking through to port. On January 21 and 22, the District lowered wicket dams near Paducah to prevent their destruction by ice, but it also was a time of unusually low river flow and the stage on the lower river, without the dams up and holding pools, soon fell below the minimum nine-foot depth required for barge traffic. The critical need of riverside industries and cities for coal and petroleum forced the District to send lockmen back out on the river in a blizzard on January 27 to raise the wickets, risking loss of the dams to the ice and also lives of the lockmen. To raise a wicket dam, it was necessary for lockmen to work on the river in a maneuverboat, which required the services of a pilot, three deckhands, and a winch operator. Out they went on the ice-choked river during snow and sub-zero temperatures, raising each of the three hundred wickets at each dam one at a time, working on treacherous footing as spray from the river coated boats, wickets, and men with icy glaze. As wickets came up, narrowing the space through which the river flowed, powerful river currents tried to suck the maneuverboats over the dams and ice floes collected behind the boats, pushing them toward the opening in the dams.[34]

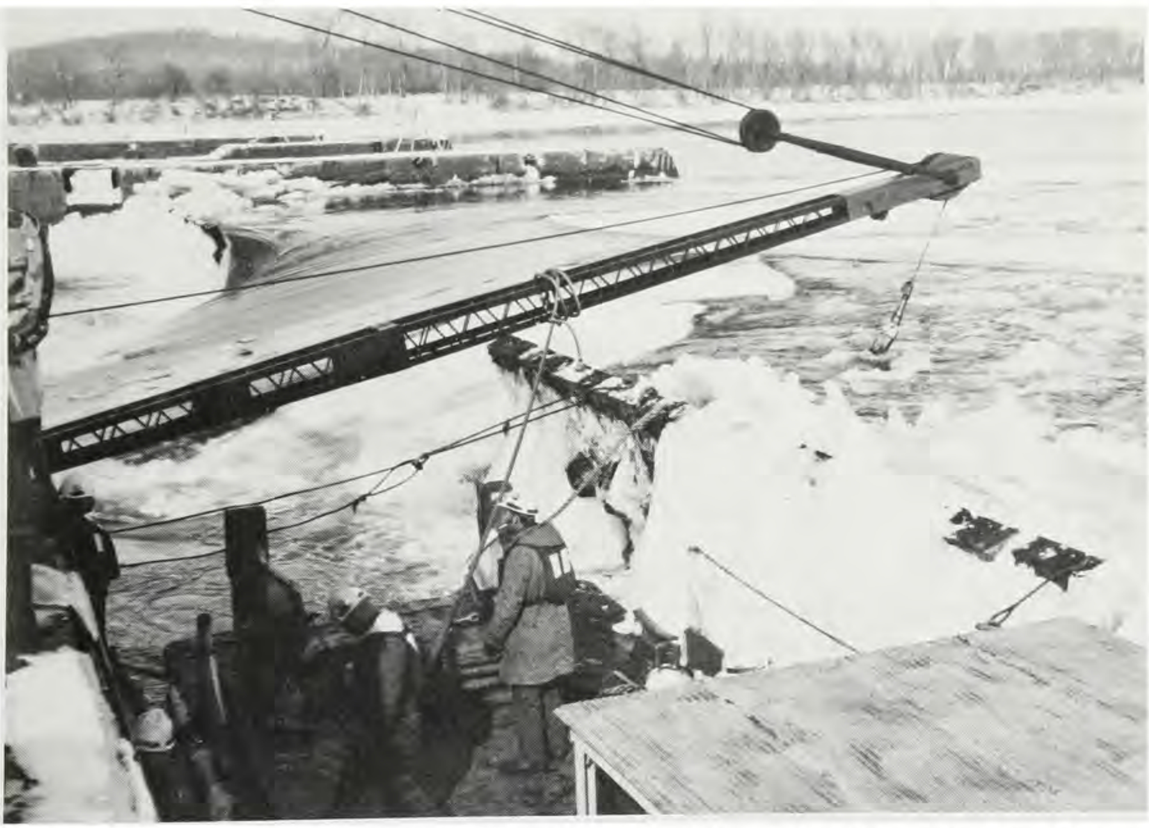
Raising dams on the lower 135 miles of the Ohio where navigation modernization structures had not been completed required three days of hazardous and freezing work. It was accomplished without loss of life or serious injury and the gamble paid off. The pools above the dams rose steadily restoring navigable depths by February 1, and the tows could move once more, provided their towboats were powerful enough to break through the ice.[35]

As traffic began to move, the lockgates at Dam 51 became inoperative. Rocks accumulated on the lockfloor blocked movement of the gates, and Corps diver Randy Noe, wearing all the insulation to be found, went into the frigid water to move the rocks. "It was a bunch of rocks on the gate sill," he remarked on his return to surface after two hours underwater. "Some of them were pretty big. I pushed them out of the way with my hands and feet and shoved them into holes where I knew they wouldn't bother the gate operation again. Man, it was cold! I've been down a lot of times but never before in weather like this."[36]

On February 1, the day navigation was restored on the lower Ohio, the District received its first snow removal mission from the federal disaster coordinating agency. It was asked to reopen roads in Indiana blocked by snow drifts up to fifteen feet high. The snow had overwhelmed resources of the state and local highway departments and had brought normal life in Indiana to a halt; people were running out of heating fuel and delivery trucks could not get through the snow and, for the same reason, grocery shelves were emptying of stock; the sick could not get to hospitals, nor could emergency vehicles travel far.[37]

On February 2 the District sent resident engineers, supply contract experts, and construction inspectors out into the Indiana blizzard as mobile teams, working with state and local highway agencies to award contracts to firms with equipment suitable for road clearance. Often working under oral agreements pending formal contracts, contractors with 134 bulldozers, graders, and other equipment promptly went to work pushing back the snow. By February 13, ninety-four contracts had been completed and roads in twenty-four Indiana counties were again passable.[38]

Emergency operations on the Ohio had not ended on the first of February, for one crew from Louisville Repair Station continued work downriver repairing wickets at Dam 50 damaged by the ice and another was on duty upstream at Markland Dam, repairing a tainter gate. Most of the remainder of the repair station personnel were called out on February 14 after a small aircraft crashed into the Ohio a short distance upstream of McAlpine Dam. At the request of the Federal Aviation Administration and local police, the Engineer towboat *Patoka* with a whirly crane spent



Crewmen work on the maneuverboat at the ice-covered wickets of Dam 50 on the Ohio, January 22, 1977.

several days fishing through the ice in search of the aircraft, and did pull up enough pieces for positive identification of the plane.[39]

As the ice began to swirl downstream in late February and snow began to melt, the public became worried about the threat of flooding on the order of 1937. Noah Whittle, the District's chief hydrologist, reassured them there was no need for concern. The 1937 flood had been preceded by heavy rains and there had been no heavy rain in late 1976 and early 1977; in fact, drought conditions had prevailed. At the end of the ice skating and snow season, Brigadier General E. R. Heiberg, III, at Ohio River Division dispatched a final situational summary to the Chief of Engineers in which he commented:

> We lucked out. The winter of 1976-77 was the coldest ever recorded, and will be remembered for many years. Even though the freeze and subsequent closing of schools and industries had a severe impact on the lifestyle and economy of the area, we did manage to keep our locks and dams operational and mother nature let us off with no disastrous floods.[40]

Floods of April 1977

The General sounded the all clear a tad too early. Beginning on April 4, rains of six inches in ten hours over the central Appalachians sent seething floods down mountainsides into the Cumberland, Big Sandy, and Clinch River basins and into the forks of the Kentucky River and the Licking River within the Louisville Engineer District. Cave Run Dam on the Licking River held enough floodwater to reduce the river stage at Farmers, Kentucky, by fourteen feet, and Carr Fork Dam cut 2.5 feet off the flood crest at Hazard, Kentucky, reducing flood damages in that area by one-half. Heavy damages still occurred, especially along streams without dams for flood storage; flood control dams can reduce the height and resulting devastation of floods, but can seldom eliminate flooding entirely.[41]

Centering near Cumberland Gap where the states of Kentucky, Tennessee and Virginia meet, the torrential rains caused flooding at the corners of the three engineer districts headquartered at Nashville, Huntington, and Louisville; the Louisville District became the lead district for emergency operations during the disaster recovery effort in Kentucky. The District's first challenge came through a request from state officials in Kentucky for help with water supply problems. Because water supply plants and sewage treatment plants usually were located on the floodplains adjacent to streams, they often were the first community facilities flooded, with resulting contamination of community water supplies. Several Kentucky towns temporarily lost their water supplies during the April 1977 floods, and the District assisted them under its emergency authorities by contacting Fifth Army headquarters and arranging the delivery of fourteen water purification units (erdlators) from Forts Campbell and Knox. When the purification units reached the thirsty towns, the District also supplied thousands of plastic bottles for distribution of potable water, along with chemicals and other items needed to sustain operation of the erdlators.[42]

The federal disaster coordinating agency requested the District to assess the extent of flood damages, and on April 6 eighteen engineer teams scattered through the mountains for what were called "windshield surveys," which provided initial damage estimates, and later undertook preparation of some three hundred detailed damage survey reports. Those reports were used by the coordinating agency to assist in determining what funding should be allocated to local governments for repairs to the damaged facilities.[43]

On April 14 and 17, the coordinating agency also "tasked" the District with debris removal from some flooded communities, for the repair of a few sewage treatment plants, and for preparation of sites, or parks, for mobile homes that would be supplied to those made homeless by the floods. The District opened a disaster field office at London, Kentucky, near flooded areas and committed seventy-one of its employees to the emergency for two months. Emergency Operations Manager Norman Gilley handled liaison for the district with the federal coordinating agency, Harold Frankel supervised damage survey report preparation, and Joseph Theobald directed contract preparations. The disaster team awarded thirty-three contracts for removal of flood debris, two for sewage treatment plant repairs, and ten for construction of mobile home parks located throughout the fifteen affected counties. By the end of May the debris removal and treatment plant repairs were done and ninety percent of the mobile home sites were finished.[44]

Joseph Theobald and Harold Frankel at the London, Kentucky, Disaster Field Office examine a graph of work in progress for recovery from flood disaster in Southeast Kentucky, April 22, 1977.

"The men of the Army Corps of Engineers seem to work both night and day," said one flood victim in tribute to the disaster team: "They were everywhere, helping us to dig out of the ruins." That was a fair assessment of the activities of the Engineers after disasters, for they worked with a sense of urgency to get the job done quickly to return life in the disaster-stricken communities back to as near normal as possible; and, because contracts specified that work would proceed from dawn to dusk, the Engineers worked those same hours and in the evenings tried to catch up with paperwork.[45]

Operation SNOW BLOW

Though it hardly seemed possible at the time, the winter of 1978 roared in during January with biting cold and heavy snow equal to that of 1977. District personnel struggled merely to get to the office throughout January of 1978 because a record 28.4 inches of snow fell over the Falls City that month. A blizzard on January 26 dropped a record 15.7 inches accompanied by winds generating a wind-chill factor of sixty-five below zero. Glum truckdrivers crowded roadside restaurants throughout the District, sipping endless streams of coffee while awaiting snow plows. Workers trying to get to their jobs skidded off icy roads and abandoned their cars. Farmers were running out of heating oil at their homes, and scattered food shortages occurred where delivery trucks could

The Louisville District mobilized contractors for snow removal after the '78 Blizzard. This equipment plowed open roads in Washington County, Indiana, January 31, 1978.

not get to the stores. Factories closed. Waterlines froze. On television, the governor announced Kentucky was "closed for the day." Eleven weather-related deaths occurred in Indiana and more in other states. Basketball games were cancelled, and when that happens Kentucky and Indiana are in trouble.[46]

When state highway departments exhausted their men and equipment the National Guard went to work. In Indiana, the Guard formed task forces for clearing interstate highways, each force equipped with bulldozers, wreckers, front-end loaders, fuel trucks, ambulances, and a heavy tank, which had sufficient weight and traction to move even the heaviest trailer trucks. At last the President declared the existence of a major disaster and the Corps of Engineers was directed to clear secondary roads in Indiana and Ohio. The situation was so serious at the time that four hundred engineer troops and their equipment were airlifted from Forts Bragg, Knox, and Campbell into snowbound airports in Ohio to remove snow in areas near the airports. The engineer troops referred to their mission in Ohio as Operation SNOW BLOW[47]

When the federal disaster assistance coordinating agency called upon the Louisville District for snow removal in

Indiana, the District's immediate problem was getting personnel through the drifted roads, but somehow the personnel managed to reach their destinations and get the work underway. Stanley Hunter, from the District's recreation resources branch, headed up work at snowbound Muncie, Indiana, and he announced on his arrival there: "We'll have 75 pieces of equipment operating in the city by noon, and we're going to keep bringing 'em in and bringing 'em in until we're done." The District contracted some retired personnel for work during the emergency, such as C. J. Walters who returned to service for duty in eastern Indiana and hired 120 contractors for snow clearance in six counties, first punching holes through the drifts to permit resumption of traffic, then widening the corridors to twenty feet for two-way traffic. Victor Boarman at the Poseyville, Indiana, office explained the snow removal priorities: "We tried to handle the emergency situations first, where someone was either out or very low on fuel oil or where someone had to get in to a doctor.[48]

Sixty-five personnel from the District's construction division along with people from supply and other divisions braved the snow and cold to get into disaster areas, and once there they called every contractor they knew or could find with roadwork equipment, renting equipment at uniform rates to plow open secondary and rural roads while state agencies and the Federal Highway Administration cleared primary highways. Within ten days the District had awarded 1,143 contracts for a total of about $4.2 million, and within twelve days 1,700 contractor personnel operating 1,300 pieces of equipment had cleared some 44,000 miles of secondary roads, allowing traffic to move again until warm weather melted snow and ice.[4]

A Bridge Over Troubled Waters, 1978

While the District had the massive snow removal mission underway in Indiana another emergency occurred at Markland Locks and Dam, one equal to any film ever produced in Hollywood concerning earthquakes, upside-down ships, or skyscraper infernos. The scenario included an upended and sinking towboat, an enormous ice gorge crushing downriver and smashing barges against the dam, helicopters circling overhead and crashing, demolition teams blasting at the ice, petroleum barges jamming a lock and leaking explosive gasoline, and big towboats ramming repeatedly into an iceberg. And all the action was part of a race against time, for cities along the Ohio were running short of salt to melt ice-glazed roads, fuel for heating and for emergency vehicles, and coal for electric-power production; the Ohio River had to be reopened to traffic for delivery of those and other commodities. For a time the emergency became so nerve-fraying the public affairs officer representing the District at the scene pencilled at the bottom of his neatly typed list of police and emergency telephone numbers the number for "Dial A Prayer."[50]

When the ice jam developed in January 1978, the District had under construction a bridge over Markland Locks and Dam to connect Kentucky with Indiana. Pedestals to support a bridge had been put on the dam in 1964, and in 1975 construction of the bridge had begun. It lacked only paving and painting for completion when the emergency occurred in 1978, and thus all construction equipment was out of the way and the bridge arched well above the troubles in progress below.[51]

As it had in 1977, ice formed along the

Ohio during January 1978 and began piling up in the approach to Markland Locks. By January 21, Lockmaster Carroll Sheldon and his crew were struggling to pass tows through the lock because of thick ice clinging to the sides of the barges. "We're just keeping on chugging, pushing and pulling in an effort to get the tow through and open up the locks," said the lockmaster. In the meantime, waiting towboats circled upstream, trying to keep open a channel to the lock.[52]

Seventeen miles upstream of Markland an enormous ice gorge had lodged against Big Bone Island, and on January 27 the gorge broke free and surged downstream, carrying dozens of barges along with it, wedging those that did not sink smack against Markland Dam. Lieutenant General John W. Morris, Chief of Engineers, after inspecting the mess at Markland, commented: "I've seen lots of ice in my time and I've seen a lot of waterways, but I never saw so much ice and barges all packed up against a structure before."[53]

Ice continued running downriver, jamming the gorge before the dam ever higher, reaching sixty feet in thickness and filling the channel from riverbottom to ten feet above the river surface. Fuel and road salt shortages in the Ohio River valley grew increasingly serious in the meantime, and towboat captains who had those commodities aboard barges ready for delivery as soon as they could get past Markland

Towboat and petroleum barges lodged in Markland Locks during the February 1978 ice jam. Visible at the top is Markland Bridge then under construction with safety nets suspended below it.

District towboat and derrickboat breaking ice at the entrance to Markland Locks, February 3, 1978.

grew irritable during the delay. "I'll tell you why Markland didn't open up and let the ice through," said one irate captain: "It was simply because Lousville didn't want the ice down there. Someone in Louisville has a lot of pull and it doesn't take long to figure that out when you realize the Louisville District, Corps of Engineers, is headquartered there."[54]

No mode of operations at the Markland Dam could have passed such a huge gorge through the dam, and the Engineers at Markland were doing all in their power to get the ice on its way toward warmer climes. Towboats braved the ice upstream of the dam, pulling barges free from the gorge and "fatiguing" others—ramming them to flex them in hope the barges would break in two, freeing the gates of the dam. During that operation, Captain John Beatty's towboat *Clare E. Beatty* became trapped in the jam and capsized, sinking to the bottom. The owners of one barge trapped against the dam with a cargo of steel hired a helicopter "sky crane" to move the steel to bank; it hovered over the barge while its lifting sling was filled with steel, flying to the bank for unloading, then back to the barge. The troubleshooters from the Louisville Repair Station also arrived with their towboat and derricks to begin smashing ice from the lock gates and chamber with clamshell dredge buckets.[55]

An attempt to use explosives to break up the gorge began on February 1 by a demolition firm under emergency Corps contract. Helicopters put the demolition team down on the icepack while they set the charges, then removed them to a safe distance before the charges detonated. After two days of futile blasting, it appeared the removal of the gorge would require too much explosives and too much time and the effort ceased.[56]

The towboats went back to work, ramming the ice to crush it at the edges and sending it downstream through the dam with their propeller wash. At the controls of the towboat *Charles Lehman* was Captain N. "Sonny" Ivey, who had pulled the chemical barge away from Markland in 1974, moving the ice alongside the towboats *Bessie Walker, Steel Forwarder,* and *Exxon Pennsylvania.* Captains Charles Decker and J. C. Thomas were alternating at the controls of the District's towboat *Person.* "Since I've been on the river—that's thiry-one years," said Captain Thomas of the ice, "it's the worst; it's the granddaddy."[57]

Smashing into the ice time and again, riding up atop it until their weight crushed the frozen mass, then turning and jetting their prop wash to free broken chunks, the towboats inched their way upriver. The District derrickboat *Brown* dropped a fourteen-ton "headache" ball onto the ice; it sometimes bounced without making a

Cartoon concerning the ice jam at Markland Locks printed in *Louisville Times,* February 8, 1978. Courtesy: *Louisville Times.*

dent. Concern about slow progress increased, and Brigadier General E. R. Heiberg, III, of Ohio River Division warned traffic might be delayed for weeks, resulting in the shutdowns of industries dependent on supply by river. "This could cause immense damage to the economy," he said: "What does this mean to the average citizen? It interrupts transportation of energy materials—coal and petroleum— and chemicals that keep industry going."[58]

By February 6, towboats had opened a path through the thickest part of the gorge and they picked up their tows below the dam to head upriver through the lock, expecting to ram through remaining ice with the barges. The *Steel Forwarder* first passed through the 110-foot lock with a tow that was 105 feet wide, followed by the *Wally Roller* and its tow, and finally the *Exxon Pennsylvania* with a 108-foot tow of eight barges full of gasoline and fuel oil. The latter entered the lock chamber from below and when the upper gates were open started out of the lock. Part of the way out, the tow wedged tight, held by the ice as if in a vise. The towboat rocked the barges back and forth most of the day, proving only that they seemed concreted in place, and during the effort one barge ruptured, spilling gasoline into the lock chamber. Because each of the eight barges carried more than a million gallons of fuel, the spill presented an extreme hazard and all except essential personnel evacuated the vicinity of the locks, while the Gallatin County fire department sprayed the barges with foam to suppress fire hazards. During the turmoil the bright yellow helicopter transferring steel from a barge at the dam to the bank went out of control, crashing onto the Indiana bank.[59]

Water in the lockchamber was alternately raised and lowered to free the barges, but merely ruptured another barge and spilled more gasoline into the water. As the fire department continued spraying the tow, the fuel was pumped out of the leaking barges. Four days of effort failed to move the tow an inch until Saturday, February 11, when the water level in the lock was lowered and the *Exxon Pennsylvania* spun its props in reverse, pulling the tow back into the lock. The groan of metal was audible as the barges pulled free of the ice and lurched backwards a few inches. Repeated eforts dragged back the barges inches at a time until at last the upper gates could be closed, allowing the lockmaster to lower the tow so it could back out of the lock. After six days of difficulties, at 2:30 p.m. on Saturday afternoon, the lock opened to traffic once again; the sun shone and the ice melted.[60]

"Even a schoolboy could have predicted the odds against the success of that venture," said a Cincinnati newspaper editor with full benefit of hindsight concerning the lock blockage. The decision to send the tow through actually was made by many 'schoolboys,' some with graduate degrees in engineering, who were under considerable pressure to get fuel barges upstream to their destination at fuel-starved cities. A flurry of litigation and soul-searching followed the emergency. Patrick Carrigan, chief of construction-operations for the Ohio River Division, admitted the Corps had made "errors of judgment" during the ice gorge crisis and declared there would be changes in future operations procedures, while Richard C. Armstrong, chief of engineering for the Division, promised the adoption of means to avert future icing problems at Markland.[61]

Part of the engineering solution was installation of a bubbling ice control system in 1979, with air compressors pumping air through submerged pipes at the upstream entrance to the locks; the air escaping through holes in the pipes bubbled to the surface to form a curtain that shunted ice away from the lock entrance toward the center of the dam. Another problem was solved by the ice gorge itself, which sheared off most of Big Bone Island against which the gorge had formed. Shown on river maps since 1794, the island was cut down by the ice and entirely removed by the 1979 flood.[62]

When the blizzards and ice of the winter of 1978 had disappeared, work resumed on the bridge over Markland Dam, and it was completed on September 16, 1978, and dedicated by a parade of dignitaries in automobiles. One of the participants in the dedication ceremony quipped that it surely was "a bridge over troubled waters."[63]

The emergencies of the mid-1970s had thoroughly tested the response of the Louisville District and also its nerve in some instances, and it was not found wanting. During those years the District acquired its first significant experience in handling toxic barge accidents, tornadoes, ice gorge blockages, and snow removal. That experience, together with its established reputation for flood-fighting, made it one of the most capable organizations in the Corps for prompt response to most any sort of emergency and stood it in good stead when it was further tested by flooding and other calamities in subsequent years.

CHAPTER V: PLANNING CONTROVERSIES, 1970-1980

According to a story that amused District personnel during the early 1970s, God presented Moses with some good and bad news, the good news first:

> "The good news is that I am going to lead your people out of bondage. I will send plagues of lice, frogs, darkness, and boils upon the Egyptians and will turn the Nile into blood. I will part the Red Sea so the Hebrew people can escape the Pharoah's cavalry; I will send a column of dust by day and of fire by night to guide the people to the promised land, and manna will rain down from Heaven to insure your safe travel."
>
> "That sounds great, Lord," responded Moses, "but what is the bad news?"
>
> "You are the one who will have to write the environmental impact statement on all of that."

When the National Environmental Policy Act became law in 1970, all federal agencies were required to prepare environmental impact statements for projects and actions significantly affecting the human environment. With a large number of projects under construction or in the advanced planning stages, the Louisville District had a large backlog of impact statements to prepare. Such emphasis initially was placed upon the statements that the District Engineer furnished the Division Engineer with regular production reports. In June 1971, for instance, he reported the District during the previous three months, in spite of a policy change which had required revision of all statements then under preparation, had forwarded five statements to the Council on Environmental Quality and had eight more under final review.[1]

Much initial confusion prevailed concerning just what information should be included in the impact statements to make them "adequate," and federal courts through several decisions interpreting the law eventually clarified its meaning. Each time the adequacy of a statement was tested in court and found wanting, the necessary information was added not only to that statement but also to all uncompleted impact statements throughout the nation, with a resulting snowball effect. Some of the first impact statements completed were merely a few pages in length; by 1975 some were multivolume productions with tables of contents as long as the earlier statements.[2]

Alliances of landowners and environmentalists initiated considerable litigation after 1970 contesting the adequacy of environmental impact statements as leverage to force fuller consideration of potential environmental damages and in some instances to delay or stop project construction. At the proposed Red River lake project in Kentucky, for instance, where the controversy concerning the project had been dormant during the two years its environmental impact statement had been under preparation, the controversy flared anew in 1973 when the impact statement was released and litigation followed. Because that controversy attracted considerable national attention, it should be outlined in some detail.

The Bastille Day Revolution

The truce at Red River was broken on

a steamy "Bastille Day" in July 1973 when seven hundred people jammed unto a gymnasium at Stanton, Kentucky, for one of the most unruly meetings ever conducted by the Louisville District. The crowd had gathered to express opinions about the environmental impact statement released two weeks earlier and about the project in general. When Colonel Charles J. Fiala, District Engineer, opened the meeting at ten that hot Saturday, the bleachers, gym floor, and aisles along the walls were full of people, and demonstrators were active outside the building. State police were present to restrain flaring tempers, and their services were required.[3]

As Lieutenant Colonel George Shields, Deputy District Engineer, started the meeting with slides presenting project information, the opposition hooted. They also booed Congressman Carl Perkins, who supported the project, and in fact almost every speaker met catcalls, either from the project's opponents or from its proponents. After the first several hours tempers cooled somewhat and the crowd began to dwindle, but testimony continued until four o'clock that afternoon. As one District executive saw it, the crowd consisted essentially of three groups: a delegation of local people who wanted the project, a group of environmentalists who did not, and a small but vocal contingent of citizens who would be displaced by the lake and who let it be known that they did not want to move. All opinions expressed by the Bastille Day crowd were summarized in the record, made part of the final draft of the environmental impact statement, and forwarded to Washington for review; yet the debates had only begun.[4]

The media resumed its intensive coverage of the Red River controversy in 1973 with only the Clay City newspaper giving the project its unqualified approval. Because Kentucky had yet to sign a contract agreeing to pay its share of project costs, the Red River project became an issue in the 1974 elections in which Wendell Ford, the successor to Louie Nunn as Kentucky governor, opposed Marlow Cook for a seat in the U. S. Senate. Senator Cook opposed the Red River project, while Ford gave it his qualified support. "Frankly, we're puzzled," admitted the District's public affairs officer: "We don't know what the meaning of all this will be."[5]

On Earth Day in 1974, fifteen hundred protestors marched through Frankfort to the state capitol building and petitioned the Governor against the Red River project. Two days later, Governor Ford announced his support for the project and within a month he advised the District that the state would cooperate in paying for the water supply feature of the Red River project. The District sent its final environmental impact statement on the project to the Council on Environmental Quality in Washington in July 1974 for review and Congress provided $500,000 to start land acquisition on the Red River. In August, Max Bohrer, chief of real estate for the District, conducted a public meeting at Bowen to explain to irate landowners how their land would be purchased. When the landowners disrupted the meeting, Bohrer responded to their criticism: "We work for you, just like the Constitution says." H. B. Farmer, a leader of the landowners, quipped: "We ain't got no Constitution." The audience cheered him, for it was the month in which President Richard M. Nixon resigned. "I'm in no position to debate that question," Bohrer laconically responded.[6]

Shortly after that real estate meeting, Colonel Fiala announced he would suspend the purchase of project land voluntarily to provide time to respond to questions from the Council on Environmental Quality concerning the impact statement and also to consider issues raised against the project in a suit filed by the Red River Gorge Legal Defense Fund, an umbrella group organized by environmentalists and landowners. The group had several influential directors: former Secretary of Interior Stewart Udall, Audubon Society president Elvis J. Stahr, Kentucky authors Harry M. Caudill and Wendell Berry, artist Ray Harm, and Mrs. Barry Bingham of the family which published the Louisville *Courier-Journal*. Declaring he intended the impact statement to comply with both the letter and spirit of the law, Colonel Fiala said: "We can sympathize with the landowners and we understand the environmentalists' concerns, but our decision was based on what we thought was best in the long run for the majority of the people."[7]

Writing environmental impact statements then was a new art, with the challenge being to make them "adequate" in compliance with the law. Anyone could, and many did, question the adequacy of the statements, for courts then had not fully interpreted the meaning of the word. With assistance from professors at the University of Kentucky, environmentalists questioned the statement for the Red River project on several grounds, especially its analysis of the effects of the lake upon vegetation in the gorge. The opponents were not entirely negative, for some introduced constructive suggestions that the dam and lake might be supplanted by floodwalls or other protective measures at Stanton and Clay City and by reservoirs for water supply located some distance from the gorge. Rhetoric grew more acrid, however, as the controversy continued. One professor referred to the project as a "communist plot," and Audubon Society president Elvis J. Stahr said: "This project is nothing more than a boondoggle."[8]

In a report to Brigadier General Wayne S. Nichols at the Ohio River Division, the District Engineer summarized the effects of the bitter rhetoric and the media coverage it received:

> There has been widespread publicity given the Red River Lake controversy including national television coverage. Most of this publicity is critical of the Corps in general and of the project in particular. Most of this media coverage is difficult to controvert by the District without resorting to questionable tactics, and I am determined that such tactics will not be used. As a result of this well-organized publicity campaign, it becomes increasingly difficult to deal with the real issue of project merit.[9]

In December 1974 the District completed its two-volume response to queries from the Council on Environmental Quality and also filed its defense brief in the suit pending in federal court. Neither satisfied opposition to the project, and Chairman Russell W. Peterson of the Council on Environmental Quality thought the two additional volumes of data did not "significantly improve the ability of the reader or the decisionmaker to deal with the subject issues." The Kentucky campaign for election to the Senate also ended in late 1974 with a victory for Governor Wendell Ford over Marlow Cook. Ford left for Washington, succeeded as Governor by Julian Carroll who had taken no public position on the Red River controversy.[10]

The divisiveness of the controversy was highlighted by newspaper comments following a visit in February 1975 to Red River gorge by Congressman William D. Gradison, Jr., of Ohio. Along with three hundred opponents to the project, Congressman Gradison had with him Brigadier General Wayne S. Nichols and other Corps personnel to answer his questions, and a Lexington newspaper commented that those Engineers were about as welcome in the gorge as "Adolf Hitler on the streets of Tel Aviv."[11]

Eight hundred protestors marched in Frankfort again in April 1975, and in May Secretary of the Army Howard "Bo" Callaway flew into Louisville to declare that the Red River project's future lay with Governor Carroll. Later that month, Callaway informed the chairman of the Council on Environmental Quality that in his opinion the District's impact statement met all the requirements of law.[12]

The District was preparing to resume purchasing land for the dam in May when Governor Carroll asked for further delay while he considered the issues involved, and a federal court issued a restraining order suspending the project pending a full hearing. After staff study of the Red River and consultations with the District Engineer during the summer of 1975, Governor Carroll announced on September 11 that he saw no "compelling reason to build the Red River Dam." He thought sufficient recreational benefits could be achieved through state cooperation with the U. S. Forest Service in development of the gorge, that flood protection for Stanton and Clay City might be secured without an upstream dam, and that regional water supply needs could be met by other means at some future date. With loss of state support, the Chief of Engineers on October 6, 1975, suspended the Red River project, advised Congress further funding was not needed, and relegated the project to the inactive bin. Thus, the project reconsideration required by the National Environmental Policy Act of 1970 had effectively sounded the project's death knell.[13]

Kentucky River Flood of 1978

The Red River controversy briefly flared anew in 1978 after twelve inches of rain fell during the first ten days of December in the Red and Kentucky River basins, sending seething floods down those streams and others in southeastern Kentucky. Clay City and Powell County along the Red River suffered the most devastating flooding in their history and downstream communities along the Kentucky River were inundated by the highest flooding of record. At Frankfort, the Kentucky climbed to 48.5 feet on December 10, surpassing the 1937 flood of record of 47.6 feet, forcing the evacuation of 1,200 people, severing the city's water supply, and paralyzing both the city and state governments. The sole dry spot in the capital beneath the surrounding hills was the area protected by the North Frankfort floodwall, built by the District during the 1960s to protect the downtown business district.[14]

The extent of flooding surprised many Frankfort residents, and some blamed the District and its Kentucky River lockmasters for not providing an earlier warning. Though local residents had come to rely on the lockmen for information about flooding, flood forecasting was neither their responsibility nor field of expertise. As the flood went steadily higher, taking out some telephone lines and access roads, the lockmen had to leave the locks and evacuate their own families. Three lockmen at Lock 4 in Frankfort were marooned, however, by the flood on the second floor of a lockhouse three days without heat in twenty degree weather, without food except dry cornflakes, and yet they continued reporting flooding conditions on a marine radio.[15]

The flood poured out of the Kentucky River at Carrollton and continued down the Ohio, not reaching record stages along the Ohio but inundating lowlying areas,

Aerial view of Clay City, Kentucky, surrounded by the flooding Red River, December 10, 1978.

and sixteen local protection projects built by the District went into operation to keep the flood out of communities behind the floodwalls and levees. President Jimmy Carter declared a major disaster to exist in the seventeen Kentucky counties which were partly flooded, and the District's emergency operations center sent engineer teams into those counties to assess losses and prepare damage survey reports for the Federal Emergency Management Administration. The Kentucky Ornithological Society reported the flooding had also affected wildlife resources by driving birds from the flooded areas, for the Society found only half the usual number of birds during its annual count of bird populations and species that year.[16]

In the aftermath of the 1978 flooding, renewed interest in achieving some measure of flood protection in the Red and Kentucky River basins appeared. Public interst centered on improved methods of flood warning and evacuation planning, construction of an additional floodwall at Frankfort, a high dam for flood control on the mainstem of the Kentucky near Frankfort, and the controversial dam on the Red River.

Flood forecasting and warning was chiefly the responsibility of the National Weather Service, which in cooperation with state and federal agencies devised plans for a flood warning system using automated gages on the Kentucky River upstream of Frankfort and elsewhere on

Appalachian streams where flash flooding was common. The gages measured the rise and fall of streams, relaying data by radio signal to satellites for transmission to National Weather Service computers in Cincinnati and elsewhere. The plans included raising the gages at Kentucky River Locks 6 and 10 where the old gages had been overtopped by the flood of December 1978.[17]

Because evacuation from threatened areas in Frankfort had been voluntary during the 1978 flood, some people had remained in their homes until marooned by the rising river, and moving them out of the danger zones had forced rescuers to brave swift currents and floating debris at risk of their own lives. Working with city authorities, the District developed evacuation plans for Frankfort, taking into consideration a flood of such size that it might even overtop the existing floodwall. The District proposed a rigid emergency schedule of action to be followed as the river rose to higher stages and suggested that evacuation be made mandatory at a certain river stage. "It is reasonable to assume that severe flood levels greater than in 1937 and 1978 will sooner or later occur on the Kentucky River," the District warned.[18]

Frankfort City Manager Paul Royster and some of the city commissioners proposed in 1979 that the Corps construct a large dam for flood control and multiple purposes across the Kentucky River a few

Kentucky River in the streets of Frankfort, Kentucky, on December 10, 1978. State Capitol Building on hill in foreground.

miles upstream of the state capital. Initial studies by the District, however, indicated the costs of such a dam would outweigh its benefits. When he heard the District's unfavorable report on the proposed dam, Kentucky Senator Wendell Ford observed:

> This is one strange world. You try to build a dam one place and they march against you, they don't want you to do that. Then you go to another place and try to get that one built and it's hard to get the Corps to agree it's a good project when really not many people would object to something like this. It's awfully hard to know which side to get on when you're trying to develop flood protection.[19]

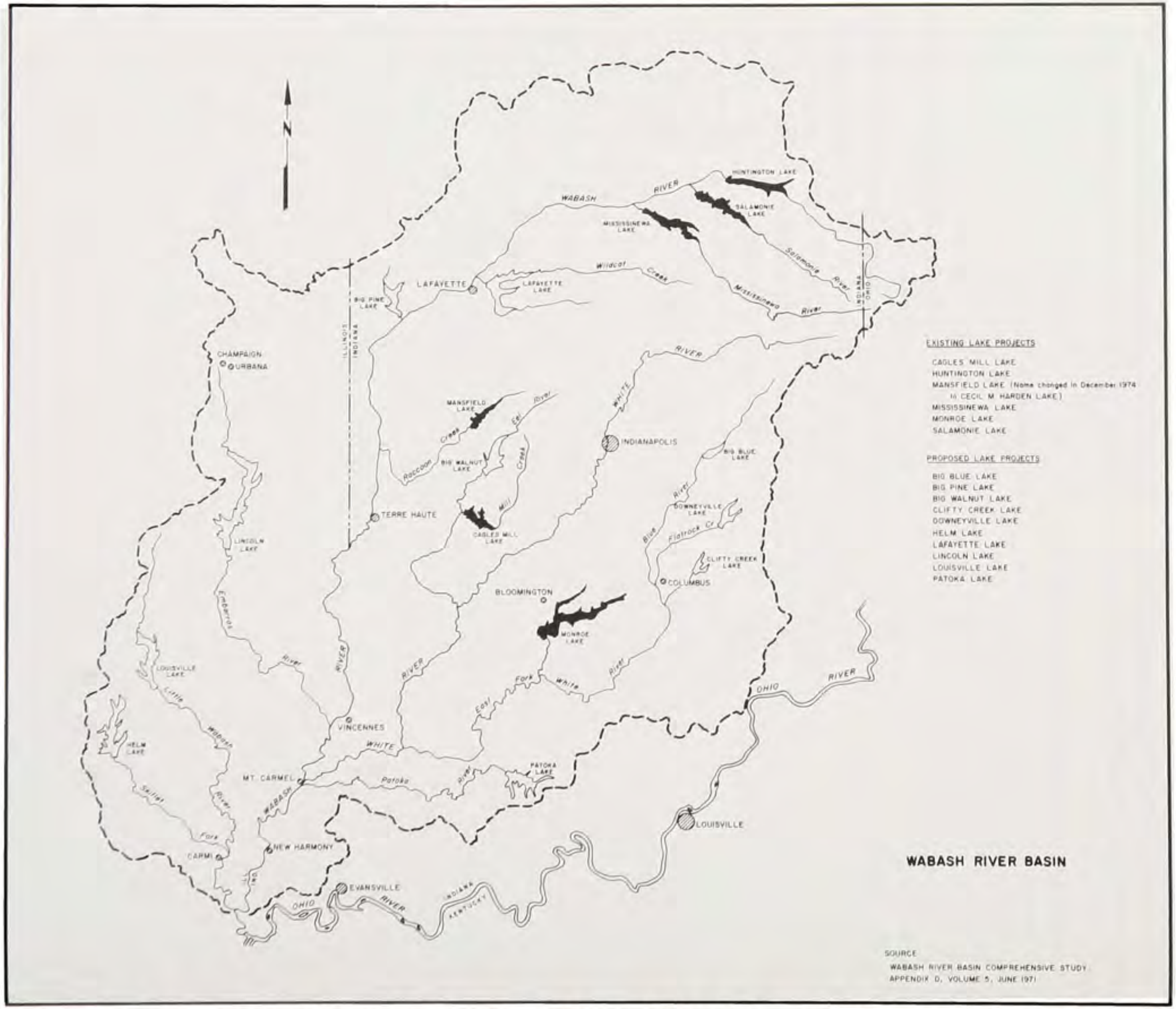
The situation was again reversed in connection with studies of a floodwall and levee proposed for the protection of South Frankfort. There, the District returned a favorable report on construction of a floodwall but the people of Frankfort appeared to oppose it. After study of nonstructural flood control procedures and several alternate alignments for the floodwall, the District selected an economical floodwall plan and presented it for public discussion to the citizens of Frankfort at a public meeting. Citizens who attended that meeting seemed opposed to the floodwall, or at least to its proposed location. Because the floodwall, like all local protection projects built since 1938, required that local government share in its cost, Robert E. Ledford of the District's planning division commented: "If the city does not want to participate in the floodwall, it won't be built."[20]

Far upstream of Frankfort at Clay City in the Red River valley, the citizens expressed some bitterness after the 1978 flood disaster, largely directed at those who had opposed the proposed dam on the Red River. Newspapers reported that those who had opposed the dam were warned out of the city at that time. Shortly after the flood subsided, the Powell County Conservation District sent a resolution to state and federal officials asking and "even begging" for flood protection and additional water supply. Congressman Carl Perkins, contending the Red River Dam might have saved Clay City and Stanton from most of the flood damages experienced in 1978, commented that the dam probably would never be constructed, at least not until after the Lexington and Frankfort area water supplies were exhausted. The mayor of Stanton declared the Red River Dam might still be built if environmentalists ceased their opposition, but a member of the Sierra Club countered: "It was a boondoggle then and it's still a boondoggle."[21]

It seemed highly improbable that Congress would ever revive the Red River project; yet, needs in the Kentucky River basin for increased flood protection, water supply, and other water management measures had not been met by 1983. Kentuckians concerned about those needs were awaiting completion of the District's Kentucky River and Tributaries Study scheduled for 1984 which would outline the Engineers' water resource planning in the region. According to the District Engineer, the study concentrated upon reducing flood damages at Frankfort and also evaluated water supply, navigation, and hydroelectric power needs from the headwaters of the Kentucky River in the Appalachians to its confluence with the Ohio River.[22]

Wabash River Basin Controversies

Though receiving somewhat less national news coverage, the multipurpose projects proposed by the District for the Wabash River basin in Indiana and Illinois were no less controversial than the Red River project in Kentucky. In that region, the District had completed six dams and



1971 map of the Wabash River Basin indicating the location of the six District lakes completed at the time and the ten multipurpose lake projects proposed in the comprehensive survey of the basin during the 1960s.

lakes by 1970; they were: Cagles Mill (1953); Cecil M. Harden (1960, known earlier as the Mansfield project); Monroe (1965); Salamonie (1966); Mississinewa (1967); and Huntington (1968). While those six were underway the District in 1963 began preparation of the Wabash River Basin Comprehensive Study aimed at planning water resource development adequate to meet the needs of the region until 2020 A.D.[23]

Called a "parent" study because it was supposed to produce offspring in the form of acceptable and needed water resource projects, the Wabash basin study was a "Level B" study. The "Level A" study was the Ohio River Basin Comprehensive Study, completed in 1970 for the 205,000 square-mile watershed of the Ohio, which was couched in general terms while the study of the 33,000 square-mile watershed of the Wabash was more specific. Completed in 1973 after a ten-year effort costing several million dollars, the Wabash study proposed construction of thirteen multipurpose dams on tributaries of the Wabash, more than a hundred small watershed projects, various land management and conservation measures to reduce runoff and erosion from agricultural lands, a large number of treatment plants for control of water pollution sources, and the preservation of about 1,700 miles of streams as environmental corridors.[24]

During the decade the Wabash study was underway, three interim reports were released, each resulting in congressional authorization for several projects. The first interim report brought authorization for the proposed Big Pine and Lafayette lakes in northwestern Indiana, the second resulted in authorization of the proposed Clifty Creek and Patoka lakes in Indiana and Lincoln lake in Illinois, and the third in authorization for Helm and Louisville lakes in Illinois and Big Walnut, Big Blue, and Downeyville lakes in Indiana. Ten of the lakes recommended in the Wabash River Basin Study thus were authorized by Congress by 1968, but of that number only the Patoka Lake was constructed. Almost all of the ten were highly controversial, meeting significant opposition from landowners in the lake areas and from environmentalists.

Each of the three lakes proposed in Illinois were located near the head of one of the western tributaries of the Wabash. The Helm project, named for a nearby community, was located on Skillet Fork of the Little Wabash in Marion County near Salem, Illinois. The Louisville project, named for Louisville, Illinois, located near the site of the proposed dam, was on the Little Wabash in Clay County with the proposed lake extending north to Effingham. Named for the President, the Lincoln project was on the Embarras River in Cumberland County with the proposed lake extending north through Coles into Douglas County. Before the advent of railroads, local governments had cleared the three streams for navigation by flatboats transporting Illinois farm products via the river system to New Orleans, but with abandonment of use of the streams for navigation they had become choked with fallen trees and sediment. Drainage troubles and flooding had become matters of serious local concern and water supply shortages occurred during droughts. Designed as multipurpose projects providing various combinations of flood control, water supply, and recreation features, the three projects on Illinois streams needed strong state and local support including sharing of project costs before they could be constructed.[28]

At public meetings concerning the three Illinos projects, strong support came from the Wabash Valley Association, an organization of farmers and civic leaders supporting water resource development in general, from owners of farms downstream of the sites of the proposed dams who wanted flood protection, and from businessmen in communities located near the lakes who wanted the water supply, recreation, and opportunities for regional economic development the projects promised. Equally strong opposition came from owners of the land that would be purchased for the construction of the projects and from environmental organizations with a leadership largely supplied by professors and students at the universities in Illinois. Since each of the three projects required state participation, the position of the state government, especially the Governor, on project planning and construction issues was critical to their future, and both project proponents and opponents sought to make the projects an issue in state elections.[26]

During the 1972 gubernatorial election in Illinois, Daniel Walker expressed his opposition to several projects proposed by the Corps in the state, and soon after his election he withdrew state support from the proposed Helm lake project on Skillet Fork. At 1974 congressional hearings on the project, the Governor's representative testified against it, pointing out the project had strong local opposition and declaring its recreation and water supply features were not needed at that time. He mentioned that the $150 million in the federal civil works budget for projects in Illinois (which is served by four Engineer Districts including Louisville) set aside only $2 million for flood protection measures in urban areas, and he believed that figure indicated misplaced priorities and a lack of sensitivity to the "substantial property damage and human suffering resulting from urban flooding in Illinois." The District thereon suspended further study of the Helm lake project and it was deauthorized.[27]

As promised during his election campaign, Governor Walker on May 10, 1973, also withdrew state support from the proposed Lincoln lake project on the Embarras River, where the District had progressed to the point of purchasing land for road access to the construction site. The Governor's opposition to Lincoln lake rested chiefly on grounds that the upper end of the lake might interfere with the functioning of an elaborate tile drainage system built by Douglas County farmers. Working with state agencies, the District restudied project formulation in search of solutions to the area's drainage problems which might also meet the needs for flood protection and water supply. Those studies continued into the administration of Governor James R. Thompson, the successor to Daniel Walker, but state government remained unwilling to cooperate in project construction, the District shelved the project in 1979, and it was deauthorized.[28]

The District's sole remaining "active" multipurpose lake project in Illinois was Louisville lake project on the Little Wabash in Clay and Effingham counties. Governor Walker indicated in 1974 he supported the project but was unwilling to participate in its recreation features. A restudy began in 1975 to devise limited recreation and water supply features, and funding was provided the state to reroute U. S. Highway 45 to an alignment outside the area to be inundated by the lake. Pointing out that communities near the proposed lake had nearly exhausted their water supplies during the summer of 1976, Governor James M. Thompson in 1977 asked the Louisville District not to ignore the needs of the Little Wabash River basin and to "proceed to a rapid completion of the plan formulation process." Other Illinois political leaders, however, suggested that area water supply needs could be met through the design of a smaller lake which might be less disruptive to the farming community on the Little Wabash floodplain, and the District began studies of alternative project designs which were continuing in 1983.[29]

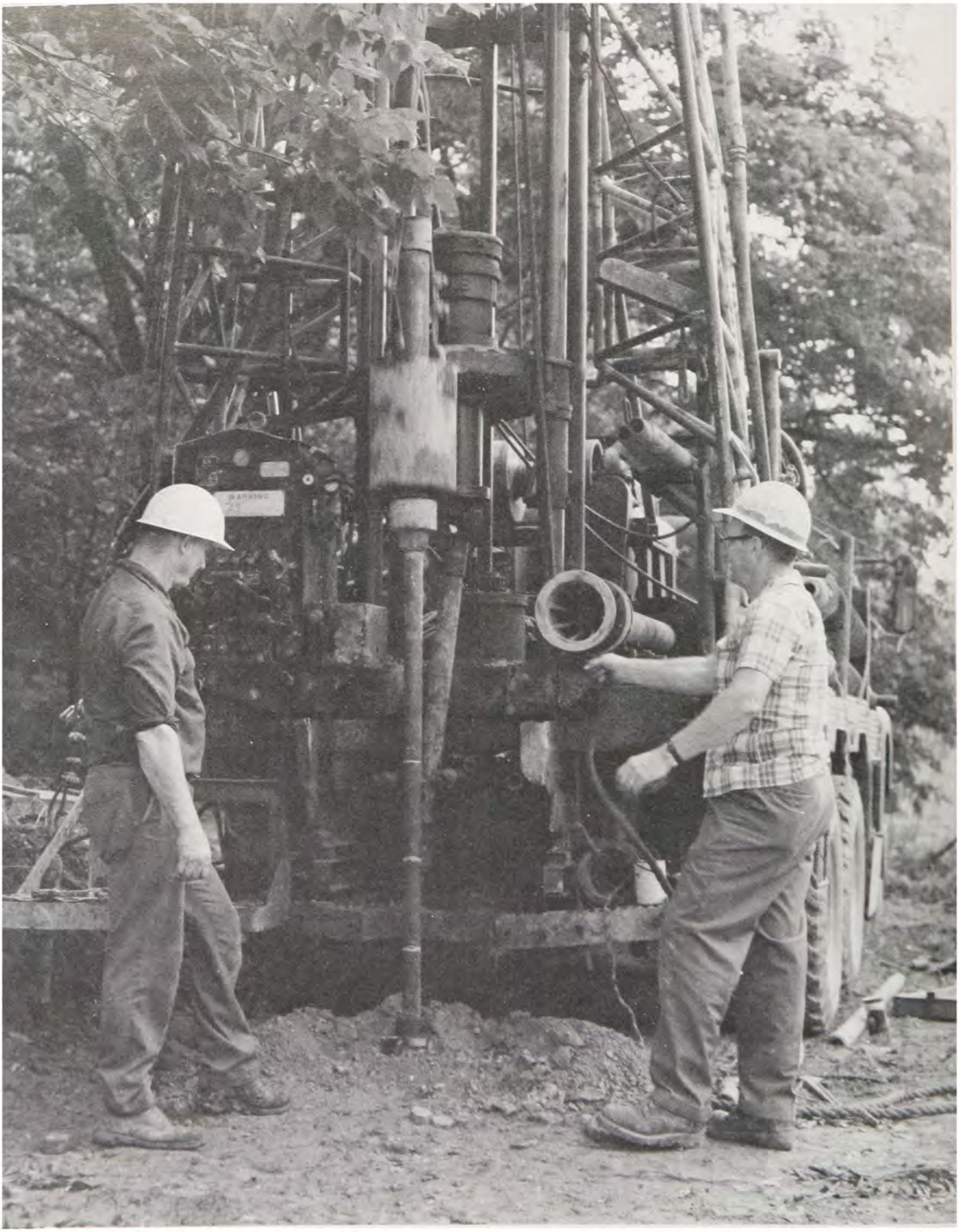
Proposed Projects in Indiana

Senators Vance Hartke and Birch Bayh along with John T. Myers and other Indiana congressmen were largely responsible for securing congressional authorization during the 1960s of seven multipurpose lakes in Indiana recommended in the Wabash River Basin Comprehensive Study. As planning progressed for the seven projects, however, alliances of landowners and environmentalists strenuously opposed each of the projects, and they generally were successful in their opposition: by 1983 most of the projects had been deauthorized and of the seven only Patoka Lake was constructed. A review of controversies surrounding the six projects which were not built should indicate the general historical pattern.

The Big Walnut project on a creek of the same name near Greencastle, Indiana, as previously noted, was stopped by the District in 1970 while a task force appointed by the District Engineer reformulated project planning to avoid inundating unusual timber stands and a blue heron rookery at the upper end of the proposed lake area. The Big Walnut Task Force made its report in 1972, recommending a solution similar to the compromise reached at the Red River project in Kentucky: the dam would be moved a few miles downstream, the elevation of the lake lowered, and the botanical relict area at the head of the lake purchased to assure its preservation. Those design changes essentially resolved the most controversial of the project's environmental impacts and earned qualified support from environmentalists.[30]

Landowners in the lake area continued to oppose the Big Walnut project, contending its estimated benefits were inflated and suggesting that foundation conditions at the dam site were unsatisfactory. While the District studied those allegations, prepared the project environmental impact statement, and revised project design, steady inflation drove estimated construction costs even higher. The resulting delay brought the project under the provisions of Section 221 of the 1970 Flood Control Act, eventually leading to the withdrawal of state support for the project in 1977.[31]

Section 221 of the 1970 Flood Control Act required state and local agencies entering into cost-sharing agreements for Corps projects to sign binding written agreements for all projects at which construction began after January 1, 1972. One interpretation of Section 221 was that it required state legislatures to commit future sessions of the legislatures to expenditures, appearing to conflict with state constitutions which forbade one session of the legislature from obligating future sessions with financial commitments. Although some states were able to make cost-sharing arrangements which avoided conflict with their constitutional limitations, the State of Indiana did not do so, with the result that planning for Big Walnut stopped in 1977 and the project was deauthorized at the request of Indiana. Delays during reconsideration of environmental impacts therefore were responsible for the demise of the Big Walnut project. Had construction begun before 1972, when the requirement of Section 221 took effect, it might well have been completed.[32]



The District investigates subsurface conditions at project sites by drilling into the foundation rock and extracting "core samples" for study. Gilbert Reynolds on the right and Bernie Toebbe on the left observe a District drillrig in operation during the 1960s.

Senators Birch Bayh and Vance Hartke secured authorization and funding for the proposed Big Pine lake in 1965 and 1966. Located on Big Pine Creek in northwestern Indiana, the project also experienced a two-year delay from 1970 to 1972 for careful study of environmental impacts. That study was not a direct result of opposition by environmentalists as was the case at Big Walnut, but resulted from efforts by the District at the request of state authorities to coordinate the project with an electric power company planning an impoundment on the same creek to secure cooling water for a power generating plant. District studies determined in 1972 that heated water created by operation of the power plant would be incompatible with the functioning of the federal project. By the time those studies were completed, however, the requirements of Section 221 of the 1970 Flood Control Act applied to the project and a strong landowner and environmentalist alliance had formed to oppose it.[33]

Larry Daniels in a District laboratory inspects the "core samples" extracted from the rock underlying the foundation of a District project.

James Jontz, who was employed by Indiana environmental and conservation clubs to oppose the Big Pine and most other Engineer projects in the state, cooperated with landowners in organizing annual "Big Pine Days." During those celebrations, groups canoed the stream, cleared litter from its banks, publicized the stream's scenic attractions, and earned favorable media coverage for their opposition to the project. Their opposition brought a request from state government in 1973 that the District search for an alternate site for the dam, thereby delaying construction at the proposed site. Demonstrating widespread public support for the environmental movement in Indiana, James Jontz won election to the Indiana House of Representatives in 1974 by defeating the majority leader of that assembly on a campaign promise to stop the Big Pine project. After election, his first action was to introduce a bill withdrawing state support from the project. That proved unnecessary, however, for in early 1976 Colonel James N. Ellis, District Engineer, killed the project because its environmental impact statement indicated environmental damages would be significant and economic benefits marginal. "The Corps' credibility is at stake all over," said Ellis: "We are going to continue to take a hard look at all of our projects."[34]

Funds for the proposed Lafayette Lake project on Wildcat Creek, a Wabash tributary near Lafayette, Indiana, were first appropriated in 1970 but were impounded by the Nixon administration during its effort to curb inflation by reducing federal expenditures. When the impounded funds were released in 1974, they were used to update project plans in light of the inflation which had occurred in construction costs. During those delays the environmenmentalists and landowners opposing Lafayette Lake conducted a campaign to stop the project, and on April 22, 1976, the Governor of Indiana withdrew state suport for the lake, citing Section 221 of the 1970 Flood Control Act as a barrier to state participation.[35]

Environmental groups subsequently sought creation of an environmental corridor, perhaps as a state park, along most of the length of Wildcat Creek to preserve the stream. Securing stream preservation and scenic easements from landowners, however, proved no less difficult than obtaining lands for impoundments. Very few of the some 1,700 miles of environmental corridors proposed for stream preservation and for nonstructural flood protection in the Wabash River Basin Comprehensive Study received such a status. Some minor support for the proposed dam and lake also persisted in the Lafayette area, and in 1979, after a flood along the creek and the Wabash, a local newspaperman wrote:

> It's a shame that this area could not have seen Lafayette Lake become a reality because it would have been another aid in keeping the Wabash under control. In addition, we feel it would have been an extremely attractive recreational addition to this community.[36]

East and southeast of Indianapolis on tributaries of the White River which flows into the Wabash were four multipurpose lakes proposed in the Wabash River Basin Comprehensive Study, three of which were authorized by Congress and a fourth, Highland lake, which was not authorized but attracted substantial local interest. All four were located within a hundred miles of the mushrooming urban area around Indiana's capital, an area badly in need of water supply and recreation opportunities according to the comprehensive study.

Vigorous support from the chamber of commerce of Columbus, Indiana, brought authorization in 1965 of Clifty Creek lake on a stream of that name which flows into East Fork of the White River, and the District pursued planning for the project without much opposition until 1970 when environmentalists urged that the project be redesigned to prevent inundation of several scenic falls on the stream and its tributaries. At request of the state, the District during 1972 and 1973 examined alternate sites for the dam that would save the falls, and in 1974 the state selected one alternate site for further study. Geologic explorations at that site, however, revealed it to be unsuitable for dam construction, and in 1975 the state accepted the originally proposed site. The District then began updating project plans and design, continuing the effort until 1978 when the state withdrew its support. The project had no water supply feature and the state was unwilling to participate in recreation features in light of the apparent conflict resulting from interpretation of Section 221 of the 1970 Flood Control Act; it was deauthorized by Congress.[37]

Authorized in 1968, the proposed lake on the Big Blue River near Greenfield, Indiana, was not funded for advanced engineering and design until 1975, after the Greenfield chamber of commerce had actively campaigned for the funding. When landowners refused access to the dam site even to drill the cores needed to determine foundation conditions, it became clear that local opposition to the project was intense. At Big Blue, the District first encountered requirements of the Endangered Species Act of 1973 when it learned a colony of Indiana bats, a protected species, lived in the area to be inundated. As required by the law, extensive studies of the bats and their habitat followed during 1977 and 1978, and 190 of them were observed in the course of the studies. At the end, the U. S. Fish and Wildlife Service concluded that construction of Big Blue lake would not critically affect the survival opportunities of the Indiana bat.[38]

At completion of the Big Blue project environmental impact statement, a local newspaper described the report as an important historical document containing 199 pages crammed with facts about population growth and average income in the area, with details about area geology and archaeology and every living thing from poison ivy to bats. Colonel Thomas P. Nack, District Engineer, conducted the usual public meeting concerning the Environmental Impact Statement at Greenfield in March 1979. The organizations attending that meeting indicated the typical division encountered by the District at most of its public meetings concerning lake projects. The opposition included the Izaak Walton League, represented at the meeting by Thomas Dustin, and the Big Blue Opposition League headed by retired Army Colonel Joseph Birgandi who owned property in the lake area. Listed as favoring the project were the Greenfield Chamber of Commerce, City Council, and Kiwanis Club; the Morristown Chamber of Commerce, American Legion Post, Lions Club, and Town Board along with the Morristown local of the United Auto Workers; the Shelbyville Chamber of Commerce and City Council; the Shelby County Commissioners, and the Wabash Valley Association. In sum, an alliance of landowners to be displaced by the project and environmentalists chiefly from outside the project area constituted the opposition, while its proponents were local civic and business leaders.[39]

The District in 1979 relocated the proposed Big Blue dam upstream 1.3 miles to secure better foundation conditions and to reduce the estimated costs of relocations from the lake area; the changes did not increase public support for the project. At Carthage, Indiana, where the city council had supported the project, a referendum on the project conducted in 1979 by the council indicated the town's citizens heavily opposed the project. When first phase studies of the project were completed in June 1979, Colonel Nack recommended that second phase studies not begin until the apparent conflict concerning interpretation of Section 221 of the 1970 Flood Control Act was settled. Indiana withdrew its support for the project in 1980 and on May 14 of that year the District relegated the project to the inactive category. "We'll never have this chance again," lamented one Greenfield businessman: "This is one of the few counties that has the opportunity to capitalize on a multipurpose project. We're selling the future short. It's being evalated in a short-term approach."[40]

The Downeyville project on Flatrock River in Decatur County, sandwiched between the proposed Big Blue and Clifty Creek projects, was authorized in 1968 but generated such little public or state interest that Congress never funded it. More public interest was expressed in several other projects proposed in the Wabash River Basin Comprehensive Study which were not authorized than in the Downeyville project—notably the Highland dam and lake proposed on Fall Creek in Indianapolis. Most other lakes proposed in the Wabash basin were located in rural areas, but Highlands dam was to be located near 79th Street and was to serve Indianapolis's immediate needs for flood control, water supply, and recreation. Like the rural projects, however, it attracted opposition from a landowner and environmentalist alliance calling itself "Save Heritage and America for Tomorrow" (SHAFT).[41]

City and state governments expressed such strong interest in the Highlands project that Congress directed the Louisville District to study authorization of the project. Senators Birch Bayh and Maurice R. Gravel, the latter as chairman of the Senate Water Resources Subcommittee, conducted a public meeting concerning the project in 1973 at Indianapolis. At that meeting the Indiana Audubon Society declared the Indianapolis area needed no more recreation facilities, that building the dam would encourage development of the downstream floodplain, and that the "real" desire behind local support for the project was at root a desire to create a lakeside residential complex. One of the major issues was whether groundwater developed by wells could meet the water supply needs of Indianapolis until 2020 A.D., and the Senators recommended authorization of the Highland project be deferred pending completion of detailed studies of groundwater supplies by the U. S. Geological Survey. The Wabash River Basin Comprehensive Study had predicted Indianapolis would be using 390 million gallons of water a day by 2020, compared to the 160 million gallons used daily in 1973. When the U. S. Geological Survey reported that tapping groundwater sources could yield as much as 59 million additional gallons a day, Senator Bayh withdrew his support from the Highlands project on May 21, 1976, effectively killing it. An official of the Indianapolis Water Company grumbled afterwards: "If Highland is abandoned, it will never again be economically feasible to develop. This will create a serious shortfall in the next fifty years, requiring transportation of water over long distances at a cost beyond estimate at this time."[42]

Project Deauthorizations

The Indiana General Assembly and members of Congress from the Hoosier State requested the deauthorization of many projects proposed in the Wabash River Basin Comprehensive Survey during the late 1970s and by 1981 had largely cleaned out the backlog of eligible projects. One of the reasons supporters of those projects lamented their loss so vociferously, warning that the chance to build them was lost forever, was the change in the computation of project discount rates which occurred during the 1970s.

As the rates of interest paid for capital by private firms increased during the 1970s, support developed for increasing the discount rate used in estimating the benefit:cost ratios of water resource projects. Though not exactly equivalent to an interest rate, the discount rate represented an estimate of the cost to the government and society of investing money in one project that could be used for another, an estimate of its "social cost." In sum, the discount rate was an artificial device used by Congress and the President to reduce the number of federal projects by making it more difficult to produce a benefit:cost ratio greater than unity. Before 1969, the discount rate was 3.25 percent; after 1969 the rate was tied to the rate paid by the government for Treasury notes, and it gradually increased to more than seven percent by 1983. A "grandfather" type clause applied, however, setting the rate for individual projects at the level prevailing when Congress authorized them. All ten of the projects in the Wabash basin that were authorized in the 1960s therefore qualified for the lower discount rate of 3.25

percent applying before 1969. When they were deauthorized or declared inactive, it meant that when, if ever, they were reconsidered, it would be at different and no doubt substantially higher discount rates, making their economic justification doubtful.[43]

Most projects in the Wabash River basin were declared inactive or deauthorized at the request of the state governments and members of Congress from those states, but the Corps itself erased others from the agenda. The Water Resource Development Act of 1974 (Public Law 93-251) required the Chief of Engineers to submit annually to Congress a list of projects which had received no funding in at least eight years and should be deauthorized. By 1981 the Corps had recommended deauthorization of about 750 projects nationwide, and Congress had deauthorized more than half of those projects, reserving the remainder for future consideration.[44]

Full consideration of project environmental impacts and conflict over interpretation of Section 221 of the 1970 Flood Control Act brought federal construction of multipurpose projects in Indiana to a stop by 1981, which explains an amusing exchange between Congressman John T. Myers and Brigadier General R. S. Kem, the Ohio River Division Engineer, at a meeting of the House Subcommittee for Water Resource Development in 1981. Congressman Myers owned farmland in the Wabash valley and had often inspected flood damages along the Wabash with the Louisville District Engineers; he was a ranking member of the House Subcommittee for Water Resource Development and perhaps the firmest advocate of such development in Indiana. Arriving late to the meeting in 1981, he introduced himself to General Kem as the only member of the committee who was entirely impartial because he had no water resource projects at all in his district. The congressman remarked:

> I have lost seven and a half crops out of the last ten years, seven and a half crops. That is not very good. The Corps comes in if a back-house floods in the city; that is a major disaster; but a farmer can go bankrupt losing his crops and this last Administration [Carter] paid no attention to it. I hope this present Administration [Reagan], with your help, will make some changes because the Corps projects are needed very badly.
>
> . . . .
>
> We apologize for starting the meeting late but we had a National Prayer Breakfast, and if you can't get it through the Corps, we pray for it.[45]

Whether the projects proposed in the Wabash River Basin Comprehensive Study and authorized by Congress during the 1960s were vital to future development of the Wabash valley would not be fully evident until sometime near 2020 A.D., the year for which the comprehensive study aimed in forecasting the future water needs of the region. If the aim of the comprehensive study was to select water resource projects that were both necessary and acceptable to state and federal governments, the study was not successful. One reason its recommendations were not accepted was timing: the study began in 1963 before the growth of an environmental consciousness in the Midwest and before enactment of the National Environmental Policy Act. National priorities had changed by the time the ten-year study was completed, and reconsideration of the projects proposed in the study required by the National Environmental Policy Act indicated many of the projects would cause unacceptable environmental damages.

CHAPTER VI:
PATOKA, CAESAR CREEK, AND TAYLORSVILLE LAKES

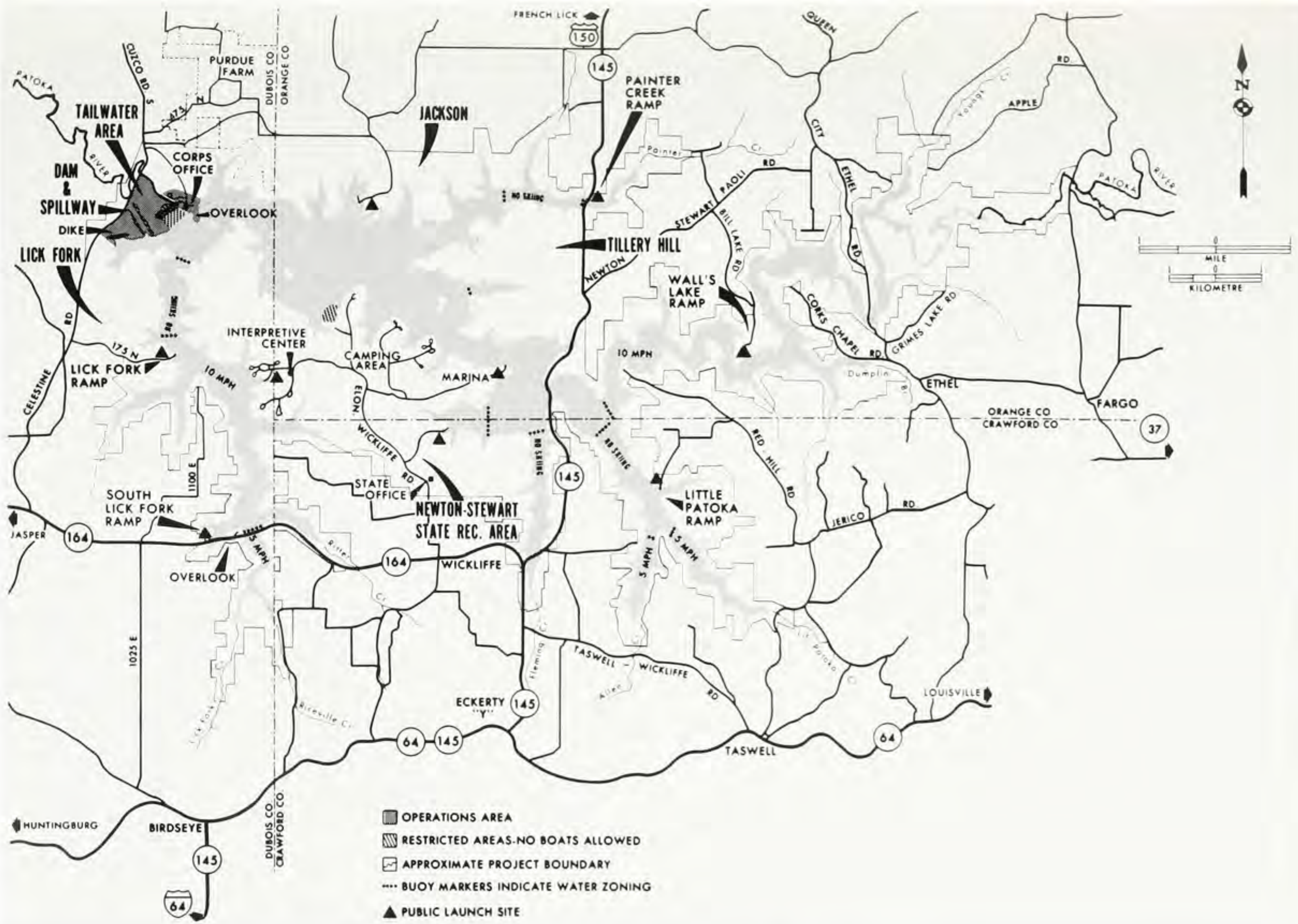
The eight multipurpose lakes completed by the Louisville District between 1970 and 1983 brought the total number of lakes built by the District to twenty. As described in an earlier chapter, five of the eight were under construction in 1970 and were completed by 1980; the District began construction of the last three after 1970 and had them in operation by 1983. Patoka Lake in southern Indiana was the eighth built by the District in the Hoosier State; Caesar Creek Lake was the fourth completed by the District in southern Ohio; and Taylorsville Lake was the eighth District lake in the Bluegrass State. While critics of the Corps sometimes implied the Corps aimed to dam every stream, the score of Louisville District lakes occupied a surface area of 131.24 square miles of the 75,550 square miles of land encompassed within the District's boundaries. In terms of area occupied, the more than 2,000 nonfederal dams located within the District far exceeded the twenty federal dams in total surface area covered; in fact, Grand Lake in Ohio, built by state government, covered a larger surface area than any of the Louisville District lakes.[1]

Because Patoka, Caesar Creek, and Taylorsville lakes were started and completed entirely within the time reviewed by this history, they merit close attention as examples of the manner in which the District carried out its responsibilities under laws effective after 1969 concerning real estate acquisition, protection of environmental and cultural resources, and other features of federal lake projects. Each of the three dams and lakes differed in design, construction, and operation from the others, but as a group they represented the "state of the art" in water resource engineering during the 1970s. Constructed during the "decade of the environment," two of the three lakes met intense opposition from environmental groups and all were vehemently opposed by people who were forced to sell their lands for public use.

Patoka Lake

Patoka Lake located near the headwaters of Patoka River, a tributary of the Wabash in southern Indiana, was the first and only multipurpose project constructed as a result of planning studies undertaken as part of the Wabash River Basin Comprehensive Study. Colonel Willard Roper and Major Kenneth McIntyre at a December 12, 1963, public meeting at Jasper, Indiana, downstream of the proposed dam site, released an interim report of the Wabash basin study recommending the Patoka project, and Dennis Heeke, a turkey farmer representing the Patoka area in the Indiana House of Representatives, headed a campaign for project authorization. Pointing out that farmers along the floodprone Patoka River seldom harvested more than four full crops out of every ten plantings, Heeke and other local project proponents won support from Congressman Winfield Denton and other members of the Indiana congressional delegation who arranged authorization for the project in 1965.[2]

Citizens who had to sell their lands for public use at the project constituted the principal opposition to Patoka Lake. They organized the Upper Patoka Valley Association, apparently under the leadership of Ben Seng, Robert Bledsoe, and Gilbert



Map of Patoka Dam and Lake, Indiana.

Kalb, to fight the proposed lake and protect the interests of landowners forced to sell their property. The State of Indiana supported the project and agreed to pay the cost of the project's water supply feature and half of the cost of recreation development, or about a third of total project costs. Patoka Lake was one of the first Corps projects built under requirements of the 1965 Water Projects Recreation Act for fifty percent cost-sharing by local sponsors.[3]

The office for real estate acquisition opened at Paoli, Indiana, in 1970 with J. Ward Vandegrift succeeded by Robert G. Stephens as project manager. As usual at such projects, disputes occurred during the land acquisition and relocation phases, though the people displaced by Patoka Lake, under the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, received more assistance with relocation than had been available to people displaced by projects completed at earlier dates. Of the three villages moved to make way for the lake—Ellsworth, Elon, and Newton-Stewart—none had more than ten occupied homes, and most land acquired for the project therefore was agricultural. At Patoka, the District acquired about 87 percent of the land through negotiated settlements compared to the 83 percent then the national average; and some land acquired through condemnation proceedings in courts was handled in that manner to secure clear title, not to settle a disputed fair market value. Yet, several memorable disputes concerning prices occurred; it will be recalled that the acquisition phase for Patoka Lake took place during a period of rapidly spiraling real estate prices.[4]

One dispute involved a demand by landowners that Corps negotiators furnish them the government appraisal of their property broken down by individual item—house, barn, pasture, croplands—rather than as a lump sum. The issue went to court, which ruled in 1974 that lump sum appraisal was in compliance with law and policy. "We appraise and buy the whole property, the good and the bad," commented the District's chief of real estate: "Otherwise we'd never be able to negotiate. If you go out to buy a car, you don't buy the steering wheel first, then the wheels, and so on."[5]

In another instance, one of the District's contract appraisers recommended the District offer a price of only a single dollar for more than fifty acres of farmland. Odd as it may seem, that offer was in perfect accord with both law and policy, and it deserves an extended discussion. The appraiser first estimated the value of the entire farm tract before, or without, construction of a lake; second, he estimated the value of the entire farm tract after the fifty acres had been covered by the lake, converting the remainder of the farm to valuable lakeshore property. He concluded what was left of the farm, as lakeshore land, would be worth as much or more than the entire farm was worth before the District took fifty acres for the lake. Since the District could not charge the owner for increasing the value of the remaining property, the appraiser concluded the District should offer the owner a dollar for his fifty acres. Though a logical and legal conclusion, it was not one that tended to assist the District in reaching an amicable settlement.[6]

At the call of Senator Birch Bayh, a rancorous public meeting followed at French Lick, Indiana, a historic spa located near the lake, on October 11, 1974, where Colonel Charles Fiala, Max Bohrer, and Ward Vandegrift were greeted with catcalls. Senator Bayh subsequently introduced legislation in Congress to require the Corps to supply landowners with itemized listings of the components of government property appraisals and to establish a review panel for arbitration of disputes over fair market value without recourse to the courts. Chief Max Bohrer of the District's real estate division philosophically observed:

> If the government and landowner have an honest disagreement, the proper forum is the U. S. District Court. The Corps of Engineers doesn't gain one way or another by the settlements. It matters not one iota, as long as it's fair to the landowner and the government. I'm most sincere when I say we try to be fair, but at the same time this is not a giveaway program. Anyway, I feel the majority of the landowners don't want anything given to them.[7]

As required under the Corps' cultural resource management program, a search for prehistoric archaeological sites was made by Indiana University under contract; the field crew excavated the sites of several prehistoric villages dating as early as 8000 B. C. One important find was a prehistoric garbage dump containing broken stone tools and remnants of food scraps indicating that hickory and walnuts were important elements in the diet of early man in Indiana near Patoka Lake.

Along with 6.6 miles of state highway, 1.6 miles of county road, and utility lines, it was necessary to relocate some 1,400 graves out of the lake area. The remains were reinterred in the landscaped and fenced Patoka Memorial Cemetery; the oldest grave moved was that of James Mellon who died in 1829. During the

Archaeologists exploring a rock shelter at Patoka Lake, Indiana, 1977.

Aerial view of Patoka Cemetery to which all graves in the lake area were relocated along with the original headstones.

cemetery relocation a rumor circulated that the removal was done under quarantine because some of the graves were of people who had died of plague. "There's nothing to it; there is absolutely no danger of contagion," said Ward Vandegrift, spiking the rumor.[8]

Rain marred the groundbreaking ceremonies, conducted on July 29, 1972, and the public affairs office moved it inside the Dubois High School gymnasium. Indiana Governor Edgar Whitcomb, Senators Vance Hartke and Birch Bayh, and Congressman Roger Zion and John T. Myers participated in the groundbreaking, which, because of heavy rains and flooding at the dam site, was done symbolically by shoveling the dirt brought into the gymnasium in washtubs. Rosiek Construction Company won the contract for the first phase of construction: building access roads, a building to house the resident engineer staff and subsequent operations personnel, and the concrete control tower and outlet culvert under the dam. Resident Engineer O. Lee Meetze, followed in 1978 by Gary V. Fitzgerald, headed the District's inspection force at the dam, which initially included construction inspector Howard Cassidy, office engineer Tony Tagliarino, and materials technicians John Crites and Frank Batte. The first-phase contract was completed in 1974, but by that date foundation conditions at the dam site had become a serious concern to the Engineers. Proper discussion of those foundation problems requires relation of some background information.[9]

Dam Safety

At a 1965 public meeting concerning a proposed multipurpose project in Indiana, a participant questioned Colonel Willard Roper, the District Engineer at the time, about what precautions would be taken to protect people living downstream of the dam should it burst. Colonel Roper's reply amused the crowd: "Sir, this dam would be built by the Corps of Engineers. It will NOT break." The reply was not braggadocio but an expression indicating the determination with which the Corps approached the subject.[10]

Historians knew of low navigation dams built by the Corps during the 19th century that had failed (see appendix relating the history of the Kentucky River project), of steel cellular cofferdams that had failed, and of diversion dams that had been overtopped during construction phases in modern times, but it was true in 1965 and it has remained true that no flood control and multipurpose dam built by the Corps has ever failed, in the sense that it broke and released the lake it contained. Dams built by nonfederal interests sometimes failed with disastrous consequences, and in 1976 a federal dam built by the Bureau of Reclamation on the Teton River in Idaho failed as it was filling for the first time; yet, the Corps of Engineers had no connection with those calamitous failures. In the aftermath of the Teton Dam failure, Congress investigated all federal dam construction and learned that Corps construction methods were safer because the Corps used independent consulting engineers to confirm the adequacy of designs and relied upon multiple defenses in building its dams to prevent their erosion by seepage. In designing dams, the Corps followed what some civil engineers thought an overly conservative policy, using safety factors which cost more during construction, but which the Corps viewed as ultrasensible measures.[11]

During design phases, the Corps considered all natural forces acting upon the dams, including earthquakes, and even unnatural forces such as bombing. To prevent overtopping of a proposed dam during floods, the Engineers estimated the maximum probable precipitation and runoff over the watershed upstream of the dam site and used those estimates to determine the height necessary for the dam and the dimensions of the spillway used to carry floodflows safely away before they went over the dam. In practice, the spillways at Engineer dams often were much larger than absolutely necessary because it was economical to use materials excavated from the spillways in the construction of the dams. With the exception of Huntington Dam on the upper Wabash, where the District built a dam with a central, gate-controlled spillway that was operated for testing purposes from time to time, the design of dams built by the District was so conservative that none of its dams ever had water pass through their spillways. Water flowing through a spillway was not an emergency, nor threatening to the dam, for the purpose of a spillway was to carry excess water safely from the lake, but the fact that none had ever been used at Louisville District projects meant the dams were so high they contained all floodflows into the lakes through controlled releases via conduits under the dams.[12]

The public often had misconceptions about the dams in the District. Some were startled when they observed cracks in the bedrock at places where dams were under construction, but practically all bedrock contained joints and fissures and project design included filling visible cracks with concrete and pumping a cement mixture called "grout" down into the rock to fill cracks not visible at the surface. Others worried about settlement of the earthfill dams, and that, too, was expected and planned for when the dams were designed and constructed. Settlement was in fact one of the advantages of an earthfill dam over a concrete dam, for earthfill dams could be constructed atop foundations where differential settlement might have cracked a concrete structure. People also worried about what would happen to a dam in the event of an earthquake, a fear frequently stimulated by "disaster films." The design of the dams normally provided earthquake protection—against settlement of the fill and wave surges in the lake—with wider crests and flatter slopes in the fill and additional freeboard at the top of dams constructed in seismically active regions.[13]

Rumors sometimes circulated that a dam was leaking. The rumors were correct, for all dams leaked to varying extents and their design included drainage systems and relief wells to carry off seepage under controlled conditions. The earthfill dams built by the District commonly contained central cores of impervious materials locked into place inside the dam by transitional and filter zones of sand and sized rock, the rock protecting the sand and the sand holding the impervious core in place as water from the lake slowly percolated through the structure to the drainage system for collection and disposal. "Seepage is something that happens a lot," explained Richard L. Schleicher, the District's assistant chief of construction: "As seepage comes through, we can pick it up and divert it so there won't be any damage to the dam."[14]

To detect any changed conditions at completed dams, monitoring devices were installed, which became even more elaborate after the 1976 failure of the Bureau of Reclamation's Teton Dam. At the Patoka Dam, for instance, twenty wellpoint and eighteen Casagrande piezometers, twenty movement markers, and three seismic accelerographs were initially installed. Piezometers were drillholes into the dam by which the Engineers monitored pressures within the structure; movement markers allowed the Engineers with electronic surveying instruments to detect movement or settlement of the structure; and accelerographs were continuous recording devices revealing even earthquake shocks not felt by workmen at the dam. Patoka Dam thus was under continuous instrumental surveillance.[15]

In addition to continuous monitoring, periodic intense inspections of dams were completed. As the dams aged, repairs often were needed at stilling basins where concrete deteriorated under the turbulent water emitted from the outlet conduits, and occasionally remedial work was required to correct developing problems in structures, foundations, and abutments. Congress funded a dam safety assurance program in 1980 to permit the Engineers to upgrade older dams in the light of engineering knowledge gained after their initial construction. In sum, dams built by the Corps of Engineers were so conservatively designed, so carefully constructed, and so thoroughly maintained, monitored, and inspected that chances of their failure were so remote as to be incalculable.[16]

Completion of Patoka Dam

An earthquake centered at San Fernando, California, in 1971 changed the design and construction procedures at the Patoka Dam in Indiana. During the California quake, the Van Norman Dam built by local interests suffered a partial failure and the Engineers were called in to help prevent its total failure, accomplished by pumping water out of the lake. Investigation determined probable cause of the failure was "liquefaction," meaning sandy soil under the dam during the earthquake lost its capacity to support the structure, and that knowledge resulted in redesign of Patoka Dam. Colonel Charles J. Fiala explained: "There was a certain type of sandy soil in California that turned into a liquid-type substance during the 1971 earthquake. We will remove some similar sandy soil at Patoka and replace it with earth that we know would be more stable in an earthquake." The redesign involved placing a deeper foundation for the dam than earlier planned and also much more extensive treatment of the foundation rock and abutments with grouting and concrete cutoff walls.[17]

The contract for building the dam went to Holloway Construction Company on December 17, 1974, which began work in early 1975 and by October had completed the diversion dam to divert the river while the foundation under the main dam was excavated and treated. About a million cubic yards of wet soil was moved out of the foundation and stockpiled, taking the excavation down some seventy feet to limestone bedrock. In that rock were the expected crevices and cavities characteristic of limestone, and the rock was treated to a "triple curtain" of grout. Holes were drilled as deep as 175 feet down into the rock in three rows and cement grout was pumped down. Resident Engineer Lee Meetze described the grouting: "We first grout two rows 20 feet apart and then come along with a staggered row in the middle of the two. We can tell by how much grout goes into the middle row how tight the grouting is." More than 100,000 cubic feet of grout was pumped into the foundation rock under Patoka Dam and concrete walls were constructed to further assure dam safety.[18]

Once the elaborate foundation treatments had been finished, the construction routine at Patoka Dam was similar to that at other multipurpose dams within the District. Layers of earth were roller compacted into place on the main dam and on a large dike built to close a low saddle at one side of the lake. Patoka Dam was completed in time to furnish flood protection during the rains, twenty-four inches greater than normal, which occurred over the basin in 1979, though wet weather did prevent opening the recreation facilities that year and the project was not dedicated until August 20, 1980. Indiana Governor Otis Bowen at the dedication called Patoka Lake "the most significant public works project in Southern Indiana during my administration." The second largest lake in Indiana, Patoka furnished daily water supply to nearby communities in six Indiana counties along with its flood control and recreation benefits.[19]

Patoka Logjam

An Indian name of uncertain origin, "Patoka" had traditionally been interpreted to mean "river jammed by logs," and the stream has merited that soubriquet, for its 118 miles between the Patoka Dam and the Wabash have been choked by snags and drift since pioneer days. At high water stages, log rafting down the Patoka to mills at Jasper had been an important commercial trade in the early 20th century, but by the 1970s logs and driftpiles clogged the crooked river at many points, slowing streamflow and diverting flood water onto adjoining farm fields. Farmers along the river organized associations during the 1970s to clear away some logjams with their own funds, and they requested assistance from the Engineers, whose first civil works project in 1824 had involved clearing logs and snags from the channels of the Ohio and Mississippi rivers. After inspecting the Patoka in 1976, Colonel James N. Ellis told Senator Vance Hartke it was the "fattest, most sluggish river in Indiana. It'll take some snagging and maybe some levees, but if you want it done and appropriate the money for us, we'll do it."[20]

Terrific rains in 1979 caused repeated flooding of farmlands along the lower Patoka, and farmers blamed it on releases from the newly completed dam in combination with the logjams restricting flow through the channel. The District revised the operating schedule for Patoka Dam, aiming at releasing less water from the lake during the planting and crop seasons, but Lieutenant Colonel Bruce Cowan, Deputy District Engineer, warned that rains on the scale of those in 1979 would continue to cause flooding. Farmers insisted the District should also clear the logjams from the channel, but the District pointed out that such work would not end all flooding, would damage the stream environment, and it might be as long as eight years before Congress funded the work. Congressman Joel Deckard and Senator Birch Bayh shortened the funding process, however, and Congress provided $1.3 million in late 1980, directing the District "to move expeditiously to immediately remove debris in the river." Noah Whittle, the District's chief of engineering, commented that it was a big job for not much money and would not solve all the flooding problems but should help.[21]

The District in 1981 therefore again performed the sort of work that had been the Engineers' initial civil works mission of 1824, though for flood protection rather than navigation improvement. Instead of axes, crosscut saws, and snagboats used for such projects in the 19th century, Resident Engineer Wayne Goodaker and inspectors Kenneth Haywood and Jerry Wade supervised about forty workmen operating chainsaws, a crane and bulldozer, and skidders, which were special winch-equipped logging machines. While the crane and bulldozer tore the logjams apart, workmen called "swampers" waded into the Patoka, hitched cables onto the fallen logs, and the skidders winched the logs onto the banks for removal.[22]

Inspector Haywood observed an improved flow down the channel not long after the clearing had begun and predicted that when the job was done the lower Patoka might become one of the better canoeing streams in southern Indiana, and Colonel Charles E. Eastburn, District Engineer, reported that outflows through the cleared section of the river were accelerating. Heavy rains in the spring of 1983 filled Patoka Lake to the brim, coming to within inches of passing through the spillway. (Patoka and Rough River Lakes in May 1983 used 90.8 percent of their flood control capacity; Buckhorn Lake in 1963 had used 98.6 percent of its capacity.) As a record 2800 cubic feet per second of water thundered through the operating tower and outlet conduit to the stilling basin, Maintenance Manager Richard Colman and Area Manager Lum Whittern were at Patoka Dam monitoring its performance under flooding conditions, and it was their opinion the cleared channel downstream of the dam had improved the capacity of the channel to carry floodflows.[23]

Caesar Creek Lake

Located on a tributary of the Little Miami River about midway between Cincinnati and Dayton, Ohio, the Caesar Creek project was authorized by Congress in 1938 but largely ignored by people in that area until record flooding in 1959 awakened public interest. A group called the Little Miami Development Association formed to seek funding for the project, and James E. Carnahan, the most active project proponent, visited the Ohio River Division office in Cincinnati to request guidance. "I was shown every courtesy but left their office without having what I went for," he later recalled, "for the Engineers observe caution, think twice before they speak and then speak guardedly." Carnahan and the association made the project an issue in state elections, winning support from Ohio Congressman Clarence J. Brown, William H. Harsha, Michael J. Kirwan, Senator Frank Lausche, and others. Congress funded the project for advanced study in 1964 with water supply, water quality, and recreation added as project features to make it multipurpose.[24]

Initially directed by Marion B. Ireland, the real estate office for both the Caesar

Mr. J. E. Carnahan of the Little Miami Development Association congratulates Brig. Gen. R. S. Kem on the completion of the Caesar Creek project. Colonel Charles E. Eastburn on the left. July 10, 1982.

Creek and the nearby East Fork project opened at Lebanon, Ohio, in 1967, and the first public meeting to explain real estate acquisition procedures was conducted on July 14, 1967, at the village of New Burlington which was to be relocated for Caesar Creek Lake. Local landowners opposing the project united with environmental groups, making Caesar Creek Lake one of the most controversial in District history, so controversial that two local histories eventually were published to relate both sides of the controversy: a history of New Burlington which was inundated by the lake and another of Blanchester located a few miles south of the dam which benefitted by the project's construction.[25]

John Baskin, a talented professional writer, moved to New Burlington during the land acquisition phase, studied the village and its people, and in 1976 published an award-winning collection of oral interviews with the people interspersed with his personal observations. Though initially viewing the Engineers as the villains who were destroying the village, he noted that the residents had voted for members of Congress who had authorized and funded the project, that both the opponents and proponents of the project were people with similar heritages, and that the engineers and builders who had surveyed and constructed the village were much like those who were designing and constructing the dam. While he lamented the loss of the community, Baskin came to the conclusion the village people were part and parcel of American technological society and therefore the construction of the dam was something they had done to themselves.[26]

James E. Carnahan in his detailed record of the history of Blanchester, Ohio, argued that, on the contrary, the Caesar Creek project was something that American technological society had done for itself. He indicated the reason he had supported the project, and in effect summarized the developmental philosophy that had motivated most of American society including the citizens of Blanchester and New Burlington, with a brief and memorable metaphor:

> A wild rose--at a distance, is rather pretty; brought close, it is not so pretty. However, the wild rose was developed by man to be amongst the most beautiful of all flowers. Therefore, we can rationally and with certainty conclude: The desired environment is BEST attained by MAN working with nature.[27]

Carnahan and the Little Miami Valley Development Association sponsored the groundbreaking ceremony for the Caesar Creek project at an auditorium near the lake site on October 9, 1971. Participants included Ohio Senator Robert Taft, Jr., Congressmen William H. Harsha and Clarence J. Brown, former Ohio Governor Frank J. Lausche, and Major General William L. Starnes of Ohio River Division. Construction actually began in 1972 under the direction of Resident Engineer Henry C. Vickers. The first work undertaken involved building access roads and four earthfill dikes closing saddles in the hills at the sides of the future lake site. It was then expected that the 2,650-foot long and 165-foot high dam would be completed by the end of 1976, but litigation stopped work in 1973.[28]

With support from the Sierra Club, Audubon Society, and Caesar Creek Preservation Association representing the landowners and environmentalists allied against the project, the State of Ohio sued in July 1973 on grounds that the project's environmental impact statement was inadequate, specifically expressing concern about water quality. The federal court enjoined construction at the project for a

Aerial view of Caesar Creek Dam and Lake, June 15, 1982. Building on the bluff next to the lake is the Regional Visitor Center.

month, then in August allowed it to resume provided that no work was begun on new features disruptive to the natural environment. The court of appeals stopped construction again for a few days in September, but the contractor managed to complete the diversion dam before winter rains set in that would have destroyed an uncompleted structure.[29]

The District's planning division rushed the updating and revision of the project's environmental impact statement to satisfy the requirements of the court while discussions concerning water quality went on with the State of Ohio, the goal being to settle legal issues before loss of the 1974 construction season. In January 1974, a catalog-sized updated impact statement was completed, its table of contents nearly as long as the first impact statement done in 1970. After the customary public review, the revised statement went to the Council on Environmental Quality in April and on May 20, 1974, the court vacated the injunction against the project to permit resumption of construction. In early 1975 the Ohio Attorney General announced the litigation had achieved its purpose by making the Engineers aware that "they must comply with the law when they tamper with the state's natural resources," and state government withdrew from the case, also committing to the lease of project lands for the operation of recreation facilities. The alliance of landowners and environmentalists persisted with litigation against the project until the court dismissed their cast in 1977.[30]

The District Engineer commended U. S. Attorney James Rattan and his staff for their efforts to keep the Caesar Creek case moving through the court system, thereby reducing the costs of work stoppages during a highly inflationary period. It should perhaps be explained that when suits were filed against the Louisville District they were directed against the federal government; hence, the defense when the Louisville District was the defendant was conducted by U. S. Attorneys of the Department of Justice. The District did employ a large number of attorneys, some in its real estate division to handle cases involving land condemnation and allied matters and others in an office of counsel advisory to the District Engineer. First known as the legal branch, the District's office of counsel was headed by four attorneys after 1945: Ralph T. Hartwell until 1956, Harry A. DeLoach from 1957 to 1970, and Fred E. Rager from 1970 to 1983 when he retired and was succeeded by Stephen E. Smith.[31]

The District in 1977 employed twelve attorneys, seven for real estate matters and five for other types of litigation generally falling into four categories: admiralty cases mostly arising from marine accidents at the District's locks and dams, cases concerning alleged negligence of District personnel under the Federal Tort Claims Act, regulatory functions cases filed either by applicants whose requests for permits had been denied or by those opposing issuance of permits, and lastly the "environmental litigation." The latter started after the National Environmental Policy Act became effective in 1970, generally testing whether project environmental impact statements were adequate and of course including the suit against the Caesar Creek project between 1973 and 1977.[32]

Another public dispute concerning Caesar Creek Lake occurred in 1976 when it shared with other Corps of Engineers projects the uncoveted "Golden Fleece Award" regularly dispensed by Senator William Proxmire of Wisconsin. "It should be recognized that the Corps provides a useful and even critical service to the country," wrote the Senator in the section of the award that went largely unnoticed, but it was his opinion that the Corps deserved the title "cost overrun king," and he mentioned as example the swelling costs of the Caesar Creek project as compared with original cost estimates. Upset by the Senator's criticism, defenders of the project pointed out that Congress had increased its own budget by some 300 percent between 1970 and 1976 and inquired if Senator Proxmire had foreseen the huge leap in the cost of living during the same period which even economists had not predicted. Robert W. Teater, the director of the Ohio Department of Natural Resources, penned a letter to the Senator protesting that nationwide inflation and delays resulting from litigation had contributed substantially to rising project costs and concluding: "Your frivolous award is also an insult to the citizens of Southwestern Ohio whose patient and dedicated efforts have withstood many frustrating setbacks and delays at the project—none of which can be blamed on the Corps."[33]

After the contractor, Butt and Head Construction Company, topped out Caesar Creek dam in late 1975, James E. Carnahan and the Little Miami Valley Development Association, thinking the Corps of Engineers subjected to "an inordinate amount of unjust criticism" conducted a picnic at the Caesar Creek project to honor Engineer personnel at work there; it was the first time of record, Mr. Carnahan observed, that Engineer personnel had been so honored. Work continued at the site, the lake was impounded in early 1978, and on July 29, 1978, Ohio Governor James A. Rhodes and most of the dignitaries who had attended the 1971 groundbreaking ceremony dedicated the project. Installation of recreation facilities at the lake continued after 1978 and the District participated in the creation of a "pioneer village" and a regional visitor center at the lake.[34]

Various federal laws provided that the District, like all federal agencies, undertake certain measures to preserve "cultural resources," or to mitigate their loss at its projects. The earliest preservation efforts of the District had concentrated upon retrieval of archaeological data concerning prehistoric occupation in reservoir areas, but Thomas Sweet and other personnel from the District's planning and operations divisions were interested in preserving the log architecture of southern Ohio at the Caesar Creek project. They cooperated with local citizens sharing a similar interest and helped with the formation of Caesar's Creek Pioneer Village, Inc., in 1973 as a nonprofit organization to move log structures from the project area and restore them at a site surrounding the historic Lukens House. Among the structures moved and saved were a Quaker meetinghouse, a schoolhouse, a smokehouse, and several log residences. To establish a working pioneer village complete with early farming methods and local

View of Caesar's Creek Pioneer Village at Caesar Creek Lake, Ohio. 1983.

crafts, the group raised funds through voluntary contributions and frequent craft festivals to support the restoration effort and subsequent operation of the village. Considered an unusual effort in historic preservation and also a unique addition to the recreation attractions at Caesar Creek Lake, the pioneer village in 1976 received honorable mention in the Chief of Engineers' Environmental Awards Program.[35]

The Caesar Creek project was also distinguished by its selection as the site for the Ohio River Division's regional visitor center, the only one within the Division. Occupying some thirty-five acres of land, the $1.3 million regional visitor center was constructed at Caesar Creek during the late 1970s and early 1980s. It included an overlook, nature trails, a large building providing office space for Engineer operations, an orientation theater for films and lectures, and interpretive exhibits concerning the environment and history of the Caesar Creek project, the history of the Ohio River basin, and the functions of the U. S. Army Corps of Engineers.[36]

Taylorsville Lake

A Louisville newspaper in 1841 reported that Salt River floods rose fast enough "to catch a squirrel running up a tree," indicating that telling tall tales ranked with racing as one of Kentucky's first sports. Yet, the Salt River, which rises near Danville, Kentucky, and flows in a general northwesterly direction to its confluence with the Ohio River a short distance downstream of Louisville, was a notoriously floodprone stream. The largest community along the Salt was Taylorsville, named for Kentucky pioneer Richard Taylor and located 3.7 miles from the site of the dam authorized by Congress in 1966.[37]

Kentucky Congressman William H. Natcher shepherded funding for Taylorsville Lake through Congress, and preconstruction planning began in 1968. It was during the planning for Taylorsville Lake that William Kreisle and the District's survey branch reduced mapping costs through the use, for the first time in Kentucky, of analytical triangulation control for checking aerial photogrammetric mapping; that is, instead of sending field surveyors onto the ground to check the accuracy of maps made with aerial photographs, the survey branch adopted a means of doing most of the work with electronic devices. Highly accurate maps were required, for all manmade structures and graves had to be relocated from areas which were to be inundated by the waters of the lake, and caves or other topographic features had to be sealed or otherwise altered if they would affect the functioning of the completed project.[38]

During the advanced engineering and design phase at Taylorsville from 1966 to 1973, the District modified the initial project plans significantly. The dam site was moved a short distance to secure better foundation conditions, lake storage was reduced as a result of more detailed hydrologic and economic studies, road relocation plans were changed at certain places, and the proposed size of project recreation areas were substantially increased, the latter change becoming the subject of dispute. In 1966 the District estimated that an average of 1.3 million visitation days annually would occur at the project and that 2,467 acres of land would be needed to accommodate the visitors. Spiraling growth of visitation to Corps lakes across the nation during the late 1960s resulted in an upward revision of the estimate of visitation to the Taylorsville lake, up to an average of 2.5 million visitation days during the early years of project operation and climbing by 2030 A.D. to 4.3 million. Plans for land acquisition for recreation facilities were accordingly revised upwards to 4,326 acres, which was more land in total but less per visitor day than the 1966 plans had provided.[39]

After the Governor of Kentucky signed an agreement in 1973 to furnish the state's share of the cost for the project's recreation features, Colonel Charles J. Fiala and his staff conducted a public meeting in September 1973 to explain the revised project plans and the procedures for acquisition of real estate. Held in a gymnasium at Taylorsville in ninety-five degree weather, the meeting hosted a crowd whose tempers matched the temperature. "The Colonel was cool as a jar of mentholated salve as he gave his prepared speech to the seething audience in the sardine-packed gym," wrote a reporter at the meeting, adding: "His cohorts who succeeded him on the podium also presented the Corps' plans with coolness and aplomb." Many of those attending the meeting were upset to begin with because they would be required to sell their land, and others had also become disturbed when they learned the acreage for recreation had been increased from the 1966 estimate of 2,467 acres to 4,326 acres. The citizens filed to the microphone, bombarding Colonel Fiala and his assistants with questions, protesting the displacement of families, the potential loss of local tax revenues, and especially the influx of city folk from nearby Louisville and Jefferson County to the project. Some expressed fears that the lake would become an amusement park for "week-end and pleasure-seeking Jefferson Countians," resulting in growing traffic congestion, increased crime, and additional littering in Spencer County. Others thought those fears ironic in view of the fact that many Spencer countians commuted daily to jobs in Jefferson County.[40]

The Taylorsville City Board and Spencer County Fiscal Court requested that the acreage needed for recreation be reduced to 800 acres, and the Governor formed an advisory group to study the issue, which at last requested the District to retain an independent consultant to review recreation visitation projections and to agree to accept the findings of that consultant as final. The District employed an independent consulting firm, which after study reduced the estimated visitation during the early years of project operation from 2.5 million to 1.4 million and calculated that 2,600 acres of land would be sufficient to serve the lesser number of visitors. Though the District's planning division had reservations concerning the findings of the consultant, the District accepted the findings, and in 1976 Colonel James. N. Ellis, District Engineer, announced the acreage to be acquired for recreation would be reduced by nearly half. "We feel that 4,300 acres was a valid amount of land for development," Ellis commented, "but we also felt that we should try to respond to the concerns of the people in Spencer County as much as possible."[41]

As was usual at District lake projects, citizens who were required to sell their property for Taylorsville Lake organized to protest what they considered unfair prices and acquisition procedures and allied with environmental groups to seek a halt to the project through legal and political activities. The Citizens Action Committee at Taylorsville had forty active members and secured support for its opposition to the project from the Kentucky Rivers Coalition and other environmental groups. Members of those groups paraded outside the Louisville District Office on February 21, 1976, carrying placards reading "CORPS GET OUT OF SPENCER COUNTY."[42]

The District's real estate project office at Taylorsville, headed successively by Charles Hooper and Kelly Cain, acquired more than eighty percent of the land needed for the project amicably; that is, without going to court for condemnation action. As was customary, the news media devoted much attention to complaints of the disgruntled landowners. The District was asked why it could not pay the full costs of buying a replacement property for each landowner, pay for the loss of business potential, or reimburse owners for the sentimental values of the land which may have been in the same family for several generations; the District answered that neither the law nor the courts allowed it. The relocations policy revision enacted by Congress in 1970 did permit the District to offer, in addition to just compensation for the fair market value of the properties, payment for moving expenses, reimbursement for some lost income, and active assistance in helping the people locate "safe, decent and sanitary" replacement housing. The law did not fit all individual situations, however, as was made plain in a case involving an elderly property owner who lived in a home without indoor plumbing and who, because his income was limited, objected to being moved into housing with indoor plumbing and other utility services because he would be unable to pay the utility bills. The law permitted the District no flexibility, not even in that case, and it was referred to the homeowner's congressman for resolution.[43]

About a hundred and sixty families had to move from the lake area, most from farm homes and from the village of Van Buren in Anderson County, which included fifty-five households, two churches, and two general stores. When some of those citizens complained the government appraisals of their property were "stingy," project manager Charles Hooper pointed out the appraisals were made by independent contract appraisers from Kentucky towns outside the project area who were not government employees and could not be told by the District what figure they should estimate as the fair market value for any property. Hooper asserted that honest differences of opinion about property values were to be expected. A real estate expert from the Office of the Chief of Engineers visited the project in 1976, and he declared there were fewer difficulties with land acquisition at Taylorsville than at many other Engineer lake projects across the nation.[44]

Construction of a road into the dam site began in June 1974 and on November 24, 1975, the District's resident engineer office opened, headed initially by Ralph Hill, followed by Kenneth Ladd and Donald Basham. They directed the work of about fourteen personnel in the resident office who were divided among four branches: technical, administrative, quality assurance, and materials testing. Construction of the dam went on in two phases, the first being the building of the concrete control tower and outlet conduit and the second being the placement of the earth and rockfill dam. Rosiek Construction Company was the contractor for the tower and conduit during the first phase.[45]

While the tower and outlet were abuilding, the District completed a value engineering study of the dam and spillway that resulted in savings of about a half million dollars. An interdisciplinary team including representatives of the District's construction, geotechnical, design, operations, and environmental resources staffs reviewed project planning and discerned that changing the location of the spillway would reduce costs. Rock excavated from the spillway was to be placed in the dam and moving the spillway site reduced the distance traveled by tracks hauling the rock. The change resulted in direct federal savings of $445,517, plus a spinoff savings of $60,000 for the Kentucky highway department because the bridge it would build over the spillway could be shorter.[46]

The opposition to the project filed suits in 1976 and 1977 alleging the project's environmental impact statement was inadequate and the contract signed by Kentucky for sharing project costs under provisions of Section 221 of the 1970 Flood Control Act was in conflict with the constitution of the Commonwealth. The death of William E. Leegan, the District's chief of engineering who was to be a principal witness in the case, delayed the hearing concerning the environmental impact statement until December 1977, and on December 12 the court found the 1971 impact statement to be "skimpy" and enjoined further construction until the District prepared an adequate statement. The injunction prevented the District from awarding the contract for placing the earth and rockfill dam as scheduled, but the court did permit continued work on the

Aerial view of Taylorsville Dam and Lake under construction, September 5, 1979. In the picture center is the solar office building on a bluff overlooking the dam. Above the building (but down in the valley) is the control tower, with the outlet conduit running from the base of the tower toward the left of the picture and under the future site of the dam embankment.

tower and outlet conduit because that would not cause additional environmental damages.[47]

The 1971 impact statement for the Taylorsville project was merely twenty pages long with a single map and no graphs and therefore required amplification. To get construction of the project back on line, the District's planning division assigned eight personnel full time to prepare a revised environmental impact statement and called upon about forty other personnel to contribute to the update; at the rate of inflation then prevailing, lengthy delays in awarding the contract for the dam could have cost millions. In just two months, the revised impact statement was in draft form, amounting to some four hundred pages chockful of maps and graphs; one of its reviewers commented that it should have been subtitled: "All You've Ever Wanted to Know about the Taylorsville Lake Project and More." After the forty-five day public review period required by law, the revised impact statement went on to higher authority, a "challenging job done in a very short time," remarked the Ohio River Division Engineer.[48]

The revised impact statement did not mollify the project opposition, whose long list of objections were forwarded with the statement to Washington, and in April 1978 representatives of the Kentucky Rivers Coalition and the Citizens Action Committee explained their reasons for opposing the project to congressional committees. Protesting the loss of agricultural lands and accompanying deterioration of traditional rural lifestyles, the opponents also deplored the increased noise levels and reduced air quality that could result from heavy traffic of carloads of tourists headed to and from the lake. They urged that construction of floodwalls and levees could solve flooding problems along Salt River without the completion of Taylorsville Dam.[49]

The 1978 construction season was lost entirely and to avoid loss of the 1979 season it was necessary that the injunction against the project be lifted early in the year; the District's office of counsel therefore pressed for an early decision by the court upon the adequacy of the revised environmental impact statement. Calling the revised statement "a great improvement" over the earlier document, the judge lifted his injunction against the project on January 30, 1979, and on the following day the District issued notice to contractors that bids for construction of the main dam and spillway would be opened in March. Richard Chleborad, the project office engineer, remarked that loss of the 1978 construction season had been extremely costly, not only in terms of increased construction costs, but also because Shepherdsville and other Salt River towns had suffered heavy damages during the December 1978 flooding.[50]

In May 1979, Potashnick Engineering Corporation, contractor for the dam, began building the diversion dam containing 350,000 cubic yards of soil and rock, later to become part of the main dam, to block Salt River and divert its flow through the tower and outlet conduit. Efforts to stop the work continued, however, through a suit testing whether contracts signed by the state for cost-sharing at Taylorsville and three other Engineer lakes in Kentucky were in conflict with the Kentucky constitution. After review of the evidence, a federal court ruled on April 2, 1980, that the cost-sharing agreement for Taylorsville was indeed invalid under the provisions of the Kentucky constitution prohibiting one session of the State General Assembly from binding future sessions for the expenditure of funds. An injunction again had stopped construction at Taylorsville during the prime working season.[51]

Intense negotiations between federal and state representatives followed the court's decision, and on May 9, 1980, Kentucky Governor John Y. Brown landed by helicopter at Taylorsville and announced on the courthouse steps his support for the project and that he was allocating funds to develop the "exciting" recreation facilities at the lake. He signed a new cost-sharing agreement on June 10, involving an arrangement whereby the state paid its share of recreation costs on an incremental basis, developing facilities as funding permitted without obligating future sessions of the legislature. The court determined the new agreement to be valid without statutory impediments and lifted its injunction against project construction on July 14, 1980. "Praise the Lord!" commented Spencer County Judge C. L. Glasscock on learning that work would resume. One of the people who had been forced to move from the project area, Judge Glasscock had initially opposed the lake, but by 1980 was eager to see it finished. He said: "I really don't think as of right now there would be very many people in Spencer County who would call it off and go back the way it was."[53]

Work resumed at the dam in double shifts, interrupted only by poor weather and occasional labor disputes. Downstream of the diversion dam, the rock foundation was excavated, cleaned, and grouted. The contractor excavated the key trench and backfilled it with impervious materials, and a parade of trucks and pan scrapers then moved earth and rock from the borrow areas and spillway to the dam for dumping atop the fill for roller compaction. Layer after layer, the dam inched higher, and on June 25, 1982, Resident Engineer Donald Basham announced it had been topped out except for a roadbed to be placed on its crest. During the autumn of 1982, the roadbed was added, the area was seeded to reestablish vegetation, the service bridge leading from the crest of the dam to the control tower was installed, and the lake area was cleared.[53]

Two special features of the Taylorsville project attracted notice. The office and maintenance building on a knoll above the dam won awards for its clean design and its steeply angled glass roof with solar collectors providing both heating and cooling within the building for energy efficiency. When District historian Charles Parrish and Guy Townsend of the planning division studied the Taylorsville area in 1974, they noticed the existence of several log structures worthy of preservation. In 1979 the District moved a log house known as the Yates House and the Ashes Creek schoolhouse, another log building at least a century old, to a site at the project for eventual restoration, thereby offering visitors an opportunity to learn more about early architecture and history in the Salt River area.[54]

On January 3, 1983, Ranger Dwight Beall moved the controls in the operations tower, closing gates to the outlet conduit at the bottom of the tower, restricting the flow of the Salt River and starting the impoundment of Taylorsville Lake. The lake rose under carefully monitored conditions to reach the proper level when dedication ceremonies were conducted at the site on May 28. Visitors pouring into Taylorsville for the dedication could observe visible improvements at that community; though the economic recession of the early 1980's had hampered planned residential and commercial developments, a new highway was open from Louisville to Taylorsville, the town was building a new high school, and

Aerial view looking upstream at Taylorsville Dam under construction on April 2, 1982. Visible in the foreground is the stilling basin. The building on the bluff in the upper right corner is the solar heated and cooled administration building.

Spencer County government had new offices. People danced in the streets of Taylorsville on the eve of the dedication, participating in a crafts fair and other festivities. As at times happened at dedications for Louisville District projects, torrential rains provided graphic evidence of the reason for which Taylorsville Lake was constructed; during May 1983 the lake prevented flood damages to downstream areas amounting to about three-quarter of a million dollars. The dedication ceremony moved under a tent next to the new solar building, where the crowd heard addresses by Lieutenant General Joseph K. Bratton, Chief of Engineers, and Congressman William H. Natcher. "If every department of the Federal government were operated as successfully as the Corps of Engineers," said Congressman Natcher during his address, "we wouldn't have any trouble in this government; you take my word for it."[55]

If by success the congressman meant the construction of dams for flood control and multiple purposes, then he certainly was correct. Taylorsville Lake was the eighth such project completed by the Louisville District during the fourteen-year period, 1970 to 1983, and it was the twentieth multipurpose project finished by the District. But Engineer dam construction was virtually stopped by 1983. No other dams were under construction in the Louisville District and there was no firm indication that others would be built in the immediate future; the reasons for that statement will be explored in a subsequent chapter. As the planning, engineering, and construction of dams slowed, the civil works program of the District was increasingly concerned with improving the operation of completed projects, for, like dam construction during the "decade of the environment," the operations of projects also had become an extremely complicated business.

CHAPTER VII: NAVIGATION MODERNIZATION, 1976-1983

The Louisville Engineer District by 1975 had completed five navigation modernization structures on the Ohio River: Markland Locks and Dam at the upstream end of the District, McAlpine Locks and Dam at Louisville, and the Cannelton, Newburgh, and Uniontown Locks and Dams on the lower river, leaving the 128.2 miles of the river nearest its mouth as the final project stage. During the late 1970s the District completed Smithland Locks and Dam, moving 72.5 miles closer to the mouth of the river with the modernization effort, and it undertook major rehabilitation of old Locks and Dams 52 and 53 to extend their useful service for some years while the fate of the proposed navigation project nearest the mouth of the river was determined.

As the modernization program moved ever nearer Cairo, the District blasted the 600-foot locks and wicket dams completed in 1929 out of the river, divesting itself of structures that had become bottlenecks to modern towboat and barge fleet traffic. In truth, 1976 to 1983 was a period of divestiture for the District in which it replaced old locks on the Ohio River, closed locks designed in the 19th century for steamboat navigation on the upper Green and Kentucky Rivers, and abandoned proposed navigation projects on the Saline and Wabash Rivers in Illinois and Indiana. By 1983 the District had fewer locks in operation than it had in 1970, and except on the lower one hundred miles of the Green River commercial navigation on tributaries of the Ohio within the District had largely ceased. Even on the Ohio River itself the towboat industry was troubled by 1983, though the trouble may have been chiefly a temporary consequence of the national economic recession of the early 1980s.

Smithland Locks and Dam

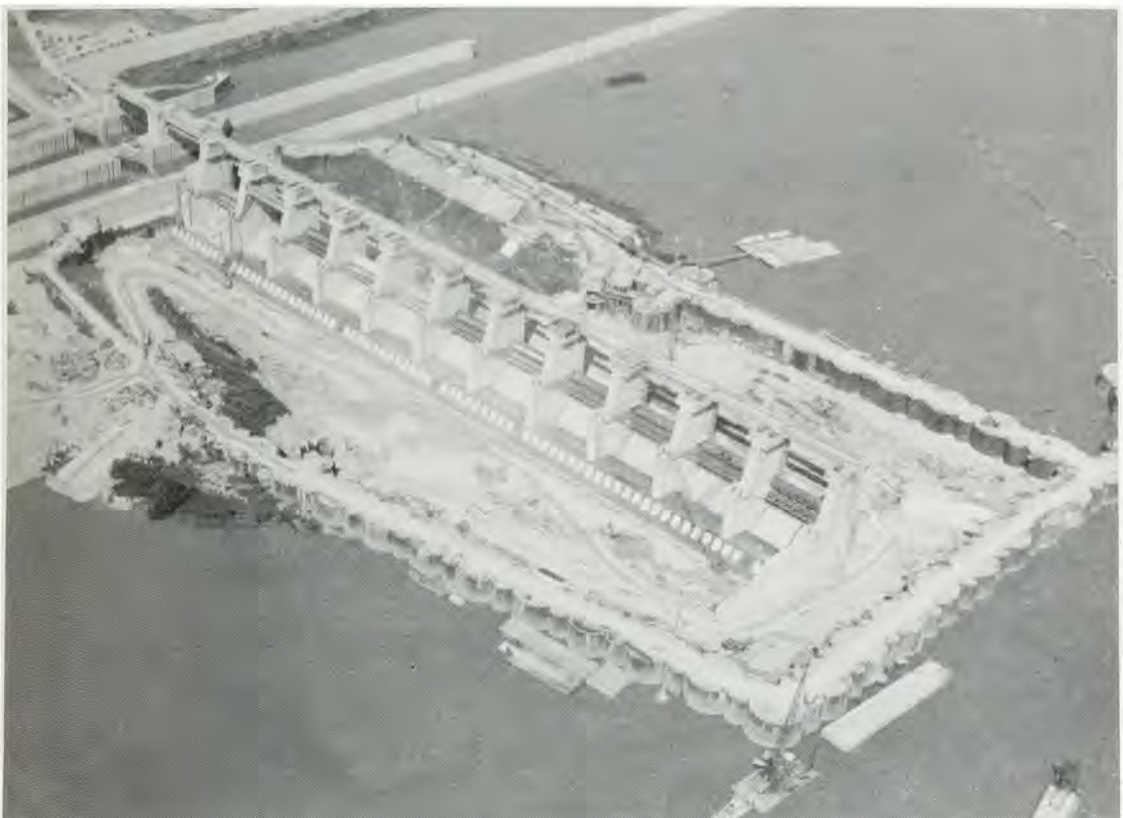
Located on the Ohio near the mouth of the Cumberland River, Smithland Locks and Dam was the sixth and last modern navigation structure completed by the Louisville District. Billed as "the world's largest twin-lock navigation facility," Smithland had two locks, each 110 feet wide and 1200 feet long inside the chamber. It replaced old Locks and Dams 50 and 51, providing a deeper pool on 72.5 miles of the river. At the time construction began in 1971, Smithland was the largest project in terms of cost the Corps of Engineers had ever constructed in the Ohio River basin.[1]

Because the Louisville District was busy with the planning and building of eight multipurpose dams on tributaries of the Ohio and with three modernization structures on the mainstem of the Ohio during the late 1960s, the Ohio River Division Engineer transferred engineering and construction for the Smithland project to the Nashville Engineer District, which had completed Barkley Dam on the Cumberland River not far from the site of Smithland Locks in 1966. The Corps broke ground for the Smithland Locks on September 25, 1971, when a crowd aboard the M/V *Mississippi* heard Congressman Kenneth Gray of Illinois and Frank Stubblefield of Kentucky describe the project before a blast started excavation on Dog Island, a 138-acre island which became the site of the twin locks. Resident Engineer Bernard Wethington inspected the work of the contractor joint venture of the Dravo,

S. J. Groves, and Gust K. Newberg companies which undertook the $84 million contract for the locks. The contractors were to excavate some nine million cubic yards of material from Dog Island, using it to form an earthberm cofferdam, instead of steel sheetpile cells, surrounding the site of the twin locks.[2]

While construction of the locks progressed, the design of the three-quarter mile long dam was reviewed and in 1973 the largest single value engineering savings in Corps history, amounting to nearly $19 million, was achieved in the design for Smithland Dam by reducing the number of 110-foot wide metal tainter gates from seventeen to eleven, thereby changing the configuration of the dam to a 1,390-foot gated section and a 1,572-foot long fixed weir section. The Nashville District opened the bids for the dam on August 6, 1974, and the job went to the joint venture of J. A. Jones and Nello L. Teer companies. By the time the locks were completed in 1976, work had begun at the dam.[3]

Richard H. Russell, the chief of construcion division, transferred from the Louisville to the Nashville Engineer District in 1975 to direct excavation of the divide cut on the Tennessee-Tombigbee Waterway, a challenging task involving an excavation volume ranking with that at the Panama Canal early in the century. He was succeeded as chief of construction at



Aerial view of the construction of Smithland Dam, September 5, 1978. The completed locks are visible in the upper left corner of the picture. The piers supporting the eleven giant tainter gates are nearly completed inside the cofferdam.

Louisville by Jack E. Kiper and subsequently by Gordon M. Stevens. As the Cannelton, Newburgh, and Uniontown Locks and Dams were completed, the Louisville District's workload declined during the late 1970s, and on July 5, 1977, the Ohio River Division Engineer transferred the Smithland project back to Louisville from Nashville and directed the Louisville District to move ahead "with vigor and precision" at Smithland with the twenty-eight new employees it had acquired with the transfer of the project.[4]

At the time the Louisville District acquired the Smithland project, work on the twelve piers and eleven tainter gates was being rushed to recover time lost during labor disputes and the 1975 flooding on the lower Ohio. A contract had been awarded to the Dunbar and Sullivan Company for dredging some 4.5 million cubic yards of materials from the approaches to the lock entrances, preparing for operation of the locks when construction of the fixed weir opposite the locks closed the channel that had been left open for traffic while the locks and gated section of the dam were built. The District saved another $1.3 million at the Smithland project in 1978 by eliminating a ten-foot high concrete wall from the fixed weir and other design modifications. Value engineering was a sort of "professional suggestion box" instituted by the Corps to provide for intensive interdisciplinary study of project designs to determine whether project goals might be accomplished more economically. "It is also sometimes the view of one outside the normal design or engineering pattern," said Gordon Stevens, "who looks at things differently and sees part of the forest which the trees have been hiding from the pragmatists."[5]

Because building the fixed weir—the last section of the dam—required closing the last open channel through which towboat traffic passed the dam, it became necessary to open the Smithland Locks to navigation, and that milestone was celebrated on October 27, 1979, coinciding almost to the day with the Fiftieth Anniversary of the completion of the original fifty-three locks and wicket dams on the Ohio in 1929. A commemorative flotilla of boats with a barge of displays concerning Ohio River history created under the direction of Charles A. "Chuck" Schumann of the Louisville public affairs office had descended the Ohio from Pittsburgh during October, and it anchored at Smithland on October 27 for dedication of the $252 million project. On hand were former Congressman Kenneth Gray of Illinois, who had ushered funding for the project through Congress, and his successor Paul Simon. The stars of the ceremony, however, were representatives of the communities on the Kentucky and Illinois ends of the structure. Livingston County Judge Floyd Hooks pointed out that by court decision the dedication of the locks, though adjoining and connecting to the Illinois bank, was being conducted in Kentucky, while Alan E. Kingsley of Pope County responded by welcoming the crowd to "Hamletsburg Locks and Dam" because Hamletsburg, Illinois, was the village located nearest the locks.[6]

Participants in the dedication ceremony seemed impressed by the size of the structure. Its foundation went down as far as a hundred feet below the surface of the river. In addition to the fixed weir under construction near the Kentucky bank, the gated section included twelve piers soaring ninety feet above the river, with eleven electrically operated, 110-foot wide, steel tainter gates suspended between the twelve piers. Atop the piers was a prestressed concrete service bridge carrying a

Col. Thomas P. Nack addresses the crowd at the dedication of Smithland Locks on the Ohio, October 27, 1979.

mobile crane on rails for use in placing emergency bulkheads to hold out the river when repairs to the tainter gates became necessary. The lockwalls and guidewalls together were three-quarters of a mile in length, and each of the two lock chambers contained four horizontally framed, mitering gate leaves, each leaf weighing some 250 tons. The valves closing the culverts that would empty and fill the lock chambers through a sidewall port system were hydraulically operated: each lock would fill in eight minutes and empty in nine. The size of the project inspired the quip that Livingston County, Kentucky, had become the "best dammed county" in the United States, for with the completion of Smithland it had three of the largest navigation dams in the world: Smithland on the Ohio, Barkley on the Cumberland, and Kentucky Locks and Dam on the Tennessee River.[7]

At the end of the construction season in 1979, fifteen of the twenty-two cells, each composed of 160 steel sheetpiles driven in a circle, filled with gravel, and capped with concrete, in the fixed weir next to the Kentucky bank had been completed, leaving seven more cells to be constructed and about 650 feet of the dam still uncompleted. Because the weir was incomplete, the pool upstream of the dam could not be raised, nor could the District remove old Locks and Dams 50 and 51, and the final year of operations for those old locks proved a headache for both the District and the towboat industry. Because towboat and barge traffic had adjusted to the 1200-foot locks available upstream of Locks 50 and 51 it was necessary to break the tows in two or more sections to get them through the old 600-foot locks, and towboats at 50 and 51 sometimes had to wait as long as six days for their turn in the locks. The situation was further complicated at the Smithland project, where the flow through the unfinished section of the fixed weir pulled downbound tows and barges toward the Kentucky bank and where the dredged channel in the approach to the locks had rock ledges at its sides. After towboats had twenty-five accidents in the river section between Lock 50 and Smithland Locks during the winter of 1979-1980, the operations division of the District, at the request of towboat firms, supplied a "helper" boat to assist in aligning barge tows as they prepared to enter the lock chambers.[8]

During the final stage of construction at Smithland in 1980, two serious accidents occurred. On April 6 the towboat *Nelson M. Broadfoot* slammed a gasoline barge into the lock guidewall, spilling about 70,000 gallons of gasoline into the lock chamber. Several tense days of severe fire hazard followed while the leaking barge was cautiously removed from the lock and the gasoline pumped into a truck for disposal; during that emergency a storm threatened to ignite the petroleum with lightning flashes. On August 26, the little *Linda Lou*, which was moving rock at the dam for the contractor, struck one of the dam's piers and capsized, going down in the swift water at the entrance to a tainter gatebay and drowning two members of the crew.[9]

The loss of the *Linda Lou* and its crew raised the number of fatal accidents during the construction of Smithland Locks and Dam to three—three too many—and the figure warrants a brief discussion of safety engineering. Work at construction sites, where heavy equipment constantly moved, was always hazardous, especially at river projects where work often was performed within the restricted areas inside cofferdams. The toll of lives lost at dam projects during the early 20th century was enormous: ninety-eight workmen lost their lives during the construction of Boulder (Hoover) Dam on the Colorado River and the building of Wilson Dam on the Tennessee River took fifty-six lives. Those losses resulted in the formation of offices for safety engineering at Engineer Districts in 1933, and safety engineers began reviewing project plans and construction procedures to identify and correct hazardous conditions while resident engineers were given the authority to shut down work any time safety hazards were detected. Within a few years after the safety offices opened, work at Engineer projects had become much safer, with reductions in the number of fatalities and also the costs of medical care, workmen's compensation, and lost time resulting from on-the-job injuries.[10]

The Louisville District's safety office reviewed project plans, designs, construction, and operations for safety sufficiency, advising the District Engineer concerning where improvements were needed, managing the accident statistical and records program, and conducting investigations of accidents to prescribe corrective measures. Under the premise that accidents were preventable if hazards were foreseen and eliminated, the safety engineers maintained a close watch on Corps and contractor activities to prevent accidents before they occurred, and the office had the support of the District Engineers. In 1978, for instance, Colonel Thomas Nack directed every resident engineer to call him personally to explain the circumstances of each accident and to describe the measures taken to prevent such a recurrence. "The Corps of Engineers are probably the hardest—and best—people in the world to work for when it comes to safety," declared one contractor.[11]

After the fixed weir at Smithland was completed, the eleven tainter gates were lowered against their sills between the piers on September 22, 1980, closing river flow and raising the new pool. It went up at controlled rates by stages to permit the demolition and removal of old Locks and Dams 50 and 51. After parts of those structures that might be used were salvaged, the contractors drilled holes into the concrete of the locks and dams, inserted explosives, and blasted the old structures into fragments for removal. Old Lock and Dam 50 delayed traffic to its very end, for as the demolition contractor drilled holes into the structure there were thirty-one tows waiting to go upstream and twenty-five waiting to move downstream. The removal of the two locks and dams ended an era on the Ohio River, because they were the last dams on the Ohio with only single 600-foot locks to handle traffic.[12]

Another era also ended in 1981 when the District removed a stone dike from the downstream channel leading into Smithland Locks. Captain Henry M. Shreve, the famed steamboatman who also served as Superintendent of Western River Improvements for the Corps of Engineers before 1840, had built the stone dike in 1834 to connect the toe of Dog Island with the head of Cumberland Island, thereby diverting the low water flow of the Ohio down the channel nearest the Kentucky bank to improve access to the port of Smithland and the mouth of the Cumberland River. With modifications, the stone dike had served Ohio River navigation for a century and a half; it was in fact the third dam or dike ever constructed by the Corps of Engineers.[13]

The Lower Ohio

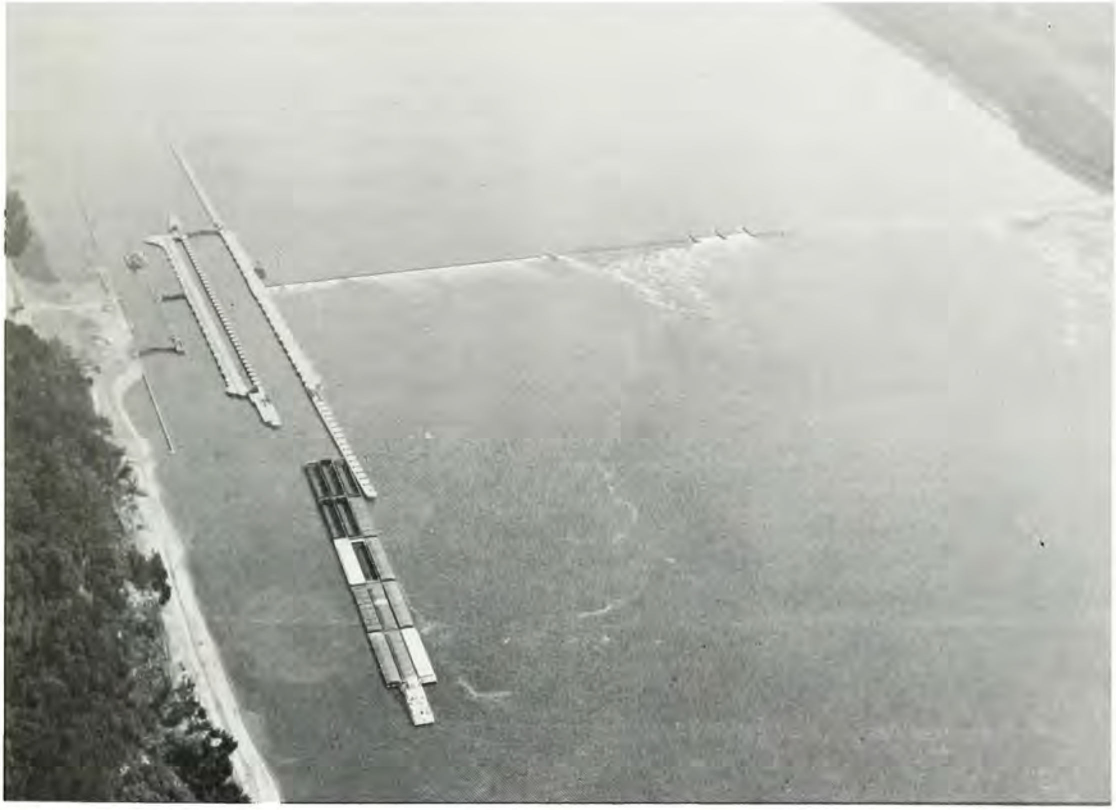
Completion of the Smithland project left only sixty-one miles of the Ohio nearest its mouth without the deep and wide pools afforded by the modern navigation structures on its upstream reaches. That lower river section, where Locks and Dams 52 and 53 continued in operation was one of the most heavily traveled sections of the river, where traffic entering or leaving the Cumberland, Tennessee and Mississippi Rivers also navigated the Ohio. A project known as the Mound City Locks and Dam had been proposed for construction on the lowermost section of the Ohio when the entire modernization project for the river had been planned during the 1950s. A 1970 study recommended that the Corps proceed with construction of the Mound City project, but the Ohio River Division Engineer rejected that recommendation, thinking it more practical from the budget and other standpoints to build a new 1200-foot "austere" lock at Dam 53, like the temporary lock built at Dam 52 in 1969, and undertake major rehabilitation of 52 and 53 in order that their useful life might be extended to the end of the 20th century.[14]

Plans for a new 1200-foot lock alongside the old 600-foot lock at Dam 53 called for construction of the lockwalls with circular steel sheetpile cells, similar to those used in 1969 for the walls of Lock 52; the lock, however, was to be constructed riverward of the old lock instead of excavated into the bank as was the case at Lock 52. When bids for the new 1200-foot lock at Dam 53 were opened on June 20, 1974, they proved the first unacceptable bids received on a major District project in years. Worried by the national fuel shortage and price escalation and by a steel shortage making it difficult to find the large quantity of steel sheetpiles needed for the job, the contractors apparently inflated their bids to cover the expected difficulties; the lowest bid was fifty-six percent higher than the government estimate. The District then began a nationwide search for steel sheetpiling and after a month had located about 17,500 tons of the piling which were shipped to the District from California, New York, Virginia, and Pennsylvania, as the District, in effect, cornered the market for piling. With adequate piling available, the contract was awarded and work began at Lock 53 in August 1974.[15]

Resident Engineer Bernard Wethington and the contractors experienced many difficulties while trying to install the new lock at No. 53. Dredging and piledriving were hampered by huge boulders in the foundation. The weakness of the foundation forced a redesign of the cofferdam. Relief wells had to be drilled to relieve artesian pressures. The worksite, moreover, was flooded by the third highest flood of record in the spring of 1975 and by repeated flooding throughout the late 1970s, overtopping the cofferdam and stopping construction for weeks each year. Not until 1980 was the 1200-foot lock ready for service.[16]

Because contractors with the necessary experience and equipment were no longer available—because all the wicket dams on

Double lockage at Lock 53, September 18, 1973. The first section of the tow is in the lock chamber while the second section and towboat wait upstream.



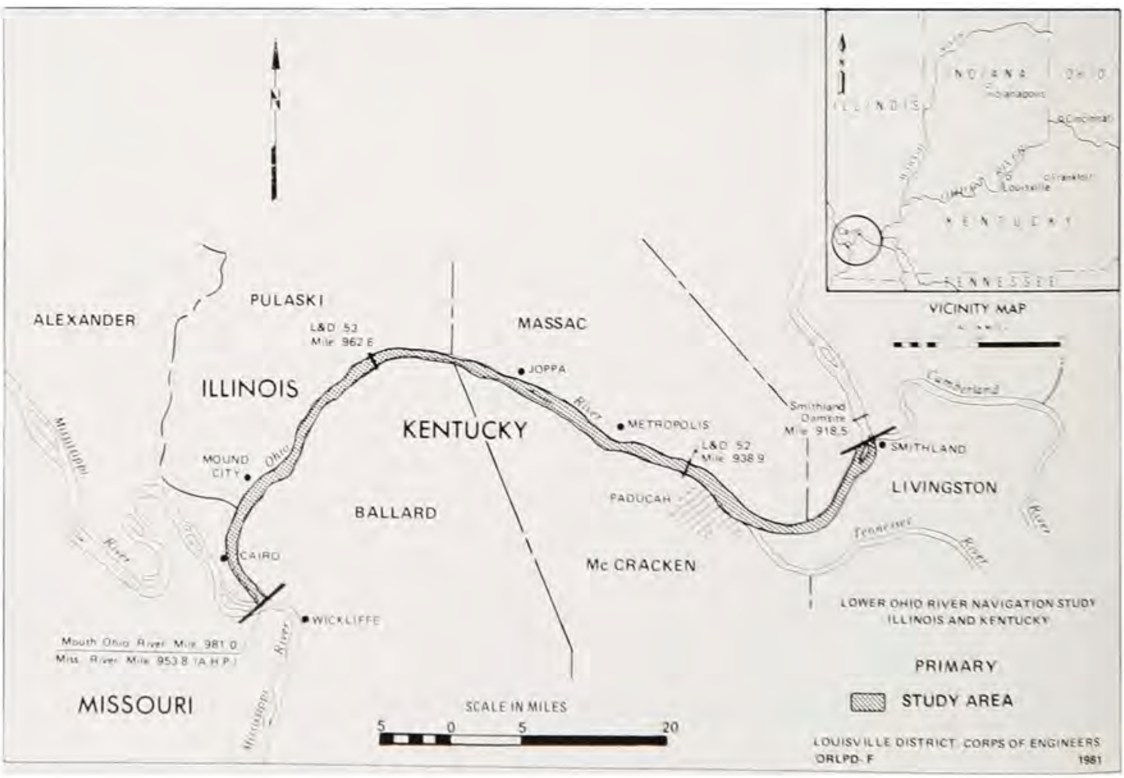
Aerial view upstream toward Lock and Dam 53, one of the two remaining Chanoine wicket dams in the Louisville District. The barge tow is entering the temporary 1200-foot lock chamber. September 7, 1983.

the river except 52 and 53 were gone by 1980—the Louisville repair station crew reconditioned the beartraps—the automatic sluices or weirs—at Dam 52 in 1981 and also repaired the lockgates. By a stroke of luck, the repair station crew was still on hand when a towboat rammed the lockgates the day after repairs had been completed and was able to remove the gates and install spares in short order. In 1982, major rehabilitation of both Locks and Dams 52 and 53 began under contract. The work involved installing new hydraulic and electrical operating systems, repairing and replacing damaged wickets, updating lighting and safety features, placing additional stone in the aprons downstream of the wickets to protect against scouring, and other reconditioning necessary to keep the two fifty-year old relics functioning until plans for modernizing the lower river were completed.[17]

Colonel Charles E. Eastburn told the Chief of Engineers in 1982 that the Lower Ohio River Navigation Study, considering alternatives for improving the lower river, was the "most significant study" underway in the Louisville District. Some engineers were of the opinion that the proposed Mound City Locks and Dam would never be constructed, but several events on the lower river indicated something would eventually be required to provide a more stable situation. In 1977, for instance, when a towboat accidentally smashed through the wickets of Dam 52 and its pool was lost through the gap, it not only threatened to slow and block towboat traffic, but also to reduce water supply for two large private power generation plants and one Department of Energy plant, an event the District averted by arranging with the Nashville Engineer District and the Tennessee Valley Authority for release of additional water from their dams on the Cumberland and Tennessee rivers. A drought in late 1980 also reduced the flow of the Ohio near its mouth to the extent that several towboats grounded on sandbars and emergency dredging was needed to reopen the channel. The delay in the decision on modernizing the lower river seemed wise, for the commodity-movement patterns of traffic navigating that stretch of river which served as the connector between Ohio, Mississippi, Cumberland and Tennessee River commerce, was in flux and was likely to change substantially after the expected completion of the Tennessee-Tombigbee Waterway in 1985.[18]

Caving Banks

In February 1982 the real estate project office at Marion, Kentucky, closed. The District had opened it in 1970 to purchase land and easements for Smithland Locks and Dam, and it had employed as many as thirteen people who had purchased 3,077 acres of land outright (in fee simple) that would be permanently inundated by



Smithland pool and easements on another 10,554 acres along the Kentucky and Illinois banks of the pool that would be inundated only part of the year. The job at Smithland, as at most other of the navigation modernization structures, had involved very few relocations because families seldom built homes near enough to the floodprone Ohio to require their purchase for project purposes. Since the real estate acquisition had required moving very few people, practically no graves, and few changes to utility systems except water intakes, the operation of the Marion project office was justly described as having "proceeded smoothly."[19]

Colonel John Rhett, the District Engineer, foresaw a future problem in 1970, however, when he told the Division Engineer: "We have received an abnormal number of complaints on caving banks on the Ohio River. The complaints are in general that our operations or construction have caused the problem." Thus began what were to become known as the "caving banks" cases, a series of legal actions in various courts that were still continuing in 1983. The owners of lands along both banks of the Ohio River contended that construction of the navigation modernization facilities with deeper pools caused or accelerated the caving of their lands into the river and that the District should therefore pay claims for the loss of those lands.[20]

The first suit was filed on July 16, 1975, in the U. S. Court of Claims as a class action by landowners along the Cannelton, Newburgh, and Uniontown pools, asking for damages exceeding $100 million. Case preparation went on during several years, and, after a warning from Colonel James N. Ellis that an inadequate defense in the cases might cost taxpayers millions, Bragadier General E. R. Heiberg, III, formed the Study Group for Bank Erosion Claim Litigation headed by William H. Browne of the Ohio River Division, with hydraulic engineer David A. Beatty and biologist Jeremiah S. Parsons of the Louisville District serving with the study group and William Kreisle of the District survey branch helping with map work. Extensive studies of caving banks began: specific sites were surveyed and mapped, soils were sampled and tested, hydrologic and hydraulic data were collected and analyzed, historic photographs and descriptions of caving banks were collected, and the effects of wave action and other variables were studied. The field work in connection with the studies cost the life of District employee Allen E. Curtis, who was at work on the Ohio on December 3, 1980, when high winds and waves capsized his boat, spilling four surveyors into the river--the three others survived by clinging to the boat then swimming for help.[21]

The initial studies were completed at the Louisville District office from April to June 1977 and drafts of the resulting report were supplied to both the counsel for the government and the attorneys for the litigants. Hubert Crean of the Justice Department represented the government when the U. S. Court of Claims heard the case during the "blizzard of '78" in Louisville. The Engineers did not deny that bank caving had occurred, but contended, in sum, that the erosion and deposition of soil along the banks of the river was a natural process unchanged by either the original canalization project of 1929 or the navigation modernization project and that, if anything, the higher pools of the modernization project tended to reduce bank caving because the river did not drop so far down after flooding. Attorneys for the landowners argued that the caving banks resulted directly from the action of

A caving bank cuts into a roadway at Clarksville, Indiana, on the Ohio, January 28, 1976.

the pools of the modernization structures, that the Engineers had acquired easements for the projects through "fraud and misrepresentation," and the landowners therefore were entitled to compensation for their land that caved into the river.[22]

The first ruling in the series of cases was handed down by the U. S. Court of Claims on Halloween of 1979, which determined that the caving bank phenomena on the Ohio was a natural and historic process, neither caused nor worsened by construction of the modernization structures. The court also dismissed allegations that Engineer real estate personnel had misrepresented the facts when the easements were purchased from the landowners, commenting the records reflected "an honest effort by the Corps to be fair and forthright."[23]

Attorneys for the landowners, charging the Louisville District had suppressed evidence supporting the claims of the landowners, appealed the decision of the court in 1980. In a bizarre twist in August 1980, the government's reply was marred by a typographical error seeming to admit the allegations by the attorneys for the landowners were true, and the error was immediately followed by headlines reading: "U. S. Admits Errors in Building Ohio Dams." Attorney Hubert Crean promptly explained a mistake had been made in preparing the government's reply, for the government actually denied the allegations, and the court and the attorneys for the plaintiffs graciously accepted that explanation. On March 11, 1981, the full panel of the U. S. Court of Claims upheld the earlier decision and dismissed the landowners' claims, but many other landowners also had filed suit and litigation was continuing in 1983.[24]

While not at all humorous to landowners along the Ohio or to the Corps of Engineers, the caving banks issue was the subject of levity elsewhere. After about an acre of land caved into the Green River in 1980, a Rochester fisherman accepted full responsibility. "What happened was this," he said, "I had two trotlines stretched across the river. Both of them were tied to the trees on the bank. I got hold of a monster catfish on each trotline, the fish pulled the tree into the river and the bank came with it. It's simple as that." The Louisville District wished that the caving bank problems were as simple as that.[25]

The District had a limited continuing authority to undertake measures for the protection of riverbanks where caving threatened navigation, flood control, or public facilities, which it used on occasion where applicable, and sometimes Congress approved bank protection work at specific sites. Largely through the efforts of Kentucky Senator Walter "Dee" Huddleston, the Rabbit Hash project in Boone County, Kentucky, was funded in 1976. A road at Rabbit Hash along the bank of the Ohio

Aerial view of the bank protection placed under District supervision alongside the highway at Rabbit Hash, Kentucky, on the Ohio River near Cincinnati.

threatened to crumble into the river, and, with special funding provided by Congress, the Louisville District undertook and completed what were termed "emergency interim" repairs to save the highway.[26]

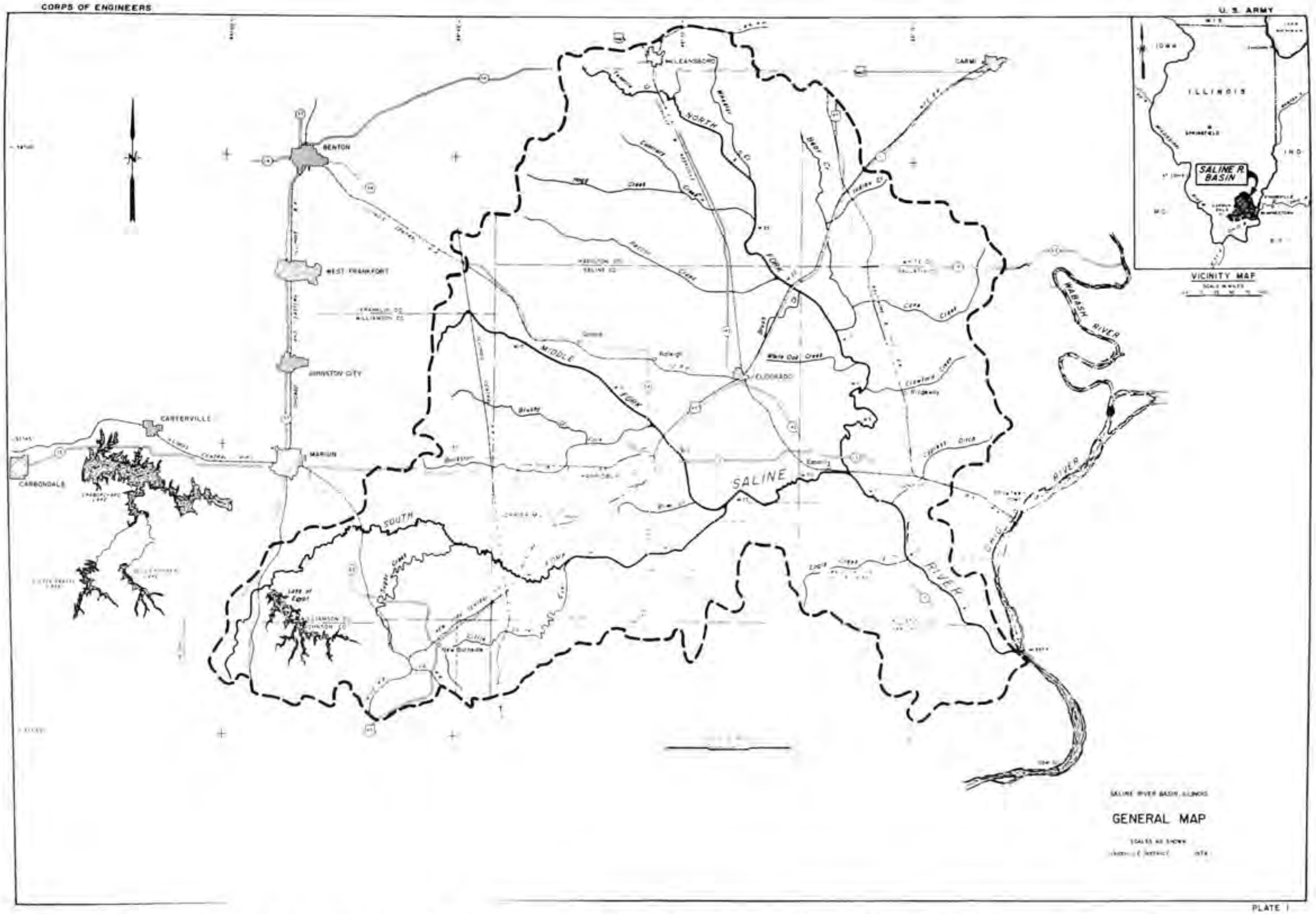
The District also participated in a five-year program of bank protection research authorized in Section 32 of the Streambank Erosion Control Evaluation and Demonstration Act of 1974 (Public Law 93-251). Under that authority, while the Waterways Experiment Station at Vicksburg experimented with scale models of bank protection methods, various Engineer Districts including Louisville built demonstration projects to determine the comparative costs and effectiveness of various methods. Of the ten demonstration projects undertaken within the Ohio River Division, three were in the Louisville District, located at Mount Vernon, Indiana, and Moscow and Milford, Ohio, the latter on the bank of the Little Miami River. Each project was an experiment with varying bank protective devices and materials. At Mount Vernon, riprap, sand and cement bags, and fabriform were placed on the caving bank; at Milford, gabions, rock dikes, and reinforced earth were tried; and at Moscow the experiment involved use of gravel, vegetation, and riprap. Work began at Mount Vernon in 1976, in 1978 at Milford, and at Moscow in 1979. The District continued monitoring the effectiveness of the methods used at each site in 1983 while the final report on the research and demonstrations was being prepared.[27]

Wabash and Saline River Navigation Studies

Just as completion of the Smithland Locks and Dam on the Ohio ended the era of 600-foot locks on the Ohio River, the studies done by the District during the 1970s of potential navigation projects on the Wabash and Saline Rivers in Illinois and Indiana also marked the end of an era. Both studies were unfavorable to improvements for navigation on the two rivers, which reach into the Illinois and Indiana coalfields. They were the last of many studies done by the District concerning the extension of new navigation projects up several tributary streams—in the case of the Wabash, all the way to its source and onward to the Great Lakes.

The Saline River and its three forks drain Gallatin, Hamilton and Saline Counties in southeastern Illinois, and as its name implied the river once was used to transport salt in small craft from saline works that operated in the area during the early 19th century. Shipments of coal also were loaded aboard barges at Mitchellsville, Equality, and Broughton along the Saline and its forks during the 19th century for transport to markets along the Ohio River and elsewhere. The Louisville District studied Saline River navigation in 1913 and learned that small steamboats ascended the river at high water to bring out farm produce and that an eight-foot channel for navigation as far upstream as Equality could easily be provided through dredging, but, while the stream was classed as a navigable water of the United States, it was never improved for navigation.[28]

When it became apparent that Smithland Dam on the Ohio River would extend slackwater for navigation some fifteen miles up the Saline River, Congress in 1970 approved a study to improve the channel to open it for barge shipments of coal and grain. After consideration of several alternative plans, the District in 1978 reported that the estimated costs of improving the Saline for navigation would exceed the potential benefits, ending the



The Saline River and its tributaries lying in Southeastern Illinois was studied by the Louisville District in the 1970s as a potential waterway for the transport of coal and other commodities. Map from *Saline River Basin, Illinois: Feasibility Report for Water Resource Development* (1979).

The routes of the proposed Cross-Wabash Waterway connecting the Ohio River with the Great Lakes which was studied and rejected by the Louisville District during the early 1970s.

hope that the coal in the area might be loaded directly into barges for marketing. There was, however, a project authorized in 1958, largely through the efforts of Illinois Senator Everett Dirksen, for clearing the Saline and parts of its forks to improve their flow capacity and provide improved drainage of the adjacent countryside. The District completed that work in 1980 and turned it over for maintenance to the Saline Valley Conservancy District.[29]

The Wabash River had also supported commercial navigation dating back to pioneer days; indeed, the first commercial traffic of firm record in the Ohio River basin was a fur shipment by French traders in 1705 from the Wabash to the Gulf of Mexico for export. Boatloads of furs also ascended the Wabash and its tributary Little River to Fort Wayne and the Great Lakes. The Wabash and its many tributaries supported an enormous flatboat traffic transporting foodstuffs of Illinois and Indiana to New Orleans during the 19th century, and also a steamboat commerce as far upstream as the mouth of the Mississinewa River and also on the White River system to Indianapolis. An Army Engineer District at Indianapolis during the late 19th century improved the Wabash and White Rivers for navigation, even constructing a lock and dam on the Wabash, but the projects were abandoned after railroad competition drove commerce from the river. Interest persisted, however, in restoring the use of the Wabash for waterborne commerce, especially in the shipment by barge of the coal and grain of Illinois and Indiana.[30]

The proponents of restoring navigation on the Wabash River suggested that the project should become the southern leg of what was to be called the "Cross Wabash Waterway," involving the construction of canals from the upper Wabash overland to connect with Lakes Erie and Michigan. In response to resolutions of Congress in 1967, the Louisville District began study of the Cross Wabash Waterway. Preliminary studies by 1972, however, had concluded the canal project was not feasible and had restricted further study to the potential for restoring navigation from the mouth of the Wabash upstream as far as Mt. Carmel, Illinois. At a raucous hearing conducted by Colonel Charles J. Fiala and Lieutenant Colonel George Shields at Vincennes, Indiana, on April 23, 1973, some 3,000 people crowded into an auditorium designed to seat only 880 to loudly proclaim their support or opposition to the improvement of the lower Wabash River for navigation.[31]

The District released its findings on the Wabash River project on December 17, 1976. It had studied seven different systems of opening the Wabash to barge navigation as far upstream as Mt. Carmel, but it found none of the systems desirable as an investment of federal funds and it recommended the idea be dropped. "We are disgusted, mad and unhappy with the operation of your office," said the chairman of the Wabash Valley Association in comment on the findings to the District Engineer. Environmentalists apparently were pleased by the report, and one wrote that: "Colonel Ellis is probably to be commended for his candid assessment, in spite of political pressure behind the canal." It appeared improbable in 1983 that the revival of Wabash River commercial navigation would ever transpire.[32]

Green River Navigation

Like the Wabash, the Green River in western Kentucky had been navigated since pioneer days by a substantial flatboat traffic as far upstream as Greensburg and

Aerial view of coal barges moored in the mouth of the Green River, April 19, 1979.

Aerial view looking upstream at Green River Lock and Dam 3 near Rochester, Kentucky. July 30, 1981.

by steamboats to Mammoth Cave. To aid that commerce, state government during the 1830s built four locks and dams on the Green and one on its tributary Barren River to extend slackwater for commercial navigation as far as Bowling Green, Kentucky. The federal government purchased the state project in the late 19th century and the Engineers built Locks and Dams 5 and 6 on the Green River and another on the Rough River, a tributary. Commercial navigation on the upper Green River ceased by 1951, and Locks 5 and 6 along with the Rough River Lock were closed.[33]

While shipment of coal from mines along the lower hundred miles of the Green River began during the 1950s and the District built larger locks at Dams 1 and 2 nearest the mouth of the river to serve that traffic, no substantial commerce upstream of Lock and Dam 3 developed, and when the 19th century stone and timbercrib dam at Lock 4 washed out on May 24, 1965, it was not repaired. The remaining stone and timbercrib dams of the Green River project were in such leaky condition by the 1960s that the District sometimes resorted to a 19th century technique for plugging the leaks to maintain pools by dropping hay and coal dust into the pools where the material would be drawn into the crevices in the dams, temporarily blocking the leakage. The timbercrib of Dam 1 was removed in 1970 and replaced with a new dam built economically of the steel sheet-piling cells of the sort used for cofferdams on the Ohio River and also for the temporary lockwalls constructed at Locks 52 and 53. When the contractor, Traylor Brothers, finished rebuilding Dam 1 for less than a million dollars in 1970, the tonnage moving on the Green River amounted to about eighteen million tons annually, chiefly coal bound for steam electric power plants along the Ohio River.[34]

Public interest continued in restoring Green River Dam 4 and revitalizing navigation on the upper Green and also in a proposed high, multipurpose dam on the Green near Lock and Dam No. 3 at Rochester. The District Engineer advised the Governor of Kentucky in 1971, however, that there was little chance for the restoration of the old locks or for modernization of facilities on the Green until coal or other commercial traffic began using the river upstream of Lock 3. On November 21, 1973, the District deactivated Lock 4 on the Green and Lock 1 on the Barren River, and "mothballed" the structures. The lockhouses and reservation at Lock 4 were deeded to Butler County which planned the development of a public park and local museum at the site.[35]

When a towboat firm barged about 60,000 tons of coal through Green River Lock 3 at Rochester in 1976, indicating that shipments might continue, and while

District workmen installing electric power for the operation of Green River Lock 3, 1977.

rumors circulated that grain and farm produce from along the upper Green might also start moving via the river, the District sent its repair station crew with the towboat *Patoka* up the Green in 1977 to repair Lock 3. The crew cleared the pool above Dam 3 and installed new lower gates in the lock, replacing the ancient manually operated capstans which had opened and closed the lock gates since the 1830s with an ingenious device allowing operation of the gates with a small electric drill working through a reduction gear. The change in gate operation ended an era, because Lock 3 was the last in the District and in the United States to be operated by hand with the appliances that had been used at locks since their invention during the Renaissance in Europe.[36]

Studies of a proposed high multipurpose dam at Rochester and of a dozen other plans for the future development, or nondevelopment, of the Green River system were underway during most of the 1970s. The Barren River Area Development District, headed by Jack Eversole and with the support of local civic and business leaders, pressed the Corps for the contruction of a new high dam or at least for restoration of commercial navigation facilities as far upriver as Bowling Green. They said the negative reports made by the District on the feasibility of modernizing the Green River had not adequately considered the potential for hydropower production and for industrial development which might result from modernization. "We tend to feel the Corps had prejudged the situation and are making their findings fit the plans," declared Jack Eversole, adding: "There are facts that the Corps ignores when making a study." Others apparently agreed with him, for when the District Engineer announced in 1979 that studies indicated neither the construction of a multipurpose project on the Green, nor restoration of the old locks and dams was economically justifiable, Congressman William H. Natcher arranged for funding by Congress of a renewed study to be undertaken during the 1980s.[37]

Two disputes concerning the Green River locks and dams made headlines during the early 1980s, one involving the proposed removal of Dam 6 and the other the closing of Lock 3. Environmentalists proposed the removal of Dam 6 to open the upper Green to canoeing and to lower the water level in the Mammoth Cave system, which was thought to threaten with extinction the blind shrimp living in the cave system; other citizens feared removal of the dam might threaten local water supplies and curtail operations of the *Miss Green River* which carried tourist excursions along the river in the pool of Dam 6. While the District had expended large sums to maintain Dam 6, it did not object to its removal, for it had served no commercial navigation other than the excursion boat for years. The decision on the issue apparently hinged upon whether the U. S. Fish and Wildlife Service determined that the blind cave shrimp qualified as an endangered species.[38]

Under pressure from Washington to reduce staffing and expenditures, the District proposed the closure of Lock 3 on the Green River, along with other antiquated locks on the Kentucky River upstream of Frankfort, in 1980. Only four barges passed through Lock 3 in 1980 and the coal tonnage moving on the river downstream of Lock 3 was declining. "Right now there's a lot of pressure to reduce the number of federal employees," commented Larry Dickson, chief of the District's waterways management branch, adding that "once a lock or other facility doesn't support itself, it's hard to justify keeping it open.[39]

The reaction of the citizens in the Green River valley was highly critical of the decision to close Lock 3. The editor of the Morgantown, Kentucky, newspaper declared that the "pencil-pushing public servants" at the Louisville District were wrong in thinking that the operation of navigation locks should be profitable, and local officials asked how they could develop traffic on the river if the locks were closed. Green River historian Helen Crocker urged that Lock 3 be preserved as a historic site, as an example of the ingenuity of the pioneer engineers who built and operated it without power equipment.[40]

The Reagan administration insisted that personnel cuts at civil works projects be implemented, and on October 1, 1981, Green River Lock 3 ceased operation. It was placed in a caretaker status providing for periodic inspection and repairs necessary to maintain the pool. Rumor had it that a lockmaster still roamed the reservation of Lock 3 at night. The family of Lockmaster Randall Lytle, who were the last to live in the lockhouse at No. 3, were convinced the house was haunted, perhaps by the spirit of the old lockmaster. Mr. Lytle's children in fact had referred to the ghost as "Casper," after the cartoon character. Those who heard the story were amused by the thought of an apparition walking in circles at the capstans, opening the locks for diaphanous steam packets with excursion parties once again headed upriver to Mammoth Cave.[41]

Kentucky River Navigation

Efforts by the District to divest itself of the operations of antiquated locks and dams on the Kentucky River upstream of Frankfort marked the history of the project from 1970 to 1983. Like the Green River locks, the Kentucky River project was initially constructed by state government during the 1830s. The state had built the first five locks and dams and operated them until Congress directed the Corps of Engineers to take charge of the project in 1880 and to extend slackwater navigation farther upstream to Beattyville, Kentucky, at the head of the river; that was accomplished through construction of nine more locks and dams by 1917, bringing the total on the river to fourteen. (A brief summary of the history of the construction of the Kentucky River project is included as an informational appendix to this volume.)

The Kentucky River project, with lock chamber dimensions proportioned to fit flatboats and steamboats, essentially was obsolete by the time it was opened all the way to Beattyville in 1917, for by that date steamboats were being supplanted by towboats and barges which generally needed larger locks than those available on the Kentucky River for profitable operation. Traffic navigating the Kentucky River was never great, though most historical studies of the project indicate that the investment in its construction was recompensed in terms of general regional economic development and the reduction in railroad rates that occurred to help the railroads compete with waterways transport. Commercial navigation on the upper Kentucky River had largely ceased by 1951, when the District first proposed ending the operations of the locks; but operations continued when Kentuckians promised that commercial use of the stream would resume. Coal was barged from the vicinity of Beattyville to the power generating plant at Ford near Lock 10 from 1954 to 1964, but when that traffic ended the sole remaining commerce on the river was shipment of sand and

Manual operation of the lock gates on the Kentucky and Green rivers required physical strength. Walking in circles, the lockmen turned a rack and pinion to move the lock gates.

gravel moving chiefly from the mouth of the river upstream to Frankfort.[42]

Under the leadership of Captain Bill Hughes, the Commonwealth Towing Company formed in 1973 to tow sand and stone upriver to Camp Nelson and coal downriver from near Beattyville and Heidelberg to the Ohio River; the firm hoped eventually to have as many as ten towboats in operation on the river hauling 2.5 million tons a year including pulpwood, petroleum, and prestressed concrete in addition to coal and aggregate. Each tow, however, had to be disassembled at all fourteen locks on the Kentucky and locked through a single barge at a time for reassembly on the other side of the locks, a process requiring hours to pass each of the locks which no doubt had something to do with the end of efforts in 1977 to navigate the river upstream of Lock 4.[43]

Some lockmen on the Kentucky River had been required to live on the reservations at the locks where their presence would prevent vandalism to government property and also make them available on standby to operate the locks when necessary. The lockmen brought a class action suit during the 1970s, and in 1977 they won a large settlement for services performed in addition to their regular eight-hour workday. The locks upstream of Lock

4 were no longer serving substantial commercial traffic, and to reduce operating costs they were closed to all except commercial traffic during the winter months and the hours of operation during the summers were restricted.[44]

When the District announced in April 1980 it was considering the cessation of operations of the ten locks upstream of Lock 4 at Frankfort, vehement protest came from the public and from the Governor and General Assembly of Kentucky. The General Assembly, moreover, urged the District to plan modernization of the locks, lengthening them to 600 feet. At a public meeting concerning lock closure held at Lexington on June 26, 1980, for the first time in years the District encountered a united public opinion: everyone including environmentalists opposed closing the locks. One representative of an environmental group at the meeting commented that the Kentucky River locks and dams had "recreational, educational, and scientific values" to the region and to the state. Others believed that the project still had the potential for supporting commercial navigation of some sort, that the locks should remain open to serve the recreation traffic thought vital to the local tourism industry, and that closing the locks might threaten regional water supplies. Thirteen communities, the largest being Lexington, relied on the Kentucky River for water supply; Lexington was pumping more than

Aerial view looking upstream at Kentucky River Lock and Dam 4, Frankfort, Kentucky. May 5, 1964.

thirty million gallons of water daily from the Kentucky for transport through pipelines to the city.[45]

Colonel Thomas Nack, Neal Jenkins, Robert Woodyard, and Kenneth Mathews of the Louisville District reassured the crowd at the 1980 public meeting that the end of lock operations upstream of Frankfort would not also mean an end to project maintenance and a threat to the area's water supply. They pointed out that recreational use of the river had declined from 12,400 lockages in 1970 to 3,290 in 1979, and more than half of the latter were through the lower four locks which also served a commercial sand and gravel towing firm. When one speaker asked why the locks on the Kentucky were not modernized and a proposed high, multipurpose dam built on the river upstream of Frankfort, Neal Jenkins, chief of the District's planning division, responded that a study of that proposal was to be completed in 1984, but the modernization concept involved significant environmental and sociopolitical issues. Colonel Nack bluntly added: "This was a very orderly meeting here tonight. Very calm, even though it was an emotional topic. If we were having a public meeting for that dam, there would have been a small revolution."[46]

William R. Gianelli, the Assistant Secretary of the Army for Civil works who was nominally responsible for the personnel cuts and lock closures, after intense lobbying by Kentuckians and additional funding from Congress, directed the District to reopen some of the upriver locks during the summer of 1982 to serve recreation traffic and in the meantime to rush its study of the project. He hoped that state and local governments would make plans for continuing lock operations. In 1982 the Kentucky General Assembly approved the opening of negotiations for eventual state operation of the locks and created a task force to study that and related subjects. State operation of the locks could not be approved or funded until the General Assembly convened in 1984, and state officials in 1983 thought the outcome uncertain because state government had budgetary constraints of a magnitude equal to those faced by some federal agencies. Locks and Dams 5 through 14 remained closed and in caretaker status pending final determination of their disposition.[47]

No means had yet been devised in 1983 to assure continued navigation on the upper Kentucky River, nor to assure ample water supply for the increasing population and burgeoning industrial development within its basin and the Bluegrass region, nor for the control of catastrophic flooding on the order of that which inundated Frankfort in December 1978—at least, no means that were both politically and environmentally acceptable. When the two newspapers in Lexington merged in 1983 and the editors listed the priorities for the future of the Bluegrass region which they intended to support, they did not assign high priorities to flood control or navigation, but did indicate that a safe and reliable water supply for central Kentucky would be vital to the region's future economic development; therefore, it appeared that improved water supply might be the most urgent concern of Kentuckians during the late 20th century. Those interested in the subject were awaiting release of the District's Kentucky River and Tributaries Study and the convening of the Kentucky General Assembly in 1984 for the determination of the future of Kentucky River navigation and regional water resource development.[45]

From 1970 to 1983, the history of the

Kentucky River Lockmasters Meeting, April 2, 1975. From left, standing: John R. "Jack" Bleidt (Chief, Operations Division), Roy Parrish, Lock 6; John Sparks, Lock 4; John Lambert, Lock 11; Richard Finney, Lock 6; Ralph Conway, Lock 8; Charles Dees, Lock 7; Earl Gulley, Lock 12; Jessie Dalton, Lock 10; John Lawson, Lock 14; seated from left: Randall Lytle, Green River Lock 3; Roy Berry, Lock 13; Charles Ballman, Lock 9; Estill Thomas, Lock 2; Russell Dees, Lock 1.

Louisville District's navigation mission seemed to bring an era to a close. Operation of the last wicket dams with 600-foot locks on the Ohio River ceased in 1980 with the completion of Smithland Locks and Dam, the sixth navigation modernization structure completed by the District, leaving only two wicket dams, both with 1200-foot temporary locks, in operation on the lower Ohio. Studies of potential new navigation projects on the Saline and Wabash Rivers were terminated by unfavorable reports during the 1970s. Squeezed by budgetary and manpower constraints, the District by 1983 had ceased operation of all but the two locks nearest the mouth of the Green River and all but four of the locks on the Kentucky River. Barring unforeseen events radically altering the thrust of the District's navigation mission, it appeared that the immediate future of the navigation mission would consist chiefly of operating and maintaining existing projects.

While the Louisville District closed the nine locks numbered 43 through 51 on the Ohio, Lock 3 on the Green, and Locks 5 through 14 on the Kentucky River after 1970, the pattern of operations within the District was one of general growth. In the same period the District completed four more navigation modernization structures on the Ohio to bring the total to six and finished eight more multipurpose dams and lakes on tributaries of the Ohio, bringing the number operated by the District to twenty. The percentage of the District's civil works budget assigned to operations therefore increased after 1970, though part of that increase resulted from an accompanying relative decline in the District's engineering and construction for civil works.

The District's operations division, headed in 1983 by Kenneth Mathews and his assistant Norman Longworth, was responsible for both the operations and the maintenance of the District's civil works projects. Formally established on January 1, 1946, the operations division has had only four chiefs in its history: Oren Bellis from 1946 to 1965, John R. "Jack" Bleidt from 1966 to 1976, William N. "Norb" Whitlock from 1977 to 1979, and Mr. Mathews thereafter. They supervised the operation of essentially two types of facilities: locks, dams, and channels serving navigation, and dams and lakes for flood control and multiple purposes. Floodwalls and levees, called local protection projects, were operated and maintained by the local cooperating agencies rather than the Corps, though the District did monitor and inspect them regularly.[1]

Multipurpose Project Operations

When Charles Ellet, Jr., in the 1850s first proposed the construction of dams on tributaries of the Ohio River to control flooding and serve other purposes, he speculated that the operation of the dams would be quite simple. His scheme involved stationing people with rain gages at the headwaters of the streams who, at the start of flooding, would send warnings by telegraph to the operators of the gates at the dams. He believed that a few dams in the mountain gorges under the constant attention of some twenty operators would suffice to control Ohio River floods.[2]

While Ellet had correctly conceived the essential elements of the system, his simplistic conception of the complexities of operating dams for flood control and multiple purposes would seem ludicrous to the men and women who actually operated such dams in 1983. Those personnel worked in the Louisville District's operations division as part of its natural resources branch, known originally as the reservoir branch and subsequently as the recreation resources branch before receiving its present title; the chiefs of the branch successively were Charles E. Rager, Frederick R. Huelson, and Glen Bayes. For closer administration of the projects, however, the District in 1965 had established three area offices—the Green River, Middle Wabash, and Upper Wabash areas—and during the 1970s had created two additional area offices, the Upper Kentucky and Miami River areas. Each was headed by an area manager who was responsible for operations at the three or four lakes nearest the office.[3]

While the operation of the twenty dams within the District had required more than one person at each as Ellet had predicted, the number had not greatly exceeded his prediction. The District projects administered by the three area offices in Indiana and Ohio usually had only two or three Corps personnel at each lake, and the number was but slightly larger in Kentucky where the District also operated recreation areas around the lakes.[4]

Each of the twenty dams and lakes in the District had unique operational procedures and problems, the variations resulting from differences in lake size and basin topography, in the design of the dams, and in the arrangements for the operation of recreation facilities; yet, the routine at each resembled that at the others. Each morning, personnel at the dams reported by radio the lake levels, water temperatures, and other data concerning project conditions to area offices and the District office. At the District office and at the reservoir control center at Ohio River Division the data from the lakes was analyzed, chiefly by computers after 1970, taking into consideration flooding or drought conditions on tributary streams and also on the mainstems of the Ohio and Mississippi Rivers all the way to the Gulf of Mexico. Instructions then were issued to raise or lower the gates in the control towers of the dams to release the optimum amount of water from the lakes to the rivers below. At a console inside the control towers, personnel at the dams changed the position of the hydraulically operated

Operators cross the service bridge and enter control towers like this one at Cecil M. Harden Lake to open gates at various levels in the base of the towers and release water from the lakes into conduits passing under the dams.

steel gates in the bases of the towers which controlled flow from the lakes into the outlet conduits under the dams. Openings at various levels in the underwater sections of the towers allowed the release of warm water from the upper parts of the lakes or cold water from their bottoms, the choice generally depending upon the fish and wildlife environmental conditions downstream of the dams.[5]

The dams had operation manuals and procedures especially devised for each structure because some lakes, located in flat to rolling terrain, were slow to fill, while others, like Buckhorn Lake, in mountainous terrain could be filled by flash flooding at the rate of a foot an hour. Operational procedures also varied with project purposes: all the lakes had minimum conservation pools at the bottom and flood control storage at the upper elevations, but not all had storage allocated for water supply or water quality. The operations generally aimed at maintaining a steady pool for summer recreation, followed by an autumn drawdown to have the full flood control storage capacity available at the start of winter rains.[6]

When flooding appeared imminent, personnel at the dams frequently checked rainfall and streamflow gages, relaying that data to the area and District offices and following the regulation plans for each dam unless orders to deviate from the plans were issued by the District office. The dams trapped floodwaters in the lakes for subsequent release at controlled rates to regain flood control storage capacity before the next heavy rains arrived. During flood control operations, the Engineers considered the effects of ground saturation and snow melt on stream runoff and the conditions downstream of the dam, especially during planting and harvesting seasons, in making releases from the dams. When flooding occurred in the vicinity of the dams, the personnel at the dams and area offices went to the threatened areas to secure information and to offer technical assistance to local authorities, sometimes even performing rescues. In 1969, for instance, after flooding occurred on a stream near Barren River Dam in Kentucky, Kenneth H. Skaggs, William A. Winn, and Alvin J. Davidson from the Barren River project, at risk of their own lives, rescued a woman who had been swept away by flash flooding and marooned in a treetop.[7]

While floods sometimes made the work of the natural resource management personnel at the District's lakes difficult, even exciting, most of their yearly work was routine. In addition to daily data collection and reporting, operation of gates in the dams, and paperwork, they performed minor maintenance work and monitored the condition of the dams, watching for bubbles or muddy water emitting from the drains downstream of the dams which might signal trouble, for deterioration of the concrete forming parts of the dams, and for other evidence indicating the project was in need of repairs. Because the multipurpose dams in the District were no more than thirty years old, major rehabilitation of the projects had not become necessary by 1983, but considerable routine maintenance was required: the control of vegetation on the dams and in the operations areas, the repair of hydraulic lines, hoists, and gate operating mechanisms, and repairs to the concrete stilling basins downstream of the dams which were subject to the action of the turbulent waters released through the outlet conduits.[8]

Perhaps the most challenging maintenance problems at District dams during the 1970s were the difficulties experienced with bulkheads at the Brookville, Caesar

The stone siltation barrier dam at Carr Fork Lake, Kentucky, catches sediment before it enters the lake. September 13, 1976.

Creek, and Cave Run dams. In 1977 a bulkhead—a rectangular metal plate used to close the entrance to the outlet conduit under a dam—suspended by steel cables inside the control tower at Brookville Dam became jammed in its guide channels at the bottom of the tower and beneath 110 feet of water. By lowering an underwater television camera down into the well, the cause of the binding was determined and the bulkhead dislodged by tapping with a weight lowered for the purpose. A similar problem at Caesar Creek Dam in 1979 was solved by divers, who went down inside the well and released the bulkhead, rounding and smoothing the tight spots on the bulkhead and guides with grinders. The District's engineering division subsequently modified bulkhead design, adding casters on their sides and also strengthening the crane apparatus used for lifting the bulkheads.[9]

Sedimentation

During drawdowns at the District's lakes the oddest things sometimes were found. At Salamonie Lake in 1974 a suitcase containing $200,000 turned up; it was bogus money that proved useful to the U.S. Secret Service in the prosecution of counterfeiters. At Nolin River Lake, an Indian dugout canoe once was discovered. All kinds of theories concerning the origin of the mysterious craft were considered; it seemed logical that the craft might have been hidden in a cave during prehistoric times, a cave subsequently inundated by the lake, and somehow had worked free and floated into the lake. As it turned out, the dugout had been built by Indians, but in South America and brought north by someone who owned a camp on the lake.[10]

The District also inspected its lakes after their drawdown to determine the amount of sedimentation occurring, and it performed electronic sounding in the lakes from time to time for the same purpose. It was rare for one of the District's lakes to be entirely emptied for inspection, but it was done in 1971 at Cagles Mill Lake which had been impounded in 1952. The purpose was to remove rough fish from the impoundment and to restock with game fish. Biologists removed nearly a million pounds of fish including some very large bass and a catfish weighing seventy-one pounds. Meanwhile, the District studied the amount of sedimentation that had occurred during twenty years, a task easily accomplished because concrete block markers were placed on the lake bottom for the purpose during construction, and it was learned that sedimentation in the lake was minimal.[11]

Because the opponents of Engineer lake projects often objected that the lakes would fill too quickly with sedimentation, a brief discussion of the subject may be warranted. Recognizing that streams emptying into the lakes would erode their banks naturally and carry sediment into the lakes, the District's engineering division made an allowance for that condition in project designs, reserving storage in the lakes to compensate for the estimated deposition of sediment during the project's first century of service or longer. At a few District lakes the rate of sedimentation was faster than anticipated, partly as a result of strip-mining in the watersheds upstream of the lakes. At Carr Fork Lake near Hazard, Kentucky, the District in 1976 built sediment detention barriers across Defeated Creek and at Littcarr upstream of the lake, their purpose being to trap sediment behind the barriers before it entered the lake. At lakes located in mining areas, one of the duties of natural resource managers was to monitor mining activities in the watersheds upstream of the lakes for any work that might affect the projects, and through an understanding with state authorities the District was allowed to review applications for mining permits to suggest modifications for the protection of the lakes.[12]

While some of the District's lakes were troubled by sedimentation, especially in their upper reaches where streams entering the lakes slowed and dropped their sediment load, the concern that the lakes would eventually fill and become useless was thought chimerical by engineers who were aware of the capabilities of powerful dredges, which easily could remove both sediment and organic accumulations from the lakes. If that should become necessary, after many years of operation, the chief difficulty would not be removing the sediment but finding a place to put it. A bit of ingenuity could solve that difficulty, for the sediment, if uncontaminated by toxic wastes, could be a valuable addition to farm fields or even create level croplands where none before existed.[13]

Recreation Management

"You are constantly on the firing line and are usually the only contact the public has with the Corps of Engineers, " said Major General William L. Starnes of Ohio River Division in his 1971 address to a conference of project resource managers and rangers. The conference chiefly concerned three new programs that were starting up at the time: a legal citation authority for Corps rangers, the collection of user fees at Corps-operated campgrounds, and the use of service contractors rather than Corps personnel for the collection of garbage and other normal maintenance services around the lakes. General Starnes warned the resource managers they faced some difficult problems:

> For reservoir management people, it means a very expanded and varied role. As you well know on any weekend you find yourself managing fair sized communities. You will have to be the mayor, the fire chief, possibly the sheriff, traffic cop, nurse and town psychiatrist. Let's face it, your job is a tough one and it's going to get a lot tougher.[14]

Many problems encountered by natural resource managers during the 1970s emanated from the sheer numbers of people flocking to the lakes for recreation . When the Corps began counting in 1946, its projects experienced 5 million visitation days; the number grew to 109 million in 1960, 276 million in 1970, and 480 million in 1982 at the 442 lakes then in operation nationwide. When the Louisville District planned Rough River Lake in the 1950s, it estimated 60,000 visitation days during the first year, rising ultimately to 100,000 a year; with 1.8 million visitation days in 1982, Rough River Lake was tops among the six lakes in the District which were visited by recreationalists during more than a million visitation days that year. No

Natural Resource Managers and Rangers Conference for Louisville District personnel at Owensboro, Kentucky, September 1983.

Recreational boaters await their turn at a boat launching ramp at Brookville Lake, Indiana, June 21, 1975.

lake in the District had less than a quarter million visitation days in 1982, making the District total for 1982 more than 17 million visitation days.[15]

Many visitors to the lakes during the 1950s were boaters, fishermen, and tent campers content with primitive facilities. The following quarter century brought rolling motor homes, elaborate camper trailers, and people who wanted hot showers, flush toilets, electricity, and even entertainment. Powerful speedboats, large houseboats, motorcycles, off-the-road vehicles, and even snowmobiles were seen at the lakes during the 1970s as their owners competed with and often disturbed the fishermen, backpackers, and others who preferred solitude and wilderness survival challenges. Meeting those differing and often conflicting public demands troubled the natural resource managers for the District throughout the years after 1970.[16]

With the large crowds came litter in abundance. "They just don't understand that a little bit here and a little bit there adds up," said E. H. Collette, a District natural resouce manager. "The first thing you know, you've got a big problem," he concluded. The managers and rangers gathered some of the litter and got help from contractors in some instances. They also organized cleanup days at some lakes and received volunteer assistance from scout troops, civic clubs, and sportsmen.[17]

The crowds also brought corresponding increases in vandalism, rowdyism, and even serious crime. After a shooting, a chain beating, and harrassment of campers in 1969, the District Engineer directed the managers of Corps-operated recreation areas to begin night patrol of camping areas during holiday weekends. Called Operation BLANKET, the patrols provided welcome additional security for the campers. Congress in 1969 gave the Corps authority to issue legal citations to people dumping trash on project lands, and expanded that authority in the 1970 Flood Control Act to include acts of vandalism and other disturbances. While Corps rangers were not law enforcement agents nor were they armed, they were permitted to issue citations requiring the appearance of offenders in federal court, backed up by fines and potential prison sentences. In its first year of full operation in 1972, the rangers in the Louisville District issued more than two hundred warnings and fifty-one citations with practically a one hundred percent conviction rate. To further bolster the program, the District in 1978 entered into contracts with local law enforcement agencies to increase security at its projects. "Most of the time we don't enjoy writing tickets," said Edward Benningfield, a ranger at Green river lake: "We try to give a verbal or written warning first.

A full to capacity small boat harbor adjacent to a camping area at Barren River Lake, May 28, 1972.

Crowded public beach at the District's Mississinewa Lake, Indiana, July 26, 1976.

I wish people wouldn't put me on the spot so I wouldn't have to write any citations."[18]

Under authority of the Land and Water Conservation Act of 1965, the collection of admission fees from those using Corps recreation campgrounds began on a selective basis during the late 1960s and was fully implemented during the 1970s. After the pilot period, the user fees were collected only at family and group camping areas where utility services were furnished. No fees were imposed for use of picnic areas, boat ramps, or other day use areas, and where the camping fees were collected the Corps also provided a primitive campground without utilities free of charge. The funds collected served to defray maintenance costs at the campgrounds and to pay for additional improvements. The amount of the fees collected at District projects in 1982 varied with the facilities made available, the highest being seven dollars per night.[19]

To meet the public demand for a few basic educational and entertainment facilities at District lakes, interpretive centers and programs were initiated during the 1970s. The District opened in 1972 its first interpretive center at Green River Lake near Campbellsville, Kentucky. It housed displays concerning project and area history and regional geology, wildlife, and environmental features. At the urging of Brigadier General Wayne Nichols, Ohio

River Division Engineer, the "visitor perception and interpretive service" began in 1975. After visiting state parks within the Division, General Nichols noted that most offered educational lectures or films for campers in the evenings, and he directed the District to undertake similar programs at the lowest cost possible. The District built primitive amphitheaters at five of its Kentucky lakes in 1975 and the resource managers organized interpretive programs generally conducted by local college students and teachers, at a cost per site of less than a thousand dollars per year. The programs were well received by the campers and continued during subsequent summers.[20]

In addition to routine and flood emergency project operations, to the patrol, user fee collection, and service contracts administered at recreation areas, to conducting interpretive programs, removing litter, and monitoring strip mining activities, the resource management personnel also regularly patrolled the boundaries and shorelines of the lakes watching for encroachments onto government property. Encroachments occurred for a variety of reasons, most commonly the cutting of trees especially at Christmas time; the District had an extensive reforestation program at its projects, planting tens of thousands of trees each year. Shoreline management was a sometimes controversial program initiated in the early 1970s.[21]

Under restrictive land acquisition policies in effect at the time the District built its first dams for flood control, private

Young volunteers bagging shoreside litter at Rough River Lake, Kentucky.

property owners had built private homes along the shoreline and constructed docks and retaining walls for personal use. Conflicts developed as a result between those land owners and other citizens using the lakes, as recreational use of the projects intensified, causing frequent headaches for the Corps and for the state agencies which operated recreation facilities. Monroe Lake in Indiana, completed in 1965, was often described as a classic case of overuse and accompanying shoreline management troubles. The construction of private homes around the lake sent lakeshore property prices up to $10,000 an acre, and millions were invested in boats and water sports equipment in use on the lake. Though state officials estimated the lake area provided adequate room for the operation of no more than a thousand boats, by 1974 there sometimes were fifteen hundred boats on the lake, resulting in many boat accidents and several fatalities.[22]

At lakes built after 1970, national policy permitted the District to acquire wider buffer zones between private property lines and the shoreline to avert some of the problems that arose at the older projects, and the District adopted shoreline management programs at the lakes for protection of the natural lake environment and to help achieve project purposes. Implementation of the program was often hampered, however, by organized resistance from the owners of lakeshore property who wished to build docks without paying permit fees and preferred clearing vegetation and mowing down to the waterline instead of leaving the natural vegetation in place.

Neither shoreline management, nor any of the other programs implemented at District lakes during the 1970s, lightened the burdens of resource managers and rangers, for attendance at the lakes continued to grow during the 1980s in spite of a national economic recession. As a result of budgetary constraints, a large number of recreation areas at District lakes remained undeveloped for many years after the lakes had begun operation, resulting in increased crowding at completed facilities. And in 1982 the District had to reduce services at three and close six public recreation sites at its lakes in Kentucky. "The lack of manpower and the reduction in the operation and maintenance budget makes this a necessity," announced Colonel Charles E. Eastburn, the District Engineer in 1982: "It costs more each year to collect the garbage and maintain the sites at an acceptable level. We know this will produce some dissatisfaction and inconvenience, but it is dictated by the hard core reality of rising costs and the reduction of money and people within the Corps."[23]

Channel Maintenance

Many citizens were familiar with the District's locks and dams on the Ohio, Green, and Kentucky Rivers but not with its open channel projects that were not visible to the casual observer. Open channel navigation projects actually were the oldest civil works mission of the Corps, dating back to 1824 when Congress directed it to clear the Ohio and Mississippi rivers of snags and sandbars. From 1871 to the 1920s, the Engineer District at Cincinnati was responsible for clearing and dredging the channel of the Ohio River; it transferred that task to the Louisville District during the 1920s, and the Cincinnati District was later absorbed by the Louisville and Huntington Districts, leaving only the Division office at Cincinnati.[24]

The history of the open channel projects in the Louisville District has been marked by a gradual concentration and reduction in the mission. In 1931 the District operated three large hydraulic pipeline dredges, two dipper dredges, and a tributary snagging fleet, and the Cincinnati District had dredges stationed at Fernbank near Ohio River Dam 37 and at Frankfort, Kentucky; by 1983 no Engineer District in the Ohio River basin owned a dredge. Before the Second World War the Louisville Engineer District had a navigation division which apparently was considered the most important in the District, for the District Engineer had a special navigation advisor in his executive office. At the end of the Second World War, however, the District reduced its channel maintenance facilities, closing depots and fleet moorings at Paducah, Owensboro, Cincinnati, and Frankfort, concentrating the remaining floating plant and personnel at the Louisville Repair Station, and selling its last dredge, the *Jewett*, in 1955.[25]

After 1955 all dredging on the Ohio was performed by dredges from the St. Louis District, notably the *Ste. Genevieve*, a steam-powered hydraulic cutterhead dredge known on the river as the "Genny," which entered the Ohio each summer and worked its way upstream clearing away sandbars and other obstructions. In 1972, for instance, the "Genny" excavated seventeen shoals on the Ohio, pumping about 4 million cubic yards of materials out of the navigation channel. The "Genny" retired in 1972 and a competitive contract went to the owners of the dredge *Elco* for all dredging on the Ohio, but a low water emergency forced remobilization of the "Genny" in 1973 and again in 1974 to supplement work by contractors. In early 1975, however, Newburgh and Uniontown Locks and Dams were completed and their deeper pools reduced dredging requirements. From about 4 million cubic yards of dredging annually, the amount required in the District dropped to 1.8 million in 1975, 1.4 million in 1976, and less than one million in 1977.[26]

The navigation section, located during the 1970s within the District's project operations branch and after July 1980 in the waterways management branch headed by Larry Dickson, administered the open channel maintenance work. The section monitored channel conditions to locate obstructions and warn rivermen of their locations, to plan the annual dredging program, and to regularly update navigation charts, which are maps of the rivers used by boat captains and others. Channel inspection was performed by a survey party headed by Walter L. Copeland until 1975 and Robert Van Winkle afterwards. Until 1977, the work was done aboard the survey boat *Bailey*, named for S. M. Bailey who once headed the District's flood control division, and afterwards aboard the *Thomas Hutchins*, named for the first American Army Engineer to map the Ohio. The *Hutchins* was a thirty-seven foot craft with twin diesels and screws, equipped with wide-scan sonar sounding gear and an electronic positioning device which recorded hydrographic survey data on tapes that could be tied to the District's computer system by telephone for the plotting of survey maps.[27]

The navigation section became responsible in 1978 for contracting for channel maintenance work in the Louisville and also in the Huntington and Nashville Engineer Districts. The section normally awarded two dredging contracts per year, one for a large dredge to work on the Ohio and another for a smaller dredge to open access to boat ramps. Other contracts became necessary during extended droughts and low water seasons, like that of late 1980 when additional dredging was required near the mouth of the Ohio, bringing the total volume of materials dredged in the District that year to 1.3 million cubic yards. The completion of Smithland Locks and Dam in 1980 was expected to reduce the annual dredging volume in the District during its early years of operation. However, since the Smithland project raised the pool of old Dam 50 by only four feet, it was expected that shoals would eventually form on that stretch of river and send the annual dredging volume in the District upward again.[28]

Maintenance Engineering

Described as the District's troubleshooters, the personnel and equipment at the Louisville Repair Station represented a concentration of functions which had much greater scope during the District's early history. The first centers for lock and dam repairs in the District were at Woodbury on the Green and Frankfort on the Kentucky River, servicing the structures inherited on those streams from state government during the 1880s; except at the Louisville and Portland Canal, there were no locks and dams on the Ohio River in the District before 1910. After 1910, repair stations opened on the Ohio at Fernbank near Cincinnati and at Paducah, Owensboro, and Louisville. Equipped with a large number of dredges and derrickboats, the maintenance personnel in the District before 1946 repaired all the locks and dams, dredged and snagged all the channels, removed wrecked vessels, and even participated in project construction in the days before much of that work was contracted to private firms.[29]

A. D. "Gus" Thau, chief of the District's maintenance branch during the 1940s, consolidated all floating plant and repair personnel at Louisville, closing the other repair stations. After several reorganizations, the modern maintenance engineering branch with Howard Boatman as chief was established in 1967, including two sections: communications section responsible for the four radio systems (VHF marine, VHF-FM, HF-SSB, and HF law enforcement nets) used in the District; and the repair station which was headed during the 1970s by A. John Colombo, Robert Willis, Elmer "Butch" Schlensker, and Martin Clegg. The repair station had shops and facilities—most constructed in 1959 when the station was relocated—on Shippingport Island and a small fleet moored when not in service in the canal surge basin near McAlpine Locks. Though the number of personnel at the repair station subsequently dwindled, in 1970 about sixty highly skilled technicians worked at the station, fabricating wickets and custom parts for the locks and dams when not at work on the river with the repair fleet.[30]

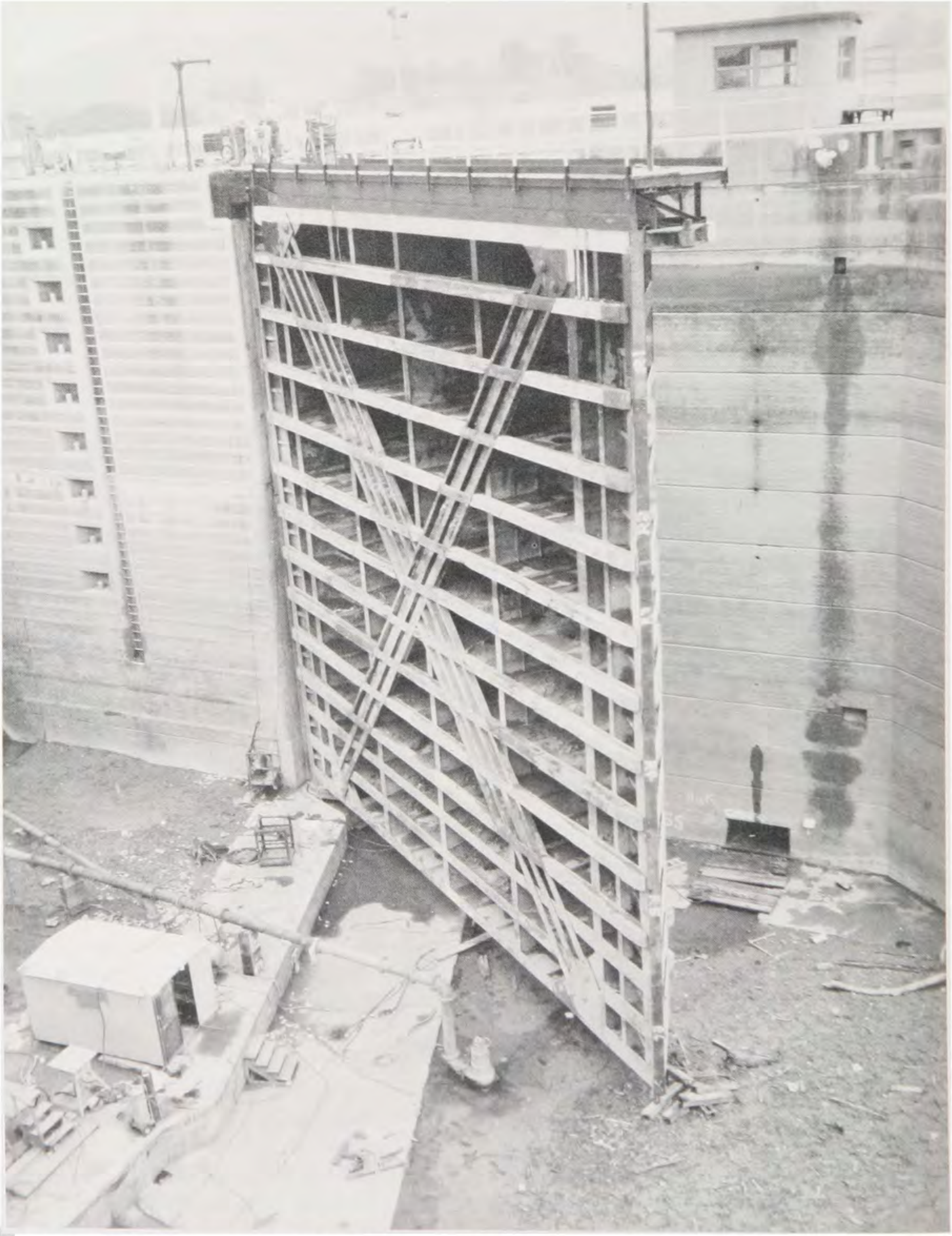
The District fleet in 1970 included the towboats *Patoka* and *Iroquois*, a shop boat with a machine shop, a power barge with diesel generators, a hundred-ton steam-driven A-Frame built by Howard Boat Works in 1927, and several work barges. During 1970 the *Iroquois* was transferred to the Nashville District and replaced with the *Person*, named for John L. Person, the District Engineer from 1948 to 1950. A new and larger derrickboat capable of lifting 135 tons replaced the A-Frame in 1976; it was named the *Brown* after Edgar W. Brown, the District derrickboat operator who died in an accident at Kentucky River Lock 3. The shop boat also was replaced in 1982.[31]

Though emergencies often altered schedules, the District fleet, or fleets when two repair jobs went on simultaneously, usually departed the repair station after spring high water subsided, not to return

The Louisville District repair fleet underway on October 23, 1974. The towboat, *Person,* pushes the shop barge, power generator barge, derrickboat, along with small craft and barges carrying spare lock gate leaves at the bow and portside of the tow.

until the onset of winter. In the summer of 1976, as an example, Superintendent "Butch" Schlensker and forty men left the repair station headed for the Kentucky River with the *Patoka* pushing seven barges including the derrickboat, the shop boat, and the generator barge that furnished power to operate tools and light the work areas. They spent much of the summer reconditioning lock gates and repairing culverts at the locks on the upper Kentucky River. Working in relatively isolated areas, the crew was equipped for almost any repair work that might arise. Aboard the shop boat were carpentry tools, lathes, grinders, drill presses and other metal working machines, and the power barge had sufficient output to light a small city. The crew included welders, electricians, carpenters, divers, machinists, and other skills, organized and ready to work two twelve-hour shifts in an emergency.[32]

As described in another chapter, emergencies frequently occurred throughout the 1970s, especially downstream of Louisville on the Ohio where the old wicket dams and locks were plagued by a series of accidents and damaged by ice during the winters of 1977 and 1978. When Smithland Dam was completed in 1980, ending the operation of



Repair work underway on the lock gates at Markland Locks near Cincinnati, July 21, 1981.

all wicket dams except 52 and 53 on the lower Ohio, the burden of the repair work was somewhat lightened and the fabrication of wickets, previously done at the repair station, was contracted to a private firm. On the other hand, by that date the first navigation modernization structures built in the District were completing twenty years of service and were needing maintenance.

Markland Locks, the first modern locks built in the District and opened in 1959, were repaired in 1975; it was the first 1200-foot lock pumped out for repairs on the Ohio. Because lock gate leaves at the modern structures were too heavy for lifting and boating to the repair station, they had to be reconditioned in place. The repair crew returned to Markland in 1981 to recondition the lower lock gate leaves in the 600-foot chamber, raising the gate leaves and refinishing their pintles, bushings, and miter and quoin blocks. "Your repair station crew did a good job jacking up and reconditioning the two lower gate leaves on the 600-foot lock at Markland," Brigadier General R. S. Kem told the District Engineer, adding: "Your unique technique was quite efficient and it could well have wide application throughout the Ohio River system." Though the modernized locks and dams contained many design improvements, it was apparent by 1983 that routine maintenance tasks would continue to require the services of the repair station crew, who also were handy people to have available when emergencies arose.[33]

Lock and Dam Operation

As operations of the old 600-foot locks and wicket dams ceased during the 1970s, the neat red brick lockhouses that had lined the Ohio from Pittsburgh to Cairo emptied and the tightly knit communities of lockmen at each of the old structures dissolved. "In the older days, we had to keep closer tabs on the dam and the crew had to work together to put it up or down," recalled Peter English, who had helped build Lock 46 at Owensboro in 1924 and who had retired as its lockmaster in 1973. "Men off duty had to let us know where they could be reached in case we needed them," he said. "When there were changes in the fluctuations of the pool we had to raise or lower the wickets in a matter of a few hours."[34]

There was a strong community spirit at the old locks. Lockmasters and assistants lived on the reservation, other lockmen and damtenders lived nearby, and they often planted community gardens and held frequent feasts and fish fries after the work was done. Though the number of personnel at each of the locks suffered gradual attrition over the years through use of temporary help and other measures, in the early days each of the locks was served by eighteen employees. Unrestricted by modern personnel selection procedures and knowing the lockmasters would have to work and live with the crew, the District administration in the early days generally gave lockmasters a relatively free hand to choose the employees at their locks.[35]

As the modernization structures were completed in general downstream order, the old locks and wickets dams were deactivated, their personnel transferred if they did not retire, the dams and riverwalls of the locks blasted from the channel, and the lockhouses and reservations disposed of as surplus by the District's real estate division. The fates of a few of the sites may be of interest. The site of Lock 43 was sold at public auction in 1981 and purchased for development as a small private recreation park. The sites of Locks 46 and 47 were acquired by nearby communities at Owensboro and Newburgh to add to the municipal park system. The Kentucky fish and wildlife department hoped to convert the Lock 50 site into a boat ramp, if funding ever became available for the purpose.[36]

Toward the end of their service the last of the 600-foot locks and wicket dams became real headaches for the operations division, for towboat traffic had adapted to the new 1200-foot locks, which meant double-locking and massive traffic jams at the remaining 600-foot locks, with frequent accidents resulting. Lockmen at the old locks were worked as hard as ever in their lives, and the repair crew from Louisville were up and down the river like a yo-yo. The troubles experienced in 1978 alone will suffice as an example of the difficulties.

Early in 1978 ice damaged wickets at dams on the lower river and the repair station crew replaced the wickets. Operation of the locks, though they were crowded by traffic, was generally routine during the early summer until August when the *Nelson M. Broadfoot* lost barges from its tow. The barges crashed over Dam 50, followed by the towboat *Jack Bullard* trying to catch the barges, making repairs to wickets at Dam 50 necessary for the second time that year. On September 22, the *Bessie Walker*, always remembered in the District for its role in the 1974 Operation BIG STINK, was inside the chamber of Lock 50 being lifted with its tow to the upper pool when the *C. J. Bryan* and its coal

Repair work underway at Lock 50 on September 27, 1978.

tow rammed into the lower lock gate leaves, smashing them open. Pilot Sam Woodford on the *Walker* saw the *Bryan* coming at the gate leaves behind him, and he later recalled: "I knew we were going to be busy. I never touched the steering lever. I put the engines full speed ahead. We dropped nine or ten feet in a few moments, as the broken gate permitted the water to gush out. Somehow we held. We were not swept back."[37]

Lockmaster Lewis Kelly credited Woodford with saving the *Walker* and its crew, for after the water left the lock chamber the pilot then had to stop the lunge of his tow under full power toward the upper lock gate leaves; if he had rammed the upper leaves, the entire river flow would have poured in atop his boat and flushed it out of the chamber, probably to capsize below the lock. The accident, of course, stopped use of the lock and all traffic on that part of the river until the repair station crew returned from Louisville with the last set of spare gate leaves in the District—all others had already been damaged in accidents.

When Captain Charles Decker and the *Person* arrived at Lock 50 with the spare gate leaves and the repair fleet, they had to pass through the dam to get to the lower entrance to the lock, and thus began the "Great Ohio River Towboat Race." When the wickets of the dam were dropped the pool would be lost, and the waiting towboats were to race through the dam with the *Person*, hoping to get on their way before pool water was gone. With Lockmaster Kelly on the radio lining up the tows and telling them when to move—a task somewhat resembling playing a huge video game for high stakes—the race began on September 29 with Colonel Thomas P. Nack and A. John Colombo riding shotgun while Captain Decker deftly threaded the gap with the *Person* and its precious cargo of gate leaves. Forty-one tows, most of them 1200 feet long and 105 feet wide, charged through the gap in the dam with the *Person* and were on their way before the pool was exhausted.[38]

Captain Decker positioned the derrickboat *Brown* and spare gate leaves at the lower end of Lock 50, Corps divers went into the water to inspect damages to the gates, and the derrickboat hoisted the damaged gate leaves out of the water and installed the new set, reopening the lock to navigation on October 2, by which time there were sixty-six tows waiting. William "Norb" Whitlock, the District's chief of operations, estimated that delays to towboat operations had cost perhaps $5 million. He convened a meeting of towboat firms on October 10 to warn that the District had no more spare gate leaves and urge greater caution during lockage, for the loss of another lock gate could have stopped traffic for up to six weeks while replacement gates were fabricated.[39]

Most but not all operations division personnel were happy to see the last of Dam 50 and the other obsolete 600-foot locks when Smithland Locks and Dam was completed in 1980. "I hate to see it go," said Lockmaster John W. Cummings when Dam 51 was blasted in 1980: "The old dam has a lot of meaning for me. It has made me feel that I have accomplished something in life." After forty years of service to the Corps, twenty-three of them as lockmaster at 51, Cummings and other oldtimers like him had accomplished a great deal, moving a volume of traffic each year that multiplied tenfold during their forty years on the river.[40]

The locks and dams section of the District's waterways management branch entered a new era in 1980, with every dam on the Ohio having at least one 1200-foot

Explosives demolish Lock and Dam 50, December 26, 1980.

lock and with major changes in operations procedures taking place, especially at the six navigation modernization structures completed between Cincinnati and Smithland. Because each of the new structures except McAlpine had replaced two or more of the wicket dams, the number of lockmen was reduced each time a modern structure was completed. Further reductions at the new structures became possible as a result of labor-saving electrical appliances and the centralized control and surveillance systems being installed at the new locks. Lockmaster Randall Priest at Cannelton explained:

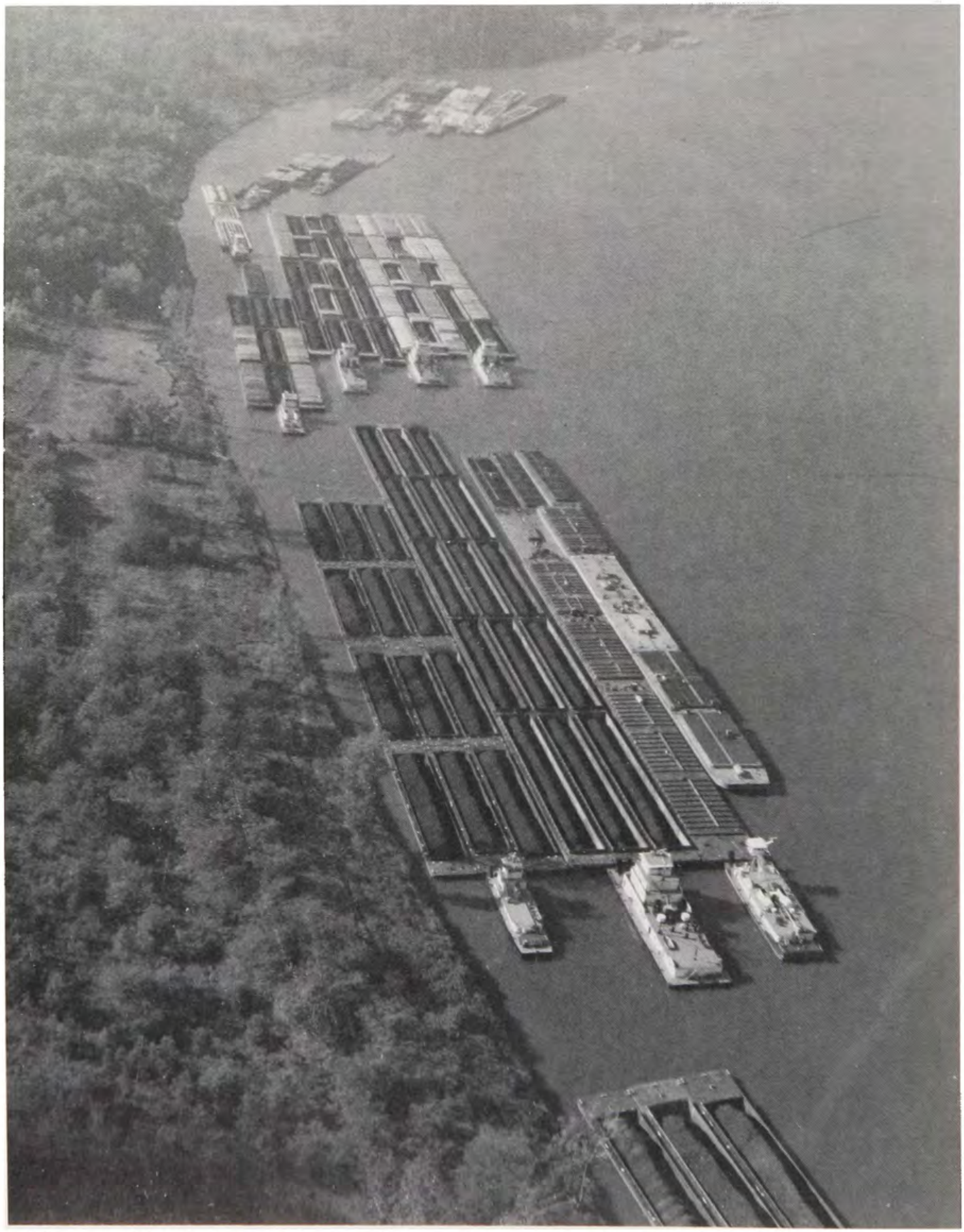
> We're no longer manually raising and lowering the dam. We can do it with the push of a button. In some cases, we can fix a mechanical problem before it causes real problems. We have a preventative maintenance system—a computer that tells us when certain parts of the system are due for repair.[41]

Crews of about fifteen lockmen divided into shifts manned the modern locks and dams day and night, and were constantly busy in spite of appliances which made it possible to maneuver the tainter gates on the dams and the lockgates without leaving the control room. Perhaps their work was somewhat less physically exhausting than it had been when lockmen opened the gates by walking in circles pushing the handles of capstans, but modern lockmen had to learn much more than how to push buttons. Keeping all the complicated mechanisms and the miles of wiring functional was a major challenge. Lockmaster Joseph Rumage at Newburgh commented that Murphy's Law was his byline and he thought it his duty to maintain the equipment before malfunctions occurred.[42]

Neither lockmaster nor lockmen lived at the new dams, but a community spirit survived for they shared common interests in the river and their work. Only two lockmen were required to man the lock gates while the remainder on each shift performed routine maintenance, collected and reported data on river stages and conditions, and waited for the emergencies that were sure to come. At one moment they might be clearing litter from the parking lot and a moment later they might be donning diving gear to enter the river and examine the underwater structures; one moment they might be painting metalwork, and the next they might be helping extinguish a fire aboard a towboat or rescuing a small boat about to go over the dam.

Amusing or interesting incidents at the locks were told and retold by the lockmen. Though it complicated logbooks and commercial statistics, deer swimming downriver have occasionally been locked through the new chambers, and the lockmen have frequently saved wildlife tangled in drift upstream of the dams. A beaver once attempted to dam a lockchamber with driftwood. At times rescues have become

A lockman operates a modern lock from control panels similar to these at McAlpine Locks, May 10, 1977.



Tows awaiting lockage at Lock and Dam 50 before Smithland Locks were completed and Dam 50 removed.

necessary, especially of small craft whose owners, in spite of the many warning signs and extensive publicity given the hazards, persisted in approaching too near the dams. Lockmaster Carroll Sheldon, who retired at Markland Locks in 1982, recalled there had been but one fatality during his six years as lockmaster: a woman swimming too far into the river upsteam of the dam was taken by the strong currents. Oddly, a year later the lockmen saved the woman's daughter from a similar fate by catching her small boat before it was drawn over the dam.[43]

Lockmen at the new dams no longer had to go out on the river in all kinds of weather to raise or lower the wickets, facing the extreme hazards of that service in winter, but accidents still occurred. The most shocking transpired on January 12, 1979, when lockmen Joseph Meredith and Laymon Emerson, while clearing drift from the wall of McAlpine Dam, were knocked, evidently by a shifting tree trunk, from the wall and into the icy river to their deaths. Falls were apparently the most frequent accidents occurring at the new structures, chiefly in winter when everything near the river was coated with ice, and that was one reason lockmen welcomed the advent of spring more than most.[44]

Commercial Traffic

While lock and dam operations were revolutionized after 1970, there were no comparable changes in the towboat traffic they served, at least none equivalent in scope to the invention of the steamboat, the development of diesel towboats, or the application of radar to waterways navigation. Moving day and night, weekends and holidays, giant tows plied the river without much notice. About the only times crowds gathered at riverside to watch the traffic came during the maiden voyage of the *Mississippi Queen*, the first steamboat built for long-distance passenger traffic in a half century, and in 1976 during the national bicentennial and 1979 during the fiftieth anniversary celebration of completion of Ohio River canalization when the Corps and the towboat industry conducted boat pageants and displays at port cities. Crowds also gathered in July 1981 when a seventy-two megawatt power generator, the most massive object ever to navigate the Ohio, scraped upriver through the locks and under the bridges to Greenup Locks and Dam where it was installed to convert Ohio River water into home lighting.[45]

The generating plant had floated all the way from France, crossing the Atlantic and Gulf and ascending the Mississippi and Ohio Rivers in tow, representing one of the more interesting trends in inland waterways commerce. Colonel John T. Rhett, Jr., the District Engineer in 1972, recognized that trend and predicted:

> I can see the day when there will be shipping ports all along the river system dealing in overseas trade. There have been at least two shipments from overseas unloaded in Louisville and there is no reason why the trend will not continue. What this means to the people of the Ohio Valley is they may buy goods cheaper and industry will be enticed to locate here.[46]

Public riverports sponsored by the states of Indiana and Kentucky opened along the Ohio during the 1970s to serve both foreign and domestic comerce. Kentucky by 1983 had ten such ports, those on the Ohio located at Ashland, Maysville, Covington, Louisville, Owensboro, Henderson, and Paducah. Indiana had two on the Ohio, one at Mt. Vernon near Evansville and one at Six Mile Island near Jeffersonville and Clarksville. As public entities with combined local, state, and federal funding, the riverport authorities wrestled with a wide variety of political, funding, and environmental controversies during their developmental phases with varying degrees of success. The ports included river terminals connected to rail and highway transport, warehouses and industrial parks, and foreign trade zones. The latter allowed importers to assemble and manufacture products in the zones without paying customs taxes until the products left the zones; hence, businesses manufacturing clothing, for instance, would not pay taxes on the fabric wasted in the manufacturing processes. One of the more successful of the riverports was the Southwind Maritime Centre at Mt. Vernon, Indiana, which handled a million tons of commodities in 1981 and which became involved in planning a new system of grain shipments to foreign ports. The plans were to load barges at Mt. Vernon with grain, not to be transferred to ships at Gulf ports as was customary, but to be floated nine barges at a time onto a sunken "super barge" that would be pumped out and raised for towing across the Gulf of Mexico.[47]

While waterborne commerce in 1983 seemed on the verge of some modal changes, the traffic from 1970 to 1981 enjoyed a steady growth with few operational changes. The apparent trends in floating plant involved the use of more powerful diesel towboats, large jumbo and specialized cargo barges, and an increasing average number of barges per tow, meaning more efficient and economical commodity transport by fewer yet larger tows. Coal, petroleum, and energy-related commodities constituted the predominant volume of tonnages moving on the Ohio, though the shipment of grain and other farm produce destined largely for foreign markets was on the increase while petroleum shipments began to level off as new pipelines were completed. Approximately 160 million tons of commodities, about half coal, moved on the Ohio in 1980, but the volume slipped somewhat thereafter, apparently the result of the national economic recession of 1981 and 1982. Marine industry forecasters still predicted the total annual tonnage moving on the Ohio might climb to about 200 million tons by 1990, accompanied by a substantial increase in the number of lockages to be handled by the Louisville District's operations division.[48]

In addition to the effects of the economic recession, the marine towing industry was troubled by the user tax first imposed on waterborne commerce in 1980. During the 1970s, the proponents of the "cost-recovery" philosophy of government, led in the Senate by Senator Peter Dominici of New Mexico and with the support of President Jimmy Carter, enacted a user fee which tacked a four-cent tax on the price of each gallon of marine fuel effective October 1, 1980, and increasing incrementally to ten cents a gallon by 1985 with the proceeds going into a trust fund for waterways improvements. President Ronald Reagan also lent his support to the "cost-recovery" concept, supporting substantial increases in the user fee. Representatives of the towboat industry rejoined that the proposed increases were inequitable, contending that recreation craft using the waterways and cities and industries relying on the rivers for water supply also benefitted from waterways projects but were not paying a share of user fees. William W. Worrell, director of the Ohio Valley Improvement Association, warned that greatly increased user fees would make river shipment less attractive and divert traffic to less energy efficient and environmentally acceptable transportation modes and also contribute to inflationary

Lt. Gen. Joseph K. Bratton, Chief of Engineers, addresses the International Inland Waterways Conference at the Kentucky Fair and Exposition Center in Louisville, August 28, 1983.

trends. "There'll be a ripple effect," he explained: "The increased cost to the river industry will be passed on and will raise the cost of the end product being transported."[49]

Perhaps as a result of the double "whammy" handed waterways shippers by the recession and user fees, they were becoming increasingly vocal and organized during the 1980s, as indicated by the International Waterways Conference conducted in Louisville in August 1983 at the state fairgrounds and by the formation of the first "waterways bloc" of congressmen organized since one in the early 1920s had secured the canalization of the Ohio all the way to Cairo. Led by Congressman Thomas D. Luken of Cincinnati, the bipartisan Ohio Valley Congressional Coalition formed in 1982 included among its charter membership congressmen from Kentucky, Ohio, Mississippi, Alabama, Tennessee, and Pennsylvania. The effects of a more politically active towboat industry upon the Louisville District and federal civil works policies in general could not be predicted in 1983.[50]

Regulatory Functions

> The time may come when Congress will vest the War Department or some other federal agency full control over the discharge of sewage into navigable waters. As to the wisdom of such a course we are not now concerned. What we wish to do is call attention to the fact that the War Department now has no control over the subject.[51]

Thus wrote the editors of an engineering journal in 1907 when they learned that the Corps of Engineers would be unable to use a provision of the 1899 Rivers and Harbors Act called the "Refuse Act" to protect waterways against pollution by liquid effluents. Because the Engineers lived and worked on the rivers, they were personally offended by water pollution and sought to use Section 10 of the 1899 Rivers and Harbors Act, granting them jurisdiction over navigable waters, and Section 13, authorizing them to stop the dumping of refuse into waterways, to prevent it, but without much success. As the authors of the 1907 editorial indicated, legal authorities prevented much use of the 1899 act for pollution control. But in 1970 the time mentioned in the editorial at last came.[52]

Perhaps the greatest impact of the national environmental movement upon the District's operations division was felt in its permits, or regulatory functions, starting in 1966 when the first crack in the historic limitation by the courts of the application of the 1899 act to solid refuse appeared in the form of a court interpretation defining refuse as "all foreign substances and pollutants" except those emitting from city streets and sewers. In 1968, about a year before enactment of the National Environmental Policy Act, the Chief of Engineers directed District Engineers, during their reviews of permit applications, to consider not only effects upon navigation, but also upon fish and wildlife, water quality, aesthetics, ecology and the general public interest. That policy was upheld by a court decision in 1970 and further strengthened by subsequent legislation by Congress.[53]

President Richard Nixon on December 23, 1970, signed an executive order directing the Corps of Engineers to use its "Refuse Act" authority to enforce water quality standards pending the enactment of specific water quality legislation. The order required the Corps and its Louisville District to quickly devise a permit program to assure that firms and agencies discharging pollutants into navigable waterways would meet certain standards before they were granted permits. Organizing its permit and water quality program in 1971, the District vigorously pursued the objectives of the program until enactment of the Federal Water Pollution Control Act Amendments of 1972 (Public Law 92-500, subsequently amended in 1977 and renamed the Clean Water Act). The District transferred the 1,007 permit applications it had received to the newly formed Environmental Protection Agency on November 20, 1972, as part of the some 22,000 applications the Corps had received nationally under the permit program.[54]

A dispute arose concerning proper interpretation of the Federal Water Pollution Control Act which extended the protection of federal law to all "waters of the United States." Environmentalists contended that phrase should be literally interpreted as all water in the nation, while the Chief of Engineers argued that Congress surely had meant only navigable waters, for a literal interpretation of "waters" could mean that federal permits would be required even for the construction of farm ponds, could cost as much as $53 million annually to enforce, and would require the Corps to employ an additional 1,750 people to administer the enforcement program. Environmentalists pointed out that the Corps had not exercised its full authorities over even navigable streams, and the National Resources Defense Council and the National Wildlife Federation took the issue to court, winning a decision on March 27, 1975, that Congress by "waters" had intended all water in the nation, navigable or not, and also a directive for the Corps to extend its jurisdiction over navigable waters to the fullest extent allowed by law.[55]

The Chief of Engineers directed District Engineers throughout the nation to restudy streams within their Districts to determine whether they might qualify as navigable waters and thus be afforded the protection offered by Section 10 and related provisions of the 1899 Rivers and Harbors Act. The Louisville District in 1974 had started studies of all streams within its boundaries, contracting for studies of historical navigation and for field surveys of the streams to learn their condition. Many streams in the District had not been navigated by an interstate commerce since the 19th century, when they supported a fur trade transported in canoes and the shipment of frontier staples in flatboats or the commercial rafting and floating of logs to sawmills. Because most of that type of commerce had ended before 1899, the Louisville District had never exercised jurisdiction over those streams as navigable waters and had generally limited its authority to streams that had supported steamboat navigation or had been improved for navigation by the direction of Congress. Yet, the streams which had supported 19th century commerce appeared to qualify as navigable waters of the United States under federal law and were so designated by the District Engineer, resulting in a substantial expansion of the number of streams protected under "Section 10 jurisdiction" during the mid-1970s.[56]

The District Engineer's administrative determinations of stream navigability were subject to court review, for only the courts in the end could make final decisions on stream navigability, and the determinations were soon tested in court. Jennings Kearby of the District's office of counsel orchestrated the first navigability case in 1975 at Fort Wayne, Indiana, concerning the status of the Little River, which as the name implied was a tiny tributary of the Wabash that had been navigated before 1830 by furtraders in canoes. Ample historical evidence showed that the commerce had existed and that the U. S. Treasury Department had collected customs taxes at Fort Wayne from British traders using the stream as a route to Canada, and the court determined that the Little River was indeed a navigable water of the United States. Stephen E. Smith of the office of counsel directed the defense in a 1980 case testing the navigability of the Miami River and its tributaries in Ohio. Though a much larger stream than the Little River, commercial navigation on it had also ceased about 1830 when the state canal from Lake Erie to Cincinnati opened for traffic. The federal district judge determined the Miami River not to be navigable, but the court of appeals overturned that decision in part, holding that the substantial flatboat traffic using the stream for interstate commerce before 1830 qualified the lower 117 miles of the Miami as navigable waters of the United States.[57]

With an expanded jurisdiction over navigable waters under Section 10 of the 1899 Rivers and Harbors Act, and with the responsibility assigned the Corps under Section 404 of the Federal Water Pollution Control Act of 1972 for passing on permit applications for dredging and filling activities in all waters of the United States, the District in December 1975 established its regulatory functions branch, headed by William F. Christman, in the operations division to handle permit applications. The branch had two sections, one for the evaluation of permit applications and the other for field surveillance and investigations. During its first eighty years of operation, the District had acted upon only 2,000 permit applications; with expanded jurisdiction, the number grew rapidly during the 1970s and also required a longer time for processing. Before 1970, applications for the construction of noncontroversial structures had often taken less than a week to process. "When navigation was the only factor, we considered ourselves experts," remarked William F. Christman. "Now there are 12 to 15 factors looked at--aesthetics, wildlife, flood protection, energy needs, air and water quality-- and we have to get opinions from all kinds of agencies. The feeling of the people also is very important."[58]

In accord with the regulatory reform policies of President Ronald Reagan, vigorous efforts to reduce the number of required permit applications and to speed the processing of noncontroversial applications were underway during the early 1980s. One technique involved the issuance of general or "blanket" permits allowing minor, noncontroversial activities in the waters of the United States to proceed without formal, individual permit application. "I am quite proud of the progress we have made," Colonel C. E. Eastburn told the Chief of Engineers in 1982. "When I assumed my watch in the District in 1980, eight general permits had been issued. As of today, a total of 20 general permits have been issued and five more should be processed and completed by the close of this fiscal year."[59]

When applications for controversial permits were pending, and there were many of them, regulatory functions were among the most visible of the District's activities. Perhaps the most controversial permit of all was that for construction of the Clark Maritime Centre, a public riverport planned by Indiana near Jeffersonville upstream of Louisville at Six Mile Island; the port included a barge terminal, an industrial park, and connecting transport modes. At several public hearings it became apparent that Indiana had support from citizens desiring the potential economic and employment opportunities the riverport might supply, while the Commonwealth of Kentucky and other citizens feared that construction of the port might degrade the water quality of the river and cause erosion at Six Mile Island which had been designated a nature preserve by Kentucky. Hoosiers supporting the riverport claimed that Kentucky was seeking to stop or delay the riverport to reduce competition for the nearby riverport located in Jefferson County, Kentucky.[60]

The District found the permit application and accompanying environmental impact statement for the riverport in order, but in view of the intense opposition to the project conducted another public hearing on November 9, 1978, at Louisville because the issue involved water quality on the Ohio River, which was claimed by Kentucky to the low water line on the Indiana bank. Lieutenant Governor Robert Orr of Indiana attended that meeting, and it was said that Kentuckians did not make him welcome. Afterwards, the District forwarded the permit application to Washington and in early 1979 the Chief of Engineers and the Secretary of Army approved it. Kentucky then brought suit, questioning the adequacy of the riverport's environmental impact statement, and on June 10, 1980, a federal district judge ruled the environmental statement had not adequately considered alternate sites for the riverport at other Indiana sites on the Ohio. At the request of Indiana, the decision was appealed, and the court of appeals on July 29, 1981, overturned the decision of the district judge, allowing construction of the Clark Maritime Centre to begin in 1982, after ten years of planning and controversy.[61]

While the riverport controversy was in progress, Kentucky and Indiana at last agreed to a serious effort to settle the historic dispute concerning the boundary between the two states along the Ohio River. By virtue of its 1792 admission to the Union, Kentucky asserted jurisdiction over the Ohio River to the low water mark on the Indiana bank and also along its border with the states of Ohio and Illinois. Construction of dams, however, had placed the low water mark as it existed in 1792 mostly underwater, and the river had often, as practically all rivers do, eroded one bank and filled another and even changed its course, notably near Evansvsille, Indiana, where a portion of Kentucky was located on the north bank of the river after it created a cutoff changing its course.[62]

The boundary issue created conflicts concerning which state could collect fishing license fees on the Ohio River, how much of the costs of bridges should be paid by Kentucky and how much by the states north of the river, and where the law enforcement responsibilities of one state ended and the other's began. The issue even troubled the Louisville District in instances where the services of local law enforcement agencies were needed at the locks and dams on the river, and in 1971 there was litigation concerning whether the new Smithland Locks on Dog Island were located in Kentucky or Illinois, one of the ramifications being the determination of which labor unions would have jurisdiction during construction of the locks. The Supreme Court on January 21, 1980, considered the boundary issue and ruled that the Kentucky boundary was the low water mark on the north bank of the Ohio as it had existed in 1792, meaning somewhere within the pools of the modern dams. There being no sufficiently accurate maps of the Ohio made in 1792 to permit absolute determination of that low water mark, representatives of state governments began negotiating to establish a permanent boundary line based largely upon maps made by the Corps of Engineers between 1895 and 1914 before many of the dams were constructed.[63]

The operations of the Louisville District after 1970 were complicated by the boundary and other disputes between state governments, by the expansion of its regulatory authorities in response to national environmental protection policies, and by the extensive maintenance requirements at its locks, dams, and lakes. Under stringent manpower and budgetary constraints, the District's operations division had to offset the staffing of the eight new multipurpose dams completed by the District between 1970 and 1983 through reductions in force elsewhere, notably through closing obsolete locks and dams. When considered in the light of constant dollars and total personnel, the operations division grew but little after 1970, though in comparison to the decline in construction and engineering for civil works the District's operations of completed facilities were requiring an increasing percentage of its budget. That trend was apparent throughout the Corps of Engineers, for in fiscal year 1984 a larger percentage of the national civil works budget was allocated to operations and maintenance than to engineering and construction for new projects for the first time in Corps history.[64]

CHAPTER IX: MISSION DIVERSIFICATION

The 1970s could well be described as the "decade of diversification" for both the Corps of Engineers and its Louisville District. In addition to the usual military construction and civil works missions, the District during the 1970s gained experience in a wide variety of other engineering activities in response to changing national priorities, national emergencies, and to various public needs as they became evident. In response to the national environmental movement and to congressional mandates on behalf of that movement, the District emphasized nonstructural flood control methods and instituted more environmentally sensitive procedures in planning for a growing workload of small projects in its Continuing Authorities program. To reverse the perceived deterioration of water quality, the District became involved in wastewater management studies and, as a support agency, in the construction of facilities designed to produce improved water quality. When a series of private dam failures with catastrophic results occured, the District and other Corps installations by the direction of Congress undertook an inventory of dams followed by dam safety inspections. When the oil embargo of 1974 caused the "energy crisis," the District initiated various energy conservation measures, experimented with solar energy, and studied the hydropower potential at its dams and on streams within its jurisdiction. For brief periods the District served as constructing engineer for the United States Postal Service, as surveyors and real estate agents for the Federal Energy Administration, and as developmental authority for the first and only National Wildlife Conservation Area at the Falls of the Ohio River in cooperation with the Department of the Interior.

Between 1970 and 1983, the Louisville Engineer District gained firsthand experience with wastewater management, with devising solutions for urban water resource problems, with the construction of post offices, with nonfederal floodplain management and nonfederal dam construction, and with the production of solar and hydropower. In sum, its personnel learned how to function as consulting architect-engineers and how to provide support services for elements of government other than the Army, earning the sobriquet "the Federal Engineers."

Postal Support Mission

The first support service of the Louisville District during the 1970s involved the rather surprising, complex, and short-lived mission of building post offices. Congress in 1970 reorganized the U. S. Post Office Department as the U. S. Postal Service, a public corporation expected eventually to operate on self-produced revenues. To get the new postal organization off to a flying start, Congress provided it with authority to issue up to $10 million in bonds for capital improvements, because the Postal Service needed to modernize older facilities and to build new bulk-mail handling centers on the periphery of urban areas near the airports and interstate highway system. The new centers were to be highly mechanized with computer controlled, high-speed mail processing equipment. Wanting those new facilities available for use by 1975, the Postal Service in 1970 called for assistance from the Corps of Engineers, which at its more than thirty Engineer Districts across the nation had a decentralized professional engineering and construction force readily available for swift mobilization and action.[1]

The Chief of Engineers established a postal construction support office and sent orders for mobilization to the District and Divisions. Though he feared "bedlam" because of the wide variety of tasks the mission required and because the U. S. Postal Service had very tight deadlines for the completion of many of its projects, Brigadier General George A. Rebh, heading the postal mission at the Office of the Chief, told the Ohio River Division Engineer he had no doubt the Districts would be able to "absorb this workload, establish a workable relationship with the various postal headquarters in rapid fashion, and get on with the job."[2]

Lieutenant Colonel George D. Shields, the Deputy District Engineer, spearheaded the organization for the postal mission in the Louisville District, which in 1971 was to include the post office design, construction, and real estate work for all the Ohio River Division except on-site construction inspection of postal work in the other three Districts which would be handled by their personnel. To coordinate the work within the Louisville District, Colonel Shields created a postal construction support office supervising generally the work in the real estate leasing branch, the postal branch established in the engineering division, and the elements of construction supervision. Shields was succeeded as postal coordinator for the District by Major John E. Moore.[3]

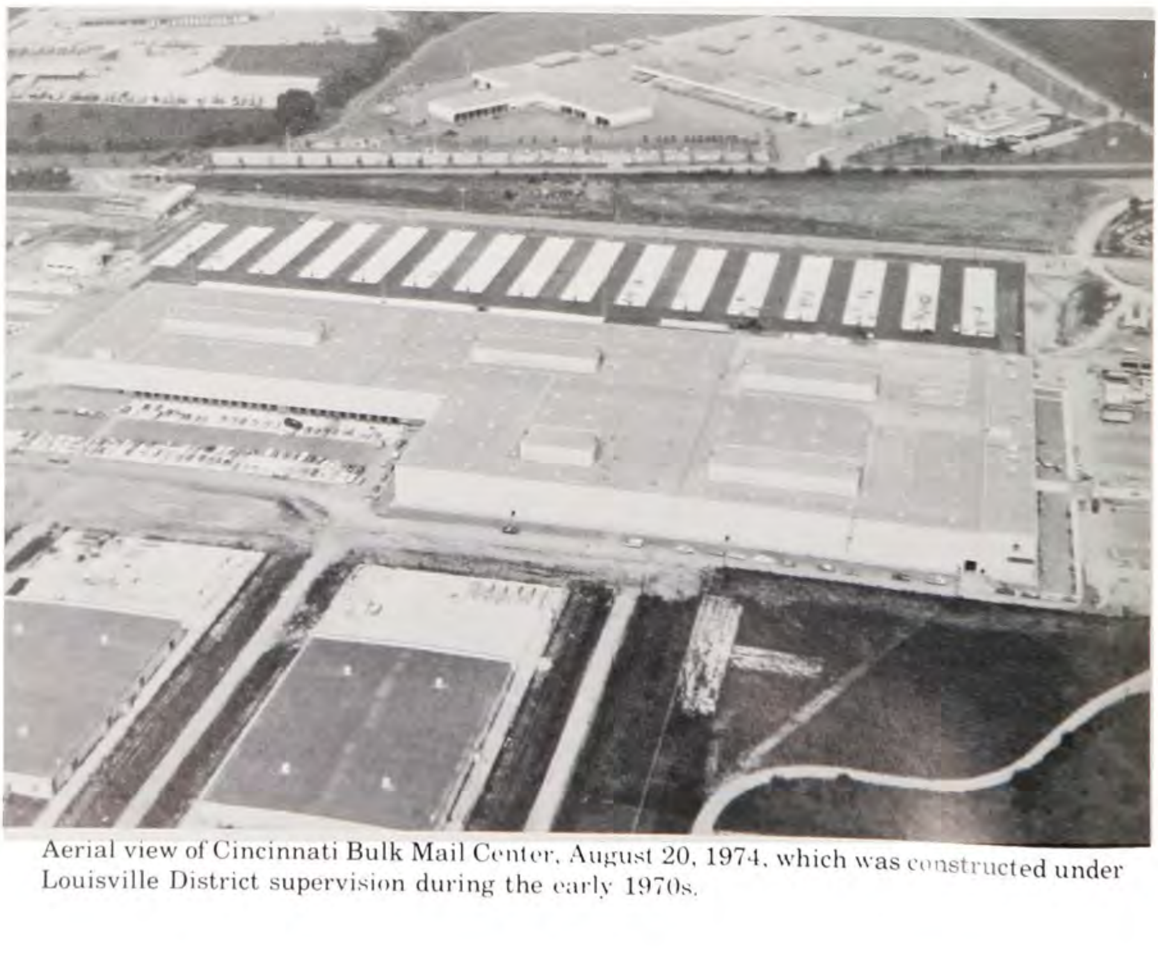
In early 1972 the District was designing and preparing to award contracts for the construction of new postal facilities at Lexington and Richmond Kentucky, and a bulk-mail center at Cincinnati, Ohio, with thirty-four new employees on board for that work. The Corps had initially expected its support services would be limited to the construction of major new postal facilities, but in 1972 it was also assigned responsibility for the repair and modification of all postal facilities. There were about five hundred post offices needing repairs in the Louisville District alone, and the District's postal workload of $4.5 million worth of construction in 1972 was predicted to mushroom to $50 million in 1973 and perhaps to $90 million in 1974. Similar figures were predicted throughout the Corps, and the Chief of Engineers commented: "We've got a bear by the tail."[4]

At the end of 1972 the District had the post office at Lexington half finished and contractors at work on the facilities at Richmond and Cincinnati. Design was also progressing on the smaller postal facilities, with the emphasis there on standard designs for reasons of economy, and about thirty of those smaller lease and construct structures were ready for contract advertising by the end of the year. Just as the postal construction mission seemed about to become routine, however, a realignment began in early 1973 to divide mission responsibilities along the boundaries of postal regional organizations rather than following the civil works boundaries established by Corps Districts. Instead of the Louisville District handling postal design and real estate for all projects within the Ohio River Division, the Pittsburgh Engineer District was assigned the Eastern Postal Region, the Memphis District the Southern Postal Region, with Louisville retaining the Central Postal Region, effective February 1, 1973.[5]

On the date that reorganization was to take effect, the "bear's tail" escaped the grasp of the Corps. Authorities in Washington decided it appeared unseemly for the construction service of the Army to be building facilities for the U. S. Postal

Service, a quasi-public corporation. Orders came to transfer all postal construction functions back to the U. S. Postal Service by June 1. The Louisville District had just shipped its files concerning projects in the Eastern and Southern Postal Regions to Pittsburgh and Memphis Districts; when the files arrived at their destinations, they were immediately shipped back to Louisville for close out and for shipment to postal authorities.[6]

After the rapid mobilization of 1971 and the urgent efforts to get projects underway to meet the short deadlines established by the Postal Service, the District began its stand down in February 1973, which required a reduction-in-force of fifty employees, most of them having worked less than a year. Some were picked up by the District for civil works, others transferred to the Postal Service, and the remainder were laid off. The District completed the post office at Lexington, accepting the facility from the contractor on May 23, 1973, and delivering it to postal authorities. It also continued to direct construction of the post office at Richmond, which was completed in September 1973, and of the Cincinnati bulk-mail center. The Cincinnati project had fallen behind schedule, largely as a result of the many design changes made after construction had begun. "Contract administration is becoming more difficult and considerable manpower is being expended in processing drawing changes and administration," said



Aerial view of Cincinnati Bulk Mail Center, August 20, 1974, which was constructed under Louisville District supervision during the early 1970s.

Colonel Charles J. Fiala in comment on the delay at Cincinnati.[7]

With the exception of the Lexington, Richmond, and Cincinnati facilities which the District continued to manage until their completion, the postal projects were transferred from the District by June 30, 1973. Though the Lexington and Richmond jobs were done by September, the work at Cincinnati suffered additional delays. The delays resulted from the design changes, from the high congestion of the work, all under a single roof with consequent safety problems, and also from late delivery of scores of truckloads of complicated mail-handling equipment that had to be properly installed. The District finally turned the Cincinnati bulk-mail center over to postal authorities for operation on June 30, 1975, leaving only the settlement of contractor claims to get the District entirely out of the post office contruction business. The Chief of Engineers laconically summed up the results of the post office mission throughout the nation:

> The current interlude--in and out-- of the Postal Construction business, was truly a demonstrated example of the flexibility of our organization. I know that this billion dollar a year business was placed in our hands because of our past record of achievement. Neither we nor the Postal Service wanted to sever the relationship but the powers that be seemed to believe we were getting too big. Regardless, while we are in the process of transfering it back to the USPS, we do have another very satisfied customer.[8]

Wastewater Management

The Louisville District and the Corps in 1983 was actively involved in a national effort for the better management of wastewater in support of the Environmental Protection Agency. The Corps and the District had developed expertise and gained experience in the field of wastewater management during the early 1970s while searching for solutions to wastewater and other urban water resource problems. Nearly seventy percent of the nation's population lived in urban areas by 1970 and, in spite of the expenditure of some $6.2 billion on waste treatment plants between 1956 and 1970, the nation's waterways had become increasingly polluted. Some Corps officers during the late 1960s urged that the Corps organization be used to solve urban wastewater problems and Colonel John Rhett, the District Engineer in 1969, declared that "increasing our professional capabilities in some of the most significant of these other planning fields, particularly that of community and urban planning, is highly desirable."[9]

Congress in 1971 directed the Engineers to initiate pilot wastewater management studies in six urban areas across the United States to formulate alternative methods for treating wastewater before its return to streams and groundwater. The resulting studies often suggested use of land treatment methods, or the spraying of effluents on areas such as abandoned strip mines to restore the productivity of those lands, but that proposal met social and political resistance. Those studies had scarcely started when the Corps recognized that planning for wastewater treatment could not easily be separated from planning for all urban water resource problems, and Congress approved that concept in 1972. It authorized the Corps to conduct urban studies to assist local governments trying to meet their obligations under the provisions of the 1972 Federal Water Pollution Control Act Amendments which mandated improved water quality and the construction of the facilities needed to achieve it.[10]

The Cincinnati, Lexington, and

Louisville urban areas expressed initial interest in securing assistance from the Louisville District with studies of their wastewater and general water resource problems, but only Lexington obtained funding from Congress for a $750,000 three-year urban study. Hugh A. Ward became chief of the urban studies branch established by the District in 1973, and he announced the branch would devise five alternate plans for meeting the water resources needs of Lexington and parts of six nearby counties included in the urban area. The District would supply the engineering and help bring the concerned local governments together at a series of workshops and meetings to discuss the issues; the District would not press for approval of the alternate plans developed, nor would it be involved in implementing the plan selected by local governments. The District's urban study service therefore resembled that of a consulting engineer. Some environmentalists were enthusiastic about the urban studies efforts. "This is what we've been trying to get the Corps to do for five years," commented a representative of the National Wildlife Federation: "Every time we have testified about the need to clean up the nation's water, we have said that it is a shame the Corps is wasting its time and money on useless, indeed harmful, dams when it could be constructively involved in cleaning up air and water pollution."[11]

The emphasis at Lexington, as with other ongoing urban studies, was placed on intensive public involvement and frequent meetings with representatives of local governments, on shifting decision making to the local governments while the Corps provided consulting engineering services for wastewater treatment, drainage, water supply, water quality, urban flooding, and in sum every water-related problem perceived in the Lexington area. The urban studies branch even printed *Bluegrass Water News*, a newsletter aimed at keeping local citizens interested in and supportive of the urban studies program.[12]

When the Lexington urban study was completed in 1978 and submitted to local government for implementation, the District's planning division informed local officials the District could participate in none of the various plans that had been proposed until it secured authority and funding from Congress for the purpose. One interesting recommendation of the urban plan involved the creation of environmental corridors along streams to preserve them from further structural development, allowing their use as both greenbelt floodways and as recreation areas; that proposal met opposition, however, from property owners along the streams who opposed public use of streams crossing their properties. Another planning feature called for construction of small impoundments on streams in the Bluegrass region for water supply and recreation purposes, but it also encountered opposition. "Why not dam up the Kentucky River?" asked the editors of the Frankfort *State Journal* in September 1978: "It's narrow and always a dirty brown color and . . . all those overhanging trees obstruct the view of the countryside." Ironically, genuine support for construction of a high multipurpose dam on the Kentucky River near Frankfort developed less than two months later in the aftermath of the devastating flood that inundated much of the capital city.[13]

Because many urban areas proceeded directly with construction of wastewater treatment plants for the improvement of water quality through application for grants supplied by the Environmental Protection Agency, rather than awaiting the results of long-term water resource studies done by the Corps, the promising urban studies efforts of the Corps came to an unofficial end about 1980, and the Lexington urban study became the only one of its sort completed by the Louisville District. At more than fifty of its civil works and military projects, the Corps built land treatment facilities for wastewater disposal as demonstrations of the merits of the system, and the Corps developed considerable expertise within its organization for urban water resource planning; yet, a primary Corps mission for the design and construction of facilities aimed at solving urban water resource problems never developed. The expertise and experience gained during the mission remained, however, and stood the Corps and District in good stead when they undertook a wastewater management support service for the Environmental Protection Agency.[14]

Nowhere more than in the wastewater management grant program administered by the Environmental Protection Agency was the full magnitude of the success of the national environmental movement more evident. The Federal Water Pollution Control Act Amendments of 1972, incorporated into the Clean Water Act of 1977, created a huge federal program designed to improve national water quality and involving the expenditure of billions of dollars. The acts established stringent water quality standards that every firm and government agency had to meet by specific deadlines. That stick was accompanied by a carrot in the form of federal grants of up to seventy-five percent of the costs of building facilities needed to treat effluents. Second in dollar size only to the interstate highway system as the largest public works program in American history, and far exceeding the costs of the Engineers' flood control and navigation programs, the wastewater management program was not branded "pork barrel," nor were there discussions of imposing user fees. The program was a tribute to the success of environmentalism in the nation.[15]

Aiming at making rivers clean enough for swimming by 1985, the Environmental Protection Agency in 1977 asked the Corps of Engineers for assistance with the efforts to achieve advanced "secondary" treatment of effluents from municipalities and local government sewage plants by the mid-1980s. Tasks assigned the Corps did not include the actual design and construction of the facilities but utilized its engineering capabilities to review the plans for new waste treatment plants, to recommend needed improvements in the plans, and to oversee construction through on-site inspections. Commenting that the work for the Environmental Protection Agency, along with the urban studies effort, should improve the public image of the Corps of Engineers, Colonel James N. Ellis, District Engineer, added:

> We're in an identity crisis now. In one part of the country we oppose construction that would destroy a flood plain and we're heroes. In another place, it's just the opposite. Actually, I think we're going to be at our best coming to grips with the combined economic and environmental effects of urban growth. These are engineering problems, and after all, we're engineers.[16]

Under agreements negotiated with the Chicago and Atlanta regional offices of the Environmental Protection Agency, the Louisville District entered the wastewater management program in 1978. Every few weeks it received lists of communities in Kentucky and Indiana that had received federal grants for new waste treatment plants, additions to existing plants, or the

Belmont wastewater treatment plant was one of two at Indianapolis, Indiana, monitored by the Louisville District while they were upgraded. December 1979.

extension of sewer lines. Construction division personnel checked the record of the grantees and the consultants they employed for both funding and construction capabilities and followed up the initial review with inspections of the work as it progressed. The District had no authority to order the correction of deficiencies, but it reported them to the regional office administering the grant. By the end of 1978 the District was monitoring twenty-eight grants in Indiana and twelve in Kentucky with fulltime inspection in progress at the largest projects in Indianapolis, Gary, and Louisville.[17]

Richard Schleicher, assistant chief of construction, coordinated the District's wastewater grant program in the District office, and O. Lee Meetze became area engineer at a field office for the work at Greenwood in suburban Indianapolis. In 1979 they supervised a grant monitoring effort that had increased to seventy-five grants in Indiana and seventy-two in Kentucky. Under a revised interagency agreement of 1980, the Corps expanded its role in the program to include reviewing the "biddability and constructability" of plans for facilities, advising the grantees on contracting procedures and reviewing contract change orders. By 1981 the District had twenty-two personnel assigned to the wastewater grant mission administering 256 grants in Kentucky and Indiana worth some $1.2 billion in federal funds. Some individual plants were enormous; the $270 million wastewater plant in Indianapolis, for instance, in terms of cost ranked in size with the largest single military contract ever awarded by the Engineers.[18]

The Environmental Protection Agency again in 1982 requested Corps assistance in connection with efforts to clean up hazardous and toxic wastes called the "Superfund" program. Certain toxic waste dumps requiring remedial engineering to prevent further contamination of the surrounding environment were to be cleaned up through contracts with private firms, with the Corps of Engineers in some emergency situations serving as the government's contracting officer. Some Engineer Districts in the Ohio River Division had received missions in the "Superfund" program by 1983, but the Louisville District had yet to receive such an assignment.[19]

Dam Safety Inspection

The ability of the District and the Corps to respond to changing national priorities was also tested during the national dam safety inspection effort conducted between 1972 and 1982. Following the failure of a mine slag pile forming a dam on Buffalo Creek, West Virginia, in February 1972, with the consequent loss of more than a hundred lives, Congress directed the Engineers to inspect all similar mine tailing impoundments for safety, and the states of Illinois, Indiana, and Kentucky were assigned to the Louisville District. Working with state authorities, the District inspected mining along streams in all three states; it found no slag piles in the relatively flat terrain of Indiana and Illinois that seemed extremely hazardous, but of the 245 sites inspected in Kentucky it found 14 that were very hazardous and 46 that were unsafe. Those reports were submitted to Congress and to state governments, which notified mining companies that remedial actions were necessary. When the Engineers checked what had been done in 1976, they found the companies had removed or repaired all the hazardous dams.[20]

Just as the inspection of mining impoundments had begun, the nation was shocked again by the heavy loss of life following the failure of private dams at Rapid City, South Dakota, and in the northeastern states during the Hurricane AGNES disaster of 1972; and in August Congress enacted the National Dam Safety Inspection Act (Public Law 92-367) ordering the Corps to inventory all dams in the United States more than twenty-five feet high or storing more than fifty acre-feet of water and to follow that up with a safety inspection of nonfederal dams. Through contracts with state governments to supply lists and descriptions of the dams in each state, the Louisville District learned there were about eight hundred nonfederal dams in Kentucky and five hundred in Indiana of which more than two hundred were rated as "high hazard," meaning not that they were unsafe but that their failure was likely to destroy property and lives. By 1974 the national inventory of dams had grown to 49,000, of which only about 2,000 were federally constructed. While Congress had funded the inventory of dams, it had not supplied money requested by the Corps of Engineers to undertake safety inspections of the structures. The budget office representing the views of the President rejected the request of the Corps for funds to undertake the dam inspections, apparently preferring to rely upon state governments for the inspection work.[21]

Another private dam failure in 1977

finally brought funding for the safety inspection program. In November of 1977 a dam at Toccoa Falls, Georgia, failed during heavy rains, leaving thirty-eight people dead at the Toccoa Falls Bible College; the dam had been listed on the Corps inventory as hazardous. Immediately following that disaster, President Jimmy Carter ordered the Engineers to start inspecting dams for safety, promising that the necessary funding would be forthcoming for the action.[22]

Action there was. The Louisville District, like every other District in the country, fielded teams cooperating with state agencies for the inspection of dams thought to present the greatest hazards and negotiated contracts with architect-engineer firms to complete the remainder of the inspections. At the conclusion of the mission in 1981, the District had located and inventoried a total of 1,033 dams in Kentucky and 797 in Indiana, inspected 287 in Indiana and 321 in Kentucky, and furnished the reports to state governments for further action because the Engineers had no authority to require the modification of unsafe dams. The Corps nationwide inventoried 68,153 dams and inspected 8,818, finding 2,925 of those inspected unsafe for various reasons, chiefly inadequate spillway capacity. Under maximum flooding conditions at dams with inadequate spillways, water would overtop the dams, probably eroding them and causing their failure and releasing their lakes.[23]

At the conclusion of the dam inspection program, Colonel Charles E. Eastburn, the District Engineer, told the Division Engineer that the District had completed the work at an average cost of $6,400 for each dam inspected, which he thought was the lowest in the Corps. He apparently was correct, for the average cost per dam within the entire Division was $7,300 and the average nationally was $9,230. Brigadier General R. S. Kem, the Division Engineer, responded: "Louisville District's performance record on the non-Federal Dam Inspection Program is commendable. Not only did the District produce the work on schedule each year while handling three times as many inspections as anyone else, but also the District work cost approximately 10 percent less than the Division average."[24]

Not everyone was pleased by the results of the dam safety inspections, for residential associations, land developers, local water districts, and individuals who owned the unsafe dams were faced with expensive repairs and modifications to bring their dams into compliance with safety standards. They principally objected to use by the Engineers of "probable maximum precipitation" records within the Ohio River basin to determine the desirable spillway capacity. The Kentucky record for the most rain in six hours was 8.85 inches at Scottsville in 1969, and the most rain in a single day at Louisville was 6.97 inches, but the Engineers used 26.7 inches of rain in six hours to compute the "probable maximum precipitation" used to establish spillway capacity; that figure exceeded the record rain experienced in any single month within Kentucky-- the 22.97 inches that fell over Earlington, Kentucky, in January 1937. The Corps thought that figure realistic, however, for a rain of that magnitude had occurred at Smethport, Pennsylvania, located on a tributary of the Ohio River in July 1942. A member of the District's hydrology branch commented that because such a rain had fallen once in the Ohio River basin it was merely "a matter of fortune that it hasn't occurred here."[25]

After the dam safety inspections were completed and the final reports submitted to state governments and to Congress, the Corps closed the mission because it lacked the authority necessary to force owners of unsafe dams to make the modifications needed; it asked Congress for sufficient funding to update the inventory of dams regularly and it recommended that state governments establish continuing and effective dam safety inspection programs. In the absence of federal funding for such programs, however, few states undertook systematic dam inspections, and the final Corps report on the subject to Congress concluded with a rare bit of cynicism: "Most states have shown an unwillingness to implement and maintain effective dam safety programs with state funds. Additional dam failures will likely occur before the states give adequate priority to their dam safety programs."[26]

Energy Crises and Hydropower

When the oil embargo, subsequent fuel shortages, and escalating prices for energy began in late 1973, the Louisville District was inevitably affected: the use of government vehicles was rationed, making routine travel required for the performance of District missions difficult, and firms bidding on contracts for Corps projects sometimes qualified their bids with the phrase "subject to the availability of fuel." On February 28, 1974, the District established an energy conservation committee to search for ways to reduce the District's energy uses. Office thermostats were turned down in winter, up in the summer, and it became rather uncomfortable in various sections of the District office, depending in part on the angle of the sun in relation to the building during the day. Those and many similar energy conservation measures eventually produced results: by 1981 Corps installations throughout the nation were using about thirty-eight percent less energy than they had in 1974, saving some $60 million in energy costs in 1981 alone.[27]

As part of its energy conservation efforts, the District also experimented with solar power. In 1979 solar-heated water systems supplemented electric service in buildings at the Cave Run, Rough River, and Barren River lakes, and the District began construction of a solar heated and cooled office and maintenance building at the Taylorsville Lake project. The 6,650 square-foot building at Taylorsville had glass roof panels which allowed the sun to heat a solution which in turn heated water supplying the building with heating and air-conditioning. Having a heat storage capacity of one and a half days, with a backup electrical system for periods when sunshine was inadequate, the solar system at Taylorsville was expected to supply more than half the power needed in the building. The amount of electricity used would eventually permit full assessment of the system's cost effectiveness, and that information would be disseminated for public use.[28]

In connection with the District's response to the national energy emergency, it should be noted that for a brief interlude in 1976 and 1977 the District furnished support services to the Federal Energy Administration. At the request of that agency in connection with efforts to secure a national strategic petroleum reserve as a hedge against future oil shortages, the District's real estate division undertook to map the routes of pipelines and subsequently to acquire the easements and lands needed for petroleum reserve storage sites planned at Lexington, Kentucky, and Ironton, Ohio. Because the requesting agency wanted the reconnaissance and mapping completed by May 1, 1977, the District's real estate division worked initially under very tight deadlines. The District mapped the two sites and the routes of the pipelines, marking the centerline of the routes and appraising the lands along the rights-of-way. The work was complicated by a request from the agency after surveys had nearly been completed that the route of a pipeline be moved about a mile from its original location. Near the end of 1977, the Federal Energy Administration placed both the proposed petroleum reserve storage sites in the deferred category, and the District suspended its activities.[29]

Steep increases in the cost of electric power generated at oil, coal, and nuclear plants during the 1970s stimulated renewed public interest in development of clean and renewable hydroelectric power. Hydropower plants during the 1930s had supplied about thirty percent of all electricity used in the nation, but that figure had declined to about twelve percent by 1977 because the low cost of oil and coal made it more economical to build steam plants than hydroelectric dams. Many of the small municipal dams that once supplied communities with electricity had been abandoned, and when the Corps proposed that hydropower be included as a purpose of its high dams it was often informed that power produced at the dams would not be economical in comparison with steam electric plants. The percentage of the decline of hydropower was relative, however, to the immense growth of national demand for electric energy, for the Corps actually multiplied its hydropower production ten fold between 1930 and 1978.[30]

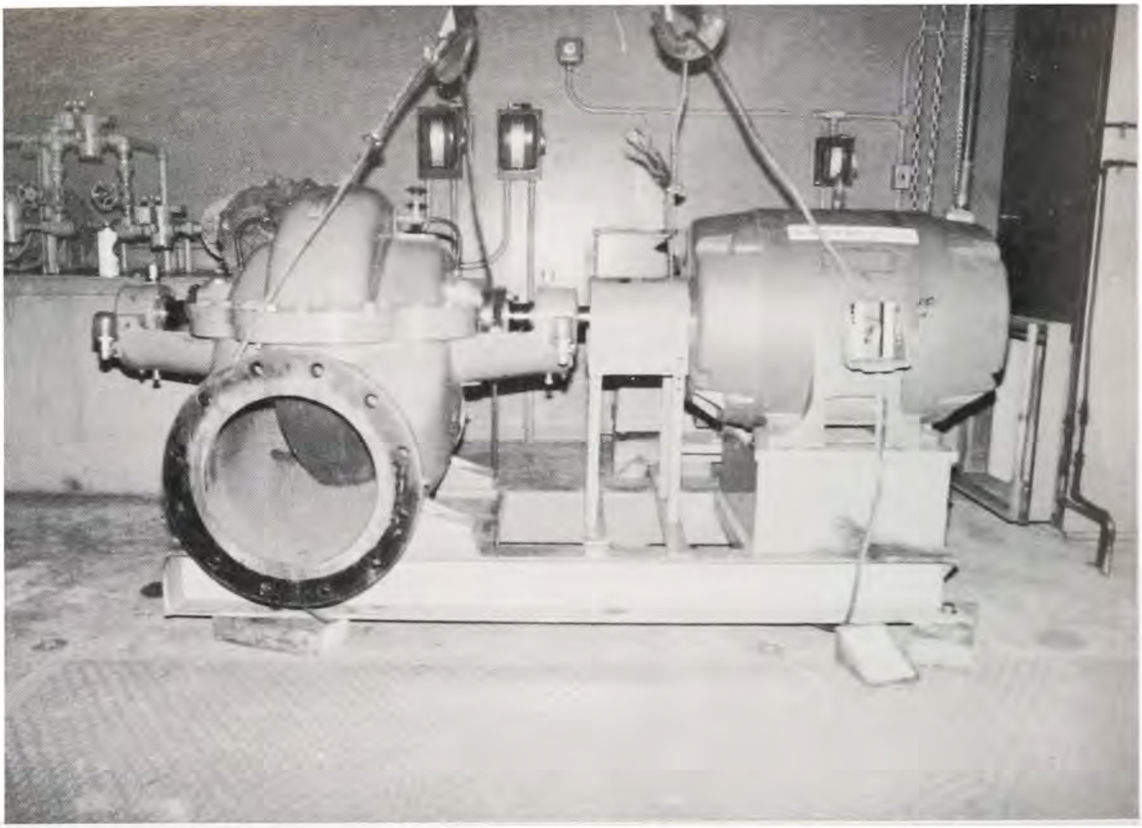
Taylorsville Lake office building with solar panels furnishing heat and cooling for energy conservation.

The Corps by 1978 had more than sixty dams generating hydropower, producing about a quarter of all hydropower in the nation and supplying about four percent of the total national energy consumption. The Corps hydropower dams were concentrated, however, in areas such as the Pacific Northwest and the Cumberland River basin where public and congressional support for government-produced energy was apparently stronger than elsewhere. No dams within the Louisville District were designed for government-produced hydropower, though at a few projects hydropower was produced through cooperative arrangements with private utility companies. Since the 1920s, the Louisville Gas and Electric Company had operated a hydropower plant at McAlpine Dam and the Kentucky Utilities Company had produced electric power at Dam 7 on the Kentucky River. At the old wicket dams on the Ohio River, the "head," or fall, of the river was insufficient for economical hydropower production, but the navigation modernization structures replacing two or more old wicket dams offered an increased head for power production; facilities were provided in the District's design of the new dams to permit the addition of hydropower generators when it became desirable. The Public Service Company of Indiana took advantage of that feature at Markland Locks and Dam downstream of Cincinnati, installing a hydropower generating plant at the dam during the mid-1970s.[31]

The rising cost of oil and other fuels during the 1970s made hydropower more attractive financially at both Corps projects and at private dams; the Corps inventory of dams revealed that only 800 of the some 50,000 dams in the nation produced hydropower. With increased financial incentives, the long stagnant technological development of turbines for hydropower production resumed during the 1970s with much resulting improvement in their capability for producing power under low heads. Congress in 1978 enacted legislation providing incentives for the development of hydropower at small dams and requiring that regional public utilities purchase the power at the dams, no matter who produced it. The District, like other Corps field offices, was flooded after 1978 with permit applications for study of the hydropower potential of streams within its jurisdiction and at its navigation and flood control dams.[32]

By 1981 the District had received applications to study the development of hydropower at forty-seven dams, generally two or three applications for each dam, and all had to be reviewed in the District's engineering division and forwarded with comment to the Federal Energy Regulatory Commission, the new name for the Federal Power Commission that had been established in 1920. Because federal law gave municipally owned utility systems priority over investor-owned utility companies, the small town of Vanceburg, Kentucky, secured permits for the study and development of hydropower at several navigation modernization structures on the Ohio River, including the four new dams downstream of McAlpine Dam at Louisville. Vanceburg made news in 1980 when it arranged the shipping of a power plant all the way from France by sea and by river up the Ohio to Greenup Locks and Dam.[33]

The District also studied the hydropower production potential at sites throughout the region to supply information requested by the Department of Energy and the Chief of Engineers for the National Hydropower Study. With Dennis J. Kamper serving as hydropower coordinator, the District also studied under



Interior of the control tower at Brookville Dam and Lake, Indiana, with the equipment for hydroelectric power production ready for installation.

authority of Section 216 of the 1970 Flood Control act, the development of hydropower at its multipurpose projects, centering upon the Brookville, Harsha, Caesar Creek, Cagles Mill, and Rough River dams. Conversion of those dams into major sources of hydropower would have required nearly complete reconstruction of the dams, but the concept for the study involved conversion of the existing dams merely to produce sufficient power for operation of the dam with any surplus power to be marketed through the existing power systems. "Every little bit we can generate with hydro displaces some nonrenewable fuel," commented Mr. Kamper, and he added: "Frankly, there is a potential at any site with water falling through a height. The trick is to get the water to turn a turbine efficiently and to generate more revenues than it costs to build."[34]

The District conducted its first experiment with hydropower at one of its multipurpose projects by installing a small turbine in the control tower of Brookville Dam in Indiana where a generous water supply and relatively constant head were available. Though the limited space available inside the tower restricted the size of the turbine, it was estimated it might produce sufficient power for the structures operated by the District at the site and perhaps save the equivalent in energy of 7,000 gallons of oil annually. Power excess to project needs was to be fed back into the commercial electric system to offset metered charges. Installation of the turbine began in 1981, but the generator had yet to be operated in 1983, awaiting a policy decision on disposal of the power it could produce.[35]

The Engineers did not tout hydropower as a solution to the nation's energy problems, though they did point out it could help establish a better power source mix. Unless great advances were made in turbine technology, few of the Engineer dams already built offered opportunities for substantial power production unless pumped storage projects were developed. There was one pumped storage facility at an Engineer project on the Allegheny River, at which water was pumped into a reservoir at night or other periods of low power demand, then released to produce hydropower during peak demand periods, functioning somewhat like a giant automobile battery. The main contribution of projects in the Louisville District to national energy needs was not hydropower production but the ample water supply they furnished for cooling fossil and nuclear power plants and the reliable water transport they provided for delivery of fuel used to produce electricity.[36]

The Falls of the Ohio

While the Engineers during the 1870s had campaigned on behalf of the creation of a national parks system and had operated the first national park until the National Park Service was established, their role in park and fish and wildlife management during the 20th century had generally been limited to the development of their flood control and multipurpose projects. It therefore was somewhat unusual in 1981 when Congress directed the District to purchase and subsequently manage a wildlife conservation area at the Falls of the Ohio within the Louisville urban area.[37]

What to do with the Falls of the Ohio, the fossilized coral limestone reefs near McAlpine Locks and Dam, had troubled both the states of Indiana and Kentucky and the Corps of Engineers for many years before 1981. Because the Falls had blocked river navigation during pioneer days, the city of Louisville and the cities on the Indiana side had grown there at the point where river freight was transshipped, and in 1830 a public corporation had completed the Louisville and Portland Canal to carry river boats past the Falls. The Louisville Engineer District had been established chiefly to take care of that canal and to improve navigation at the Falls during the post Civil War era; it had constructed a dam across the head of the Falls in the 19th century, had rebuilt it as Dam 41 about 1915, and had replaced that dam with McAlpine during the 1960s. Those dams had inundated a portion of the Falls of the Ohio, but the Falls nearest Indiana on the downstream side of McAlpine Dam had remained. The area interested geologists and paleontologists who found nearly 900 species of coral fossils at the site and ornithologists who sighted some 245 species of birds near the Falls.[38]

The National Park Service investigated the Falls area in 1968 and recommended it become a park administered by a bi-state commission, and when Congress approved that concept in 1970 the states of Kentucky and Indiana formed such a commission. The bi-state commission met several years, but was beset by funding and other difficulties and never developed the proposed park. The Louisville District was intensely

Aerial view of the Falls of the Ohio, the exposed limestone reef below McAlpine Dam which in 1981 became a National Wildlife Conservation Area. Visible near the top of the picture are the hydroelectric power plant and locks of McAlpine Locks and Dam.

interested in planning for the Falls area because it related directly to the functioning of the McAlpine Locks and Dam and to operations of the repair station located on Shippingport Island between the canal and the Falls. Shippingport Island was government property and was used only by permission of the District for bird and other nature studies. In 1972 the District began studies of McAlpine Locks and Dam, including scale model testing at the Waterways Experiment Station at Vicksburg and encompassing ways by which project operations might be modified to remove silt deposits that were forming atop the limestone reef at the Falls.[39]

During the Louisville bicentennial celebration of 1978 several interesting suggestions were made by the public for development of the Falls area. One proposed construction of a historical park on Shippingport Island with a replica of the fort built on Corn Island in 1778 by George Rogers Clark. Another suggestion involved a giant fountain or water spout near the tip of Shippingport Island that would have sent skyward a spray resembling the fleur-de-lis, the symbol of Louisville. A third suggested construction of a canoe slalom along the Indiana bank, providing a thirty-seven foot drop from the dam to the downstream end of the falls and practically year-round whitewater canoeing in the center of the Louisville urban area. None of those suggestions earned substantial community support.[40]

The District completed its study of the McAlpine project in 1978 and one recommendation called for building a deflector dike and a slight reduction in the dam crest upstream of the fossil beds to remove the sediment covering them—after some agency had been made reponsible for protecting the Falls and their fossil beds from vandalism. Congressmen in Indiana and Kentucky introduced bills to make the Falls of the Ohio a national park, a wildlife management area, or a wildlife conservation area, and in 1981 a bill sponsored by Congressman Gene Snyder of Kentucky was enacted, allowing the Department of the Interior to designate a wildlife conservation area at the Falls and providing that the Corps of Engineers would acquire the lands needed and also manage the area after it was established. Working with the Department of the Interior, the District's planning and real estate divisions studied development of the site and titles to the lands which might be acquired, and at the end of August 1982 Congressman Gene Snyder and Romano Mazzoli of Kentucky and Lee Hamilton of Indiana together with federal and local officials aboard the *Belle of Louisville* dedicated what was to become the sole National Wildlife Conservation Area in the United States. Initial funds needed for management planning and land acquisition were allocated in 1983.[41]

Continuing Authorities

One of the few elements of the District's civil works mission that expanded during the late 1970s and early 1980s was its continuing authorities efforts headed up by Robert E. Ledford of the planning division. In a series of authorizations, Congress had extended discretionary authority to the Engineers to undertake small flood control projects without requesting specific authority and funding for each individual project from Congress, thereby reducing the time from project conception to completion from an average of about twenty-six years for the larger projects to five years or less for small projects in the continuing authorities program.

The Louisville District had one of the larger continuing authorities program in the nation during the early 1980s. When local interests complained of frequent flooding by small streams or of their need for bank protection for public facilities, they could contact the District directly for action rather than going to Congress, though some of the small projects began when congressmen referred constituents to the District. After a local sponsor—a city or county—sent a letter to the District stating they were legally and financially capable of meeting various responsibilities required by the program including, among other things, furnishing rights-of-way and making necessary alterations to bridges and utility systems, the District conducted a brief study to assess the program, devise various alternative solutions and determine their economic feasibility, and decide which, if any, of the continuing authorities applied to the particular situation.[42]

The continuing authorities program included a number of authorities given the Engineers by Congress. Under Section 205 of the 1948 Flood Control Act, the District could consider undertaking small flood control projects costing no more than $2 million in federal funds, or $3 million in cases where communities had suffered a major flooding disaster during the previous five years. Under that authority, the District might construct a project to provide flood protection, which might include development of a greenbelt park along the stream as a nonstructural flood control measure along with enlarging the stream channel or other appropriate measures. Section 208 of the 1954 Flood Control Act allowed the District to clear streams of snags, logjams, and other debris obstructing their flow up to a federal cost limit of $250,000. Public facilities threatened by caving banks such as roads, utilities, water or sewage plants, or other facilities could get assistance from the District under Section 14 of the 1946 Flood Control Act, again limited to a federal cost of a quarter of a million dollars. In some instances, Public Law 99 covering Engineer emergency repair of existing flood control structures was applied, along with a few other less often used continuing authorities provided by Congress.[43]

Once the District determined one of the continuing authorities applied to a local situation and there appeared to be an economically feasible solution to the problem, representatives of the District's planning division presented the results to the affected community at a public meeting, where those representatives were candid about the role of the District as a partner with the local sponsor representing the citizens. When Robert Ledford and Gordon Trainor presented plans for clearing Lick Creek to the people of Hartford City, Indiana, in August 1981, Ledford told the crowd: "You're not stuck with us. We're not directed to do this by Congress; they didn't say go up and bug the people in Blackford County. If it meets our rules and regulations, we'll recommend it, if you want it. If you don't like it, we'll pack our bags and go home." In some instances, that was precisely what they did, for the local governments wanting help usually had limited resources to pay the local share of project costs and maintenance.[44]

If the local sponsor wished to proceed, the District prepared detailed plans itemizing the benefits and costs of the project including its environmental, social, or cultural impacts and sent a report to higher authority for approval. Though Section 221 of the 1970 Flood Control Act stiffened the contractual agreements required for local cooperation, though rising inflation caused troubles for local communities trying to raise the cost of the local cooperation requirements, and though construction schedules were often disrupted when local sponsors encountered problems securing rights-of-way, the continuing authorities program proved an expeditious and effective approach to smaller local water resource difficulties. By 1981 the District had completed thirteen snagging and clearing projects (Section 208), eleven small flood control projects (Section 205), seventeen bank protection projects (Section 14), and had about thirty additional continuing authorities projects under study.[45]

One of the more interesting projects in recent years was at Perryville, Kentucky, on the Chaplin River where flood protection blended with beautification and the preservation of historic buildings. A favorable report completed at the end of 1976 called for enlargement of about three-quarters a mile of stream channel passing through Perryville. The channel would not be a concrete-lined ditch, but rather would retain the pools and riffles of the stream to preserve aquatic life, would be lined with trees and shrubs to create a park-like atmosphere, and would preserve historic buildings adjacent to the river, including the restoration of a stone retaining wall behind "Merchant's Row" on the left streambank. At a July 10, 1981, meeting, Robert Ledford pointed out the project would be a partnership,the Engineers supplying the engineering and construction, the city the rights-of-way and maintenance, and the citizens the lands for the project, and therefore local sponsors should

Aerial view of the Chaplin River flowing through Perryville, Kentucky, April 2, 1981. The Louisville District began a unique local protection project at this site in 1983.

make the decision whether or not to proceed. Within a week after that meeting, Perryville was inundated by flooding that cut off electric service, flooded homes, forced people to seek refuge, and closed the main highway through the city to traffic at the Chaplin River bridge. Construction of the project began in late 1983.[46]

Criticism of the District's continuing authorities program generally emanated from two sources: from citizens who thought the several years required to plan and complete one of the projects, though very fast in comparison with projects requiring specific authorization of Congress, still too long and blamed the delay on "bureaucratic red tape," and from environmentalists who deplored the loss of wildlife habitat and other damages that can result from stream channelization—which involved widening and enlarging streams often at the cost of vegetation and aquatic life. In comment on stream channelization projects, a member of the Kentucky Audubon Society said: "We feel it only satisfies landowners, politicians, and the Corps of Engineers—in other words, a huge pork-barrel program."[47]

The District sometimes rejected proposed channelization projects on precisely the grounds mentioned by environmentalists. The Deputy District Engineer, Lieutenant Colonel Bruce M. Cowan, announced in 1981, for instance, that the District had disapproved an extensive stream channelization project proposed in Indiana because it would damage "a biologically significant area providing excellent fish and wildlife habitat." And at channelization works that were undertaken the District adopted various mitigation measures: clearing snags and logjams with hand labor to avoid damages to vegetation resulting from use of heavy equipment, performing excavation on only one side of the stream to leave the other bank in its natural condition, or making the new channel a greenbelt floodway while leaving the old channel with its meanders to carry low water flows.[48]

Nonstructural Flood Control

Because floodplains were created by rivers, the rivers used them and mankind therefore had only two basic choices: to build structures to protect the inhabited sections of floodplains or to move out of the way of floods, the latter often described as nonstructural flood control. Though nonstructural flood control received added emphasis during the 1970s, the Engineers had been interested in the concept for a number of years. Zoning for floodplain management was a local, not federal, prerogative however, and the bulk of the public looked upon zoning as an infringement of their property rights. Brigadier General E. R. Heiberg, III, the Ohio River Division Engineer, in 1977 described the problems encountered by the Corps with nonstructural flood control:

> You're walking into a political thicket when you walk in as a federal guy and suggest local zoning as the answer. We're normally told: solve the flooding problem. We're not asked to come up with suggestions that local people have better zoning laws. Our emphasis should always be on nonstructural solutions. The unfortunate part is in West Virginia and East Kentucky, when you talk about nonstructural solutions, you're immediately up against the problem: where do they go?[49]

The Louisville District started active pursuit of better nonstructural flood control through improved floodplain management in 1966 when it established a floodplain management services section headed by Steven Thrasher. That year it began producing floodplain information studies identifying for local governments

View of the Louisville District's Word Processing Center, January 1984. The Center opened in 1977 to speed the District's written communications.

the precise location of lands subject to flooding. Congress added teeth to the program when it approved federally subsidized flood insurance in 1968, later requiring that the insurance be made available only to communities which had adopted zoning to achieve better floodplain management. The District's floodplain information effort therefore merged with flood insurance studies, used to establish a base for setting insurance premium rates, which were undertaken through agreement with the Department of Housing and Urban Development and subsequently with the Federal Emergency Management Agency.[50]

The Louisville District in 1970 completed the first flood insurance study within the Ohio River Division at Aurora, Indiana, and by 1974 had scores of similar studies underway. The Corps completed thousands of those studies across the nation during the 1970s and in 1980 the effort began to draw to its close, with the Federal Emergency Management Agency undertaking to complete the work at the communities still not covered. Reflecting that decline of workload, the District in 1982 merged its floodplain management branch with its project planning branch into a single special studies branch comprising eleven people and headed by

View of interior of the Louisville District's Automatic Data Processing Center, January 1984.

Robert E. Ledford. That branch would handle both the District's continuing authorities program and its floodplain management efforts along with a variety of other studies.[51]

While floodplain management and nonstructural flood control received the increased emphasis they deserved as befitted the "decade of the environment," the 1970s could with equal propriety be described as the "decade of diversification" for the Corps of Engineers and its Louisville District. During those years the District gained firsthand experience with wastewater management, solar power, and hydroelectric power. It inventoried every dam in its area and inspected those which were hazardous; it performed intense studies of urban water resources, built post offices, mapped strategic petroleum reserves, and conducted flood insurance studies. It provided support services for several other agencies learning in the process how to function in the role of consulting engineer. Some of the support services were short term and others of a longer range character, but all challenged the flexibility of the District, proving it was able to mobilize and demobilize in short order as circumstances required and providing it with a reservoir of experience that should prove useful in the future.

CHAPTER X: MISSIONS OF THE 1980s

When Jimmy Carter was elected President in 1976 after a campaign in which he promised to put the Corps of Engineers out of the dam-building business, there was little he needed to do to fulfill his campaign promise within the Louisville District, for no new big dams had been authorized for construction within the District since 1968. By the time President Carter was elected the District's civil works mission was waning as navigation modernization structures on the Ohio moved rapidly toward completion and eight multipurpose dams on the tributaries steadily rose toward their full heights. By 1983 the last of those big dams was completed and the District's civil works mission was concentrated chiefly on finishing three large local protection projects at Louisville, Cincinnati, and Evansville, all of which had been authorized for construction before 1971. The "decade of the environment" apparently brought to a close the construction of traditional civil works projects, or at least the most active phase, in the Louisville District, and during the 1980s it returned to its military construction and real estate functions, a change that might warrant labeling the 1980s the "decade of defense."

The large local protection projects at Louisville, Cincinnati, and Evansville combined flood protection with various recreational and industrial development goals of local governments, all requiring that local sponsoring agencies pay a large share of project costs, acquire the rights-of-way, and maintain the projects after their completion. The extent of local participation in those projects meant that several elements of the Louisville District's organization did not have an extensive role in their completion and functioning.

During the 1980s, the engineering division no longer designed big dams, the real estate division no longer acquired lands for large civil works projects, and the construction division no longer administered the construction of big dams. As those elements declined, the operations and maintenance of completed projects increased; yet, even the operations division did not experience major expansion, for the new locks on the Ohio River replaced two or three old locks and recreation facilities at the multipurpose dams completed after 1970 were managed by state agencies, not by the District. It seemed in 1980 that the District would eventually become an operations only District, as had occurred at other Engineer Districts. Then, in 1981 military construction and real estate missions returned to the District after a ten-year absence.

Each year the District conducted an Engineer Day awards ceremony, held on June 16 on the anniversary of the appointment of the first Chief Engineer of the Army in 1775, at which personnel distinguished by their work or long service to the District were honored. At the 1976 ceremony, Colonel James N. Ellis pointed out the District was in transition. Within the year, William E. Leegan had succeeded Roy Karlen as chief of the District's engineering division, Neal Jenkins had followed Leegan as chief of planning division, Richard H. Russell had transferred to the Nashville District leaving Jack E. Kiper as chief of construction division, and John R. Bleidt retired that month as chief of operations division, to be succeeded by William N. Whitlock. Colonel Ellis mentioned the number of personnel employed by the District had been dwindling and warned that additional reductions lay ahead as the big dams were finished. Ellis said he was abandoning several controversial projects in earlier years that had consumed a great deal of the District's attention without productive results. The only civil works projects coming on line for the "out years" were four large local protection projects: the Dayton and Mill Creek projects located within the Cincinnati metropolitan area, the Pigeon Creek project at Evansville, and the Southwest Jefferson County project at Louisville.[1]

Dayton, Kentucky, Local Protection Project

Just before leaving office, President Gerald Ford submitted to Congress the largest civil works budget in American history, and when President Jimmy Carter reviewed that budget he loosed a bombshell on February 19, 1977, with a "hit-list" of nineteen projects he wanted removed from the budget and a directive requiring critical review of all major water resource projects with respect to their economic and environmental impacts. Colonel James Ellis commented that he welcomed the review: "There were a number of projects authorized as far back as the 1930s—frankly there were some old dogs that really needed a fresh look."[2]

On the Carter hit-list was the local protection project at Dayton, Kentucky, across the Ohio River from Cincinnati, which apparently was included because it was

District personnel and retirees gather at the 1975 Awards Day luncheon, an event conducted by the Louisville District on or near Engineer Day, June 16, of each year.

authorized in 1938 at a lower discount rate than that prevailing in 1977. Parts of Dayton had been flooded some eighty times since 1858, or an average of eight times every eleven years, and after half the town was flooded in 1937 Congress approved construction of 8,170 feet of levee and two pumping plants to hold out the river. Dayton was unable to raise the funds required as its share of project costs and flooding continued for years, reducing property values in the city with accompanying losses of tax revenues and deterring businesses and industry from locating in the community, which except for flooding was a desirable site in the Cincinnati urban area. Plans for urban renewal in Dayton hinged upon the achievement of some measure of flood protection, and in 1970 the citizens voted to tax themselves to retire bonds needed to finance the city's share of the levee costs. When news reached Dayton that its levee was on the hit-list, some taxpayers were outraged and one remarked: "I don't think he [Carter] is aware of the fact that Dayton put its pocketbook where its mouth is. I don't think he knows Dayton exists. But these hard-headed Dutchmen here will remember him."[3]

During its review of the project, the District held a public meeting attended by Senator Wendell Ford and other officials at Dayton on March 29, 1977, and none of the several hundred people attending expressed any opposition to the project. After the record of that meeting went to Washington, President Carter removed Dayton from his hit list, indicating that strong local participation in project costs and the lack of any significant opposition to it convinced him its funding should continue.[4]

A bulldozer flattened one of the condemned buildings at the levee site to break ground for the Dayton project on January 3, 1978, and three weeks later President Carter added $1.9 million to his budget to fund continued work at Dayton. Demolition of old buildings in the way of the levee was followed by rerouting a main sewer line to two new outfalls; excavation and backfilling of the key trench under the levee began in 1979, followed by placement of the levee fill and construction of the two pumping stations in 1980. Resident Engineer James Houchins and Construction Inspector Robert Hess provided the on-site supervision for the District. Work fell behind schedule during the rainy summers of 1979 and 1980 because it became difficult to control the moisture content of the levee fill, but the last dirt was placed on November 16, 1981. The levee crown was later paved as a walkway connecting with recreation parks the city planned to develop alongside the levee. When Colonel Charles E. Eastburn dedicated the project on September 25, 1982, Dayton officials announced that several industries planned to locate in an industrial park protected by the levee; hence, the project provided the town not only with flood protection but also with opportunities for urban renewal, recreation, and new industrial and employment development.[5]

Southwest Jefferson County Local Protection Project

The City of Louisville had been protected by a twenty-one mile long levee and floodwall with thirteen pumping stations built between 1947 and 1956, but that project afforded no protection to the suburban Jefferson County area that also suffered flooding. During the 1937 flood, 15,000 county residents were flooded out of their homes for weeks, and in 1964 a flood forced evacuation of the Valley

David Crabill House at Clarence J. Brown Reservoir, Ohio, as restoration began.

Village and Pleasure Ridge Park communities, also closing the major north-south route, Dixie Highway. The population of Jefferson County mushroomed during the 1950s and 1960s without much concern about the hazards of development on the Ohio River floodplain, and serious flooding damages occurred in the county about every ten years. After the 1964 flood, the county requested the District to plan flood protection along the Ohio River in the southwestern part of the county. Congress authorized the project in 1968 and in 1972 voters of the county approved funding for the local share of project costs; Congressman Gene Snyder and Jefferson County Judge Todd Hollenbach broke ground for the project on October 27, 1973.[6]

The completed levee and concrete T-wall would stretch about thirteen miles along the Ohio from the mouth of the Salt River north to tie into the levee around Louisville, would average about twenty-five feet high, and would protect against floods the size of that of 1937 with three additional feet of freeboard, holding the river out of about 24,100 acres of land adjacent to Dixie Highway and Lower River Road. Four large pumping stations would handle the flows of Mill Creek and Lower Mill Creek together with other interior drainage, and initial plans proposed the impoundment of Pond Creek, creating a small recreation lake near the southern end of the levee. To direct construction, the District opened the Louisville Resident

Office in 1974 headed initially by John Emmerich who was succeeded by Norman Longworth and others. The project was divided into five sections for construction, starting with sections 1 and 2. As the first section neared completion in 1976, work on the second was delayed while archaeological study of the levee and borrow areas was undertaken as part of the District's cultural resources management program.[7]

In the 1974 Archeological and Historic Preservation Act (Public Law 93-291; "Moss-Bennett Act"), Congress extended the provisions of previous legislation concerning cultural resources management to include all federal projects and also approved the use of project funding for the recovery, protection, or mitigation of cultural resources affected by the projects. The Louisville District's efforts under the program were administered by the planning division, largely by Charles Parrish and Donald Ball who coordinated the efforts with State Historic Preservation Officers, the Heritage Conservation and Recreation Service (later absorbed into the National Park Service), and the Advisory Council on Historic Preservation. The District's cultural resources management program earned several awards, notably for the preservation of historic structures at Caesar Creek Lake and Clarence J. Brown Reservoir in Ohio.[8]

Preliminary surveys of the levee area in southwestern Jefferson County resulted in the collection of some fifty-six cartons of artifacts, indicating it was rich in archaeological sites perhaps dating back to the

David Crabill House at Clarence J. Brown Reservoir, as restoration neared completion.

Archaeologists screening the excavated materials for artifacts at the Southwest Jefferson County levee project, May 30, 1977.

Paleo-Indian period of prehistoric times. The levee construction schedule was altered in 1977 while archaeologists from the Universities of Kentucky and Louisville excavated the four most promising sites near the levee under a contract from the District administered by the National Park Service. Beneath several feet of alluvium deposited by the Ohio River were found nearly four hundred human burials and the midden of an Indian culture contemporaneous with that of Ancient Egypt. More funds were expended on these sites than on any archaeological "dig" in Kentucky history in the process of excavating as deep as twenty-one feet before reaching the lowest levels of evidence left by prehistoric peoples of the Ohio Valley. At the conclusion of the excavations, the University of Kentucky Department of Anthropology prepared an elaborate report of its findings, the artifacts recovered were added to the Falls of the Ohio collection at the University of Louisville, the sites again covered, and work progressed at the levee.[9]

Three of the five sections of levee, or nine of the thirteen total miles of levee that would be constructed, were completed by 1983, and two of the four pumping stations were ready for operation. Resident Engineer Gary Fitzgerald pointed out to the press, however, that the partly completed project would supply little flood protection in Jefferson County until the gaps in the levee system were entirely closed and all the pumping stations were in operation.[10]

Pigeon Creek Local Protection Project

The District began construction in 1939 of a floodwall and levee system to protect Evansville, Indiana, against flooding on the scale of that of 1937. By 1949, it had completed the first sections in the Howell and Knight township areas fronting on the Ohio River, thereby securing the city against direct assaults by Ohio River floods. A gap remained between those two sections, however, where Pigeon Creek entered the Ohio, which allowed the Ohio's waters to back into the city and flood low-lying areas adjacent to Pigeon Creek. Another hazard became evident in May 1961 when ten inches of rain fell over the Pigeon Creek watershed in a few days, sending torrents of floodwater down the creek from its headwaters. Some citizens wanted the District to build a dam on the creek to control headwater flooding and also for water supply and recreational uses, but the District reported such a dam lacked economic justification. It recommended instead the construction of levees along the creek to protect against both headwater flooding and backwater from the Ohio River. Evansville accepted that recommendation, proposing that the levee and creek area become a fifteen-mile long greenbelt

Archaeological excavations underway at the Southwest Jefferson County Local Protection Project in 1977 while construction of the levee continues in the background.

Aerial view of levee construction in progress in the foreground along Pigeon Creek in Evansville, Indiana.

park somewhat resembling Rock Creek Park in Washington, D C. Plans included hiking and bridle trails, bikeways, canoe launch areas, picnic and recreation areas along the creek connecting with two city parks and converting the creek from what was described as an "open cesspool-illicit dump" into a plus for Evansvsille.[11]

The District started building the levee unit nearest the mouth of Pigeon Creek in 1975, but the project encountered several snags. President Jimmy Carter included it in his 1977 "hit-list" of projects for reconsideration, then dropped it and allowed work to continue. The District, however, dropped plans in 1977 for levee construction on both sides of the creek because the levee on the Howell side was not economically justified. When the first levee section was completed in 1978, a delay ensued while the local sponsoring agency acquired the rights-of-way for the subsequent sections.[12]

Colonel Charles E. Eastburn informed the people of Evansville in August 1981 that funding requests for the greenbelt park along the levee and creek had been returned disapproved from the Office of the Chief of Engineers because local sponsors had hoped to donate lands rather than funds toward paying their share of recreational features and that proposal had been rejected. Since the sponsors were unable to provide the approximately $1.25 million needed to develop recreation features, Colonel Eastburn concluded "the recreation plan as presently formulated is no longer viable." Work on the levee continued, however, and in 1983 the District was completing another section extending farther upstream along the south side of the creek. Resident Engineer Wayne Goodaker said part two of levee unit two was expected to be completed late in 1984.[14]

Mill Creek Local Protection Project

While difficult to imagine in 1983, Mill Creek on the west side of Cincinnati during the 19th century was a placid, willow-lined stream suitable for swimming and fishing. On its banks was a race track that also served as a boxing arena for champion John L. Sullivan. By 1892, however, the lower section of the valley nearest Cincinnati had begun to fill with industry and residential development and engineers were debating the future of the stream. Some thought it should be dredged and converted into a harbor for steamboats; others thought its valley should be filled to raise the land and streets to the level of adjacent parts of the city. Nothing was done, and as the lower valley became increasingly industrialized both flash floods from upstream and Ohio River backwater floods caused huge property losses. And when the creek was not washed with floods, it served as an unofficial dump.[14]

After backwater flooding during the 1937 Ohio River flood heavily damaged industry in the Mill Creek valley, the District constructed a barrier dam across the mouth of the creek. When the Ohio rose to flood stage, the barrier dam was closed with bulkheads to hold out the Ohio and pumps in the dam moved the flow of Mill Creek through the structure. Two more pumps were added to the barrier dam during the 1970s to raise the summer flow of the creek to the level of Markland pool.[15]

The District constructed its first dam for flood control and multiple purposes on Mill Creek's West Fork in 1952. Covering only 560 acres at maximum flood storage, the little lake helped reduce flood damages along the creek and, because of its location within the Cincinnati urban area, it consistently ranked among the top projects in the District for recreation usage. Hamilton County operated the recreation facilities at the lake, known locally as Winton Woods park, and normally served more than a million visitors per year.[16]

As part of its study of comprehensive water resource development in southwestern Ohio, the District released an interim report in 1970 on Mill Creek flooding problems. It proposed channel enlargement and levee construction along the lower eighteen miles of the stream, from the barrier dam upstream to the Butler County line. The Millcreek Conservancy District, headed for many years by Donald H. Rolf, Sr., and supported by the industries damaged by flooding, secured a promise of state financial support and congressional authorization for the project in 1970. Initial project plans had considered a Soil Conservation Service project for control of flooding at the upper end of the creek in Butler County as well as plans for nonstructural flood control through floodplain management. Butler County residents opposed floodplain management along their section of the stream, but opposition to the project was minimal, even from environmental organizations. The local chapter of the Izaak Walton League, for instance, commented that while it deplored stream channelization in general it considered Mill Creek more of an "open sewer" than a stream.[17]

After the Millcreek Conservancy District agreed in 1973 to acquire enough property to allow construction of a detention dam on the creek if the floodplain in Butler County were developed, the District expedited planning to start construction in 1975, for the project had an excellent benefit:cost ratio of about three to one and repetition of previous flooding might cause tens of millions of dollars worth of damages in the industrialized valley. William Leegan, then chief of planning for the District, considered Mill Creek the most challenging project facing the Engineers. He visualized the conversion of the creek from an "open sewer" into a matchless recreation resource serving the Cincinnati urban area, with a greenbelt replete with parks, trails, and boating. It was at Mill Creek that Leegan thought the District had its best opportunity to demonstrate its capabilities as " a well-balanced resource planning and development agency."[18]

The plans included eighteen miles of channel enlargement, two miles of levees, eight miles of landfills, three pumping stations, the modification of twenty-nine bridges, the relocation of seven miles of sewer lines, and the purchase and development of about 620 acres of land along the creek for high-density, urban recreation use. It thus was a large project costing

Aerial view of part of the Mill Creek local protection project, October 21, 1982. The new lined stream channel is visible amongst the industrial plants and paralleling the highway.

more than some multipurpose dams constructed by the District. Calling the creek a "little monster" because it was flooding the day he saw it, Governor James A. Rhodes of Ohio broke ground for the project on April 23, 1981. James Houchins became the resident engineer. The project was divided into nine sections for phased construction over a period of perhaps fifteen years.[19]

The End of the Big Dam Era?

The declining workload for civil works in the Louisville and other Engineer Districts during the 1980s was generally conceded by the Corps itself to mark the end of the "big dam era." The reasons for that decline naturally were the subject of some interest and debate. The decline was attributed to the national environmental movement, the overabundant red tape, to increases in the discount rate used to calculate project benefits, to the rise of an urban political majority, to effects of inflation and of Section 221 of the 1970 Flood Control Act on the ability or willingness of state and local governments to enter into cost-sharing agreements, or to all of the above and more. A few observations on the reasons based upon historical records seem in order.

Earth Day of 1970 was the apparent peak of popular participation in the national environmental movement, and the National Environmental Policy Act and Federal Water Pollution Control Act Amendments (Clean Water Act) wrote into law many of the goals of that movement. The preparation of the required environmental impact statements for big dam projects delayed construction at several sites within the Louisville District, but not one of the District's projects was permanently stopped by the courts because its environmental statement was inadequate. Yet, the required environmental impact reassessment at many projects planned by the District in the 1960s resulted in their modification, abandonment, or deauthorization. Some multipurpose projects authorized by Congress during the 1960s might well be under construction in the 1980s had not the National Environmental Policy Act required their reassessment.

By 1983 the Corps and the Louisville District had established a working relationship with many environmental organizations. A 1979 Brookings Institution study in fact found the Corps had made genuine and conscious efforts to accommodate itself to the spirit as well as the letter of environmental legislation, perhaps in a better fashion than any other federal agency, though also warning that the accommodation might slip without vigilance. At the same time, many environmentalist leaders had dropped their apocalyptic rhetoric of a decade earlier. Jackie Swigart, an environmentalist who in 1979 became chief of Kentucky's Department of Natural Resources and Environmental Protection, said: "The environmental movement of the Sixties was marked by adversary relationships. I've learned that you do not solve problems if everybody's fighting each other."[20]

While litigation by alliances of environmentalists and landowners often delayed project construction and the efforts required for compliance with environmental legislation sometimes slowed the project planning process, the impact of the environmental movement upon traditional water resource development should not be overemphasized. The massive migration of population from rural to urban areas between 1945 and 1970 perhaps was equally significant.

When urban residents complained of

flooding, uncertain water supply, or degraded water quality, Congress supplied assistance with revenue sharing, block grants, and urban renewal programs, not through assignment of that work to the Engineers, and the efforts of the Corps to become involved in solving urban water problems through such programs as the urban studies and wastewater management experiments essentially failed to get off dead center. Except where its local protection projects at Louisville, Cincinnati, and Evansville were modified to fit with urban needs for recreation and industrial development space, the role of the Louisville District in urban areas by 1983 was largely ancillary, in the form of participation in the wastewater grant program of the Environmental Protection Agency and through supplying floodplain management studies to local governments for action.

The impasse in water resource development in general occurred in Washington after planning in the field had been completed. By 1983 it had been eight years since Congress had authorized new projects with an omnibus water resource bill. In the Louisville District in fact, no major projects had been authorized by Congress after 1970. Noting that some 115 projects recommended by the Corps were collecting dust in offices other than the Office of the Chief of Engineers, Lieutenant General Joseph K. Bratton in 1982 said: "The problem right now is that this system is interrupted. It works fine up to the point where I sign my name to it, but it won't go any further than that in the absence of application of the new cost sharing proposals."[21]

The fact that the last omnibus water resource development act became law in 1976 may be indicative of the reason for the lack of action since. President Jimmy Carter in his 1976 election campaign promised to get the Corps of Engineers out of the "dam-building" business, and, in effect, he kept his promise. When President Carter needed swift completion of the dam safety inspection program or the rapid construction of airfields in Israel, he called on the Engineers and they delivered, but his water resource policies accelerated the decline of civil works. When he established an independent review board under the Water Resources Council in Washington, which was to study and pass on projects before their submission to Congress for authorization and funding, Congress refused to provide funding for the review board, and a standoff between the President and Congress ensued with a resulting stalemate in water resource development. President Carter also desired that state and local governments be required to pay a quarter of project costs assigned to flood control, previously a one hundred percent federal investment. The disagreement over that cost-sharing proposal continued throughout the Carter administration and into the Reagan administration, which was why the Chief of Engineers in 1982, as quoted above, said that none of the proposed projects would move through Congress until the conflict over cost-sharing was settled. How the issue would be settled was still under debate in 1983.[22]

Return of the Defense Mission

The transfer of military construction and real estate missions, loosely referred to as MILCON, from the Louisville District to other installations of the Corps of Engineers in 1970 deprived the District of its direct support role for the Army and Air Force and in fact deprived the entire Ohio River Division of that valuable experience, for no District within the Division was left with a direct support function for national defense. Without having personnel with experience on a daily basis with the intricacies of building cantonments, air bases, and other military installations, whether the District and Division would be capable of responding to a demand for immediate mobilization in an effective manner was questionable, and that was important to overall readiness for national defense because the heavily populated and industrialized states within the Ohio River basin had made major contributions to the success of national mobilization in 1942. As early as 1974, therefore, studies at the Office of the Chief of Engineers suggested that perhaps it would be wise to return military construction and real estate mission to the District and the Ohio River Division.[23]

With the loss of military construction in 1970 and the subsequent gradual diminishment of its civil works activities, the District sought to maintain its engineering and construction capabilities through furnishing support services for several federal agencies other than the Army and in 1975 it volunteered its services to the European Division of the Corps, which was in charge of constructing the facilities needed by elements of the Army stationed in Europe. Late that year, it volunteered to prepare complete construction plans and specifications for a European Division project involving the rehabilitation of eight motor maintenance buildings at Smith Army Barracks in Baumholder, Germany; it was the sort of work the District had done for thirty years at Fort Knox. A team of engineers from the District departed Louisville in January 1976, inspected the buildings to be rehabilitated in Germany, and returned to the District to draw up the plans. Within three months of the date the work was assigned to the District, it had completed the on-site inspection, prepared the designs and specifications for the $1.3 million project, and delivered them to the European Division. Afterwards, the Ohio River Division Engineer told the District Engineer: "The timely response certainly reinforces my feeling that ORD has the capability to take on a military mission."[24]

The Army in 1974 transferred engineering support for facilities engineers—known earlier as "post engineers"—from the Deputy Chief of Staff for Logistics to the Chief of Engineers, who established a directorate for facilities engineering in his office headed by Brigadier General William R. Wray and established what were to become known as One-Stop Centers in various Engineer Districts to provide engineering services to facilities engineers who requested them. The One-Stop Center concept offered the most complete technical engineering services of an Engineer District to the facilities engineers at military installations with a single telephone call. A military assistant to the District Engineer answered the call from a facilities engineer and then served as liaison, arranging the services requested by the facilities engineer through coordination with the geotechnical, structural, mechanical, and other engineers on the District staff, thereby relieving the facilities engineer of the need for any further coordination. The Louisville District's One-Stop Center served nearby Fort Knox and other military installations in the immediate Louisville area. During 1978 the District tested soils, foundations and paving materials for the Fort Knox facilities engineer, evaluated for the Huntsville Enginer Division the foundation for a bag-loading building at the Army ammunition plant at Charlestown, Indiana, and performed soils engineering services for the Armor and Engineer Board at Fort Knox during the tests it conducted comparing the capabilities of Army and private earth-moving equipment. By 1979 the District had anwered twenty-nine requests from the Fort Knox facilities engineer for various operations and maintenance studies, leading to a remark by the Director of Civil Works for the Corps that the coordination between the District and the facilities engineers would "significantly enhance the transition from peacetime to wartime operations as the Corps began to undertake the massive engineering and construction needed to mobilize and deploy the combat forces."[25]

The District's One-Stop program offered to facilities engineers support with project engineering and design, with economic analysis, with the contract procurement of private architect-engineering firms, and with master planning, and that broad spectrum of services involved the District in an increasing number of widely varying tasks. At Fort Knox the District reviewed specifications for road construction, conducted structural surveys for building renovations and improvements, and studied deteriorated plaster at the Ireland Army Hospital. It prepared master plans for two projects at Camp Perry, Ohio, surveyed the boundary of Fort Benjamin Harrison in Indiana, and on several occasions drilled and investigated the subsurface conditions for foundations and drainage at various military installations. The requested soils and materials testing was accomplished at the materials laboratories the District had in operation at the Taylorsville and Louisville civil works project offices.[26]

The District completed fifty-two assignments under the One-Stop program in 1981. They included the redesign of a firing range at Camp Perry, Ohio, repairs to the heating plant and waste treatment plant at Fort Knox, and a rushed mission for renovation and rehabilitation of five hundred barracks buildings at the "Home of Armor." The urgent barracks rehabilitation task, which included replacement of old electrical and plumbing systems, was received by the District on July 16, 1981. The District inspected the buildings, prepared designs and specifications, advertised the work for bidding by construction firms, and opened the bids on September 15, merely sixty-two days for a complex $3.5 million repair job, a record of speed ranking with those established by the engineers who worked for the District during the Second World War.[27]

When the Army was having difficulty during the late 1970s recruiting sufficient men and women to fill the ranks authorized for the "all volunteer" force, the Recruiting Command appealed to the civil works organization of the Corps of Engineers for assistance. A recruiting effort began in 1979 in the Louisville District and elsewhere throughout the civil works installations of the Corps. Engineer officers stationed in the District and Corps rangers at the District's lakes who often were invited to address civic groups, high school classes, and similar local organizations took every opportunity to encourage enlistment in the armed forces, and advertisements on behalf of enlistment were placed on prominent display at visitor centers and other Corps offices throughout the District. By early 1980 the District was referring about eighty potential recruits each quarter to local recruiting officers. Office space was made available for use of representatives of recruiting commands, and the reservations around some District multipurpose projects were made available for military training purposes, notably to the Ohio National Guard and the Department of Military Science at Morehead State University in Kentucky. Corps cooperation with military recruiting efforts continued, though it became less urgent as the Army filled its ranks with volunteers during the national economic recession of the early 1980s.[28]

Throughout the 1970s the District retained its responsibility for planning mobilization in the event of military conflict, and that job was largely the duty of the District's emergency operations planner, a position renamed the emergency management officer in 1978, who also was responsible for planning and coordinating the District's response to natural disasters and other emergencies. As described in an earlier chapter, the District's ability to respond to operational emergencies on the rivers and to natural disasters such as flooding and tornadoes had been thoroughly tested during the 1970s. Though somewhat less dramatic than the "Day of a Hundred Tornadoes" of 1974 and the Markland ice jam of 1978, the District continued to respond to such natural disasters during the early 1980s, and in 1981 it became involved in an unusual disaster situation.

On February 13, 1981, much of the City of Louisville was rocked by the explosion of hexane gas in its sewer system, which blasted street paving skyward at some points, opening gaping holes in the streets and leaving miles of the sewer system and street paving above it in bad shape. Had the disaster been a flood or a tornado the District would have mobilized immediately for action, but there was question as to whether a sewer explosion qualified as a "major disaster" eligible for federal aid under disaster assistance legislation. After the President determined the explosion indeed qualified for federal disaster assistance, the Federal Emergency Management Agency (established in 1978 as the successor to previous federal disaster coordinating agencies) called upon the District to prepare damage survey reports and to inspect the subsequent repairs made to the sewer system and streets. Teams of engineers from the District working with state and local agencies donned high boots, oxygen backpacks, and shoulder harnesses for safety and climbed down into the sewers for inspection of the damages. At many places where the explosion had broken up the streets, damages were obvious, but the uplift resulting from the explosion had also cracked the sewer lines at many other points making their reconstruction or replacement necessary. The repair work turned into a major two-year effort, involving the entire replacement of the sewer lines at some points and the installation of concrete caps atop cracked sewers at other places; and most of the work took place in quite confined construction spaces between buildings on each side of the streets.[29]

Congress took advantage of the expertise developed by the Corps civil works

Engineer teams inspect damages of the sewer explosion in Louisville, February 19, 1981.

organization when dealing with natural disasters when in 1980 it provided $3 million to expand the Engineers' emergency management offices for improved preparedness planning for military mobilization. With that funding, the District in 1980 elevated emergency management from a section to a branch of its operations division with a staff of four headed by Norman Gilley to handle planning for the ultimate environmental hazards: natural disasters and wars. In November 1980 the Corps participated in an Army-wide exercise called Mobex 80, testing the mobilization system to learn what actions were needed to improve the national defense readiness posture. Similar test mobilization exercises followed each year, and a number of conferences and seminars on the subject of mobilization were conducted. The conferences, like that sponsored by the Kentuckiana Post of the Society of American Military Engineers in November 1982, focused on how the District and its contractors would work together with the armed forces to meet the exigencies following a declaration of war and how the vast industrial resources of the Ohio River basin could be most swiftly converted from peacetime to military production.[30]

At his retirement as chairman of the Joint Chiefs of Staff in 1982, General David C. Jones commented upon the renewed emphasis on mobilization planning, an emphasis he had supported during his eight years of service with the Joint Chiefs of Staff:

> We've been comfortable through the years by sort of being unprepared, always kind of expecting things to work out. We had a great industrial base, we had allies to save us time, the advantage of geography protecting us, and therefore we could be the Minutemen. We could always get organized; we had time to do something.
>
> Well, that is no longer true. We have got to be able to do it right the first time, to be more innovative and imaginative rather than bureaucrats.[31]

Echoing that thought, the Chief of Engineers pointed out that "our adversaries are historians," by which he meant that committees of Congress and subsequently historians had been critical of military mobilization planning, or rather the lack of it, during 1941. He and the Louisville District Engineer emphasized that mobilization planning did not mean the nation was going to war and in fact would serve as additional deterrence to the outbreak of war if potential adversaries were aware the nation's construction industry and industrial might could be brought into action in short order; those were the tasks that had largely been accomplished through the decentralized organization of the Corps of Engineers in 1942. The Chief of Engineers in 1981 said the goal of the Engineer mobilization groups was essentially to cut the response time in half.[32]

Army recruiting support, emergency mobilization planning, and One-Stop engineering support services dovetailed nicely with the return of military construction and real estate missions to the Louisville District in 1981. Though the District and Division Engineers had lobbied in Washington on behalf of returning "MILCON" to the District for several years, they did not receive a favorable hearing until 1981 when the Reagan administration's substantial increases in the budget for national defense resulted in corresponding growth in the requirements of the Army and Air Force for military construction support from the Engineers. Brigadier General R. S. Kem, the Ohio River Division Engineer, commented that two of the best arguments for returning "MILCON" to Louisville were that only by performing such a mission could the expertise and experience required during mobilization be developed and that the Louisville District still employed some of the personnel who had participated in military construction activities before 1970, notably Gordon M. Stevens, the chief of construction who had supervised military construction as assistant chief in 1970.[33]

District personnel during the summer of 1981 visited other Engineer Districts with military construction missions to ascertain the relationship between the military workload and staffing and to learn how those Districts were handling their military responsibilities, and thus were ready to move when the Chief of Engineers announced on November 17, 1981, that the District would receive supervision of military construction in five states—Kentucky, Ohio, Indiana, Illinois, and Michigan—an area larger than it had supervised in 1970 with an annual budget of up to $135 million a year, compared to the District's $90 million budget for civil works. The memorandum of understanding for the transfer was signed on December 18 between the Louisville and the Mobile, Baltimore, Omaha, and Kansas City Engineer Districts which previously handled military construction in portions of the five-state area. All military work was to be transferred no later than April 1982, and Edward Hoagland, the District's resource manager, would serve as coordinator for the transition.[34]

Colonel Charles E. Eastburn announced

Chiller plant constructed at the Rock Island Arsenal, October 4, 1983.

Hospital at Fort Campbell completed by the Louisville District, October 19, 1982.

in 1981 the District would be losing 131 personnel under the civil works reductions then in effect, but might gain as many as 381 personnel for military construction and real estate missions, a net gain that would return the number of personnel employed by the District nearly to the level that had prevailed before 1970. Even the increased staff would have as much work as they could efficiently handle, for the new military work included about $120 million worth of construction at Wright-Patterson Air Force Base in Ohio, a complete renovation of the Army's Rock Island Arsenal in Illinois, the completion of a major hospital at Fort Campbell, and projects at Rickenbacker Air Force Base in Ohio, Chanute and Scott Air Force Bases in Illinois, Fort Sheridan, Illinois, the Detroit Arsenal and Michigan Army Missile Plant, and the Lima, Ohio, and Detroit plants which produced all military tanks for the Army.[35]

The engineering division established a separate military branch for the mission, headed initially by Darrell Gordon and subsequently by Patrick Lankswert. The branch had about seventy personnel in 1983 divided into five sections: program development and management, facilities support, industrial, and Army and Air Force sections. The military branch was responsible for preparing designs and specifications for a wide variety of military

Engineer inspector and contractor workmen drilling caissons at Rock Island Arsenal, October 4, 1983.

construction tasks: the development of standard designs for some repetitive structures, the complex design of a few new and esoteric buildings, and the intricate design tasks required for renovation of existing buildings. Many aging barracks at military posts, for instance, had been constructed when the Army was practically all male and had consisted largely of short-time draftees rather than volunteer and career soldiers; the barracks renovations therefore commonly involved ripping out gang latrines and showers and adding partitions and individual bathrooms to convert the barracks into a more comfortable longer-term living space. Most older buildings on the posts had also been constructed at a time when energy conservation was not a major concern, and the renovation involved adding insulation and other design changes to make the structures more energy efficient.[36]

The return of the military real estate mission effectively doubled the size of the District's real estate division under chief Robert R. Humphreys from forty-eight to one hundred personnel. Lawrence R. Link, Jr., the assistant chief, returned to the District with the new mission from the Baltimore District; actually, he had transferred from the Louisville District with the mission in 1970 to the Baltimore District but had remained in the same building all the while, working in an area office established at Louisville by the Baltimore District. Though its last project office for real estate in connection with civil works had closed at Taylorsville in

Construction of barracks at Fort Campbell, October 19, 1982.

1982, the division acquired another field office at Chicago with sixteen personnel for the military work.[37]

Though land acquisition was not a major part of the military real estate mission, the District's real estate division had underway the largest military leasing effort in the United States and was responsible for managing land resources at existing military reservations and disposing of surplus properties. It leased recruiting facilities for all four armed services throughout the five-state military area, handling 665 leasing actions in fiscal year 1984, by far the largest effort of its kind in the United States. As the building industry revived in 1983 throughout the nation, the real estate division also found itself marketing the timber on military reservations, notably at Fort Knox. And in compliance with a directive from the Reagan administration, the divison also arranged the sale of surplus federal properties to help retire the national debt and help stimulate local economic development. The surplus lands sold at military reservations and obsolete civil works projects contributed to the 112 Corps of Engineers and 307 Army surplus properties offered for sale to the public across the nation in 1983, with the resulting revenues placed in a special Treasury account reserved for retirement of the national debt. The Reagan administration hoped to realize as much as $17 billion through surplus land sales by 1990.[38]

Chief Gordon M. Stevens chose not to establish a separate military branch in the construction division but to preserve geographic administration through area offices, some of which were inherited from other Engineer Districts. He thought that, while the inspection of military projects differed from that of dams and civil works projects, both the military and civil works consisted chiefly of contract administration by construction division personnel and the people in the field offices were, or would become, equally facile at handling both. The Cincinnati Area Office, for instance, administered the Mill Creek local protection project for civil works, a military project for the Defense Supply Agency, the wastewater grant program in eastern Kentucky for the Environmental Protection Agency, and other tasks as they arose no matter what their character.[39]

Military construction work was done by private firms under competitive bidding procedures, much like civil works projects, and most of the work was standard building renovation, family housing construction, and the like, but done under rigid time schedules mandated by Army or Air Force authorities. The military work involved more frequent change orders after construction had begun, and the contract administration branch of the construction division increased in size, for by 1983 it was processing some seventy change orders each month, compared to about twenty-five a month when the District had civil works only.[40]

Before the return of military construction, the District's One-Stop program had been administered by a single Engineer officer serving as coordinator handling a workload averaging $250,000 a year. After 1981 the program expanded substantially to meet the needs of twenty-seven military agencies at nine posts and bases with a potential workload of 105 jobs and $43 million annually. By 1982 the facilities engineer support section of the District's military branch under chief Dennis Kamper had a staff of four and was expected to grow as the workload developed. Of the total military mission, transition coordinator Edward Hoagland said in sum: "The work is coming on in steamrollers,

The Louisville District was involved in renovation work at the Ireland Hospital, Fort Knox, Kentucky, October 5, 1982.

with new design projects coming up almost every day. The people we have on board are all working overtime. The projects range from the $100 million hospital at Wright-Patterson and a $75 million heating plant at Chanute Air Force Base, and refurbishment of the entire Rock Island Arsenal to simply tackling a huge backlog of maintenance and repairs at other bases, which had been put off for years for lack of defense funding."[41]

Some of the first military projects tackled by the District included an avionics shop and parachute repair building for the Air Force Reserves at O'Hare Airfield at Chicago, a biotechnology laboratory and flight control development laboratory at Wright-Patterson Air Force Base, rehabilitation of the Detroit Arsenal and of the Indiana Army Ammunition Plant at Charlestown, runway repairs at Godman Airfield and construction of family housing and classroom buildings at Fort Knox, plus barracks and family housing renovation at Fort Campbell. The District inherited the construction of a hospital at Fort Campbell from the Mobile District, which was completed on September 17, 1982, and also undertook a "high tech" job at the home of the "Screaming Eagles" involving building a flight simulator recreating with a camera moving on tracks over a map the sensation of flight for pilot training with startling realism. Of special interest was renovation at the Rock Island Arsenal of historic buildings constructed during the 19th century where the high ceilings were lowered to conserve energy and additional windows were installed behind the old windows for more insulation.[42]

Construction of major additions to the hospital at Wright-Patterson Air Force Base began in late 1982. The twenty-five year old 350-bed hospital, built when most airmen were male, would have its open bay wards converted into private and semi-private rooms with separate bath and showers. Additions would double the size of the hospital, making it second largest in the Air Force. It would have a circular intensive-care ward, with patient beds on the outside of the circle and nursing station in the center; there would be nine new operating rooms, a dental clinic, an auditorium, and expanded outpatient areas. The structure would be upgraded to modern medical and safety codes, with concrete walls replaced with steel frameworks and expansion joints to add flexibility in case of earthquake and with more fire escapes, better ventilating and air-conditioning systems, and oxygen and suction facilities beside each bed.[43]

From the Navy Civil Engineer Corps, the District in November 1982 acquired two more Air Force installations, the Newark and Grissom Air Force Bases. Grissom in northern Indiana was the

Interior of Flight simulator built at Fort Campbell under Louisville District administration, October 19, 1982.

Hospital construction at Wright-Patterson Air Force Base under Louisville District direction, September 1, 1983.

world's largest refueling base, serving the tanker planes used to refuel Strategic Air Command bombers while in flight. Newark in central Ohio was the home of the Aerospace Guidance and Metrology Center, which repaired the guidance systems of aircraft, missiles, and submarines and maintained standards of measurement and calibration for the design of precision equipment.[44]

The reassignment of military construction and real estate missions to Louisville meant that, for the District at least, the 1980s were to be the "decade of defense." The initial magnitude of the assignment indicated it would keep the District busy for years, providing a flexibility in the District's workload that should level out the peaks and valleys of the civil works mission. At the end of his tour as District Engineer in 1983, Colonel Charles E. Eastburn remarked that the return of "MILCON" should "insure the longevity and well-being of the Louisville District for a long time."[45]

EPILOGUE

The election of Ronald Reagan as President in 1980 was accompanied by a nearly complete change in the chain of command of the Louisville Engineer District: Colonel Charles E. Eastburn became District Engineer, Brigadier General R. S. Kem became the Division Engineer, and the new Chief of Engineers was Lieutenant General Joseph K. Bratton. Those officers were responsible for implementing the several changes in the Corps and District programs mandated by the Reagan administration. In keeping with the President's policy of giving national defense, at least in funding levels, priority over other federal activities, the Corps increased its emphasis on its mobilization and military construction functions in support of the Army and Air Force.

In civil works, the Reagan administration sought to break the impasse that had existed since 1976 by instituting several initiatives. The election of President Reagan was widely interpreted as a vote for less federal regulation, a "back-to-the-states" vote favoring the return of some federal programs to state and local governments and to private interests, and that interpretation was borne out by some of the early actions of the administration in the field of water resource policy. A month after his inauguration, the President fired the entire staff of the Council on Environmental Quality and employed a new staff fewer in number and with only a quarter of its previous funding. As part of the administration's efforts to make government more efficient, it streamlined the Ohio River Basin Commission and other similar commissions right out of existence effective September 30, 1981. Established to continue the comprehensive water resource planning begun during the 1960s, the Ohio River Basin Commission had been criticized for producing too many plans and too few actions; the State of Ohio had withdrawn its support and funding from the commission in 1977. Composed largely of planners serving in an advisory capacity without authority to initiate project legislation and without a political constituency, the Ohio River and other river basin commissions, once thought a promising step toward an end to haphazard water resource development, had operated for about a decade before their termination. The Corps of Engineers had supported the river basin commissions, if only as a means of keeping abreast of the concerns of the state governments and of changing water resource policies. After federal support ended in 1981, the Ohio River Basin Commission, hoping to continue with state support alone, shifted its headquarters from Cincinnati to Lexington where a small office opened, but federal contributions had amounted to more than twice as much as those of the states toward the commission's budget.[1]

As part of its "mandate" to reduce federal regulations, the Reagan administration essayed "regulatory reform" programs which extended to the regulatory functions the Corps of Engineers exercised over the nation's waterways under Section 10 of the 1899 Rivers and Harbors Act and Section 404 of the 1977 Clean Water Act. To make permit requirements less burdensome upon the general public, the Reagan administration urged the implementation of an extensive system of national, or "general," permits to allow the alteration of stream environments in certain categories to proceed without formal individual applications for permits from those undertaking the alterations, and it also expressed hope that state governments would assume direction of some regulatory responsibilities.[2]

The President's personal representative directing the regulatory reform program and "back-to-the-states" water resources policies for the Corps of Engineers was William R. Gianelli, the Assistant Secretary of the Army for Civil Works. A former Engineer officer and director of the California state water resources agency, Gianelli had once defined an environmentalist as a man who had built his mountain cabin last year and a developer as a man who wanted to build one next year. Mr. Gianelli visited the Louisville District in November 1981, reviewing the District's regulatory program, its navigation projects, the construction of Taylorsville Dam, and the bank caving problem along the Ohio River.[3]

Mr. Gianelli announced in 1983 the Reagan administration would press for three changes in national water resource policies: increased involvement of state and local governments in project planning, reduction of state and federal expenditures for civil works, and the payment of a greater share of project costs by the beneficiaries, meaning the state and local governments or their agents. He proposed that water resource project studies be broken into two parts: a federal reconnaissance followed by a feasibility study only if the project appeared feasible and local or state sources were willing to pay half the cost of the continuing study, thereby saving some of the $100 million

Hon. William R. Gianelli at left tours the Louisville Repair Station, October 22, 1981.

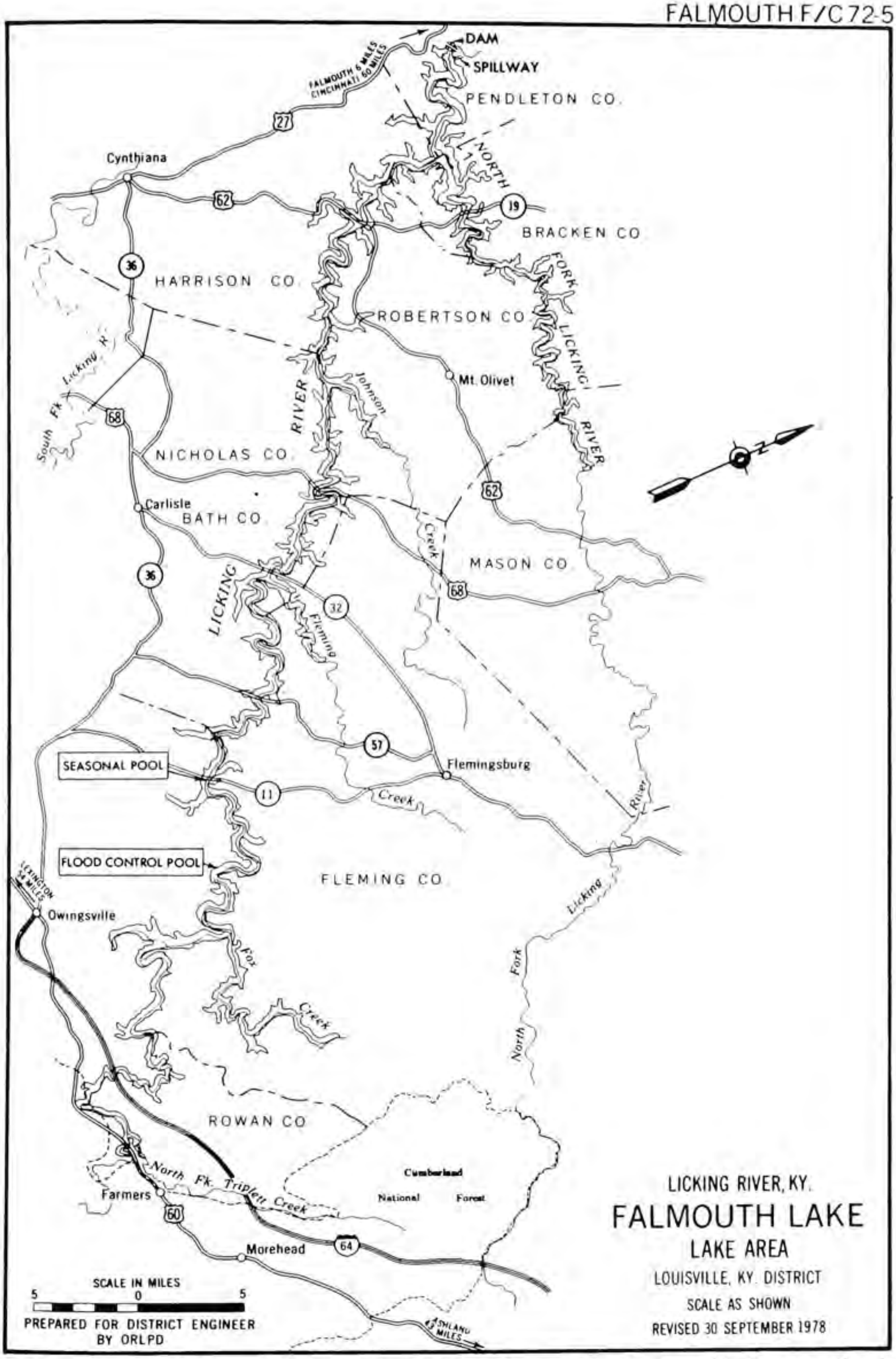
the Corps had expended between 1973 and 1981 on feasibility studies that ended with negative decisions. State or local governments could pay their half of the study costs, however, by direct participation in the studies, thereby becoming more intimately involved in the planning process. He also proposed that state and local governments pay not only the customary one hundred percent of water supply costs and fifty percent of recreation costs at multipurpose projects, but also thirty-five percent of the costs of the projects' flood control features. To accomplish the latter, he expected state or local governments to form flood control districts with assessing and taxing authority to recover the costs of flood control projects, and he averred that their willingness to tax themselves would be a "powerful test of the project's merits that substitutes for the kind of bureaucratic scrutiny that inevitably delays a project's implementation and increases its costs."[4]

Those were indeed innovative proposals, but whether Congress would be willing to abandon traditional benefit:cost tests for projects and allow them to proceed if state and local agencies wanted them, or whether state and local agencies would be willing to share flood control costs in addition to existing cost-sharing requirements for water supply and recreation remained questionable in 1983. Congress in the 1936 Flood Control Act had required local interests to purchase the lands as their share of the cost of reservoir projects built for flood control, but when it became apparent the requirement essentially meant no reservoirs would be constructed it had repealed that provision in the 1938 Flood Control Act. And in the Ohio River basin in 1983 it was apparent that state governments might not participate in any further cost-sharing agreements for projects so long as Section 221 of the 1970 Flood Control Act remained in effect.[5]

The Louisville District did have some experience with cooperation with existing and active flood control or conservancy districts. It was cooperating with the Millcreek Conservancy District which was sharing the costs of the Mill Creek local protection project at Cincinnati, and it was pursuing a similar cooperative arrangement with the Miami Conservancy District while planning flood protection for Fairfield, Ohio, a few miles north of Cincinnati.[6]

Some twenty-two bills proposing various cost-sharing arrangements between the Federal and the state and local governments for water resource projects were considered by Congress during the early 1980s, perhaps the best known being that proposed by Senators Peter Dominici and Daniel Moynihan. The Dominici-Moynihan bill transferred responsibility for project selection to state governments and allocated federal civil works funding to states on a formula based upon total land area and population, abandoning benefit:cost justifications if states were willing to pay a flat twenty-five percent of project total costs. In making a case for the bill, Senator Dominici declared that water resource policies and water shortages might be the major federal issues of the 1980s and warned: "It is not an exaggeration to say that we may face a disaster unless we take the initiative in seeking new and innovative approaches that make certain we are building priority projects across the land."[7]

In the summer of 1983, Congress was again attempting to enact an omnibus water resources development bill that would authorize seven hundred new projects, deauthorize as many old projects, and also increase the cost sharing required



Map of the proposed Falmouth Lake on the Licking River in Kentucky which was authorized by Congress in 1936 but never constructed.

of state and local governments to twenty-five percent in most cases. One of several exceptions to the cost-sharing requirement in the bill approved by the House Public Works Committee was the Falmouth Dam project. Located on the Licking River 60.6 miles above its mouth in Northern Kentucky, the Falmouth Dam was one of the first multipurpose projects recommended by the Corps and it was authorized by Congress in 1936. A very large dam and lake, it had excited an even larger controversy in Kentucky throughout the years since 1936, and by direction of Congress the Corps had started and stopped its studies of the project on several occasions.[8]

One of the interesting innovations in the omnibus bill approved by the House committee was the creation of an $800 million fund for loans to finance the repair and expansion of local water supply systems, perhaps reflecting congressional consideration in the aftermath of the drought of late 1980 and early 1981. That drought had resulted in such a reduction of riverflow that the lower Ohio and even the Mississippi River were closed to navigation because they became too shallow. The towboats *Sonny Ivey, Olmstead, Agnis Mae,* and *Billy Waxler* along with some fifty barges became stranded on sandbars near the mouth of the Ohio during the drought and the Louisville District had to send dredges to the site to reopen the channel while the Memphis District performed similar work on the Mississippi. During that drought the Corps began contingency planning, studing water conservation measures and methods of changing the operations of its multipurpose dams to provide additional emergency water supplies. Rains in the spring of 1981 ended the immediate emergency, but many Engineers thought water supply would, or at least should, eventually become a Corps mission. According to state authorities, communities in Kentucky between 1980 and 1983 suffered twenty-six water supply emergencies of varying degrees of severity.[9]

What did the future hold for the Louisville District and the Corps of Engineers in general? The Louisville District could expect a stable workload because of its military mission, but for the Districts with civil works alone the trend seemed fairly evident. In 1967 Congress had appropriated some $1.3 billion for civil works as opposed to $3.3 billion in 1982; yet, when expressed in constant dollars allowing for inflation the funding provided in 1982 was somewhat less than in 1967. The figure had remained near the level of that of 1967 only because the costs of increased operations and maintenance at completed projects had offset the decline of appropriations for new construction. Barring the assignment of significant new civil works missions, the nonmilitary work of the Louisville and other Engineer Districts was destined to become largely operations and maintenance supplemented by major rehabilitation work needed at aging civil works projects.[10]

The District and the Corps did receive one new assignment in 1983, or perhaps more precisely an old assignment renewed. When President Reagan signed the Jobs Bill on March 25 to provide work for the unemployed during the economic recession, he allocated $462.7 million of the appropriation to the Engineers who would employ about 20,000 men and women for temporary work in connection with Corps projects. The Corps had furnished "work relief" at its projects during the Depression of the 1930s and in fact had become the first federal agency to adopt the concept in 1916 when it put people to work repairing damages after a major flooding disaster.

US Army Corps
of Engineers
Louisville District

Louisville District Staff

District Engineer

COL D. G. Lee

Deputy District Engineer Military

LTC H. P. Conley

Deputy District Engineer

LTC T. P. Hueman

Executive Assistant

F. R. Huelson

Planning

N. E. Jenkins

Engineering

N. M. Whittle

Real Estate

R. R. Humphreys

Construction

G. M. Stevens

Operations

[illegible] Mathews

Programs

W. H. Schulz

Safety

H. G. Peters

Counsel

S. E. Smith

Res. Mgt. Of

E. L. Hoogland

Procurement

J. A. Mackin, Jr.

Personnel

W. E. Nunley

Adm. Svcs.

M. R. Best

Public Affairs

M. K. Pedigo

ADP Center

C. R. Gowin

EEO Officer

P. A. Wiggington

Value Engr.

W. J. Laskee

The 1983 Jobs Bill funds were used solely for temporary positions, with workers assigned to performance of repairs at locks and dams and lakes or to completion of some small streambank protection and flood control or navigation projects under the District's continuing authorities program.[11]

In 1983 the Louisville Engineer District completed fourteen years of service to the people of the lower Ohio River Basin since the year of crises that had beset it in 1970; some were fat but most had been lean years. Military construction had left the District; and a decade later it returned. Post office construction, urban planning, wastewater management, and dam inspection missions had come to the District at various times; and most had left. Natural disasters and operational emergencies had often challenged the ability of the District to respond, sometimes leaving scant breathing time between their occurrences; yet, all had been handled and generally to the satisfaction of all concerned. The number of people employed by the District had shrunk by 1980 to about three-quarters of what it had been in 1970, and by 1983 it had returned to about what it had been in 1970.

New Presidents, new Chiefs of Engineers, Division Engineers, and District Engineers came to direct and supervise the work of the District; all made their mark then left and another followed. Practically the entire executive leadership of the District changed between 1970 and 1983, and those retiring or departing learned, perhaps to their surprise, that the District continued to function without them. The District, in sum, was a flexible institution that would survive so long as it provided services needed by American technological society.

On July 28, 1983, another change of the guard occurred. At a change of command ceremony, Colonel Charles E. Eastburn departed and Colonel Dwayne G. Lee took command as District Engineer. Colonel Lee was the forty-fifth District Engineer at Louisville and the most recent of a long line of distinguished officers who had commanded the Falls City Engineers. The line of succession actually could be traced back to Major Stephen H. Long who had constructed the first federal dam on the Ohio River in 1824 and who had supervised the Office of Western River Improvements at Louisville for nearly thirty years before the Civil War. Many District personnel in 1983 parked their cars on a lot adjacent to the District Office which had been the site of Major Long's office.

During Major Long's thirty-year tour at Louisville, Congress had started and stopped civil works projects three times, leaving Major Long and his staff with no ongoing program. During the interims when his civil works projects lacked funding, Long had surveyed canals and railroads for state governments, and he selected the future site of Atlanta, Georgia, during one of those surveys. He had designed improved steamboats and better railroad locomotives, and he had devised a new type of trussed bridge. He had kept his staff busy by building hospitals for the U. S. Treasury Department, by constructing steamboat transports and dredges for the Army Quartermaster Corps, and by whatever other work that came to hand. Major Long's record was the heritage of the Louisville Engineer District, for its hallmark was its ability to respond flexibly to the challenging needs and demands of the American people.

Col. Dwayne G. Lee accepts the flag from Brig. Gen. R. S. Kem at the Change of Command ceremony in the Louisville District office, July 28, 1983.

APPENDIX

UPRIVER TO THE THREE FORKS: KENTUCKY RIVER PROJECT CONSTRUCTION, 1836–1917

As one of the pioneer slackwater navigation systems in America, the Kentucky River project was a source of pride to progressive Kentuckians and a landmark in the annals of waterways engineering. Reasoning that 255 miles of reliable waterways transportation from the mouth of the river at Carrollton upstream to the Three Forks at Beattyville would open the agricultural, forest, and mineral resources of the Bluegrass and Appalachian regions of Kentucky to development, the state government commenced construction of the locks and dams in 1836. Its efforts ended in 1844 when the fiscal resources of the state were exhausted after the first five locks and dams nearest the mouth of the river had been completed, however, and construction did not resume until 1880 when the state gave the project to the federal government. The U. S. Army Corps of Engineers renewed the effort to extend slackwater navigation upriver to the Three Forks in 1880, and after thirty-seven years of construction reached that goal in 1917 with completion of Lock and Dam 14. Designed to serve 19th century steamboat and flatboat commerce, the project performed that function well, but it was ill-suited as an artery for 20th century towboat and barge fleet commerce and hence did not play a significant role in the development of Kentucky's coal fields.

Lying entirely within the Commonwealth of Kentucky, the Kentucky River is formed at the confluence of its North, Middle, and South Forks, which drain the timber and coal-rich western slopes of the Kentucky Appalachians. The river flows in a general northwesterly direction through a steeply palisaded gorge across the fertile Kentucky Bluegrass, snakes through the state capital at Frankfort, and empties into the Ohio River at Carrollton midway between Cincinnati and Louisville. In the absence of railroads and improved highways, the Kentucky was a major commercial outlet for pioneers of the Bluegrass, who marketed their farm products in flatboats down the inland waterways to New Orleans, imported goods up the river system in keelboats and pushboats, and even built sailing ships at Frankfort.[1]

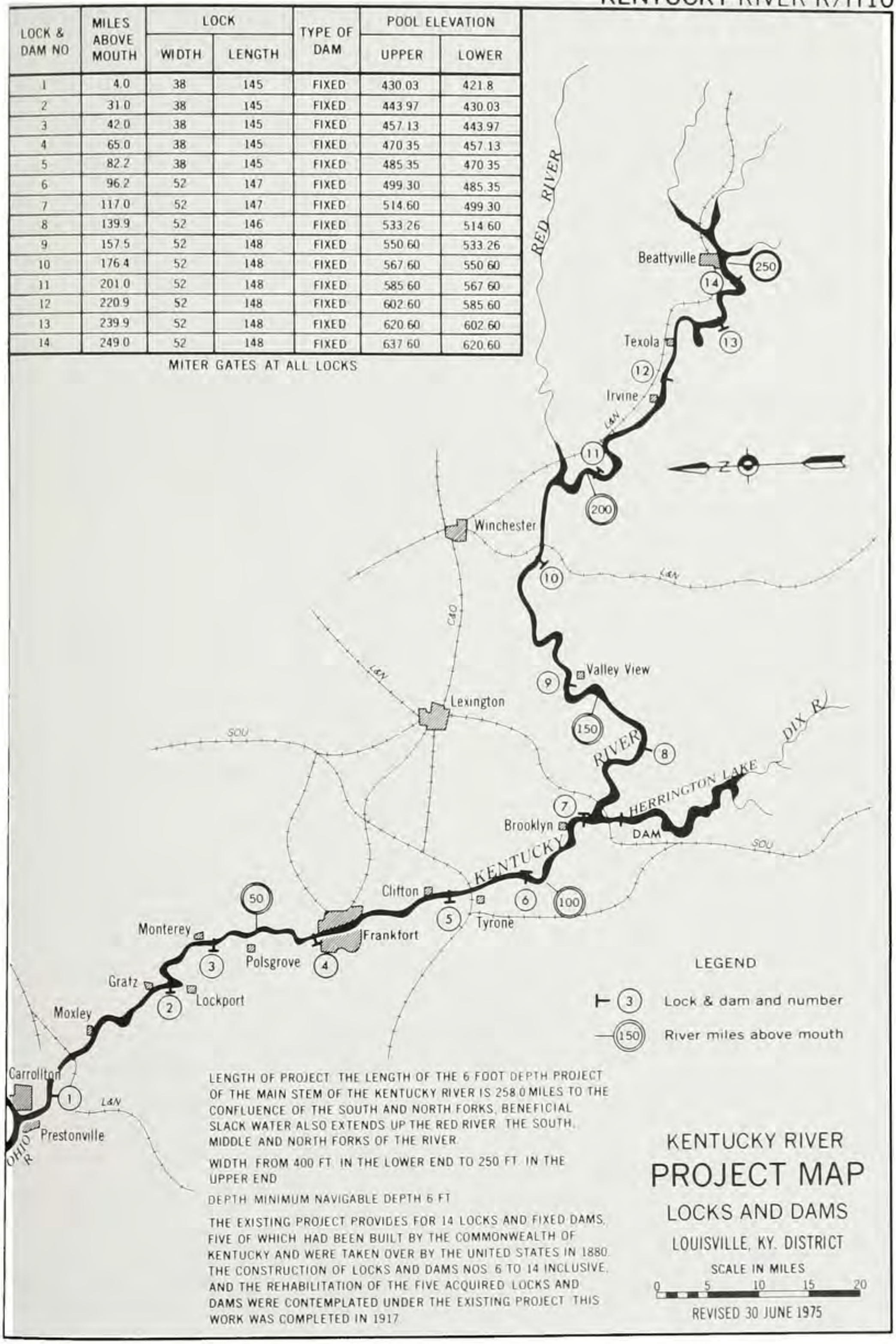
Because the river channel could be navigated only at moderate to high river stages and then at peril, boat captains, farmers, and merchants at an early date became interested in improving the Kentucky, clearing obstructions and deepening the channel at shoals to reduce hazards and to lengthen the time it could be used for commerce. The Kentucky legislature discussed improvement of the river in 1792, the channel was first surveyed in 1799, and in 1801 the state chartered a company to clear the channel, giving the company power to collect tolls to recover the costs of the work. No significant improvements were accomplished, however, until steamboats began operation on the river in 1816 and the state in 1818 appropriated funds for channel clearance.[2]

After the channel had been cleared of obstructions, steamboats and larger craft still could not navigate during periods of low flow, which often continued during several months of each year, and in 1828 the state requested a federal survey of the river to plan a project that could supply a

KENTUCKY RIVER R/H10

LOCK & DAM NO	MILES ABOVE MOUTH	LOCK		TYPE OF DAM	POOL ELEVATION	
		WIDTH	LENGTH		UPPER	LOWER
1	4.0	38	145	FIXED	430.03	421.8
2	31.0	38	145	FIXED	443.97	430.03
3	42.0	38	145	FIXED	457.13	443.97
4	65.0	38	145	FIXED	470.35	457.13
5	82.2	38	145	FIXED	485.35	470.35
6	96.2	52	147	FIXED	499.30	485.35
7	117.0	52	147	FIXED	514.60	499.30
8	139.9	52	146	FIXED	533.26	514.60
9	157.5	52	148	FIXED	550.60	533.26
10	176.4	52	148	FIXED	567.60	550.60
11	201.0	52	148	FIXED	585.60	567.60
12	220.9	52	148	FIXED	602.60	585.60
13	239.9	52	148	FIXED	620.60	602.60
14	249.0	52	148	FIXED	637.60	620.60

MITER GATES AT ALL LOCKS



LENGTH OF PROJECT. THE LENGTH OF THE 6 FOOT DEPTH PROJECT OF THE MAIN STEM OF THE KENTUCKY RIVER IS 258.0 MILES TO THE CONFLUENCE OF THE SOUTH AND NORTH FORKS. BENEFICIAL SLACK WATER ALSO EXTENDS UP THE RED RIVER. THE SOUTH, MIDDLE AND NORTH FORKS OF THE RIVER.

WIDTH. FROM 400 FT. IN THE LOWER END TO 250 FT. IN THE UPPER END.

DEPTH. MINIMUM NAVIGABLE DEPTH 6 FT.

THE EXISTING PROJECT PROVIDES FOR 14 LOCKS AND FIXED DAMS, FIVE OF WHICH HAD BEEN BUILT BY THE COMMONWEALTH OF KENTUCKY AND WERE TAKEN OVER BY THE UNITED STATES IN 1880. THE CONSTRUCTION OF LOCKS AND DAMS NOS. 6 TO 14 INCLUSIVE, AND THE REHABILITATION OF THE FIVE ACQUIRED LOCKS AND DAMS WERE CONTEMPLATED UNDER THE EXISTING PROJECT. THIS WORK WAS COMPLETED IN 1917.

KENTUCKY RIVER
PROJECT MAP
LOCKS AND DAMS
LOUISVILLE, KY. DISTRICT

REVISED 30 JUNE 1975

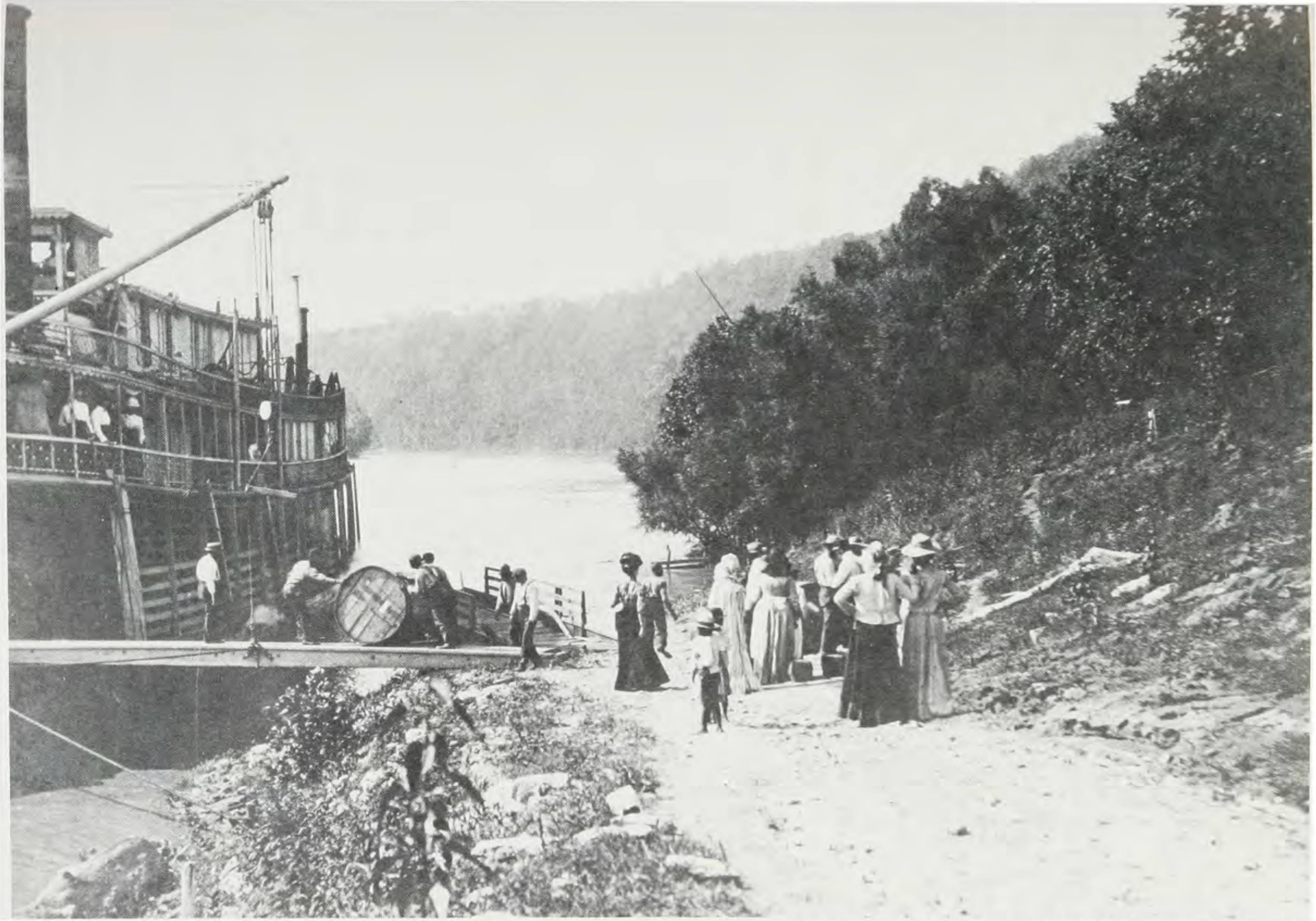
more reliable transportation artery. Lieutenants William Turnbull and Napoleon B. Buford of the Army Engineers mapped the river as far upstream as Boonesborough in 1828 and recommended federal funding for construction of an experimental dam at Frankfort to determine the "practicability and expediency" of navigation improvements on the Kentucky and similar inland streams. The federal government then sought to restrict its waterways transportation projects to rivers serving the commerce of several states, however, and no federal assistance for the Kentucky River project was forthcoming until 1880.[3]

During the early 1830s, Kentucky like many other states became interested in transportation projects, then known as "internal improvements," to provide avenues to market for its agricultural, forest, and mineral resources. The Kentucky River at that time supported a substantial steamboat trade on its lower sections during favorable water stages, a growing traffic in log rafts, and significant shipments in flatboats of salt from manufacturers on the South Fork, iron products from furnaces on the Red River, and coal from mines at Three Forks and at Troublesome Creek and Hazard on the North Fork. To plan a project to improve navigation, thereby enhancing opportunities for the development of Kentucky's resources, the state employed Major R. Phillip Baker in 1835 as state engineer. Baker had been trained in waterways surveying and engineering by Major Stephen H. Long of the Army Engineers, had supervised a navigation project on the Tennessee River, and had directed canal construction for the State of Alabama.[4]

Conducting his survey during the dry autumn of 1835, Major Baker determined the flow of the Kentucky was sufficient to maintain a six-foot depth for navigation with enough flow remaining to supply power for mills. Estimating the river fell about 228 feet in the 255 miles between the Three Forks and its mouth, Baker advised the Kentucky Board of Internal Improvement that by constructing fifteen locks and dams, each capable of lifting a steamboat at least fifteen feet, a minimum channel depth of six feet could be supplied for navigation year round nearly to the Three Forks. Though not certain that the tolls collected from the traffic would be sufficient to defray the costs of construction and maintenance, he believed the regional economic development resulting from project construction would amply reimburse the state for its investment, and he pointed out:

> In its present condition, even with the most favorable tide, the river affords but a precarious and hazardous navigation, and in consequence, nearly the whole of the transportation required by this extensive district of country is driven to the expensive and tardy resort of road wagonage. Hence, many articles, and the natural resources of the country, and such as would be produced if easy and cheap communications were offered for their carriage, are either entirely neglected or are produced to a very limited extent. This is especially true in relation to the various resources presented by the mines and forests of the mountain districts, which articles are of the first necessity to the inhabitants of the older settled parts of the State, but which will not bear the cost of land transportation.[5]

Major Baker selected the sites for four locks and dams downstream of Frankfort, locating bedrock foundations for all except Lock and Dam 1 nearest the Ohio; he left selection of lock sites upstream of Frankfort for further study. After studying the dimensions and capacities of steamboats then in use, he recommended the locks be 38 feet wide and 170 feet long inside their chambers, sufficiently large to



The steamboat, *Falls City,* loads tobacco hogsheads and passengers on the Kentucky River in 1900. From Hibben Collection, Kentucky Historical Society, Frankfort.

pass steamboats capable of transporting 250 tons of commodities. He strongly urged the locks be constructed of cutstone masonry to avoid the high maintenance costs common to locks built of timber on canal systems.[6]

Because floods, ice, and drift had quickly destroyed the first dams built on the inland rivers, only a single successful slackwater navigation project had been completed on a river west of the Appalachians before 1835. While admitting that "more frequent failures occurred in this than in any other class of construction," Baker maintained that waterways engineering knowledge had advanced to the point that skilled engineers could build dams on the Kentucky River which would stay in place. As proof, he submitted a report by Sylvester Welch, the chief engineer of the canal then building from Philadephia to Pittsburgh who had directed construction of ten locks and dams on the Kiskiminetas River in Pennsylvania as part of the canal; those structures had supported not only canalboat navigation but also steamboat traffic ascending from the Allegheny River. But Baker warned state authorities that unless they secured the services of experienced engineers capable of designing and building staunch dams "they will be apt to fail."[7]

The Kentucky Board of Internal Improvement accepted Baker's advice and sent a representative to Pennsylvania to hire the engineers who had directed "internal improvements" in the Keystone State. Sylvester Welch accepted the appointment as Kentucky's Chief Engineer and brought with him Matthew R. Stealey as resident engineer for the Kentucky River project, Alonzo Livermore as resident engineer for the Green River project, and Antes Snyder and William B. Foster, Jr., as engineers in charge of surveys. Foster was the brother of Stephen Collins Foster and, tradition says, with his income as engineer purchased the composer his first piano. The principal exception to the Pennsylvania rule was Napoleon B. Buford, a Kentucky native and Army officer who had surveyed the Kentucky and Licking Rivers in 1828 and who became resident engineer on the Licking River project.[8]

In consultation with state authorities, Sylvester Welch and Matthew R. Stealey revised Baker's plans for the Kentucky River, probably taking into account the funding pinch the state government encountered even before construction began. The legislature in early 1836 had approved the sale of $2 million worth of bonds to fund transportation projects, but could market only $350,000 worth of the bonds and had to borrow an additional $100,000 to commence construction in 1836. The revised plans reduced the size of the locks to a clearance inside their chambers of 38 by 145 feet, sufficient only for 200-ton steamboats. The planning revision called for construction of seventeen locks and dams, with an average lift of fourteen feet at each structure, to provide six-foot slackwater navigation to Three Forks and estimated the cost of building all seventeen would total $2.3 million, of which $701,405 would be used to complete the first five locks and dams nearest the river's mouth.[9]

Welch and the Board of Internal Improvement warned the state legislature that construction of the first five locks and dams would not generate benefits sufficient to reimburse their costs, for not until slackwater extended all the way to Three Forks and the resources of the mountains were developed would a large traffic commence. "Unless acomplished to the extent indicated, the policy of the improvement would be very questionable," they commented, adding: "If stopped at any intermediate point, the advantages to be derived from the improvement, will of course, be diminished, and might not equal the expense of its construction."[10]

After advertising for sealed proposals from potential contractors, Welch opened the bids in July 1836, finding that all were higher than the amounts estimated by the engineers. The bids were rejected, but the state offered to enter into contract for the amount of the engineers' estimates and some contractors, to their subsequent regret, accepted. Joseph Barbour Company took the contract for Building Lock and Dam 1, Raush and Farquharson took No. 2, Thomas and Adam Darlin took No. 3, and Wilson Knott and Company accepted the work at Nos. 4 and 5. The contractors were to furnish all materials and labor needed to build the structures except the hydraulic lime used as mortar which the state purchased at Louisville and furnished to the contractors. Special contract provisions specified the contractors would not be paid for "bailing water" (pumps were not then available) from the temporary cofferdams built to keep out the river while the locks were built, and that the contractors would, when directed by the resident engineer, fire "disorderly or quarrelsome" workmen.[11]

A steamboat packet on the Kentucky River near Beattyville, June 28, 1886. It passes a pushboat loaded with merchandise visible at the bow of the steamer, and in the background near the bank is an Engineer piledriver boat preparing to work in connection with construction of the beartrap dam.

While the contracts called for completion of all five locks and dams by November 1, 1838, allowing thirty months for the work, that proved an impossible deadline. The price of building materials and labor mushroomed because the contractors had to recruit skilled labor from Pennsylvania, offering high wages to make relocation attractive, and because they were competing for materials and supplies with contractors at work on the Green and Licking Rivers and on turnpike roads. At the end of the first year the resident engineer sadly reported little had been accomplished on the Kentucky, for costs had proven much higher than his estimates and the contractors had been unwilling to "prosecute their contracts vigorously."[12]

When the national financial panic of 1837 and subsequent economic recession disrupted money markets, the state found it could not sell its bonds for financing transportation projects, and it required the contractors to accept state bonds as payment for the work they had completed. The contractors could not persuade their creditors to accept the state bonds without offering substantial discounts, with the result that some contractors bankrupted and those who stayed to finish the work claimed they were financially ruined. Rather than thirty months, building the first five locks and dams required seven years, and a cost overrun occurred, amounting at Dam 1, for instance, where the foundation was difficult to secure, to 274 percent of the original estimate. According to an Army engineer officer who conducted an intense review of the state project records in 1882, the initial construction from 1836 to 1844 was "but a record of delays, disappointments and miscalculations."[13]

By installing temporary operating equipment at the uncompleted structures, the resident engineer locked through the first steamboat, the *New Argo* commanded by John Armstrong, upstream to Frankfort on February 14, 1840, but construction of the five dams was not completed until 1844. The cost of the five locks and dams published at the time was $901,932.70; yet, project records indicated the costs footed up to $939,000 by 1844, to which were later added the claims of contractors settled after 1844. The construction by the state actually totaled about $1.1 million, or an average of $220,000 for each of the five structures, and the total was not exhorbitant when compared to the 1836 cost estimate of $701,405, but voters in the bankrupted state thought the figure scandalous.[14]

For its investment, the state acquired five solidly built stone-masonry locks which served navigation on the river the following one and a half centuries (though repaired and modified, the five locks were still in service in 1983) along with five cheaply built, stone-filled timbercrib dams that leaked badly from the start. The project provided ninety-five miles of six-foot slackwater navigation from the mouth of the river to the vicinity of Oregon, Kentucky, some thirty miles upstream of Frankfort. The project was still 160 miles from its goal at the Three Forks, however, and an opportunity to develop and market by slackwater the "inexhaustible" resources of the Kentucky mountains was still unrealized.

During the early years of operation the project supported a bustling steamboat commerce. Because the Lexington and Ohio Railroad then ended at Frankfort, the railroad fed the produce and manufactures of the Bluegrass region directly onto steamboats at Frankfort for further shipment to Louisville and New Orleans; the operators of the railroad also constructed and operated steamboats out of the port of Frankfort. The amount of tolls collected from river traffic climbed to $49,638.79 in 1847 and remained high until 1852 when the railroad bridged the river at Frankfort and opened direct rail service into Louisville, ending the transshipment of freight from rail to river at Frankfort and also hampering use of the river upstream of the capital because the bridge clearance was too low for steamboats to pass under at higher river stages. To compete with the railroad, state government reduced the tolls for lockage on the river but with little effect other than to deplete the amount of funding available for project maintenance.[15]

The state collected, all told, $472,620 in tolls and other revenue at the Kentucky River project from 1843 to 1866 and expended $314,489 for its operations and maintenance, leaving a net income insufficient to pay one percent on the capital invested in construction and entirely inadequate to capitalize construction of the locks and dams needed to extend slackwater to the Three Forks. It was patently unfair to judge the benefits realized from the project in terms of the amount of tolls collected, however, declared the official who had charge of the project in 1864. He explained:

> Taking into consideration the notorious fact that the true advantages of the most successful improvements are not known by the dividends declared, but by the facilities that they afford for transportation, travel, and the development of the resources in the country, the increase of real estate in the vicinities of the two lines of improvement [Kentucky and Green River projects] has more than paid the State already for the investment.[16]

The Kentucky River project served national defense during the Civil War. Camp Nelson, seventy miles upstream of Frankfort, became a training and staging base for Union Army Engineers where they built pontons for bridging the rivers of the South, and Fort Bramlette, a cantonment on a hill overlooking Camp Nelson, became a Union Army supply depot and recruiting center. Those posts were supplied in part by river transport, and the produce of the rich farms in the valley moved by river and connecting rail lines to supply Union armies in the South. To keep traffic moving on the river during the military emergency, the Union Army officer in charge of the project placed timbers atop the crowns of the dams in 1863 to raise the pools an additional three feet, offsetting the loss of pools resulting from leakage through the dams during dry seasons. That proved a mistake, however, for the modification created a three-foot vertical fall of water onto wooden decking on the back slopes of the dams, smashing the decking, exposing the stone inside to the action of the river and wrecking the dams from summit to base.[17]

Lacking funds for repair of the dams, the state after the Civil War leased the project to the Kentucky River Navigation Company, which promised to repair the dams and begin construction of the locks and dams needed to reach the Three Forks. Though eight counties along the river voted bond issues to purchase $700,000 worth of stock in the company, it neither maintained the existing structures nor built more and the entire scheme collapsed. By 1873, floods were undermining the dams and breaching them in their centers, creditors of the company were foreclosing by attaching the bonds issued by the counties, and the state had initiated litigation to break the lease and recover control of the project. While the courts were considering the case, the project fell into ruin, becoming more an obstruction than an aid

Repairs underway at the timbercrib Dam 4 on September 7, 1885. In the background is the Kentucky River Mill, using water power at the dam to manufacture carpet backing and twine. The stiffleg derrick or boom hanging over the heads of the workmen helped move heavy timbers.

to navigation because the breached dams closed the river to commerce entirely except when submerged by floods.[18]

Rivermen, shippers, and other Kentuckians interested in waterways navigation and development of resources in the mountain area at the headwaters of the Kentucky River conducted an extensive campaign during the 1870s for restoration and extension of the locks and dams, seeking both state and federal funding. Nathaniel S. Shaler, state geologist from 1873 to 1880, urged that the improvement of Kentucky River navigation was vital to the future development of the resources in the mountains which he had located and publicized during his geological surveys; he also supported industrial development along the lower river and was a director of a company which in 1878 began constructing a mill at Dam 4 in Frankfort to convert hemp produced in the Bluegrass region into carpet backing and twine. Judge Lysander Hord of Frankfort conducted a publicity campaign aimed at securing public support for the project and directed efforts in the Kentucky legislature to secure state funding. Thomas Turner of Richmond had assisted Shaler with the geological surveys in 1873 and after election to Congress in 1876 he sought a federal survey of the Kentucky and funding for construction. Judge Hord was honored as the "father of the Kentucky River navigation," but Shaler and Turner were no less deserving of that sobriquet.[19]

The efforts of those three leaders and other Kentuckians supporting waterways navigation earned such substantial public support that when the State Court of Appeals on November 22, 1877, restored control of the project to state government, the Governor immediately employed Captain Robert H. Fitzhugh, a Confederate Army Engineer who had established himself in Kentucky as railroad surveyor and consulting engineer during the postwar years, to inspect and report the condition of the locks and dams on the Kentucky. Fitzhugh reported on December 10 the five locks needed new wooden gates but were otherwise serviceable; the timbercrib dams, however, were rotten from the combs to the waterline and all except Dam 4 were breached in the center. He thought the breaches could be quickly closed with piling and stone and the remaining portions of the dams repaired by rebuilding their deteriorated upper sections above the waterline. He estimated restoring the five locks and dams to service would cost only $84,802 and building the new locks and dams needed to provide slackwater navigation onto Beattyville at the Three Forks would cost about $989,600 bringing total project costs to $1,074,402, not including the expenditures of the state during 1836 to 1844.[20]

The Kentucky general assembly on March 8, 1878, rejected a bill funding project repair, but it did approve the use of state convicts for repair work if local governments supplied the construction materials. Judge Hord thereon launched a promotional campaign on behalf of county bond issues for rebuilding the project, but he met a dismal reception. In June 1878, even the voters of Frankfort and Franklin County, who probably had most to gain from the restoration of navigation, defeated a bond issue for the purpose. Rejected by the state legislature, defeated at the polls by the voters, the Kentucky River navigation project as a state and local initiative appeared dead.[21]

Thomas Turner and other congressmen from Kentucky had better success in Washington, and obtained in the Rivers and Harbors Act of July 15, 1878, a $3,000 appropriation for a federal survey of the river. The Chief of Engineers assigned the survey to Colonel William E. Merrill, the officer commanding the Army Engineer office at Cincinnati, and at the recommendation of Kentuckians the colonel employed Captain Robert H. Fitzhugh to make the survey. Fitzhugh wagoned boats and a survey party to the upper Kentucky, boated down it in the autumn of 1878, and submitted a favorable report to the colonel late in the year. He stuck to his 1877 estimate of less than $100,000 for repair of the five existing structures and strongly urged the extension of slackwater navigation to Beattyville at Three Forks and even a considerable distance up each of the forks. On the question of project benefits versus costs, he thought it "supererogatory to enter into a detailed exhibit of the probable business to be developed by the proposed improvement, and especially so when the acknowledged productiveness of the counties involved is manifestly equal to the demands of any investment necessary to its relief from commercial thraldom."[22]

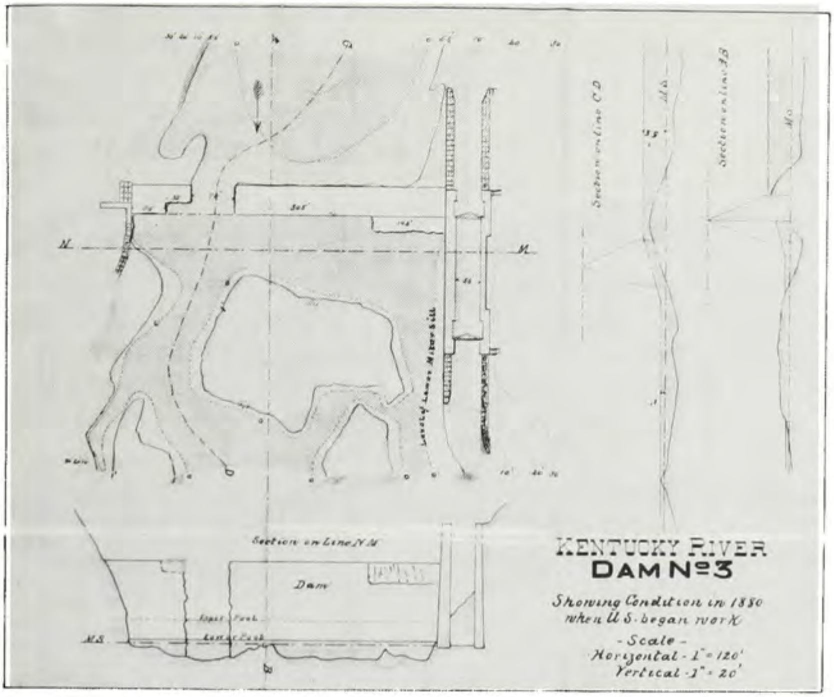
Colonel Merrill forwarded the survey report to Washington on January 14, 1879, and by the time it reached Washington Judge Hord and Professor Shaler were in the capitol testifying with Congressman Turner on behalf of an appropriation for the Kentucky River. They obtained it in the Rivers and Harbors Act of March 3, 1879, which provided $100,000 to commence the march of the Army Engineers toward the Three Forks.[23]

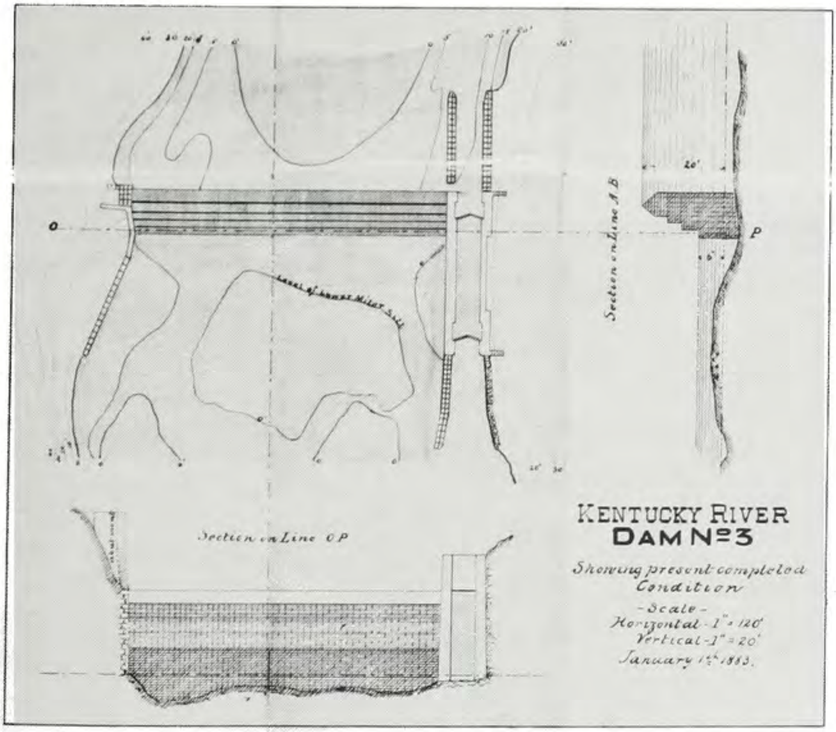
Because the state had not delivered titles to the project and granted jurisdiction over the property to the United States, the project reconstruction did not begin in 1879. When the state ceded the project to the federal government on January 24, 1880, federal authorities refused to accept it because the state law granted "concurrent" rather than full jurisdiction over the project to the United States. Judge Lysander Hord introduced a second bill of cession deleting the word "concurrent" which the state legislature enacted on March 22, 1880, and which was accepted by federal authorities. The act had one condition which specified the federal government would honor the lease granted by the state in 1878 to Nathaniel S. Shaler and his associates for use of water power at Dam 4 to operate the Kentucky River Mills.[24]

Colonel William E. Merrill was fully occupied with the construction of Davis Island Dam on the Ohio River near Pittsburgh in 1880, and the Chief of Engineers ordered Captain James W. Cuyler to Cincinnati to take charge of the Kentucky River project. Cuyler opened a second Engineer office (later named the Second Cincinnati District) at Cincinnati in early April 1880, employed Captain Robert H. Fitzhugh as his assistant engineer, and inspected the Kentucky River by steamboat on April 13. Leaving Fitzhugh at Frankfort to undertake the detailed surveys, Cuyler returned to Cincinnati to rush the preparation of project plans.[25]

Partly because the river was closed to regular navigation, an economic recession and coal famine was in progress in the Frankfort vicinity in 1880, and Cuyler observed that public sentiment was "very urgent and impatient that immediate work should be undertaken." Hoping to restore navigation by the end of 1880, Cuyler hastened his planning, sent his plan of action to Washington, and received the approval of the Chief of Engineers in merely four days. He proposed closing breaches in Dams 1 to 3 with piling and stone, tearing the rotten tops of the old dams down to the waterline, and rebuilding the dams along their original structural lines. He thought Captain Fitzhugh had somewhat underestimated the costs of reconstruction, and he raised Fitzhugh's estimate of $84,802 to $100,000, which happened to be the amount appropriated by Congress, and he also estimated an additional $35,000 would be needed to repair Dam 5.[26]

Because completing detailed surveys, preparing contract specifications and plans, and advertising for contractor bids would have lost the entire low water working season of 1880, Cuyler decided to hire workmen, purchase construction materials, and do the work under government supervision rather than by contract. After two months of preparation, work began in June 1880 with efforts to remove the superstructure of the old dams. One of the dams was soaked in oil and put to the torch, but its waterlogged timbers would not burn. Demolition with explosives was out of the question because the blasting would damage foundation sections of the dams on which the new superstructure would be placed. Workmen therefore began ripping the old dams apart piece by piece, a slow process further hampered by





The upper map shows the breached condition of Kentucky River Dam 3 when the federal government acquired it in 1880, and the lower map shows it in 1882 after its reconstruction. *National Archives, Record Group 77.*

unusually high river stages during the summer of 1880.[27]

Cuyler's plans for reopening navigation to Frankfort by the end of the year were aborted by the condition of the dams. As the workmen ripped them apart, the captain was amazed to learn they "consisted merely of a mass of timbers of sizes from 20 inches diameter to 6 inches, thrown together without any system of framing or bolting, and either originally without stone filling, or what had been put in of this had been washed out." Instead of taking out only the tops of the dams down to the waterline, they had to be razed to bedrock and entirely reconstructed. Detailed surveys also revealed that water rushing through the breaches in the dams had scoured the riverbottom to depths of fifty feet. Reflecting upon the bitter lesson of 1880, Cuyler declared the experience proved it was cheaper to build entirely new dams than it was to attempt to rebuild atop old ones.[28]

Work resumed in the summer of 1881 and by Halloween all that remained to reopen navigation into Frankfort was to suspend new wooden lock gates on their anchorages in the lock walls and to install operating mechanisms. Floods came early again in 1881 and with them on November 1 came a disaster at Dam 1. Broken stone, called riprap, had not been

The timbercrib and piling used to close the breach around the abutment of Dam 1 remained only partly completed on August 10, 1883, when this picture was taken looking upstream toward the dam. The lock was to the left out of the picture; note the stepped or battered configuration of the wooden decking atop the timbercrib dam.

Lockmen turn the capstans which operated the lock gates at Kentucky River Lock 1 on August 10, 1883. The stepped dam visible at left showing no flow over the dam indicates either an extreme drought or that river flow still passed through the breach in the dam abutment made by the river in 1881; note the timber piling on the far bank driven to close the breach was not entirely completed. The lockmen wore suits with vests and doubtless posed the picture for posterity.

applied along the bank and atop the abutment of Dam 1 opposite the lock to protect them against scouring by the river, and the flood cut into them, undermining the abutment, breaking through around the dam, and soon scouring itself an entirely new channel bypassing the dam. Called "flanking," it was the worst kind of disaster because it forced the construction of a second dam across the new channel. Cuyler rushed to the site, fired the resident engineer, and took personal charge of the repairs, assembling all the men and plant he could obtain to drive rows of piling across the gap, fill the area between the piles with trees, and drop broken stone atop the trees. That work turned the river back into its original channel, but at an additional cost of $60,000.[29]

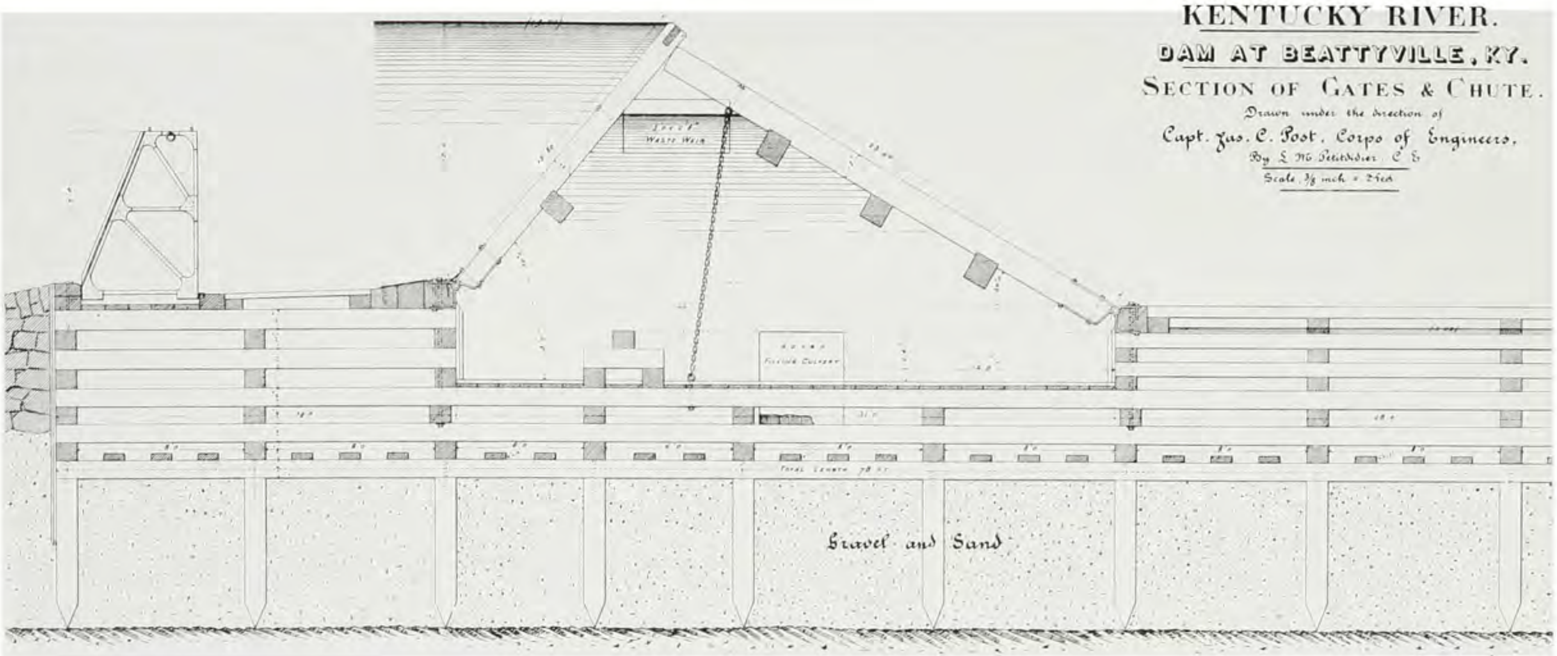
By continuing work through the winter as river stages permitted, Cuyler finished the repair job, installed lock gates and related equipment, and reopened navigation into Frankfort in March 1882. River commerce immediately resumed and within three months the project had served

25 steamboats, 52 flatboats, 30 barges and 128 rafts of saw logs. A legal complication arose, however, that was to bring Cuyler's career to an end. Except for testing purposes, funds appropriated by Congress for project construction could not be used for operation of the locks, and Cuyler, moreover, had expended the construction funds. He asked the Chief of Engineers in March to allot him funds for operations or to allow him to charge tolls on traffic as had been the practice of the state earlier. Since the Corps of Enginers had never before operated a system of river locks and dams, Congress in 1882 had not established a policy on the funding of operations, and the Chief had to raise the issue with Congress. By late April, Cuyler had spent every penny appropriated for construction and had contracted debts which could not be paid until Congress made an additional appropriation. Cuyler therefore laid off workmen and closed the locks in early May, causing such a public clamor that the Chief of Engineers forwarded money to pay lockmen, taking it temporarily from appropriations for surveys. That temporary funding arrangement continued until 1884 when Congress created an "indefinite" appropriation as standing funding for the operations of locks and dams.[30]

Closing the locks to navigation in May 1882 won Cuyler no friends in Kentucky and complaints about his management of the project grew loud. Creditors holding his notes for $6,000 held a public meeting of protest in Frankfort in August 1882 and resolved that he should be investigated. Pointing to cost and time overruns, one critic predicted that if Cuyler remained in charge of the Kentucky "the coal fields of the mountains will never be reached in the next hundred years."[31]

A board of officers appointed to investigate met at Frankfort on November 27, 1882, to hear complaints of the public and to audit accounts and review the work. They found the Rivers and Harbors Acts of 1879, 1880, and 1881 had furnished a total of $325,000 for the Kentucky River and all had been expended by May 1, 1882, on repair of the four lower locks and dams; none at all had been spent on Dam 5. It reported further that Cuyler's 1880 estimate of $135,000 for the repairs had clearly been misinformed, that he had made unfortunate choices in personnel selection, and that he should not have published overly optimistic predictions of when navigation to Frankfort would be restored. Suffering from "intense nervous depression," Cuyler took leave of the Kentucky River and died on April 10, 1883.[32]

Captain James C. Post, who succeeded Cuyler, continued the repair work at Dam 5 and started planning Lock and Dam 6 but concentrated upon a deep penetration of the territory, moving directly to the head of the Kentucky at the Three Forks. Coal mine operators along the Three Forks then were loading flatboats with coal on gravel bars in the rivers to await high "tides" to carry them downriver to markets at Frankfort and below. They suffered many losses; a January 1879 ice jam, for instance, destroyed the flatboats and spilled their cargoes into the rivers. The operators wanted a dam built across the Kentucky at Beattyville to create a slackwater pool on the lower sections of the Three Forks where they could load their flatboats and secure them in tributary streams safe from ice and flash floods. In compliance with their requests, Kentucky Congressman John D. White inserted into the Rivers and Harbors Act of August 2, 1882, a $75,000 appropriation for construction of a "lock and movable dam" at Beattyville.[33]



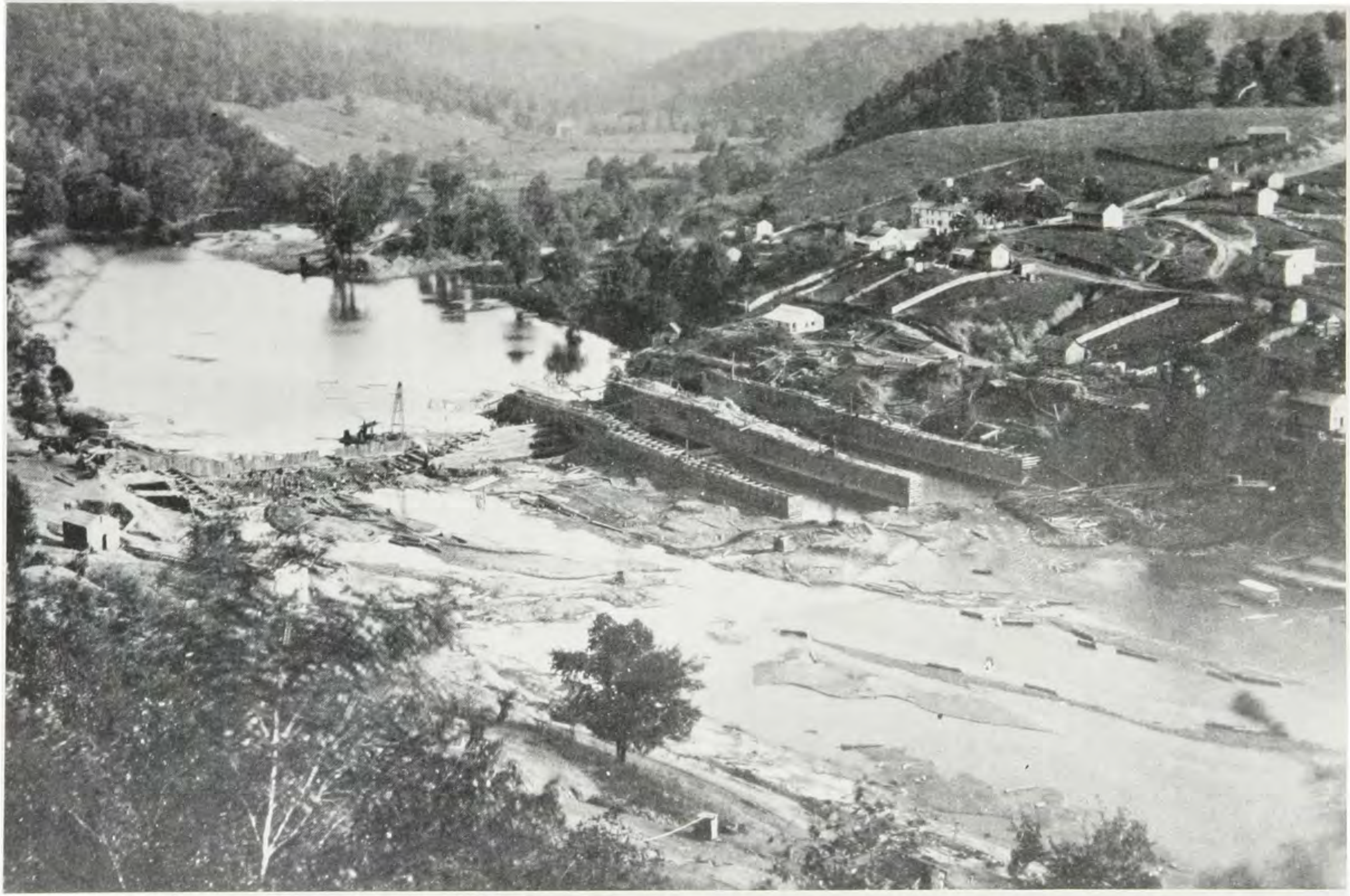
1884 plans for the Beattyville beartrap showing the leaves in a raised position holding a pool. Water from the upstream pool passed through the culvert under the leaves and forced them to an upright position as far as the chain would permit. The metal trestle shown to the left of the beartrap was one of a series that could be raised to the position shown to form an emergency dam, allowing repairs to the beartraps.

A board of officers composed of Captain Post, Colonel William E. Merrill, and Lieutenant Colonel William P. Craighill rode horseback through the mountains into Beattyville in November 1883 to conduct a public meeting where they learned river commerce at the Three Forks was 650,000 bushels of coal, 6 million board feet of saw logs, and 5,000 crossties, of which about ten percent were lost each year on the way downriver. Pushboats took feathers, ginseng, and country produce downriver and returned with groceries, drygoods, and merchandise vital to people at the Three Forks because mountain roads were impassable in winter and spring and the nearest railroad was forty-five miles from Beattyville.[34]

Because a navigation lock would have served little purpose until the 160 miles of river from Lock 5 to Beattyville were canalized, rivermen at Beattyville suggested construction of a movable dam that could be dropped to create an artificial "tide" to carry coalboats and rafts downstream to Frankfort. Colonels Merrill and Craighill then were building such movable dams on the Ohio and Kanawha rivers using the Chanoine wicket design, but they feared flash flooding and running drift at the Three Forks would prevent maneuvers of the wickets. The board of officers went from Beattyville to Pennsylvania to inspect movable dam weirs in use on the Monongahela and Susquehanna rivers that were called beartraps and used to "splash" rafts and watercraft downstream. The beartraps had two leaves, or large rectangular panels hinged to a dam foundation, that collapsed one atop the other: by opening a valve, water from upstream passed through a culvert to an outlet under the leaves and caused the leaves to rise and block river flow, thus holding a pool upstream of the dam. When boats were ready to head downstream, the valve was closed and the leaves sank to rest atop the dam foundation, opening a chute through the dam. Water from the pool flushed through the chute and the boats followed, gliding down a slope to the river channel below and riding the artificial wave to their destinations. The board recommended that Captain Post design a movable beartrap dam for construction at Beattyville as an experiment.[35]

Captain Post designed a stone-filled timber dam across the Kentucky between Beattyville and Proctor with two sixty-foot wide beartrap gates occupying two chutes in the dam. Seventy-foot long guidewalls upsteam of the dam would direct boats into the chutes, and downstream would be three-hundred-foot guidewalls to keep boats in the chutes and atop the slopes as they descended to the river channel below. Post sent assistant engineer R. S. Burnett upriver with the snagboat *Kentucky* to Beattyville in 1885 to hire labor and purchase timber and stone. Burnett started construction in October 1885, and by 1886 he had two hundred men at work, driving piling, building cribwork, dropping stone into the cribs, and framing the beartrap leaves.

The job proved an engineer's nightmare. Supplies and materials arrived whenever they could be gotten upriver or over mountain roads from the railroad forty-five miles away. Workmen tired quickly of the isolated work site and frequently departed for more interesting jobs. Floods from one or more of the Three Forks inundated the work site an average of once a week. Still, Burnett pushed the job day and night, though how he accomplished much at night without electric light remains a mystery, and somehow he managed to finish the dam in a single year. Testing of the dual beartraps began on



Beattyville dam and beartrap chutes under construction in 1886 at Kentucky River Mile 254.5. Note the piledriver at work driving wooden sheetpiling along the upstream face of the dam. *National Archives, Record Group 77.*

October 30, 1886, and they functioned well, raising and lowering neatly when the valve in the wall between the two chutes was opened and closed. When the leaves were flat against the dam foundation, however, the water rushing through the chutes reached a high velocity and created a "short chopping sea" of rough waves at the base of the slopes. Raftsmen entering the chutes sometimes became frightened and jumped for their lives, leaving their rafts to ram into the guidewalls and break apart or to run wildly down the slope and come apart in the waves below. The turbulent waves at the base of the slope sometimes broke apart the flimsy wooden coalboats.[36]

Shortly after the beartraps opened to navigation, such as it was, the engineer noticed the wooden floors of the downstream slopes rising from uplift pressures, and to relieve the pressures he bored holes through the flooring and began driving sheet piling along the upstream face of the dam to cut off river flow that might be creating the pressures. A November flood stopped that work and the uplift continued, lifting the flooring and even pulling the piling which held the flooring in place. Once the floors had been lifted, the backlash of the waves below washed out the stone, tearing away the slopes and guidewalls all the way back to the beartraps and the dam itself. Damage was so severe that the Chief of Engineers ordered the board of officers which planned the project back to Beattyville for a reconsideration.[37]

The officers saw the damages could be repaired, but they knew not how to reduce turbulence at the bottom of the slopes and therefore recommended the experiment with beartraps end and a stone masonry navigation lock be constructed to move boats from the upstream pool to the channel below. Beartraps were subsequently built at dams on the Ohio River, a few remaining in use in 1983, but for passing drift and regulating pool levels; never again were they designed as substitute for navigation locks.[38]

Lieutanant William L. Sibert reported to Beattyville in 1887 to take charge of lock construction. He later planned the nine-foot navigation project on the Ohio River and served as division engineer on the Panama Canal project, becoming one of the foremost waterways engineers of his time. At Beattyville, he cut the crest off the top of the dam to permit passage of rafts and coalboats over it at high water stages, dropped the materials below the dam to check further scouring, and established a rock quarry to cut out the limestone blocks needed for walls of the navigation lock. A cofferdam ringing the site of the beartraps was built, the beartraps were razed, the foundation rock cleared, and by 1890 preparations were underway to begin placing the stone masonry of the lock walls.[39]

In 1890 the Three Forks area received its first railroad service, and that changed the conditions that had resulted in contruction of the beartrap dam. The Kentucky Union Railway crossed the North Fork of the Kentucky six miles upstream of Beattyville in 1890, and another railroad known locally as the "Riney'B" was laying track along the Kentucky headed upstream into Beattyville. Commenting that building the navigation lock would be very expensive and "its usefulness when completed less than it should be," the Engineer in charge recommended in 1890 that construction of the Beattyville lock cease. With approval from the Chief of Engineers, work stopped on February 25, 1891, the dam was extended through the cofferdam for the lock to the Proctor side of the river, and the tools and equipment were shipped downriver for use in the contruction of Lock 6.[40]

While the beartrap experiment was underway at Beattyville during the 1880s, construction had continued downstream at Locks 5 and 6. Once the four locks and dams downstream of Frankfort had been repaired and navigation to the capital city restored, the Engineers began the repair of Dam 5. Five sealed bids for building a new dam at Lock 5 were opened on October 20, 1884, and the contract went to Israel V. Hoag, formerly an assistant engineer for the Corps who had entered business for himself. Hoag rebuilt Dam 5 in a single season for $66,505, opening Lock 5 for navigation on January 1, 1886, completing the first hundred miles of the march toward Beattyville and finishing reconstruction of the old state project.[41]

Commerce on the Kentucky River meanwhile revived, climbing from nearly nothing in 1880 to a value of $5.4 million in 1884 and $10.8 million in 1887. Eight steamboat packets and six towboats entered the trade, transporting passengers and hogsheads of tobacco from Frankfort to Louisville for the same fare: a dollar a head. To compete with river traffic, railroads serving Frankfort reduced their rates by nearly two-thirds, and the retail price of coal at Frankfort by 1885 was less than half what it had been in 1880. The engineer in charge of the Kentucky River observed the reduction in railroad rates and resulting savings to consumers would soon repay the government investment in reconstructing the project, and he declared project benefits appeared widespread: "The people tributary to the river seem to have been stimulated to new life. . . as is evident by the generally improved condition of the farms and farm-houses and the increased acreage under cultivation."[42]

When the Engineer submitted plans in 1887 for Lock and Dam 6, the first on the river to be constructed from scratch by the Corps of Engineers, the Chief of Engineers convened a board of officers to review the plans because Lock and Dam 6 would set the pattern to be followed at other locks upstream. After review of the plans, the board decided the width of the lock chamber should be increased to fifty-two feet, as compared with thirty-eight feet at Locks 1 through 5, in order to provide for lockage of two coal barges of 25 feet abeam at one time.[43]

Building a lock and dam on the Kentucky River ideally required three years: the first to quarry stone for the lock walls and collect construction materials and plant at the site, the second to build a cofferdam around the site of the lock and erect the lock walls, and the third to build the timbercrib dam. Building Lock and Dam 6 took longer because of contractor failures. A contract for furnishing 11,000 cubic yards of stone for lock masonry was awarded in May 1887, but the stone was not delivered by August 1888 and the contractor took a $6,000 penalty for his failure. Another contractor took the job, opened two quarries in Kentucky without finding the quality stone demanded by the Engineers, and finally purchased oolitic limestone in Indiana, delivering it in May 1890. Securing the stone for Lock 6 therefore took three years, the time in which the entire structure should have been completed.[44]

Assistant Engineer R. S. Burnett commenced building the cofferdam around the lockpit on May 14, 1891. It was composed of 206 timber piles the size of telephone poles driven into the riverbed with timber stringers spiked to the piles, wooden sheetpiling driven in a line against the stringers, and gravel and clay heaped against the wall thus formed; it protected the lockpit from seven-foot river rises. When it was completed, the pumps aboard the snagboat *Kentucky* removed water from inside the cofferdam and workmen went down inside to strip mud and gravel from the top of the bedrock, loading it with shovels into wheelbarrows for removal up ramps. Cracks and seams in the bedrock were sealed with cement and masons began laying courses of precisely cut stone blocks, one course atop another, forming the masonry of the lock walls. Most masons and skilled workmen on the Kentucky River project were Irish and Italian emigrants and their sons who had learned their trade in the old country and followed the work from river to river across the nation.[45]

With work on the lock walls going well, R. S. Burnett, having all the materials on hand, decided to start building the dam, framing the timber cribs upstream, floating them down into place along the line of the dam, pinning them together with drift bolts at the corners, and filling them with stone. After the cribs were in their places, double-lapped wooden sheet-piles were driven down along the upstream face of the dam, the crown and downstream

Workmen at Lock 6 pose on September 14, 1891, apparently with the wife and daughter of the photographer in the center of the group. Close observers will detect the water boy with bucket standing on the edge of the lock masonry and the men holding shovels, wheelbarrows, and other power tools of the era. Overhead is a crane mounted on rails for handling the cutstone; the empty barrels alongside the masonry had contained the cement used as mortar.

slopes were capped with timbers, and dredged fill was banked against the face of the dam. Burnett received a hard-earned commendation for completing the 412-foot long and 60-foot wide dam in the autumn of 1891, thereby allowing Lock 6 to open to navigation on December 2, 1891.[46]

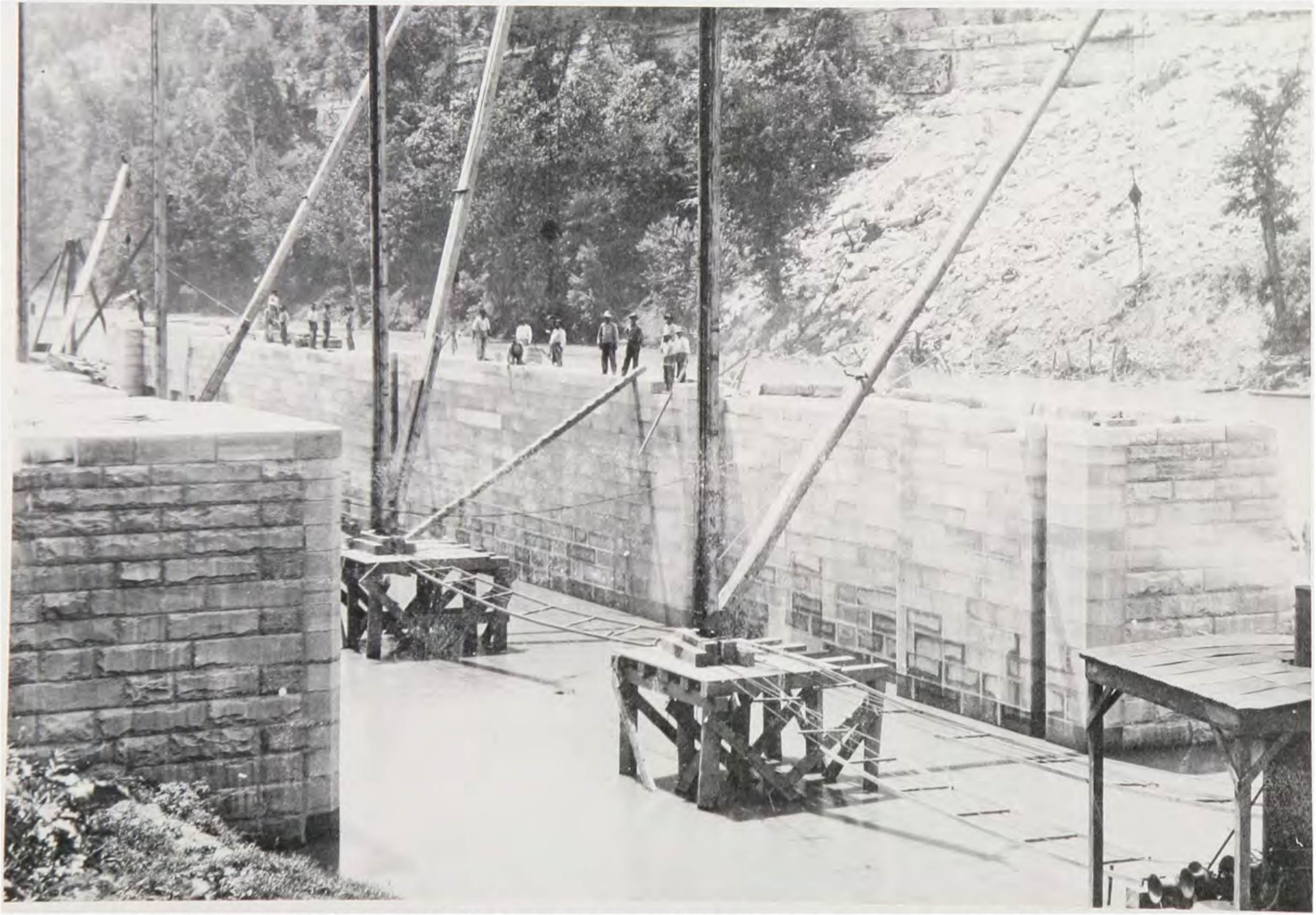
Surveys to select the site of Lock 7 began before Lock 6 was completed, and in retrospect they seem simple. Knowing where the pool upstream of Dam 6 would become too shallow to provide a minimum six feet of water for navigation, a survey party headed upstream toward that point, some of the crew pushing a shanty boat with poles upriver to serve as office and quarters while the surveyors with their transits ran a line of levels along the bank. Averaging about a mile a day, the surveyors moved upriver in search of the point farthest upstream where a rock foundation could be found for Lock 7 at the upper end of the pool of Dam 6. They ascertained the existence of foundation bedrock by driving steel rods with a sledgehammer through the gravel in the riverbottom until the rods clanged against rock, making sure to drive enough times to be certain they had not merely hit a boulder.[47]

Securing land for the lock and dam was equally simple. As the survey crew worked upriver, they contacted landowners along the banks, conducted preliminary negotiations for the land needed, and sometimes found owners willing to sign options to sell their land for a specified price on the spot. Because the Kentucky River upstream of Frankfort has a narrow floodplain, the dams inundated few valuable bottomland farms and the landowners were pleased to have the slackwater available for their own use and knew, moreover, the project would enhance the value of the remainder of their property and bring prosperity to their community during construction.[48]

It was at Lock 7 where the Engineers first encountered a landowner who did not want to sell. The operators of a saw mill near the lock site complained the lock and dam would interfere with operation of a log boom they had in the river to catch saw logs floated downstream from the headwaters, and also objected that "during the process of its construction an irresponsible and undesirable class of people would be attracted to the locality, who would make improper use of their premises and be liable to set fire to them." A board of engineers searched for an alternate site for Lock 7 but found none and it became necessary to condemn the land for the lock in court.[49]

Lieutenant William W. Harts and Associate Engineer John M. G. Watt opened a resident office at the site of Lock 7 in 1896 and had stone quarried for the navigation lock at Beattyville boated downriver for use in Lock 7. When the stone arrived, Harts and Watt had the cofferdam completed and a double-track tramway on an incline into the lockpit ready to place the stone in the lock walls. The tramway was an ingenious arrangement with a small railcar on each track and the railcars linked together by a wire cable running around a drum at the top of the incline; as one car carrying a stone went down one track, it pulled the empty car up the other track to the head of the incline for loading. The first stone was placed in Lock 7 on August 4, 1896, and it opened to navigation on December 11, 1897, after only two construction seasons and at low cost. Dam 7 cost an average of $2.00 per cubic foot of dam as compared with $3.35 per cubic foot at Green River Dam 5 completed in 1899.[50]

Plans for Lock and Dam 8, twenty-nine miles closer to Beattyville and the Three Forks than Lock 7, called for a structure



Construction of stone-masonry Lock 7 in 1887. Steam engine at the right supplied power for the stiffleg derricks inside the lock chamber for moving the cutstone masonry blocks.

high enough to lift boats eighteen feet. Before the building of Lock 8, lock lifts exceeeding fifteen feet had been overcome through building two or more locks in a series (as was done at the Louisville and Portland Canal locks on the Ohio River). The eighteen-foot lift at Lock 8 was the highest of record for stone masonry and timbercrib construction, marking the peak of the art of building with those materials. With a bid of $261,000, Thomas A. Sheridan won the contract for Lock and Dam 8 on September 20, 1898; the bid was $39,000 below the government estimate of $300,000. Construction procedures at Lock 8 differed a little from those used at 6 and 7, except the contractor used a cableway, or highline, to move stone instead of tramways or derricks. Rowan County freestone served as backing for the lock walls, which were faced with Indiana oolitic limestone. The contractor performed well, and Lock 8 opened to traffic on October 15, 1900, bringing 19th century engineering with stone masonry and timbercribs to an end.[51]

By the turn of the century the Corps of Engineers questioned the wisdom of continuing the march toward Three Forks. Lieutenant William W. Harts restudied the project rationale and economics in 1896 and noted that railroads had entered the upper Kentucky valley in 1892, that shipment of coal in flatboats from the Three Forks to Frankfort had ended in 1894, and that the chief commerce remaining on the upper river consisted of rafted and floated saw logs, a trade which was hampered rather than helped by the contruction of locks and dams. Observing that there were only three towns on the upper river--Ford with a population of 381, Irvine with 500 people, and Beattyville/Proctor with a population of a thousand mountaineers--Lieutenant Harts concluded the upper river would never support a profitable steamboat packet trade.[52]

Because of the narrow, winding channel and small lock capacity, a four-barge coal tow running night and day would require at least three days to descend from Beattyville to Carrollton, the same amount of time required for twenty-four barge tows of coal to descend the Ohio from Pittsburgh to Carrollton. Lieutenant Harts therefore thought it unlikely that coal from the Three Forks would ever compete in the Ohio River trade with coal from the Monongahela. Estimating that every lock and dam built upstream of Lock 7 would cost $300,000, or a total of $2 million to build the seven structures needed to extend slackwater navigation to the Three Forks, to which would be added operating costs of more than $100,000 a year, Lieutenant Harts concluded:

> This cost is so large and the benefits to be obtained depend so much on the capacity of the coal-fields and the cheapness of marketing coal, that the question at once arises whether it is certain that the general benefits to the United States will justify the enormous expense. It would be a matter of much chagrin if, upon completion of the system, but little coal was found or the commerce in coal should be found to be so unprofitable as to make it impossible to compete with other coal regions. The United States would then have an extensive slackwater system on its hands, expensive to maintain, with little or no commerce to justify the expenditure.[35]

During the waning years of the 19th century the Cincinnati Engineer Office restudied the Kentucky River project in search of methods by which construction costs could be reduced. The first seven locks and dams had an average lift of fifteen feet, at which average lift the number of additional structures necessary to reach Beattyville was eight. By increasing the average lift at the structures remaining to be constructed to eighteen feet, the number of structures to be built could be reduced to seven, making a total of fourteen. The change in plans was made, which was why Lock and Dam 8 was built with an eighteen-foot lift. It was estimated the last seven locks and dams could be completed for a total of $3 million which, added to the $1.8 million expended on the first seven, would bring total project costs to $4.8 million. With that figure in hand, the Engineer in charge recommended that project construction cease with Lock and Dam 8 at the end of the century. "In reality," he observed, "the local benefit of the improvement did not justify going above Frankfort, in the fourth pool, which is the only city of importance on the river. The only warrant for the extension upstream was to tap the coal field of Beattyville."[54]

Though the Engineers concluded in 1898 the march to the Three Forks should stop at the midway point, and they consistently reported that opinion to higher authorities and Congress thereafter, Kentuckians disagreed and even sought to double the pace of the march. Pointing out that building a single lock and dam at a time, each taking about three years, would prevent reaching Beattyville for more than fifteen years, Kentuckians urged that two or more of the structures be constructed simultaneously, and they obtained, more or less, what they wanted.[55]

The Chief of Engineers in 1901 established the Central Division office at Cincinnati to supervise the activities of several Engineer District offices in the Ohio River basin, and on November 22, 1901, Lieutenant Colonel Thomas H. Handbury, the first Central Division (now known as Ohio River Division) Engineer, inspected the Kentucky River by steamboat and observed the start of construction at Lock 9. Finding the principal goal of project construction was to furnish "a cheap means for transporting the coal found in the headwaters of the Kentucky River to market," Handbury therefore directed Major Ernest H. Ruffner, the Cincinnati Engineer officer, to prepare immediately the plans and specifications for Lock and Dam 10 and to acquire the sites for Locks 11 and 12, rather than awaiting completion of Lock and Dam 9.[56]

Engineer offices in 1901 were not organized by function—engineering, real estate, construction, and operations—but by geographic area, and Major Ruffner's staff at the Cincinnati "District Office" was quite small: a principal engineer, a draftsman, a chief clerk, and a few assistant draftsmen and clerks. As was the case on other rivers within the District, the Kentucky River project was largely directed by an assistant engineer in the suboffice at Frankfort and by resident engineers at construction sites. To speed work on the Kentucky, Major Ruffner assumed personal charge of the work and "shook up" the staff. Assistant Engineer John M. G. Watt thereon transferred to the Tennessee River where he directed construction of a lock with a thirty-six foot lift, then the world record, and subsequently he went to Panama for the Gatun Locks project. The resident engineers on the Kentucky also departed and Major Ruffner had difficulty replacing them. He promoted his chief draftsman to Assistant Engineer and hired two engineers fresh out of college, one of them being William H. McAlpine, the "Mr. Mac" for whom McAlpine Locks and Dam at Louisville were named after he ended his career fifty years later as senior engineer in the Corps.[57]

Major Ruffner's principal achievement on the Kentucky was to convert it from the masonry and timbercrib engineering of the

Workmen shovel muck off the foundation rock inside the Lock 9 cofferdam on August 11, 1903. Near the top of the picture a steam pump sucks water from inside the cofferdam. In the center, a skip loaded with muck rises on cables suspended from a derrick.

19th century to the reinforced concrete construction of the 20th. That began with permanent repairs to the leaky timbercrib dams on the lower river. Starting with Dam 1 in 1901, the deteriorated upper sections of the timbercrib dams were ripped out and replaced with concrete caps from four to eight feet thick; at the same time, the stepped, or "battered," sections of the back slopes of the dam were converted to a smooth slope. All timbercrib dams were thus modified during the first decade of the 20th century, reducing persistent leakage and annual maintenance costs. Lock and Dam 9 and the five locks and dams upstream of 9 were also designed as concrete and steel structures and used steel instead of wooden lock gates.[58]

Major Ruffner awarded the contract for Lock and Dam 9 to the Sheridan-Kirk Company and construction began on July 15, 1901. The Corps purchased and furnished 20,000 barrels of Portland cement at $1.73 a barrel for the concrete to the contractor (cement quality then was quite variable and the Corps furnished it as a quality control measure). Assembling plant and materials at the Lock 9 site in 1901, the contractor built the lock in 1902, finished the dam in 1903, and opened the lock to navigation on December 3, 1903. The major change in construction methods involved building the dam inside cofferdams. Cofferdams had previously been used for building stone masonry locks, but not for timbercrib dams which were constructed "in the wet." At 9, the contractor used three cofferdams, one for the lock, followed by one on the opposite side of the river for the dam abutment and first monolith of the dam, and a third around the central section of the dam. Inside the cofferdams, monoliths, or concrete sections, were "poured" into forms built for the purpose.[59]

A year after awarding the contract for Lock and Dam 9, Major Ruffner opened the bids for Lock and Dam 10, and the low bid came from Mason and Hoge Company of Frankfort for $183,725. The design and construction methods at 10 were similar to those at 9, and Mason and Hoge performed well. Except for contracts to supply lumber and materials or to build such minor project features as lockhouses, Mason and Hoge Company was the sole firm from the Kentucky River valley to receive a major contract on the project. There being no local preference by the government in awarding contracts, which went to the lowest responsible bidders, the locks and dams on the Kentucky were largely built by contractors from Ohio, West Virginia, and Indiana, who as a rule brought to the jobs their own administrative and engineering staffs and their own skilled workmen. Project construction benefited the Kentuckians hired as common labor and proved a boon to the merchants in the vicinity of construction sites, but did not stimulate the Kentucky construction industry to any appreciable extent.[60]

Major Ernest H. Ruffner suffered a

The March 1905 flood cut a channel behind Kentucky River Lock 10. After repairs, the lock stood midstream between two dams. This 1908 picture shows lockhouses in the background and derrickboats at each end of the lock.

"flanking" disaster at Locks 9 and 10 in March 1905 when a swift flood cut new channels behind and around the locks. On receiving the news, Ruffner steamed upriver aboard the snagboat *General O. M. Poe* and arrived on March 12 at the locks to attempt closing the breaches around the locks. Workmen assembled timbercribs upstream of the locks and attempted floating the cribs at the end of wire cables downstream into the breaches where they were to be filled with stone to block flow through the breaches. The powerful current of the flood snapped the cables, however, and nothing further could be done until the flood receded; the gaps behind the locks widened to more than 200 feet, even sweeping away lockhouses.[61]

When investigation in April 1905 revealed the cause of the debacle had been a failure to armor the new fill behind the locks with rock, resulting in the loss of the fill at flood stage, Ruffner concluded the reasons for the washout lay in a phrase in the construction contract specifications that had escaped his attention: "The paving shall in no case be placed until nearly all the embankment and back fill has been subject to exposure during winter and spring rains." The specification was intended to permit settlement of the fill before permanent stone paving was applied, but in the aftermath of the failure Ruffner recognized that temporary protection should have been provided to prevent washout. Repairs began immediately and consisted of building a second dam at each of the locks, running from the back of the lock across the breach to the new shoreline and built to an elevation higher than that of the first dam to assure that the river would not again pass behind the locks. Completed in 1906 at a cost of about $200,000, the repair work left Locks 9 and 10 standing between two dams, seemingly constructed in the middle of the river.[62]

W. E. Talbott and Company of Dayton, Ohio, had completed Lock 11 but had not started dam construction when the 1905 flood damaged Locks 9 and 10, and Lieutenant Colonel Ruffner reviewed the plans for Dam 11 in light of the disaster at 9 and 10. Dam 11 was to be a fixed concrete structure providing an eighteen-foot lift, and, fearing that its height would restrict river flow and invite another "flanking," Ruffner recommended its lift be reduced to fourteen and a half feet. Assistant Engineer Benjamin F. Thomas, an expert on dam design and construction and a "trouble-shooter" for the Corps, was transferred from the Big Sandy to the Kentucky River to take charge of the project and redesign the dams.[63]

Pointing out that reducing the height of Dams 11 through 14 would force construction of a fifteenth lock and dam with a corresponding increase in project costs, Thomas recommended that movable crests be placed atop the fixed concrete sections of the dams to secure the full eighteen-foot lift during low water stages; the movable crests could be lowered at flood stages. With approval from the Chief of Engineers, the contract for construction of Dam 11 was modified on March 11, 1906: the fixed concrete section would provide a twelve-foot lift, and atop the concrete dam would be a movable Poiree needle crest to hold an additional six feet of water during low flows. The movable crest consisted of twenty-six steel trestles spaced eight feet apart and hinged to the top of the concrete dam. The trestles collapsed sideways to lie flat atop the concrete dam at flood times, and when floods had passed the lockmen operated a winch on the lock wall, winding in chains attached to the trestles and raising the trestles to an upright position. As

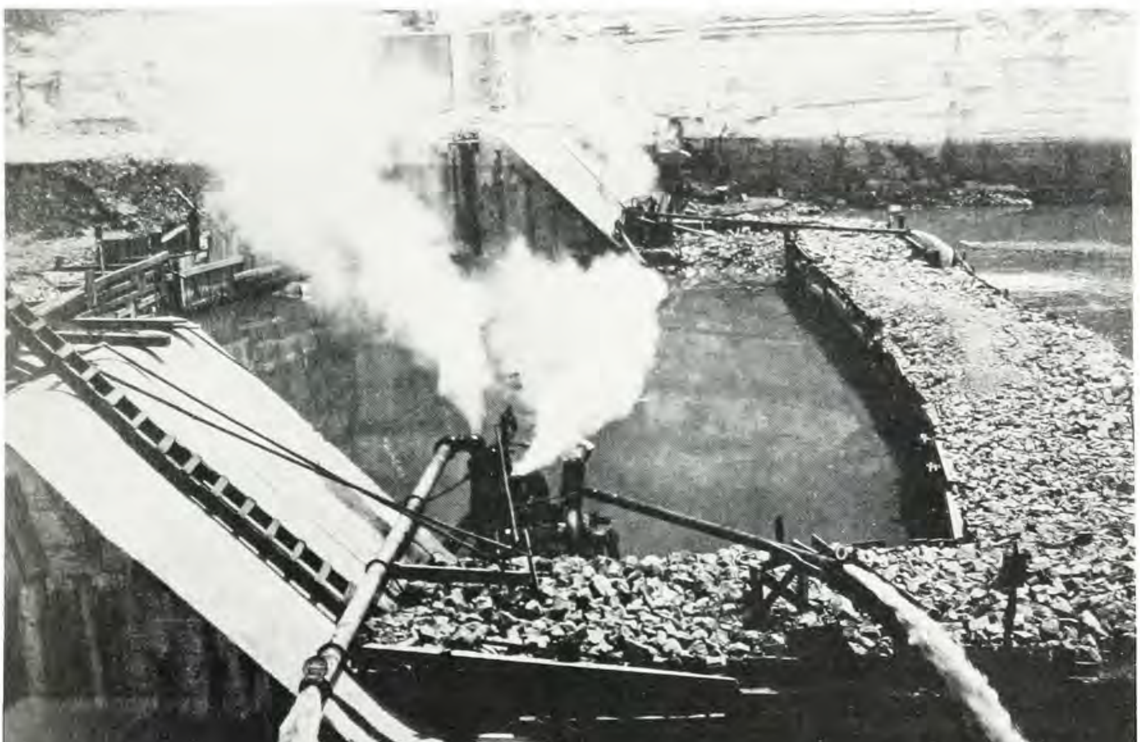
Kentucky River 13 with the lock and lockhouses in the background on November 18, 1914. Floating upstream of the dam in the foreground are drift and a boat for carrying wooden needles for the wickets. The workmen have finished installing the steel trestles of the Poiree needle crest atop the dam. During subsequent low water stages, the needles or timbers were placed vertically from the top of the trestles down to the masonry of the dam to add six feet of depth to the pool upstream of the dam.

the trestles rose, the lockmen placed eight-foot sections of metal walkway and rails from the top of one trestle to the top of the next, creating a working platform atop the trestles. Moving out along the walkway, the lockmen dropped wooden timbers called needles into position with one end resting against the top of the concrete dam and the other against rails at the top of the trestles. When all the needles were in place side by side from the lock wall to the dam abutment, a dam six feet higher than the concrete dam was formed, holding a pool that would furnish six feet of slackwater upstream to the next lock in the series.[64]

Dam 11 was completed on December 26, 1906, but winter floods surging over the dam destroyed chains linking the trestles together and they could not be raised the following spring. William H. McAlpine built a needle or maneuver boat resembling those used at wicket dams on the Ohio River and thereafter the trestles at Dam 11 were raised and the needles placed by the lockmen working on the deck of the maneuver boat, using a grappling hook to catch onto the trestles. "This is not an easy thing to do with 4 or 5 feet of water on the dam," McAlpine noted, "but a scheme has been devised by the lockmen which is quite successful in accomplishing this."[65]

Because of that trouble, Benjamin Thomas subsequently substituted the A-frame movable crest he had invented for the Poiree needle design at Dams 12, 13, and 14. The A-frames consisted of closely spaced trestles that collapsed one partly atop another like a row of dominoes. When raised to an upright position, their wide upstream legs formed the dam, eliminating the use of wooden needles. Much simpler in operation than needle dams, the A-frames on the Upper Kentucky worked satisfactorily for a number of years.[66]

The contract for building Lock and Dam 12 with a movable crest was awarded in June 1907 to Ohio River Contracting Company of Evansville, Indiana, which had considerable experience with dam construction on the Ohio. Handling their contract well, the firm completed Lock and Dam 12 in three working seasons and opened it to navigation on January 13, 1910. With the completion of Lock 12, the Engineers were only fifteen miles from their destination at the Three Forks, but were critical of continuing the march upstream. When the District Engineer in



Construction underway at Dam 14 about 1914. Two concrete monoliths of the dam are completed and a cofferdam filled with stone enclosed the area between the monoliths. A steam pump dewaters the interior of the cofferdam to prepare for the construction of more monoliths inside.

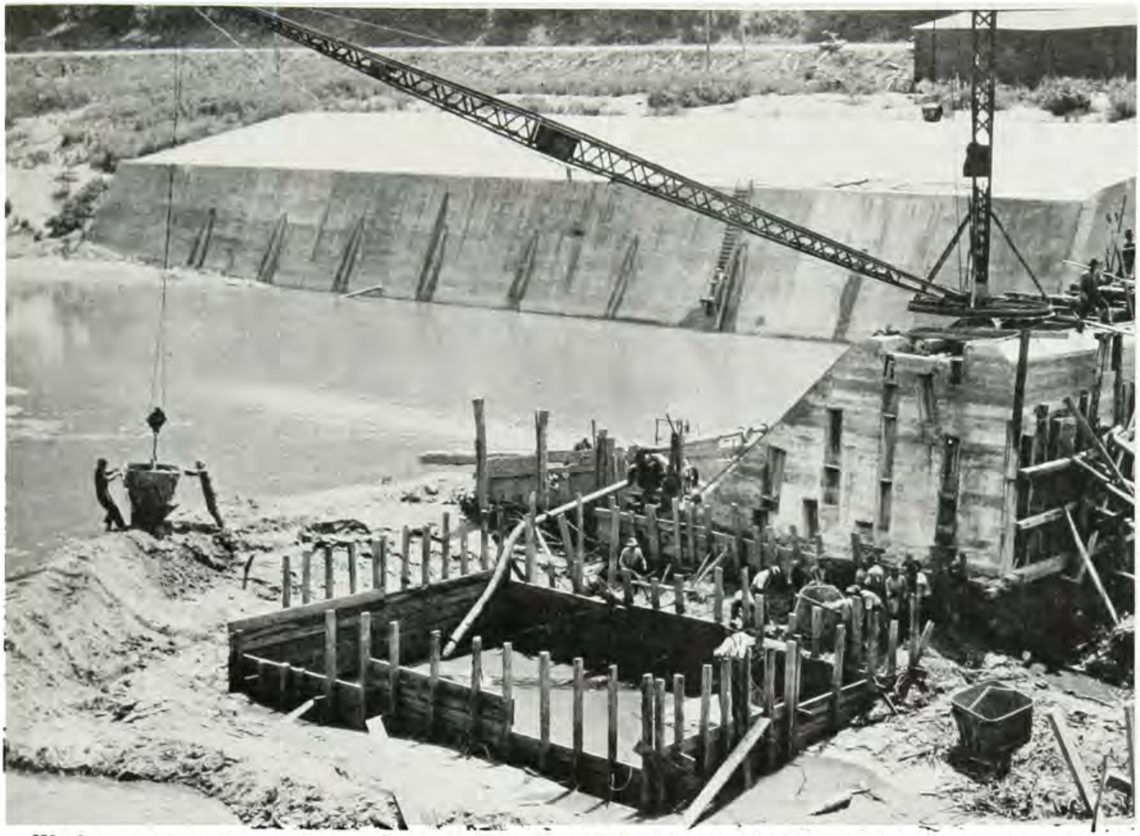
1910 requested an allotment to remove an obstructive rock ledge from the channel near Lock 11 and the Chief of Engineers questioned whether commercial traffic at Lock 11 justified such an expenditure, the District Engineer responded:

> I am forced to reply that the commerce of the river will not warrant the expenditure of the money for the removal of this ledge, nor, as at present, does it warrant the expenditure of any money for the improvement of this river. At the same time, the improvement is being carried on, some of the money being expended at Locks Nos. 12 and 13 and allotted for No. 14, and there is just as much need of the removal of the ledge in question as there is of construction of Locks Nos. 13 and 14.[67]

By direction of Congress, the march toward Beattyville continued. Smith, Towles and Company of Roderfield, West Virginia, with a bid of $272,960, took the contract for building Lock 13 in 1909, and as the lock neared completion in 1910 a separate contract for the construction of Dam 13 went to a contractor from Cincinnati. Dam 13 was to be completed by September 1, 1912, but the contractor lost several cofferdams and failed after completing the dam abutment and two of the ten concrete monoliths, each twenty-four feet wide, which were to compose the dam. When the bonding company for the contractor offered to finish the dam rather than forfeit the bond it had made for the contractor, the Corps accepted.[68]

Thinking the contractor then building Lock and Dam 14 would have a vested interest in completing Dam 13 because it would provide slackwater to 14 for delivery of construction materials, the bonding company subcontracted the remainder of the work at Dam 13 to the contractor at Lock 14. Shortly after starting work at Dam 13, the subcontractor complained that government payments for work completed were not as large as he had hoped and pressed the bonding company for more cash, which the company furnished by guaranteeing the subcontractor $10,000 worth of credit. When that credit was exhausted, the subcontractor stopped work and returned to the bonding company to demand renegotiation of the contract on more favorable terms. The bonding company agreed, provided the subcontractor paid the $10,000 worth of notes on time, but when those notes went unpaid the entire arrangement collapsed.[69]

After a futile search for another subcontractor, the bonding company hired a superintendent and the necessary labor to finish Dam 13 on its own. The new superintendent somehow made an enemy of a mountaineer in the vicinity who vowed the superintendent would either leave or die, however, and the president of the bonding company, wishing to keep the superintendent at work, paid the mountaineer a visit. He described the fellow as "one of the typical bad men of the eastern Kentucky mountains. He always packs around a couple of guns, which he seems to use indiscriminately when drinking, which is not infrequently. He has the whole community terrorized, and most people from the sheriff down, give him a wide berth." Though the fellow was courteous to the president, he subsequently went to Dam 13 and drove the superintendent and office engineer off the job at pistol point, and work stopped while more supervisory personnel were hired. At the work site, bullets flew overhead at night, one passing through the resident engineer office, and Corps construction inspectors trying to flag down the night train had their lanterns shot out. When even the Italian laborers called for their pay so they could depart, the bonding company employed an armed night watchman. The trouble ended shortly thereafter when the mountaineer died.[70]



Workmen prepare to pour another concrete monolith at Dam 13 on August 4, 1914. The crane suspending the bucket is raising the cofferdam, merely an earthen berm, a few more inches, probably with material excavated from inside the concrete forms for the monolith.

Lock 13 opened to navigation on November 14, 1914, more than two years behind schedule but supplying slackwater to within six miles of Beattyville; yet, those last miles of the march proved the hardest. Theodore E. Burton, chairman of the House Committee on Rivers and Harbors who won a national reputation early in the century for his opposition to "porkbarrel" projects, told the Chief of Engineers that in his opinion the completion of Lock 13 provided slackwater near enough to the coal fields and he thought it wise to omit construction of Lock and Dam 14 from further waterways appropriation bills. That omission came to the attention of Kentucky congressmen, who thereon attended meetings of the Rivers and Harbors Committee with a draft of a bill appropriating funds for Lock 14 in hand. As was customary, the Chief of Engineers asked the District Engineer in charge of the Kentucky to comment upon the bill for the construction of Lock 14, and he received a terse telegram in reply: "In my opinion construction of lock and dam fourteen, Kentucky River, is not advisable. It would promote no public interest if authorized."[71]

Congress nonetheless funded Lock and Dam 14 and bids for its construction were opened on May 26, 1911, with the low bid coming from Gahren, Dodge and Maltby Company of New York City. Never having heard of the firm, the District Engineer made inquiry and learned it had constructed many buildings in New York and had recently made F. B. Maltby its chief engineer. Maltby had designed the immense concrete mixing and delivery plant for Gatun Locks in Panama and thus was well qualified for supervising work at Lock and Dam 14, which was to be built of concrete. The District Engineer therefore accepted the firm's bid, setting the contract completion date for the last day of 1913.[72]

The work at Lock 14 bogged down after Maltby had some dispute with his partners and left the firm; at the end of 1913, only forty-seven percent of the work had been completed. While the District Engineer recommended forfeiture of the contract, the Chief of Engineers thought it wise to waive the time limit for a reasonable period, but progress did not improve in 1914 and in 1915 the contracting firm became overwhelmed by debts, leaving materials suppliers and laborers unpaid. By direction of the District Engineer, Assistant Engineer H. G. McCormick at the Heidelberg resident office seized the plant of the contractor on March 21, 1916, took inventory of equipment to ascertain the rental rate to be paid the contractor, ordered the Engineer floating plant upstream from Frankfort, employed the labor needed and set to work to complete Dam 14 "as expeditiously as possible."[73]

About eighty-six percent of the work, including the lock walls, the abutments, and two of the ten concrete monoliths in the dam, was completed when McCormick commenced. He pushed the job and by the end of 1916 the concrete dam stretched across the river, the steel lock gates were in place, the pool reaching up into the North, Middle, and South Forks was cleared of snags and boulders, and the lock operating mechanisms were installed. On January 20, 1917, three years behind schedule, the gates of Lock 14 swung open for the first time, ending the thirty-seven year march of the Engineers upriver to the Three Forks and their "inexhaustible" coal resources.[74]

Not including the $1.1 million state investment in project construction between 1836 and 1844, the federal investment in the Kentucky River project from 1880 to 1917 totaled $4.2 million, or approximately $300,000 per lock and dam. The opponents to waterways projects at the time referred to the Kentucky River project as "pork-barrel," mentioning the 1877 estimated project cost of $1 million and thus implying a more than 300 percent cost overrun. The Engineers claimed their efficiency had saved taxpayers $600,000 during construction, basing their claim on comparison of the $4.2 million actual cost with the 1898 final estimate of $4.8 million. Construction costs on the Kentucky River project actually compared quite favorably with those of other projects. On the Kanawha River in West Virginia between 1878 and 1898, the Engineers provided ninety miles of slackwater through construction of ten locks and dams at a total cost of about $4 million, or $400,000 per lock and dam; the locks were similar in construction and slightly larger than those on the Kentucky and the dams were the expensive movable Chanoine wicket type. On the Ohio River from 1878 to 1929 the Corps established 981 miles of slackwater by building fifty-one locks and dams at an average cost of more than one million dollars per lock and dam; the locks, however, were 110 by 600 feet in dimensions and the movable Chanoine wicket dams were three-quarters of a mile long at many places. There was a major difference betweeen the project on the Kentucky and those on the Ohio and Kanawha Rivers: the latter two projects supported a large and steadily increasing towboat and barge traffic transporting coal and other commidities; the Kentucky did not.[75]

When the gates opened at Lock 14 in January 1917, the event was welcomed with no fanfare, no pageant of stately steamboat packets and workday towboats winding its way past the Kentucky River palisades upstream to celebrate the occasion, and in fact the event was not even mentioned in the Frankfort newspapers. A day afterwards, apparently by chance, a Frankfort newspaper editor asked his readers: "What has happened to the river trade? What has become of the fine floating palaces and large freighters that formerly plied the trade from points on the Kentucky River to New Orleans?" The editor answered his question by declaring that railroads had conspired to drive river competition out of business.[76]

Waterways commerce on the inland rivers had indeed reached its nadir in 1917. On the Kentucky, only two packets, the *Royal* and the *Falls City No. 2,* still ran to Frankfort and they, too, would soon leave the river. Two towboats, the *Nellie Willett* and the *Willie B.,* were moving barges of crossties and tobacco, and a few gasoline-engine boats towed log rafts and barges of sand and gravel. Traffic on the Ohio was in little better condition, for in 1916 the historic delivery of Monongahela coal in huge barge fleets down the Ohio and Mississippi had ceased. The Kentucky River project had its roots in the dreams of Geologist Nathanial S. Shaler and Judge

Log rafts on the Kentucky River near Irvine about 1920. From Dunn Collection, Kentucky Historical Society, Frankfort.

Lysander Hord, both dead by 1917, that the slackwater would allow Kentucky coal to compete with Monongahela coal in the Ohio River trade, and ironically, even the competition had been wiped out by 1917.[77]

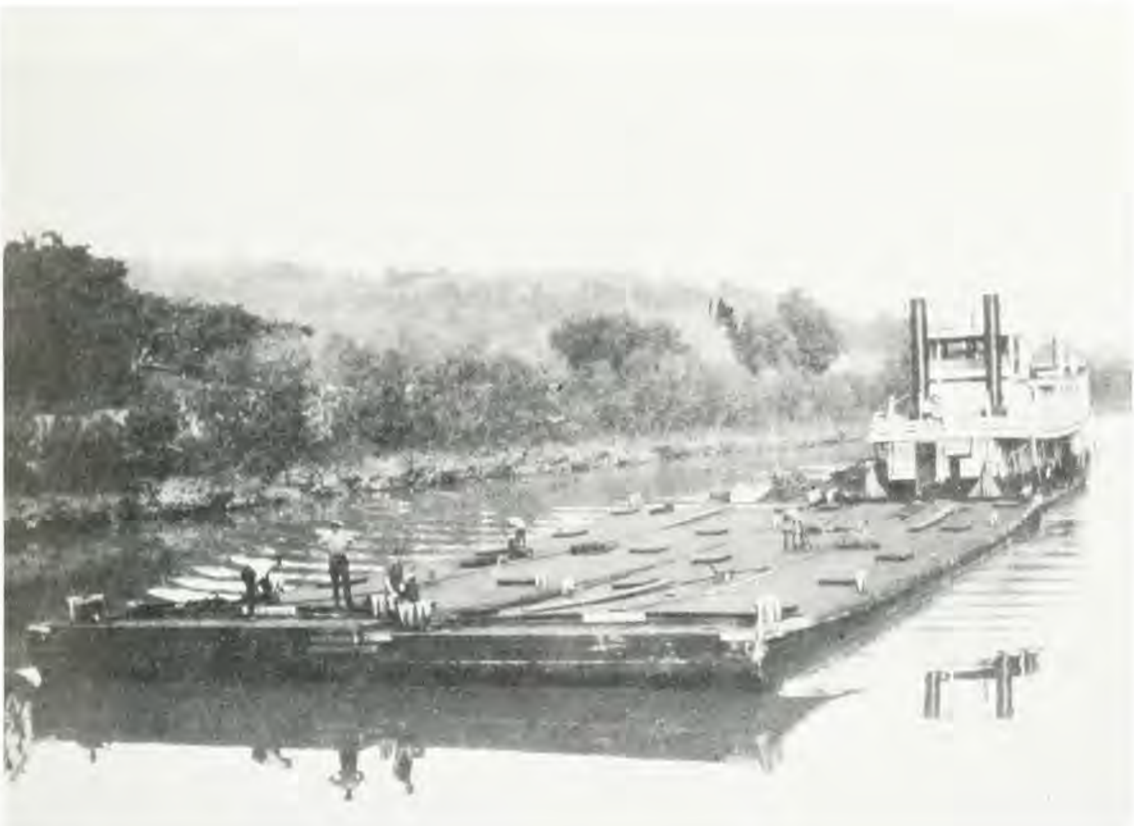
The Engineers had gone to work on the Kentucky in 1880 during a time of coal famine at Frankfort, and project completion in 1917 also came during a coal shortage, apparently the result of a railroad system faltering under the burdens imposed by the defense production of the First World War. The price of coal in Frankfort had become so high the city government had organized a municipal coal company to sell it at cost to prevent the poor from freezing. Perhaps as an effort to draw public attention to completion of the project, the Engineer towboat *Gregory* arrived at Lock 4 in Frankfort on February 7, 1917, with two small barges containing 8,500 bushels of coal, the first coal towed down the Kentucky from the Three Forks. When the Frankfort newspaper reported the coal had cost 10 cents a bushel loaded on barges at Beattyville and 3 cents a bushel for transport to Frankfort, about half the price of coal delivered to Frankfort by railroad, the trip of the *Gregory* did draw interest.[78]

Businessmen soon took a close look at the Beattyville coal field, for the entry of the United States into the First World War in April 1917 sent coal prices even higher and exacerbated the railcar shortage, burdening railroads to the extent that they were nationalized during the war. Mining coal on the Upper Kentucky suddenly became more attractive financially, and by the end of 1917 two towboats were pushing coal barges regularly down to Frankfort. In 1918, the barging of crude oil from the field at Irvine, Kentucky, to refineries began.[79]

Because engineer officers were needed at the front and on military construction during 1917, Benjamin F. Thomas, a civilian engineer, became the Cincinnati District Engineer, and at the request of the towing companies beginning operation on the Kentucky he made several modifications to the project. He supervised construction in 1918 of guardwalls at the entrance to the locks to protect barge tows against swinging out from the bank and being carried by the current over the dams. The towboat captains objected to the movable crests on Dams 11 through 14 because during the time required to raise the crests the six-foot depth for navigation was sometimes lost and the tows stranded on a shoal. Thomas took out the movable crests and raised the fixed dams with timbers to their fully authorized heights.[80]

Coal and oil shipments on the Kentucky seemed promising and public support developed for building additional locks and dams on the North and South Forks to extend slackwater farther into the coal field. During the customary public meetings and investigations of those proposals, the Engineers learned that public opinion overwhelmingly favored an extension of the project. One businessman who owned coal lands on the South Fork asserted that extending slackwater farther up South Fork would allow delivery of coal to Ohio River towns much more economically than by railroad and declared the project would result in an end to feuding and moonshining in the area and thus produce sociological benefits. "It seems very foolish," he argued, "to have spent millions in canalizing the Kentucky River through districts that give it little or no business and then refrain from constructing the few miles necessary to connect it with a district that will make it extremely useful."[81]

The Engineers remained unconvinced that extending the project would produce any substantial benefits and so reported to



Towboat *Advance* with barges of crude oil on the Kentucky River near Dam 8 in July 1919. *National Archives, Record Group 77.*

Congress. Under the direction of Assistant Engineers Lucien Johnson, N. B. Humphrey, Samuel Eversole, and others, the operation and maintenance of the fourteen locks and dams continued for decades in support of a gradually diminishing commerce. The barging of crude oil on the river, begun in 1918, climbed to 136,482 tons in 1925 and ceased in 1931 with the advent of pipelines and depletion of the Irvine oil fields. As the timber accessible to the river and its tributaries was cut out, the rafting of logs declined and the last shipment of record was made in 1939. Coal shipments held steady at near 10,000 tons a year throughout the 1920s and 1930s, increased somewhat during the Second World War, then declined. By 1948 Kentucky River commerce had dwindled to 72,614 tons, mostly of gasoline on the way to tank farms at Frankfort and Camp Nelson. Extensive recreation traffic used the river, enjoying its fishing and scenery, but that traffic did not qualify in the eyes of Congress or the courts as commercial traffic of the sort for which the project had been authorized.[82]

In 1951 the Louisville Engineer District first proposed closing the locks on the upper river. When Kentuckians assured the District that coal shipments would resume on the upper river, the District agreed in 1953 to continue lock operations, contingent upon development of sufficient commercial navigation to justify the expenditures, and a genuine, though sporadic, effort to ship coal on the river ensued and continued until 1977.[83]

Speculation concerning alternative histories is irresistible. What might have happened if Congress, instead of dribbling construction funding over thirty-seven years, had funded the entire project and directed that it be completed within ten years after 1879? The march to the Three Forks could have been completed before railroads entered the coal field and miners could have become accustomed to marketing by river transport; hence, shipments might have continued and increased, justifying subsequent modernization of the locks and dams. And what if the Engineers had constructed Chanoine wickets instead of fixed dams, thereby allowing barge tows to descend the river at higher stages without the delays incident to fourteen lockages? Perhaps the Kentucky River now would resemble the Kanawha River in West Virginia, where Chanoine wicket dams were constructed in a short period of time; that is, be an industrialized river supporting a large commerce.

One unanswerable question remains: did the benefits resulting from project construction outweigh its costs? The answer would require elaborate computer analysis, converting construction and operations costs along with benefits to navigation from 1836 to 1983 into constant dollars for comparison purposes. Even were that done, the computations would not include the project's effects on the environment, its service to national defense during the Civil War and First World War, its enhancement of real estate values, its contribution to regional water supply and economic development, and other indirect impacts. If public opinion carries any weight, however, Kentuckians made it plain in 1980 when the Engineers proposed closing the locks on the upper river that they thought the project had benefits exceeding any contributions it may have made to commercial navigation.

NOTES

1. Standard histories of the Kentucky River are Thomas D. Clark, *The Kentucky* (New York: Farrar and Rinehart, 1942); Mary Verhoeff, *The Kentucky River Navigation* (Louisville: Filson Club Publications No. 28, 1917); and John Winston Coleman, *Steamboats on the Kentucky River* (Lexington: Winburn Press, 1960).

2. Verhoeff, *The Kentucky River Navigation*, pp. 1-26; Leland R. Johnson, "Definition of Navigable Waters of the United States: Kentucky River, Kentucky," 18 August. 1973, in Regulatory Functions Branch, U.S. Army Engineer District, Louisville, KY.

3. Leland R. Johnson, *The Falls City Engineers: A History of the Louisville District, Corps of Engineers, United States Army* (Louisville: U. S. Army Engineer District, 1975), pp. 147-51; U.S., Congress, House, *Survey–Kentucky River*, H. Doc. 58, 20th Cong., 1st Sess., 1829, pp. 1-3. Copies of the 1828 maps survived and may be seen at the Inland Rivers Library, Cincinnati, Ohio, and the Survey Branch, U.S. Army Engineer District, Louisville, KY.

4. Frankfort, KY., *Frankfort Commonwealth*, 27 Sept. 1834; Louisville, KY., *Public Advertiser*, 31 Aug. 1835; John F. Smith, "Salt-Making Industry of Clay County, Kentucky," *Filson Club History Quarterly* 1 (April 1927):134-41; Verhoeff, *The Kentucky River Navigation*, pp. 163-64; Kentucky, General Assembly, *Kentucky House Journal: Reports, 1835-36* (Frankfort: Kentucky General Assembly, 1835-36), appendix, pp. 49-94; Leland R. Johnson, *Engineers on the Twin Rivers: A History of the Nashville District, Corps of Engineers, United States Army* (Nashville: U.S. Army Engineer District, 1978), p. 36.

5. Kentucky, General Assembly, *Kentucky House Journal: Reports, 1835-36*, appendix, pp. 49-94, quotation on pp. 83-84.

6. Ibid., p. 61.

7. Ibid., pp. 57-66. A discussion of the Kiskimenitas River project is in Leland R. Johnson, *The Headwaters District: A History of the Pittsburgh District, U.S. Army Corps of Engineers* (Pittsburgh: U.S. Army Engineer District, 1979), pp. 89-90.

8. Sylvester Welch, "Report of the Chief Engineer of Kentucky for 1838," in Kentucky, General Assembly, *Kentucky House Journal: Reports, 1838-39*, appendix, pp. 71-99.

9. "Report of the Expenditures of the Board of Internal Improvement," in Kentucky, General Assembly, *Kentucky House Journal: Reports, 1836-37*, appendix, pp. 192-93; Board of Internal Improvement, "Report for 1836," in ibid., pp. 74-75.

10. Ibid., p. 74.

11. Ibid., pp. 193-96.

12. Board of Internal Improvement, "Report for 1837," in ibid., p. 73.

13. Verhoeff, *The Kentucky River Navigation*, pp. 29-32; Kentucky General Assembly, *Kentucky House Journal, 1840-41*, p. 222; Maj. James W. Cuyler, "Statement to the

Board of Engineer Officers Constituted by S. O. No. 115, Headquarters, Corps of Engineers, Washington, D.C.," 25 Oct. 1882, File 629, Letters Received 1882, Records of the Office of Chief of Engineers, Record Group 77, National Archives, Washington, D.C. (cited hereafter as NARG 77).

14. Maj. James W. Cuyler, "Statement to the Board of Engineer Officers Constituted by S. O. No. 115, Headquarters, Corps of Engineers, Washington, D.C.," 25 Oct. 1882, File 629, Letters Received 1882, in NARG 77; Matthew R. Stealey to Sylvester Welch, 1 Dec. 1840, in *Journal of the Franklin Institute* 31 (May 1841):377-79.

15. Verhoeff, *The Kentucky River Navigation*, pp. 108-10; Kentucky, General Assembly, *Legislative Documents, 1846* (Frankfort: General Assembly, 1847), pp. 486-87; Thomas D. Clark, "The Lexington and Ohio Railroad," *Kentucky Historical Society Register* 31 (January 1933):9-28; J. Winston Coleman, Jr., "Kentucky River Steamboats," *Kentucky Historical Society Register* 63 (Oct. 1965):314.

16. Verhoeff, *The Kentucky River Navigation*, pp. 26-32; "Special Report of the Board of Internal Improvement, 1864," in Kentucky, General Assembly, *Legislative Documents, 1864* (Frankfort: General Assembly, 1864), p. 7.

17. Kentucky, General Assembly, *Legislative Documents, 1864*, pp. 7-8; Lexington, KY, *Lexington Herald*, 1 June 1982.

18. Kentucky River Navigation Company, *Charter Meeting of Corporators and Address of the Executive Committee of the Kentucky River Navigation Company with the Reports of George Stealey, Civil Engineer* (Frankfort: Kentucky River Navigation Company, 1865), passim; Verhoeff, *The Kentucky River Navigation*, pp. 32-33; Bennett H. Young, *A History of Jessamine County, Kentucky* (Louisville: Courier-Journal Printing Co., 1908), p. 155.

19. Frankfort, KY, *Kentucky Yeoman*, 27 Jan., 12 Feb., and 21 Mar. 1876; L. F. Johnson, *The History of Franklin County* (Frankfort: Roberts Printing Co., 1912), p. 195; Nathaniel S. Shaler, "General Report of the Geological Survey of Kentucky, (1873)" in *Geological Surveys of Kentucky* 3 (Frankfort: 1877):5; Jonathan T. Dorris, "Major Squire Turner, Lawyer, Statesman, and Economist," *Filson Club History Quarterly* 25 (Jan. 1951):33-50; Nathaniel S. Shaler and John R. Proctor, "On the Importance of Improvement in the Navigation of the Kentucky River to the Mining and Manufacturing Interests of Kentucky," *Bulletin of the Kentucky Geological Survey* 1 (1877):22-45; Willard R. Jillson, "A History of the Kentucky Geological Survey," *Kentucky Historical Society Register* 19 (Sept. 1921):90-112.

20. Citizens of Frankfort, KY, petition to President Rutherford B. Hayes, 9 Apr. 1877, File 704, Letters Received 1877, NARG 77; Lysander Hord to John M. Harland, 26 Apr. 1877, File 779, Letters Received 1877, NARG 77; Lysander Hord, *Letters in Relation to the Improvement of the Kentucky and Other Rivers, and the Kentucky Penitentiary* (Frankfort: A. G. & J. A. Hodges, 1877), pp. 1, 7, 60-65; Frankfort, KY, *Kentucky Yeoman*, 22 Nov. 1877; R. H. Fitzhugh to Thomas Turner, 2 Dec. 1880, in Frankfort, KY, *Kentucky Yeoman*, 7 Dec. 1880; U.S. Army, Corps of Engineers, *Annual Report of the Chief of Engineers for 1879* (Washington, DC: Government Printing Office, 1880), pp. 1407-10 (this serial publication cited hereafter as *Annual Report* followed by the fiscal year of the report).

21. Kentucky, General Assembly, *Kentucky House Journal, 1877-78* (Frankfort: General Assembly, 1878), pp. 385, 961; Frankfort, KY, *Kentucky Yeoman*, 23 Apr., 30 Apr., 2 July, 21 July 1878; see editorials in *Engineering News* 5 (7 Mar. and 25 Apr. 1878):74, 129.

22. Frankfort, KY, *Kentucky Yeoman*, 23 July 1878; U.S. Army, Corps of Engineers, *Annual Report, 1879*, pp. 1398-1421.

23. Frankfort, KY, *Kentucky Yeoman*, 21 Jan., 23 Feb., and 6 Mar. 1879.

24. Kentucky, General Assembly, *Kentucky House Journal, 1879-80* (Frankfort: General Assembly, 1880), pp. 734-35, 791-92, 1005-06; Russell W. McRery, "Kentucky River Mills, 1886," Manuscript 336, Kentucky Historical Society Library, Frankfort, KY; Frankfort, KY., *Frankfort Roundabout*, 15 Feb. 1890; Johnson, *The History of Franklin County, Ky.*, pp. 29-30.

25. Maj. (Bvt. Col.) William E. Merrill to Brig. Gen. A. A. Humphreys, 7 Apr. 1879, File 906, Letters Received 1879, NARG 77; note in *Engineering News* 7 (27 Mar. 1880):111; Frankfort, KY, *Kentucky Yeoman*, 14 Apr. 1880.

26. Capt. James W. Cuyler to Brig. Gen. Horatio G. Wright, 4 May 1880, File 1213, Letters Received 1880, NARG 77.

27. Ibid.; Maj. James W. Cuyler, "Statement to the Board of Engineers Officers Constituted by S. O. No. 115, Headquarters, Corps of Engineers, Washington, D.C.," 25 Oct. 1882, File 629, Letters Received 1882, NARG 77.

28. U.S. Army, Corps of Engineers, *Annual Report, 1881*, pp. 1971-79.

29. Frankfort, KY, *Kentucky Yeoman*, 3 Nov. and 15 Nov. 1881; U.S. Army, Corps of Engineers, *Annual Report, 1883, p. 1562; U.S. Army, Corps of Engineers, Annual Report, 1882*, pp. 1945-51; Capt. James W. Cuyler to Brig. Gen. Horatio G. Wright, 9 May 1882, File 976, Letters Received 1882, NARG 77.

30. U.S. Army, Corps of Engineers, *Annual Report, 1882*, pp. 1945-49; Brig. Gen. Horatio G. Wright to Robert Lincoln, 20 Apr. 1882, Letters Sent 1882, NARG 77; Brig. Gen. Horatio G. Wright to Maj. James W. Cuyler, 13 May 1882, Letters Sent 1882, NARG 77; Capt. John G. Parke to Maj. James W. Cuyler, 20 May 1882, Letters Sent 1882, NARG 77; U.S. Army, Corps of Engineers, *Annual Report, 1884*, p. 1728.

31. Congressman John D. White to Robert Lincoln, 29 Apr. 1882, File 976, Letters Received 1882, NARG 77; Frankfort, KY, *Kentucky Yeoman*, 31 Aug. 1882; William H. Murray to Sen. John S. Williams, 4 Sept. 1882, File 976, Letters Received 1882, NARG 77.

32. Frankfort, KY, *Kentucky Yeoman*, 28 Nov. 1882; "Report of the Board of Engineer Officers constituted by Par. I, Special Orders No. 115, Headquarters, Corps of Engineers, U.S. Army, Washington, D.C., October 25, 1882," File 629, Letters Received 1882, NARG 77; Cuyler, James W., 3657 ACP 1877, Old Military Records (NNMO), National Archives, Washington, DC.

33. Brig. Gen. Horatio G. Wright to Cong. John D. White, 6 May 1882, Letters Sent 1882, NARG 77; Frankfort, KY, *Kentucky Yeoman*, 18 Jan. 1879; Louisville, KY, *Courier-Journal*, 18 May 1882; Maj. James W. Cuyler to Brig. Gen. Horatio G. Wright, 3 May 1882, File 1305, Letters Received 1882, NARG 77.

34. U.S. Army, Corps of Engineers, *Annual Report, 1883*, pp. 1560-64; Verhoeff, *The Kentucky River Navigation*, p. 129; U.S. Army, Corps of Engineers, *Annual Report, 1884*, pp. 1728-49.

35. U.S. Army, Corps of Engineers, *Annual Report, 1884*, pp. 1728-49; Edward Wegmann, *The Design and Construction of Dams* (New York: John Wiley & Sons, 1922), pp. 344-45.

36. U.S. Army, Corps of Engineers, *Annual Report, 1884*, pp. 1728-46; U.S. Army, Corps of Engineers, *Annual Report, 1886*, pp. 1604-05; *Prospectus of the Three Forks Investment Company: Its Beattyville Town Site* (Louisville: Courier-Journal Printing Co., 1889), pp. 1-15.

37. U.S. Army, Corps of Engineers, *Annual Report, 1886*, pp. 1604-05; U.S. Army, Corps of Engineers, *Annual Report, 1887*, pp. 1872-77.

38. U.S. Army, Corps of Engineers, *Annual Report, 1887*, pp. 1872-77. The first beartrap weirs on the Ohio River were built in 1889 at Lock and Dam No. 1 near Pittsburgh, and beartraps were in operation in 1983 at Lock and Dam No. 52 near Paducah, KY.

39. U.S. Army, Corps of Engineers, *Annual Report, 1888*, pp. 1770-74; U.S. Army, Corps of Engineers, *Annual Report, 1890*, p. 2262; Edward B. Clark, *William L. Sibert, The Army Engineer* (Philadelphia: Dorran & Company, 1938), passim.

40. Frankfort, KY, *Frankfort Roundabout*, 1 Mar. 1890; U.S. Army, Corps of Engineers, *Annual Report, 1890*, pp. 2262-63; U.S. Army, Corps of Engineers, *Annual Report, 1891*, pp. 2449-55; Elmer G. Sulzer, "Kentucky's Abandoned Railroads: The 'Riney-B'," *Kentucky Engineer* 8 (Feb. 1946: 14-19, 28-30).

41. U.S. Army, Corps of Engineers, *Annual Report, 1885*, p. 1875; U.S. Army, Corps of Engineers, *Annual Report, 1886*, pp. 1604, 1610.

42. U.S. Army, Corps of Engineers, *Annual Report, 1885*, pp. 1881-82; Verhoeff, *The Kentucky River Navigation*, pp. 112-14.

43. U.S. Army, Corps of Engineers, *Annual Report, 1887*, pp. 1877-80.

44. Ibid., pp. 1873-75; U.S. Army, Corps of Engineers, *Annual Report, 1889*, pp. 1970-71; U.S. Army, Corps of Engineers, *Annual Report, 1890*, p. 2264.

45. U.S. Army, Corps of Engineers, *Annual Report, 1891*, pp. 2450-53; U.S. Army, Corps of Engineers, *Annual Report, 1892*, pp. 2083-84. The workmen apparently moved from the Kentucky River project to projects on the Kanawha, Big Sandy, Green, and Cumberland Rivers, moving from one job to another, sometimes on their own and sometimes moving with contractors like the Sheridan-Kirk Company which had contracts on several river projects.

46. U.S. Army, Corps of Engineers, *Annual Report, 1892*, pp. 2083-84.

47. U.S. Army, Corps of Engineers, *Annual Report, 1893*, pp. 2618-19; Lieutenant William W. Harts to Capt. James G. Warren, 31 Jan. 1898, File 24511, General Correspondence, 1894-1923, NARG 77; Benjamin F. Thomas and D. A. Watt, *The Improvement of Rivers* (New York: John Wiley & Sons, 1913), pp. 335-38, 344-48.

48. Lieutenant William W. Harts to Capt. James G. Warren, 31 Jan. 1898, File 24511, General Correspondence, 1894-1923, NARG 77.

49. U.S. Army, Corps of Engineers, *Annual Report, 1894*, pp. 1980-81; Lt. Col. Amos Stickney to Brig. Gen. Thomas L. Casey, 9 Mar. 1894, File 4774, General Correspondence, 1894-1923, NARG 77.

50. U.S. Army, Corps of Engineers, *Annual Report, 1896*, pp. 2516-19; U.S. Army, Corps of Engineers, *Annual Report, 1898*, pp. 2017-19; Thomas and Watt, *The Improvement of Rivers*, p. 536; John M. G. Watt, discussion of R. C. McCalla, "Improvement of the Black Warrier," *Transactions of the American Society of Civil Engineers* (New York, 1902):283-84.

51. U.S. Army, Corps of Engineers, *Annual Report, 1899*, pp. 2516-27, 2521-22; U.S. Army, Corps of Engineers, *Annual Report, 1900*, pp. 3367-69.

52. Maj. James F. Gregory to Brig. Gen. William P. Craighill, 24 Aug. 1896, File 7759, General Correspondence, 1894-1923, NARG 77, contains the report by Harts.

53. Ibid.

54. U.S. Army, Corps of Engineers, *Annual Report, 1898*, pp. 2012-16; U.S. Army, Corps of Engineers, *Annual Report, 1899*, pp. 2513-14; Capt. Harry F. Hodges to Brig. Gen. John D. Wilson, 22 July 1899, File 7024, General Correspondence, 1892-1923, NARG 77.

55. U.S., Congress, House, *Deterioration of River and Harbor Works*, H. Doc. 230, 56th Cong., 1st Sess., 1900, pp. 11-12; Governor J. W. Beckham, Secretary of State C. B. Hill, and others to Secretary of War, 1902, File 42086, General Correspondence, 1894-1923, NARG 77; Maj. Harry F. Hodges to Maj. James G. Warren, 27 Mar. 1906, File 7759, General Correspondence, 1894-1923, NARG 77; Louisville, KY, *Courier-Journal*, 26 Apr. 1904.

56. Lt. Col. Thomas H. Handbury to Brig. Gen. G. L. Gillespie, 30 Nov. 1901, File 40934, General Correspondence, 1894-1923, NARG 77.

57. U.S. Army, Corps of Engineers, *Annual Report, 1901*, p. 2713; U.S. Army, Corps of Engineers, *Annual Report, 1903*, pp. 1751-52; Maj. E. H. Ruffner to Brig. Gen. G. L. Gillespie, 12 Mar. 1903, File 45998, General Correspondence, 1894-1923, NARG 77; note in *Engineering News* 65 (9 Mar. 1911):307.

58. Lt. Col. E. H. Ruffner to Brig. Gen. A. Mackenzie, 12 July 1905, File 56153, (General Correspondence, 1894-1923, NARG 77; William H. McAlpine, discussion of J. S. Walker, "Elements Affecting Lock Construction of Canalized Rivers Having Fixed Dams," *Professional Memoirs, Corps of Engineers* 3 (Oct.-Dec. 1911):587-90.

59. Capt. Harry F. Hodges to Brig. Gen. John M. Wilson, 4 Mar. 1901, File 7759, General Correspondence, 1894-1923, NARG 77; U.S. Army, Corps of Engineers, *Annual Report, 1901*, pp. 2744-46; U.S. Army, Corps of Engineers, *Annual Report, 1904*, p. 2644.

60. "Abstract of Proposals, Lock and Dam 10," 19 May 1902, File 42086, General Correspondence, 1894-1923, NARG 77; U.S. Army, Corps of Engineers, *Annual Report, 1903*, p. 1748; U.S. Army Corps of Engineers, *Annual Report, 1904*, p. 2644.

61. Thomas and Watt, *The Improvement of Rivers*, p. 669; Lt. Col. E. H. Ruffner to Brig. Gen. A. Mackenzie, 14 Mar. 1905, File 7759, General Correspondence, 1894-1923, NARG 77.

62. Col. G. J. Lydecker, Maj. James G. Warren, and Maj. William L. Sibert to Brig. Gen. A. Mackenzie, 28 Apr. 1905, File 7759, General Correspondence, 1894-1923, NARG 77; Lt. Col. E. H. Ruffner to Brig. Gen. A. Mackenzie, 1 May 1905, File 7759, General Correspondence, 1894-1923, NARG 77; U.S. Army, Corps of Engineers, *Annual Report, 1907*, p. 1786.

63. U.S. Army, Corps of Engineers, *Annual Report, 1904*, pp. 2644-45; Maj. James G. Warren to Brig. Gen. A. Mackenzie, 15 Jan. 1906, File 7759, General Correspondence, 1894-1923, NARG 77; Lt. Col. E. H. Ruffner to Brig. Gen. A. Mackenzie, 14 Mar. 1905, File 7759, General Correspondence, 1894-1923, NARG 77; William H. Hall and H. C. Corns, "Benjamin F. Thomas, M. ASCE," *Transactions of the American Society of Civil Engineers* 87 (1924):1435-36.

64. Thomas and Watt, *The Improvement of Rivers*, p. 521; Lewis M. Adams, "An A-Frame Movable Top to Provide Increased Depths above Fixed Dams," *Professional Memoirs, Corps of Engineers* 3 (Apr.-June 1911):315-35, includes discussions of the needle and A-Frame dams by Thomas and by William H. McAlpine.

65. U.S. Army, Corps of Engineers, *Annual Report, 1910*, p. 1999; Lewis M. Adams, "An A-Frame Movable Top to Provide Increased Depths above Fixed Dams," *Professional Memoirs, Corps of Engineers* 3 (Apr.-June 1911):332-34 quotes McAlpine.

66. U.S. Army, Corps of Engineers, *Annual Report, 1914*,

p. 2825, Lewis M. Adams, "An A-Frame Movable Top to Provide Increased Depths above Fixed Dams," *Professional Memoirs, Corps of Engineers* 3 (Apr.-June 1911):315-35.

67. U.S. Army, Corps of Engineers, *Annual Report, 1907*, p. 1782; U.S. Army, Corps of Engineers, *Annual Report, 1910*, p. 1996; Maj. John C. Oakes to Chief of Engineers, 10 Aug. 1910, File 6884, General Correspondence, 1894-1923, NARG 77.

68. U.S. Army, Corps of Engineers, *Annual Report, 1910*, p. 1992; U.S. Army, Corps of Engineers, Annual Report, 1913, p. 2650; U.S. Army Corps of Engineers, *Annual Report, 1914*, p. 2819.

69. Citizens Trust & Guaranty Co. to Chief of Engineers, 26 June 1913, File 87154, General Correspondence, 1894-1923, NARG 77.

70. Ibid.; District Engineer to Chief of Engineers, 20 May 1914, and related correspondence, File 88247, General Correspondence, 1894-1923, NARG 77; U.S. Army, Corps of Engineers, *Annual Report, 1915*, p. 3083, H. G. McCormick, "Retaining Wall Failure at Lock No. 13, Kentucky River," *Professional Memoirs, Corps of Engineers* 7 (Nov.-Dec. 1916): 734-45.

71. Theodore E. Burton to Maj. Harry F. Hodges, 10 Jan. 1907, File 53430, General Correspondence, 1894-1923, NARG 77; Congressman John W. Longley to Chief of Engineers, 27 Dec. 1909, File 74273, General Correspondence, 1894-1923, NARG 77; Maj. James G. Warren to Chief of Engineers (telegram), 8 Jan. 1910, File 74273, General Correspondence, 1894-1923, NARG 77.

72. Maj. John C. Oakes to Chief of Engineers, 27 May 1911, File 80193, General Correspondence, 1894-1923, NARG 77; U.S. Army, Corps of Engineers *Annual Report, 1911* pp. 2195-97.

73. Maj. R. R. Ralston to Chief of Engineers, 4 Feb. 1916, File 80193, General Correspondence, 1894-1923, NARG 77; Maj. R. R. Ralston to H. G. McCormick, 21 Mar. 1916, File 80193, General Correspondence, 1894-1923, NARG 77.

74. U.S. Army, Corps of Engineers, *Annual Report, 1916*, pp. 2911-12; U.S. Army, Corps of Enginers, *Annual Report, 1917* pp. 3017-21.

75. John Howe Peyton, "Traffic on the Ohio River," *Engineering News* 63 (17 Feb. 1910):189; U.S. Army, Corps of Engineers, *Annual Report, 1929*, pp. 1294-95; John P. Hale, "History of the Great Kanawha River Slack Water Improvement," *West Virginia Historical Magazine* 1 (April 1901):49-75; U.S. Army Engineer Division, Ohio River, *Ohio River Navigation Past-Present-Future* (Cincinnati: U.S. Army Engineer Division, 1980), passim; Johnson, *The Falls City Engineers*, p. 187.

76. Frankfort, KY, *State Journal*, 21 Jan. 1917.

77. Ibid., 28 Jan., and 8 Feb. 1917.

78. Frankfort, KY, *State Journal*, 7 Feb., 9-10 Feb., 15 Feb. 1917.

79. Lt. Col. W. P. Stokey to Chief of Engineers, 18 Jan. 1918, File 6684, General Correspondence, 1894-1923, NARG 77; Madison, IN, *Madison Courier*, 23 June 1917; U.S. Army, Corps of Engineers, *Annual Report, 1919*, p. 3122.

80. Benjamin F. Thomas to Chief of Engineers, 13 May 1918, File 6884, General Correspondence, 1894-1923, NARG 77; Lucien S. Johnson to District Engineer, File 121861, General Correspondence, 1894-1923, NARG 77.

81. James H. Flinn to Lucien S. Johnson, 26 Nov. 1920, File 97513, General Correspondence, 1894-1923, NARG 77; U.S. Army, Corps of Engineers, *Annual Report, 1922*, p. 1411.

82. U.S., Congress, House, *Kentucky River, Kentucky*, H. Doc. 85, 73rd Congress, 1st Sess., 1933, p. 3; Oscar Parks to District Engineer, 18 Dec. 1940, File 1520-03, Waterways Management Branch, U.S. Army Engineer District, Louisville, KY.; U. S. Army, Corps of Engineers, *Annual Report, 1949*, p. 835.

83. U.S. Army, Corps of Engineers, *Annual Report, 1951*, p. 1498; R. G. West to Brig. Gen. A. W. Pence, 9 July 1951, in A. W. Pence File, Historical Files, U.S. Army Engineer Division, Ohio River, Cincinnati, Ohio. Recent commerce and the closing of the locks on the upper Kentucky River are discussed in Chapter VII of this volume.

NOTES

PROLOGUE

1. Leland R. Johnson *The Falls City Engineers: A History of the Louisville District, Corps of Engineers, United States Army* (Louisville: U.S. Army Engineer District, 1975, cited hereafter as Johnson, *Falls City Engineers*), pp. 43-56, 74-102, and 133.

2. Ibid., pp. 121-89, 227-51. Records concerning the origins of the Corps are printed in Paul K. Walker, ed., *Engineers of Independence: A Documentary History of the Army Engineers in the American Revolution* (Washington, DC: Office of the Chief of Engineers, 1981).

3. Johnson, *Falls City Engineers*, pp. 190-208, 252-72.

4. Ibid., pp. 209-26.

5. Ibid., pp. 1-5; U.S., Congress, Senate, Committee on Public Works, *Civil Works Program of the Corps of Engineers: A Report to the Secretary of Army by the Civil Works Study Board*, 89th Cong., 2d Sess., 1966, explains the internal operations of civil works elements of the Corps.

6. Johnson, *Falls City Engineers*, pp. 1-5; Martin K. Pedigo to author, 1 March 1983; U.S. Army, Corps of Engineers, Engineer School, *The Corps of Engineers Officer* (Fort Belvoir, VA: U. S. Army Engineer School pamphlet 600-1, 1974), pp. 1-25.

7. Johnson, *Falls City Engineers*, p. 308; Lt. Gen. Frederick J. Clarke, "Remarks, U.S. Army Engineer School, Fort Belvoir, VA.," 6 March 1970 (copy in U.S. Army Engineer District, Louisville, Public Affairs Office, Project Files, cited hereafter as PAOF). The legend mentioned refers to the Savannah District Engineer who in 1898 was exposed by his fellow officers and subsequently convicted of defrauding the government.

8. William F. Pollard, "Organization and Functions, Louisville District," Memorandum 10-1-3, 26 May 1978, in U.S. Army Engineer District, Louisville, Records Management Office, Louisville District Historical File (cited hereafter as LDHF).

9. Ibid., appendices A-S; U.S. Army Engineer District, Louisville, "History of Louisville District, Corps of Engineers, April 1968," in LDHF, and cited hereafter as Louisville District, "History of Louisville District, April 1968."

10. Johnson, *Falls City Engineers*, pp. 252-80.

11. Ibid.; Col. Charles J. Fiala, "Speech at Four Winds," 31 Oct. 1972, in PAOF; Lt. Gen. Frederick J. Clarke, "Remarks to ASCE Water Resources Conference, Atlanta, Ga.," 24 Jan. 1972, in PAOF.

12. Col. R. R. Wessels to Col. John A. Graf, 7 Feb. 1968, in LDHF; Col. John T. Rhett, Jr., to Sen. Marlow W. Cook, 9 Feb. 1970, in PAOF; Dayton, OH, *Dayton Daily News*, 17 Feb. 1969, quoting the Letcher County sheriff.

13. Samuel C. Florman, "Hired Scapegoats: In Support of the U.S. Army Corps of Engineers," *Harper's Magazine*, May 1977; n.p. (reprint in PAOF); Urbana, IL, *The Daily Illini*, 30 Oct. 1971; Booneville, KY, *Peoples Journal*, 20 July 1972; John Baskin asserted that Maj. Gen. Richard H. Groves, Director of Civil Works, had no "feelings" in an undated newspaper clipping in the Caesar Creek folder, PAOF.

14. The author was acquainted with the personnel mentioned and the descriptions are his own.

15. U.S. Army Engineer District, Louisville, *Information Bulletin* (a brief monthly inhouse publication; copies maintained in Records Management Office, Louisville District, and cited hereafter as Louisville District, *Information Bulletin*), Aug. 1969 and Feb. 1973.

16. Ibid., Aug. 1969.

17. Lt. Gen. William F. Cassidy, "Remarks, Annual Convention, National Reclamation Association, Oklahoma City, Okla.," 17 Nov. 1968, in PAOF; Lt. Gen. John W. Morris, *The Corps of Engineers and the American Environment* (Washington, DC: Office of the Chief of Engineers, EP 360-1-15, 1978), p. 8.

18. James A. Mitchell to Executive Assistant, "Office Move: Exodus from 830 W. Broadway Bldg., began 18 July and completed 31 July 1969," in LDHF; Louisville District, *Information Bulletin*, Aug. 1969.

CHAPTER I: YEAR OF CRISES: 1970

1. Louisville *Courier-Journal*, 21-23 Apr. 1970, 20 Apr 1980; Stephen Fox, *John Muir and His Legacy: The American Conservation Movement* (Boston: Little, Brown and Company, 1981), pp. 325-26.

2. Williama G. Berberet, "The Historical Framework of Environmental Politics" (Duquesne History Forum paper, Pittsburgh, PA, 29 Oct. 1971), passim; Fox, *John Muir and His Legacy*, pp. 351-57; *Louisville Times*, 4 Sept. 1974, Louisville *Courier-Journal*, 23 Apr. 1972; Lt. Gen. Frederick J. Clarke, "Press Briefing," Washington, DC, 2 Apr. 1970, transcript in LDHF; Col. John T. Rhett, Jr., "Remarks, Louisville Kiwanis Club Meeting," 1 Sept. 1971, in PAOF.

3. Fox, *John Muir and His Legacy*, passim; Rhett, "Remarks, Louisville Kiwanis Club Meeting," 1 Sept. 1971, in PAOF.

4. Clarke, "Press Briefing," Washington, DC, 2 Apr. 1970, in LDHF.

5. Louisville District, *Information Bulletin*, Feb. 1970; Elizabeth B. Drew, "Dam Outrage: The Story of the Army Engineers, " in Stephen E. Ambrose and James A. Barber, Jr., eds., *The Military and American Society: Essays and Readings* (New York: Macmillan Publishing Co., 1972), p. 276.

6. U. S. Army, Corps of Engineers, Institute for Water Resources, *Environmental Guidelines for the Civil Works Program of the Corps of Engineers* (Fort Belvoir, VA: Institute for Water Resources Report 70-5, 1970), pp. 3-4; Maj. Gen. Willard Roper to Col. John T. Rhett, Jr., 26 Mar. 1970, in LDHF; Martin Reuss, *Shaping Environmental Awareness: The United States Army Corps of Engineers Environmental Advisory Board, 1970-1980* (Washington, DC: Office of the Chief of Engineers, 1983), reviews the formation and activities of the Chief's advisory board.

7. Col. John T. Rhett, Jr., to Maj. Gen. Willard Roper, 9 Jun. 1970, in LDHF; Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 8 Sept. and 8 Dec. 1970, in LDHF.

8. U.S., Congress, Senate, Committee on Public Works, *Civil Works Program of the Corps of Engineers: A Report to the Secretary of the Army by the Civil Works Study Board*, 89th Cong., 2d Sess., 1966, pp. 10, 17, 92-104.

9. Ibid.; Col. J. C. H. Lee, Jr., to Col. John T. Rhett, Jr., 27 Mar. 1970, in LDHF.

10. Col. J. C. H. Lee, Jr., to Col. John T. Rhett, 27 Mar. 1970, in LDHF; Maj. Gen. Willard Roper to Lt. Gen. Frederick J. Clarke, 2 Jul. 1970, in LDHF; Louisville District, *Information Bulletin*, Oct. 1970; Maj. Gen. William L. Starnes to Lt. Gen. Frederick J. Clarke, 24 Sept. 1970, in LDHF; Louisville District, General Orders No. 11, 11 Sept. 1970, copy in Records Management Office, U.S. Army Engineer District, Louisville, KY. Acording to organizational charts in the Records Management Office, planning in the District during the 1930s and 1940s was done by the Projects Division headed by Samuel M. Bailey, which included Hydrology and Hydraulics Branch under Charles E. Breitbeil, Surveys Branch under John E. Blanchar, and Projects Branch under John H. Kurrasch; that division was absorbed by the Engineering Division during the 1950s, with John H. Kurrasch remaining as chief of the Planning and Reports Branch. On 11 March 1963, the Planning and Reports Branch was replaced by the Project Planning Branch under William E. Leegan and the Basin Planning Branch under Jack F. Bruce. The first chiefs of the six branches of Planning Division in 1970 were: Russell J. Whistler, Economics; David F. French, Environmental Resources; Orvill Chinn, Floodplain Management; Charles B. Sargent, Project Planning; Neal E. Jenkins, Plan Formulation; and Lillian Fleischman, Services.

11. Ohio River Coordinating Committee, *Ohio River Basin Comprehensive Survey* (14 vols.; Cincinnati: U. S. Army Engineer Division, 1969), and Wabash River Coordinating Committee, *Wabash River Basin Comprehensive Survey* (14 vols.; Louisville: U. S. Army Engineer District, 1971) were the reports mentioned; Col. Willard Roper to Brig. Gen. Walter P. Leber, 8 Apr. 1966, in LDHF; Louisville *Courier-Journal*, 16 Jul. 1967 and 19 Jan. 1969; Maj. Gen. Willard Roper to Lt. Gen. Frederick J. Clarke, 25 Mar. 1970, in LDHF.

12. Johnson, *Falls City Engineers*, pp. 273-74; U. S. Army Engineer District, Louisville, *Big Walnut Lake: Special Report on Alternatives* (Louisville: U.S. Army Engineer District, 1972), pp. 1-2; Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 8 Mar. 1971, in LDHF; Col. James N. Ellis to Sen. Birch Bayh, 25 Mar. 1976, in LDHF.

13. Col. James L. Lewis to Col. Robert W. Lockridge, 9 Apr. 1963, in LDHF; U.S. Army Engineer District, Public Affairs Office, "Red River Lake Chronolgy," 1974, in PAOF.

14. William Woo, "Kentucky Controversy: Conservationists Score in Fight to Save a Scenic Area," in *St. Louis Post-Dispatch*, 11 May 1969; Louisville *Courier-Journal*, 15 Jan. 1968.

15. John Ed Pearce, "Powell County," in Louisville *Courier-Journal*, 16 July 1978; Leland R. Johnson, "Definition of Navigable Waters of the United States: Red River, Kentucky," 27 May 1974, in U.S. Army Engineer District, Louisville, Waterways Management Branch files.

16. Harry M. Caudill, *Night Comes to the Cumberlands: A Biography of a Depressed Area* (Boston: Little, Brown and Co., 1963), pp. 385-88.

17. Louisville *Courier-Journal*, 18 May and 2 Dec. 1965, and 15 June 1966; Maj. Morris L. Gardner to Brig. Gen. Walter P. Leber, 15 July 1965, in LDHF.

18. Ravenna, KY, *Citizen Voice*, 1 Aug. 1974; Louisville *Courier-Journal*, 16 July 1978; Wendell Berry, *The Unforeseen Wilderness: An Essay on Kentucky's Red River Gorge* (Lexington: University of Kentucky Press, 1971) presented a description of the gorge.

19. Louisville *Courier-Journal*, 28 Sept. 1966, 30 July 1967, 26 Apr. 1968.

20. Ibid., 17 Aug. 1967; Clay City, KY, *Clay City Times*, 14 Sept. 1967; *Louisville Times*, 10 Oct. 1967; Col. R. R. Wessels to Brig. Gen. Willard Roper, 8 Sept. 1967, in LDHF; Col. R. R. Wessels to Col. John A. Graf, 7 Nov. 1967, in LDHF; Col. R. R. Wessels to Lt. Gen. William F. Cassidy, 9 May 1968, in LDHF.

21. *New York Times*, 20 Nov. 1967; *Washington Star*, 19 Nov. 1967; Louisville *Courier-Journal*, 19 Nov. 1967; Clay City, KY, *Clay City Times*, 21 Dec. 1978.

22. Louisville *Courier-Journal*, 19 Nov. 1967; William O. Douglas, "The Public Be Damned," *Playboy*, July 1969, p. 188.

23. *Louisville Times*, 27 Nov. 1967; see also Robert R. Wessels, "Red River Gorge," *Kentucky Club Woman*, January 1968, pp. 15-17, and Edwin Shrake, "Operation Build and Destroy," *Sports Illustrated*, April 1968, p. 49, and Ray Harm, "Red River Gorge," *Kentucky Club Woman*, January 1968, pp. 14-16.

24. Colonel R. R. Wessels to Col. John A. Graf, 8 Dec. 1967, in LDHF; Louisville *Courier-Journal*, 16 Feb. 1968.

25. U.S. Army, Office of the Chief of Engineers, *Red River*

Reservoir, Kentucky: Reconnaissance Study(Washington, DC: Office of the Chief of Engineers, 1968), passim; Louisville *Courier-Journal*, 26 July 1968; Col. R. R. Wesssels to Col. John A. Graf, 9 Apr. 1968, in LDHF.

26. Louisville *Courier-Journal*, 12-14 Feb. and 1 Mar. 1969; Lexington, KY, *Herald*, 26 Feb. 1969; Maj. Gen. Willard Roper to Lt. Gen. William F. Cassidy, 2 Apr. 1969; in LDHF; Red River Defense Fund, "Help Save Red River," *Cumberland Sierrian*, July-Aug. 1974, n. p.

27. Martin K. Pedigo to Vince Wagner, 9 Sept. 1970, in PAOF.

28. "Background Information for Press Briefing," 1 Apr. 1970, manuscript in LDHF; Lexington, KY, *Herald*, 27 Aug. 1970; Louisville *Courier-Journal*, 27 Aug. 1970; Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 8 Sept. 1970, 8 Mar. 1971, and 7 June 1971, in LDHF; *Louisville Times*, 15 Apr. 1971.

29. Lt. Gen. Frederick J. Clarke to Maj. Gen. William L. Starnes, 14 Apr. 1971, in LDHF; Maj. Gen. William L. Starnes to Col. John T. Rhett, Jr., 7 May 1971, in LDHF.

30. Louisville *Courier-Journal*, 20 June 1971 and 15 Oct. 1971; *Louisville Times*, 14 Oct. 1971; and Col. John T. Rhett, Jr., to John L. Franson, 27 Apr. 1971, in PAOF.

31. Johnson, *Falls City Engineers*, pp. 209-26.

32. Brig. Gen. Walter P. Leber to Lt. Gen. Walter K. Wilson, Jr., 22 Jan. 1965, in LDHF; Lt. Gen. Frederick J. Clarke, "State of the Corps Message," 30 Mar. 1970, in LDHF; discussions of military construction before 1970 by author with Richard H. Russell, L. Ryan Ringo, and other District personnel directing the mission were conducted during the 1970s.

33. Johnson, *Falls City Engineers*, pp. 209-26; Brig. Gen. Walter P. Leber to Lt. Gen. William F. Cassidy, 23 July 1965, in LDHF.

34. Brig. Gen. Walter P. Leber to Lt. Gen. Walter K. Wilson, Jr., 15 July 1964, in LDHF; Col. Willard Roper to Brig. Gen. Walter P. Leber, 6 May and 3 June 1966, in LDHF. Because contract negotiations for rushed work at Fort Campbell in 1966 were delayed because no one in the District was familiar with cost-plus-fixed-fee contracts—such contracts had not been awarded in years—Colonel Roper recommended that every Engineer District occasionally award such a contract as part of its training for military mobilization.

35. Col. R. R. Wessels to Col. John A. Graf, 5 Jan. 1968, in LDHF; Brig. Gen. Willard Roper to Lt. Gen. William F. Cassidy, 27 Dec. 1968 and 1 July 1969, in LDHF; interview, author with Richard H. Russell, Nashville, TN, 26 Mar. 1980.

36. Office of the Assistant Secretary of Defense, "News Release," 6 Mar. 1970, in LDHF. The other "losing" Districts were located at Norfolk, Chicago, Kansas City, Seattle, Jacksonville, and Albuquerque; the New England Division also lost military construction in 1970 and the Honolulu District merged with the Pacific Ocean Division.

37. Patrick A. Gragnon to Col. John T. Rhett, Jr., 14 Apr. 1970, in LDHF.

38. Col. John T. Rhett, Jr., to Maj. Gen. Willard Roper, 9 Mar, 9 June, and 16 July 1970, in LDHF; Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 16 Sept. 1970, in LDHF.

39. Maj. Gen. Willard Roper to Lt. Gen. Frederick J. Clarke, 25 March and 2 July 1970, in LDHF.

CHAPTER II: NAVIGATION MODERNIZATION, 1970-1975

1. Leland R. Johnson, "Waterways: The Fourth Pillar of Defense," *Military Engineer* 72 (Nov.-Dec. 1980): 404-08; also printed in U.S. Army, Corps of Engineers, Institute for Water Resources, *National Waterways Roundtable Papers: Proceedings on the History and Evolution of U.S. Waterways and Ports* (Fort Belvoir, VA: Institute for Water Resources Report 80-2, 1980), pp. 23-35.

2. Lt. Gen. Walter K. Wilson, Jr., "Address, St. Paul, Minn.," 31 Aug. 1961, in PAOF.

3. Johnson, *Falls City Engineers*, pp. 233-35; E. E. Abbott, "Design for a 'New' Ohio River," *Civil Engineering* 32 (Oct. 1962):46-69.

4. Johnson, *Falls City Engineers*, pp. 233-35; U.S. Army Engineer District, Louisville, *Project Maps and Data Sheets* (3 vols. Louisville: U.S. Army Engineer District, 1978), 1:32.

5. E. F. Larkin, "Contractor's Planning for Navigation Locks," in American Society of Civil Engineers,, *Journal of Waterways and Harbors Division* 84 (Mar. 1958): paper 1572.

6. U.S. Army Engineer District, Louisville, *Project Maps and Data Sheets* 1:35; Johnson, *Falls City Engineers*, pp. 233-35; Louisville District, *Information Bulletin*, Nov. 1972.

7. Leland R. Johnson, "19th Century Engineering: The Davis Island Lock and Dam," *Military Engineer* 71 (July-Aug. 1979):256; Louisville District, *Information Bulletin*, Apr. 1970.

8. Leland R. Johnson, "Ohio River Traffic Density" (draft of report prepared for Bill Berkman, Navigation Section, Louisville District, 1978, in author's files); remarks of Brig. Gen. R. S. Kem, International Inland Waterways Conference, Louisville, KY, 26 Aug. 1983.

9. Louisville District, *Information Bulletin*, Apr. 1970; Metropolis, IL, *Metropolis News*, 29 Aug. 1968; Paducah, KY, *Sun-Democrat*, 23 Feb. 1969.

10. Maj. Gen. Willard Roper, "A Temporary Approach to Locking" (undated manuscript in PAOF), passim; Paducah, KY, *Sun-Democrat*, 12 Feb. 1969.

11. Leland R. Johnson, "Upriver to Three Forks: The Kentucky River Project, 1835-1917" (140-page unpublished manuscript at Office of Administrative Services, U.S. Army Engineer District, Louisville, KY), passim; Johnson, *Falls City Engineers*, p. 183; Leland R. Johnson, *The Headwaters District: A History of the Pittsburgh District, U.S. Army Corps of Engineers* (Pittsburgh: U.S. Army Engineer District, 1979), pp. 167-69.

12. Col. R. R. Wessels to Col. John A. Graf, 9 May 1968, in LDHF; Col. John T. Rhett, Jr., to Maj. Gen. Willard Roper, 9 Mar. 1970, in LDHF; Maj. Gen. Willard Roper, "A Temporary Approach to Locking," passim.

13. Paducah, KY, *Sun-Democrat*, 7 Dec. 1969; Louisville District, *Information Bulletin*, Jan. 1970; U.S. Army, Office of the Chief of Engineers, *1970 Distinguished Design Awards* (Washington, DC: Office of the Chief of Engineers, 1971), pp. 20-21.

14. Interview, author with Richard H. Russell, Nashville, 26 March 1980. Until 1946 the District had a combined construction-operations division headed by Oren Bellis with E. E. Pontrich and W. C. Pitzer as assistant chiefs. William G. Gilchrist in January 1946 became the first chief of the District's Contruction Division; his successors were Charles E. Breitbiel, 1946-51; William A. Turner, 1951-56;

Eugene E. Pontrich, 1956-64; Walter S. Langsford, Jr., 1964-66, and Frank C. Kintler who acted as chief until the appointment of Mr. Russell in December 1966. In 1970 Gordon M. Stevens was assistant chief for military construction and Jack E. Kiper was assistant chief for civil works; both later served as chief of the Construction Division. The Ohio River Division on 1 June 1970 merged its construction and operations supervisory function in a division headed by Patrick H. Carigan and subsequently by Jack E. Kiper. See Louisville District, "History of Louisville District, April 1968," construction section, n. p.

15. Col. John T. Rhett, Jr., to Maj. Gen. Willard Roper, 9 Mar. and 9 June 1970, in LDHF; Maj. Gen. William L. Starnes to Lt. Gen. Frederick J. Clarke, 22 Dec. 1970, in LDHF.

16. Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 6 Sept. 1972, in LDHF; *Evansville Press,* 18 Sept. 1973; Brig. Gen. Willard Roper to Col. Jesse L. Fishback, 19 May 1967, indicates engineering and design for Smithland Locks and Dam was assigned to Nashville District on 4 Nov. 1965 and real estate and construction on 19 May 1967; the construction of Smithland Locks began 25 Sept. 1971.

17. This section is based upon personal observations by the author of the work and discussions with personnel of the Construction Division in several Engineer Districts since 1968. Technical data, construction reports, and photographs of the work are collected in the District's technical library and files of the Construction and Engineering Divisions.

18. Eugene Miller, Harry Thomas, and Herschel St. Ledger, "Unusual Design Features: Cannelton Locks and Dam" (draft of paper presented to American Society of Civil Engineers, 1969, in PAOF), passim. Jeremiah Burnham Tainter received patents for his sector gates on 6 July 1886, according to a note in *Engineering News-Record* 89 (10 Aug. 1922):247.

19. Louisville District, *Information Bulletin,* Aug. 1969; Cannelton, IN, *Cannelton News,* 5 Nov. 1974; interview, author with Richard H. Russell, Nashville, TN, 26 Mar. 1980. Construction contractors submit with their proposals a schedule of progress usually following the "critical path method."

20. Colonel Charles J. Fiala, "OVIA Presentation," 26 Oct. 1973, in PAOF; Louisville District, *Information Bulletin,* Aug. 1969; Cannelton, IN, *Cannelton News,* 5 Nov. 1974.

21. Brig. Gen. Willard Roper to Lt. Gen. William F. Cassidy, 3 Apr. 1967, in LDHF; Col. R. R. Wessels to Col. John A. Graf, 7 Nov. 1967, in LDHF; Col. John A. Graf to Lt. Gen. William F. Cassidy, 29 Mar. 1968, in LDHF; Col. R. R. Wessels to Col. John A. Graf, 7 June 1968, in LDHF.

22. Maj. Gen. William L. Starnes to Lt. Gen. Frederick J. Clarke, 30 Mar. and 22 Dec. 1971, in LDHF.

23. Maj. Gen. William L. Starnes to Lt. Gen. Frederick J. Clark, 21 June 1972, in LDHF.

24. Louisville *Courier-Journal,* 22 Apr. 1972; Cannelton, IN, *Cannelton News,* 25 Apr. and 23 May 1970; Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 5 Dec. 1974, in LDHF; Max Bohrer to Hines, Inc., 28 Apr. 1972, in PAOF.

25. Louisville *Courier-Journal,* 3 Nov. 1974; Cannelton, IN, *Cannelton News,* 5 Nov. 1974; Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 5 Dec. 1974, in LDHF.

26. W. B. Beer, "Plant Engineering: A Key to Production on Newburgh Locks Project," *Construction Digest* (KY, IN, and IL), 15 Aug. 1968, pp. 34-39.

27. n.a., "Dravo to Build New Type Cofferdam Complex," *World Dredging and Marine Construction* 6 (Aug. 1970):16, 41; Martin K. Pedigo, "Figure Eight Sub Coffer Dams Eliminate Internal Bracing Need on Newburgh Dam Pier Foundation" (unpublished manuscript, 1973, in PAOF), passim.

28. Louisville District, *Information Bulletin,* Apr. 1971; *Evansville Press,* 14 Mar. and 12 July 1973. The Louisville District's Value Engineering Program was established in April 1965.

29. Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 5 Dec. 1973, in LDHF; Lt. Col. John E. Moore to Brig. Gen. Wayne S. Nichols, 6 Sept. 1974, in LDHF; *Evansville Press,* 3 July 1974.

30. U.S. Army Engineer District, Louisville, Uniontown Resident Office, "Uniontown Locks and Dam Foundation Report" (2 vol. manuscript, 1972, in the District Technical Library), n. p., lists personnel and describes foundation conditions.

31. Ralph B. Peck, "Report on Changed Conditions, Failure of Stage I Cofferdam, Uniontown Dam" (manuscript enclosed in Uniontown Resident Office, "Uniontown Locks and Dam Foundation Report"), n. p.

32. Interviews with District and contractor personnel at the site are printed in U.S. Army Engineer District, Louisville, *Report of Board of Investigation on Failure of Cofferdam, Uniontown Dam, Ohio River* (Louisville: U. S. Army Engineer District, 1971).

33. Ibid., p. 41.

34. Ibid.

35. Ibid.

36. Ibid.; Peck, "Report on Changed Conditions, Failure of Stage I Cofferdam, Uniontown Dam," passim; U.S. Army Engineer Division, Ohio River, *An Analysis of Cellular Sheet Pile Cofferdam Failures* (Cincinnati: U.S. Army Engineer Division, 1974), prints comparisons of Uniontown cofferdam failure with other failures.

37. Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 7 June 1971, in LDHF; Uniontown Resident Office, "Uniontown Locks and Dam Foundation Report," n. p.

38. Peck, "Report on Changed Conditions, Failure of Stage 1 Cofferdam, Uniontown Dam," n. p.

39. Lt. Gen. Frederick J. Clarke to Maj. Gen. William L. Starnes, 29 Apr. 1971, in LDHF; Maj. Gen. William L. Starnes to Lt. Gen. Frederick J. Clarke, 22 Dec. 1971, in LDHF; see also interview with George Brunner, office engineer, in Henderson, KY, *Gleaner and Journal,* 12 Jan. 1975.

40. Col. Charles J. Fiala, "Address to Evansville Audubon Society," 18 June 1974, in PAOF; National Audubon Society, *Audubon News Release,* 11 June 1971, in PAOF.

41. Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 4 Dec. 1975, in LDHF.

CHAPTER III: THE IMPOUNDMENT QUINTET OF 1970

1. Johnson, *Falls City Engineers,* pp. 256-69; Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 5 June 1973, in LDHF; Louisa, KY, *Big Sandy News,* 5 Sept. 1973; see project descriptions in Volume 2 of U.S. Army Engineer District, Louisville, *Project Maps and Data Sheets* (3 vols.; Louisville: U. S. Army Engineer District, 1978).

2. Louisville District, *Information Bulletin*, July 1971; U.S. Army Engineer District, Louisville, *Project Maps and Data Sheets*, Vol. 2, provides comparative data.

3. See note 2.

4. Under Whitney I. Gregory and Samuel M. Bailey, the Engineering Division until 1961 had five branches: Design, Arthur I. Gulden, chief; Planning and Reports, John H. Kurrasch, chief; Hydraulics, C. L. Cowan, chief; Materials Investigations, R. F. Jackson, chief; and Surveys, John E. Blanchard, chief. The number of branches expanded during the 1960s with the addition of Military Design headed by Eugene B. Stokes, Engineering Services under C. V. Edwards, and Relocations headed by S. D. Sullivan. The successors to Gregory, Bailey, and Hayes as chief of Engineering Division were Roy E. Karlen, 1972-75; Herschel St. Ledger who acted as chief during late 1975; William E. Leegan, 1975-77; and Noah Whittle since. See Louisville District, "History of Louisville District, April 1968," engineering section, n. p.

5. Pollard, "Organization and Functions, Louisville District," appendix N, n. p.

6. Ibid., appendix L; see also Louis D. Hightower, "Engineer Construction Contracting," *Military Engineer* 66 (Jan.-Feb. 1974)34-36.

7. Interview, author with Joseph Theobald, Louisville, KY, 8 Feb. 1983; Louisville District, *Information Bulletin*, Mar. 1970. The Supply and Procurement Division was established in Feb. 1951 with David S. Green, Jr., as chief and with four branch chiefs: John T. Kearney, Contract Administration; Wallace I. Stone, Industrial Mobilization; Cobert W. Lagle, Property; and Charles M. Knosp, Procurement. Ivan C. Uland, Hassell D. Hager, and Charles M. Knosp served successively as chief of the Supply and Procurement Division during the 1950s and 1960s; William F. Pollard was chief from 1970 to 1974 and James A. Mackin, Jr., since 1974. See Louisville District, "History of Louisville District, April 1968," supply section, n. p.

8. Edward Gowen, "Real Estate, the First Construction Service," *Military Engineer* 66 (Sept.-Oct. 1974):316-17; U.S. Army, Office of the Chief of Engineers, *Engineer Update* (monthly inhouse publication, 1976-1983), Dec. 1982, p. 6; "Historical Data, Real Estate Division, 1 Jan. 1966-31 Dec. 1970" (undated manuscript in LDHF), passim; Max Bohrer, "Patoka Lake," 15 July 1976 (manuscript in PAOF). Established 26 July 1947 with Clifton B. Raymer as chief, the Real Estate Division initially had four branch chiefs: Clifton B. Raymer, Management and Disposal; T. L. Edelen, Acquisition; Gladys Dravo, Realty Control; H. E. Ahrens, Appraisals. Fred Morgan was chief of the division from 1955 to 1973 and was succeeded by Max Bohrer and Robert R. Humphreys. See Louisville District, "History of Louisville District, April 1968," real estate section, n. p.

9. Gowen, "Real Estate, the First Construction Service," pp. 316-17; Neal E. Jenkins to Robert B. Eagleston, 5 May 1980, in Box 1152, Records Management Office, U.S. Army Engineer District, Louisville, KY; U.S. Department of Justice, *Progress, Property and Just Compensation* (Washington, DC: Government Printing Office, 1963), pamphlet; Attica, IN, *Daily Ledger-Tribune*, 13 Jan. 1967. The percentages vary a few points from time to time and from project to project.

10. Interview, author with Robert R. Humphreys, Louisville, KY, 24 May 1983.

11. This section based upon personal inspection by the author of resident engineer offices, materials laboratories, and construction sites since 1968.

12. Ibid.; see also project plans in U.S. Army Engineer District, Louisville, *Project Maps and Data Sheets*, Vol. 2.

13. See U.S. Army Engineer District, Louisville, *Project Maps and Data Sheets*, Vol. 2.

14. The change from "reservoirs" to "lakes" was required by the Chief of Engineers in Circular No. 1130-2-75, 10 Aug. 1970; see discussion in Leland R. Johnson, *The Headwaters District: A History of the Pittsburgh District, U. S. Army Corps of Engineers* (Pittsburgh: U.S. Army Engineer District, 1979), p. 303; Col. R. R. Wessels to Brig. Gen. Willard Roper, 8 Sept. 1970, in LDHF.

15. Col. James N. Ellis, "Remarks, Cecil M. Harden Lake Name Changing Ceremony," 24 June 1977, in PAOF.

16. Ibid.

17. Johnson, *Falls City Engineers*, pp. 266-67; Springfield, OH, *News-Sun*, 15 Sept. 1974.

18. Springfield, OH, *News-Sun*, 16 Oct. 1966 and 17 Mar. 1968; n. a. "Ohio Dam Tower Raised by Big Lifts," *Construction Digest*, (KY, IN, and IL), 23 Nov. 1967, p. 8.

19. Springfield, OH, *The Sun*, 13 Feb. 1969 and 14 Oct. 1970; U.S. Army Engineer District, Louisville, *Project Maps and Data Sheets*, 2:196.

20. Louisville District, *Information Bulletin*, Sept. 1974; Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 5 Dec. 1974, in LDHF; Col. James N. Ellis to Brig. Gen. Wayne S. Nichols, 4 Mar. 1975, in LDHF.

21. Louisville *Courier-Journal*, 15 Jan. 1968.

22. Brookville, IN, *Whitewater Valley Explorer*, 25 July 1979; *Brookville Democrat*, 9 Dec. 1965.

23. *Brookville Democrat*, 9 Dec. 1965; Brookville Park Ranger to Chief, Recreation Resource Management, 17 Feb. 1978, in PAOF; Richmond, IN, *Palladium Item*, 18 Aug. 1979; *Evansville Courier and Press*, 24 Oct. 1971; Louisville *Courier-Journal*, 20 July 1973.

24. *Indianapolis Star*, 12 Dec. 1965; Brookville, IN, *Whitewater Valley Explorer*, 22 Sept. 1977; Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 8 Sept. 1975, in LDHF.

25. Col. James N. Ellis, "Remarks, Annual Engineer Day Luncheon," 18 June 1976, in PAOF; *Brookville Democrat*, 20 Dec. 1973; *Indianapolis Star*, 10 Jan. 1974.

26. Hazard, KY, *Hazard Herald*, 8 June 1961, 30 Apr. 1964, and 14 Apr. 1966.

27. Ibid., 15 Apr. 1966; Louisville *Courier-Journal*, 2 May 1966.

28. Hazard, KY, *Hazard Herald*, 3 June 1969; Col. John T. Rhett, Jr., to Malcolm H. Holliday, Jr., 14 Apr. 1970 in PAOF; Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 5 Dec. 1973, in LDHF; Louisville District, *Information Bulletin*, Mar. 1976 and Aug. 1976; Lt. Col. Walter K. Wilson, III, "Remarks, Carr Fork Lake Dedication," 7 Aug. 1976, in PAOF.

29. Johnson, *Falls City Engineers*, pp. 264-66; Morehead, KY, *Morehead News*, 12 Aug. 1965 and 5 Dec. 1968.

30. Morehead, KY, *Morehead News*, 9 Aug. 1973; Greenup, KY, *Greenup News*, 19 Apr. 1973.

31. Morehead, KY, *Morehead News*, 8 Aug. 1974; Owingsville, KY, *Bath County News*, 7 Dec. 1967.

32. *Louisville Times*, 19 Sept. 1973; *Cincinnati Post*, 9 Aug. 1974; Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 4 Dec. 1975; n. a., "Cave Run Lake, Kentucky: History of Zilpo Road" (four-page undated manuscript in PAOF).

33. Owingsville, KY, *Bath County News-Outlook*, 20 July 1972; Hazard, KY, *Hazard Herald*, 15 Apr. 1966; Louisville *Courier-Journal*, 8 Nov. 1971.

34. Owingsville, KY, *Bath County News-Outlook*, 8 Mar. 1979.

35. U. S. Army Engineer District, Louisville, *Report on Cave Run Flood Emergency, Licking River, Kentucky* (Louisville: U.S. Army Engineer District, 1971), pp. 1-5.

36. U. S. Army Engineer District, Louisville, *Report of Ad Hoc Committee on Cave Run Flood Emergency, Licking River, Kentucky* (Louisville: U.S. Army Engineer District, 1971), pp. 3-1-8.

37. Ibid., pp. 3-1-8; Louisville *Courier-Journal*, 20 July 1971; *Louisville Times*, 20 July 1971; *Evansville Press*, 20 July 1971.

38. Interview, author with Richard H. Russell, Nashville, TN, 26 Mar. 1980.

39. Morehead, KY, *Morehead News*, 22 July 1971; U.S. Army Engineer District, Louisville, *Report of Ad Hoc Committee on Cave Run Flood Emergency*, pp. 3-1-8.

40. Interview, author with Richard H. Russell, Nashville, TN, 26 Mar. 1980.

41. U.S. Army Engineer District, Louisville, *Report of Ad Hoc Committee on Cave Run Flood Emergency*, pp. 4-1-2; U.S. Army Engineer District, Louisville, *Report on Cave Run Flood Emergency, Licking River, Kentucky*, p. 4.

42. U.S. Army Engineer District, Louisvile, *Report of Ad Hoc Committee on Cave Run Flood Emergency*, pp. 5-1-6.

43. U.S. Army Engineer District, Louisville, *Report of Ad Hoc Committee on Cave Run Flood Emergency*, pp. 5-1-6; Louisville District, *Information Bulletin*, July 1974; Lt. Col. John E. Moore to Brig. Gen. Wayne S. Nichols, 6 Sept. 1974, in LDHF; Ashland, KY, *Ashland Daily Independent*, 18 Apr. 1980; U. S. Army Engineer District, Louisville, *Project Maps and Data Sheets*, 2:70.

44. Col. Willard Roper to Brig. Gen. Walter P. Leber, 6 May and 3 June 1966, in LDHF.

45. U. S. Army Engineer District, Louisville, Special Orders No. 28, 14 June 1971, in LDHF; U. S. Army Engineer District, Louisville, *Project Maps and Data Sheets*, 2:62.

46. *Cincinnati Enquirer*, 27 June 1971; interview, author with Martin K. Pedigo, Louisville, KY, 25 Aug. 1983; Maj. Gen. William L. Starnes to Lt. Gen. Frederick J. Clarke, 22 Dec. 1971, in LDHF; Dayton, OH, *Dayton Daily News*, 19 June 1972; Painesville, OH, *Painesville Telegraph* 15 May 1972.

47. Louisville District, *Information Bulletin*, Sept. 1974; Clermont County, OH, *Clermont County Review*, 5 Sept. 1974.

48. Richard H. Russell, "Overtopping of Barrier Dam at East Fork Reservoir, 30 August 1974," 9 Sept. 1974 (copy furnished author by Construction Division, Louisville District).

49. Ibid.; interview, author with Richard H. Russell, Nashville, TN, 26 Mar. 1980; *Cincinnati Post*, 31 Aug. 1974.

50. Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 5 Dec. 1974, in LDHF; Louisville District, *Information Bulletin*, June and Nov. 1975.

51. Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 4 Mar. 1975 and 4 June 1976, in LDHF; U.S. Army Engineer District, Louisville, *Project Maps and Data Sheets*, 2:62; U.S. Army Engineer District, Louisville, "News Release," 27 July 1982, in PAOF; Col. Charles E. Eastburn, "Remarks, Harsha Lake," 9 July 1982, in PAOF.

CHAPTER IV: EMERGENCY OPERATIONS, 1972-1978

1. Johnson, *Falls City Engineers*, pp. 190-208, 252-55; Leland R. Johnson, "Emergency Response: The Army Engineer Disaster Relief Mission, Vol. I: Origins to 1950" (unpublished 452-page manuscript, Historical Division, Office of the Chief of Engineers, 1981), reviews all the emergency operations mentioned.

2. Louisville District, "History of Louisville District, April 1968," operations section, n. p.; Pollard, "Organization and Functions, Louisville District," appendix M; Col. Willard Roper to Brig. Gen. Walter P. Leber, 9 Apr. 1964 and 17 Feb. 1965, in LDHF.

3. Johnson, "Emergency Response: The Army Engineer Disaster Relief Mission," reviews the history of emergency operations procedures and authorities of the Corps; the author has also participated in emergency operations activities of the Corps and has written afteraction reports upon those operations.

4. Clark F. Norton, *Emergency Preparedness and Disaster Assistance: Federal Organization and Programs* (Washington, DC: Library of Congress Congressional Research Service Report No. 78-102, 1978), pp. 1-5.

5. Johnson, *Falls City Engineers*, p. 237; Maj. Gen. William L. Starnes to Lt. Gen. Frederick J. Clarke, 20 Mar. 1972, in LDHF; Louisville District, *Information Bulletin*, Apr. 1972.

6 U. S. Army Engineer District, Louisville, "Summary of Accident and Recovery Operations, Chlorine Barge Incident" (undated manuscript supplied author by Operations Division, Louisville District), n. p.

7. Ibid.

8. Ibid.; Louisville *Courier-Journal*, 24 Feb. 1978.

9. U. S. Army Engineer District, Louisville, "Summary of Accident and Recovery Operations, Chlorine Barge Incident," n. p.

10. Ibid.; Louisville District, *Information Bulletin*, Apr. 1972.

11. Louisville *Courier-Journal*, 24 Feb. 1978.

12. Ibid.; U. S. Army Engineer District, Louisville, "Summary of Accident and Recovery Operations, Chlorine Barge Incident," n. p.

13. Louisville District, *Information Bulletin*, Apr. 1972 and May 1978.

14. Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 6 Dec. 1972 and 5 Mar. 1973, in LDHF; Louisville *Courier-Journal*, 27 Jan. 1974; Louisville District, *Information Bulletin*, May 1972.

15. U. S. Army Engineer District, Louisville, *After Action Report on Markland Barge Incident of January 1974: Operation BIG STINK* (Louisville: U.S. Army Engineer District, 1974), passim.

16. Ibid.; Louisville *Courier-Journal*, 16 Jan. 1974.

17. *Cincinnati Post*, 17 Jan. 1974.

18. Ibid.; *Louisville Times*, 16 Jan. 1974.

19. *Cincinnati Post*, 17 Jan. 1974.

20. Ibid.; Louisville *Courier-Journal*, 20 Jan. 1974.

21. Louisville *Courier-Journal*, 5 Apr. 1974.

22. Ibid.

23. Louisville District, *Information Bulletin*, Apr. 1974.

24. Col. Charles J. Fiala, "Remarks--Emergency Operations Course, 1-3 October 1974, Seattle, Washington" (draft in PAOF).

25. Ibid.

26. Ibid. Some of the chief District personnel at the field offices were: Donald Crane, James Houchins, William H. Cheesman, and Joseph Patton at Xenia; George Brunner, Pepper Roberts, and Capt. Robert Eshenbaugh at Madison-Hanover; and Henry Vickers, Joseph Theobald, Lee Benson, and Joseph Seckinger at Monticello.

27. Ibid. The author personally observed the tornado emergency and subsequent recovery operations at both Nashville and Louisville.

28. U.S. Army Engineer Division, Ohio River, "News Release," 10 Mar., 10 Apr., and 10 May 1975 in PAOF; the author reconnoitered the flood situation in the vicinity of Paducah and photographed it at crest stage.

29. See note 28.

30. Lt. Col. Walter K. Wilson, III, "Remarks and Presentation, IG Inspection," 9 Jan. 1978, in PAOF; Paducah *Sun-Democrat*, 18 Aug. 1976.

31. Lt. Col. Walter K. Wilson, III, "Remarks and Presentation, IG Inspection," 9 Jan. 1978, in PAOF.

32. Ibid.; U.S. Army Engineer Division, Ohio River, *Summary Report of the Ohio River Division Ice Committee* (Cincinnati: U. S. Army Engineer Division, 1978), summarizes the history of ice conditions on the Ohio River during the past century.

33. *Louisville Times*, 19 Jan. 1977; Columbus, OH, *Capitol Times*, 26 Jan. 1977; Owensboro, KY, *Messenger & Inquirer*, 20 Jan. 1977.

34. Martin K. Pedigo, "Winter of '77: Ice on the Ohio," *Water Spectrum* 9 (Spring 1977):30-36.

35. Ibid.

36. Louisville *Courier-Journal*, 4 Feb. 1977.

37. Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 3 Mar. 1977, in LDHF; *Louisville Times*, 7 Feb. 1977.

38. Norman R. Gilley, "Report on Emergency Snow Removal in State of Indiana in February 1977" (undated afteraction report in PAOF).

39. Louisville District, *Information Bulletin*, Feb. and Mar 1977; Charles A. Schumann, "Chronology, Ice '77" (undated manuscript in PAOF).

40. Louisville *Courier-Journal*, 27 Jan. 1977; Brig. Gen. E. R. Heiberg, III, to Lt. Gen. John W. Morris, 25 Mar. 1977, in LDHF.

41. Louisville District, *Information Bulletin*, Apr. 1977; see also Kentucky, Department of Natural Resources, Division of Water Resources, *The Floods of April* (Frankfort: Division of Water Resources, 1977).

42. U. S. Army Engineer District, Louisville, *After Action Report: April 1977 Southeastern Kentucky Flood Disaster* (Louisville: U.S. Army Engineer District, 1978), pp. 1-5, 10-11.

43. Ibid.

44. Ibid.; Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 31 May 1977, in LDHF.

45. Louisville District, *Information Bulletin*, June and Aug. 1977.

46. Interview, author with Martin K. Pedigo, Louisville, KY, 25 Aug. 1983; Connersville, IN, *News Examiner*, 2 Feb. 1978; U.S. Army Engineer District, Louisville, *Falls City Engineer* (brief inhnouse monthly publication; Louisville: U.S. Army Engineer District, 1978-1983, cited hereafter as Louisville District, *Falls City Engineer*), Jan. and Feb. 1978.

47. Jeffersonville, IN, *Jeffersonville Evening News*, 28 Jan. 1978; U.S. Army, Office of the Chief of Engineers, *Engineer Update* (monthly inhouse publication: Washington, DC: Office of the Chief of Engineers, 1976-1983, cited hereafter as Office of the Chief of Engineers, *Engineer Update*), May 1978, p. 3.

48. Muncie, IN, *Muncie Press*, 2 Feb. 1978; Poseyville, IN, *Posey County News*, 9 Feb. 1978.

49. *Louisville Times*, 31 Jan. 1978; Col. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, 26 May 1978, in LDHF.

50. *Evansville Press*, 11 Feb. 1978; Charles A. Schumann, "PAO Master File: Markland Incident, 1978" in PAOF.

51. Col. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, 5 Dec. 1977, in LDHF.

52. Louisville *Courier-Journal*, 23 Jan. 1978.

53. Office of the Chief of Engineers, *Engineer Update*, May 1978, p. 3; Louisville *Courier-Journal*, 29-30 Jan. and 30 Mar. 1978.

54. Frankfort, KY, *State Journal*, 1 Feb. 1980; Lawrenceburg, IN, *Dearborn County Register*, 2 Feb. 1978.

55. Louisville *Courier-Journal*, 30 Mar. 1978; *Cincinnati Enquirer*, 5-6 Feb. 1978.

56. *Cincinnati Enquirer*, 5-6 Feb. 1978.

57. Ibid.

58. Ibid.; *Indianapolis News*, 1 Feb. 1978.

59. Charles A. Schumann, "Winter Siege at Markland" (undated television script in PAOF), pp. 1-8.

60. Ibid.; Louisville *Courier-Journal*, 9-12 Feb. 1978.

61. *Cincinnati Enquirer*, 11-13 Feb. 1978, 15 June 1978; Warsaw, KY, *Gallatin County News*, 22 June 1978.

62. Warsaw, KY, *Gallatin County News*, 4 Feb. 1982; Hamilton, OH, *Journal-News*, 29 Jan. 1982; Louisville District, *Falls City Engineer*, June 1979.

63. Warsaw, KY, *Gallatin County News*, 21 Sept. 1979.

CHAPTER V: PLANNING CONTROVERSIES, 1970-1980

1. Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 7 June 1971, in LDHF; Louisville *Courier-Journal*, 16 Feb. 1976. The Moses story was related to the author on several occasions during the 1970s by various District personnel.

2. Col. Charles J. Fiala, "Remarks, Hulman Institute," 6 Nov. 1971, in PAOF.

3. Louisville District, *Information Bulletin*, Aug. 1973; Louisville *Courier-Journal*, 15 July 1973; interview, author with Martin K. Pedigo, Louisville, KY, 25 Aug. 1983.

4. Louisville District, *Information Bulletin*, Aug. 1973; Frenchburg, KY, *Menifee County Journal*, 18 July 1973.

5. Clay City, KY, *Clay City Times*, 19 July and 9 Aug. 1973; Col. Charles J. Fiala to Col. Kenneth McIntyre, 4 Sept. 1973, in LDHF; *Louisville Times*, 19 Sept. 1973; Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 5 Dec. 1973, in LDHF; Louisville *Courier-Journal*, 25 Apr. 1974.

6. Frankfort *State Journal*, 21 Apr. 1974; Governor Wendell Ford to Col. Charles J. Fiala, 20 May 1974, in Box 1175, Records Management Office, U.S. Army Engineer District, Louisville, KY; Whitesburg, KY, *Mountain Eagle*, 22 Aug. 1974.

7. *Louisville Times*, 24 Aug. 1974; Red River Defense Fund, "Help Save Red River," *Cumberland Sierran*, July-Aug. 1974, n. p.; *Lexington Leader*, 10 Feb. 1975.

8. Lt. Col. John E. Moore to Brig. Gen. Wayne S. Nichols, 6 Sept. 1974, in LDHF; transcript of interview with Martin K. Pedigo broadcast on "All Things Considered," 14 Oct. 1974, in PAOF; University of Kentucky, *Kentucky Kernel*, 7 Feb. 1975; *Cincinnati Post*, 2 May 1975.

9. Col. James N. Ellis to Brig. Gen. Wayne S. Nichols, 4 Mar. 1975, in LDHF.

10. U. S. Army Engineer District, Louisville, *Response to Comments by the Council on Environmental Quality on the Final Environmental Impact Statement, Red River Lake Project* (2 vols. Louisville: U.S. Army Engineer District, 1974), passim; *Save Our Red River, et al. v. Corps of Engineers, et. al.*, Civil No. C 74-320, U. S. District Court, Western District of Kentucky, Defense Brief, 5 Dec. 1974, in Box 1175, Records Management Office, U.S. Army Engineer District, Louisville, KY; *Cincinnati Enquirer*, 1 Dec. 1974; Russell W. Peterson to Howard H. Callaway, 24 Jan. 1975, in Box 1175, Records Management Office, U.S. Army Engineer District, Louisville, KY.

11. *Lexington Leader*, 17 Feb. 1975; *Cincinnati Post*, 15 Feb. 1975.

12. Frankfort *State Journal*, 27 Apr. 1975; Louisville *Courier-Journal*, 17 May 1975; Howard H. Callaway to Russell W. Peterson, 27 May 1975, in Box 1175, Records Management Office, U.S. Army Engineer District, Louisville, KY.

13. *Louisville Times*, 22 Feb. 1975; Col. James N. Ellis to Brig. Gen. Wayne S. Nichols, 5 June 1975, in LDHF; Governor Julian Carroll to Col. James N. Ellis, 11 Sept. 1975, in Box 1175, Records Management Office, U.S. Army Engineer District, Louisville, KY; Brig. Gen. E. R. Heiberg, III, to Lt. Gen. William C. Gribble, Jr., 26 Sept. 1975, in LDHF; Lt. Gen. William C. Gribble, Jr. to Brig. Gen. E. R. Heiberg, III, 23 Oct. 1975, in LDHF; U. S., Senate, Committee on Appropriations, *Public Works for Water and Power Development and Energy Research Appropriations Bill, 1976*, Comm. Print. 94-505, 94th Cong., 1st Sess., 1975, pp. 65-66.

14. Charles A. Schumann, "Staff Meeting Flood Notes," 11 Dec. 1978, in PAOF; Louisville District, "News Release," 15 Dec. 1978, in PAOF; Louisville *Courier-Journal*, 11 Dec. 1978; *Cincinnati Post*, 10-11 Dec. 1978.

15. Frankfort *State Journal*, 15 and 22 Dec. 1978, 25 Mar. 1979; Louisville *Courier-Journal*, 17 Dec. 1978.

16. Louisville *Courier-Journal*, 18 Dec. 1978, "Louisville District Situation Report," 13 Dec. 1978, in PAOF.

17. *Lexington Herald*, 17 Aug. 1981; Frankfort *State Journal*, 1 Apr. 1979.

18. Frankfort *State Journal*, 19 Oct. 1980 and 2 Mar. 1981.

19. Ibid., 6 Mar. 1979.

20. Ibid., 31 Jan. 1977, 23 Nov. 1981, 6-7 and 21 May 1982.

21. *Lexington Leader*, 11 Dec. 1978; Louisville *Courier-Journal*, 11, 15 and 20 Dec. 1978; Winchester, KY, *Winchester Sun*, 27 Dec. 1978. Arguments presented by the Sierra Club indicate they thought the project a "boondoggle" because planning had underestimated project costs and environmental impacts while overestimating its value for flood control and recreation. See U.S. Army Engineer District, Louisville, *Final Environmental Impact Statement: Red River Lake Project, Kentucky* (Louisville: U. S. Army Engineer District, 1974), n.p.

22. Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 May 1981, in LDHF.

23. Brig. Gen. Walter P. Leber to Lt. Gen. Walter K. Wilson, Jr., 19 Dec. 1963, in LDHF; Col. Charles J. Fiala, "Presentation to Lt. Gen. William Gribble," 1973, in LDHF.

24. Wabash River Coordinating Committee, *Wabash River Comprehensive Survey* (14 vols. Louisville: U.S. Army Engineer District, 1971), I:passim; Maj. Gen. William L. Starnes, "Remarks to Wabash Valley Association," 10 Feb 1971, in PAOF.

25. U. S. Army Engineer District, Louisville, *Project Maps and Data Sheets*, 2:224, 233-34; see also navigability reports in files of Regulatory Functions Branch, Operations Division, U.S. Army Engineer District, Louisville, KY.

26. Col. Charles J. Fiala to Senator Charles H. Percy, 27 Oct. 1972, in Box 1153, Records Management Office, U.S. Army Engineer District, Louisville, KY; Col. John T. Rhett, Jr., to Chief of Engineering Division, "Lincoln Reservoir," 10 Dec. 1969, in PAOF; "Louisville Lake Pre-Formulation Conference, Nov. 1972" (manuscript minutes in PAOF), passim.

27. Centralia, IL, *Centralia Sentinel*, 29 Aug. 1974; Leo M. Eisel to Col. Charles J. Fiala, 2 May 1974, enclosing copy of congressional committee testimony, in Box 1153, Records Management Office, U.S. Army Engineer District, Louisville, KY; Maj. Walter K. Wilson, III to Governor Daniel Walker, 17 Mar. 1976, in Box 1153, Records Management Office, U.S. Army Engineer District, Louisville, KY.

28. Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 2 June 1972, in LDHF; Decatur, IL, *Decatur Herald*, 11 May 1973; Tuscola, IL, *Tuscola Review*, 24 May 1973; Maj. Gen. William L. Starnes to Lt. Gen. Frederick J. Clarke, 21 June 1973, in LDHF; Col. Thomas P. Nack to Governor James R. Thompson, 20 Nov. 1978 and 14 Mar. 1979, in Box 1153, Records Management Office, U.S. Army Engineer District, Louisville, KY.

29. Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 10 June 1974, in LDHF; Governor James R. Thompson to Col. James N. Ellis, 23 June 1977, in Box 1152, Records Management Office, U.S. Army Engineer District, Louisville, KY; Effingham, IL, *Daily News*, 9 Apr. 1979; Flora, IL, *Daily-News Record*, 20 Mar. 1979; U.S., Congress, Senate, Committee on Appropriations, *Energy and Water Development Appropriations, Hearings, Fiscal Year 1982*, 97th Cong., 1st Sess., 1981, p.311.

30. Johnson, *Falls City Engineers*, pp. 273-74; U. S. Army Engineer District, Louisville, *Big Walnut Lake: Special Report on Alternatives* (Louisville: U.S. Army Engineer District, 1972), pp. 1-2; Col. Charles J. Fiala, "Speech at Four Winds," 31 Oct. 1972, in PAOF.

31. Col. James N. Ellis to Senator Birch Bayh, 25 Mar. 1976, in PAOF; Greencastle, IN, *Banner Graphic*, 26 Jan. 1976 and 22 Mar. 1977.

32. Brig. Gen. E. R. Heiberg, III, to Maj. Gen. Ernest Graves, Jr., 16 Jan. 1976, in LDHF; Joseph D. Cloud to Col. Thomas P. Nack, 5 Mar. 1980, in Box 975, Records Management Office, U.S. Army Engineer District, Louisville, KY; Bloomington, IN, *Herald Times*, 1 Oct. 1978.

33. Lafayette, IN, *Journal and Courier*, 20 Sept. 1966; Attica, IN, *Daily Ledger-Tribune*, 26 Dec. 1966 and 16 July 1967; Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 28 May and 3 Dec. 1971, in LDHF. In his letter of 3 Dec. 1971, Col. Rhett remarked: "As time goes on, we are finding it more and more difficult to separate the true environmental impact from impact upon real estate owned by the people who would use the environmental argument as a reason for stopping a project."

34. Lafayette, IN, *Journal and Courier*, 14 May and 8 Nov. 1973 and 11 Jan. 1975; Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 5 Mar. 1973, in LDHF; Attica, IN, *Daily Ledger-Tribune*, 22 Jan. 1974; Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 5 Mar. and 2 Sept. 1976, in LDHF; Louisville *Courier-Journal*, 22 Feb. 1976.

35. Lafayette, IN, *Journal and Courier*, 29 Jan. 1973; Roy E. Karlen to R. Kerkhoff, 29 Oct. 1974, in PAOF; Col. James N. Ellis to Brig. Gen. Wayne S. Nichols, 5 June 1975, in LDHF; Neal E. Jenkins to Erlena Guzis, 26 Mar. 1976, in Box 1153, Records Management Office, U.S. Army Engineer District, Louisville, KY; Col. James N. Ellis to Chiefs of Divisions, 23 Apr. 1976, in PAOF

36. Lafayette, IN, *Journal and Courier,* 26 Apr. and 22 May 1976; Frankfort, IN, *Frankfort Morning Times,* 21 Feb. 1979; Lafayette, IN, *Lafayette Leader,* 15 Apr. 1982.

37. Col. Willard Roper to Brig. Gen. Walter P. Leber, 9 Jan. 1964, in LDHF; Columbus, IN, *Columbus Republic,* 24 Apr. and 17 May 1972 and 30 Jan. 1975; n. a. "Status Report, June 1973, Clifty Creek Lake, Clifty Creek, Indiana," in Box 1153, Records Management Office, U.S. Army Engineer District, Louisville, KY; Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 4 Mar. 1976 and 3 Mar. 1977, in LDHF; Louisville *Courier-Journal,* 21 Mar. 1979.

38. Col. James N. Ellis to Brig. Gen. Wayne S. Nichols, 4 Mar. 1975, in LDHF; Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 2 Sept. 1976, in LDHF; Col. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, 5 Dec. 1977 and 12 Dec. 1978, in LDHF.

39. U. S. Army Engineer District, Louisville, *Draft Environmental Impact Statement: Big Blue Lake, Big Blue River Basin, Indiana* (Louisville: U.S. Army Engineer District, 1978), pp. 1-199; Greenfield, IN *Greenfield Reporter,* 30 Mar. 1979.

40. Greenfield, IN, *Greenfield Reporter,* 1 June 1979, 7 Feb., 2 Apr., and 31 May 1980; Robert E. Ledford, "Memorandum: Carthage, Indiana, Referendum, 18 April 1979," 20 April 1979, in Box 1152, Records Management Office, U.S. Army Engineer District, Louisville, KY; U.S. Army Engineer District, Louisville, *Phase I Plan Formulation General Design Memorandum: Big Blue Lake, Wabash River Basin* (Louisville: U.S. Army Engineer District, 1979), pp. 1-3; Col. Thomas P. Nack, "Transcript of Remarks at Public Meeting," Greenfield, IN, 27 Mar. 1979, in Box 1152, Records Management Office, U.S. Army Engineer District, Louisville, KY.

41. Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 5 Mar. 1973, in LDHF; Col. Charles E. Eastburn to Jim Jontz, 31 Jan 1983 (copy furnished author by Planning Division, Louisville District); "Presentation by Colonel Charles J. Fiala to the Water Resources Subcommittee, Public Works Committee, United States Senate," Indianapolis, IN, 30 May 1973, in PAOF; Col. Charles J. Fiala, "Wabash Valley Association, Remarks, French Lick, Ind.," 2 Feb. 1973, in POAF.

42. Maj. Gen. William L. Starnes to Lt. Gen. Frederick J. Clarke, 21 June 1973, in LDHF; "Statement from the Indiana Audubon Society, Inc., to the Senate Public Works Committee at the Public Field Hearings on the Proposed Highland Lake Project," 30 May 1973, in PAOF; *Indianapolis Star,* 22 May and 24 July 1976.

43. Bory Steinberg, "Planning Versus Implementation: The Story of the Seventies," *Water Spectrum* 14 (Winter 1981-82): 32-33; Louisvsille *Courier-Journal,* 4 Nov. 1973 and 12 Dec. 1976; Comptroller General of the United States, *Improvements Needed in Making Benefit-Cost Analysis for Federal Water Resource Projects* (Washington, DC: Government Accounting Office Publication 13-167941, 1974), pp. 1-4; Louisville District, *Information Bulletin* , July 1977; U. S., Congress, House, Committee on Appropriations, *Energy and Water Development Appropriations for 1982, Hearings,* 97th Cong., 1st Sess., 1981, p.. 72.

44. Louisville *Courier-Journal,* 29 July 1977; Louisville District, "News Release," Oct. 1977, in PAOF; U.S., Congress, House, Committee on Apppropriations, *Energy and Water Development Appropriations for 1982, Hearings,* 97th Cong., 1st Sess., 1981, p. 123.

45. Greencastle, IN, *Banner Graphic,* 10 Aug. 1979; U. S., Congress, House, Committee on Appropriations, *Energy and Water Development Appropriations for 1982, Hearings,* 97th Cong., 1st Sess., 1981, pp. 1433-34.

VI: PATOKA, CAESAR CREEK, AND TAYLORSVILLE LAKES

1. Martin K. Pedigo to author, 1 Mar. 1983; U. S. Army Engineer District, Louisville, *Grand Lake, St. Marys, Ohio: Survey Report for Flood Control and Allied Purposes* (2 vols. Louisville, U. S. Army Engineer District, 1981) reports on the largest lake in terms of surface area covered within the District; it was built by the State of Ohio about 1840 for canal water supply.

2. *Louisville Times,* 14 Dec. 1963 and 31 Aug 1978; Col. Willard Roper to Brig. Gen. Walter P. Leber, 9 Jan. 1964, in LDHF.

3. Louisville *Courier-Journal,* 21 and 23 July 1974; Louisville District, *Project Maps and Data Sheets,* 2:223.

4. Louisville *Courier-Journal,* 13 Oct. 1974; *Indiana Rural News,* July 1974.

5. Louisville *Courier-Journal,* 23 July 1974.

6. Ibid., 2 Sept. 1974; interview, author with Robert R. Humphreys, Louisville, KY, 24 May 1983.

7. Louisville *Courier-Journal,* 21 July and 13 Oct. 1974 and 12 Apr. 1976.

8. Robert G. Stephens to Tom McCullum, 29 Mar. 1977, in PAOF; New Albany, IN, *New Albany Tribune,* 15 Dec. 1977; Evansville Press, 15 Apr. 1977.

7. Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 6 Sept. 1972, in LDHF; Bloomington, IN, *Herald-Times,* 30 July 1972; Jasper, IN, *Dubois County Daily Herald,* 10 June 1972 and 2 Feb. 1973; *Evansville Courier,* 11 Aug. 1974.

10. Shelbyville, IN, *Shelbyville News,* 17 Dec. 1965.

11. Comptroller General of the United States, *Actions Needed to Improve the Safety of Dams Built by the Bureau of Reclamation and the the Corps of Engineers,* (Washington, DC: Government Accounting Office Publication B-125045, 1977), passim; Frankfort *State Journal,* 9 June 1976.

12. Information supplied by Charles E. Parrish, Historian, Planning Division, Louisville District, 26 Aug. 1983.

13. Morehead, KY, *Morehead News,* 19 July and 23 Aug. 1973; Reginald A. Barron and Charles F. Corns, "Seismic Safety for Dams," *Military Engineer* 63 (July-Aug. 1971):236-38.

14. Ralph B. Peck, "Let's Get It Straight about Those Dams!" *Military Engineer* 70 (Jan.-Feb. 1978):20-23; *Cincinnati Enquirer,* 5 Aug. 1980.

15. Jasper, IN, *Jasper Herald,* 1 Apr. 1977; Chief of Geotechnical Branch to Chief of Design Branch, "Annual Instrumentation Evaluation," in Box 975, Records Management Office, U.S. Army Engineer District, Louisville, KY, Kenneth Robertson, "Monitor Those Dam Movements Precisely!" *Military Engineer* 71 (May-June 1979):182-184.

16. Brig. Gen. E. R. Heiberg, III, to Maj. Gen. Charles McGinnis, "Periodic Inspections Problems in ORD," 12 Sept. 1977, in LDHF; U.S. Congress, House, Committee on Appropriations, *Energy and Water Development Appropriations for 1982, Hearings,* 97th Cong., 1st Sess., 1981, p. 122.

17. Reginald A. Barron and Charles F. Corns, "Seismic

Safety for Dams," p. 238; Jasper, IN, *Dubois County Daily Herald*, 17 Dec. 1973.

18. Louisville *Courier-Journal*, 19 Dec. 1974 and 28 Nov. 1976; Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 5 Mar. 1976, in LDHF; Jasper, IN, *Jasper Herald*, 25 Mar. 1977.

19. Benjamin I. Kelly and Steven D. Markwell, "Seepage Control Measures at Patoka Dam, Indiana," American Society of Civil Engineers, Preprint 3455, ASCE Convention, Chicago, IL, 16-20 Oct. 1978; Col. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, 2 Sept. 1977, in LDHF; *Louisville Times*, 15 and 20-21 Aug. 1980; Louisville *Courier-Journal*, 22 June 1979; Jasper, IN, *Jasper Herald*, 19 May 1981.

20. *Indianapolis Star*, 3 Oct. 1971; Vincennes, IN, *Vincennes Sun-Commercial*, 11 July 1976.

21. *Evansville Courier*, 15 Feb. and 17 Dec. 1980; Princeton, IN, *Daily Clarion*, 4 Nov. 1980; Col. Charles E. Eastburn, "Briefing to Honorable William R. Gianelli," n. d. [Nov. 1981], in LDHF.

22. Jasper, IN, *Jasper Herald*, 25 Sept. 1981.

23. Princeton, IN, *Daily Clarion*, 20 Oct. 1981; Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 30 Sept. 1981, in LDHF; interview, author with Lum Whittern and Richard Coleman, Patoka Lake, IN, 26 May 1983; data supplied by David Beatty, Hydraulics and Hydrology Branch, Louisville District.

24. J. E. Carnahan, "Address at Groundbreaking," 9 Oct. 1971, in PAOF.

25. Col. R. R. Wessels to Brig. Gen. Willard Roper, 7 Aug. 1967, in LDHF; *Cincinnati Enquirer*, 25 Feb. 1973.

26. John Baskin, *New Burlington: The Life and Death of An American Village* (New York: New American Library, 1977, reprint of 1976 ed. by W. W. Norton and Company), pp. ix-xi.

27. James E. Carnahan, *History of Blanchester, Ohio, with Addenda* (Evansville, IN: Unigraphic, Inc., 1979), p. 319.

28. J. E. Carnahan, "Address at Groundbreaking," 9 Oct. 1971, in PAOF; Louisville District, *Information Bulletin*, Sept. 1971; Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 5 June 1973, in LDHF.

29. Lebanon, OH, *Western Star*, 23 May 1973; *Cincinnati Post*, 20 July 1973; *Cincinnati Enquirer*, 25 Aug. 1973; Col. Charles J. Fiala to Col. Kenneth E. McIntyre, 4 Sept. and 5 Dec. 1973, in LDHF; Dayton, OH, *Dayton Daily News*, 16 Sept. 1973.

30. Lebanon, OH, *Western Star*, 9 Jan. 1974 and 26 Feb. 1975; Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 10 June 1974; *Cincinnati Post*, 19 Mar. 1977.

31. Col. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, 5 Dec. 1977, in LDHF; Louisville District, "History of Louisville District, April 1968," counsel section, n. p.

32. Col. James N. Ellis, "Address to Louisville Chapter, Federal Bar Association," 23 June 1977, in PAOF.

33. Office of Senator William Proxmire, "News Release," 22 Dec. 1976, in PAOF; Dayton, OH, *Dayton Daily News*, 5 Jan. 1977; Robert W. Teater to Sen. William Proxmire, 24 Jan. 1977, in PAOF.

34. Brig. Gen. E. R. Heiberg, III, to Maj. Gen. Ernest Graves, Jr., 16 Jan. 1976, in LDHF; James E. Carnahan, *History of Blanchester, Ohio*, p. 294; Col. Thomas P. Nack to Col. Myron D. Snoke, 28 Sept. 1978, in LDHF.

35. Theodore J. Karamanski, "History as an Empowering Force in Cultural Resource Management," *Public Historian* 2 (Spring 1980):71-76; Ronald W. Johnson, "The Historian and Cultural Resource Management," *Public Historian* 3 (Spring 1981): 43-51; *Louisville Times*, 5 Jan. 1978; interview, author with Charles Parrish, Louisville, KY, 10 Mar. 1982.

36. Interview, author with Charles Parrish, Louisville, KY, 10 Mar. 1982; "Louisville District News Release," 27 July 1982, in PAOF.

37. *Louisville Journal*, 19 Mar. 1841; Shelbyville, KY, *Sentinel-News*, 16 Feb. 1978; Louisville District, *Project Maps and Data Sheets*, 2:227.

38. Louisville *Courier-Journal*, 19 Sept. 1971; Col. John T. Rhett, Jr., to Maj. Gen. Willard Roper, 9 Mar. 1970, in LDHF.

39. Col. Charles J. Fiala to Judge Jesse Kelien, 6 Sept. 1973, in PAOF.

40. Taylorsville, KY, *Spencer Magnet*, 13 Sept. 1973 and 13 June 1974; Louisville *Courier-Journal*, 15 Nov. 1974; Shepherdsville, KY, *Pioneer News*, 13 Sept. 1973; *Louisville Times*, 20 July 1974.

41. "Louisville District News Release," 26 Feb. 1976, in PAOF; U.S. Army Engineer District, Louisville, "Taylorsville Lake, Ky., Supplement" (bound manuscript in Louisville District Technical Library, 1976), passim.

42. *Louisville Times*, 9 Jan. 1978; Louisville *Courier-Journal*, 22 Feb. 1976.

43. Louisville District, *Information Bulletin*, Apr. 1976; Louisville *Courier-Journal*, 12 Apr. 1976.

44. U.S. Army Engineer District, Louisville, *Final Updated Environmental Impact Statement, Taylorsville Lake, Salt River Basin* (Louisville: U.S. Army Engineer District, 1978), p. 4-42; *Louisville Times*, 16 Oct. 1975; Louisville *Courier-Journal*, 19 Dec. 1975, 28 Mar. and 19 June 1976, 18 Feb. 1979, and 14 June 1982.

45. Louisville District, *Information Bulletin*, July 1974; Donald L. Basham, "Taylorsville Resident Office Briefing," 22 July 1982, in LDHF.

46. Louisville District, *Falls City Engineer*, Oct. 1978; Taylorsville, KY, *Spencer Magnet*, 23 Nov. 1978; Louisville *Courier-Journal*, 13 Dec. 1977.

47. Colonel James N. Ellis to Brig. Gen. E. R. Heiberg, III, 5 Mar. 1976, in LDHF; Col. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, 5 Dec. 1977, in LDHF.

48. *Louisville Times*, 22 Feb. 1978; U.S. Army Engineer District, Louisville, *Final Updated Environmental Impact Statement, Taylorsville Lake, Salt River Basin*, passim.; Brig. Gen. E. R. Heiberg, III, to Lt. Gen. John W. Morris, 30 June 1978, in LDHF.

49. U.S., Congress, Senate, Committee on Appropriations, *Hearings, Public Works for Water and Power Development and Energy Research Appropriations, Fiscal Year 1979*, 95th Cong., 2d Sess., 1978, pp. 1570-1618; John Ed Pearce, "Spencer County," in Louisville *Courier-Journal*, 16 Apr. 1978.

50. Col. Thomas P. Nack to Col. Myron D. Snoke, 28 Sept. 1978, in LDHF; *Louisville Times*, 13 Sept. and 8 Dec. 1978; Mt. Washington, KY, *Star*, 8 Feb. 1979; Louisville District, *Falls City Engineer*, Feb. 1979.

51. Taylorsville, KY, *Spencer Magnet*, 16 Aug. 1979; Lt. Col. Richard C. Bennett, "Opposition Testimony: FY 1980 Appropriations," 25 Apr. 1979, in Box 1153, Records Management Office, U.S. Army Engineer District, Louisville, KY; Louisville *Courier-Journal*, 3 Apr. 1980; Col. Thomas P. Nack to Maj. Gen. Harry A. Griffith, 30 May 1980, in LDHF.

52. Taylorsville, KY, *Spencer Magnet*, 15 May and 17July 1980; *Louisville Times*, 11 June and 15 July 1980; Louisville *Courier-Journal*, 24 July 1979.

53. Louisville *Courier-Journal*, 13 Dec. 1980; interview, author with Gordon M. Stevens, Louisville, KY, 9 Feb. 1983; Taylorsville, KY, *Spencer Magnet*, 1 July 1982.

54. *Louisville Times*, 6 Mar. 1975; Taylorsville, KY, *Spencer Magnet*, 24 Jan. 1980; Lawrenceburg, KY, *Anderson*

County News, 20 Nov. 1980; interview, author with Charles Parrish, Louisville, KY, 21 May 1982.
55. Louisville *Courier-Journal*, 5 Jan. 1983; *Louisville Times*, 29 Mar. 1982; Louisville District, *Falls City Engineer*, July 1983; Taylorsville, KY, *Spencer Magnet*, 26 May 1983.

VII: NAVIGATION MODERNIZATION, 1976–1983

1. Brig. Gen. Willard Roper to Lt. Gen. William F. Cassidy, 27 Dec. 1968, in LDHF; Brig. Gen. Wayne S. Nichols to Lt. Gen. William C. Gribble, Jr., 20 Dec. 1973, in LDHF.
2. n. a., "Dravo Underway with Smithland Locks," *World Dredging and Marine Construction* 7 (Oct. 1971):32; the author attended the groundbreaking ceremony on 25 Sept. 1971.
3. Paducah *Sun-Democrat*, 23 Mar. 1972; Maj. Gen. William L. Starnes to Lt. Gen. Frederick J. Clarke, 21 Sept. 1972, in LDHF; *Louisville Times*, 7 Aug. 1974.
4. Brig. Gen. E. R. Heiberg, III, to Col. James N. Ellis, 5 July 1977, in LDHF; Richard H. Russell to Jack E. Kiper, 1 Oct. 1977, in PAOF.
5. Col. James N. Ellis, "Remarks, Ohio Valley Improvement Association," Cincinnati, OH, 21 Oct. 1977, in PAOF; Paducah *Sun-Democrat*, 27 Sept. 1977 and 12 and 16 Nov. 1978; Lt. Col. Walter K. Wilson, III, "Remarks and Presentation, IG Inspection," 9 Jan. 1978, in PAOF.
6. Golconda, IL, *Herald-Enterprise*, 18 Oct. 1979; Louisville *Courier-Journal*, 28 Oct. 1979; Martin K. Pedigo to Robert R. Skaggs, 1 Nov. 1980, in PAOF; William J. Hull, "Fifty Years on the Ohio," *Water Spectrum* 11 (Fall 1979): 15-23.
7. Golconda, IL, *Herald-Enterprise*, 18 Oct. 1979; Louisville District, *Project Maps and Data Sheets*, 1:46; Paducah *Sun-Democrat*, 28 Oct. 1979.
8. Paducah *Sun-Democrat*, 20 Nov. 1979 and 17 Aug. 1980; Louisville *Courier-Journal*, 27 Feb. 1980.
9. Paducah *Sun-Democrat*, 26-28 Aug. 1980; Louisville *Courier-Journal*, 8 Apr. 1980.
10. Leland R. Johnson, *Engineers on the Twin Rivers: A History of the Nashville District, Corps of Engineers, United States Army* (Nashville: U.S. Army Engineer District, 1978), p. 173; H. B. Vaughan, Jr., "Safety Pays! The Corps of Engineers Proves It," *Military Engineer* 31 (Sept.-Oct. 1939): 363-65.
11. Louisville District, *Falls City Engineer*, Mar. 1982; Col. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, 26 May 1978, in LDHF; n. a., "Weather and a Wild River Sock It to Levee Project," *Construction Digest* (KY, IN and IL), 21 Nov. 1968, n. p. The chiefs of the Louisville District Safety Office have included Robert B. Lorch, Walter S. Worthington, Allen Bailey, and Harold G. Peters; see Louisville District, "History of Louisville District, April 1968," safety section, n. p.
12. Marion, KY, *Crittenden County Press*, 25 Sept. 1980 and 29 Apr. 1982; Col. Joseph A. Yore to Lt. Gen. Joseph K. Bratton, 23 Dec. 1980, in LDHF; Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 Jan 1981, in LDHF.
13. Smithland, KY, *Livingston Ledger*, 26 Nov. 1981; Louisville District, *Falls City Engineer*, Jan. 1982; interview, author with Kenneth Matthews, Pittsburgh, PA, 21 Oct 1981.
14. Maj. Gen. William L. Starnes to Lt. Gen. Frederick J. Clarke, 22 Dec. 1970, in LDHF; Louisville District, *Project Maps and Data Sheets*, 1:48.
15. Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 27 Jan. 1972, in LDHF; Brig. Gen. Wayne S. Nichols to Lt. Gen. William C. Gribble, Jr., 20 June 1974, in LDHF; Louisville District, *Information Bulletin*, July 1974.
16. Col. James N. Ellis to Brig. Gen. Wayne S. Nichols, 4 Mar. 1975, in LDHF; Brig. Gen. E. R. Heiberg, III, to Maj. Gen. Ernest Graves, Jr., 16 Jan. 1976, in LDHF; Metropolis, IL, *Metropolis Planet*, 16 Oct. 1980.
17. Louisville District, *Falls City Engineer*, Jan. 1982; Col. Charles E. Eastburn, "Briefing to Honorable William R. Gianelli," n. d. [Nov. 1981], in LDHF; Paducah *Sun-Democrat*, 26 July 1981; Col. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, "Ohio River Locks and Dams 52 and 53, Reconnaissance Report for Major Rehabilitation," 3 Nov. 1977 (copy in District Technical Library), passim; see also U. S. Army Engineer District, Louisville, *Locks and Dams 52 and 53, Ohio River: Design Memorandum for Major Rehabilitation* (Louisville: U.S. Army Engineer District, 1978).
18. Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 May 1981, in LDHF; Metropolis, IL, *Metropolis Planet*, 29 May 1981; Col. Charles E. Eastburn, "Brief for Lt. Gen. Bratton," 2 Mar. 1981, in LDHF; Brig. Gen. E. R. Heiberg, III, to Lt. Gen. John W. Morris, 28 June 1977, in LDHF.
19. Paducah, *Sun-Democrat*, 5 Jan. 1982; Marion, KY, *Crittenden County Press*, 7 Jan. 1982.
20. Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 8 Sept. 1970, in LDHF; see also William H. Browne, "Effect of Navigation Dams on Banks of Ohio River," and Joseph Hagerty, "Multi-factor Analysis of Bank Caving along a Navigable Stream," in U.S. Army, Office of the Chief of Engineers, Institute for Water Resources, *National Waterways Roundtable, Proceedings, Regional Development, Technology, A Look Ahead* (Fort Belvoir, VA: Institute for Water Resources Report 80-1, 1980), pp. 443-61, 463-93.
21. Brig. Gen. E. R. Heiberg, III, to Lt. Gen. William C. Gribble, Jr., 26 Sept. 1975, in LDHF; Brig. Gen. E. R. Heiberg, III, to Col. James N. Ellis, 5 July 1977, in LDHF; Louisville District, *Information Bulletin*, Oct. 1977; U.S. Army Engineer Division, Ohio River, *Ohio River Basin Erosion Study* (Cincinnati: U.S. Army Engineer Division, 1977), passim; Louisville *Courier-Journal*, 3-4 Dec. 1980.
22. Louisville District, *Information Bulletin*, July 1977 and June 1978; *Louisville Times*, 13 Sept. 1978.
23. Col. Thomas P. Nack to Col. Myron D. Snoke, 28 Sept. 1978, in LDHF; Louisville *Courier-Journal*, 8 Nov. 1979; Marengo, IN, *Hard Times*, 14 Nov. 1979.
24. *Cincinnati Enquirer*, 20 Aug. 1980; *Louisville Times*, 20 Aug. 1980 and 12 Mar. 1981; Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 May 1981, in LDHF.
25. Morgantown, KY, *Green River Republican*, 27 Aug. 1980.
26. *Cincinnati Enquirer*, 1 Apr. 1976; Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 3 Mar. 1977, in LDHF.
27. U.S. Army, Office of the Chief of Engineers, *Interim Report to Congress: The Streambank Erosion Control Evaluation and Demonstration Act of 1974* (Washington, DC: Office of the Chief of Engineers, 1978), pp. E31, E35, and E43; U.S. Congress, House, Committee on Appropriations, *Energy and Water Development Appropriations for 1982, Hearings*, 97th Cong., 1st Sess., 1981, pp. 15, 48-49.
28. Leland R. Johnson, "Definition of Navigable Waters

of the United States: Saline River, Illinois," 28 May 1974, in Regulatory Functions Branch files, Operations Division, U.S. Army Engineer District, Louisville, KY.

29. Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 5 Mar. 1976, in LDHF; U.S. Army Engineer District, Louisville, *Saline River Basin, Illinois: Navigation Improvements* (Louisville: U.S. Army Engineer District, 1978), passim; Louisville District, *Project Maps and Data Sheets,* 3:184.

30. Leland R. Johnson, "Definition of Navigable Waters of the United States: Wabash River, Indiana, Illinois, and Ohio," 15 May 1974, in Regulatory Functions Branch files, Operations Division, U.S. Army Engineer District, Louisville, KY; Johnson, *Falls City Engineers,* pp. 138-42.

31. Johnson, *Falls City Engineers,* pp. 240-42; Mt. Carmel, IL, *Wabash Valley News,* May 1973.

32. Louisville *Courier-Journal,* 16 May 1976; Brig. Gen. E. R. Heiberg, III, to Lt. Gen. John W. Morris, 17 Dec. 1976, in LDHF; *Evansville Courier,* 30 Nov. 1976; *Evansville Press,* 23 Dec. 1976; Terre Haute, IN, *Star,* 3 Dec. 1976.

33. Johnson, *Falls City Engineers,* pp. 142-47, 241-43.

34. Ibid.; Paducah, *Sun-Democrat,* 7 Dec. 1969; Col. John T. Rhett, Jr., to Senator Marlow W. Cook, 12 May 1971, in PAOF.

35. Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 7 June 1971, in LDHF; Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 5 Dec. 1973, in LDHF; Morgantown, KY, *Green River Republican,* 20 Nov. 1974.

36. Morgantown, KY, *Green River Republican,* 15 June 1977; Louisville District, *Information Bulletin,* Aug. 1977; Greenville, KY, *Greenville Leader,* 10 Aug. 1977.

37. Russellville, KY, *News-Democrat,* 10 Aug. 1978; Central City, KY, *Messenger-Times-Argus,* 19 July 1978; Bowling Green, KY, *Daily News,* 23 Mar. 1979; U.S. Army Engineer District, Louisville, *Green and Barren Rivers, Kentucky: Navigation Study* (Louisville: U.S. Army Engineer District, 1979), passim; Owensboro, KY, *Messenger & Inquirer,* 22 Jan. 1981.

38. Bowling Green, KY, *Daily News,* 27 July 1979 and 31 Mar. 1982; *Louisville Times,* 12 Feb. 1980; Louisville *Courier-Journal,* 2 Feb. 1981.

39. Morgantown, KY, *Green River Republican,* 29 Apr. 1981; Morganfield, KY, *Union County Advocate,* 7 May 1981.

40. Morgantown, KY, *Green River Republican,* 29 Apr. 1981; Bowling Green, KY, *Daily News,* 10 May 1981; Hartford, KY, *Ohio County News,* 15 Oct. 1981; Henderson, KY, *Gleaner & Journal,* 30 Sept. 1981.

41. Henderson, KY, *Gleaner & Journal,* 30 Sept. 1981; Owensboro, KY, *Messenger & Inquirer,* 10 Aug. 1981.

42. Johnson, *Falls City Engineers,* pp. 147-51, 244-46; see also the history of Kentucky River project construction printed as appendix to this volume.

43. *Lexington Leader,* 20 June 1973; Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 5 Mar. 1973, in LDHF; Louisville District, *Information Bulletin,* Apr. 1975; Louisville *Courier-Journal,* 7 Jan. 1975.

44. *Lexington Herald,* 30 June 1977; Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 3 Mar and 31 May 1977, in LDHF; Irvine, KY, *Estill County Citizens Voice & Times,* 7 Aug. 1980.

45. U.S. Army Engineer District, Louisville, *Kentucky River and Tributaries, Upper Kentucky River Navigation Project, Situation Report* (2 vols.; Louisville: U. S. Army Engineer District, 1980), Vol. 2 prints resolutions and corresondence.

46. Ibid., p. 35.

47. Frankfort *State Journal,* 28 Aug. 1980 and 16 Nov. 1981; *Lexington Herald,* 24 Sept. 1980 and 21 Oct. 1981; interview, author with Charles Parrish, Louisville, KY, 10 Mar. 1982; Louisville *Courier-Journal,* 30 June 1983; Col. Charles E. Eastburn, "Briefing for Lt. Gen. Bratton," Cincinnati, OH, 2 Mar. 1982, in LDHF.

48. Nicholasville, KY, *Jessamine County Journal,* 29 Apr. 1982; *Lexington Herald-Leader,* 3 Jan. 1983.

VIII: THE OPERATIONS DIVISION SINCE 1970

1. Louisville District, "History of Louisville District, April 1968," operations section, n. p.; Pollard, "Organization and Functions, Louisville District," appendix M, n. p. In 1946 the five branch chiefs of Operations Division were: Thomas P. Bailey, Locks and Dams; Ben C. Threlkel, Permits and Commercial Statistics; I. J. Mix, Maintenance and Repair; P. Loveland, Channels; and M. J. Brown, Flood Control Structures.

2. Charles Ellet, Jr., *The Mississippi and Ohio Rivers* (Philadelphia: Lippincott, Grambo and Co., 1853), pp. 305-06.

3. Louisville District, "History of Louisville District, April 1968," operations section, n. p.; interview, author with Ronald Waller, Louisville, KY, 28 June 1983. The five area office chiefs in 1981 were: Ben Schoby, Upper Wabash Area at Marion, Indiana; Lum Whittern, Middle Wabash Area at Bloomington, Indiana; James Pratt, Miami River Area at Waynesville, Ohio; Steven J. Furlong, Green River Area at Leitchfield, Kentucky; and Daniel H. Barett, Upper Kentucky Area at Jackson, Kentucky.

4. U.S. Army Engineer District, Louisville, Organization Chart, Annex C, ER 500-1-1, Sept. 1981 (copy in Records Management Office, U.S. Army Engineer District, Louisville, KY.

5. Richmond, IN, *Palladium-Item,* 5 Dec. 1973, and Peru, IN, *Peru Tribune,* 8 Apr. 1978, print descriptions of reservoir operations; Area Resource Manager for Upper Kentucky Area to Chief of Recreation Resource Branch, 11 Apr. 1975, in PAOF; Noah Whittle to Neal Jenkins, "DF: Big Blue Lake," 2 Feb. 1979, in Box 1152, Records Management Office, U.S. Army Engineer District, Louisville, KY; interview, author with Lum Whittern and Richard Colman, Patoka Lake, IN, 26 May 1983; interview, author with Steven Lee, Caesar Creek Lake, OH, 5 Oct. 1983.

6. See note 5; interview, author with David Zagurny, William H. Harsha Lake, 6 Oct. 1983.

7. See note 5 and Louisville District, *Information Bulletin,* Nov. 1969.

8. Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 30 Sept. 1981, in LDHF; interview, author with Deborah Chenoweth, Caesar Creek Lake, 5 Oct. 1983.

9. Frederick Huelson to Noah Whittle, "Bound Lifting Beam, Brookville Lake," 8 Mar. 1977, in Box 975, Records Management Office, U.S. Army Engineer District, Louisville, KY; Noah Whittle to Ken Mathews, 13 Mar. 1980, in ibid.; interview, author with Steven Lee, Caesar Creek Lake, 5 Oct. 1983.

10. Louisville *Courier-Journal,* 21 Mar. 1974; interview, author with Charles Parrish, Louisville, KY, 21 May 1982.

11. Louisville District, *Information Bulletin,* Oct. 1971; Col. John T. Rhett, Jr., to Brig. Gen. William L. Starnes, 3 Dec. 1971, in LDHF; Louisville District, *Falls City Engineer,* June 1978.

12. Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 1 Dec. 1976, in LDHF; Col. Thomas P. Nack, "Briefing for Secretary Hildebrand," 1 Nov. 1977, in PAOF; Louisville *Courier-Journal,* 15 June 1979.

13. Lt. Col. George Shields to Cong. Carl Perkins, 21 July 1971, in PAOF. The author discussed sedimentation with engineers and dredging experts and personally inspected 19th century milldams and small hydropower dams that were abandoned by their owners and allowed to fill with sediment. After sediment consolidation, the reservoirs had become flat grasslands with streams meandering across the surface and cascading down the dam masonry.

14. Maj. Gen. William L. Starnes, "Remarks, Reservoir Management Seminar, Pipestem State Park, W. Va.," 26 Jan. 1971 (copy supplied author by Ohio River Division); Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 2 June 1972, in LDHF.

15. Maj. Gen. William L. Starnes, "Remarks, Reservoir Management Seminar, Pipestem State Park, W. Va.," 26 Jan. 1971; U. S., Congress, House, Committee on Appropriations, *Energy and Water Development Appropriations for 1982,* 97th Cong., 1st Sess., 1981, p. 260; data on visitation supplied by Ronald Waller, Assistant Chief of Natural Resources Branch, U.S. Army Engineer District, Louisville, KY.

16. Maj. Gen. William L. Starnes, "Remarks, Reservoir Management Seminar, Pipestem State Park, W. Va.," 26 Jan. 1971.

17. Campbellsville ,KY, *Central News-Journal,* 29 July and 13 Dec. 1976; *Lexington Herald,* 26 Aug. 1976; Hazard, KY, *Herald Voice,* 10 Apr. and 1 Oct. 1981. In the spring of 1981 cleanup effort, sixty cubic yards of litter was collected at Rough River Lake, eleven loaded 2.5-ton trucks at Carr Fork Lake, and over 2,000 filled garbage bags at Cave Run Lake.

18. Col. John T. Rhett, Jr., to Maj. Gen. Willard Roper, 5 Sept. 1969, in LDHF; Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 6 Sept. 1971, in LDHF; Lebanon, OH, *Western Star,* 10 May 1972, quoting Charles Schumann; Campbellsville, KY, *Central News-Journal,* 2 June 1980, quoting Ed Benningfield; Col. Thomas P. Nack to Maj. Gen. Louis W. Prentiss, Jr., 1 June 1979, in LDHF.

19. Col. Willard Roper to Brig. Gen. Walter P. Leber, 8 Apr. 1966, in LDHF; Cadiz, KY, *Cadiz Record,* 27 June 1974, Taylorsville, KY, *Spencer Magnet,* 22 Apr. 1982.

20. Louisville District, *Information Bulletin,* June 1972; Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 6 Sept. 1972; in LDHF; Brig. Gen. Wayne S. Nichols to Lt. Gen. William C. Gribble, Jr., 26 June 1975, in LDHF; Col. James N. Ellis to Brig. Gen. Wayne S. Nichols, 5 June 1975, in LDHF; Col. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, 2 Sept. 1977, in LDHF.

21. Campbellsville, KY, *Central News-Record,* 13 Dec. 1976; Col. James N. Ellis to Brig. Gen. Wayne S. Nichols, 5 June 1974, in LDHF.

22. *Indianapolis Star,* 28 July 1974; Louisville *Courier-Journal,* 23 June 1974.

23. Col. James N. Ellis to Brig. Gen. Wayne S. Nichols, 5 June 1974, in LDHF; Col. Thomas P. Nack to Maj. Gen. Harry A. Griffith, 30 Jan. 1980, in LDHF; Carlisle, KY, *Carlisle Mercury,* 29 Apr. 1982.

24. Leland R. Johnson, "The Contest of 1824," *Military Engineer* 65 (May-June 1973): 164-71; Leland R. Johnson, "The Contract of 1824," *Military Engineer* 65 (July-Aug. 1973):252-57; Johnson, *Falls City Engineers,* pp. 181-82, 232.

25. Johnson, *Falls City Engineers,* p. 232; Louisville District, "History of Louisville District, April 1968," operations section, n. p.

26. Louisville District, *Information Bulletin,* Dec. 1972 and June 1978; *Evansville Press,* 18 Oct. 1973 and 24 Oct. 1974; Col. James N. Ellis, "Remarks, Ohio Valley Improvement Association," Cincinnati, OH, 21 Oct. 1977, in PAOF.

27. Louisville District, *Information Bulletin,* Apr. 1975, Mar. 1976, Jan. 1977, Mar. 1977, Apr. 1977. Bill Berkman, navigation section chief during the 1970s and history buff who made his own flintlock rifles and often participated in frontier reenactments, was responsible for the interesting bicentennial series of river navigation charts with artwork on their covers and historical narrative within.

28. Louisville District, *Information Bulletin,* Apr. 1978; Col. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, 26 May 1978, in LDHF; Tell City, IN, *Tell City News,* 2 Sept. 1981; Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 Jan. 1981, in LDHF.

29. Johnson, *Falls City Engineers,* p. 232; Louisville District, "History of Louisville District, April 1968," operations section, n. p.

30. Louisville District, "History of Louisville District, April 1968," operations section, n. p.; Pollard, "Organization and Functions, Louisville District," appendix M; Greenville, KY, *Greenville Leader,* 2 Aug. 1978.

31. Col. John T. Rhett, Jr., to Maj. Gen. Willard Roper, 9 June 1970, in LDHF; Louisville District, *Information Bulletin,* Apr. 1975, Mar. 1982, Apr. 1982.

32. Nicholasville, KY, *Jessamine County Journal,* 24 June 1976; Winchester, KY, *Winchester Sun,* 13 Sept. 1976.

33. Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 8 Sept. 1975, in LDHF; Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 30 Sept. 1981, in LDHF; Brig. Gen. R. S. Kem to Col. Charles E. Eastburn, 18 Nov. 1981, in LDHF; Louisville District, *Falls City Engineer,* May 1978.

34. *Evansville Courier,* 2 Jan. 1975.

35. Ibid. As listed by the District organization chart for 1944, the Ohio River lockmasters in the District were: Peter B. English at 41; Raymond D. Frost, 43; Thomas J. Reid, Jr., 44; Kenneth C. Coleman, 45; Tony C. Rouse, 46; Arnold J. Bailey, 47; Shirly Cook, 48, Roy H. Hape, 49; William D. Hatcher, 50; George F. Hollis, 51; Daniel A. Wilder, 52; and Leonard Vanzant, 53. Each had supervision of seventeen employees except English at 41 who had thirty-two.

36. Louisville *Courier-Journal,* 24 Aug. 1981; *Evansville Press,* 15 Dec. 1978; Paducah *Sun-Democrat,* 21 July 1980; Marion, KY, *Crittenden County News,* 8 Apr. 1982.

37. See accounts by reporter Bill Powell in Paducah *Sun-Democrat,* 10 Aug. 1978, Louisville *Courier-Journal,* 25-30 Sept. and 5 Oct. 1978.

38. See note 37.

39. Louisville *Courier-Journal,* 5 Oct. 1978.

40. Ibid., 11 Aug. 1980.

41. Brig. Gen. Wayne S. Nichols to Lt. Gen. William C. Gribble, Jr., 25 Mar. 1974, in LDHF; *Evansville Courier,* 29 Mar. 1981, prints an interview with Lockmaster Randall Priest.

42. *Louisville Times,* 27 Aug. 1971 (interview with Lockmaster James Davis); *Evansville Press,* 20 Dec. 1976 (interviews with Lockmasters Earl McCrady and Harry Cummings); Louisville *Courier-Journal,* 18 June 1982 (interview with Lockmaster Joseph Rumage).

43. Louisville District, *Information Bulletin,* Feb. 1973.

Covington, KY., *Post & Times Star,* 19 Feb. 1981 (interview with Lockmaster Carroll Sheldon).

44. Louisville District, *Falls City Engineer,* Jan. 1979.

45. The author witnessed the events mentioned; they also were described in newspapers at port cities and in issues of the *S&D Reflector,* journal of the Sons and Daughters of Pioneer Rivermen at Marietta, OH. For the voyage of the generator station, see *Evansville Courier,* 22 July 1981, and the note in *Engineering News-Record* 207 (10 Sept. 1981):14.

46. Col. Rhett was quoted in *Evansville Courier,* 31 Jan. 1972.

47. Reports by James Nutter, executive director of the Kentucky Port and River Development Commission, were printed in Pikeville, KY, *Appalachian News-Express,* 8 Oct. 1981, and Shively, KY, *Shively Newsweek,* 9 Aug. 1979; see *Waterways Journal,* 13 Mar. 1982, p. 22, and *Evansville Press,* 22 Jan. 1982 describing the riverport at Mt. Vernon, IN.

48. Anthony L. Kucara, "Constraints Threaten Barge Industry," *Water Spectrum* 13 (Spring 1981):23-29; Louisville *Courier-Journal,* 16 Sept. 1979; Madison, IN, *Madison Courier,* 24 Nov. 1979; *Evansville Courier,* 29 Mar. 1981.

49. *Evansville Courier,* 29 Mar. 1981; T. R. Reid, *Congressional Odyssey: The Saga of a Senate Bill* (San Francisco: W. H. Freeman & Co., 1980), traced the legislative history of the waterways user fee. Other studies of federal waterways policies are: William J. Hull and Robert W. Hull, *The Origin and Development of the Waterways Policy of the United States* (Washington, DC: National Waterways Conference, 1967), and National Waterways Foundation, *U. S. Waterways Productivity: A Private and Public Partnership* (Huntsville, AL: Strode Publishers, 1983).

50. *Cincinnati Post,* 20 Feb. 1982.

51. Note in *Engineering News* 57 (2 May 1907):487.

52. Albert E. Cowdrey, "Pioneering Environmental Law: the Army Corps of Engineers and the Refuse Act," *Pacific Historical Review* 44 (Aug. 1975):331-49; Johnson, *Falls City Engineers,* pp. 270-72; Leland R. Johnson, *Men, Mountains and Rivers: An Illustrated History of the Huntington District, U.S. Army Corps of Engineers* Huntington: U.S. Army Engineer District, 1977), pp. 263-68; Leland R. Johnson, *The Headwaters District: A History of the Pittsburgh District, U. S. Army Corps of Engineers* (Pittsburgh: U. S. Army Engineer District, 1979), pp. 294-99; Leland R. Johnson, *Engineers on the Twin Rivers: A History of the Nashville District, Corps of Engineers, United States Army* (Nashville: U. S. Army Engineer District, 1978), pp. 245-46.

53. Lt. Gen. Frederick J. Clarke, "Remarks to ASCE Water Resources Conference, Atlanta, Ga.," 24 Jan. 1972, in PAOF; Col. Charles J. Fiala, "Speech to Propeller Club," Cincinnati, OH, 16 Oct. 1974, in PAOF.

54. Lt. Gen. Frederick J. Clarke, "Remarks, Engineer Dinner, Fort Belvoir, Va.," 4 May 1973, in PAOF; Louisville District, *Information Bulletin,* June 1971; Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 6 Dec. 1972, in LDHF.

55. *Washington Post,* 28 Mar. 1975; Office of the Chief of Engineers, "Minutes: Environmental Advisory Board Meeting, 20-21 May 1975, Huntington District," in Box 1175, Records Management Office, U.S. Army Engineer District, Louisville, KY; *National Resources Defense Council, Inc., et al. v. Callaway,* 392 F. Supp. 685 (D.D.C., 1975).

56. Brig. Gen. Wayne S. Nichols to Maj. Gen. John W. Morris, 4 Jan. 1974, in LDHF; Col. James N. Ellis to Brig. Gen. Wayne S. Nichols, 5 June 1975, in LDHF. The author performed the historical studies under contract to the District.

57. *United States v. The Joint Allen, Huntington, Wells and Whitley County Drainage Board,* Civil No. F 75-52, U.S. District Court for the Northern District of Indiana, Fort Wayne Division; Decision of United States Court of Appeals for the Sixth Circuit, Case No. 81-3242, *Miami Conservancy District v. Clifford L. Alexander, et. al.,* 12 Nov. 1982; Carl M. Becker, "Professor for the Plaintiff: Classroom to Courtroom," *Public Historian* 4 (Summer 1982):69-77; Leland R. Johnson, "Public Historian for the Defense," *Public Historian* 5 (Summer 1983):65-76. The author served as witness in both cases mentioned.

58. Louisville District, *Information Bulletin,* Mar. 1976; Col. Charles J. Fiala, "Speech to Propeller Club," Cincinnati, OH, 16 Oct. 1974, in PAOF; *Evansville Press,* 29 Sept. 1980.

59. Office of the Chief of Engineers, *Engineer Update,* June 1982, p. 10; U.S., Congress, House, Committee on Appropriations, *Energy and Water Development Appropriations for 1982,* 97th Cong., 1st Sess., 1981, pp. 1432-33; Col. Charles E. Eastburn, "Briefing for Lt. Gen. Bratton," Cincinnati, OH, 2 Mar. 1982, in LDHF.

60. Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 4 June 1976, in LDHF; Jeffersonville, IN, *Jeffersonville Evening News,* 22 Dec. 1978.

61. Jeffersonville, IN, *Jeffersonville Evening News,* 22 Dec. 1978 and 13 June 1980; Louisville *Courier-Journal,* 22 Oct. 1981.

62. Louisville *Courier-Journal,* 3 July 1982.

63. Ibid.; Col. Thomas P. Nack to Maj. Gen. Harry A. Griffith, 30 Jan. 1980, in LDHF.

64. John F. Wall, "A Challenge to the Corps of Engineers," *Military Engineer* 75 (July-Aug. 1983):328.

IX: MISSION DIVERSIFICATION

1. George A. Rebh, "Postal Construction and the Price of Postage Stamps," *Military Engineer* 64 (July-Aug. 1972):262-65.

2. Ibid.; Brig. Gen. George A. Rebh to Maj. Gen. William L. Starnes, 27 Jan. 1972, in LDHF.

3. Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 8 Sept. and 3 Dec. 1971 and 6 Mar. 1972, in LDHF; Louisville District, *Information Bulletin,* Feb. 1974.

4. Col. John T. Rhett, Jr., "Remarks for Awards Luncheon," 19 June 1972, in PAOF; Max Bohrer, "Substance of Remarks Made by MG Koisch, Command Inspection," 10 Nov. 1971, in PAOF; Col. Charles J. Fiala, "Remarks, OVIA Meeting," 12 Oct. 1972, in PAOF; Lt. Gen. Frederick J. Clarke, "Remarks, Division Engineers Conference," 3 May 1972, in PAOF.

5. Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 6 Sept. and 6 Dec. 1972 and 5 Mar. 1973, in LDHF.

6. Interview, author with Joseph Theobald, Louisville, KY, 8 Feb. 1983; Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 5 June 1973, in LDHF.

7. Col. Charles J. Fiala to Col. Kenneth E. McIntyre, 4 Sept. 1973, in LDHF; Col. Charles J. Fiala, "OVIA Presentation," 26 Oct. 1973, in PAOF; Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 5 June 1973; in LDHF.

8. Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 5 Dec. 1973, in LDHF; Brig. Gen. E. R. Heiberg, III, to Lt.

Gen. William C. Gribble, Jr., 26 Sept 1975, in LDHF; Lt. Gen. Frederick J. Clarke, "Remarks, Engineer Dinner, Fort Belvoir, Va.," 4 May 1973, in PAOF. When the postal construction mission came to the District in 1971, bringing with it new employees and internal reorganizations, it became the responsibility of the Office of Administrative Services to secure office space and furnishings for the new employees, ship the records in and out, and handle many other tasks the postal mission generated. As the mission arrived in 1971, James Mitchell, who served as chief of the Office of Administrative Services until 1972, handled the office reorganization within the District. Roy P. Germano, chief of the Office of Administrative Services from 1972 to 1980, handled internal reorganization when the postal mission ended and also during several other brief missions the District undertook during the 1970s. Mary R. Best, who succeeded Germano in 1981, met a similar challenge when military construction returned to the District. A number of changes within the Office of Administrative Services after 1970 are worthy of historical note: In 1977, the office absorbed the District's Security Office, previously headed by Louis R. Thompson and Allard M. Sanders, and the District's Technical Library, which had been established in 1974 with Jean Stephenson, Edna Lenz, and Douglas Blunk serving successively as librarian. The District's Visual Aids Branch headed by Engene Corn merged in 1980 with the reproduction section to become the Reprographics Branch, responsible for producing both graphic and printed information for the District. During the 1970s the District's Records Management Office began microfilming records, starting with hydrologic data; and on November 10, 1977, a Word Processing Center was created to centralize the output of written communications. From 1970 through 1983, the District's Automatic Data Processing Center, headed by Edward G. Metka, succeeded in 1977 by Charles R. Gowin, handled increasing applications of computers for engineering data analysis and other purposes.

9. Elizabeth B. Drew, "Dam Outrage: The Story of the Army Engineers," in Stephen E. Ambrose and James A. Barber, Jr., eds., *The Military and American Society: Essays & Readings* (New York: Macmillan Publishing Co., Inc., 1972), 294-95; U. S. Army, Office of the Chief of Engineers, *The Urban Studies Program of the Army Corps of Engineers* (Washington, DC: Office of the Chief of Engineers, 1972), passim; Col. John T. Rhett, Jr., to Maj. Gen. Willard Roper, 5 Sept. 1969, in LDHF.

10. U. S. Army, Office of the Chief of Engineers, Institute for Water Resources, *Urban Studies Evaluation Program* (Fort Belvoir, VA; Institute for Water Resources, 1977), passim.

11. Col. John T. Rhett, Jr., to Maj. Gen. William L. Starnes, 3 Dec. 1971, in LDHF; Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 5 Dec. 1973, in LDHF; Frankfort *State Journal*, 8 Nov. 1973.

12. Col. Charles J. Fiala, "OVIA Presentation," 26 Oct. 1973, in PAOF; Col. James N. Ellis to Brig. Gen. Wayne S. Nichols, 5 June 1973, in LDHF.

13. Nicholasville, KY, *Jessamine County Journal*, 5 Oct. 1978; Frankfort *State Journal*, 11 Sept. 1978; U.S. Army Engineer District, Louisville, *Metropolitan Lexington Urban Study: Water Resources Analysis* (Louisville: U.S. Army Engineer District, 1978), passim.

14. Brig. Gen. Wayne S. Nichols to Maj. Gen. John W. Morris, 4 Jan. 1974, in LDHF; Maj. Gen. John W. Morris to Brig. Gen. Wayne S. Nichols, 12 July 1974, in LDHF; interview, author with Neal Jenkins, Louisville, KY. 26 Aug. 1983.

15. *Indianapolis Star*, 18 Sept. 1977; Office of the Chief of Engineers, *Engineer Update*, Aug. 1983, p. 6; Louisville *Courier-Journal*, 20 Apr. 1980.

16. Col. Thomas P. Nack, "Briefing for Secretary Hildebrand," 1 Nov. 1977, in PAOF; Louisville *Courier-Journal*, 27 Feb. 1975.

17. Col. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, 26 May 1978, in LDHF; Col. Thomas P. Nack to Col. Myron D. Snoke, 28 Sept. 1978, in LDHF; Louisville District, *Falls City Engineer*, Apr. and Dec. 1978.

18. Interview, author with Richard Schleicher, Louisville, KY, 9 Feb. 1983; Col. Thomas P. Nack to Maj. Gen. Harry A. Griffith, 27 Sept. 1979 and 30 Jan. 1980, in LDHF; Col. Charles E. Eastburn, "Speech to Ft. Knox Rotary Club," 15 Apr. 1982, in LDHF. The largest military construction contract ever awarded by the Corps was for about $270 million worth of work at Arnold Engineering Development Center, Tullahoma, Tennessee, during the 1970s.

19. Nashville *Tennessean*, 6 Feb. 1983; Brig. Gen. R. S. Kem to Lt. Gen. Joseph K. Bratton, 12 Nov. 1981, in LDHF; Office of the Chief of Engineers, *Engineer Update*, Mar. 1982, p. 1. The Huntington Engineer District was directing some "Superfund" cleanup work in Ohio in 1983.

20. U. S. Army Engineer Division, Ohio River, *Final Summary Report: Inspection and Appraisal of Coal Mine Refuse Banks and Associated Impoundments* (Cincinnati: U.S. Army Engineer Division, 1975), pp. 1-3; Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 6 Sept. 1972, in LDHF; Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 5 Dec. 1973, in LDHF; U.S. Army Engineer District, Louisville, *Final Report: Inspection and Appraisal of Coal Mine Refuse Banks and Associated Impoundments in the Commonwealth of Kentucky* (Louisville: U.S. Army Engineer District, 1974), passim.

21. Col. James N. Ellis to Editor, *Louisville Times*, 23 June 1976; Brig. Gen. E. R. Heiberg, III, to Editor, *Cincinnati Post*, 23 Apr. 1977; Lexington *Herald-Leader*, 9 Sept. 1973; *Indianapolis Star*, 16 Mar. 1977; Robert Norton, "Dam Safety Inspection: A Review." *Military Engineer* 73 (Jan.-Feb. 1981):26-29.

22. *Lexington Herald*, 11 Nov. 1977; "Louisville District News Release," 8 Nov. 1977, in PAOF; *Cincinnati Enquirer*, 16 Dec. 1977.

23. Lt. Col. Walter K. Wilson, III, "Remarks and Presentation, IG Inspection," 9 Jan. 1978, in PAOF; Col. Thomas P. Nack to Col. Myron D. Snoke, 28 Sept. 1978, in LDHF; John F. Wall, "A Challenge to the Corps of Engineers." *Military Engineer* 75 (July-Aug. 1983):330.

24. Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 Jan. and 30 Sept. 1981, in LDHF; Brig. Gen. R. S. Kem to Col. Charles E. Eastburn, 18 Nov. 1981, in LDHF; U. S., Congress, House, Committee on Appropriations, *Energy and Water Development Appropriations for 1982*, *Hearings*, 97th Cong., 1st Sess., 1981, p. 43.

25. Louisville *Courier-Journal*, 18 Apr. 1980; *Louisville Times*, 18 Apr. 1979.

26. Office of the Chief of Engineers, *Engineer Update*, Nov. 1982, p. 7; Spencer, IN, *Spencer Evening World*, 29 June 1981; U.S. Army, Office of the Chief of Engineers, *National Program of Inspection of Non-Federal Dams: Final Report to Congress* (Washington, DC: Office of the Chief of Engineers, 1982), p. viii.

27. Brig. Gen. Wayne S. Nichols to Lt. Gen. William C. Gribble, Jr., 25 Mar 1974, in LDHF; Louisville District, Special Orders No. 3, 28 Feb. 1974, in LDHF; Office of the Chief of Engineers, *Engineer Update*, Mar. 1982, p. 3.

28. Brig. Gen. E. R. Heiberg, III, to Maj. Gen. John W.

Morris, 16 July 1976, in LDHF; Col. Thomas P. Nack to Maj. Gen. Harry A. Griffith, 27 Sept. 1979, in LDHF; *Louisville Times*, 19 May 1978.

29. Brig. Gen. E. R. Heiberg, III, to Maj. Gen. John W. Morris, 17 Dec. 1976, in LDHF; Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 1 Dec. 1976, 3 Mar. and 31 May 1977, in LDHF; Col. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, 2 Sept. and 5 Dec. 1977, in LDHF; Max Bohrer, "FEA Project, Ironton, Ohio," 15 Sept. 1977, in PAOF; Louisville District, *Information Bulletin*, Mar. 1977.

30. *Cincinnati Post*, 26 June 1979; U.S., Congress, House, Committee on Appropriations, *Energy and Water Development Appropriations for 1982, Hearings*, 97th Cong., 1st Sess., 1981, p. 51; D. R. Smith and S. C. Wilhelm, "Reaeration of Hydropower Releases," *Environmental and Water Quality Operational Studies* E-82-3 (Apr. 1982):2-5.

31. Robert N. Janopaul and David C. Miller, "Small Hydro Project Potential at Existing Dams," *Military Engineer* 70 (Sept.-Oct. 1978):318; *Louisville Times*, 4 Jan. 1977; Frankfort, IN, *Morning Times*, 8 Apr. 1978.

32. Louisville *Courier-Journal*, 14 Feb. 1982; *Evansville Courier*, 22 July 1981; Lexington *Herald-Leader*, 8 Mar. 1981.

33. Brig. Gen. R. S. Kem to Lt. Gen. Joseph K. Bratton, 2 July 1981, in LDHF; Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 May 1981, in LDHF.

34. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, 26 May 1978, in LDHF; Col. Thomas P. Nack to Col Myron D. Snoke, 28 Sept. 1978, in LDHF; Lt. Gen. William C. Gribble, Jr., to Brig. Gen. Wayne S. Nichols, 15 May 1974, in LDHF; Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 May 1981, in LDHF; Lebanon, OH, *Western Star*, 21 Jan. 1981.

35. Noah M. Whittle, "Hydropower Addition, Brookville Lake, Indiana," 8 Sept. 1980, in Box 975, Records Management Office, U.S. Army Engineer District, Louisville, KY; interview, author with John J. Speaker, Louisville, KY, 25 May 1983; interview, author with Neal Jenkins, Louisville, KY, 26 Aug. 1983.

36. Interview, author with Neal Jenkins, Louisvile, KY, 26 Aug. 1983; Ralph B. Peck, "Let's Get It Straight About Those Dams!" *Military Engineer* 70 (Jan.-Feb. 1978):22; U.S., Congress, House, Committee on Appropriations, *Energy and Water Development Appropriations for 1982, Hearings*, 97th Cong., 1st Sess., 1981, p. 14.

37. Kenneth H. Baldwin, *Enchanted Enclosure: The Army Engineers and Yellowstone National Park, A Documentary History* (Washington, DC: Office of the Chief of Engineers, 1076), passim; interview, author with Charles Parrish, Louisville, KY, 10 Mar. 1982.

38. Johnson, *Falls City Engineers*, pp. 121-36; Louisville District, *Falls City Engineer*, Apr. 1983.

39. Louisville *Courier-Journal*, 13 Apr. and 17 July 1972; Col. Charles J. Fiala to Maj. Gen. William L. Starnes, 5 June 1973, in LDHF; *Louisville Times*, 8 Dec. 1977.

40. Louisville *Courier-Journal*, 9 Sept. 1978; *Louisville Magazine*, Jan. 1978 (clipping in PAOF).

41. U. S. Army Engineer District, Louisville, *McAlpine Locks and Dam, Ohio River, Study Report Revised* (Louisville: U.S. Army Engineer District, 1979), pp. 1-5; U.S., Department of the Interior, National Park Service, *The Falls of the Ohio: Study of Alternatives* (Washington, DC: Department of the Interior, 1981), pp. 1-10; Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 30 Sept. 1981, in LDHF; Louisville *Courier-Journal*, 16 Dec. 1981; Louisville District, *Falls City Engineer*, Oct. 1982 and Apr. 1983.

42. U. S., Congress, Senate, Committee on Public Works, *Civil Works Program of the Corps of Engineers*, 89th Cong., 2d Sess., 1966, p. 27; Robert E. Ledford to Executive Office, 10 Apr. 1975, in PAOF.

43. n. a. "Congressional Briefing," 3 Oct. 1977, in PAOF; Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 May 1981, in LDHF.

44. Muncie, IN, *Muncie Star*, 27 Aug. 1981. Mr. Ledford in Sept. 1983 corrected the quotation as it had appeared in the *Star*.

45. Ibid.; Col. Thomas P. Nack to Maj. Gen. Harry A. Griffith, 30 Jan. 1980, in LDHF; U. S. Army Engineer District,, Louisville, Continuing Authorities Projects Index Map, 1980; Barbourville, KY, *Mountain Advocate*, 10 Sept. 1981.

46. Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 3 Mar. 1977, in LDHF; Danville, KY, *Advocate-Messenger*, 2 Apr., 10 July, 15 July 1981.

47. Morganfield, KY, *Union County Advocate*, 18 Apr. 1979; *Louisville Times*, 12 Feb. 1980.

48. Muncie, IN, *Muncie Star*, 10 June 1980; F. Douglas Shields, Jr., "Environmental Considerations for Flood Control Channel Modifications," *Environmental & Water Quality Operational Studies* E-81-74 (June 1981):1-6.

49. Col. John T. Rhett, Jr., to Cong. John T. Myers, 13 Nov. 1969, in PAOF; *Cincinnati Post*, 18 May 1977.

50. Col. Willard Roper to Brig. Gen. Walter P. Leber, 6 Apr. 1966, in LDHF; Louisville *Courier-Journal*, 16 July 1967 and 19 Jan. 1969; *Louisville Times*, 5 Sept. 1974; note in *Natural Hazards Observer* 6 July 1982):1-2.

51. Major Gen. Willard Roper to Lt. Gen. Frederick J. Clarke, 25 Mar. 1970, in LDHF; Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 5 Dec. 1974, in LDHF; Col. Charles E. Eastburn to Col. Joseph A. Yore, 29 Sept. 1980, in LDHF; Col. Charles E. Eastburn to Brig. Gen. R. S Kem, 29 May 1981, in LDHF; Louisville District, *Falls City Engineer*, Apr. 1982.

X: MISSIONS OF THE 1980s

1. Col. James N. Ellis, "Remarks, Annual Engineer Day Luncheon," 18 June 1976, in PAOF.

2. Col. James N. Ellis, "Remarks, Awards Day," 16 June 1977, in PAOF; *Evansville Courier and Press*, 20 Feb. 1977; Louisville *Courier-Journal*, 20 Feb. 1977; *Indianapolis Star*, 22 Feb. 1977.

3. *Cincinnati Enquirer*, 29 Feb. 1976; *Cincinnati Post*, 12 Mar. 1977.

4. *Cincinnati Enquirer*, 30 Mar. 1976; *Cincinnati Post*, 30 Mar. and 16 and 20 Apr. 1977.

5. *Cincinnati Enquirer*, 3 and 24 Jan. and 15 Dec. 1978; *Cincinnati Post*, 4 Aug. 1980; Louisville District, *Falls City Engineer*, Oct. 1982; n. a., "Flood Levee Dedicated," *Military Engineer* 75 (Jan.-Feb. 1983):43; Col. Charles E. Eastburn, "Remarks, Dayton Floodwall Dedication," 25 Sept. 1982, in LDHF; Louisville *Courier-Journal*, 19 Nov. 1981.

6. U. S. Army Engineer District, Louisville, *Flood Plain Information: Ohio River, Jefferson County, Kentucky* (Louisville: U.S. Army Engineer District, 1973), passim; Valley Station, KY, *Valley Advertiser*, 14 Dec. 1978; Col. Willard Roper

to Brig. Gen. Walter P. Leber, 9 Apr. 1964, in LDHF; Louisville *Courier-Journal*, 28 Oct. 1973.

7. Louisville District, *Information Bulletin*, Feb. 1974; Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 4 Dec. 1975 and 4 June 1976, in LDHF.

8. Louisville District, *Falls City Engineer*, Nov. 1978 and Jan. 1979; interview, author with Charles Parrish, Louisville, KY, 10 Mar. 1982.

9. Louisville *Courier-Journal*, 19 Aug. 1977; Louisville District, *Information Bulletin*, May and Nov. 1977; Col. Thomas P. Nack to Brig. Gen. E. R. Heiberg, III, 2 Sept. 1977, in LDHF; University of Kentucky, Department of Anthropology, *Excavations at Four Archaic Sites in the Lower Ohio Valley, Jefferson County, Kentucky*(2 vols. Lexington; University of Kentucky, 1979), passim; Brig. Gen. E. R. Heiberg, III, to Col. Thomas P. Nack, 26 Sept. 1977, in LDHF.

10. Valley Station, KY, *Valley Advertiser*, 10 Dec. 1980; data supplied by Construction Division, U.S. Army Engineer District, Louisville, KY.

11. *Evansville Courier*, 21 June 1961; *Evansville Press*, 12 May 1961, 29 July 1970, 25 May and 31 July 1976.

12. *Evansville Courier*, 23 Mar. 1977 and 20 Aug. 1978; Col. Charles J. Fiala, "Address to Evansville Audubon Society," 18 June 1976, in PAOF.

13. *Evansville Courier*, 20 Aug. 1981; *Evansville Press*, 11 Feb. 1982; data supplied by Construction Division, U.S. Army Engineer District, Louisville, KY.

14. *Cincinnati Post*, 15 Apr. 1981; note in *Engineering News* 28 Aug. 1982):179.

15. Louisville District, *Project Maps and Data Sheets*, 3:75; U.S. Army Engineer District, Louisville *Final Environmental Impact Statement: Mill Creek Local Protection Project, Cincinnati, Ohio* (Louisville: U.S. Army Engineer District, 1974), pp. 8-9.

16. U.S. Army Engineer District, Louisville, *Final Environmental Impact Statement: Mill Creek Local Protection Project, Cincinnati, Ohio*, p. 11.

17. Ibid., p. 18; Maj. Gen. Willard Roper to Lt. Gen. Frederick J. Clarke, 5 Jan. 1970, in LDHF; U.S. Army Engineer District, Louisville, *Interim Survey Report on Mill Creek in Southwestern Ohio for Flood Damage Reduction and Recreation* (Louisville: U.S. Army Engineer District, 1970), passim; *Cincinnati Post*, 2 Feb. 1974.

18. *Cincinnati Post*, 12 Oct. 1973; Col. Charles J. Fiala to Brig. Gen. Wayne S. Nichols, 5 Dec. 1973, in LDHF; *Cincinnati Enquirer*, 14 Nov. 1974; Jesse T. Crask, "Meeting of the Evendale Management Association on 13 March 1974," 14 Mar. 1974, in Box 1153, Records Management Office, U.S. Army Engineer District, Louisville, KY; William Leegan to Chief of Engineering Division, "Review of Recreation R.O.W. Lands, Mill Creek, Ohio," 3 Mar. 1975, in Box 1153, Records Management Office, U.S. Army Engineer District, Louisville, KY.

19. *Cincinnati Enquirer*, 24 Apr. 1981 and 3 May 1982; Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 May 1981, in LDHF; *Cincinnati Post*, 15 Apr. 1981; Col. Charles E. Eastburn, "Speech to SAME, Detroit, Mich.," 6 Dec. 1982, in LDHF.

20. Charles Yoe, *The Declining Role of the United States Army Corps of Engineers in the Development of the Nation's Water Resources* (Fort Collins: Colorado State University, 1981), pp. x-xii; Daniel A. Mazmanian and Jeanne Nienaber, *Can Organizations Change: Environmental Protection, Citizen Participation, and the Corps of Engineers* (Washington, DC: The Brookings Institution, 1979), passim; *Washington Post*, 31 July 1981; *Louisville Times*, 28 July 1982. The decline of civil works in the Louisville District was accompanied by personnel and budget reductions. The number of personnel declined from about 1200 in 1970 to less than 900 in 1980, about a twenty-five percent reduction during the decade; further reductions began in 1980 when President Jimmy Carter ordered a "two-for-one" hiring policy and continued on inauguration day, January 20, 1981, when President Ronald Reagan ordered a total freeze on hiring. The District's personnel office, headed from 1968 to 1978 by Henry H. Rinkel and by William E. Nunley after 1978,, presided over the personnel reductions and also a change in the character of District personnel mandated by federal equal employment opportunity legislation. Two District offices were chiefly concerned with budgetary matters: Program Development headed by William H. Schulz and Resources Management, known earlier as the Office of the Comptroller, headed by Wallace I. Stone until 1972, by Thomas M. Filburn from 1972 to 1977, and by Edward Hoagland since 1977. Program Development prepared the yearly spending estimates and Resource Management monitored activities and expenditures of the District to assure they were on schedule and within cost limits.

21. See paper by Robert Grieves, Director of the Kentucky Water Resources Research Institute, printed in Louisville *Courier-Journal*, 31 May 1981; Lt. Gen. Joseph K. Bratton "Speech to OVIA at Pittsburgh," 29 Oct. 1982, quoted in *Waterways Journal*, 6 Nov. 1982.

22. U. S., Congress, House, Committee on Appropriations, *Energy and Water Development Appropriations for 1982, Hearings*. 97th Cong., 1st Sess., 1981, pp. 69-73; Bory Steinberg, "Planning Versus Implementation: The Story of the Seventies," *Water Spectrum* 14 (Winter 1981-82):35-36; Lt. Gen. John W. Morris to Maj. Gen. Louis W. Prentiss, Jr., 16 Jan. 1979, in LDHF.

23. Lt. Gen. William C. Gribble, Jr., to Brig. Gen. Wayne S. Nichols, 18 July 1974, in LDHF; Brig. Gen. E. R. Heiberg, III, to Maj. Gen. Ernest Graves, Jr., 16 Jan. 1979, in LDHF.

24. Col. James N. Ellis to Brig. Gen. E. R. Heiberg, III, 4 Dec. 1975 and 2 Sept. 1976, in LDHF; Brig. Gen. E. R. Heiberg, III, to Col. James N. Ellis, 8 Oct. 1976, in LDHF.

25. Elizabethtown, KY. *Hardin County Enterprise*, 4 Apr. 1974; Col. Thomas P. Nack to Col. Myron D. Snoke, 28 Sept. 1978, in LDHF; Col. Thomas P. Nack to Maj. Gen. Harry A. Griffith, 27 Sept. 1979, in LDHF; Maj. Gen. E. R. Heiberg, III, to Maj. Gen. Harry A. Griffith, 17 Apr. 1980, in LDHF.

26. Col. Thomas P. Nack to Maj. Gen. Harry A. Griffith, 30 Jan. 1980, in LDHF; Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 May 1981 and 30 Sept. 1980, in LDHF.

27. Col. Charles E. Eastburn, "Briefing to Honorable William R. Gianelli," n.d. [Nov. 1981], in LDHF; n. a., "One-Stop Program," undated manuscript in LDHF.

28. Col. Thomas P. Nack to Maj. Gen. Harry A. Griffith, 30 Jan. and 30 May 1980, in LDHF; Col. Charles E. Eastburn to Col. Joseph A. Yore, 29 Sept. 1980, in LDHF.

29. Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 May and 30 Sept. 1981, in LDHF; *Louisville Times*. 4-5 Mar. 1981; Brian J. Bobo, "Federal Disaster Assistance, Louisville Sewer Explosion," *Kentucky Engineer* 18 (Nov. 1982):8-9; interview, author with Norman Gilley, Louisville, KY, 29 June 1983.

30. Col. Edward C. Rapp, "Preparedness Is Protection," in Office of the Chief of Engineers, *Engineer Update*, June 1982, p. 2; Maj. Gen. Harry A. Griffith to Lt. Gen. John W. Morris, 23 June 1980, in LDHF; U.S., Congress, House, Committee on Appropriations. *Energy and Water Development Appropriations for 1982. Hearings*. 97th Cong., 1 Sess., 1981. pp. 7-9, 17; Louisville District, *Falls City Engineer*, Jan. 1983; Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 Jan.

1981, in LDHF; n.a., "Ohio Valley Regional Conference," note in *Military Engineer* 75 (Jan.-Feb. 1983):53-54.

31. Louisville *Courier-Journal*, 18 June 1982.

32. U.S., Congress, House, Committee on Appropriations *Energy and Water Development Appropriations for 1982, Hearings*, 97th Cong., 1st Sess., 1981, pp. 121-22; Col. Charles E. Eastburn, "Speech to Bluegrass Chapter, Kentucky Society of Professional Engineers, Lexington," Dec. 1982, in LDHF. Gen. Edward C. Meyer, Army Chief of Staff, visited the Louisville District on 18 Dec. 1980; see Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 Jan. 1981, in LDHF.

33. Maj. Gen. E. R. Heiberg, III, to Brig. Gen. R. S. Kem, 3 June 1981, in LDHF; interview, author with Brig. Gen. R. S. Kem, Pittsburgh, PA, 5 Oct. 1982.

34. Brig. Gen. R. S. Kem to Lt. Gen. Joseph K. Bratton, 2 July 1981, in LDHF; Louisville District, *Falls City Engineer*, Jan. 1982.

35. Louisville District, *Falls City Engineer*, Feb. 1982; Col. Charles E. Eastburn, "Remarks to the Louisville Chapter of Federally Employed Women," 6 July 1982, and "Speech to Fort Knox Rotary Club," 15 Apr. 1982, in LDHF; information supplied by Executive Assistant, U.S. Army Engineer District, Louisville, KY.

36. Interview, author with John J. Speaker, Louisville, KY, 25 May 1983; Louisville District, *Falls City Engineer*, Feb. and Apr. 1983; interview, author with Gordon M. Stevens, Louisville, KY, 9 Feb. 1983.

37. Interview, author with Robert R. Humphreys, Louisville, KY, 24 May 1983; interview, author with Lawrence R. Link, Jr., Louisville, KY, 24 May 1983; Col. Charles E. Eastburn, "Speech to Bluegrass Chapter, Kentucky Society of Professional Engineers, Lexington," Dec. 1982, in LDHF.

38. Interview, author with Robert R. Humphreys, Louisville, KY, 24 May 1983; n. a., "More than Half the Federal Land for Sale Provided by the Army," *Army*, Aug. 1982, p. 61.

39. Interview, author with Gordon M. Stevens, Louisville, KY, 9 Feb. 1983.

40. Ibid.

41. Louisville District, *Falls City Engineer*, July 1982; Louisville *Courier-Journal*, 19 Mar. 1982.

42. Louisville District, *Falls City Engineer*, Mar., July, Oct. 1982; interview, author with Gordon M. Stevens, Louisville, KY, 9 Feb. 1983; interview, author with John J. Speaker, Louisville, KY, 25 May 1983.

43. Dayton, OH, *Dayton Daily News*, 11 Jan. 1982.

44. Louisville District, *Falls City Engineer*, Jan. 1983; Col. Charles E. Eastburn, "Speech to SAME Post, Detroit, Mich.," 6 Dec. 1982, in LDHF.

45. Louisville District, *Falls City Engineer*, Aug. 1983.

EPILOGUE

1. Louisville *Courier-Journal*, 20 Mar. 1981; L. H. Blakey, "Balancing Environmental and Economic Concerns," *Military Engineer* 74 (July-Aug. 1982):270-73; Frankfort *State Journal*, 2 Sept. 1981; *Cincinnati Post*, 24 June 1981; David C. Harrison, "Institutional Barriers to National Water Policy," *Water Spectrum* 14 (Spring 1982;6-7; Col. Joseph A. Yore to Lt. Gen. Joseph K. Bratton, 23 Dec. 1980, in LDHF.

2. *Washington Post*, 5 Nov. 1981; Office of the Chief of Engineers, *Engineer Update*, June 1982, p. 10.

3. Lt. Frederick J. Clarke, "Remarks, Commonwealth Club, San Francisco, Calif.," 21 Jan. 1972, in PAOF; Brig. Gen. R. S. Kem to Lt. Gen. Joseph K. Bratton, 12 Nov. 1981, in LDHF.

4. William R. Gianelli, "Funding Water Development Projects," *Military Engineer* 75 (July-Aug. 1983):332-34; Office of the Chief of Engineers, *Engineer Update*, July 1983, p. 2.

5. U. S., Congress, House, Committee on Flood Control, *Comprehensive Flood Control Plan for Ohio and Lower Mississippi Rivers, Hearings on H.R. 7393 and H.R. 7464*, 75th Cong., 1st Sess., 1937, p. 73; Leland R. Johnson, *The Headwaters District: A History of the Pittsburgh District, U.S. Army Corps of Engineers*, p. 207.

6. Col. Charles E. Eastburn to Brig. Gen. R. S. Kem, 29 May 1981, in LDHF.

7. U. S., Congress, *Congressional Record*, 97th Cong., 1st Sess., 5 Mar. 1981, p. S.1804-05.

8. Louisville *Courier-Journal*, 4 Aug. 1983; Johnson, *Falls City Engineers*, pp. 264-66.

9. Louisville *Courier-Journal*, 4 Aug. 1983; Paducah *Sun-Democrat*, 5 Feb. 1980; *Louisville Times*, 12 Jan. 1981; *Lexington Herald*, 5 Jan. 1981; Louisville *Courier-Journal*, 8 Feb. and 24 Aug. 1983; U.S., Congress, House, Committee on Appropriations, *Energy and Water Development Appropriations for 1982, Hearings*, 97th Cong., 1st Sess., 1981, pp. 11-13.

10. U.S., Congress, Senate, Committee on Appropriations, *Energy and Water Development Appropriations, Hearings, Fiscal Year 1982*, 97th Cong., 1st Sess., 1981, p. 179.

11. Note in *Military Engineer* 75 (May-June 1983):276; John F. Wall, "A Challenge to the Corps of Engineers," *Military Engineer* 75 (July-Aug. 1983):331; Leland R. Johnson, "Emergency Response: The Army Engineer Disaster Relief Mission, Vol. I: Origins to 1950" (452-page unpublished manuscript, Office of the Chief of Engineers, 1981), pp. 143-59.

BIBLIOGRAPHY

A. Congressional Documents:

U.S. Congress. House. Committee on Flood Control. *Comprehensive Flood Control Plan, Ohio and Lower Mississippi Rivers, Hearings on H. R. 7393 and H.R. 7646.* 75th Cong., 1st Sess., 1937.

U.S. Congress. Senate. Committee on Public Works. *Civil Works Program of the Corps of Engineers: A Report to the Secretary of the Army.* 89th Cong., 2d Sess., 1966.

U.S. Congress. Senate. Committee on Appropriations. *Public Works for Water and Power Development and Energy Research Appropriation Bill, 1976.* 94th Cong., 1st Sess., 1975.

______. *Hearings, Public Works for Water and Power Development and Energy Research Appropriations, Fiscal Year 1979.* 95th Cong., 2d Sess., 1978.

______. *Energy and Water Development Appropriations, Hearings, Fiscal Year 1982.* 97th Congress., 1st Sess., 1981.

U.S. Congress. House. Committee on Appropriations. Subcommittee on Energy and Water Development. *Energy and Water Development Appropriations for 1982, Hearings.* 97th Cong., 1st Sess., 1981.

U.S. Congress. *Congressional Record.* 97th Cong., 1st Sess., 5 March 1981.

B. Corps of Engineers Printed Reports:

U.S. Army Engineer District, Louisville. *Information Bulletin.* Monthly inhouse publication. Louisville: U.S. Army Engineer District, 1968-1977.

______. *Falls City Engineer.* Monthly inhouse publication. Louisville: U.S. Army Engineer District, 1978-1983.

______. *Flood Plain Information Study: Pigeon Creek, Vanderburgh County, Indiana.* Louisville: U.S. Army Engineer District, 1967.

______. *Red River Reconnaissance Study.* Louisville: U.S. Army Engineer District, 1968.

______. *Interim Survey Report on Mill Creek in Southwestern Ohio for Flood Damage Reduction and Recreation.* Louisville: U.S. Army Engineer District, 1970.

______. *Report of Board of Investigation on Failure of Cofferdam, Uniontown Dam, Ohio River.* Louisville: U.S. Army Engineer District, 1971.

______. *Salt River Basin, Kentucky: Feasibility Report for Water Resource Development.* Louisville: U.S. Army Engineer District, 1971.

______. *Report on Cave Run Flood Emergency, Licking River, Kentucky.* Louisville: U.S. Army Engineer District, 1971.

______. *Report of Ad Hoc Committee on Cave Run Flood Emergency, Licking River, Kentucky.* Louisville: U.S. Army Engineer District, 1971.

______. *Licking River Basin, Kentucky: Feasibility Report for Water Resource Development.* Louisville: U.S. Army Engineer District, 1971.

______. *Report of Markland Emergency Gate Ad Hoc Committee.* Louisville: U.S. Army Engineer District, 1971.

______. *Special Report, Big Walnut Lake: Study of Alternatives.* Louisville: U.S. Army Engineer District, 1972.

______. *Flood Plain Information: Ohio River Jefferson County, Kentucky.* Louisville: U.S. Army Engineer District, 1973.

______. *After Action Report on Markland Dam Incident of January 1974: "Operation BIG STINK."* Louisville: U.S. Army Engineer District, 1974.

———. *Reconnaissance Report on Alternatives to Lincoln Lake, Embarras River Basin, Illinois.* Louisville: U.S. Army Engineer District, 1974.
———. *Final Report: Inspection and Appraisal of Coal Mine Refuse Banks and Associated Impoundments in the Commonwealth of Kentucky.* Louisville: U.S. Army Engineer District, 1974.
———. *Flood Plain Information: Kentucky River, Vicinity of Frankfort, Kentucky.* Louisville: U.S. Army Engineer District, 1974.
———. *Final Environmental Impact Statement: Red River Project, Kentucky.* Louisville: U.S. Army Engineer District, 1974.
———. *Final Environmental Impact Statement: Mill Creek Local Protection Project, Cincinnati, Ohio.* Louisville: U.S. Army Engineer District, 1974.
———. *Response to Comments by the Council on Environmental Quality on the Final Environmental Impact Statement, Red River Lake Project, Kentucky.* Louisville: U.S. Army Engineer District, 1974.
———. *Phase I Plan Formulation: General Design Memorandum, Big Walnut Lake, White River Basin.* Louisville: U.S. Army Engineer District, 1976.
———. *Patoka Lake Master Plan.* Louisville: U.S. Army Engineer District, 1976.
———. *Feasibility Report, Wabash River Navigation Improvements.* Louisville: U.S. Army Engineer District, 1977.
———. *Project Maps and Data Sheets.* 3 vols. Louisville: U.S. Army Engineer District, 1978.
———. *After Action Report: April 1977 Southeastern Kentucky Flood Disaster.* Louisville: U.S. Army Engineer District, 1978.
———. *Metropolitan Lexington: Water Resources Analysis.* Louisville: U.S. Army Engineer District, 1978.
———. *Draft Environmental Impact Statement: Big Blue Lake, Big Blue River Basin, Indiana.* Louisville: U.S. Army Engineer District, 1978..
———. *Locks and Dams 52 & 53, Ohio River: Design Memorandum for Major Rehabilitation.* Louisville: U. S. Army Engineer Ditrict, 1978.
———. *Final Updated Environmental Impact Statement, Taylorsville Lake, Salt River Basin, Kentucky.* Louisville: U.S. Army Engineer District, 1978.
———. *Saline River Basin, Illinois: Navigation Improvements.* Louisville: U.S. Army Engineer District, 1978.
———. *Green and Barren Rivers, Kentucky: Navigation Study.* Louisville: U.S. Army Engineer District, 1979.
———. *McAlpine Locks and Dam, Ohio River, Study Report Revised.* Louisville: U.S. Army Engineer District, 1979.
———. *Saline River Basin, Illinois: Feasibility Report for Water Resources Development.* Louisville: U.S. Army Engineer District, 1979.
———. *Phase I Plan Formulation General Design Memorandum: Big Blue Lake, Wabash River Basin.* Louisville: U.S. Army Engineer District, 1979.
———. *Kentucky River and Tributaries, Upper Kentucky River Navigation Project, Situation Report.* Louisville: U.S. Army Engineer District, 1980.
———. *Kentucky River and Tributaries: Upper Kentucky River Navigation Project Situation Report, Public Involvement Record.* Louisville: U.S. Army Engineer District, 1980.
———. *Stage 2 Hydropower Study, Cagles Mill Lake, Indiana.* Louisville: U.S. Army Engineer District, 1981.
———. *Grand Lake, St. Marys, Ohio: Survey Report for Flood Control and Allied Purposes.* Louisville: U.S. Army Engineer District, 1981.

______. *Kentucky River and Tributaries: Upper Kentucky River Navigation Project Disposition Report.* Louisville: U.S. Army Engineer District, 1982.
______. *Final Environmental Impact Statement: Louisville and Jefferson County, Kentucky, Riverport Authority.* Louisville: U.S. Army Engineer District, 1982.

U.S. Army Engineer Division, Ohio River. *An Analysis of Cellular Sheet Pile Cofferdam Failures.* Cincinnati: U.S. Army Engineer Division, 1974.
______. *Final Summary Report: Inspection and Appraisal of Coal Mine Refuse Banks and Associated Impoundments.* Cincinnati: U.S. Army Engineer Division, 1975.
______. *Ohio River Bank Erosion Study.* Cincinnati: U.S. Army Engineer Division, 1977.
______. *Summary Report of the Ohio River Division Ice Committee.* Cincinnati: U.S. Army Engineer Division, 1978.

U.S. Army Engineer School. *The Corps of Engineers Officer.* Fort Belvoir, VA: U.S. Army Engineer School 600-1, 1974.

U.S. Army. Office of the Chief of Engineers. *Engineer Update.* Monthly inhouse publication. Washington, DC: Office of the Chief of Engineers, 1976-1983.
______. *Red River Reservoir, Kentucky: Reconnaissance Study.* Washington, DC: Office of the Chief of Engineers, 1968..
______. *1970 Distinguished Design Awards.* Washington, DC: Office of the Chief of Engineers, 1971.
______. *The Urban Studies Program of the Army Corps of Engineers.* Washington, DC: Office of the Chief of Engineers, 1972.
______. *A Perspective on Flood Plain Regulations for Flood Plain Management.* Washington, DC: Office of the Chief of Engineers, 1976.
______. *The Corps of Engineers and the American Environment.* By Lt. Gen. John W. Morris. Washington, DC: Office of the Chief of Engineers, 1978.
______. *Interim Report to Congress: The Streambank Erosion Control Evaluation and Demonstration Act of 1974.* Washington, DC: Office of the Chief of Engineers, 1978.
______. *Waterpower '79: An International Conference on Small Scale Hydropower, October 1-3, 1979.* Washington, DC: Office of the Chief of Engineers, 1980.
______. *Corps-Wide Structural Engineering Conference.* Washington, DC: Office of the Chief of Engineers, 1980.

U.S. Army. Office of the Chief of Engineers. Institute for Water Resources. *Environmental Guidelines for the Civil Works Program of the Corps of Engineers.* Fort Belvoir, VA: Institute for Water Resources Report 70-5, 1970.
______. *Public Involvement in the Corps of Engineers Planning Process.* By James R. Hanchey. Fort Belvoir, VA: Institute for Water Resources Report 75-R4, 1975.
______. *Urban Studies Program Evaluation Report.* By Kyle E. Schilling, et al. Fort Belvoir, VA: Institute for Water Resources Policy Study, 1977.
______. *Estimate of National Hydroelectric Power Potential at Existing Dams.* By Richard J. McDonald et al. Fort Belvoir, VA: Institute for Water Resources, 1977.
______. *National Waterways Roundtable: Proceedings, Regional Development, Technology, A Look Ahead.* Fort Belvoir, VA: Institute for Water Resources Report 80-1, 1980.
______. *National Waterways Roundtable Papers: Proceedings on the History and Evolution of U.S. Waterways and Ports.* Fort Belvoir, VA: Institute for Water Resources Report 80-2, 1980.
______. *Report of Survey of Corps of Engineers Construction Workforce.* By Mark C. Dunning. Fort Belvoir, VA: Institute for Water Resources Report 81-R05, 1981.

C. Printed Reports by Agencies Other than Corps of Engineers:

City-County Planning Commission of Lexington and Fayette County Kentucky. *The Historical Development of Lexington and Fayette County, Ky.* Lexington, KY: City-County Planning Commission, 1963.

Comptroller General of the United States. *Improvements Needed in Making Benefit-Cost Analyses for Federal Water Resource Projects.* Washington, DC: Government Accounting Office Publication B-167941, 1974.

_____. *Actions Needed to Increase the Safety of Dams Built by the Bureau of Reclamation and the Corps of Engineers.* Washington, DC: Government Accounting Office Publication B-125045, 1977.

Evansville-Vanderburgh Regional Planning Commission. *Flooding along Pigeon Creek in Vanderburgh County, Indiana–How to Avoid Damage.* Evansville, IN: Evansville-Vanderburgh Regional Planning Commission, 1967.

Kentucky. Department for Natural Resources. Division of Water Resources. *The Floods of April.* Frankfort, KY: Division of Water Resources, 1977.

Ohio. Department of Natural Resources. *The Little Miami of Ohio: A Study of a Wild and Scenic River.* Columbus, OH: Dept. of Natural Resources, 1967.

Ohio River Basin Commission. *Great Miami River Basin Comprehensive Coordinated Joint Plan.* Cincinnati: Ohio River Basin Commission, 1976.

_____. *Kentucky and Licking River Basin Comprehensive Coordinated Joint Plan.* Cincinnati: Ohio River Basin Commission, 1976.

_____. *Lower Ohio Main Stem Comprehensive Coordinated Joint Plan.* Cincinnati: Ohio River Basin Commission, 1978.

_____. *Middle Ohio Main Stem Comprehensive Coordinated Joint Plan.* Cincinnati: Ohio River Basin Commission, 1978.

Ohio River Coordinating Committee. *Ohio River Basin Comprehensive Survey.* 14 vols. Cincinnati: U.S. Army Engineer Division, 1969.

U.S. Department of Interior. National Park Service. *The Falls of the Ohio: Study of Alternatives.* Atlanta, GA: National Park Service, 1981.

U.S. Department of Justice. *Progress, Property and Just Compensation.* Washington, DC: Department of Justice, 1963.

University of Kentucky. Department of Anthropology. *Excavations at Four Archaic Sites in the Lower Ohio Valley, Jefferson County, Kentucky.* Lexington: University of Kentucky, 1979.

University of Kentucky. Water Resources Institute. *Anticipations of Change: A Socio-Economic Description of a Kentucky County Before Reservoir Construction.* Lexington: Water Resources Institute Report 28, 1970.

_____. *Factors Affecting Relocation in Response to Reservoir Development.* Lexington: Water Resources Institute Report 29, 1970.

_____. *Evaluation of the Social Impact of Reservoir Construction on the Residential Plans of Displaced Persons in Kentucky and Ohio.* Lexington: Water Resources Institute Report 26, 1970.

_____. *Sociological Impact of Reservoirs on Local Government Institutions.* Lexington: Water Resources Institute Report 65, 1973.

_____. *Social and Cultural Impact of a Proposed Reservoir on a Rural Kentucky School District.* Lexington: Water Resources Institute Report 60, 1973.

_____. *Social Costs and Benefits of Water Resource Construction.* Lexington: Water Resources Institute Report 64, 1973.

______. *Displacement of Persons by Major Public Works.* Lexington: Water Resources Institute Report 80, 1974.
______. *Dams and People: Geographic Impact Area Analysis.* Lexington: Water Resources Institute Report 97, 1976.
______. *Organized Resistance to an Imposed Environmental Change: A Reservoir in Eastern Kentucky.* Lexington: Water Resources Institute Report 110, 1978.
______. *Landowners, Recreationists, and Government: Cooperation and Conflict in Red River Gorge.* Lexington: Water Resources Institute Report 134, 1982.
Wabash River Basin Coordinating Committee. *Wabash River Basin Comprehensive Survey.* 14 vols. Louisville: U.S. Army Engineer District, 1971.

D. Interviews:

Best, Mary R. Interviewed by the author. Louisville, KY. 2 February 1983.
Chenoweth, Deborah. Interviewed by the author. Caesar Creek Lake, OH. 5 October 1983.
Colman, Richard. Interviewed by the author. Patoka Lake, IN. 26 May 1983.
Gilley, Norman. Interviewed by the author. Louisville, KY. 29 June 1983.
Hooper, Charles B. Interviewed by the author. Nashville, TN. 21 September 1982.
Humphrey, Robert R. Interviewed by the author. Louisville, KY. 24 May 1983.
Jenkins, Neal E. Interviewed by the author. Louisville, KY. 26 August 1983.
Kem, Brig. Gen. R. S. Interviewed by the author, Pittsburgh, PA. 5 October 1982
Lee, Steven. Interviewed by the author. Caesar Creek Lake, OH. 5 October 1983.
Link, Lawrence R. Interviewed by the author. Louisville, KY. 24 May 1983.
Mathews, Kenneth. Interviewed by the author. Pittsburgh, PA. 21 October 1981.
Parrish, Charles E. Interviewed by the author. Louisville, KY. 10 March and 21 May 1982.
Pedigo, Martin K. Interviewed by the author. Louisville, KY. 25 August 1983.
Russell, Richard H. Interviewed by the author. Nashville, TN. 26 March 1980.
Schleicher, Richard L. Interviewed by the author. Louisville, KY. 9 February and 28 June 1983.
Speaker, John J. Interviewed by the author. Louisville, KY. 25 May 1983.
Stevens, Gordon M. Interviewed by the author, Louisville, KY. 9 February and 25 May 1983.
Theobald, Joseph L. Interviewed by the author. Louisville, KY. 8 February 1983.

Waller, Ronald C. Interviewed by the author. Louisville, KY. 28 June 1983.
Whittern, Lum. Interviewed by the author. Patoka Lake, IN. 26 May 1983.
Zagurny, David. Interviewed by the author. William H. Harsha Lake, OH. 6 October 1983.

E. Manuscripts:

Berberet, William G. "The Historical Framework of Environmental Politics." 30-page unpublished paper presented at Duquesne History Forum, Pittsburgh, PA. 29 October 1971.
Johnson, Leland R. "Emergency Response: The Army Engineer Disaster Relief Mission, Vol. I: Origins to 1950." 452-page unpublished manuscript at Historical Division, Office of the Chief of Engineers, Washington, DC.
______. "Upriver to Three Forks: The Kentucky River Project, 1835-1917." 140-page unpublished manuscript at Office of Administrative Service, U.S. Army Engineer District, Louisville, KY.
Pollard, William F. "Memorandum 10-1-3: Organization and Functions, Louisville District," 26 May 1978. 75-page unpublished manuscript in Louisville District Historical Files, U.S. Army Engineer District, Louisville, KY.
U.S. Army Engineer District, Louisville. "History of Louisville District, Corps of Engineers, April 1968." 100-page unpublished manuscript in Louisville District Historical Files, U.S. Army Engineer District, Louisville, KY.
U.S. Army Engineer District. Uniontown Resident Office. "Uniontown Locks and Dam Foundation Report." 2 vols. June 1972. Copy in Technical Library, U.S. Army Enginer District, Louisville, KY.

F. U.S. Army Engineer District, Louisville, Active Files:

Louisville, KY. U.S. Army Engineer District, Louisville. Office of Administrative Services. Louisville District Historical Files (LDHF). Four cubic feet of miscellaneous historical records of District activities, the most significant being copies of correspondence between the District Engineer, Division Engineer, and Chief of Engineers.
Louisville, KY. U.S. Army Engineer District, Louisville. Public Affairs Office. Public Affairs Office Files (PAOF). Sixteen cubic feet of correspondence, newspaper clippings, speech drafts, news releases, and miscellaneous items organized alphabetically by subject or name of project.
Louisville, KY. U.S. Army Engineer District, Louisville. Records Management Office. 4,000 cubic feet in 2,000 boxes of retired files from all District elements.
Louisville, KY. U.S. Army Engineer District, Louisville. Technical Library ("Falls City Technical Library"). Along with printed materials, the library has some bound manuscript reports.
Louisville, KY. U.S. Army Engineer District, Louisville. Operations Division. Regulatory Functions Branch. Eight cubic feet of permit actions and determinations of navigability which contain historical reports and documentation.

G. Articles:

Abbott, Edwin E. "Design for a 'New' Ohio River." *Civil Engineering,* 32 (October 1962):46-49.
Adamcik, Robert J. "Tornado Cleanup." *Military Engineer,* 66 (July-August 1974):225-27.

Barron, Reginald A. and Charles F. Corns. "Seismic Safety for Dams." *Military Engineer,* 63 (July-August 1971):236-38.

Bischoff, Dan. "The Corps Works with Nature." *Louisville Magazine,* November 1979, pp. 20-24.

Becker, Carl M. "Professor for the Plaintiff: Classroom to Courtroom." *Public Historian,* 4 (Summer 1982):69-77.

Beer, W. B. "Plant Engineering: A Key to Production on Newburgh Locks Project." *Construction Digest* (KY, IN, and IL), August 15, 1968, pp. 34-39.

Blakey, L. H. "Balancing Environmental and Economic Concerns." *Military Engineer,* 74 (July-August 1982):270-73.

Bobo, Brian J. "Federal Disaster Assistance, Louisville Sewer Explosion." *Kentucky Engineer,* 18 (November 1982):8-9.

Bregman, Irvin and Gerald A. Yager. "The Corps Uses A-E Services." *Military Engineer,* 71 (January-February 1979):15-17.

Cowan, Bruce M. and Richard E. Mayo. "A User-Oriented Management Information System." *Military Engineer,* 70 (March-April 1970):111-13.

Cowdrey, Albert E. "Pioneering Environmental Law: The Army Corps of Engineers and the Refuse Act." *Pacific Historical Review,* 44 (August 1975):331-49.

"Crane for Smithland Lock." *Military Engineer,* 64 (March-April 1972):130-31.

Douglas, William O. "The Public Be Damned." *Playboy,* July 1969, pp. 143, 182-88.

"Dravo to Build New Type of Cofferdam Complex." *World Dredging and Marine Construction,* 6 (August 1970):16 and 41.

"Dravo Underway with Smithland Locks." *World Dredging and Marine Construction,* 7 (October 1971):32.

"Flood Levee Dedicated." *Military Engineer,* 75 (January-February 1983):43.

Florman, Samuel, C. "Hired Scapegoats: In Support of the U.S. Army Corps of Engineers." *Harper's Magazine,* May 1977 (reprint).

Gianelli, William R. "Funding Water Development Projects." *Military Engineer,* 75 (July-August 1983):332-34.

Gowen, Edward. "Real Estate, The First Construction Service." *Military Engineer,* 66 (September-October 1974):316-17.

Harm, Ray. "Red River Gorge." *Kentucky Club Woman,* January 1968, pp. 14-16.

Harrison, David C. "Institutional Barriers to National Water Policy." *Water Spectrum,* 14 (Spring 1982):1-7.

Heiberg, E. R., III. "Of Floods and War." *Military Engineer,* 73 (November-December 1981):395-98.

Hightower, Louis D. "Engineer Construction Contracting." *Military Engineer,* 66 (January-February 1974):34-36.

Howard, R. B. "River Lock Completed Four Months Early." *Civil Engineering,* 35 (November 1965):51-53.

Hull, William J. "Fifty Years on the Ohio." *Water Spectrum,* 11 (Fall 1979):15-23.

Janopaul, Robert N. and David C. Miller. "Small Hydro Project Potential at Existing Dams." *Military Engineer,* 70 (September-October 1978):318-22.

Johnson, Leland R. "Public Historian for the Defense." *Public Historian,* 5 (Summer 1983):65-76.

———. "Waterways: The Fourth Pillar of Defense." *Military Engineer,* 72 (November-December 1980):404-08.

———. "19th Century Engineering: The Davis Island Lock and Dam." *Military Engineer,* 71 (July-August 1979):256-58.

———. "The Contest of 1824," *Military Engineer,* 65 (May-June 1973):164-71.

———. "The Contract of 1824." *Military Engineer,* 65 (July-August 1973):252-57.

Johnson, Ronald W. "The Historian and Cultural Resource Management." *Public Historian,* 3 (Spring 1981):43-51.

Karamanski, Theodore J. "History as an Empowering Force in Cultural Resource Management," *Public Historian* 2 (Spring 1980):71-76.

Kelly, Benjamin I. and Steven D. Markwell. "Seepage Control Measures at Patoka Dam, Indiana." ASCE Preprint 3455, ASCE Convention, Chicago, Illinois, October 16-20, 1978.

Kreisle, William E. "Survey Design and Procedures for an Earthfill Dam and Lake." *Civil Engineering,* February 1971, pp. 43-46.

Kucara, Anthony L. "Constraints Threaten Barge Industry." *Water Spectrum,* 13 (Spring 1981)23:29.

Larkin, F. J. "Contractor's Planning for Navigation Locks." *Journal of the Waterways and Harbors Division, ASCE,* 84 (March 1958):paper 1572.

Lilienthal, David E. "Lost Megawatts Flow over Nation's Myriad Spillways." *Military Engineer,* 70 (March-April 1978):82-85.

McCraw, William F. "Meldahl Locks and Dam on the Ohio River." *Civil Engineering,* September 1963, pp. 56-59.

Morris, John W. "Maintaining Engineer Readiness." *Military Engineer,* 69 (January-February 1977):13-16.

Norton, Robert. "Dam Safety Inspection: A Review." *Military Engineer,* 73 (January-February 1981):26-29.

"Ohio Dam Tower Raised by Big Lifts." *Construction Digest* (KY, IN, and IL), November 23, 1967, n.p..

"114th Annual Engineer Dinner Remarks: Chief of Engineers, Lt. Gen. Joseph K. Bratton Sums Up Corps Commitments Around the Globe." *Engineer,* 11 (Summer 1981):14-16.

Peck, Ralph B. "Let's Get It Straight about Those Dams!" *Military Engineer,* 70 (January-February 1978):20-23.

Pedigo, Martin K. "Winter of '77: Ice on the Ohio." *Water Spectrum,* 9 (Spring 1977):30-35.

"Plant Engineering: A Key to Production on Newburgh Locks Project." *Construction Digest* (KY, IN and IL), August 15, 1968, pp. 35-39.

Rebh, George A. "Postal Construction and the Price of Postage Stamps." *Military Engineer,* 64 (July-August 1972):262-65.

Red River Defense Fund. "Help Save Red River." *Cumberland Sierrian,* July-August 1974, n.p.

Robertson, Kenneth. "Monitor Those Dam Movements Precisely!" *Military Engineer,* 71 (May-June 1979):182-84.

Shields, F. Douglas, Jr. "Environmental Considerations for Flood Control Channel Modifications." *Environmental & Water Quality Operational Studies,* E-81-4 (June 1981):1-6.

Shrake, Edwin. "Operation Build and Destroy." *Sports Illustrated,* April 1, 1968, n. p.

Smith, D. R. and S. C. Wilhelms. "Reaeration of Hydropower Releases." *Environmental & Water Quality Operational Studies,* E-82-3 (April 1982):2-5.

Steinberg, Bory. "Plananing Versus Implementation: The Story of the Seventies." *Water Spectrum,* 14 (Winter 1981-1982):23-28.

Vaughan, H. B., Jr. "Safety Pays! The Corps of Engineers Proves It." *Military Engineer,* 31 (September-October 1939):363-65.

Wall, John F. "A Challenge to the Corps of Engineers." *Military Engineer,* 75 (July-August 1983):328-31.

Walstad, Paul J. and Joseph H. Kasimer. "Construction Claims: Investigating and Presenting Them." *Military Engineer,* 74 (September-October 1982):376-80.

Wessels, Robert R. "Red River Gorge." *Kentucky Club Woman,* January 1968, pp. 15-17.

H. Books:

Ambrose, Stephen E. and James A. Barber, Jr., eds. *The Military and American Society: Essays & Readings.* New York: Macmillan Publishing Co., Inc., 1972.

Baldwin, Kenneth H. *Enchanted Enclosure: The Army Engineers and Yellowstone National Park, A Documentary History.* Washington, DC: Office of the Chief of Engineers, 1976.

Baskin, John. *New Burlington: The Life and Death of an American Village.* New York: Plume Books, W. W. Norton and Company, 1977.

Berry, Wendell. *The Unforeseen Wilderness: An Essay on Kentucky's Red River Gorge.* Lexington: University Press of Kentucky, 1971.

Carnahan, James E. *History of Blanchester, Ohio, with Addenda.* Evansville: Unigraphics, Inc., 1979.

Cauffield, Joyce V. B. and Carolyn E. Benfield, eds. *The River Book: Cincinnati and the Ohio.* Cincinnati: Program for Cincinnati, 1981.

Ellet, Charles, Jr. *The Mississippi and Ohio Rivers.* Philadelphia: Lippincott, Grambo and Co., 1853.

Fox, Stephen. *John Muir and His Legacy: The American Conservation Movement.* Boston: Little, Brown and Company, 1981.

Hull, William J. and Robert W. Hull. *The Origin and Develolpment of the Waterways Policy of the United States.* Washington, DC: National Waterways Conference, Inc., 1967.

Johnson, Leland R. *The Falls City Engineers: A History of the Louisville District, Corps of Engineers, United States Army.* Louisville: U.S. Army Engineer District, 1975.

______. *Men, Mountains and Rivers: An Illustrated History of the Huntington District, U.S. Army Corps of Engineers, 1754-1974.* Huntington: U. S. Army Engineer District, 1977.

______. *Engineers on the Twin Rivers: A History of the Nashville District, Corps of Engineers, United States Army.* Nashville: U. S. Army Engineer District, 1978.

______. *The Headwaters District: A History of the Pittsburgh District, U. S. Army Corps of Engineers.* Pittsburgh: U. S. Army Engineer District, 1979.

Mazmanian, Daniel A. and Jeanne Nienaber. *Can Organizations Change: Environmental Protection, Citizen Participation, and the Corps of Engineers.* Washington, DC: The Brookings Institution, 1979.

National Waterways Foundation. *U. S. Waterways Productivity: A Private and Public Partnership.* Huntsville, AL: Strode Publishers, 1983.

Norton, Clark F. *Emergency Preparedness and Disaster Assistance: Federal Organization and Program.* Washington, DC: Library of Congress Congressional Research Service, 1978.

Reid, T. R. *Congressional Odyssey: The Saga of a Senate Bill.* San Francisco: W. H. Freeman & Co., 1980.

Reuss, Martin. *Shaping Environmental Awareness: The United States Army Corps of Engineers Environmental Advisory Board, 1970-1980.* Washington, DC: Office of the Chief of Engineers, 1983.

Sheaffer, John R. *Introduction to Flood Proofing: An Outline of Principles and Methods.* Chicago: Center for Urban Studies, University of Chicago, 1967.

Walker, Paul K., ed. *Engineers of Independence: A Documentary History of the Army Engineers in the American Revolution.* Washington, DC: Office of the Chief of Enginers, 1981.

Yoe, Charles. *The Declining Role of the United States Army Corps of Engineers in the Development of the Nation's Water Resources.* Fort Collins, CO: Colorado Water Resources Research Institute, Colorado State University, 1981.

I. Newspapers (from which citations are made):

Ashland, KY. *Ashland Daily Independent*
Attica, IN. *Daily Ledger-Tribune*
Barbourville, KY. *Mountain Advocate*
Bloomington, IN. *Herald-Times*
Booneville, KY. *Peoples Journal*
Bowling Green, KY. *Daily News*
Brookville, IN. *Brookville Democrat*
Brookville, IN. *Whitewater Valley Explorer*
Cadiz, KY. *Cadiz Record*
Campbellsville, KY. *Central News Journal*
Cannelton, IN. *Cannelton News*
Central City, KY. *Messenger-Times-Argus*
Centralia, IL. *Centralia Sentinel*
Cincinnati, OH. *Cincinnati Enquirer*
Cincinnati, OH. *Cincinnati Post*
Clay City, KY. *Clay City Times*
Clermont County, OH. *Clermont County Review*
Columbus, IN. *Columbus Republican*
Columbus, OH. *Capitol Times*
Connersville, IN. *News Examiner*
Covington, KY. *Post & Times Star*
Danville, KY. *Advocate-Messenger*
Dayton, OH. *Dayton Daily News*
Decatur, IL. *Decatur Herald*
Effingham, IL. *Daily News*
Elizabethtown, KY. *Hardin County Enterprise*
Evansville, IN. *Evansville Courier*
Evansville, IN. *Evansville Press*
Flora, IL. *Daily-News Record*
Frankfort, IN. *Frankfort Morning Times*
Frankfort, KY. *State Journal*
Frenchburg, KY. *Menifee County Journal*
Golconda, IL. *Herald-Enterprise*
Greencastle, IN. *Banner-Graphic*
Greenfield, IN. *Greenfield Reporter*
Greenup, KY. *Greenup News*
Greenville, KY. *Greenville Leader*
Hartford, KY. *Ohio County News*
Hazard, KY. *Hazard Herald*
Hazard, KY. *Hazard Herald Voice*
Henderson, KY. *Gleaner & Journal*
Indianapolis, IN. *Indianapolis Press*
Indianapolis, IN. *Indianapolis Star*
Indianapolis, IN. *Indiana Rural News*
Irvine, KY. *Estill County Citizens Voice & Times*
Jackson, KY. *Jackson Times*
Jasper, IN. *Dubois County Daily Herald*

Jasper, IN. *Jasper Herald*
Jeffersonville, IN. *Jeffersonville Evening News*
Lafayette, IN. *Journal and Courier*
Lafayette, IN. *Lafayette Leader*
Lawrenceburg, IN. *Dearborn County Register*
Lawrenceburg, KY. *Anderson County News*
Lebanon, OH. *Western Star*
Louisa, KY. *Big Sandy News*
Louisville, KY. *Courier-Journal*
Louisville, KY. *Louisville Times*
Lexington, KY. *Lexington Herald*
Lexington, KY. *Lexington Leader*
Lexington, KY. *Lexington Herald-Leader*
Madison, IN. *Madison Courier*
Marengo, IN. *Hard Times*
Marion, KY. *Crittenden County Press*
Metropolis, IL. *Metropolis News*
Metropolis, IL. *Metropolis Planet*
Morehead, KY. *Morehead News*
Morganfield, KY. *Union County Advocate*
Morgantown, KY. *Green River Republican*
Mt. Carmel, IL. *Wabash Valley News*
Mt. Washington, KY. *Star*
Muncie, IN. *Muncie Press*
Muncie, IN. *Muncie Star*
Nashville, TN. *Tennessean*
New Albany, IN. *New Albany Tribune*
New Castle, KY. *Henry County Local*
New York, NY. *New York Times*
Nicholasville, KY. *Jessamine County Journal*
Owensboro, KY. *Messenger & Inquirer*
Owingsville, KY. *Bath County News*
Paducah, KY. *Sun-Democrat*
Painesville, OH. *Painesville Telegraph*
Peru, IN. *Peru Tribune*
Pikeville, KY. *Appalachian News-Express*
Poseyville, IN. *Posey County News*
Princeton, IN. *Daily Clarion*
Ravenna, KY. *Citizens Voice*
Richmond, IN. *Palladium Item*
Russellville, KY. *News-Democrat*
St. Louis, MO. *St. Louis Post-Dispatch*
Shelbyville, IN. *Shelbyville News*
Shelbyville, KY. *Sentinel-News*
Shepherdsville, KY. *Pioneer News*
Shively, KY. *Shively Newsweek*
Smithland, KY. *Livingston Ledger*
Spencer, IN. *Spencer Evening World*
Springfield, OH. *News-Sun*

Springfield, OH. *Sun*
Taylorsville, KY. *Spencer Magnet*
Tell City, IN. *Tell City News*
Terre Haute, IN. *Star*
Tuscola, IL. *Tuscola Review*
Urbana, IL. *The Daily Illini*
Valley Station, KY. *Valley Advertiser*
Vincennes, IN. *Vincennes Sun-Commercial*
Warsaw, KY. *Gallatin County News*
Washington, DC. *Washington Post*
Washington, DC. *Washington Star*
Whitesburg, KY. *Mountain Eagle*
Winchester, KY. *Winchester Sun*

INDEX

*U.S. GOVERNMENT PRINTING OFFICE: 1985 560-440

LOUISVILL
MILITARY SU

: DISTRICT
PPORT AREA

**Refer to Inside Front cover for Civil Works Area map.