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COMPREHENSIVE BASIN STUDY. WHITE RIVER BASIN, ARKANSAS AND MISS--ETC(U)
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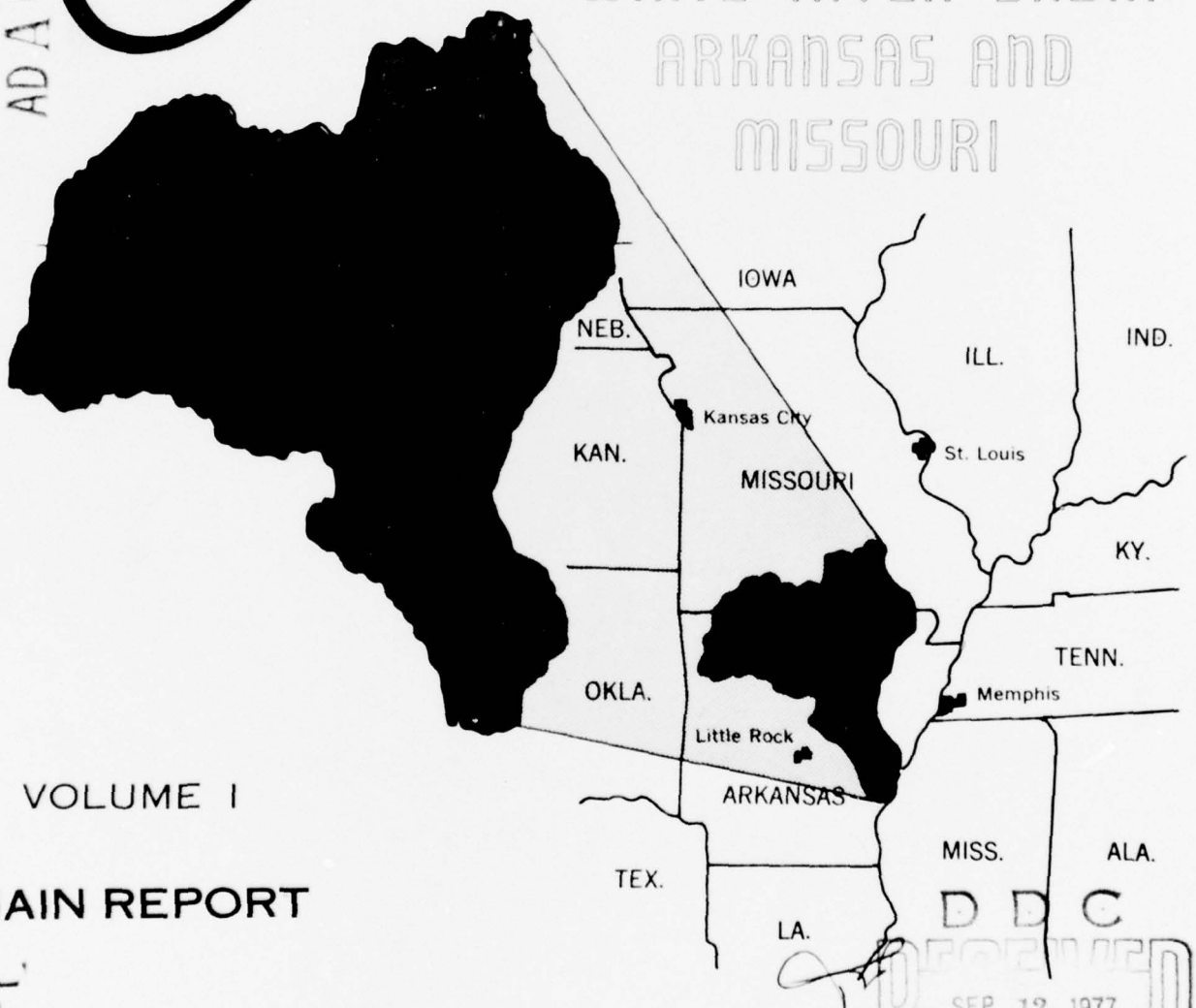
Comprehensive basin study

WHITE RIVER BASIN ARKANSAS AND MISSOURI



VOLUME I

MAIN REPORT

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COMPREHENSIVE BASIN STUDY
WHITE RIVER BASIN
ARKANSAS AND MISSOURI

VOLUME INDEX

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(6)

COMPREHENSIVE BASIN STUDY

WHITE RIVER BASIN

MISSOURI AND ARKANSAS

Volume I.

MAIN REPORT

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COMPREHENSIVE BASIN STUDY
WHITE RIVER BASIN
ARKANSAS AND MISSOURI
JUNE 1968

This study has been reviewed and accepted by the White River Basin Coordinating Committee composed of representatives of the Departments of Agriculture; Army; Commerce; Health, Education, and Welfare; and the Interior; the Federal Power Commission; and the States of Arkansas and Missouri. The Little Rock District, Corps of Engineers, acted as chair agency.

The White River Basin Coordinating Committee report was prepared at field level and presents a proposed plan for the development and management of the water and related land resources of the White River Basin. The report is subject to review by the interested Federal agencies at departmental level, by the Governors of the affected States, and by the Water Resources Council prior to its transmittal to the President of the United States for his review and ultimate transmittal to the Congress for its consideration in authorizing Federal participation in implementing the plan.

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DONALD L. MARTIN
Federal Power Commission

R. J. MacCONNELL
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COMPREHENSIVE BASIN STUDY
WHITE RIVER BASIN
ARKANSAS AND MISSOURI

SUMMARY

1. INTRODUCTION

The purpose of the White River Basin Comprehensive Study, authorized in 1962 and included in the 1963 Civil Works budget, was to determine the foreseeable short- and long-term water and related land resource needs in the basin; formulate a plan of development to provide for the best use, or combination of uses, of the resources of the basin to meet these needs; determine what projects or programs within the plan should be initiated within the next 10- to 15-years; and determine the extent of Federal and non-Federal participation in these projects or programs.

2. ORGANIZATION

a. The White River Basin Coordinating Committee, composed of representatives of the Departments of Agriculture; Army; Commerce; Health, Education, and Welfare; and the Interior; the Federal Power Commission; and the States of Arkansas and Missouri, was formed to provide guidance for conducting the study and to coordinate the efforts of the Federal, State, and local agencies concerned. The District Engineer, Little Rock District, Corps of Engineers, was Chairman of the Committee.

b. An Inter-Agency Planning Committee, composed of a representative of each member of the Coordinating Committee, and operating under its guidance, was responsible for continued field level coordination and administering preparation of the studies and report.

c. Work groups were formed to determine water and related land resource needs and conduct other specialized studies. Member agencies of the work groups were those which had an interest or responsibility for accomplishing certain phases of the study. The Chairman agency was generally the agency which has responsibility for conducting that phase of the study under existing Federal legislation.

3. THE BASIN

a. The White River Basin contains about 27,765 square miles, 17,143 in northern and eastern Arkansas and 10,622 in southern Missouri. About 62 percent of the basin is in forest and the remainder is principally agricultural lands.

b. The main economic activities in the basin are agriculture and light manufacturing. Principal crops grown are soybeans, cotton, rice, and hay. Principal manufactured products are those that originate from forests and foods and the apparel industries.

c. The White River Basin economic study area is composed of 49 counties all or partially within the basin, plus adjacent Pulaski County, which are directly affected by the utilization of the water and related land resources of the basin. Its population was about 1,188,000 in 1960 and is expected to grow to about 2,400,000 by the year 2020. In 1960 the per capita personal income of the economic study area was about $1,410 which was only about 64 percent of the national average for that year. However, as the basin becomes less dependent on agriculture, its economy is expected to expand faster than that for the Nation. The expanding economy will intensify the need for development of the water and related land resources of the basin and forms the basis for projected resource needs.

d. Major water and related land resource developments in the basin are 6 Federal dam and reservoir projects having a storage capacity of 16,062,000 acre-feet for flood control, hydroelectric power, water supply, and recreation and fish and wildlife uses; 10 Federal local protection levees which protect about 484,000 acres of rich alluvial valley land; about 10 private levees which benefit about 275,000 acres; numerous drainage facilities; 9 watershed protection and flood prevention programs encompassing about 560,000 acres and including 57 storage structures and 453 miles of agricultural water management channels; 3 National Forests comprising about 1,200,000 acres of Federal lands with many recreation sites, trails, and scenic drives; a national wildlife refuge containing more than 116,000 acres; 110 miles of National Scenic Riverways with adjacent land holdings in fee-title and scenic easements comprising about 87,000 acres; 2 national fishery research stations; about 17,000 acres in 14 State parks; 24 State game management and hunting areas comprising about 267,000 acres; 11 State fishing lakes having an area of about 2,765 acres; 7 fish hatcheries; 14 stream segments comprising about 44,500 acres managed by the States for trout fishing; and numerous municipal parks, lakes, and private ponds.

4. WATER RESOURCE PROBLEMS AND NEEDS

a. The studies reveal that, even with the existing and scheduled developments functioning, the water and related land resource needs are great and are expected to increase rapidly with the expanding economy.

b. Flood losses, considering projected future economic conditions, are estimated to average about $97,000,000 annually on 1,940,000 acres of agricultural land and other property subject to flooding.

c. There are about 3,400,000 acres in the basin which suffer wetness hazard. This includes about 1,800,000 acres of crop and grassland

on which agricultural production is impaired because of the wetness hazard.

d. There are about 9,000,000 acres in the basin which produce below optimum capacity because of abusive farming practices, overcut forest, overgrazed land, or general lack of proper land management.

e. Considering the availability of water for the basin as a whole, there is sufficient water to serve all purposes. However, several cities and communities located in headwater areas of the basin are now or will be experiencing municipal water shortages in the future during low flow periods unless proper facilities are planned and constructed. In 1965 approximately 48 million gallons per day (m.g.d.) were used in the basin for municipal and industrial water supply purposes. This use is expected to increase to 140 m.g.d. by 1980; 196 m.g.d. by 2000, and 257 m.g.d. by 2020.

f. Pollution of streams in the basin at the present time is not extensive or widespread. However, severe pollution problems do exist on the James River downstream from Springfield, Missouri, and on the White River downstream from Fayetteville, Arkansas. On the James River downstream from Springfield, it is estimated that an average flow of 27.4 m.g.d. would be required by 2020 to augment existing flows for control of water quality. Approximately 12.5 m.g.d. would be required on the White River downstream from Fayetteville by 2020 for the same purpose. Also, there are several small communities located in headwater areas which have potential localized pollution problems.

g. In most upstream headwater areas irrigation water will have to come from storage for that purpose. In the Coastal Plain portion of the basin there will be sufficient ground water and surface water to meet projected water supply and irrigation requirements to the year 2020.

h. It is estimated that the amount of hydroelectric power that could be advantageously utilized in the market area in addition to existing and planned hydro-developments in the area will increase from 4,240 to 29,640 megawatts between 1980 and 2020.

i. The demand for outdoor recreation and fishing and hunting opportunities is rapidly increasing. The demand for recreation opportunities for the four major recreation activities of boating, swimming, camping and picnicking is expected to increase from 18.0 million activities occasions in 1965 to 144.4 million activities occasions in 2020. Unsatisfied demand for man days of fishing opportunities will amount to 704,000 man days by 2020. Unsatisfied demand for all types of hunting in the basin will amount to about 1,154,000 man days of hunting by 2020 unless present restrictions on use of lands for hunting are removed.

j. The crooked alignment of the White River and low stages during summer and fall months greatly restrict its use for navigation. It is estimated that if a 9-foot deep navigable channel were provided, commerce on the lower White River would amount to about 6.5 million tons by 1980 and increase to about 15 million tons by 2020.

k. There is a need for the preservation of areas of archaeological and historical importance and the many points of natural scenic beauty.

l. Continued development of the water and related land resources of the basin dictates a need for good water management. Development of an adequate hydrologic instrumentation system and increased hydrologic studies will be important in the future.

5. PLANNING CONCEPTS

The objective of plan formulation was to develop a comprehensive plan which would serve as a guide for the best use of the water and related land resources of the basin to meet all foreseeable short- and long-range needs. To accomplish this objective the Coordinating Committee adopted the following planning concepts.

a. A coordinated comprehensive plan for the time-phased development of the water and related land resources of the White River Basin through the year 2020 would be formulated and presented in the report.

b. Elements of the comprehensive plan should be compatible with each other and should provide an arrangement of projects and programs flexible enough to meet the changing pattern of needs that would undoubtedly result from unforeseen demands placed on the environment of the basin.

c. Full and equal consideration would be given to all purposes which could be served by water and related land resource development.

d. In determining the composition of the plan, each separable component should be considered on the basis of the contribution it would make in net benefits to the White River Basin, the States of Arkansas and Missouri, and the entire Nation.

e. All benefits and costs, both tangible and intangible, would be given full consideration in arriving at the recommended comprehensive plan.

f. The plan would recognize expressed desires of local people and protect their rights and interests as well as those of the States and the Nation in determining the development of water and related land resources and the preservation and protection of established uses.

g. The plan would include existing, authorized, and formally proposed projects and programs of Federal and non-Federal agencies which were compatible with the balanced comprehensive development and use of the water and related land resources of the White River Basin.

h. It would be recognized in the plan that additional studies might be required for some projects and programs to support specific recommendations for State or Federal authorization or development by private interests.

i. Provisions should be made for a periodic review of the comprehensive plan. This review would serve as a basis for keeping the plan current and for subsequent action.

6. PROJECTS AND PROGRAMS CONSIDERED

a. Numerous main stem and major tributary reservoir sites were investigated for flood control, hydroelectric power, municipal and industrial water supply, water quality control, and recreation and fish and wildlife. Consideration was also given to conventional and adjacent type pumped-storage facilities for production of hydroelectric power.

b. Levees were considered for the protection of low-lying areas along the major streams where considerable flood damage would continue to be experienced even with reservoir regulation.

c. Watershed protection or land treatment measures were considered on all areas where such measures are needed to conserve and promote productivity and protect the land.

d. Floodwater retardation structures were considered in upstream areas where there are flood problems and sites for structures are available. Where there is a need, such sites were also investigated for municipal and industrial water supply, water quality control, recreation and fish and wildlife, and irrigation.

e. Channel improvement and other drainage facilities were considered for flood control and drainage on lands which are too wet for farming or where production is reduced by wetness.

f. Flood plain management was considered as an alternative for other flood control measures. However, the basin is predominantly agricultural and there is evidence that the future economy of the basin will continue to a great degree to be dependent on agriculture. Therefore, the flood plains do not and will not lend themselves to flood plain management as the chief solution for elimination of flood damages. The projects and programs included in the comprehensive plan do not preclude flood plain management if future development dictates that it

is proper. In fact, under these circumstances flood plain management would be compatible with the basin plan and complementary to it.

g. Provision of water to irrigate land which can profitably use additional water for crop production and is physically suited to irrigation was considered.

h. Various types of developments were considered to meet the needs for water and related land resource recreational opportunities in the basin and area of influence. These included main stem and major tributary reservoirs, upstream reservoirs, preservation of streams, National Scenic Rivers, preservation of areas of unusual archaeologic, historic, and natural scenic value, development of additional recreation lakes and the acquisition of additional land within National Forests, enlargement of an existing National Wildlife Refuge and an existing fish hatchery, regulation of tailwater temperatures and access to the tailwater below large reservoirs, providing access to fish and wildlife habitat within leveed areas, public lakes for fishing and hunting, stream access, municipal impoundments, farm ponds, and land acquisition for wildlife management.

i. Improvement of the lower White River from the mouth to Batesville, Arkansas, for navigation was considered.

j. Consideration was given to providing an adequate hydrologic and meteorologic monitoring network for the basin.

7. COMPREHENSIVE PLAN OF DEVELOPMENT

a. The comprehensive plan of development for the water and related land resources of the White River Basin includes existing projects and programs and those under way; certain authorized projects, and certain projects and programs proposed for authorization in prior reports; and the additional projects and programs formulated in this study to meet short- and long-term needs. To the extent practicable the projects and programs in the plan are compatible. The plan is shown on Table 21, page 96, of the main report.

b. The proposed and additional projects and programs selected for the Comprehensive Plan were divided into two time-phased categories based on the urgency of meeting the needs. One category, an early action plan, contains projects and programs which should be initiated within the next 10 to 15 years. The other category, referred to as the long-range plan, includes those measures necessary to meet future water and land resource needs but which are not economically justified at this time or for some other pertinent reason were omitted from the 10- to 15-year plan.

c. A resume' of the features included in the 10- to 15-year plan is presented in the following paragraphs.

(1) Seven main stem and major tributary reservoirs as listed below:

Project	Stream and mile	Purpose
County Line	James River - 107.8	FC,WS,WQ,R,F&W
East Fork	East Fork, Crooked Creek - 1.0	FC,WS
Wolf Bayou	White River - 311.4	FC,P,R,F&W
Wild Horse	South Fork Spring River - 14.9	FC,R,F&W
Myatt Creek	Myatt Creek - 2.2	FC,R,F&W
Bell Foley	Strawberry River - 27.2	FC,R,F&W
Quarry	Little Red River - 64.3	R,F&W

FC - Flood control
WS - Municipal and industrial water supply
WQ - Water quality control
R - Recreation
F&W - Fish and wildlife
P - Hydroelectric power

(2) Installation of two additional hydroelectric power generating units with a total capacity of 85,000 kilowatts at the existing Norfork project. Some facilities to accommodate these units were included in the initial project construction.

(3) A pumped-storage hydroelectric power installation which would have an installed capacity of about 500,000 kilowatts. Additional studies outside the scope of this investigation will be required to determine definite location and economic justification of the project.

(4) Thirteen levee projects with a total length of about 315 miles along the White, Black, Little Black, Current, Fourche, and Little Red Rivers and Crooked and Cane Creeks. These are listed below.

(a) Crooked Creek, Harrison, Boone County, Arkansas.

(b) Black River-Cane Creek, Butler County, Missouri, and Clay County, Arkansas.

(c) Little Black River, Butler and Ripley Counties, Missouri, and Clay and Randolph Counties, Arkansas.

(d) Current-Little Black Rivers, Ripley County, Missouri, and Clay County, Arkansas.

(e) Black-Current-Fourche Rivers, Randolph County, Arkansas.

(f) Flat Creek, Lawrence County, Arkansas.

(g) Black-Strawberry Rivers, Lawrence and Independence Counties, Arkansas.

(h) Clover Bend, Lawrence, Jackson, and Independence Counties, Arkansas.

(i) Curia Creek, Independence County, Arkansas.

(j) Jacksonport, Jackson County, Arkansas.

(k) Oil Trough to Hurricane Lake, Independence, Jackson, and White Counties, Arkansas.

(l) Taylor Bay to Augusta, Woodruff County, Arkansas.

(m) Little Red-White Rivers, White and Prairie Counties, Arkansas.

(5) Navigation improvements on the White River between its mouth and Newport, Arkansas. Studies made in connection with this White River Basin investigation were only sufficient to indicate that any plan of improvement developed for the basin should be compatible with navigation on the lower White River. Further study will be made outside the scope of this investigation to determine the appropriate navigation improvements and their economic feasibility.

(6) Land treatment measures on a total of about 8,880,000 acres, of which 3,380,000 are cropland, 4,040,000 are grassland, 930,000 are woodland, 20,000 are for recreational purposes, and 510,000 are wildlife habitat.

(7) Upstream reservoirs which include 813 single-purpose floodwater retardation structures, 11 floodwater retardation and municipal and industrial water supply structures, 17 floodwater retardation and recreation structures, 1 floodwater retardation and water quality control structure, 5 floodwater retardation and irrigation structures, 2 floodwater retardation and fish and wildlife structures, 1 municipal and industrial water supply structure, and 10 recreation structures, the latter on Forest Service lands.

(8) About 3,500 miles of agricultural water management channels in the Coastal Plain portion of the basin.

(9) A major flood control and drainage outlet on Bayou Des Arc, White and Prairie Counties, Arkansas.

(10) Fish and wildlife and recreation measures, which would be implemented by the State and private sector as well as the Federal Government, consist of the following:

(a) National Scenic Riverway as follows:

1. Buffalo National River, Arkansas;

2. Addition of 20 miles to Ozark National Scenic Riverways, Missouri; and

3. Eleven Point National Scenic River, Missouri and Arkansas.

(b) Preservation of segments of 19 streams with 61 access sites.

(c) Seventy-three access sites on other streams.

(d) Nine public lakes to be developed by the States of Arkansas and Missouri.

(e) Expansion of a fish hatchery, a National Wildlife Refuge, and holdings within 3 National Forests.

(f) Acquisition of 3 wildlife management areas.

(g) Numerous farm ponds and several private irrigation and fish-farming reservoirs.

(h) Eight scenic drives.

(i) Seven special scenic areas.

(j) A national recreation area.

(k) Supporting programs including an Ozark Scenic Railway, highway and access road development, tourist information, and expansion of service industries.

(10) Installation of a system of stream gaging; reservoir volume, water quality, ground water, and sediment monitoring stations.

(11) Established water quality control standards should be implemented and maintained for protection of fish and wildlife and for other purposes.

d. Projects and programs in the long-range plan were studied in sufficient detail to determine only their general applicability in meeting foreseeable needs and their compatibility with other projects and programs in the area. A resume' of the features included in the long-range plan is presented in the following paragraphs.

(1) Flood prevention projects which include 280 single-purpose floodwater retardation structures, 3 floodwater retardation and municipal and industrial water supply structures, 6 floodwater retardation and recreation structures. Of these projects, 36 floodwater retardation structures and 1 floodwater retardation and recreation structure are alternatives for major tributary reservoirs which are in the 10- to 15-year plan.

(2) Five upstream reservoirs on Forest Service lands for recreation.

(3) Ten main stem or major tributary dam and reservoirs, and a flood detention weir on the Current River. Five of the dam and reservoir projects are alternatives for other projects or programs included in the 10- to 15-year plan.

(4) The addition of 24,000 kilowatts of hydroelectric capacity to the privately owned Ozark Beach project located downstream from Table Rock Dam on the White River near Forsyth, Missouri.

(5) A pumped-storage hydroelectric power development of about 500,000 kilowatts.

(6) Three levees with a total length of about 28 miles.

(7) A channel improvement project on Flat Creek to operate in conjunction with upstream reservoirs in providing flood protection at Cassville, Missouri.

(8) Recreation and fish and wildlife measures consisting of preservation of additional Ozark streams, stream access, preservation of high quality wildlife habitat, and additional impoundments for fishing.

(9) Continued implementation and maintenance of established water quality control standards for protection of fish and wildlife and for other purposes.

(10) Augmentation of low flow for certain Ozark streams to increase flows for float fishing and other recreational purposes.

8. CONCLUSIONS

In view of the information in this report it is concluded that the plan formulated would, through efficient resource development and utilization, generally meet the projected water and related land resource needs of the basin to the year 2020. The plan, to be effective, must be implemented in the form of actual projects and programs. However, because the plan is based on long-range assumptions and projections and because it must be sufficiently flexible to be adjusted

to conform to future unforeseen changes in national, State, and local conditions, it will need periodic reviews to insure that it is properly responsive to changing times and conditions.

9. RECOMMENDATIONS

The White River Basin Coordinating Committee recommends that:

1. The comprehensive plan, as presented in Table 21 and discussed in this report, be used as a guide for the development and beneficial use of the water and related land resources of the basin;

2. The projects and programs in the 10- to 15-year category of the plan be implemented through the appropriate agency;

3. This report be a supporting document for the individual agency reports that would be the basis for authorization of the various parts of the plan;

4. That each of the affected and concerned Federal and State agencies make periodic review of the segments of the plan for which it is or may be, under law, assigned responsibility; and

5. The additional studies discussed in this report be made as soon as practicable.

COMPREHENSIVE BASIN STUDY
ON
WHITE RIVER BASIN, ARKANSAS AND MISSOURI

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COMPREHENSIVE BASIN STUDY
ON
WHITE RIVER BASIN, ARKANSAS AND MISSOURI

SECTION I - INTRODUCTION

1. AUTHORITY

a. On the basis of the recommendations of the Senate Select Committee on Water Resources Planning and at the request of the President, a program for comprehensive planning to cover the United States (except Alaska) was developed by appropriate agencies. This program was presented by the Executive Branch in its Fiscal Year 1963 budget. The program, which has been approved and partially funded by Congress, provides for a group of framework studies covering major river basins and a group of detailed comprehensive studies to provide a basis for authorization of specific projects. The White River Basin is one of those included in the program for a detailed comprehensive study.

b. The various Government agencies participated in the investigation under specific Congressional authorities as follows:

(1) Department of Agriculture.

Soil Conservation Service, Economic Research Service, and Forest Service - Section 6 of the Watershed Protection and Flood Prevention Act (Public Law 566), 83rd Congress, 68 Stat.

(2) Department of the Army.

Corps of Engineers - Resolution adopted by the Committee on Public Works, United States Senate, May 11, 1962, sponsored by Senator John L. McClellan. The text of this resolution reads as follows:

> "RESOLVED BY THE COMMITTEE ON PUBLIC WORKS OF THE UNITED STATES SENATE, That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved June 12, 1902, be and is hereby, requested to review the reports on the White River and Tributaries, Missouri and Arkansas, printed in House Document Numbered 499, Eighty-third Congress, second session, and other reports, with a view to determining the advisability of modifying the existing project at the present time, with particular reference to developing a comprehensive plan of

improvement for the basin in the interest of flood-control, navigation, hydro-electric power development, water supply, and other purposes, coordinated with related land resources."

(3) Department of Commerce.

Weather Bureau - Section 601 of the Economy Act of 1932 (47 Stat. 417).

(4) Department of Health, Education, and Welfare.

Public Health Service - The Public Health Service Act of 1944 (Public Law 410, 42 U.S.C. 201 et seq.); the Inter-departmental Agreement concerning consultation on Health Aspects of Water Pollution Control, September 1, 1967; the Clean Air Act, as amended December 13, 1963 (Public Law 88-206, 42 U.S.C. 1857 et seq.); and the Solid Waste Disposal Act of October 20, 1965 (Public Law 89-272, 42 U.S.C. 3251 et seq.).

(5) Department of the Interior.

(a) Fish and Wildlife Service - Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

(b) Bureau of Outdoor Recreation - Public Law 88-29, Stat. 20 of May 28, 1963.

(c) Bureau of Mines - Section 601 of the Economy Act of 1932 (47 Stat. 417).

(d) Geological Survey - Section 601 of the Economy Act of 1932 (U.S.C. Title 31, Section 686).

(e) Southwestern Power Administration - 28 Federal Register 6198 of June 15, 1963.

(f) National Park Service - Park, Parkway, and Recreation Area Study Act of June 23, 1936.

(g) Federal Water Pollution Control Administration - Public Law 85-500 and Memorandum of Agreement between the Department of the Army and the Department of Health, Education, and Welfare dated November 4, 1958, relative to Title III of the Water Supply Act of 1958 as amended; and the Federal Water Pollution Control Act as amended (33 U.S.C. 466 et seq.). Responsibility for these activities was transferred from Department of Health, Education, and Welfare to Department of the Interior by reorganization Plan No. 2 of 1966 effective May 10, 1966.

(6) Federal Power Commission.

Federal Water Power Act of 1920, Federal Power Act of 1935. The Flood Control Acts and other statutes.

2. PURPOSE

The purpose of this study has been to formulate a plan for development of the best use, or combination of uses, of the water and related land resources of the White River Basin to meet foreseeable short- and long-term needs. The economic and social well-being of the people was the overriding determinant in planning for the best use of the water and related land resources.

3. SCOPE

a. Studies were of such scope as to determine the general scale, features, and functions of the most suitable comprehensive plan for ultimate development of the water and related land resources of the White River Basin; the features most urgently needed for development of the ultimate plan; the economic justification of such features; and the extent of Federal and non-Federal participation therein.

b. The broad principles, basic assumptions, and procedures followed were in accordance with Senate Document No. 97, and applicable manuals and directives of each participating agency. Data generation and planning by all participating agencies were consistent with available funds.

c. The scope of the comprehensive studies relating to the development of the White River Basin as adopted by the Inter-Agency Planning Committee and approved by the Coordinating Committee consisted of the following general activity groups:

(1) Long-run economic projections of economic development, including land resource uses.

(2) Hydrologic evaluation of present and future water availability, both as to quantity and quality.

(3) Determination of present and future land resources availability, including minerals.

(4) Translation of findings under a, b, and c into water and related land resource needs and problems.

(5) General approaches that appear appropriate for solution of these needs and problems.

(6) Detailed screening of problems and solutions to determine which projects and programs should be constructed in the next 10 to 15 years.

(7) Economic and engineering studies of selected projects and programs of sufficient scope and detail to support recommendations to Congress.

4. ORGANIZATION

a. Coordinating Committee. A Coordinating Committee consisting of representatives of the Departments of Agriculture; Army; Commerce; Health, Education, and Welfare; and the Interior; the Federal Power Commission; and the States of Arkansas and Missouri, under the chairmanship of the Corps of Engineers, was established. The District Engineer, Little Rock District, Corps of Engineers, was Chairman of the Committee. Most members of the Coordinating Committee had an alternate. However, the organization of the Coordinating Committee did not preclude participation of additional agency representatives at Committee meetings as necessary to study particular objectives. The responsibility of the Coordinating Committee ceased with the completion and submission of the multiple-agency report. The main functions of the Coordinating Committee were as follows:

(1) Provide guidance for the conduct of the survey and the preparation of a comprehensive and coordinated multiple-agency report.

(2) Provide a means for full and continuing exchange of views during the study.

(3) Advise and assist all participating agencies regarding objectives, work assignments, and schedules.

(4) Assist in resolution of study problems as they arise.

(5) Make periodic review of the progress being made.

b. Inter-Agency Planning Committee. An Inter-Agency Planning Committee, consisting of a representative of each of the members of the Coordinating Committee, and operating under its guidance, was responsible for assuring the continued field level coordination between all Federal and State agencies participating in the study. Additional responsibilities of the Planning Committee were:

(1) Coordinate preparation of the multiple-agency report.

(2) Provide guidance, establish schedules, and arrange for coordination of specific activities.

(3) Resolve differences between agencies.

(4) Report progress and unresolved differences to the Coordinating Committee.

(5) Appoint ad hoc work groups to conduct certain phases of the study.

(6) Review the progress of ad hoc work group studies and the reports of the work groups.

c. Ad Hoc Work Groups. Ad hoc work groups were formed by the Inter-Agency Planning Committee as necessary for conducting certain phases of the study. Member agencies of the ad hoc work groups were those agencies which had interest or responsibility for accomplishing that particular phase of the study. The Chair Agency was generally that agency which is normally responsible for conducting that phase of the study under existing Federal legislation. The Chair Agency had the primary responsibility for coordination among the member agencies; establishment of criteria, methodology and schedules for accomplishing the report; and primary responsibility for preparation, review, and reproduction of the report of the group. The Chair Agency also had the responsibility of resolving agency difference or reporting these differences and report progress to the Inter-Agency Planning Committee. The member agencies had the responsibility of assisting the Chair Agency to conduct the study by helping to establish schedules, criteria, and methodology; and by furnishing such data as they had available and in preparing new data. They assisted in preparation and review of the report of the group.

d. Agency. Study responsibilities of each agency are presented in detail in Appendix A. In addition to participation on or in the activities of the Coordinating Committee, the Inter-Agency Planning Committee, and the ad hoc work groups, the individual agencies had other responsibilities, which included the following:

(1) Participation in the development of the overall schedule for the report and in the preparation and justification for the annual budget request.

(2) Participation in the development of a comprehensive plan within the fields in which they had primary responsibility by conducting reconnaissance-type engineering and economic studies and preparing technical reports for potential projects in the framework plan.

(3) Conducted detailed engineering and economic studies for projects and programs that should be initiated in the next 10 to 15 years.

(4) Assumed full responsibility for their work, their reports, and recommendations.

(5) Assisted in the preparation and review of the multiple-agency report including preparation of applicable appendixes.

e. Also the applicable agencies will take the necessary action to bring before Congress or appropriate committees those projects or programs for which they have primary responsibility with appropriate recommendation for construction or implementation.

5. ARRANGEMENT OF REPORT

a. The report has been arranged into a main report and a series of specialized technical appendixes covering specific areas of investigation relating to water and related land resources. The main report is a concise summary of information, data, and findings reported on in appendixes or attachments. Appendixes have been prepared on each specific sub-investigation or area of interest in order that a complete and accurate record of the data, rationale, procedures, and findings pertinent to the overall study will be presented. Appendixes have been given a letter designation and grouped into separate numbered volumes.

b. Data and material not directly pertinent to the basic objectives of the investigations or which are readily available in published documents were not included in the main report and appendixes or attachments. Appropriate references are made to sources of data used.

6. HISTORY OF PRIOR REPORTS

a. The first water and related land resource studies for the White River Basin were made by the Corps of Engineers in connection with navigation. These studies resulted in authorization of: (1) snagging and dredging on the Black River between its mouth and Poplar Bluff, Missouri, by River and Harbor Acts of June 14, 1880, and March 3, 1881, (2) snagging and dredging on the White River between Batesville, Arkansas, and the mouth by River and Harbor Act of July 13, 1892, (3) snagging and construction of wing dams on the Current River between Van Buren, Missouri, and the mouth by River and Harbor Act of August 18, 1894, and (4) fixed dams with concrete locks on the White River between Guion, Arkansas, and Batesville, Arkansas, by River and Harbor Acts of March 3, 1899, and March 2, 1907.

b. Studies for other purposes began when Congress, in the River and Harbor Act approved March 3, 1925, directed that the estimated cost of examinations, surveys, or other investigations be submitted for all navigable streams and their tributaries whereon power development appeared feasible and practicable with a view to formulation of general plans for navigation, water power, flood control,

and irrigation. The estimated cost for such investigations, including an estimate for the White River Basin, was contained in the report of the Chief of Engineers printed in House Document 308, 69th Congress, 1st session, dated April 13, 1926. The surveys, for which estimates were included in the 308 report, were authorized by the River and Harbor Act, Public Law 560, 69th Congress, approved January 21, 1927.

c. The extremely destructive floods on the lower Mississippi River in 1927 resulted in Congress approving the Flood Control Act of May 15, 1928, which placed increased emphasis on flood control by reservoir storage and appropriated funds for the surveys.

d. This congressional action lead to the preparation and publication in 1933 of the first major report by the Corps of Engineers on the water and related land resources of the White River Basin. The publication is House Document No. 102, 73d Congress, 1st session, which is often referred to as the 308 report. The report considered navigation, water power, flood control, and irrigation. However, the findings for comprehensive Federal improvements for navigation in combination with the development of potential water power, flood control, and irrigation were unfavorable and development was not deemed advisable at that time.

e. Following the great flood on the Ohio River in January 1937, Congress directed that certain prior reports be reviewed and comprehensive plans be submitted for flood protection in the Ohio and Mississippi River Valleys. This resulted in the report published in 1937 as Committee Document No. 1, 75th Congress, 1st session. This report recommended, among other works, the construction of 6 reservoirs in the White River Basin.

f. A review of Committee Document No. 1 was directed by Congress in May 1938. This review report was published in 1940 as House Document No. 917, 79th Congress, 3d session. It recommended authorization of 2 additional reservoirs in the basin.

g. During the period 1935 to 1945, by several acts and resolutions, Congress authorized a review of previous reports on the White River Basin to determine the advisability of improving it and its tributaries in the interest of navigation, flood control, hydroelectric power, water supply, and irrigation. A report made in response to this authorization was published in 1954 as House Document No. 499, 83d Congress, 2d session. This report resulted in the authorization of one additional reservoir and modification of another to include hydroelectric power.

h. The latest major report on the conservation and development of the water and related land resources of the basin was made in connection with a study of the Arkansas, White, and Red River Basins.

The report, generally known as the AWR Report, was prepared by Federal and State agencies during 1950-1954 and published in 1957 as Senate Document No. 13, 85th Congress, 1st session. The purpose of this report was to provide a general framework plan to guide more detailed future studies. Thus, the report recommended no improvements for construction.

i. In addition to the Corps of Engineers investigations discussed above, the Mississippi River Commission has been engaged in planning for flood control development in the Mississippi backwater area of the basin since the early 1920's. The latest studies made by the Commission are included in a Comprehensive Review of the Mississippi River and Tributaries project dated December 1959. This report was published in 1964 as House Document No. 308, 88th Congress, 2d session. It results in the authorization of channel improvement works on Big Creek and tributaries in the Mississippi backwater area of the White River Basin.

j. Several general studies on soil and water conservation have been prepared and the results of these studies have been utilized to the extent that they are applicable to the White River Basin. The National Inventory of Soil and Water Conservation Needs, completed in December 1959 by the Department of Agriculture, presents the 1958 status of soil and water resources by counties and States with projections of land and water uses and areas needing treatment to the year 1975. Inventories for both the Arkansas and Missouri Soil and Water Conservation Needs were developed as a part of the National Inventory of Soil and Water Conservation Needs. The Arkansas Inventory was published in 1961 through the courtesy of the Arkansas Geological and Conservation Commission. The Missouri Inventory was published in 1961 through the courtesy of the Missouri Extension Service. Data for the inventories were developed in accordance with the objective, policies, and procedures, and with the assumptions established for the National Inventory. Both Inventories were Chaired by the Soil Conservation Service of the Department of Agriculture, but numerous State and Federal agencies participated in the studies or served in an advisory capacity.

k. The Department of Agriculture also made a companion agricultural study and report for incorporation into the 1959 Mississippi River and Tributaries Project Review (House Document No. 308) prepared by the Mississippi River Commission. These studies provided drainage and irrigation improvement planning data.

l. The Soil Conservation Service has been assisting landowners plan soil and water conservation programs since it was established in 1935. This is done through locally organized and operated Soil Conservation Districts. The Service has also been planning programs for flood control and prevention since approval on August 4, 1954, of the Watershed Protection and Flood Prevention Act, Public Law 566, 83d Congress, 68 Stat. The principal structural measures planned have

been floodwater retardation reservoirs and drainage works. At the time this report was prepared, 10 watershed projects reports have been prepared by the Soil Conservation Service and approved by the Department of Agriculture for detailed planning or operation. These project reports are tabulated in Appendix A.

m. Pursuant to the Flood Control Act approved June 22, 1936, as amended and supplemented, the Forest Service provided USDA leadership in developing a flood control plan for the White River watershed above Norfork, Arkansas. Similar plans have also been developed for the Lower White River Basin. These plans consisted primarily of land treatment measures. A field level report covering the upper basin was prepared in 1950.

n. The Forest Service has performed multiple-use planning and management studies for the three National Forests in the basin. Forest surveys of Arkansas and Missouri in 1958 resulted in the following published reports, portions of which are applicable to the White River Basin·

(1) Arkansas Forests, 1960.

(2) Timber Resources of the Eastern Ozarks, 1961.

(3) Timber Resources of the Missouri Prairie Region, 1963.

(4) Timber Resources of the Missouri Southwestern Ozarks, 1966.

o. Fish and wildlife resources of the White River Basin have been reported on numerous times especially in connection with authorizing reports on water resource development projects in the basin. A basinwide report on Fish and Wildlife, dated June 1951, was prepared by the U. S. Fish and Wildlife Service. The Arkansas-White-Red River Basin Report (Senate Document No. 13, 85th Congress, 1st session) contained a comprehensive framework study for development of fish and wildlife in the basin.

p. A National Park Service report entitled "A Proposal, Ozark Rivers National Monument" proposed that portions of the Current and Eleven Point Rivers in Missouri be included in a National Monument. This report resulted in subsequent authorization by Public Law 88-492 of portions of the Current and Jacks Fork Rivers in Missouri as Ozark National Scenic Riverways. The Buffalo River in Arkansas was reported on by the National Park Service in a report dated April 1963 and entitled Buffalo National River. The report proposes that the lower 128 miles of the Buffalo River be authorized as a National River. The Eleven Point River in Missouri has been reported on by the National Wild River Study Team in several documents which propose

that portions of the Eleven Point River be made a National Scenic River.

q. The 1962 Inventory of Municipal Waste Facilities and the 1963 Inventory of Municipal Water Facilities contain information on waste and water facilities of the White River Basin. Portions applicable to the White River Basin are contained in Volume 7, Region VII, of these two reports.

r. The 1964 National Power Survey, prepared by the Federal Power Commission in cooperation with advisory committees, projects national power needs for the 1970's and 1980's and suggests the broad outline of a fully interconnected system of power for the entire country. Coordination Study Area K, which substantially represents the area covered by the Southwest Power Pool and associated systems, is the logical market area for determination of needs for future hydroelectric capacity that may be constructed in the White River Basin.

s. Planning Status Reports were prepared for the Upper White River Basin, 1964, and for the Lower White River Basin, 1965, by the Bureau of Power of the Federal Power Commission. The reports show data on existing water resource developments and known potentials, and identified needs for additional planning regarding license status of non-Federal hydroelectric developments. An Appraisal Report for the Upper White River Basin, dated 1966, was prepared for Commission use in considering matters related to relicensing the Ozark Beach power plant.

SECTION II - BASIN DESCRIPTIVE DATA

7. GENERAL BASIN DESCRIPTION

a. The White River Basin comprises about 27,765 square miles, of which 10,622 are in the southern part of Missouri and 17,143 are in the northern and eastern parts of Arkansas. The basin is fan-shaped, about 250 miles long in a north-south direction, and varies in width from about 210 miles near the Missouri-Arkansas State line to about 50 miles in the southern part near the mouth of the river. The Ozark Plateaus Province covers about three-fourths of the basin and the remaining one-fourth lies in the Mississippi Alluvial Plain section of the Coastal Plain Province and the Ouachita Province. The escarpment of the Ozark Mountain runs generally southwestward across the basin from near Poplar Bluff, Missouri, crosses the White River near Batesville, Arkansas, and extends to near Cabot, Arkansas, on the southwestern watershed divide. A general map of the White River Basin is shown on Plate 1.

b. The Ozark Plateaus Province in the White River Basin is made up of the Salem Plateau in the northern part, the Springfield Plateau generally in the western, and the Boston "Mountains" in the southern part. The Salem and Springfield Plateaus are flat to rolling and are dissected by deep, narrow, meandering stream valleys. The Boston "Mountains" form the highest and most rugged features of the province. The geological formations consist mostly of Paleozoic sedimentary rocks, limestones, dolomites, chert, sandstones, and shales. Some Precambrian igneous rocks are interspersed with the other formations in the northeastern part of the province.

c. A very small area in the southwestern part of the basin is in the Ouachita Province. The rock formations in this province are Paleozoic sandstones and shales. The eastern part of the basin is in the Coastal Plain Province. The geological formations in this province consist, in general, of poorly consolidated or unconsolidated deposits of silt, clay, sand, and gravel of Tertiary and Quaternary age.

8. WHITE RIVER

a. The White River rises in the Boston "Mountains" in the western part of the basin and flows in a generally northerly direction to the Missouri-Arkansas State line (mile 591.9), thence in a generally easterly direction for about 115 miles in southern Missouri and for about 30 miles along either side of the State line until it finally crosses into Arkansas at about mile 447.5. Downstream from that point, it flows in a generally southeasterly direction to the mouth of the Black River (mile 264.8) near Newport, Arkansas,

and then in a southerly direction to join the Mississippi River at mile 599 above Head of Passes, Louisiana.

b. The total length of the White River is about 720 miles. The elevation at its source is about 2,050 feet above mean sea level and the low water elevation at the mouth is about 107 feet above mean sea level. The fall ranges from about 25 feet per mile near the source to about 0.4 foot per mile near the mouth. The fall of the streambed throughout the greater part in the Ozark Mountains is about 3 to 4 feet per mile. The White River flows through the mountainous area in a narrow channel that in numerous places has eroded vertically through rock to a depth of more than 100 feet. The streambed in this reach is composed mostly of rocks, boulders, and gravel. From Bull Shoals Dam at mile 418.6 to the head of Beaver Reservoir at about mile 685.0, the White River now is a series of lakes formed by four dams: Bull Shoals at mile 418.6; Ozark Beach at mile 506.1; Table Rock at mile 528.8; and Beaver at mile 609.0.

c. The reach of the White River downstream from Batesville is characterized by a meandering channel and flat slopes. The banks and streambed are composed mostly of fine sand, silt, and clay. The fall of the river averages about 0.4 foot per mile in the lower valley. The channel ranges from 200 to 400 feet wide between banks whose heights range from 20 to 25 feet in the upstream third of this reach. In the downstream two-thirds of the reach, channel width ranges from 400 to 800 feet and bank heights range from 25 to 30 feet. Flow is sluggish in the lower reach because of the flat stream slopes. Oxbow lakes, which were formerly channels of the river, are common along the channel.

9. PRINCIPAL TRIBUTARIES

a. Principal tributaries of the White River and its main tributary, the Black River, with their drainage areas and the location of their confluence with the larger stream are given in Table 1.

b. The larger tributaries above Bull Shoals Dam are the Kings and James Rivers. Between Bull Shoals and the alluvial valley, the larger tributaries are Crooked Creek, Buffalo River, and North Fork River. These tributaries all lie entirely within the Ozark Plateaus Province.

c. The Black River sub-basin comprises about 31 percent of the drainage area of the entire White River Basin. This stream leaves the Ozark Plateaus in the vicinity of Poplar Bluff, Missouri, and flows for about 200 river miles along or near the edge of the Ozark escarpment to near Newport, Arkansas, where it enters the White River at mile 264.8 on the White River. The slope of the Black River averages only about 0.6 foot per mile after it enters the alluvial valley near Poplar Bluff, Missouri. The larger tributaries of the


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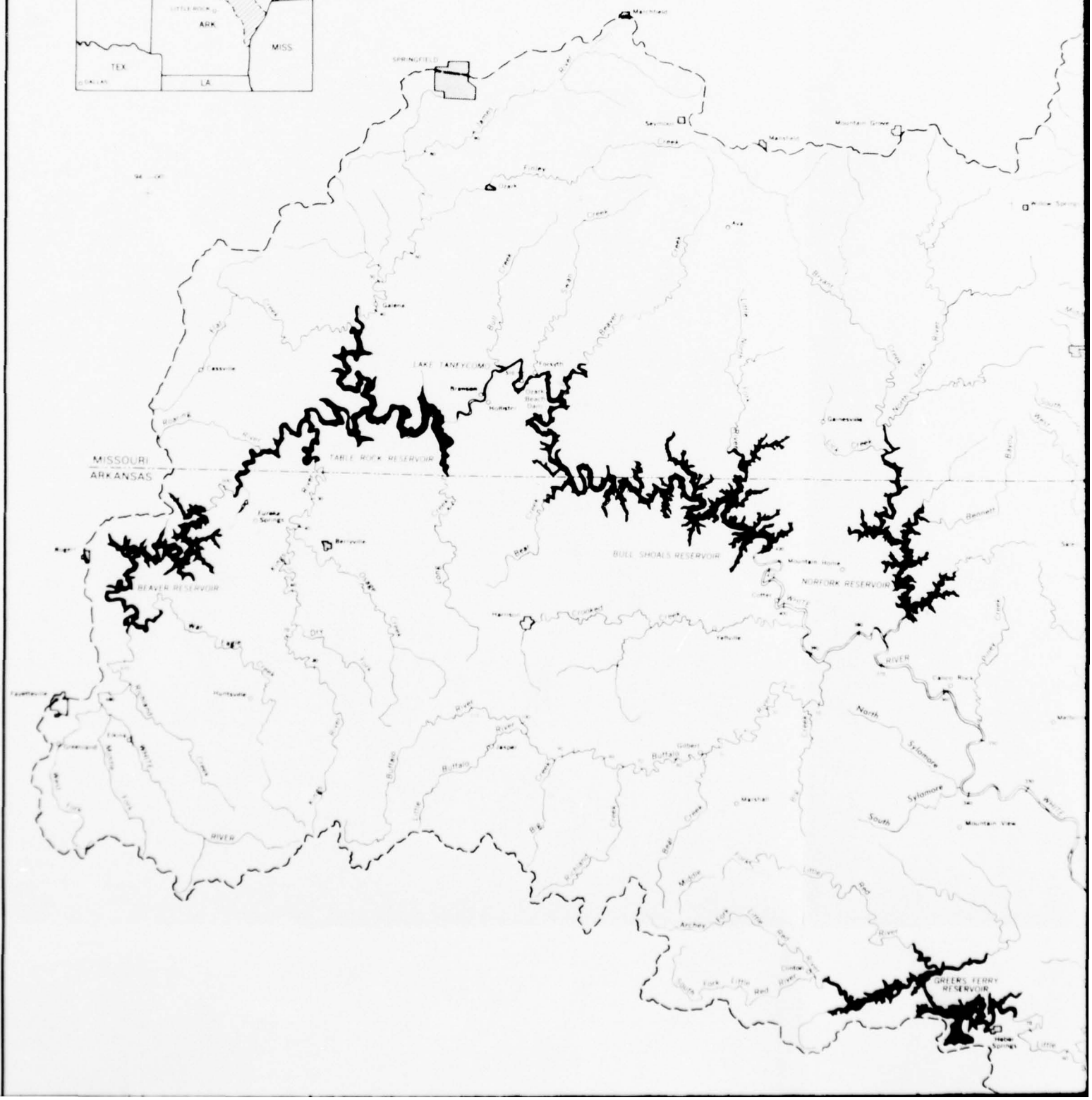
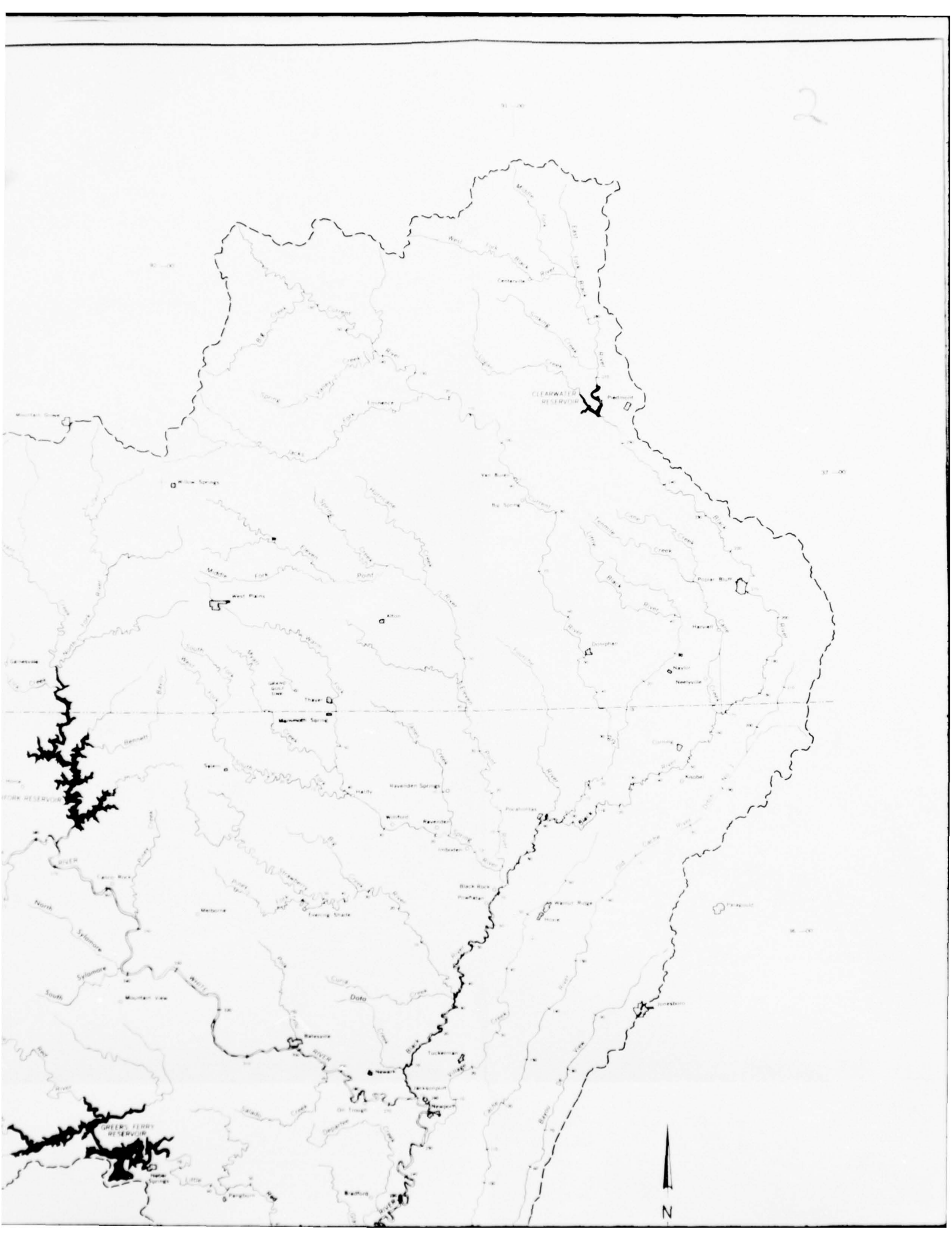
WHITE RIVER BASIN


SPRINGFIELD
LAKE TANEYCOMO
MISSOURI
ARKANSAS
TABLE ROCK RESERVOIR
BEAVER RESERVOIR
BULL SHOALS RESERVOIR
NORFORK RESERVOIR
GREERS FERRY RESERVOIR
North Sylamore
South Sylamore
Buffalo
RIVER


CLEARWATER RESERVOIR
Piedmont
West Plains
Mammoth Spring
Ravenden Springs
Black Rock
Pocahontas
Jonesboro
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GREERS FERRY RESERVOIR
Heber Springs
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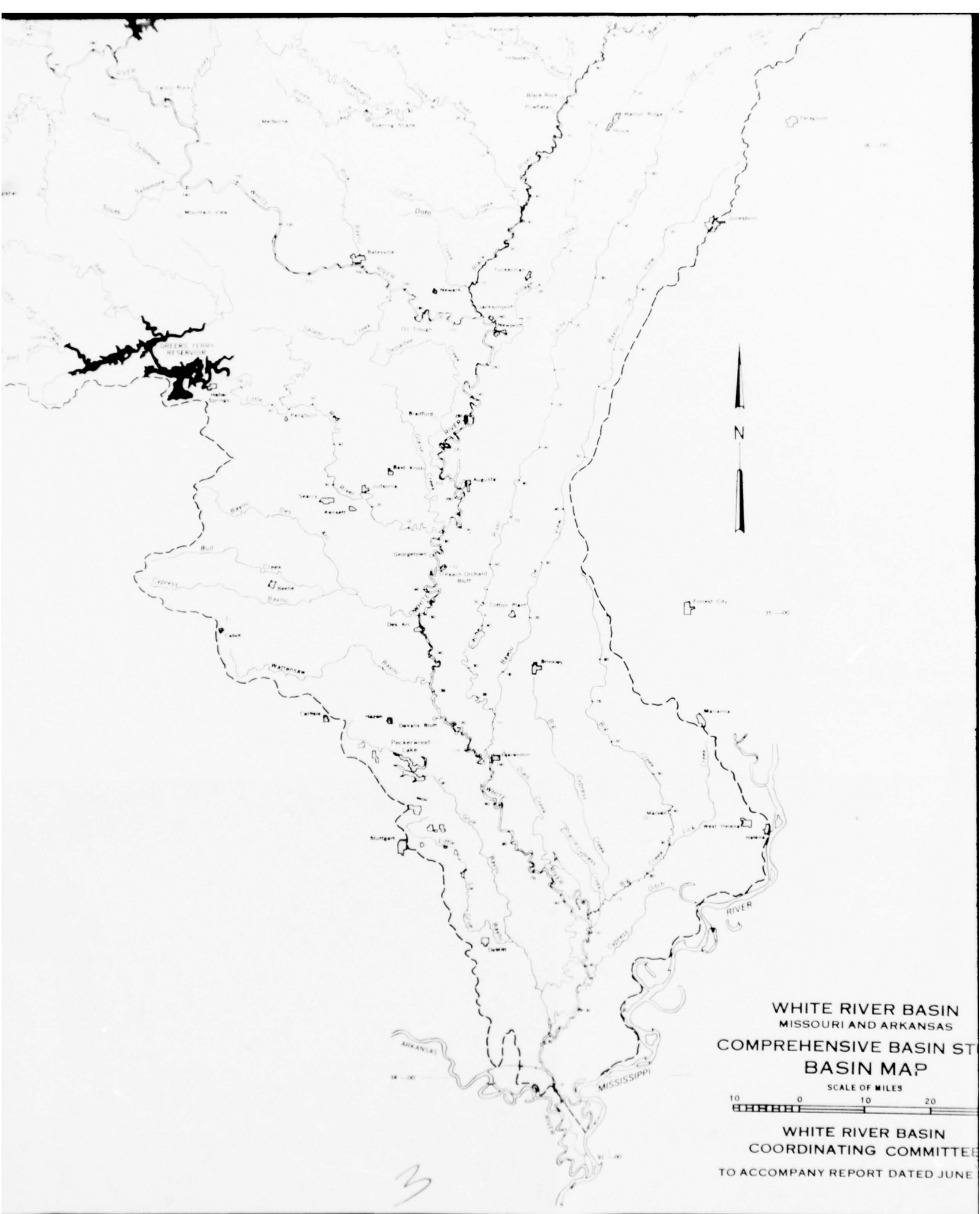


WHITE RIVER BASIN
MISSOURI AND ARKANSAS
COMPREHENSIVE BASIN ST
BASIN MAP

SCALE OF MILES
10 0 10 20

WHITE RIVER BASIN
COORDINATING COMMITTEE

TO ACCOMPANY REPORT DATED JUNE

Black River are the Current, Eleven Point, Spring, and Strawberry Rivers. These are all mountain streams which enter the Black River on its right bank.

TABLE 1

DRAINAGE AREAS AND RIVER MILES

Tributary	Drainage area (square miles)		Location of mouth of tributary (river mile)	
	First tributary	Second tributary	White River	Tributary
Kings River	594		572.4	
James River	1.456		549.8	
Crooked Creek	466		394.9	
Buffalo River	1,338		387.7	
North Fork River	1,825		376.4	
Black River	8,520		264.8	
Current River		2,613		96.2
Eleven Point River		1,196		72.0
Spring River		1,215		72.0
Strawberry River		811		32.7
Little Red River	1,792		182.6	
Bayou Des Arc	682		149.3	
Cache River	2,025		101.2	
Bayou DeView		694		10.0
Big Creek	1,027		51.9	
La Grue Bayou	595		20.3	

d. Downstream from Newport, Arkansas, the large tributaries of the White River are Little Red River, Bayou Des Arc, Cache River, Big Creek, and La Grue Bayou. All of these except the Little Red River are typical alluvial streams although the headwaters of Bayou Des Arc and La Grue Bayou drain areas in the Ozark escarpment. The Little Red River is a typical mountain stream until it enters Greers Ferry Reservoir.

10. UPSTREAM WATERSHEDS

The elevation differentials of some watersheds in the steeper terrain of the Ozark Plateaus Province may be as great as 1,200 feet in the upper White River area. Average channel slopes in this area range from 12 to 25 feet per mile with minimum and maximum slopes of about 8 and 35 feet per mile, respectively. In the less rugged mountain areas in the north and east parts of the basin, the average channel slopes range from 5 to 15 feet per mile. Channel slopes in the Coastal Plain area are generally less than 1 foot per mile.

11. LAND RESOURCES

a. Soils in the southwestern part of the Ozark Plateaus are derived mainly from sandstone and shale, are moderate to shallow in depth, and are generally moderate to low in agricultural productivity. Except for one small area of granite soils in the northeast corner, the rest of the soils in the Ozark Plateaus are derived from limestone and chert, are generally shallow, and are moderate to low in agricultural productivity. Soils of the Coastal Plain part of the basin are alluvial, generally deep, and high to moderate in agricultural productivity.

b. About 11 million acres or 62 percent of the basin is in forest. Approximatly three-fourths of this is in the Ozark Plateaus. About 13 percent or 2.4 million acres is cropland of which about 80 percent is in the Coastal Plain. Some 2.9 million acres, or 16 percent, is in pasture. About 75 percent of this is in the Ozark Plateaus. Large lakes and streams account for about 1 percent of the basin, and another 1 percent or 130,000 acres is urban. The rest of the land, about 7 percent, is used for highway, railway, and transmission lines rights-of-way; and mining operations.

12. CLIMATOLOGY

a. Temperature. The climate of the White River Basin is classified as humid and continental and exhibits a variable temperature. Maximum and minimum temperatures of 113 and -29 degrees F. have been recorded in the northern part and 110 and -13 degrees F. in the southern part of the basin. The average temperature ranges from about 55 degrees F. in the northern part to 65 degrees F. in the southern part of the basin.

b. Precipitation. The average annual precipitation ranges from about 42 inches in the northern part to about 53 inches in the southern part of the basin. The maximum precipitation recorded in the basin in any one year was 91.7 inches in 1927 at Marshall, Arkansas (Buffalo River Basin), and the minimum was 19.5 inches in 1879 at Hollister, Missouri (Upper White River Basin). Annual snowfall over the White River Basin averages about 13 inches in the northern part to about 6.0 inches in the southern part. Maximum annual amounts recorded have ranged from 32.1 inches to 26.6 inches from the northern part to the southern part of the basin, and minimum annual amounts have ranged from 2.8 inches to a trace from north to south. Table 2 shows the average monthly precipitation and the monthly distribution of the average annual precipitation in the basin, based on long-term records. Figure 1 shows isohyets of average annual precipitation over the White River Basin.

TABLE 2

AVERAGE MONTHLY AND ANNUAL PRECIPITATION
WHITE RIVER BASIN

Month	Average precipitation (inches)	Percent of average annual precipitation
January	2.5	5.5
February	2.9	6.4
March	4.0	8.8
April	4.6	10.1
May	5.4	11.8
June	4.5	9.8
July	3.6	7.9
August	4.1	8.9
September	3.7	8.1
October	3.6	7.9
November	3.5	7.6
December	3.3	7.2
Annual	45.7	100.0

c. Evaporation. Technical Paper No. 37 of the Weather Bureau, U. S. Department of Commerce, contains Evaporation Maps for the United States. The Class A pan evaporation data used in compiling the maps were obtained from all available sources which included 146 stations with complete annual records and 151 stations with seasonal records for a 10-year required period (1946-1955, inclusive). Lake evaporation was computed for 255 first-order Weather Bureau stations using air temperatures, dew point, solar radiation, and wind data. On the basis of these maps, the following average evaporation data are indicated for the White River Basin.

	Evaporation in inches	
	Average	Range
Pan evaporation, annual	55	50-60
Lake evaporation, annual	41	38-44
Pan or lake evaporation, May-October, in percent of annual	73	72-75

d. Storms. The White River Basin is subject to several types of storm rainfall. The more general storms which occur during the winter and early spring are produced by a clash of cold fronts (arctic and/or polar air masses) with moisture laden warmer air currents from the Gulf of Mexico. Resulting precipitation from this source generally occurs in moderate to large amounts. Summer storms are almost entirely of the convective and air mass variety which result in moderate to heavy rainfall amounts accompanied by thunder, hail, high winds, and

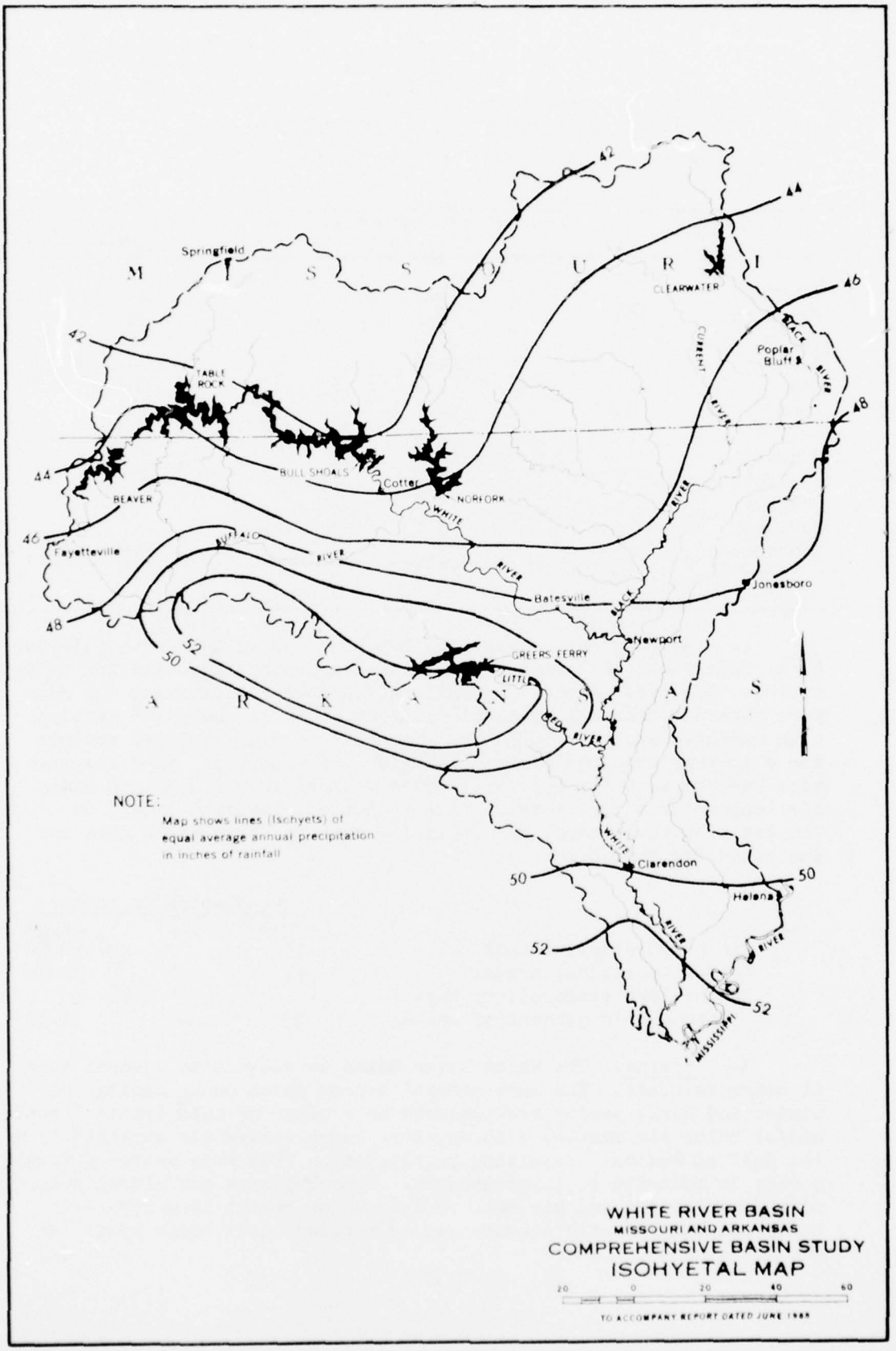

Springfield
MISSOURI
CLEARWATER
TABLE ROCK
BULL SHOALS
Cotter
NORFORK
BEAVER
Fayetteville
BUFFALO RIVER
WHITE RIVER
Batesville
Jonesboro
Newport
GREERS FERRY
LITTLE RED RIVER
ARKANSAS
Poplar Bluff
CURRENT RIVER
BLACK RIVER
Clarendon
Helena
MISSISSIPPI
42
44
46
48
50
52
NOTE:
Map shows lines (Isohyets) of equal average annual precipitation in inches of rainfall
WHITE RIVER BASIN
MISSOURI AND ARKANSAS
COMPREHENSIVE BASIN STUDY
ISOHYETAL MAP
20 0 20 40 60
TO ACCOMPANY REPORT DATED JUNE 1969

FIGURE 1

occasional tornadoes. Also, storms over the basin sometimes are associated with or follow tropical hurricanes. Some of the notable storms of record are discussed in the following paragraphs.

(1) Notable storms which occurred over large portions of the White River Basin occurred in August 1915, January 1916, April 1927, March 1935, February 1938, May 1943, April and June 1945, January 1949, and April-May 1957. The storm of April 4 to 12, 1927, averaged 11.7 inches of rainfall over the entire White River Basin and ranged from less than 6 inches over parts of the James River watershed in Missouri to 20.9 inches at Marshall, Arkansas. More than 15 inches were recorded at four other stations in the basin. This storm produced one of the more severe floods in the White River Basin.

(2) The storms of May 6 to 11 and May 13 to 20, 1943, were severe in the upper part of the White River Basin. The storm of May 6 to 11 averaged about 6 inches of rainfall over the basin, ranging from about 1 inch near the mouth of the White River to 13.1 inches at Rogers, Arkansas. The second storm covered a smaller area averaging about 2.1 inches over the basin but with a center of about 11 inches in the James River watershed.

(3) A series of small to moderate magnitude storms beginning in February 1945 culminated in the storm of April 11 to 16 during which precipitation ranged from about 1 inch in the southeastern part of the basin to 10.9 inches in the Buffalo River watershed and averaged about 5.5 inches over the entire basin. A storm in June 1945 produced an average of about 11 inches over the basin and was particularly severe over the central-northeastern part of the basin watershed which received an average of about 13.5 inches. Total precipitation during the extended period from February through June averaged about 43 inches over the basin.

(4) Many severe storms have occurred over smaller areas of the basin. On May 9, 1961, the Crooked Creek watershed above Harrison, Arkansas, and the upper Osage Creek watershed received an average precipitation of 5.0 to 9.0 and 7.0 inches, respectively, within a 2- to 3-hour period. West Plains, Missouri, and surrounding areas experienced about 4.8 inches of rainfall on May 7 to 8, 1961. Cassville, Missouri, recorded 7.2 inches of rainfall in a 24-hour period on May 13 to 14, 1956. On June 13, 1964, 4.3 inches of rainfall was recorded at Cassville. Reeds Spring, Missouri, experienced a major storm on June 5, 1965, when more than 5 inches of precipitation occurred in a little over an hour according to an unofficial measurement. A short duration storm occurred on the South Fork of Buffalo Creek, a 66-square mile tributary of the Current River about 10 miles upstream from Doniphan, Missouri, in June 1965 when about 10 inches of rainfall occurred according to an unofficial measurement.

13. STREAMFLOW CHARACTERISTICS

a. The streamflow characteristics throughout the basin are affected mainly by the topography and the type of underlying formations. Runoff from the Ozark Plateaus is rapid and the streams course through deep narrow valleys that have relatively steep gradients. In areas where the underlying rock is impermeable, most of the streamflow consists of surface runoff. In other areas, where subterranean drainage is well developed with a large number of springs, surface runoff is a lesser percent of streamflow. There are seven springs in the White River Basin known to have an average annual flow exceeding 100 cubic feet per second. The largest of these is Big Spring in the Current River area that has an average flow of 428 cubic feet per second and minimum flow of 236 cubic feet per second during the 45-year period of record.

b. Runoff and streamflow in the Coastal Plain are sluggish. The meandering channels in this area are characterized by flat slopes and relatively small capacities. Old river and creek channels form many lakes and sloughs in this area. The underlying strata are generally slowly permeable. Evaporation and transpiration losses are larger than in the mountainous area.

14. RUNOFF

a. Streamflow varies widely throughout the White River Basin. The average flow of the South Fork of Little Red River at Clinton, Arkansas, is about 1.77 cubic feet per second per square mile (c.s.m.) of the drainage area. This is approximately twice the average flow of about 0.88 c.s.m. at several locations in the northern part of the basin. The average flow for the whole basin is about 1.17 c.s.m. which is equivalent to 16 inches annually. Larger rainfall amounts and more impervious terrain in areas of high streamflow and the prevalence of caverns and sinkholes in the areas of low streamflow partially account for the variations. Also, a significant difference prevails over adjacent areas in the northern part of the basin where there are springs and caverns. Noteworthy is the 361-square mile drainage area of the Upper Eleven Point Basin at Thomasville, Missouri, where the flow averages only 0.24 c.s.m., compared to the 2,038-square mile area of the adjacent Current River at Doniphan, Missouri, where it averages about 1.32 c.s.m. Isobars of annual streamflow are shown on Figure 2.

b. Runoff characteristics, average streamflow, and low-flow yield are discussed further in Appendix D, Geohydrology. A summary of streamflow data at locations where stream-gaging records are available for a significant period of record for principal locations on the White and Black Rivers and at the furthermost downstream location on the major tributaries is given in Table 3. The table indicates the year in which the maximum and minimum annual flows occurred under conditions prevailing at time of measurement.

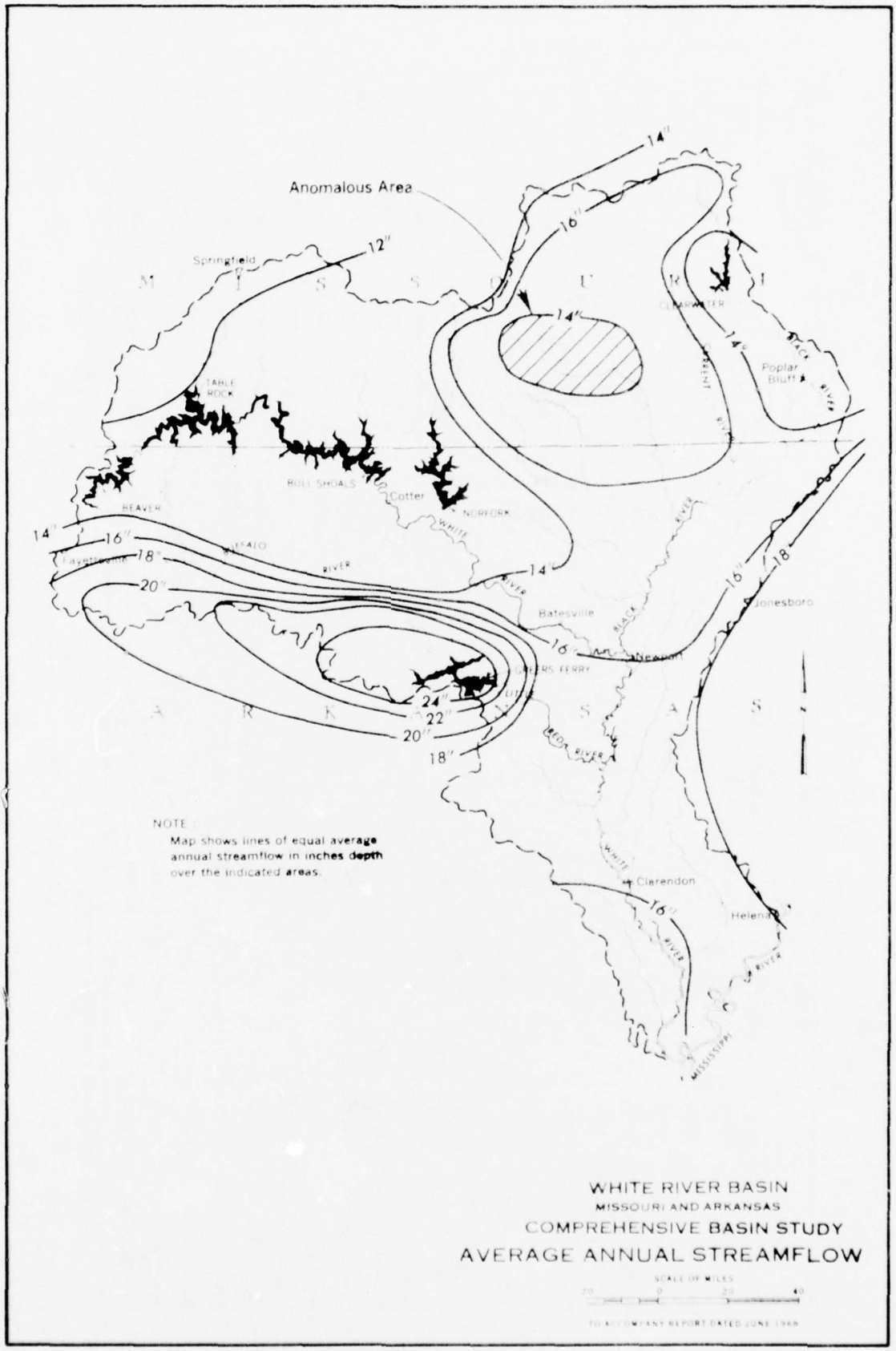

Anomalous Area
Springfield
12"
14"
16"
18"
20"
22"
24"
TABLE ROCK
BULL SHOALS
Cotter
NORFORK
WHITE
BUFFALO
RIVER
BEAVER
Batesville
Jonesboro
Poplar Bluff
BLACK
CURRENT
STRAIGHT
Clarendon
Helena
MISSISSIPPI
NOTE:
Map shows lines of equal average annual streamflow in inches depth over the indicated areas.
WHITE RIVER BASIN
MISSOURI AND ARKANSAS
COMPREHENSIVE BASIN STUDY
AVERAGE ANNUAL STREAMFLOW
SCALE OF MILES
TO ACCOMPANY REPORT DATED JUNE 1968

FIGURE 2

TABLE 3

SUMMARY OF ANNUAL STREAMFLOW(1)
WHITE RIVER BASIN, ARKANSAS AND MISSOURI

Location	River	Drainage area (sq. mi.)	Average			Maximum			Minimum		
			Volume (1,000 acre-feet)	Rate (c.f.s.)	Rate (c.s.m.)	Year	Volume (1,000 acre-feet)	Rate (c.f.s.)	Year	Volume (1,000 acre-feet)	Rate (c.f.s.)
Beaver, Ark.	White	1,186	1,105.4	1,530	1.29	1927	2,615.4	3,619	1954	285.2	395
Berryville, Ark.	Kings	532	401.8	555	1.04	1945	905.83	1,251	1954	63.89	88
Galena, Mo.	James	987	668.9	924	0.94	1927	1,805.8	2,499	1954	85.88	119
Table Rock Dam, Mo.	White	4,020	3,190.5	4,415	1.10	1927	7,365.3	10,191	1954	528.1	731
Bull Shoals Dam, Ark.	White	6,036	4,693.9	6,495	1.08	1927	10,454.8	14,466	1954	879.8	1,217
Flippin, Ark.	White	6,067	4,220.0	5,829	0.96	1945	9,984.73	13,792	1936	1,598.6	2,206
Rush, Ark.	Buffalo	1,091	936.1	1,293	1.19	1945	2,394.49	3,308	1963	273.0	377
Norfork Dam, Ark.	North Fork	1,806	1,373.0	1,900	1.05	1927	3,174.5	4,392	1954	481.0	666
Calico Rock, Ark.	White	9,965	7,035.0	9,717	0.98	1945	16,574.0	22,893	1940	3,451.76	4,768
Poplar Bluff, Mo.	Black	1,245	900.6	1,244	1.00	1945	1,712.34	2,365	1954	408.60	564
Doniphan, Mo.	Current	2,038	1,948.0	2,691	1.32	1927	3,758.9	5,201	1954	959.95	1,326
Pocahontas, Ark.	Black	4,843	4,036.0	5,575	1.15	1950	7,833.20	10,820	1954	1,725.58	2,383
Imboden, Ark.	Spring	1,162	958.5	1,324	1.14	1945	1,997.96	2,760	1941	382.02	528
Black Rock, Ark.	Black	7,323	5,870.0	8,108	1.11	1927	15,955.8	22,078	1954	2,571.60	3,552
Poughkeepsie, Ark.	Strawberry	476	369.2	510	1.07	1945	784.57	1,084	1936	103.02	142
Newport, Ark.	White	19,812	16,210.0	22,390	1.13	1927	40,850.4	56,524	1954	7,082.6	9,782
Heber Springs, Ark.	Little Red	1,146	1,273.0	1,759	1.53	1945	2,691.62	3,718	1954	412.73	571
DeValls Bluff, Ark.	White	23,431	18,570.0	25,650	1.09	1950	37,122.0	51,274	1936	7,336.90	10,134
Patterson, Ark.	Cache	1,041	831.1	1,150	1.10	1949	1,704.8	2,359	1941	260.96	361
Clarendon, Ark.	White	25,497	21,284.9	29,400	1.15	1927	57,962.9	80,203	1936	7,409.2	10,246

(1) All data are for experienced conditions.

15. FLOODS

a. Flooding in the White River Basin, as in many other basins, results from both short intense storms and extended periods of heavy precipitation. In the Ozark Plateaus Province, the steep slopes of the tributary streams cause rapid concentration of storm runoff and early peaks. In this area the short intense storms cause the most severe flooding. This type of flood occurs with little warning but is of short duration. The relative magnitude of peak flows in the Ozark Plateaus depends on variable stream and storm patterns that cause the critical synchronization of flood flows as well as on the total volume of runoff.

b. Flood peaks in the Coastal Plain generally result from longer storms or series of storms over major portions of the basin. The runoff from these storms reaches the Coastal Plains rapidly and the sudden flow results in general flooding. The crests move slowly through the Coastal Plain because of its large amount of overbank storage and extended periods of damaging stages are experienced. The volume of runoff that reaches the Coastal Plain within 2 to 4 days is the principal determining factor for peak flows in this area whereas synchronization of flows is the determining factor in the Ozark areas.

c. In both the Ozark Plateaus and Coastal Plain portions of the basin, flooding of the lower bottom areas occurs several times a year. Flooding of the higher portions of the flood plains occurs less frequently. Floods occur most often in the basin during the months of March, April, and May. However, large floods have been known to occur in every month of the year.

d. No single flood has produced the maximum experienced stages or discharges in all reaches of the White River and its tributaries. Notable floods which covered large portions of the basin occurred in August 1915, January 1916, April 1927, March 1935, February 1938, May 1943, April 1945, January 1949, and April-May 1957.

SECTION III - ECONOMIC DEVELOPMENT

16. LOCATION OF ECONOMIC STUDY AREA

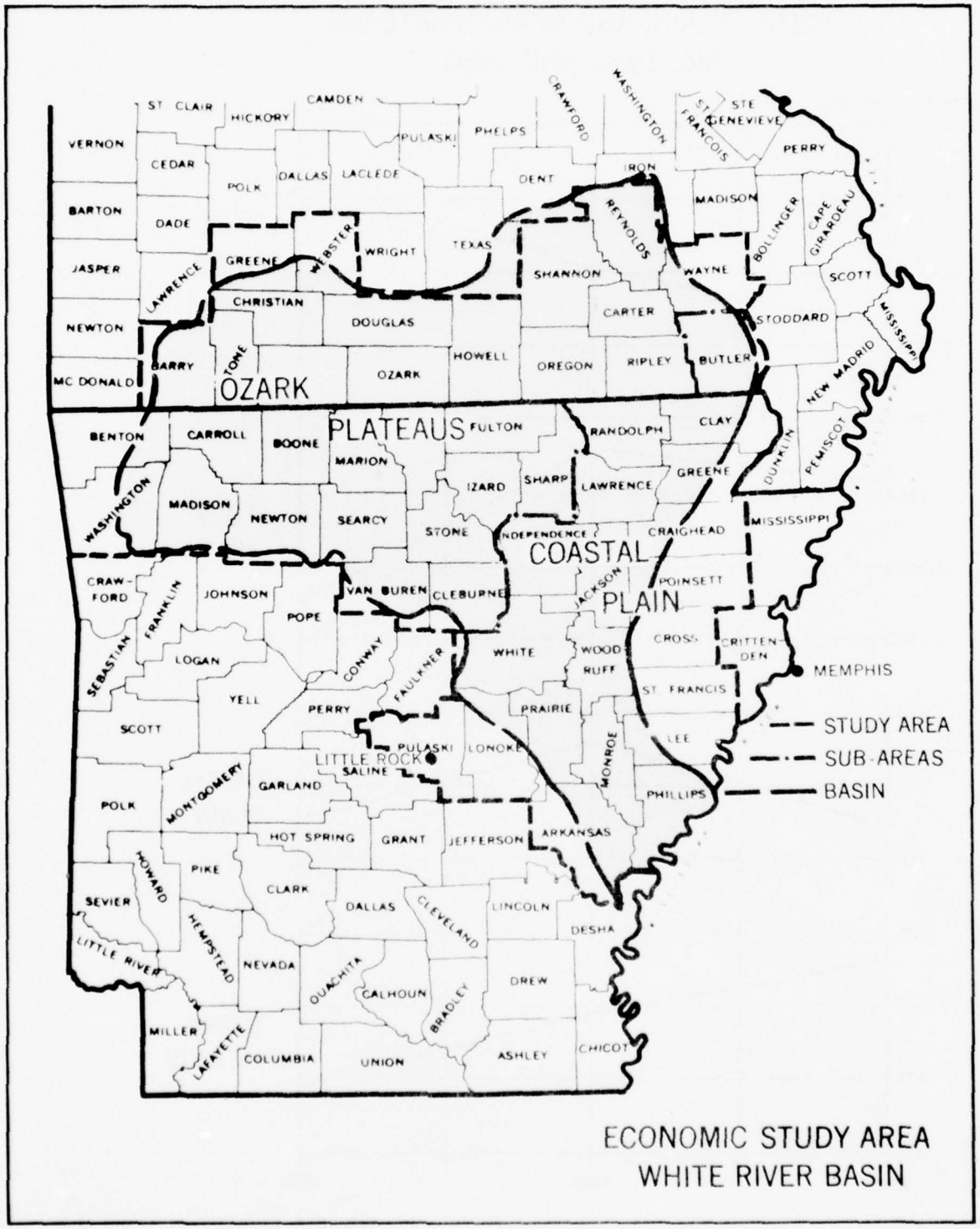
The economic activity of an area is influenced by its resources, population, employment, and personal income. For comprehensive water resource planning the White River Basin economic study area is the region directly affected by the utilization of the water and related land resources of the basin. The study area consists of 50 counties in southern Missouri and northern and eastern Arkansas, as shown on Figure 3. For analysis and comparative purposes these 50 counties are further grouped into two sub-areas, the Coastal Plain and the Ozark Plateaus. Economic development in the Coastal Plain, where land is flat to gently rolling, has been heavily oriented to commercial production of agricultural commodities. In the Ozark Plateaus, where the terrain is hilly or mountainous, economic activity and development have been more diverse.

17. CURRENT ECONOMIC DEVELOPMENT

a. Population. According to the Censuses of Population, the study area contained about 1,238,000 people in 1950 and about 1,188,000 people in 1960. Movement of rural agricultural workers and their families to urban areas, often located outside the study area, has resulted in a net population decrease of approximately 50,000. Increased mechanization of farm operations, with a resulting decline in farm employment, and the absence of alternative rural employment opportunities have contributed to out-migration and urbanization trends. Lack of adequate alternative employment opportunities in the study area is reflected in the large number of persons age 20 to 44 who have left the study area. The movement of the rural population to urban areas is continuing, but recent population estimates indicate that net out-migration has ceased and that the total study area population has begun to increase. Historical populations of the United States, study area, and the Coastal Plain and Ozark Plateaus portions of the study area are shown in Figure 4.

b. Employment. Between 1950 and 1960 agricultural employment in the study area declined from 155,000 to 77,000 and non-agricultural employment increased from 257,000 to 315,000. However, the gain in non-agricultural jobs was not adequate to provide jobs for all displaced agricultural workers. Between 1950 and 1960, total study area employment decreased from 412,000 to 391,000.

(1) The major cause of the decline in total employment was the heavy commitment of labor and capital resources to a slow growth industry - agriculture. The study area economy is currently undergoing a rapid reorientation as employment in other industries grows and agricultural employment declines. However, because of its



ECONOMIC STUDY AREA
WHITE RIVER BASIN

FIGURE 3

TOTAL POPULATION
UNITED STATES, STUDY AREA,
COASTAL PLAIN, AND OZARK PLATEAUS
1940, 1950, AND 1960

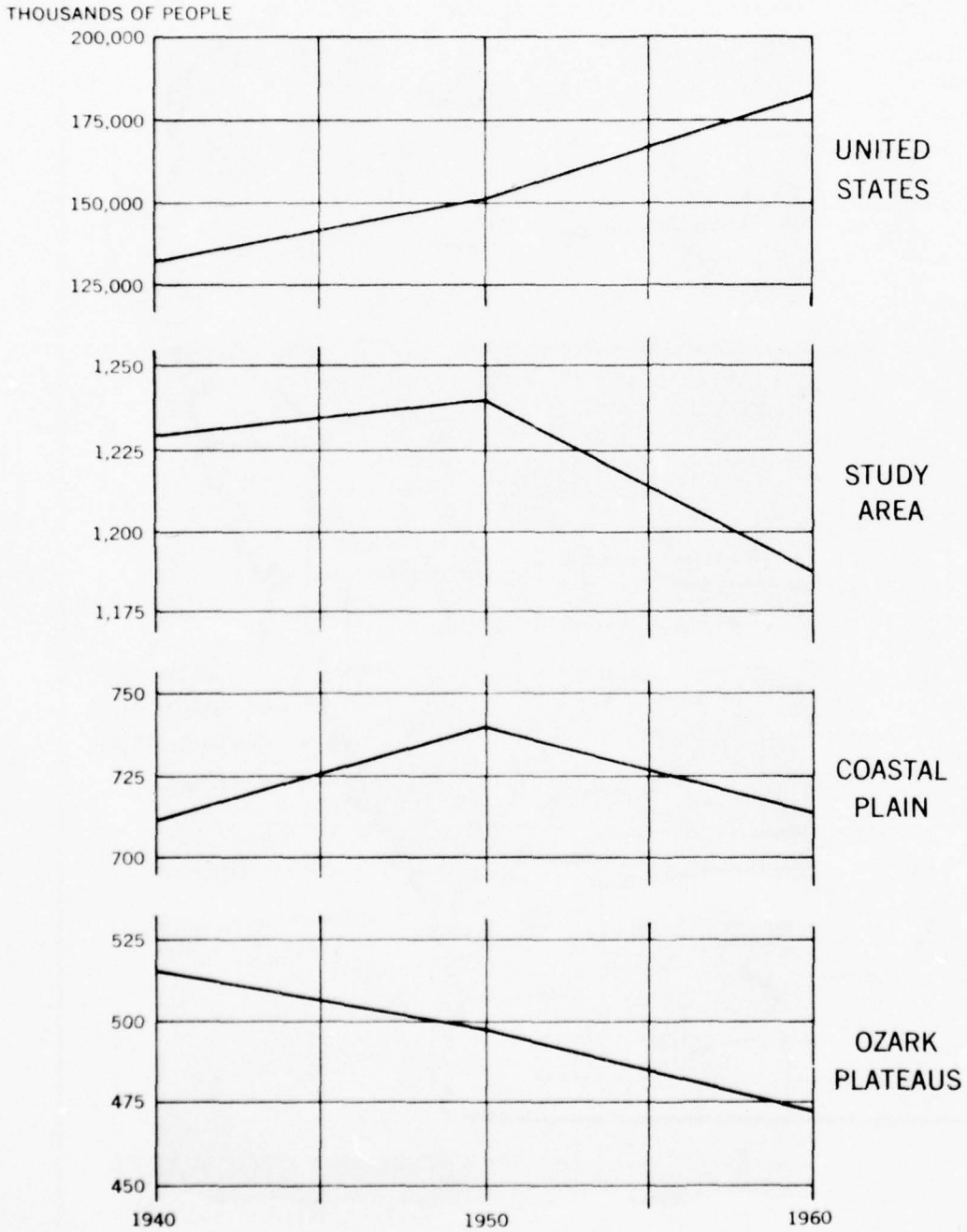


FIGURE 4

agricultural resources, the study area will continue to derive a greater share of employment and income from agriculture than will the Nation as a whole.

(2) Manufacturing industries which experienced large increases in employment between 1950 and 1960 include machinery, food and kindred products, and apparel and textile mill products. These and other increases in manufacturing employment created large numbers of jobs not only in manufacturing industries but also in service and trade activities. The service and trade categories include wholesale and retail activities; business, repair, and professional services; personal services; communications and public utilities; and other similar types of employment. Employment changes between 1950 and 1960 in the Coastal Plain and Ozark Plateaus were similar. The distribution of employment by industries is shown on Figure 5.

c. Personal income. Study area personal income, a measure of total wealth, increased from $1.3 billion in 1950 to $1.7 billion in 1960. This dollar increase, as well as all subsequent dollar amounts, is stated in terms of dollars of 1960 purchasing power. The increase in total personal income is particularly significant when considered with the declines in total population and total employment which took place during the same time period.

(1) Per capita personal income, obtained by dividing total personal income by total population, is an excellent measure of the general level of welfare in an area. In 1950 study area per capita personal income was $830, which was less than half of the national amount for that year. By 1960 it had advanced to $1,410, which was more than 60 percent of the 1960 national level.

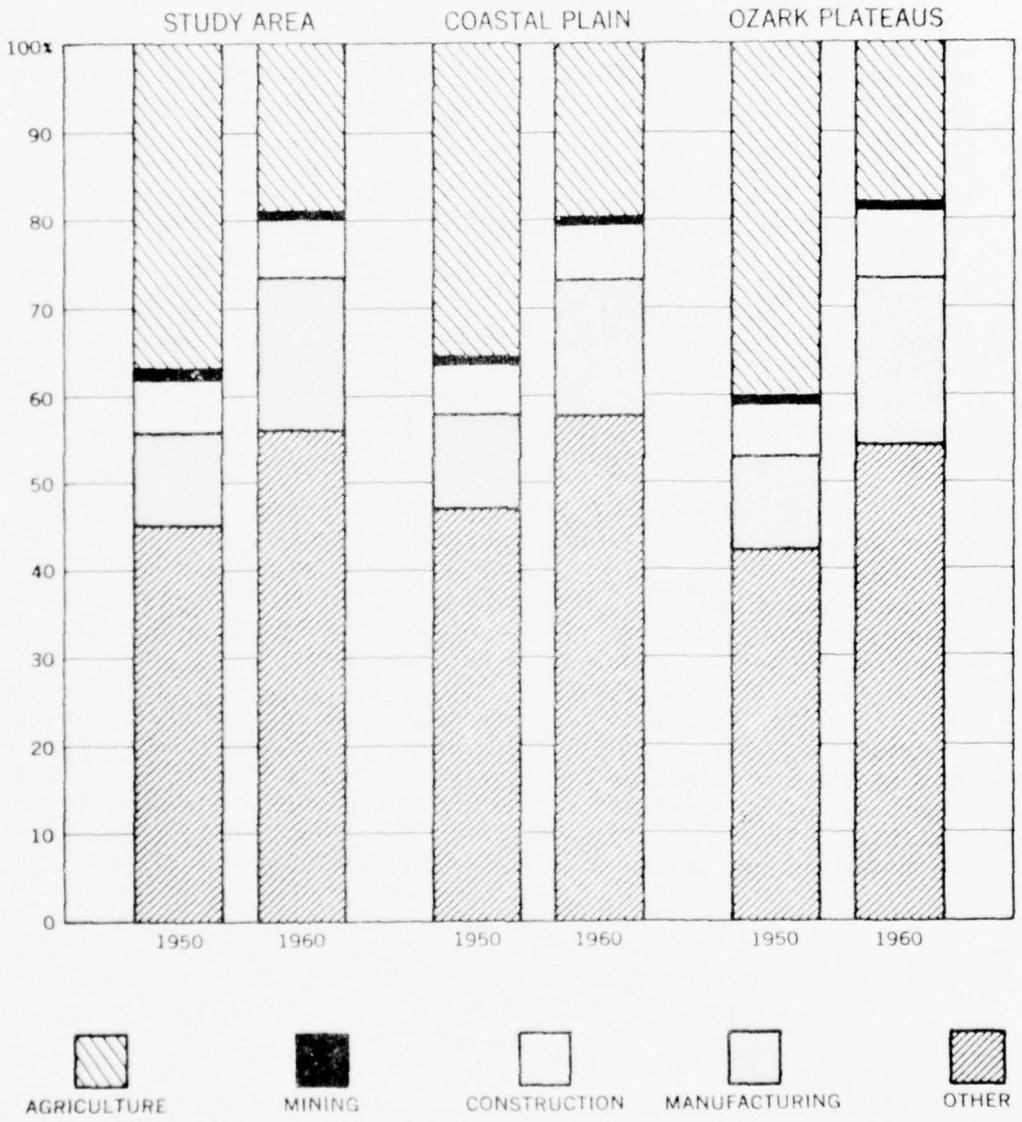
(2) Low labor force participation and the historical concentration of study area economic activity in agriculture have contributed to the low levels of per capita personal income. The increasing importance of non-agricultural activities in the study area economy has contributed to the growth in per capita personal income. Table 4 shows the total and per capita personal income for 1950 and 1960.

TABLE 4

TOTAL PERSONAL AND PER CAPITA PERSONAL INCOME
STUDY AREA, COASTAL PLAIN, AND OZARK PLATEAUS
1950 and 1960
(1960 dollars)

Area	Personal income		Per capita income	
	1950	1960	1950	1960
Study area	$1,261,000	$1,670,000	$830	$1,410
Coastal Plain	785,000	1,047,000	870	1,460
Ozark Plateaus	476,000	623,000	780	1,320

COMPONENT PROPORTIONS OF TOTAL EMPLOYMENT STUDY AREA, COASTAL PLAIN, AND OZARK PLATEAUS 1950 - 1960



SOURCE: TABLE 48

FIGURE 5

d. Land use. In 1959, approximately 60 percent of the land in the study area was classified as "farmland." About one-half of this farmland was used for crop production, one-third was in forest land, and the remainder was used for "other pasture" or "other farmland." The remaining 40 percent of study area land was classified as non-farmland and was made up of urban areas, forest lands, water areas, and other miscellaneous lands. Figure 6 shows the 1959 study area land use and the same data for the Coastal Plain and Ozark Plateaus.

LAND USE
STUDY AREA, COASTAL PLAIN, AND OZARK PLATEAUS
1959

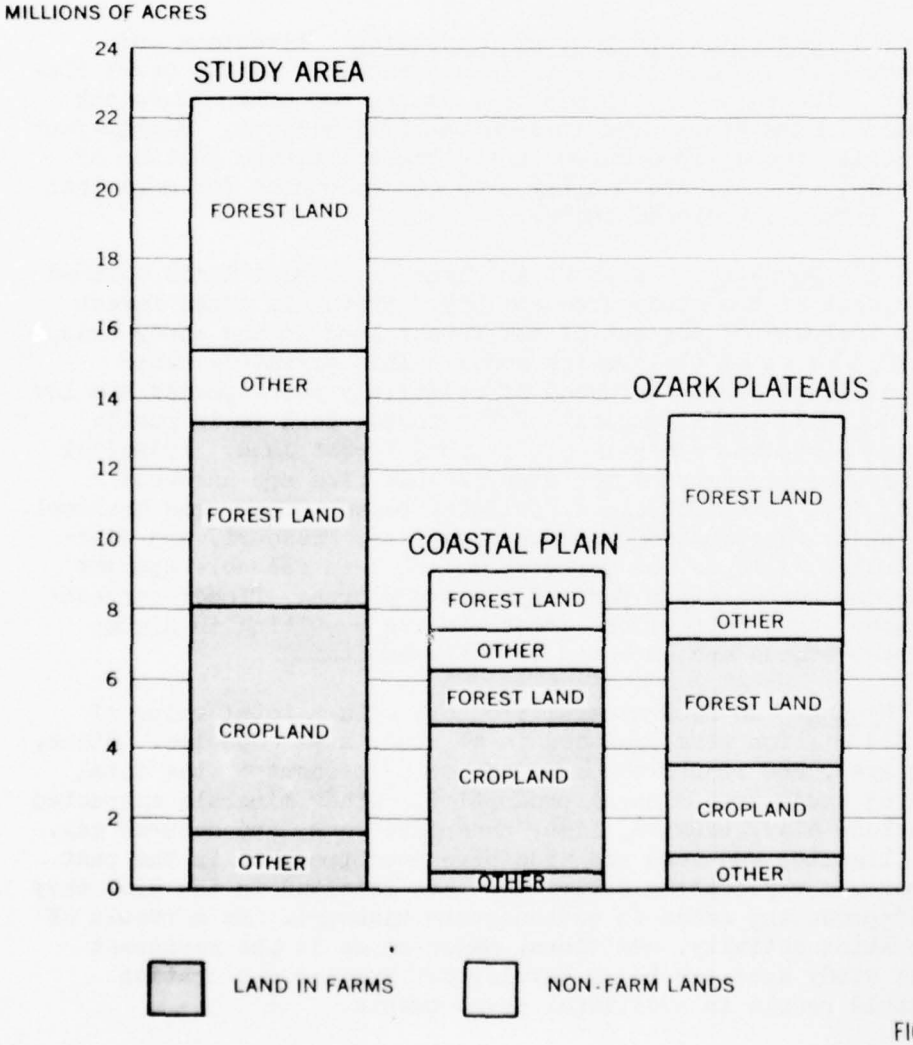


FIGURE 6

e. Agriculture. Historically the study area has been heavily oriented toward the production of agricultural commodities, including crops, livestock, and poultry. Mechanization of farming operations in recent decades has brought about a significant reduction in agricultural employment.

(1) Crop production. Crop production is principally located in the fertile Coastal Plain bottom lands. The three major crops at this time are cotton, rice, and soybeans. Other crops produced in the study area include corn, corn silage, wheat, oats, barley, sorghum, hay, potatoes, vegetables, fruits, and nuts. The value of all crops in the study area in 1964 was $359 million. The Coastal Plain portion of the study area accounted for 97 percent of this production.

(2) Livestock and poultry production. Livestock and poultry production in the study area is concentrated in the Ozark Plateaus region. The value of all poultry, dairy, and other livestock products sold in the study area in 1964 was $219 million. Eighty-four percent of this production occured in the Ozark Plateaus portion of the study area. Poultry and poultry products accounted for more than half of all livestock-related income.

(3) Forestry. As shown in Figure 6, forest lands covered about 55 percent of the study area in 1959. Privately owned forest land, which includes 87 percent of all forest land in the study area, supported 78 percent of the growing stock. This privately owned growing stock is primarily hardwood of relatively poor species and low quality. The remaining 13 percent of the forest land is in public ownership and consists primarily of National Forest land. Principal uses for the wood products of the area include pine and hardwood lumber, flooring, furniture stock, pallets, posts, poles, and charcoal. Pulp mills under construction at Cape Girardeau, Missouri, and Wickliffe, Kentucky, will provide markets for the less valuable species produced in the northeastern part of the study area. Timber harvesting and timber stand improvement practices are resulting in higher quality timber stands and improved wildlife habitat.

f. Mining. In 1963 mineral products with a total value of more than $23 million were produced in 44 study area counties. Stone, sand and gravel, and iron ore accounted for 83 percent of the total value of 1963 study area mineral production. Other minerals extracted in 1963 include clay, bauxite, lime, phosphate rock, and natural gas. Manganese, lignite, and lead and zinc have been produced in the past. Recently renewed exploration activities have resulted in the discovery of new lead-producing areas in southeastern Missouri. As a result of this exploration activity, additional major mines in the northeast part of the study area are being developed. Further exploration activity could result in additional developments.

Soil Conservation Service

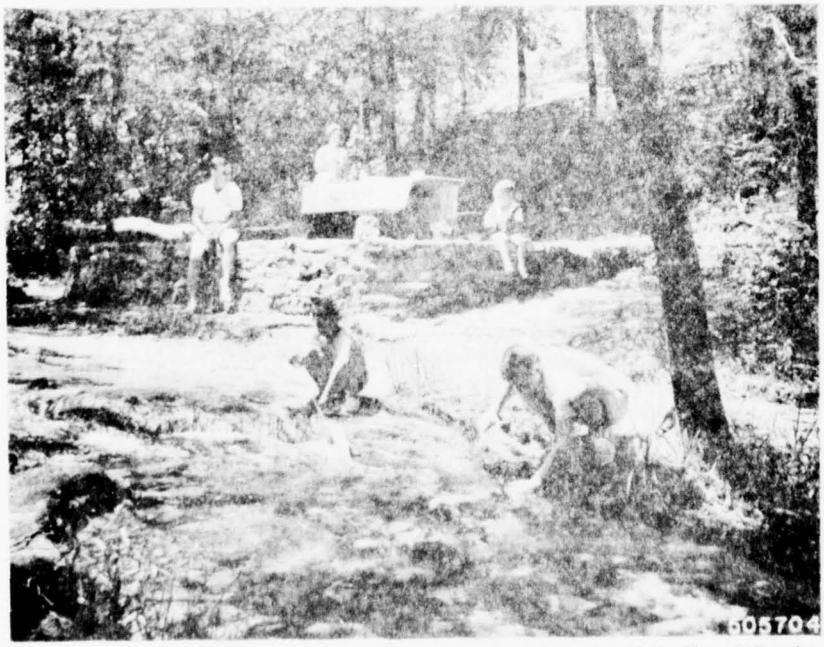
Rice production in the Coastal Plain of the White River Basin.

Soil Conservation Service

Cotton production in the Coastal Plain of the White River Basin.

U. S. Forest Service

More than half of the basin area is in forest cover, producing a variety of wood products.



U. S. Forest Service

Forests of the basin also provide aesthetic settings for outdoor recreation activities such as family picnicking.

g. Transportation. The highway transportation network in the study area is adequate for the existing state of economic development. However, the transportation required for maximum economic development is not currently available.

(1) The States and local governments have greatly improved the public road system in recent years. However, additional development of the study area highway network appears desirable. The main routes from Kansas City and St. Louis to Dallas and other major southwestern markets by-pass the area. In addition, it takes as long to travel to different tourist or business locations within some parts of the study area as it does to get there from distant metropolitan areas.

(2) In much of the Coastal Plain railroad transportation facilities are available. However, this is not true in the Ozark Plateaus. This makes the need for an adequate highway system in the Ozark Plateaus particularly important.

(3) Two cities in the study area, Little Rock, Arkansas, and Springfield, Missouri, are served by trunkline air routes, and three cities, Fayetteville, Harrison, and Jonesboro, Arkansas, are served by regional (feeder) airlines. Air taxi service is available in some other cities.

(4) Navigation on the White River at present consists of one- and two-barge tows, powered by 600 to 700 horsepower towboats. The most important commodities being moved on the river are soybeans, sand, gravel, and crushed rock. Also important are rice, wheat, logs, and materials used in connection with improvement and maintenance of waterways. Economic trends indicate that these commodities and others will continue to be shipped on the river in the future.

h. Utilities. Transcontinental gas and oil pipelines traverse the study area, and natural gas service is now available to many parts of the area. Electric power is supplied by rural electric co-ops, municipally owned and operated systems, investor-owned companies, and industrial companies. The market area for electric power produced in the White River Basin is shown on Figure 7. It includes all of Arkansas and Louisiana, most of Kansas and Oklahoma, and parts of Missouri, Mississippi, and Texas. The area was identified by the Federal Power Commission in the 1964 National Power Survey as Coordination Study Area K.

(1) Much of the hydroelectric power produced at Federal multiple-purpose projects in the White River Basin is marketed to "preference" power customers such as public bodies and cooperatives in the Preference Power User Area by the Southwestern Power Administration. The Preference Power Users Area, which is included within the boundaries of Power Supply Area K except for a portion in Southern


POWER MARKET AREAS
WHITE RIVER BASIN
KANSAS
MISSOURI
OKLAHOMA
ARKANSAS
MISS.
TEXAS
LOUISIANA
COORDINATION STUDY AREA K
AREA FOR MARKETING POWER
TO PREFERENCE POWER USERS

FIGURE 7

Missouri, is also shown on Figure 7. The Southwestern Power Administration, U. S. Department of the Interior, is the Federal agency responsible for marketing hydroelectric power generated at these projects.

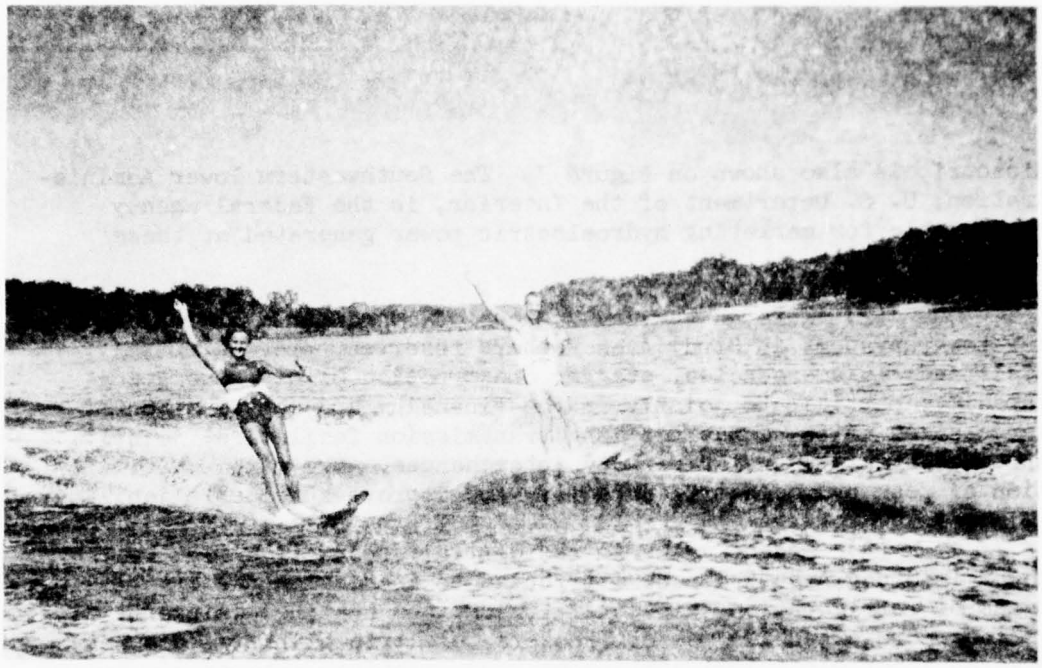
(2) Through varying degrees of coordinated operations, the power systems in Study Area K share reserves, provide mutual assistance in emergencies, stagger construction of new generating capacity, participate jointly in the financing and construction of large-sized units, construct long transmission facilities, jointly arrange large seasonal diversity interchanges, make maximum utilization of peak hydroelectric capacity, and improve service reliability.

(3) Recent gains in residential consumption of electric power in Study Area K can be attributed to increasing use of all types of refrigeration, air-conditioning, and heating equipment, as well as more extensive use of freezers, electric blankets, clothes dryers, other electrical appliances, and lighting. Use of electrical power by commercial organizations is increasing as a result of air-conditioning, diversity of retail outlets, advent of shopping centers, expansion of electric cooking, and increased recreational activities. Industries which can be expected to contribute substantially to growing demands for electric power include the petrochemical, pulp and paper, mineral, aircraft, space, food processing, cement, fertilizer, and small appliance industries.

i. Public parks and outdoor recreation. The White River Basin is nationally known for the scenic quality of its natural and man-made resources and for the recreational opportunities they offer. Basin resources provide opportunities for sightseeing, picnicking, camping, swimming, boating, water skiing, and hiking. Also available are opportunities for big and small game and waterfowl hunting and for both lake and stream fishing. National trends of increased mobility, higher income, and more leisure time have brought about increasing demands for a wide variety of weekend and extended vacation outdoor recreation opportunities. Numerous parks and related recreational areas in the basin have been the basis for establishment of the White River area as a major vacation center for mid-America. Federal, State, and local governmental investments in recreational facilities have been accompanied by numerous private developments ranging from small cabins to resort hotels and complete recreational developments.

18. PROJECTED ECONOMY

Historical economic growth can be attributed to increased efficiency in production arising from technological progress, a high rate of capital input, development of natural resources, advances in education and skills, increasing mobility of the labor force, and the



Arkansas Publicity and Parks Commission

Skiers enjoying the smooth waters of a cove on Lake Norfork.

Corps of Engineers

Swimming beaches, such as this one on Greers Ferry Lake, offer outstanding recreational opportunities.

U. S. Forest Service

Float fishing on an Ozark stream.

U. S. Forest Service

Camping - small upstream reservoirs help meet recreation needs.

economic advantages of large-scale production. Population growth and increasing female participation in the labor force have contributed to increases in annual man-hours worked. However, these influences have been partially offset by the desires of the people for shorter working hours. The resulting increase in leisure time has been and will continue to be used for increasing participation in outdoor recreation activities. All of these factors were considered in projecting the future study area economy. As stated previously, all monetary projections are in terms of 1960 dollars and, therefore, do not reflect inflationary or deflationary influences. Projections of economic activity provide a guide in determining the future needs for further development of the water and related land resources of the White River Basin.

a. Population. During the years immediately prior to 1960 the study area experienced a decline in total population. However, available estimates indicate that since that time the decline has been reversed and the population is now increasing. Between 1960 and 2020 the population is projected to increase from 1,188,000 to 2,400,000, or about double, as shown on Figure 8. Most of the increased population is expected to be concentrated in existing and emerging urban areas because of expanding employment opportunities.

b. Employment. Study area employment is projected to increase from 391,000 in 1960 to 811,000 in 2020, as shown on Figure 9. Agricultural employment is projected to decline significantly while manufacturing, construction, and other employment (including trade and service employment) is projected to increase. These trends toward increasing numbers of higher paying jobs are expected to bring about population growth, as mentioned previously, and provide a higher living standard for the study area population.

TOTAL, URBAN, AND RURAL POPULATIONS
STUDY AREA, COASTAL PLAIN, AND OZARK PLATEAUS
1950 - 2020

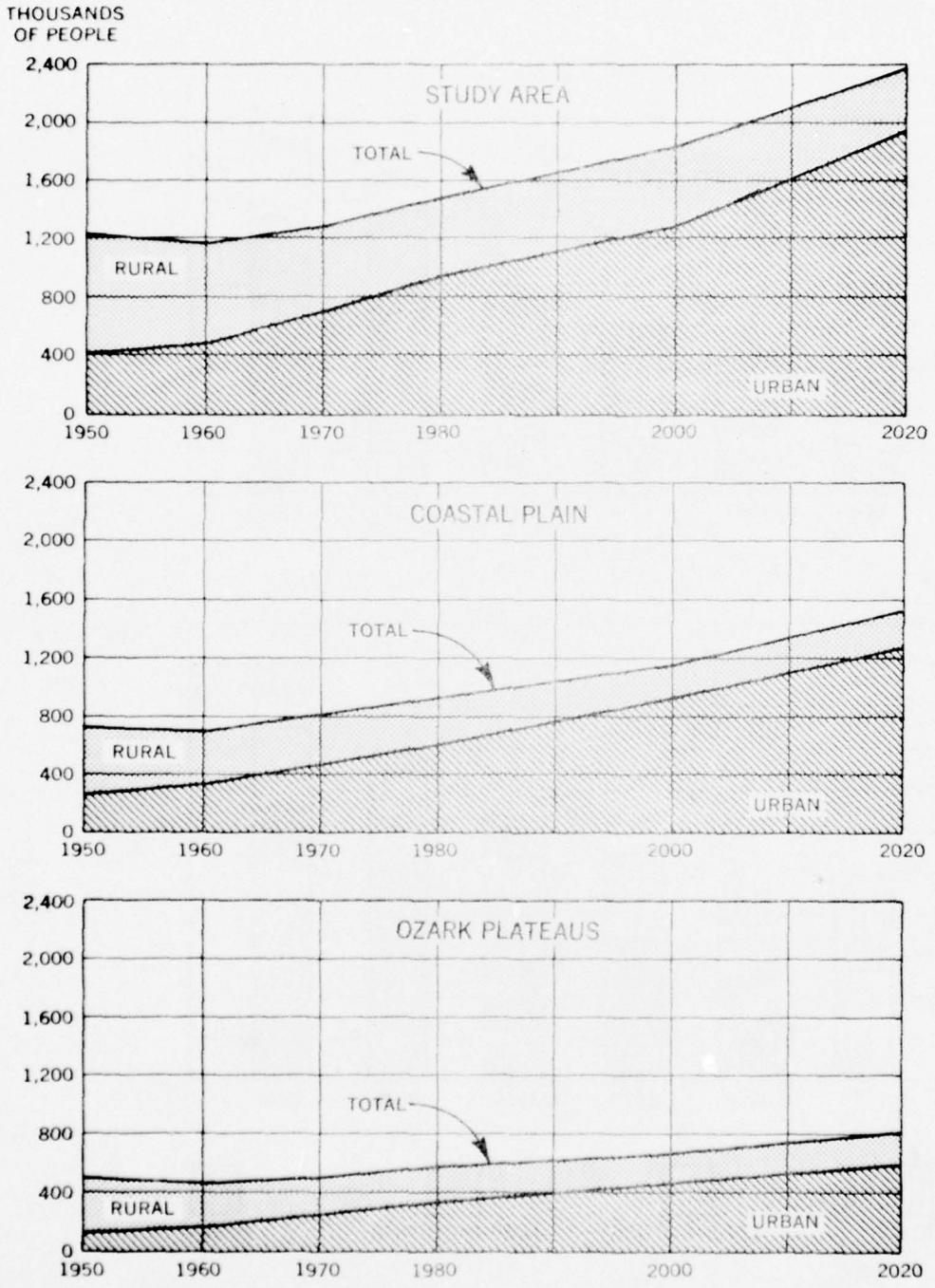


FIGURE 8

EMPLOYMENT BY INDUSTRY
UNITED STATES AND STUDY AREA
1950 - 2020

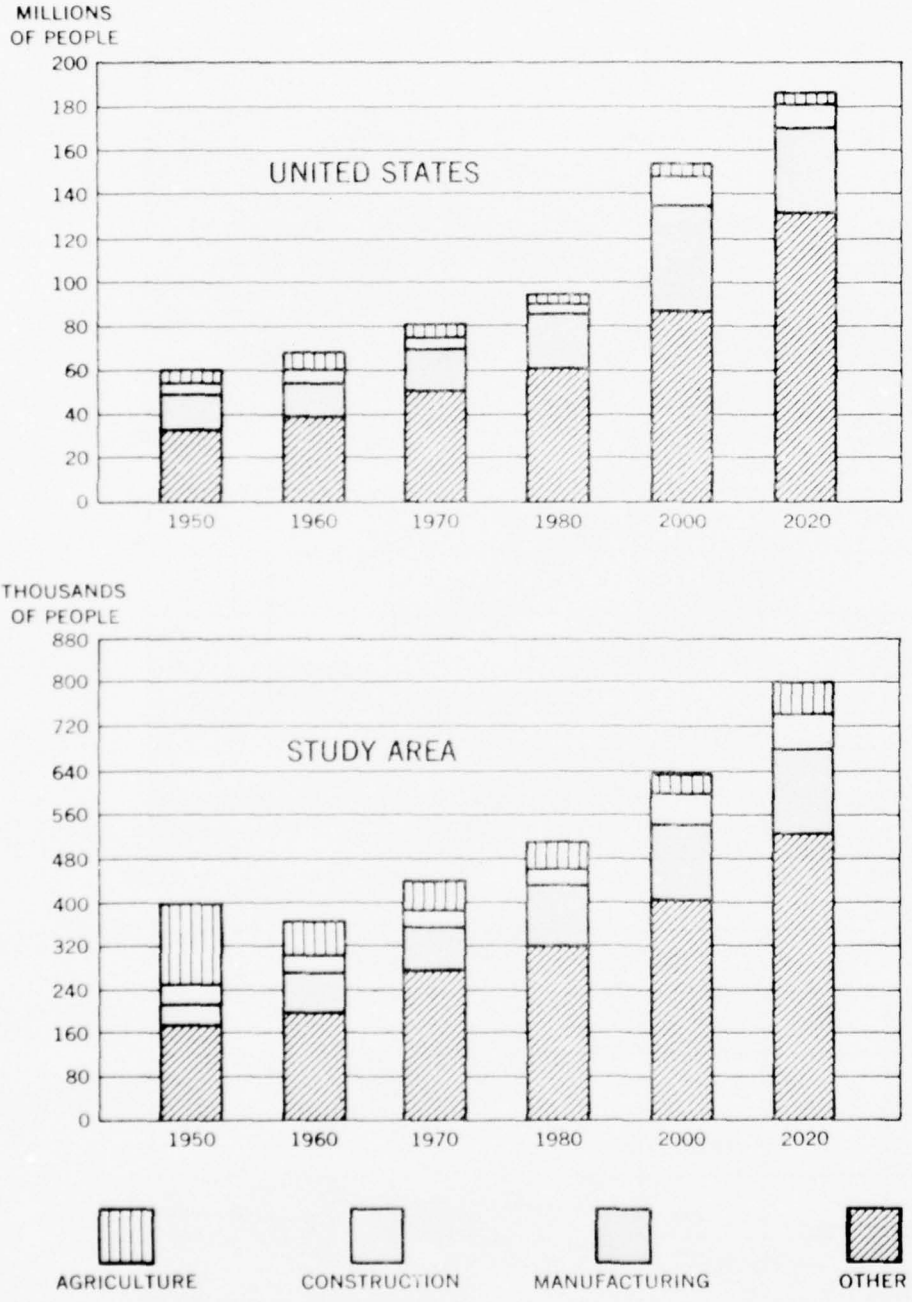


FIGURE 9

PER CAPITA PERSONAL INCOME
UNITED STATES, STUDY AREA,
COASTAL PLAIN, AND OZARK PLATEAUS
1960 - 2020

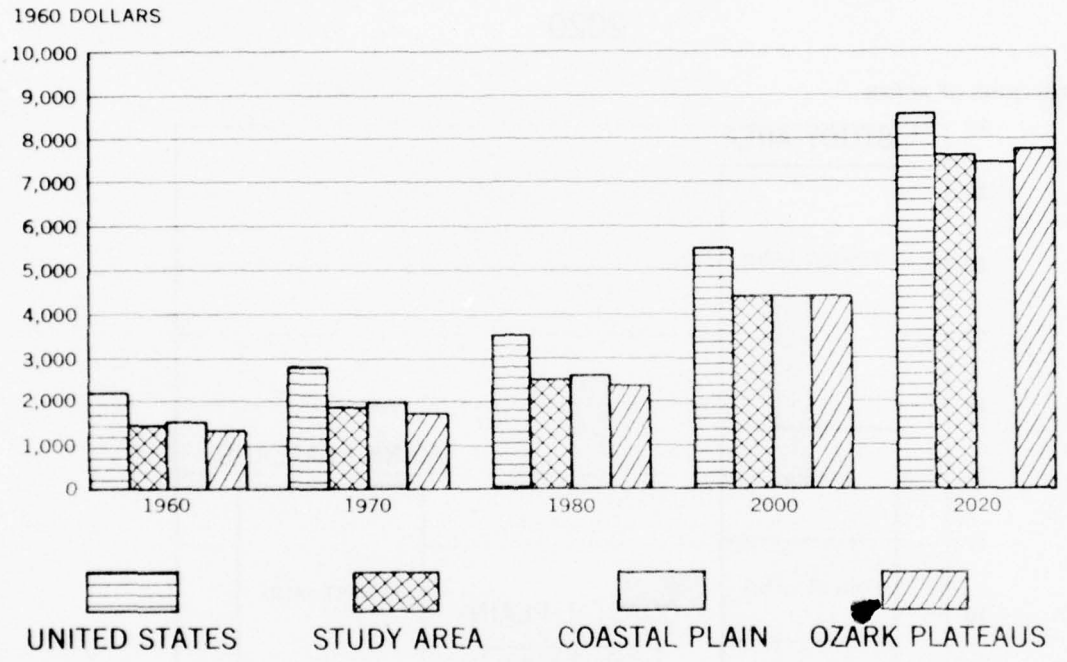


FIGURE 10

c. Personal income. Personal income is the most readily available measure of economic activity in the study area. Between 1960 and 2020 personal income in the study area is projected to continue to grow at a rate faster than national personal income. This will be the result of the study area becoming less dependent upon agricultural activities and achieving a balanced economy. Per capita personal income, shown in Figure 10, is projected to grow from $1,410 in 1960 to $7,590 in 2020. The growth of these two indicators indicates a rising standard of living and increasing output per worker. This higher living standard will be accompanied by increased demands for various water resource development functions such as more flood control, water supply, water quality control, power generation, outdoor recreation, and fishing and hunting opportunities.

d. Land use. Future land use will vary widely in the Coastal Plain and Ozark Plateaus portions of the study area. Figure 11 shows projected acreages in the principal land use categories for the year 2020.

LAND USE
STUDY AREA, COASTAL PLAIN, AND OZARK PLATEAUS
2020

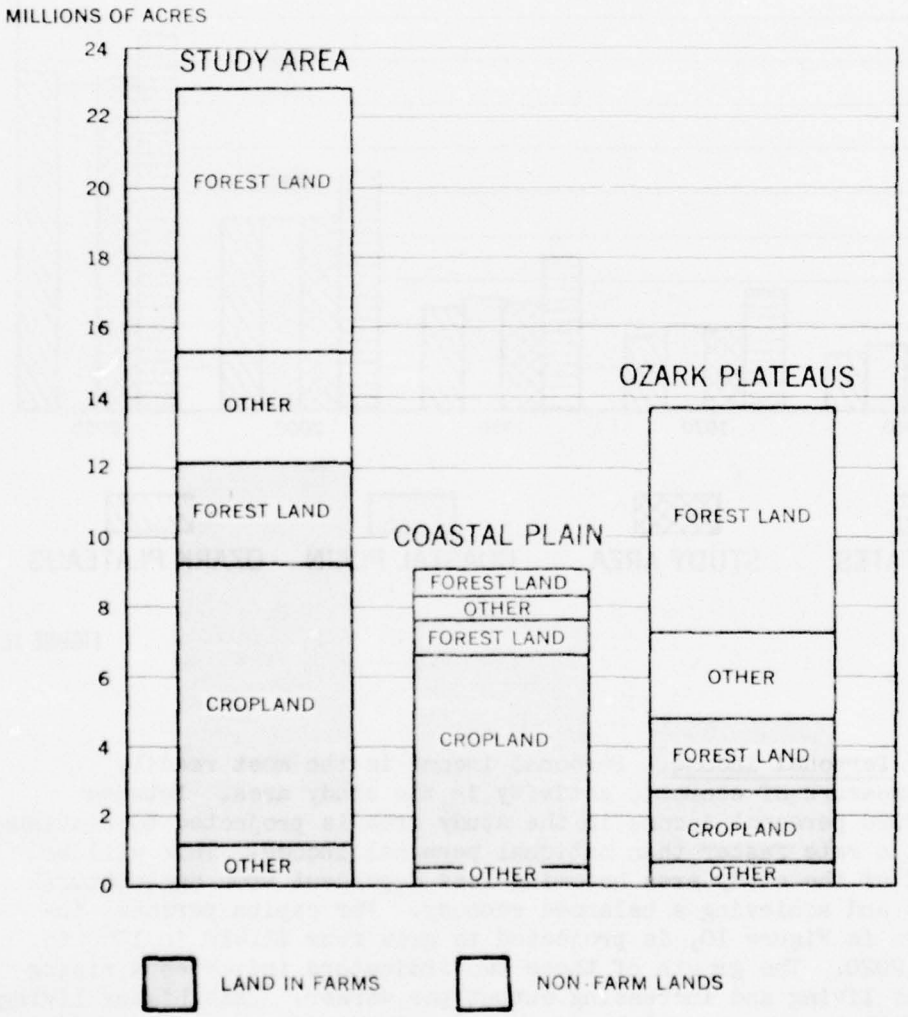


FIGURE 11

CROP AND LIVESTOCK SALES
WHITE RIVER BASIN ECONOMIC STUDY AREA
1949/50 - 2020

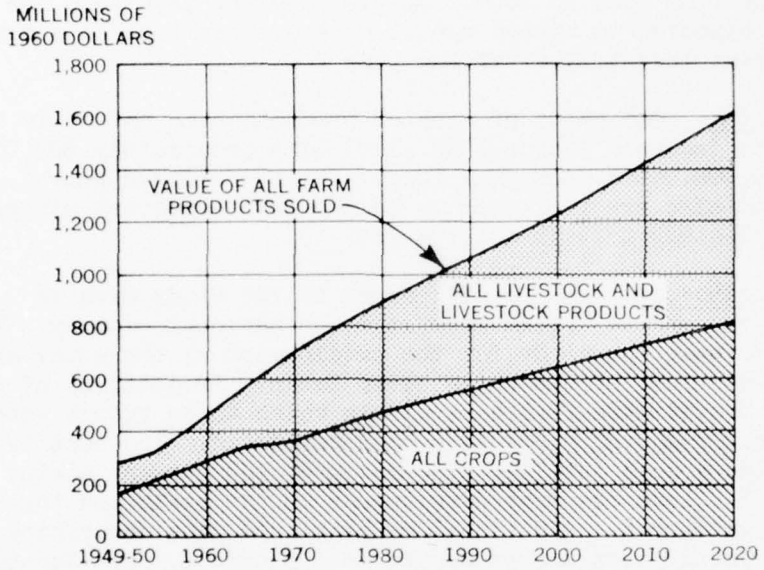


FIGURE 12

e. Agriculture. Because the resources of the study area are well suited to agricultural use, crop and livestock production is expected to continue to play an important part in the economy of the study area. Although agriculture as a source of income and employment will remain important to the study area economy, its future importance will be less than it has been in the past. Figure 12 shows historical and projected values of all crop and livestock products sold in the study area.

(1) Crop production. The value of all crops sold in the study area is expected to triple by the year 2020. Field crops in the Coastal Plain portion of the study area will account for most of this projected increase. Cotton, soybeans, and rice will continue to be the major crops of the study area.

(2) Livestock sales. Livestock sales in the study area will continue to be concentrated in the Ozark Plateaus. Total value of all livestock products sold in the study area, including poultry, dairy, and other products is projected to reach approximately $780 million by the year 2020. Most of this more-than-threefold increase over 1964 will be in poultry and poultry products sales. They will account for three-fourths of the value of all livestock products sold by the year 2020. The value of "other livestock and livestock products" sold is projected to triple by 2020, and the value of dairy products sold is expected to remain relatively constant.

(3) Forestry. Clearing of forest lands for other uses, principally crop production, is expected to result in loss of more than 2,000,000 acres of forest land in the study area by the year 2020. It is projected that only 45 percent of study area lands will be forested in 2020, as compared to 55 percent in 1959. The inventory of growing stock in the study area is projected to increase more than 50 percent from 1960 to 2000. However, by the year 2000 the annual cut is expected to exceed annual growth, resulting in a net decline in forest inventory after the year 2000.

f. Mining. The value of mineral production in the study area is projected to increase from a 1963 level of approximately $23,000,000 to almost $150,000,000 in the year 2020. Stone, sand and gravel, lime, lead, and zinc are projected to be the most important minerals produced in the study area in the future.

g. Conclusions. The total economy of the study area is projected to grow and to become more like the national economy. This growth will increase the needs for the development of the water and related land resources of the White River Basin. Projections of economic activity provide the framework within which these future water and related land resource needs have been estimated. The next two sections provide a more detailed discussion of the current status of water and related land resource development in the basin and the need for further development. Additional material and data describing the economy of the study area are presented in Appendix B, Area Economic Study.

SECTION IV - CURRENT STATUS OF RESOURCE DEVELOPMENT, USE, AND PLANNING

19. EXISTING FEDERAL WATER RESOURCE DEVELOPMENTS

a. There are six main stem and major tributary reservoir projects in the basin. Beaver, Table Rock, and Bull Shoals on the Upper White River, Norfork on the North Fork River, and Greers Ferry on the Little Red River are multiple-purpose projects. Clearwater on the Black River is a single-purpose flood control project. Table Rock and Clearwater are in Missouri and the remaining four are in Arkansas. These projects have a total storage capacity of 16,062,000 acre-feet, of which 5,477,000 is for flood control; 3,349,000 is for power generation; 925,000 is for drawdown for power generation and water supply; and 6,311,000 is for recreation, fish and wildlife conservation, and other purposes. Pertinent data for these six projects are shown on Table 5.

b. There are nine project levees on the White River and tributaries and one on the Mississippi River, the latter to provide protection for areas at the lower end of the basin from Mississippi River floods. The total length of these levees is about 166 miles and they protect about 484,000 acres of rich alluvial valley land. Pumping stations with a total capacity of 774,000 gallons per day have been constructed to remove interior runoff from the area protected by four of these levees. Pertinent data for these projects are shown on Table 5.

c. Navigation improvements have been constructed on the lower White, Current, and Black Rivers, but except for the lower 206 miles of the White River, these navigation projects have been placed in an inactive status because of lack of traffic. The original improvements consisted principally of snagging and dredging operations to maintain sufficient depth for shallow draft tows.

d. The Soil Conservation Service has nine Public Law 566 Watershed Protection and Flood Prevention Projects under construction or authorized for construction. These projects consist primarily of floodwater retardation structures, drainage facilities, and associated land treatment measures. These nine projects are listed in Table 6.

Corps of Engineers

Table Rock Dam and Reservoir, a Federal project on the White River in Missouri, provides space for storing floodwaters and water for power and recreation. A State fish hatchery is located on the left bank downstream from the dam and a recreation area is located immediately upstream from the dam.

TABLE 5

EXISTING CORPS OF ENGINEERS PROJECTS

MAIN STEM AND MAJOR TRIBUTARY RESERVOIRS

Item	Beaver	Table Rock	Bull Shoals	Norfork	Greers Ferry	Clearwater
General:						
Purpose	FC,P,WS	FC,P	FC,P	FC,P	FC,P	FC
Stream	White R.	White R.	White R.	North Fork R.	Little Red R.	Black R.
River mile	609.0	528.8	418.6	4.8	79.0	257.4
State	Arkansas	Missouri	Arkansas	Arkansas	Arkansas	Missouri
Drainage area, sq. mi.	1,186	4,020	6,036	1,806	1,146	898
Dam:						
Length in feet	2,575	6,423	2,256	2,624	1,704	4,225
Height, feet above streambed	228	252	258	216	243	154
Concrete, cubic yards	779,000	1,230,000	2,100,000	1,500,000	820,000	-
Embankment, cubic yards	1,610,000	3,320,000	-	-	3,000,000	5,500,000
Reservoir:						
Elevation, feet above m.s.l.:						
Nominal top of flood-control pool	1,130	931	695	580	487	567
Top of power pool	1,120	915	654	552	461	-
Nominal bottom of power drawdown pool	1,077	881	628.5	528.3	435	-
Top of conservation pool	-	-	-	-	-	494
Storage:						
Flood control - Acre-feet	300,000	760,000	2,360,000	732,000	934,000	391,000
Inches	4.7	3.5	7.4	7.6	15.3	8.1
Power drawdown - Acre-feet	925,000	1,182,000	1,003,000	448,000	716,000	-
Inches	14.6	5.5	3.0	4.7	11.7	-
Conservation or dead power - Acre-feet	727,000	1,520,000	2,045,000	803.000	1,194,000	22,000
Inches	11.5	7.1	6.4	8.3	19.5	0.5
Total - Acre-feet	1,952,000	3,462,000	5,408,000	1,983,000	2,844,000	413,000
Inches	30.8	16.1	16.8	20.6	46.5	8.6
Area in acres:						
Top of flood-control pool	31,700	52,250	71,240	30,700	40,500	10,400
Top of power pool	28,220	43,070	45,440	22,000	31,500	-
Top of conservation pool, or top of dead storage pool	15,540	27,300	33,800	16,070	23,700	1,600
Generators:						
Number	2	4	8	2	2	-
Capacity per unit, kilowatts	56,000	50,000	4- 40,000: 4- 45,000	35,000	48,000	-

LEVEES AND CHANNEL IMPROVEMENTS

Projects	Stream	Mile	Length (miles)	Area Benefited (acres)	Purpose
Poplar Bluff and East Poplar Bluff, Missouri	Black River	-	4.4	(1)720	FC (Levee)
Black River, Poplar Bluff, Missouri, to Knobel, Arkansas, (Arkansas portion)	Black River	140-173	37.5	71,040	FC (Levee and 35,000 g.p.m. pump station)
Skaggs Ferry, Black River east of Pocahontas, Arkansas	Black River	94-104,81-84	8.8	13,931	FC (Levee)
Newport, White River, Arkansas	White River	257.6	8.5	(1)2,000	FC (Levee)
Village Creek, White River and Mayberry Districts, Arkansas	White River	231.5-255	20.2	33,400	FC (Levee)
Augusta to Clarendon Levee, White River, Arkansas (2)	White River	108-197	39.4	217,000	FC (Levee)
Des Arc, Arkansas	White River	147.3	1.5	(1)	FC (Levee and 9,300 g.p.m pump station)
DeValls Bluff, Arkansas	White River	125.0	0.1	(1)	FC (Levee and 56,100 g.p.m. pump station
Clarendon City Levee, Arkansas	White River	100.6	6.0	(1)	FC (Levee)
White River Backwater Levee, Arkansas	White River	-	40.0	145,500	FC (Levee and 673,200 g.p.m pump station)

(1) Affords protection to property within city and adjacent area.
(2) Complete except for 6.6 mile section; area benefited information based on completed project.

Legend: FC - Flood control
P - Hydroelectric power
WS - Municipal and industrial water supply

TABLE 6

EXISTING AND AUTHORIZED
PUBLIC LAW 566 WATERSHED PROJECTS

Watershed Number and Name	Area (Acres)	Structural Measures
28 Upper Crooked Creek	56,320	19 FWR
46 Mud Creek	18,560	1 FWR and 29.9 mi. CI
69 Big Running Water Ditch	80,000	82.2 mi. CI
80 Flat Creek	23,680	5 FWR, 1 FWR&R, & 10.2 mi. CI
86 Cooper Creek	40,320	9 FWR and 3.8 mi. CI
116 Upper Culotches Bay	39,040	50.2 mi. CI
117 Big Creek-Bayou DeView	72,960	22 FWR and 8.8 mi. CI
126 Lee-Phillips	83,200	110 mi. CI
131 White River Backwater	145,920	165 mi. CI

Legend:
FWR - Floodwater Retardation
FWR&R - Floodwater Retardation & Recreation (incl. Fish & Wildlife)
CI - Channel Improvement

e. Existing Federally administered recreation, hunting, fishing, and wildlife resources include the Current-Jacks Fork Ozark National Scenic Riverways, the White River National Wildlife Refuge, 5 fish hatcheries, and 2 fisheries research stations. The Ozark National Scenic Riverways are currently under development which includes acquisition of about 87,000 acres of land and development of access and recreation facilities along about 110 miles of the Current and Jacks Fork Rivers in Missouri. The White River National Wildlife Refuge contains 112,653 acres of which 3,517 is water and the remainder is land, some of which is subject to periodic inundation.

f. National Forest acreage in the White River Basin is about 1,200,000 acres located in the Ozark-St. Francis, Clark, and Mark Twain National Forests. Thirty-six recreational areas have been developed in these national forests comprising about 300 acres of land and 75 acres of water. The National Forest Service has also developed many hiking trails, scenic drives, and extensive portions of a state-wide network of horseback riding trails within the national forests.

Corps of Engineers

Large impoundments such as Bull Shoals Lake greatly expand recreational development.

20. EXISTING NON-FEDERAL WATER RESOURCE DEVELOPMENTS

a. Existing privately owned hydroelectric power plants in the White River Basin include the Taum Sauk pumped-storage project, the Ozark Beach project, and two small projects in the Spring River Basin. The Taum Sauk project of the Union Electric Company, a pumped-storage type hydroelectric power plant, was placed in operation in 1963 at river mile 300 on the East Fork Black River near Arcadia, Missouri. The installed capacity of the plant is 350,000 kilowatts. The Ozark Beach project of the Empire District Electric Company was placed in operation in 1913 at river mile 506.1 on the White River near Forsyth, Missouri. The project consists of a concrete and earth-fill dam approximately 70 feet in height and a powerhouse containing four 4,000-kilowatt generating units and four empty bays available for installation of additional units. The two small projects in the Spring River Basin, which are owned by the Arkansas-Missouri Power

Corporation, were constructed about 1880. One of the dams is located on the outlet channel of Mammoth Spring. It is a masonry structure about 15 feet high and 120 feet long. The powerhouse was constructed in 1927 and contains one verticle-shaft turbine and 440-kilowatt generator. The other dam, located about 3 miles downstream on the Spring River, is a concrete buttress structure about 20 feet high and 600 feet long. The generating equipment consists of two 300-kilowatt units, one of which was installed in 1933 and the other in 1939.

b. Since the disastrous flood of 1927 practically all the flood control improvements undertaken in the White River Basin have been constructed by the Federal Government. Prior to that time the work by local interests consisted largely of the construction of levees and drainage systems although it included some bank protection and removal of snags from streams. The existing levees are located along the Black, Little Red, and White Rivers. Available information indicates that 90 drainage enterprises have been organized in the basin to serve about 1.7 million acres. Major drainage systems are mostly gravity flow systems that utilize natural streams, canals, and open ditches. Farm drainage systems usually consist of open ditches for removal of excess surface water from fields. The local levees and drainage works, in general, have not been coordinated or properly maintained. Consequently, most of the structures are inadequate and some are ineffective. Bank protection works have been constructed by local interests for the protection of railway bridges, State highways, and highway embankments.

c. Local interests have constructed works in different areas in the White River Basin in Arkansas for irrigating rice. The most extensive areas are located east of Newport and in the Grand Prairie. The irrigation development is primarily of the individual farm type. Pumping from wells is the principal source of irrigation water, although some irrigation water is obtained from small reservoirs and by diversion from streams.

d. The municipal water supply systems in the basin obtain about 53 percent of their supply from ground water sources; about 18 percent from surface water sources, which includes streams and municipal lakes; and the remainder from both ground and surface sources.

e. The two States, Arkansas and Missouri, administer numerous State parks, public hunting areas, game management areas, fish hatcheries and trout fishing streams in the basin. A tabulation of these areas is shown on Table 7. There are also numerous municipal parks and small fishing impoundments in the basin which are tabulated in Appendix K.

TABLE 7

EXISTING STATE FISH AND WILDLIFE AREAS

Areas	No. of areas	Admin. agency	Total acres	Wetland acres	Water acres	Activity
Arkansas						
Public hunting areas	8	AG&FC	113,500	29,400	15,600	F&H,WP
Wildlife management areas	5	AG&FC	6,980	-	-	WP
Public fishing lakes	8	AG&FC	2,489	-	2,389	F
State fish hatcheries	2	AG&FC	(warm water production)			FP
Trout management areas	7	AG&FC	-	-	42,210	
Public access areas	21	AG&FC	80	-	-	F
Public parks	7	AP&PC	3,864	-	20	F
Missouri						
Public hunting areas	6	MCC	108,795	-	900	F&H,WP
Wildlife management areas	5	MCC	37,257	-	40	F,WP
Public fishing lakes	3	MCC	276	-	86	F&H
State fish hatcheries	3	MCC	(trout production)	-		FP
Trout management areas	7	MCC	-	-	2,255	F
Public access areas	5	MCC	641	-	-	F
Public parks	7	MSPB	13,083	-	100	F&WP

Legend:

AG&FC	- Arkansas Game & Fish Commission	H	- Hunting
AP&PC	- Arkansas Publicity & Parks Commission	FP	- Fish Production
MCC	- Missouri Conservation Commission	WP	- Wildlife Production
MSPB	- Missouri State Park Board	F	- Fishing

21. AUTHORIZED FEDERAL PROJECTS

a. The authorized Federal projects in the basin are listed on Table 8. These authorized projects include three multiple-purpose reservoir projects, seven local protection projects, three Public Law 566 projects, and the Grand Prairie Region supplemental water supply project. The three Public Law 566 projects are authorized for planning only.

TABLE 8

AUTHORIZED FEDERAL WATER RESOURCE DEVELOPMENTS

MAIN STEM AND MAJOR TRIBUTARY RESERVOIRS

Project	Stream	Mile	Drainage area (sq. mi.)	Total storage capacity (acre-feet)	Purpose
AUTHORIZED BY FLOOD CONTROL ACT OF JUNE 28, 1938					
Lone Rock Reservoir (1)	Buffalo River, Arkansas	3.6	1,331	687,000	Flood control
Water Valley Reservoir (2)	Eleven Point River, Missouri and Arkansas	12.6	1,152	1,563,000	Flood control and future power
Bell Poley Reservoir (3)	Strawberry River, Arkansas	26.2	520	245,000	Flood control

LEVEE AND CHANNEL IMPROVEMENT PROJECTS

Project	Authorizing Act or Acts	Type of improvement	Stream and State	Purpose
Village Creek, Jackson and Lawrence Counties	Flood Control Act of 1962	Channel improvement	Village Creek, Arkansas	Flood control
Village Creek, White River and Mayberry Districts	Flood Control Acts of 1960 and 1962	Channel improvement, pumping station, and fish and wildlife mitigation measures	Upper Taylor Bay and Tributaries, Arkansas	Flood control
Cache River Basin	Flood Control Act of 1950	Channel improvement	Cache River and Bayou, Missouri and Arkansas	Flood control
Clarendon City Levee Improvement	Flood Control Act of 1965	Levee enlargement	White River, Arkansas	Flood control
Clarendon to Laconia Circle	Flood Control Act of 1936	Levee	White River, Arkansas	Flood control
Big Creek and Tributaries	Flood Control Act of 1965	Channel improvement	Big Creek, Arkansas	Flood control
Big Creek and L'Anguille River	Flood Control Act of 1936	Levee	Upper Big Creek, Arkansas	Flood control

UPSTREAM WATERSHED PROJECTS (4)

Watershed			Structural measures		
No.	Name	Area (acres)	Floodwater retardation structures (number)	Multiple-purpose reservoirs (number)	Channel improvement (miles)
65	Little Black River	247,680	39	-	61.4
67	Fourche Creek	199,040	24	-	30.1
87	Tri-County	228,480	31	-	57.3

SUPPLEMENTAL AGRICULTURAL WATER SUPPLY

Name of project	Improvements	Irrigation area (acres)	Diversion design capacity (c.f.s.)
AUTHORIZED BY THE FLOOD CONTROL ACT OF 1950			
Grand Prairie Region, Arkansas	Pumping station, main canal, and system of distribution canals	(5)190,000	2,200

(1) Secretary of Army has recommended that project not be constructed.
(2) Project in a deferred status.
(3) Restudied in this report for flood control, recreation, and fish and wildlife enhancement.
(4) Authorized for planning only.
(5) Approximately 125,000 acres are within the White River Basin. The remaining area is in the Arkansas River Basin.

SECTION V - WATER RESOURCE PROBLEMS AND NEEDS

22. GENERAL

a. An essential phase of the White River study was an analysis of present a d future needs or demands which can be satisfied by improvement and development of the water and related land resources of the basin.

b. In determining present needs, the effect of existing projects and programs and those to be initiated in the near future was considered. Future needs were estimated on the basis of conditions expected in the future without additional Federal investments in water and related land resources of the basin.

c. Resource problems and needs are discussed briefly in the following paragraphs. More detailed information is presented in the Appendixes listed below:

Purpose	Appendix
Land Treatment and Watershed Protection	F
Flood Problems and Losses	G
Drainage	I
Recreation	J
Fish and Wildlife	K
Hydroelectric Power	L
Navigation	M
Municipal and Industrial Water Supply	N
Water Quality Control	N
Irrigation	O

23. LAND TREATMENT AND WATERSHED PROTECTION

a. Cropland and grassland.

(1) Problems. Many problems exist concerning the conservation, treatment, and management of cropland and grassland in the White River Basin. Some of these are discussed in the paragraphs below.

(a) Many farms within the Ozark Plateaus of the White River Basin, because of size, are not efficient economic units. In many instances the owner must seek part-time employment in town to supplement his farm earnings. Even if he desired to place all needed conservation and management practices into use on his farm, he could not afford them. In other instances, after proper application of land treatment measures, the landowners and operators fail to provide adequate maintenance and management. This is often the case with absentee landowners.

Soil Conservation Service

Poor cropping practices coupled with heavy rains result in serious erosion.

Soil Conservation Service

Contour tillage system and strip cropping are conservation measures employed where erosion is the dominant problem.

(b) The problem of soil erosion in the Ozark Plateaus of the White River Basin is compounded by the tendency of landowners and operators to use the frequently flooded river and stream valleys for pasture and higher, steeper slopes for crop production. Abuse of the great agricultural bottom lands in the eastern part of the basin has created sediment which decreased the capacity of drainage outlets. At the same time, clearing of woodland has increased water runoff.

(c) The landowners and operators may fail to appreciate the value of certain lands for wildlife or recreation. This problem results to some extent from a lack of adequate conservation education. Also a high degree of coordination of conservation efforts has been generally lacking, not only in Federal and State programs but also by special interest groups.

(2) Needs. The entire basin suffers to some extent from erosion and from a lack of water conservation, drainage, irrigation, recreation, fish and wildlife conservation practices, and proper land management. Approximately 3,388,000 acres of cropland need treatment to varying extents while 4,051,700 acres of grassland, including grazed forest land, need treatment.

b. Forest land.

(1) Problems. Some of the problems of land treatment and management on forest lands are discussed in the paragraphs below.

(a) The private forest landowner in the White River Basin is faced with many problems. Most of the original timber stands in the basin were cut during the early 1900's when the lumber industry moved into the South. Fires and abuse followed; therefore, the forest lands of the basin have not been replenished with high quality forests. Most of the timber in small ownership is of poor species small size classes, and poor quality, and is perpetuated by the traditional practice of forest land grazing and annual burning. These practices have at the same time contributed to the erosion problems of the basin. Financial returns of any consequence from forest lands are usually many years apart. Much heavily depleted forest land in the basin needs to be restored to productivity, but restoration would require relatively high investments and long periods of waiting before financial returns could be realized.

(b) The same factors which have reduced the productivity of the forest lands in terms of timber and timber products have also had a corresponding detrimental effect on the hydrologic condition of the forest soils. The long history of destructive logging, widespread and repeated burning, and overgrazing, particularly in periods of prolonged drought, have seriously reduced soil cover and have contributed to the compaction of the upper portions of the soil profile. The result has been a reduction of the soils' ability to resist erosion and absorb and store water. Consequently, these soils contribute high rates of soil and water runoff during storms and

reduced low flows during dry periods. Active erosion was present on nearly 5 percent of the areas that have been sampled. Table 9 shows hydrologic condition of forest soils.

TABLE 9

PRESENT HYDROLOGIC CONDITION OF FOREST SOILS

Hydrologic condition class	Public lands	Private lands	Basin totals
	Percent		
Very good	3	1	1
Good	36	15	17
Fair	38	24	27
Poor	14	24	22
Very poor	9	36	33

(c) It is apparent, therefore, that, while a continued high level of protection and management is needed for public forest lands, the preponderance of forest lands in private ownership makes it essential that the levels of protection and management for these lands be increased. Only in this way will the forest lands of the basin be able to meet the wood fiber needs of the future and at the same time provide the stabilizing influence to the soil and water resources of which they are capable.

(2) Needs.

(a) The public forest lands plus the small percentage of private forests currently being managed under good forestry practices cannot meet the demands foreseen for this resource. If the projected needs are to be satisfied, a high level of protection from fire, insect, disease and grazing damages must be afforded all forest lands and purposeful management applied to that high percentage of the forest lands of the basin now being mistreated or ignored completely.

(b) It is estimated that 590,150 acres in the basin need tree planting measures. Hydrologic stand improvements should be implemented on about 1,735,450 acres.

Soil Conservation Service

Planting of forest trees will revegetate critically eroding areas.

Missouri Department of Conservation

Release of desirable reproduction, such as these pine seedlings, by deadening cull trees will improve forest stands.

24. FLOOD CONTROL AND PREVENTION

a. As indicated in paragraph 19, considerable flood control works have been constructed in the White River Basin. Even with these works in operation, flooding still occurs over large areas and causes extensive damage.

b. The area under consideration for determining flood control and prevention needs is described generally as that part of the flood plains that would be flooded by a repetition of the maximum flood of record with projects in the preconstruction planning stage, under construction, or existing in operation. The extent and classification of the land in this area are shown in Table 10.

TABLE 10

EXTENT AND CLASSIFICATION OF FLOOD PLAIN LANDS
(Acres)

Reach	Cleared	Forested	Urban	Total
Ozark Plateaus	383,070	72,170	830	456,070
Coastal Plain	851,660	640,950	530	1,493,140
Total	1,234,730	713,120	1,360	1,949,210

c. Intense storms of short duration cause the most severe flooding in the Ozark Plateaus part of the basin. Because stream slopes are steep and runoff is rapid, destructive flash floods cause severe property damage, erosion of land, and often loss of life.

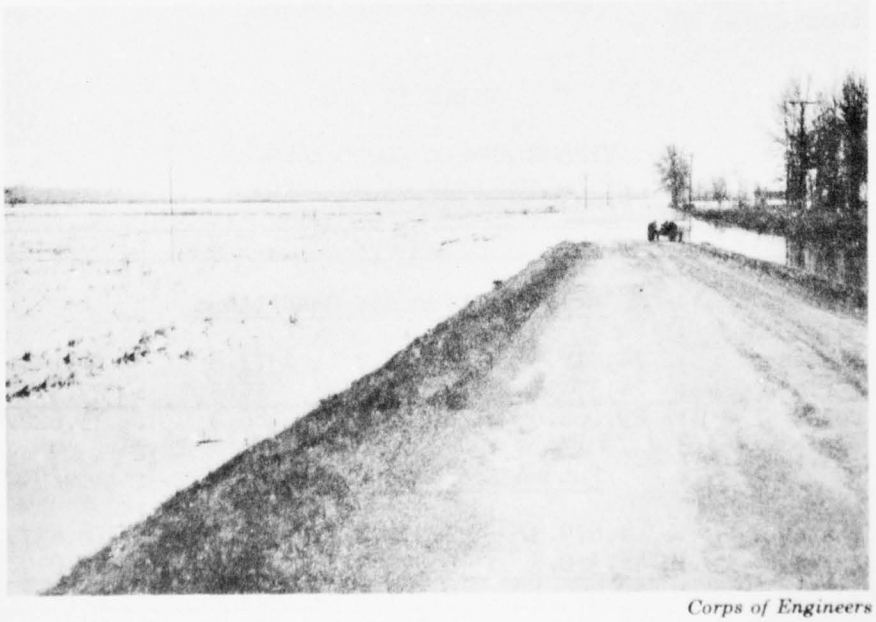
d. Extensive storms or a sequence of storms covering large areas and of long duration produce large volumes of runoff which descend rapidly upon the Coastal Plain. As a result of the very gradual channel slopes and low channel capacities of the Coastal Plain streams, flooding in this area is extensive and prolonged.

e. Flooding occurs several times a year in lower bottom areas of both the Ozark Plateaus and Coastal Plain portions of the basin. Floods occur most often in the months of March, April, and May, but large floods have occurred in every month.

f. The principal industry in the flood plains is agriculture. Major crops grown in the Ozark Plateaus are pasture, hay, corn, and silage. Major crops grown in the Coastal Plain are soybeans, cotton, rice, corn, and pasture. On the basis of adjusted normalized prices and present crop yields and distribution, the estimated gross annual value of crops in the area under consideration is $94,400,000.

Corps of Engineers

The Little Red River flooding farmland, buildings, and highways at Judsonia, Arkansas, in 1943.



Corps of Engineers

Flooding on the Black River, Butler County, Missouri, in January 1966.

g. Other industries and developments which are affected by floods include hardwood timber, commercial and public services, highway and county roads, railroads and utilities, and urban areas. Urban areas which have flood problems are Poplar Bluff, Cassville, Reeds Spring, Thayer, and West Plains in Missouri, and Pocahontas, Harrison, Walnut Ridge, Jacksonport, Augusta, and Clinton in Arkansas. The estimated value of property in the flood plain on the basis of adjusted normalized prices is $693,478,000.

h. Flood control and prevention needs have been estimated in terms of average annual flood losses expected under existing and future economic conditions. Economic indicators used in estimating future economic conditions were farm marketings, crop production expenses, net income per farm, per capita personal income, and in some cases, total crop sales. Changes in patterns of land use expected without additional flood control works were considered in estimating losses under future economic conditions.

i. The estimated average annual flood losses computed by flood frequency analysis under the conditions previously discussed are shown in Table 11. Also, due to difficulty of separating drainage damage from flood losses in the upstream watersheds these estimates include damage from inadequate drainage. Adjusted normalized prices were used for both existing and future economic conditions. About 80 percent of these losses result from farming operations. Other losses result from damage to agricultural property and lands, urban property, transportation facilities, utilities, and hardwood timber. Also included in the "other" category are losses of business and gainful occupation.

TABLE 11

AVERAGE ANNUAL FLOOD LOSSES
(In thousands of dollars)

Reach	Crop	Other	Urban	Total
	Existing Economic Conditions			
Ozark Plateaus	$4,712.5	$1,161.7	$371.6	$6,245.8
Coastal Plain	24,374.1	4,987.7	15.3	29,377.1
Sub-total	29,086.6	6,149.4	386.9	35,622.9
	Future Economic Conditions			
Ozark Plateaus	4,679.3	2,991.8	966.2	8,637.3
Coastal Plain	46,310.8	6,515.3	33.6	52,859.7
Sub-total	50,990.1	9,507.1	999.8	61,497.0
Basin total	80,076.7	15,656.5	1,386.7	97,119.9

25. DRAINAGE

a. Drainage needs, evidenced by wet lands that are frequently though not necessarily annually subject to a degree of surface or subsurface concentration of water that impairs their capacity to produce agricultural crops, exist in many low-lying areas of the White River Basin. Practically all of these areas are located in the Coastal Plain portion of the basin. Stream slopes in this portion of the basin are very gradual, generally less than 1 foot per mile, and streams have very low capacities.

b. Most of the early drainage works in the basin were constructed during the period 1900-1930. Information indicates that over 50 drainage enterprises have been organized to serve about 860,000 acres in the basin. Many of these enterprises became insolvent during the 1930's and the drainage works have lost most of their effectiveness as a result of lack of extension and maintenance. Since Federal aid for channel improvement and upstream flood prevention became available in about 1941, there have been more attempts by local interests to construct drainage systems. Generally, these local efforts have not been fully coordinated to insure that the system installed provided maximum benefits for the funds expended.

c. One of the primary drainage problems is that major drainage systems, including the major outlets and the group main and lateral canals, do not have adequate capacities to carry the flow from farm drainage systems. This has resulted from a lack of fully coordinated and planned drainage programs. Although some channel improvement work on major outlets has been accomplished, most of them are still in their natural state. The major outlets are characterized by appreciable to severe meandering, heavy undergrowth and trees in the channel section, accumulations of debris and sediment, and insufficient channel capacity.

d. The Coastal Plain portion of the basin receives an average annual rainfall of about 50 inches with heavy rains occurring at any time of the year. In addition to heavy local rainfall, large volumes of water from the Ozark Plateaus flow onto the Coastal Plain and flood extensive areas. This water inundates low-lying areas behind the stream banks and remains for long periods of time after the parent streams have returned to within their banks because of the inadequacy of the existing drainage systems.

e. Lands in the basin with a wetness hazard are shown in Table 12. Drainage of all of this land for agricultural purposes is neither practicable nor desirable. This is particularly true of the forest land and other listed in the table.

TABLE 12

LAND AREAS WITH WETNESS HAZARDS

Type	Acres (rounded)
Cropland	1,650,000
Grassland	160,000
Forest land	1,610,000
Other	10,000
Total	3,430,000

f. Many farming problems are associated with inadequate drainage. Adequate surface and subsurface drainage improves the plant environment and favorably affects plant growth. Surface drainage will remove excess water before it can infiltrate into the soil and promotes better soil aeration in the root zone. As the water percolates downward through the soil profile, the space between the soil particles occupied by free water is replaced by air. This supply of oxygen in the soil is required to promote bacterial growth. Bacterial action is necessary for the conversion of nutrients within the soil into a form which can be utilized by plants.

g. Attempts to produce crops on poorly drained land lead to higher production costs as a result of reduced plant growth and yield, or loss of fertilizers, herbicides, and pesticides. Often wet conditions delay planting, cultivation, or harvesting which reduces the efficiency of the modern highly mechanized farming operation.

h. Current crop and pasture acreages with drainage problems and the average annual damages resulting from inadequate drainage are presented in Table 13. These damages are also included in the average annual flood losses presented in Table 11. The average annual damages are based on normalized crop prices, present economic conditions, cropping patterns, and farming conditions.

TABLE 13

ACREAGE OF CROPLAND AND PASTURE WITH A DRAINAGE PROBLEM AND AVERAGE ANNUAL DAMAGES DUE TO INADEQUATE DRAINAGE

Crop	Acres inadequately drained	Average annual damages due to inadequate drainage
Soybeans	755,823	$10,846,060
Cotton	148,795	5,690,808
Corn	20,902	550,435
Wheat	36,825	339,237
Oats	26,352	184,337
Alfalfa hay	4,631	113,414
All hay except alfalfa	47,896	297,713
Other cropland except rice (1)	468,047	486,594
Rice	137,412	-
All crops	1,646,683	18,508,598
Pasture	164,746	19,770
Total	1,811,429	18,528,368

(1) Includes cropland not harvested, fruits, vegetables, other minor crops and idle fallow failure.

26. OUTDOOR RECREATION

a. Recreation area. To determine the outdoor recreation needs that could be fulfilled by the resources of the White River Basin, a recreation market area was established. It is defined as the area where approximately 80 percent of the users of the White River Basin's recreational facilities reside. This area includes the 49 counties which lie entirely or principally within the drainage basin plus certain Standard Metropolitan Statistical Areas (SMSA's), as defined by the Bureau of the Budget in 1966. The selection of the SMSA's considered in this study was based on the knowledge that people from them seek recreation opportunities within the White River Basin and thereby contribute substantially to the total demand for outdoor recreation that is supplied by the basin. Figure 13 shows the recreation area, the influencing SMSA's, and the 49-county area.

b. Demand. Recreation demand is expressed in terms of the amount and kinds of outdoor recreation facilities and activities the public desires. True demand tends to lie somewhere between what people desire and what they are actually willing to accept. It is probably nearer the latter. The demand for the four major activities of swimming, boating, camping, and picnicking in annual activity occasions was 18 million in 1965 and is estimated to be 22 million in 1970, 32 million in 1980, 68 million in 2000, and 144 million in 2020.


KENOSHA
LANSING
WATERLOO
DUBUQUE
SIOUX CITY
KALAMAZOO
JACKSON
CEDAR RAPIDS
ROCKFORD
DES MOINES
SOUTH BEND
OMAHA
CHICAGO
GARY - HAMMOND EAST CHICAGO
DAVENPORT ROCK ISLAND - MOLINE
PEORIA
LINCOLN
CHAMPAIGN URBANA
INDIANAPOLIS
MUNCIE
SPRINGFIELD
ST. JOSEPH
DECATUR
TERRE HAUTE
CINCINNATI
TOPEKA
LOUISVILLE
KANSAS CITY
ST. LOUIS
EVANSVILLE
LEXINGTON
WICHITA
SPRINGFIELD
TULSA
NASHVILLE
OKLAHOMA CITY
FORT SMITH
CHATTANOOGA
AMARILLO
LITTLE ROCK
NORTH LITTLE ROCK
MEMPHIS
LAWTON
HUNTSVILLE
GADSDEN
PINE BLUFF
BIRMINGHAM
LUBBOCK
WICHITA FALLS
DALLAS
TEXARKANA
TUSCALOOSA
COLUMBUS
MONROE
TYLER
ODESSA
ABILENE
FORT WORTH
SHREVEPORT
MONTGOMERY
JACKSON
MIDLAND
MOBILE
SAN ANGELO
WACO
BATON ROUGE
PENSACOLA
AUSTIN
BEAUMONT - PORT ARTHUR
LAKE CHARLES
LAFAYETTE
HOUSTON
NEW ORLEANS
SAN ANTONIO
GALVESTON - TEXAS CITY
POPULATION
1,000,000 or more
500,000 - 1,000,000
250,000 - 500,000
100,000 - 250,000
50,000 - 100,000
RECREATION - FISH AND WILDLIFE AREA
49 COUNTY AREA
RECREATION
FISH AND WILDLIFE
AREA
SCALE OF MILES
100 0 100 200 300

FIGURE 13

c. Supply. Taking into consideration data on existing public and private recreation facilities in the basin, a quantitative estimate was made of the number of activity occasions that could be accommodated annually. It was found that almost 13 million activity occasions for swimming, boating, camping, and picnicking can presently be accommodated annually. By considering programmed expansion of public recreation areas, the supply for 1970 showed that a total of nearly 18 million activity occasions for swimming, boating, camping, and picnicking could be accommodated annually at that time.

d. Needs. Existing needs are the demand for outdoor recreation opportunities less the present capacity of existing resources and facilities. Projected needs are the difference between projected demand and projected supply. In short, needs are unsatisfied demand, and these are translated into resource requirements of land, water, and facilities. The facilities required to satisfy the average summer Sunday demand for recreation opportunities are shown on Table 14.

27. FISH AND WILDLIFE

a. Sport fishing.

(1) The White River Basin study area contains more than 4,000 miles of clear, free-flowing Ozark Mountain streams which provide high quality smallmouth bass fishing. Many of these, including the Current, Jacks Fork, Eleven Point, Spring, James, and Buffalo Rivers, accommodate the popular and unique float-fishing opportunities that have made the Ozark region famous. Trout fishing, supported by stocked fish produced at two Federal hatcheries located in Arkansas and three State hatcheries in Missouri, is available in several cold water streams, cold water strata of Lake Taneycomo and Bull Shoals Reservoir, and almost 140 miles of cold tailwaters below Bull Shoals, Norfork, and Greers Ferry Reservoirs. Excellent warm water fishing is provided in the 182,000 acres of large impoundments, 19,000 acres of natural lakes, 10,000 acres of public fishing lakes, and approximately 3,500 miles of alluvial streams in the Coastal Plain section of the basin. In addition, the private sector provides fishing potentials in 49,000 acres of small impoundments consisting of farm ponds, irrigation reservoirs, and floodwater retarding structures.

(2) The appraisal of fishing opportunities in the basin was based primarily on (a) the standing crop of sport fish in pounds; (b) the ratio of harvestable crop to standing crop; and (c) average catch in pounds per man day. The average annual man day per acre standards used for the various types of waters vary according to habitat quality, harvest success, degree of management, and other factors. Opportunity for trout fishing is dependent upon the rate of stocking, rate of recovery and survival of stocked fish.

TABLE 14

EXISTING AND PROJECTED AVERAGE SUMMER SUNDAY UNSATISFIED DEMAND AND NEEDS
(Expressed in Terms of Facilities)

Year	Activity	Swimming capacities	Boating capacities	Camping capacities	Picnicking capacities
1965	Average summer Sunday demand	95,349	86,442	41,758	116,912
1963	Supply (public and private)	59,379	87,136	16,912	54,161
1965	Needs	35,970	----	24,846	62,751
1965	Need in facilities	60(Acres)	----	4,969(Units)	10,040(Tables)
1970	Average summer Sunday demand	114,592	104,030	50,205	140,693
1970	Supply (public and private)	106,768	111,061	32,659	68,570
1970	Needs	7,824	----	17,546	72,123
1970	Need in facilities	13(Acres)	----	3,509(Units)	11,540(Tables)
1980	Average summer Sunday demand	170,203	154,460	74,561	208,898
1980	Supply (public and private)	160,768	111,061	32,659	68,570
1980	Needs	63,435	43,399	41,902	140,328
1980	Need in facilities	106(Acres)	86,798(Acres)	8,380(Units)	22,452(Tables)
2000	Average summer Sunday demand	358,135	325,931	157,016	440,753
2000	Supply (public and private)	106,768	111,061	32,659	68,570
2000	Needs	251,367	214,870	124,357	372,183
2000	Need in facilities	419(Acres)	429,740(Acres)	24,871(Units)	59,549(Tables)
2020	Average summer Sunday demand	752,697	687,421	330,337	929,471
2020	Supply (public and private)	106,768	111,061	32,659	68,570
2020	Needs	645,929	576,360	297,678	860,901
2020	Need in facilities	1,077(Acres)	1,152,720(Acres)	59,536(Units)	137,744(Tables)

(3) Figure 14 shows the projected sport fishing needs for the basin by streams and impoundments, and by total opportunities. It should be noted that the total basin demand does not exceed the total basin supply during the 50-year projection period. This is due to the large capacity or supply of the existing impoundments. However, examinations of separate parts of the basin reveal that some areas have an excess supply of available facilities while others do not. Stream capacity is not exceeded until near the end of the projection period, however, this is only because of the relatively large capacity of the alluvial stream. The Ozark streams will reach capacity levels for both trout fishing and warm water fishing by 1980. Increased pressure on these waters will reduce the quality and degree of fishing success.

b. Hunting.

(1) Under present conditions the basin contains about 21,000,000 acres of wildlife habitat, including more than 12,400,000 acres of forest lands which support populations of big game, including deer and turkey, and other forest game species. The Coastal Plain supports large waterfowl concentrations on flooded rice fields, natural overflow bottom lands, and permanent waters distributed throughout the area. Public lands controlled by Federal and State agencies comprise only 9 percent of the available terrestrial wildlife habitat, with the remaining 91 percent controlled by the private sector.

(2) The supply of hunting opportunities was evaluated on the basis of an available level and a potential level. The available level assigned equals the 1960 use (expressed demand), and recognizes that denial of public access, competing or conflicting land use, uneven distribution of hunters in the basin, and other legal or socio-economic factors which restrict use and management of the resource, will militate against realization of the full potential over the total basin area.

(3) The evaluation of hunting opportunities is based on the population density of wildlife per 1,000 acres of habitat, a sustained rate of harvest, and the hunting standards for the various types of habitat and type of game hunted. Supply and demand levels of hunting opportunities in the White River Basin are shown in Figure 15. The solid lines in the figure indicate the supply and demand which can be expected to exist if current management levels and current restrictions on use continue. The dotted lines indicate potential levels of supply and demand which could be achieved by removal of restrictions on use and higher levels of management. Under existing restrictions and management levels demand for hunting opportunities will exceed supply in the very near future and throughout the projection period. However, with higher management levels and removal of use restrictions, supply could be expected to exceed demand.

SPORT FISHING - SUPPLY AND DEMAND
WHITE RIVER BASIN
1960 - 2020

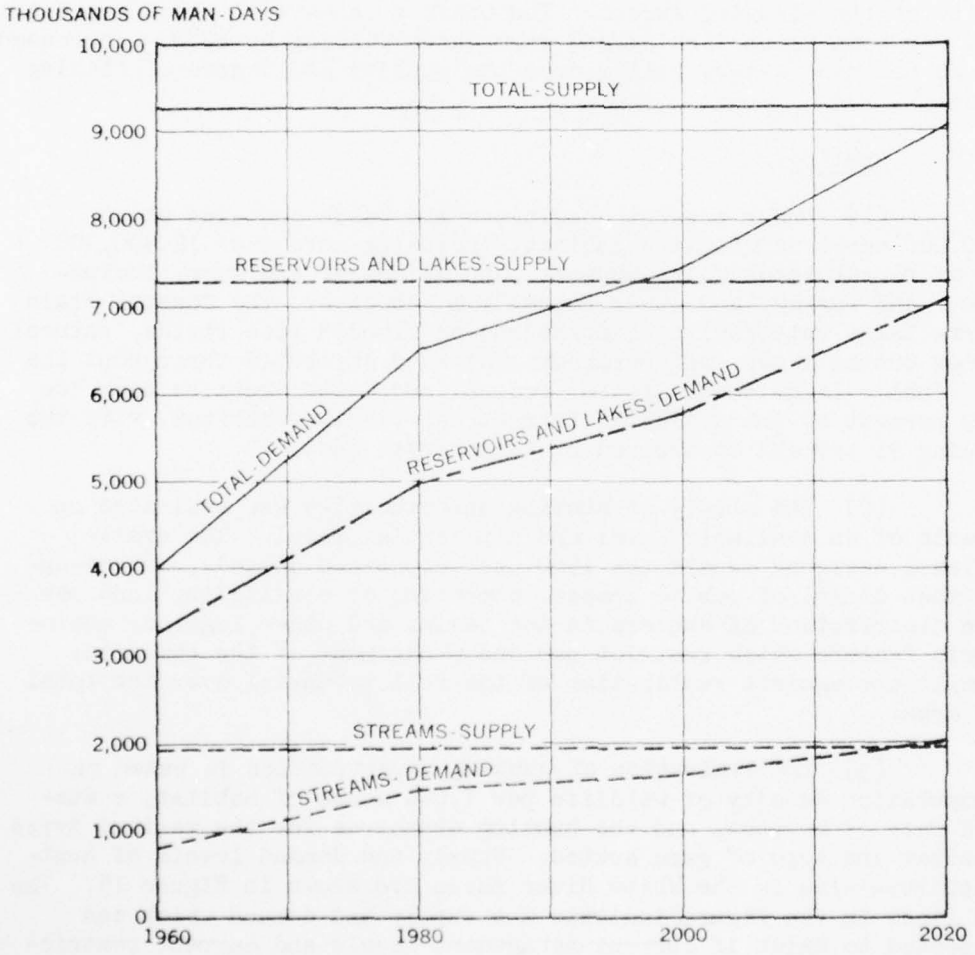
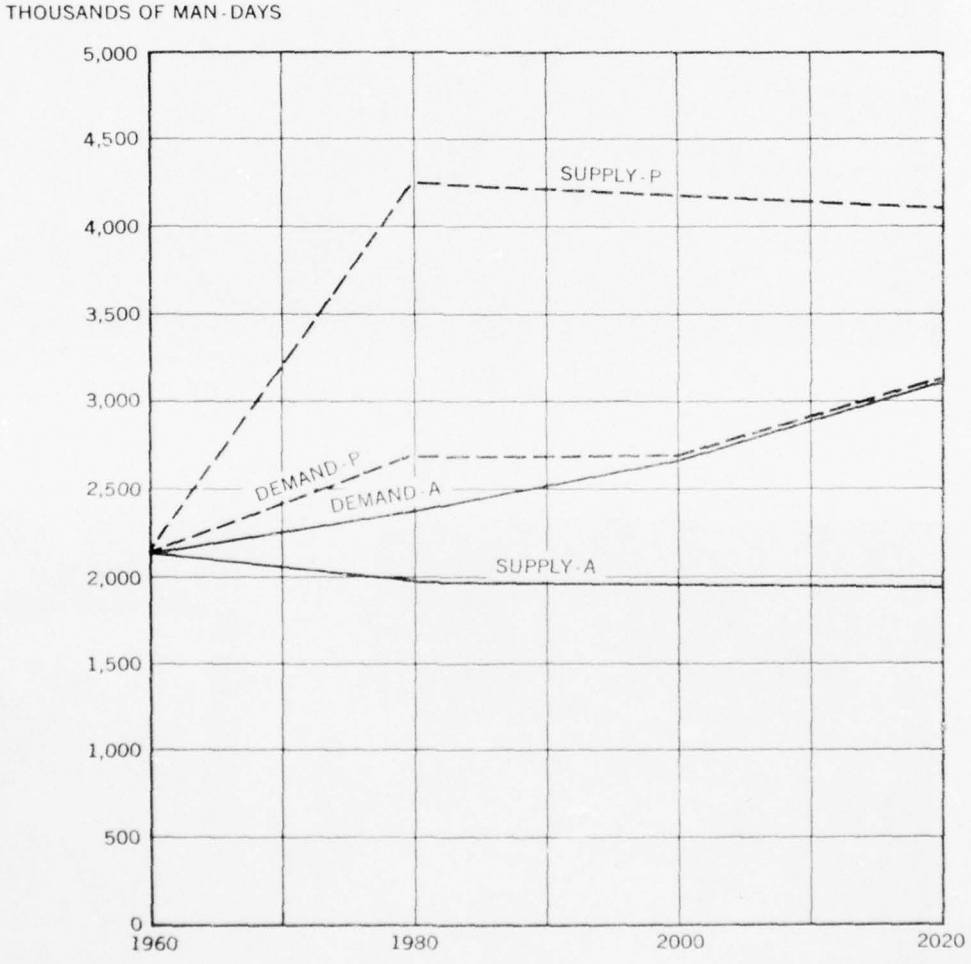


FIGURE 14

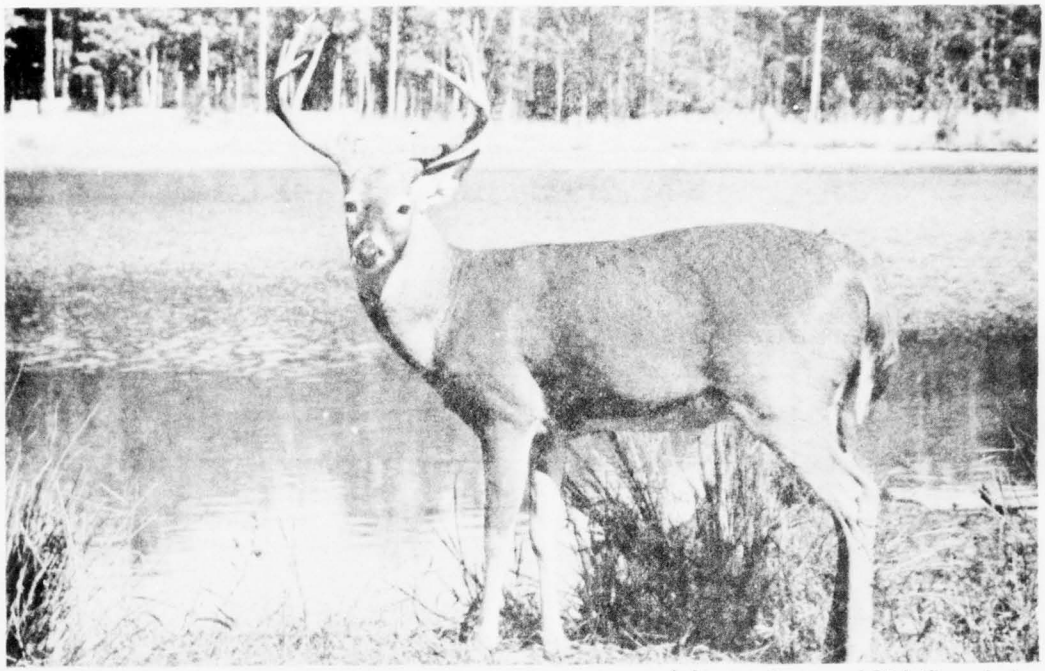
HUNTING - SUPPLY AND DEMAND
WHITE RIVER BASIN
1960 - 2020



A = AVAILABLE SUPPLY LEVEL WITH AVERAGE EXISTING LEVEL OF MANAGEMENT AND RESTRICTIONS ON USE.

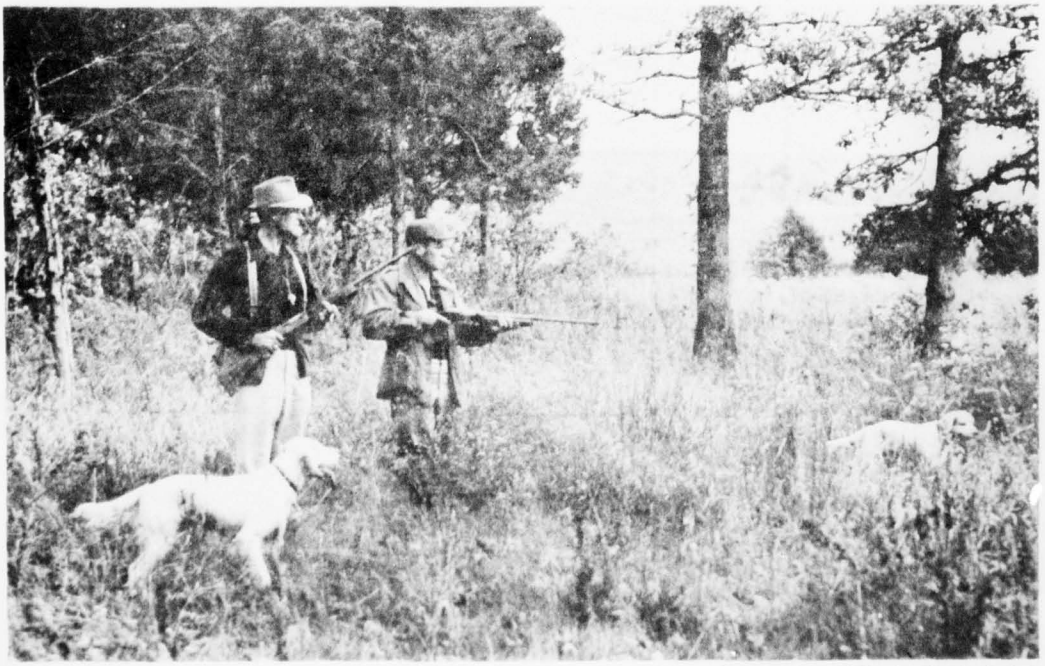
P = POTENTIAL SUPPLY LEVEL REALIZED WITH A HIGHER LEVEL OF MANAGEMENT AND REMOVAL OF RESTRICTIONS ON USE.

FIGURE 15



Arkansas Game and Fish Commission

White-tailed deer are increasing in number and distribution.



Arkansas Publicity and Parks Commission

Bird hunting in northwest Arkansas.

c. Commercial fisheries.

(1) Total commercial fishery needs for the basin will increase considerably in future years, particularly in Arkansas because of the importance of the fish-farming industry. It is estimated the demand for catfish and bait minnows within the basin and the export market area outside the basin will increase 49 percent between 1964 and 1980. Projected on a long-range basis, demand is expected to increase fourfold by 2020.

(2) Since the fish-farming industry provides over 86 percent of the total poundage of commercial fishery products produced in the basin study area at the present time, and will be required to supply an even higher proportion in the future, a greatly expanded program will be needed to satisfy demand. The surface area of pond space needed for intensive and nonintensive operations must be increased from the existing 14,221 acres to about 164,900 acres by the year 2020. Water supply requirements will increase about fourfold from 168,000 acre-feet used at present. The allocations for fish-farming production requirements, based on pond area and volume of water supply, are shown in Table 15. The volume of water supply is estimated on the basis of 6 acre-feet per surface acre for intensive and 3 acre-feet per acre for nonintensive production. The preferable source of supply is from ground water aquifers because of the greater dependability on maintaining high quality control standards necessary for efficient management.

TABLE 15

WATER SUPPLY REQUIREMENTS TO SATISFY FISH-FARMING NEEDS(1)

Year	Surface acres	Acre-feet
1964	42,221	168,000
1980	81,401	341,000
2000	110,262	464,000
2020	164,844	702,000

(1) Based on the expected pounds of fish produced per acre of water.

(3) Commercial fishing in natural waters is hampered by legal restrictions, inefficient harvesting gear, unstable market conditions, and other factors. These problems must be resolved in order to realize the resource potentials required to satisfy the demand for other commercial fishery products.

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28. HYDROELECTRIC POWER

a. The market area for power produced in the White River Basin was identified in paragraph 17h as Federal Power Commission Study Area K. Figure 16 shows the historical and estimated future data on energy for load and peak demands for Study Area K. The estimated future load growth as developed for the National Power Survey is expected to reach 35,900 megawatts by 1980. This estimate has been trended to the year 2020 for the White River Basin Study, and the expected load at that time is estimated at 182,000 megawatts. The annual load factor decreased from 60.8 percent in 1950 to 54.8 percent in 1965, due principally to the advent of residential and commercial air-conditioning. This trend appears to be reversing at this time and moderate increases in load factors to about 56.7 percent are expected in the future due partly to load building activities of the electric utility industry.

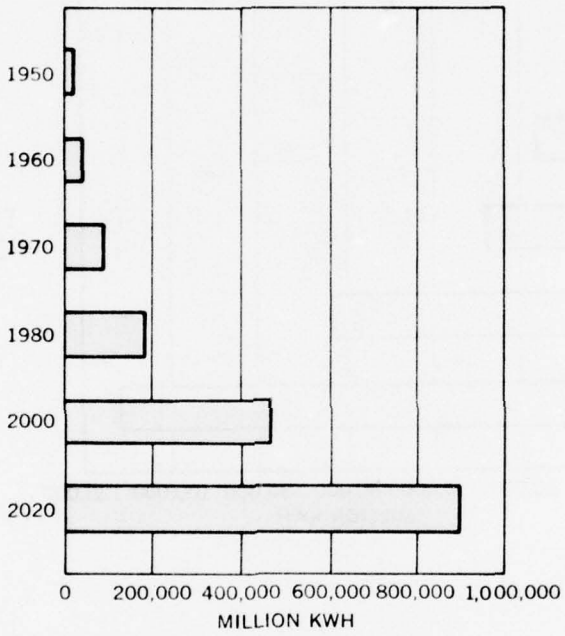
b. Hydroelectric plants are admirably suited to supplementing base load thermal plants on high peak short duration loads. Hydroelectric projects have several important advantages over thermal plants, especially for peak generation, in that they do not consume water or fossil fuels, do not contribute to water or air pollution, have low operation and maintenance costs, and have the ability to start quickly and meet load changes readily. There is a growing need for peaking capacity throughout Study Area K.

c. Projected load curves indicate that during the peak month of August the hydroelectric power capacities shown on Figure 16 which are in excess of the capacity of existing and scheduled facilities could be utilized on the load at a 20 percent plant factor. This is in the peak area of the load where hydroelectric generation is so advantageous and is a measure of the amount of hydroelectric capacity needed for a well-balanced electric power system for Study Area K.

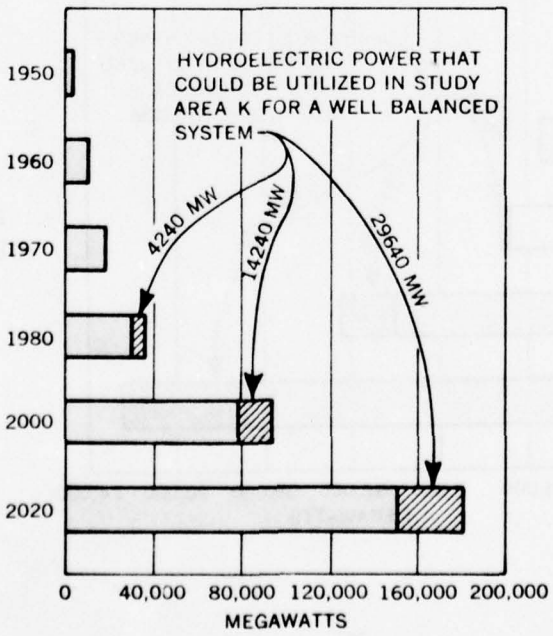
d. At the end of 1965 the preference power users owned sufficient generating plants to supply approximately two-thirds of the total load of preference power users. The other one-third of the power was obtained by purchase from private utility companies and from State and Federal agencies. Sufficient plant additions have been scheduled so that preference power users will have capacity to supply almost 90 percent of their requirements by 1970. However, because of lack of interconnections for full utilization, some of this amount would not be utilized in 1970. The actual supply probably will more closely approximate 75 percent of the load. The other 25 percent will be purchased from companies and from State and Federal agencies.

e. The projected 1980 energy for load and peak demand for the preference power users' portion of the load is shown on Figure 17. This figure also shows the estimated capacities of hydro-electric power that could be utilized in the system.

ENERGY FOR LOAD AND PEAK DEMAND FOR STUDY AREA K 1950 - 2020



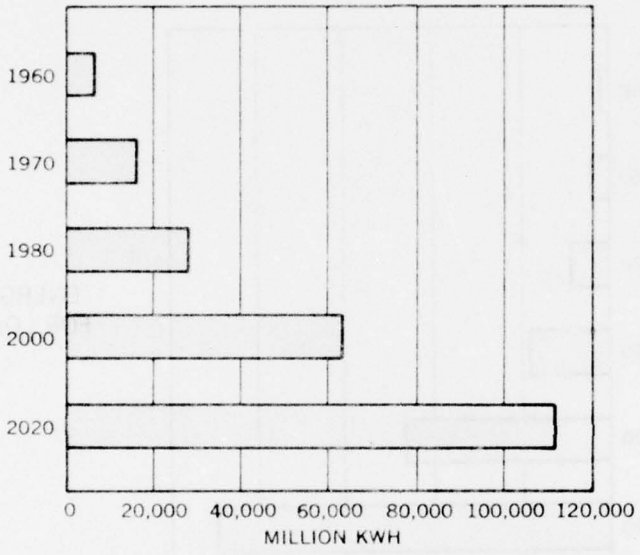
ENERGY FOR LOAD



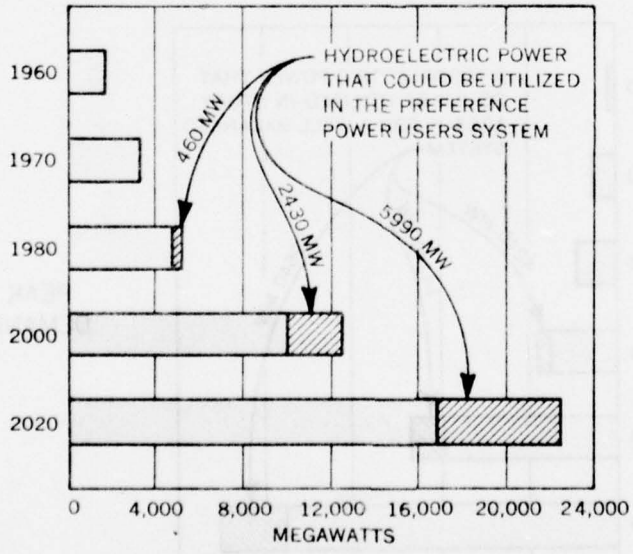
PEAK DEMAND

FIGURE 16

ENERGY FOR LOAD AND PEAK DEMAND FOR PREFERENCE POWER USER AREA 1960-2020



ENERGY FOR LOAD

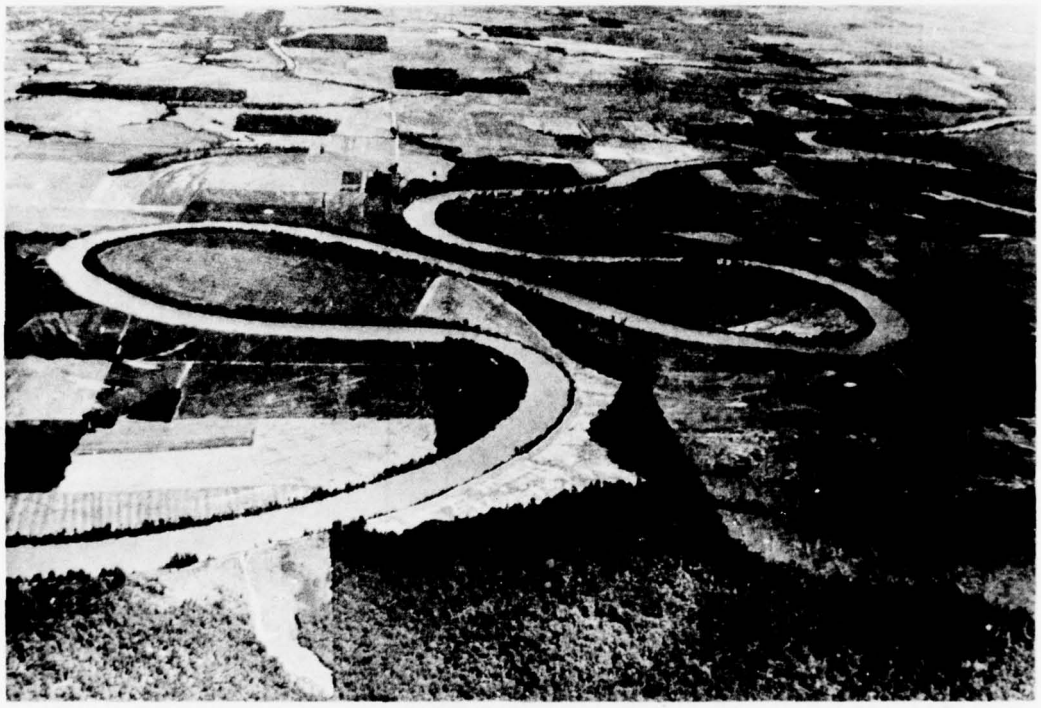


PEAK DEMAND

FIGURE 17

29. NAVIGATION

a. The White River is very crooked throughout its entire length. There are many bends with a radius of less than 1,000 feet. These bends, coupled with the existing project channel dimensions, are definite restrictions to the size and the length of the tows which may be expected to successfully navigate the stream.



Corps of Engineers

This typical segment of the White River, located 22 miles upstream from Augusta, Arkansas, shows the navigation restricting bends.

b. Commerce movement on the White River during the 6-year period 1960-1965 averaged 498,659 tons annually. During this period efforts were made to maintain a navigable depth of 4-1/2 feet from the mouth to Augusta, Arkansas. Normally, traffic on the White River consists of one- and two-barge tows, powered by 600 to 700 horsepower towboats. The barges are 195 feet long and 35 feet wide. Table 16 gives the commodity movements on the river during the 1960-1965 period.

c. A preliminary estimate of potential waterborne commerce was developed for a channel with a minimum depth of 9 feet (100 percent of the time) and a 150-foot bottom width. The commerce of the

TABLE 16

COMMERCE ON WHITE RIVER - PERIOD 1960 THROUGH 1965
(In tons)

Type cargo	Movement	1960	1961	1962	1963	1964	1965
Soybeans	Out	56,816	69,923	86,226	56,314	55,816	54,026
Rice	Out	13,888	651	-	8,045	-	-
Wheat	Out	-	-	2,700	1,122	1,460	1,613
Sand, gravel & crushed rock	Inbound	-	-	-	-	-	64,240
Sand, gravel & crushed rock	Local	139,600	179,300	285,200	194,700	202,200	195,400
Logs	Out	3,990	-	1,800	13,309	-	16,744
Logs	Local	19,818	29,916	42,715	43,329	35,641	44,169
Waterway improvement matl.	Out	79,368	54,368	116,203	41,468	160,752	268,868
Waterway improvement matl.	In	-	-	-	485	-	168,451
Waterway improvement matl.	Local	-	-	-	42,055	61,624	39,340
Limestone	Out	-	-	-	-	-	25,465
Other	Out	-	1,186	4,099	-	2,042	-
Other	In	-	-	-	-	1,450	390
Other	Local	1,692	147	136	82	242	545
Total(1)		315,172	335,491	539,909	400,909	521,227	879,251

(1) 6-Year average 498,659 tons.

"base year" (1965) was developed from a limited waterway traffic survey and a study of production and consumption of the various commodities in the area. On the basis of this preliminary study it is estimated that the commerce that would have been shipped on an improved waterway in 1965 was 3,221,000 tons. The major portion of this would be outbound commerce.

d. Projection of waterborne commerce is based on the expected growth of economy within the area. This estimated prospective commerce is presented in Table 17.

TABLE 17

PROSPECTIVE COMMERCE
(Tons)

Commodity	1965	1970	1980	2000	2020
Soybeans	450,110	540,130	801,200	1,323,320	1,773,430
Rice	447,500	492,250	537,000	604,130	671,250
Wheat	30,930	39,400	48,510	82,380	112,010
Corn	12,800	8,930	6,700	6,700	6,700
Oats	4,720	2,720	1,660	1,280	850
Barley	500	700	970	1,520	2,070
Sand and gravel	568,900	648,550	813,530	1,587,230	2,315,420
Crushed stone	1,245,000	1,419,300	1,780,350	3,473,550	5,067,150
Cotton	5,250	5,930	7,300	10,190	13,440
Cotton by-products	19,400	21,920	27,000	37,640	49,660
Cement	12,500	13,500	14,880	19,000	25,630
Fertilizer	79,000	85,500	106,500	154,200	201,600
Coal	219,000	438,000	2,190,000	3,285,000	4,380,000
Petroleum	3,000	3,240	3,570	4,560	6,150
Wood and wood products	100,130	93,120	101,130	189,250	260,340
Metals	22,320	24,110	26,560	33,930	45,760
Total (rounded)	3,221,000	3,837,000	6,467,000	10,814,000	14,931,000

30. WATER SUPPLY

a. In 1965, the urban areas of the White River Basin used an average of 48 million gallons of water per day (m.g.d.) for domestic, service and commercial business, and small industrial water supply needs, representing approximately 6 percent of the total water used in the basin. Based on the expected increase of population in the area and an expanding per capita water use, it is estimated that the water requirements for municipal purposes will increase to about 65.8 m.g.d. (74,000 acre-feet per year) by 1980, and to about 140.7 m.g.d. (158,000 acre-feet per year) by 2020. To date, existing facilities have been

developed in the basin to supply approximately 163 m.g.d. for municipal supply from reservoirs, rivers, springs, and ground water aquifers. One-third to one-half of the municipal supply in 1965 was obtained from ground water and spring flow. In viewing these water needs basinwide it would appear that sufficient resources have been developed to supply the municipal and light industrial needs beyond the year 2020. However, there are areas which have insufficient water supplies to meet projected demands of even the immediate future due to their location, lack of ground water availability, and anticipated rapid growth of urban population.

b. Water demands for water-using industries, not generally supplied by public water supply systems, are expected to approach 76.4 m.g.d. (86,000 acre-feet per year) by the year 1980 and 115.9 m.g.d. (130,000 acre-feet per year) by the year 2020.

c. Rural water use within the basin for domestic and livestock purposes was approximately 33 m.g.d. in 1965, which represented about 4 percent of the average daily water use in the basin. It is estimated that rural water demands, exclusive of irrigation, will increase to about 50 m.g.d. by 1980 and remain relatively constant. The higher demand will result from maintenance of higher living standards rather than any anticipated population growth. At present about 90 percent of the rural water supply is obtained from privately owned wells. Other sources are from farm ponds, cisterns, and streams.

d. Projected municipal, industrial, and rural water supply requirements for the water supply area are shown on Figure 18. The water supply study area which includes only a limited area outside of the White River Basin is shown on Plate N-1 of Appendix N.

31. WATER QUALITY CONTROL

a. Pollution of streams in the White River Basin at the present time is not extensive or widespread. This is because of the comparatively small population concentrations, few industries, and the high sustained flow of the White River and its major tributaries, on which most of the larger communities are located. Most water-using industries in the basin are located within the corporate limits of cities, and discharge their waste through municipal treatment systems. The most important of these industries is food and kindred products engaged principally in processing poultry, dairy, and beef products.

b. Some pollution problems do exist in the basin, however, as a result of inadequate or overloaded municipal waste treatment facilities and various industrial and agricultural operations. Pollution results from dairy feedlot operations, where cattle wastes have been allowed to enter streams and ground water formations; from industrial operations, where raw wastes, excavated materials, and gravel washings have been dumped into streams; and from agricultural operations, where pesticides

WATER SUPPLY REQUIREMENTS
WHITE RIVER BASIN
1965 - 2020

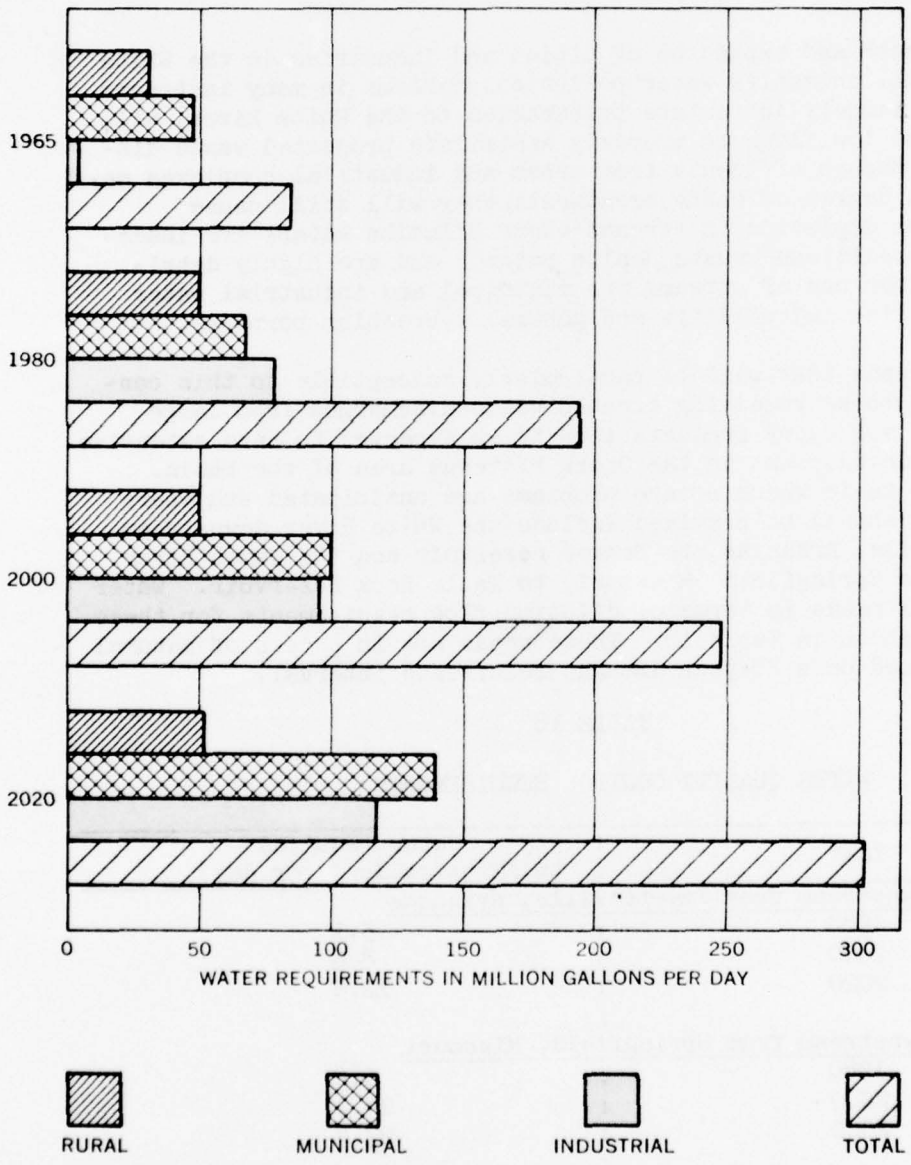


FIGURE 18

and herbicides have been sprayed directly on streams or washed into streams after application. Pollution has caused fish kills in some streams by depleting oxygen, rapidly changing temperatures, and introducing toxic materials. Other indications of pollution are increased turbidity in some streams and increased concentrations of nitrates and other plant nutrients in some ground water and surface water supplies.

c. Growth and expansion of cities and industries in the White River Basin will intensify water pollution problems in many instances. Some streams, largely intrastate tributaries to the White River, will have inadequate low flows to properly assimilate projected waste discharge. Even though effluents from urban and industrial complexes may receive a high degree of waste treatment, they will still cause critical oxygen depletion in streams where dilution waters are inadequate. Such conditions create health hazards and are highly detrimental to further use of streams for municipal and industrial water supply or for fish and wildlife and general recreation purposes.

d. Streams that will be particularly susceptible to this condition will be those receiving treated waste discharges from large beef, poultry, and dairy products industries expected to have extensive expansion and development in the Ozark Plateaus area of the basin. Streams of the basin where severe problems are anticipated and where dilution flows should be provided include the White River downstream from Fayetteville, Arkansas, to Beaver Reservoir and the James River downstream from Springfield, Missouri, to Table Rock Reservoir. Water quality control needs in terms of dilution flow requirements for these locations are shown in Table 18. These needs are in excess of natural streamflows based on a 20-year drought recurrence interval.

TABLE 18

WATER QUALITY CONTROL REQUIREMENTS

Year	Water required (million gallons per day)
White River downstream from Fayetteville, Arkansas	
1980	5.1
2000	8.6
2020	12.5
James River downstream from Springfield, Missouri	
1980	5.6
2000	14.1
2020	27.4
1980	10.7
2000	22.7
2020	39.9

e. Many small cities and rural communities located in the headwaters of tributary streams have localized pollution problems. They include West Plains, Willow Springs, Mountain Grove, Seymour, and Ava in Missouri and Harrison, Jonesboro, Walnut Ridge, and Green Forest in Arkansas. Effluents from waste treatment plants are discharged into streams which have little or no flow except where they are spring-fed. Effluents from those located in the Coastal Plain portion of the basin are discharged into broad flat channels where runoff is sluggish and channel slopes are very gradual. Streams are stagnant much of the time and cannot satisfactorily assimilate pollution loads.

f. Warmer temperatures in the White River below Bull Shoals and Norfork Dam, when there may be no significant power-water releases for 2 or 3 days, as on holiday weekends, have caused fish kills during the midsummer according to the Arkansas Game and Fish Commission. In that reach of the river where native fish could not adapt to the colder water from the reservoirs a valuable trout fishery has been substituted. The losses have occurred despite modification of power operations insofar as possible, consistent with the authorized project purpose.

g. Irrigation and large-scale fish-farming operations also create pollution problems, particularly in the Coastal Plain portion of the basin. Return flows from these operations contain varied pollutants, including dissolved solids, sulfates, chlorides, nitrogen, and phosphorus.

32. IRRIGATION

a. There are about 1,786,000 acres in the Coastal Plain portion of the basin suitable for irrigation. The most expansive single area is known as the Grand Prairie Region of Arkansas. More than half of this region lies on a wide ridge or terrace on the right bank of the White River downstream from the vicinity of DeValls Bluff, Arkansas. This terraced land comprises about 877,000 acres and is the principal rice growing area of the Grand Prairie Region.

b. All of the Coastal Plain portion of the basin is in a humid climate having an average annual precipitation of about 50 inches. Under normal conditions water supplies are adequate for general agricultural productions, but rice culture, which is of primary importance in the area, requires an alternate flooding and draining of the land and poses a special problem in supply and control of agricultural water. Provision of supplemental water for dry-crop farming is in the experimental stage but holds substantial possibilities of future development because of frequent droughts during the growing seasons.

c. In addition to the area suitable for irrigation in the Coastal Plain portion of the basin, there are some 26,000 acres in the Ozark Plateaus portion suitable for irrigation. Due to the frequent flooding of the bottomland, irrigation in this area is confined to the

higher terraces along the streams and to the relative flat interfluve areas. The present sources of water are irrigation reservoirs, farm ponds, springs, and perennial streams. There were about 280 sprinkler irrigation systems in use in the area in 1964. These systems were used for supplemental irrigation on high income crops.

d. The most important source of irrigation water is the aquifers consisting of sands and gravels of the Quaternary age. These underlie the Coastal Plain portion of the basin in thickness ranging from a few to about 400 feet. These aquifers were required to supply some 741,000 acre-feet of irrigation water in 1964 for irrigation of about 459,000 acres. When their use for irrigation purposes first began the water was confined under artesian pressure by overlying impervious clays. However, at present a free water table exists over most of the region as a result of pumping in excess of recharge inflow.

e. These ground-water supplies are being rapidly depleted. It is indicated that on a regional basis the supply will only be adequate to furnish the present withdrawal for about 20 years. However, significant local areas may encounter problems in obtaining water from wells before then.

f. The following estimates of supplemental irrigation water use in acre-feet per acre per year were used in arriving at supplemental irrigation water needs.

TABLE 19

ESTIMATED SUPPLEMENTAL IRRIGATION WATER USE
(Acre-feet per acre per year)

Crop	Average	Drought year (20% chance of occurrence)
Rice	2.0	2.5
Cotton	1.0	2.0
Soybeans	0.75	1.5
Other	1.0	1.5

g. Irrigation needs are estimated on the basis of lands which can profitably use additional water for crop production and are physically suited for irrigation. It is assumed that the lands will be essentially flood-free and adequately drained. Table 20 shows the historical and projected water requirements for the White River Basin, using the estimated annual water requirements of Table 19 for an average year and a drought year.

Soil Conservation Service

Cotton being irrigated with sprinkler system.

Soil Conservation Service

Contour border rice irrigation showing the rice soon after the first flooding.

TABLE 20

PROJECTED IRRIGATED ACREAGE AND WATER REQUIREMENTS

Use	Irrigated area(1)	Water requirement	
		Average year	Drought year
	(1,000 ac.)	1,000 acre-feet	
1964			
Rice	233	466	582
Cotton	46	46	92
Soybeans	144	108	216
Other	13	13	20
Total	436	633	910
1980			
Rice	240	480	600
Cotton	80	80	160
Soybeans	300	225	450
Other	20	20	30
Total	640	805	1,240
2000			
Rice	235	470	588
Cotton	85	85	170
Soybeans	330	248	495
Other	25	25	38
Total	675	828	1,291
2020			
Rice	230	460	575
Cotton	90	90	180
Soybeans	340	255	510
Other	25	25	38
Total	685	830	1,303

(1) Includes acreage in the Grand Prairie authorized project.

33. VECTOR AND ANNOYANCE PROBLEMS

a. The principal reasons for consideration of vector problems associated with the White River Basin water and related land resource developments are: (1) to prevent conditions suitable for transmission of vector-borne diseases, and (2) to safeguard the comfort and well-being of the public.

b. Malaria formerly was a serious disease in Arkansas and Missouri, but during recent years there has been no significant malaria transmission in these States or any other State of this country. Significant densities of the malaria mosquito (Anopheles quadrimaculatus)

still exist throughout the White River Basin. Therefore, a resurgence of malaria is an ever present threat as long as travelers and military personnel bring malaria parasites into this country.

c. Mosquito borne encephalitis has not been recognized as a public health problem in the White River Basin, but the St. Louis strain of this disease represents a threat in view of the prevalence of the vector - Culex quinquefasciatus (Southern house mosquito) - in the area.

d. Two important tick vectors in the area are Amblyomma americanus (lone-star tick) and Dermacentor variabilis (American dog tick). These species are vectors of Rocky Mountain spotted fever and tularemia.

e. Annoyance problems are especially pertinent in connection with the development and utilization of outdoor recreation areas. Past experience has demonstrated that scourges of mosquitoes - such as flood-water species (Ades vexans) and ricefield mosquitoes (Psorophora confinnis) - can be a real impediment to recreational developments. Other arthropods and rodents that may create serious nuisance problems in recreational areas include: deer flies, biting midges, wasps, ticks (especially the lone-star), chiggers, ground squirrels, rats, mice, and chipmunks.

SECTION VI - IMPROVEMENTS DESIRED

34. GENERAL

Data for developing the comprehensive plan were obtained from published and other existing sources, special field investigations, and office studies. Views of local interests were gathered at a series of public hearings and presentations of tentative plans and by direct and continuing liaison with local residents, organizations, and agencies throughout the planning process. Both formal and informal discussions were held with individuals and groups of residents in various parts of the basin. Not only were the local people informed of general progress but, in turn, useful views and expressions of local desires were obtained. Likely sources of support or opposition to plan proposals were noted.

35. PUBLIC HEARINGS

a. Extent. Two public hearings, attended by 1,235 people, were held at Marshall, Arkansas, in connection with the preparation of a Corps of Engineers report entitled "White River Basin Comprehensive Study, Missouri and Arkansas, Interim Report on Buffalo River Basin, Arkansas." The purpose of the first hearing on January 30, 1962, was to give all persons and Governmental agencies concerned an opportunity to express their views regarding the character and extent of improvements desired in the Buffalo River Basin. The second hearing was held on November 8, 1964, to present the tentatively selected plan of development of the Buffalo River Basin in order to obtain a full, frank, and public expression of the views of interested persons. After the formation of the White River Basin Coordinating Committee, its members participated in an initial series of three hearings in April 1965 to insure that full consideration would be given to the public viewpoint in planning for the optimum development of the water and related land resources of the entire basin. These hearings, attended by 804 people, were held in Clarendon and Batesville, Arkansas, and Springfield, Missouri. When a preliminary plan was developed, public presentations were made by the Committee in a final series of four public hearings during December 1967 to inform interested persons and organizations of the tentative plan and to request comments on the plan. These hearings, attended by about 1,100 people, were held in Clarendon and Batesville, Arkansas, and Poplar Bluff and Springfield, Missouri.

b. Summary of views - Buffalo River Interim Report. The majority of comments received at the hearings held in connection with the preparation of the Interim Report on the Buffalo River Basin emphasized the desirability of the construction of multiple-purpose projects for conservation, flood control, hydroelectric power, recreation, and industrial development. However, there was strong opposition by those persons who desire that the river be left in a free-flowing state and be developed as a National River.

c. Summary of views, initial hearings, White River Basin Comprehensive Study. The tenor of the initial public hearings held by the White River Basin Coordinating Committee indicated an increased public awareness and desire for a comprehensive water and land resources development study of the White River Basin. Statements were received which urged the construction of dams to satisfy the needs for flood control, hydroelectric power, and water supply. It was pointed out that the resulting recreational and industrial development opportunities would be major factors in improving the economy of the basin. The need for control of headwater streams and furtherance of soil conservation was also stressed. The projects and programs enumerated for consideration included the following: channel stabilization and dredging for navigational purposes; additional upstream flood control; and development of small watersheds to provide flood protection, recreation, irrigation, and a source of water for municipal and industrial purposes. As with all public works, there are a number of landowners who would be displaced by the reservoirs and are opposed to such programs. There were also expressions received from those who oppose public works programs in general in the interest of Government economy. Others voiced concern with preservation of historic sites and scenic beauty of the region and with maintaining the clear flowing streams.

d. Summary of views, final hearings, White River Basin Comprehensive Study.

(1) One hundred seventy-four statements were received at the hearings and 139 additional statements were received by the Office of the Chairman before and after the hearings.

(2) The reactions to the projects and programs under consideration indicated an intense public interest in development of the basin. By far the majority of the statements was in favor of the entire plan under consideration, although, many statements, after indorsing the entire plan, placed special emphasis on features of personal interest. A very few statements were in opposition to the entire plan. This opposition came from persons or organizations who felt the plan might have possible adverse effects on fish and wildlife.

(3) The statements from groups and organizations of the Coastal Plain area were almost entirely in favor of the entire plan with emphasis on control of floods by large upstream reservoirs, flood prevention programs, and levee and channel improvements. Certain projects or features were pointed out as being highly desirable and opposition appeared to be minor. The projects and programs given the most emphasis for development of the Coastal Plain area included the agricultural water management programs of the Soil Conservation Service, the levee and channel improvements of the Corps of Engineers, and a 9-foot year-around navigation channel on the lower White River.

(4) Opposition in the Ozark Plateaus area where the reservoirs would be located came chiefly from families and business

interests that would be required to move. Others expressed opposition because of economic, ecologic, and aesthetic reasons. A more detailed discussion of the results of the public hearings is given in Appendix A.

36. MEETINGS WITH PROSPECTIVE SPONSORING GROUPS

Throughout the study, liaison between local interests and representatives of the participating agencies was maintained by means of correspondence, conferences, and numerous public meetings. The purpose of the public meetings was to present preliminary studies to interested persons relevant to their particular areas within the basin and obtain their desires and comments on further studies. The consensus gained was that local interests generally favored the continuation of the comprehensive study and development of the water and related land resources of the basin.

SECTION VII - PLAN FORMULATION

37. PLANNING CONCEPTS AND CONSIDERATIONS

a. Concepts. The objective of plan formulation was to develop a comprehensive plan which would serve as a guide for the best use of the water and related land resources of the basin to meet all foreseeable short- and long-range needs. To accomplish this objective the Coordinating Committee adopted the following planning concepts.

(1) A coordinated comprehensive plan for the time-phased development of the water and related land resources of the White River Basin through the year 2020 would be formulated and presented in the report.

(2) Elements of the comprehensive plan should be compatible with each other and should provide an arrangement of projects and programs flexible enough to meet the changing pattern of needs that would undoubtedly result from unforeseen demands placed on the environment of the basin.

(3) Full and equal consideration would be given to all purposes which could be served by water and related land resource development.

(4) In determining the composition of the plan, each separable component should be considered on the basis of the contribution it would make in net benefits to the White River Basin, the States of Arkansas and Missouri, and the entire Nation.

(5) All benefits and costs, both tangible and intangible, would be given full consideration in arriving at the recommended comprehensive plan.

(6) The plan would recognize expressed desires of local people and protect their rights and interests as well as those of the States and the Nation in determining the development of water and related land resources and the preservation and protection of established uses.

(7) The plan would include existing, authorized, and formally proposed projects and programs of Federal and non-Federal agencies which were compatible with the balanced comprehensive development and use of the water and related land resources of the White River Basin.

(8) It would be recognized in the plan that additional studies might be required for some projects and programs to support specific recommendations for State or Federal authorization or development by private interests.

(9) Provisions should be made for a periodic review of the comprehensive plan. This review would serve as a basis for keeping the plan current and for subsequent action.

b. Planning considerations. To implement the broad planning concepts, the following more specific planning considerations were used to formulate and evaluate projects and programs included in the comprehensive plan.

(1) Water and related land resource projects and programs were formulated in a manner to insure that they were economically efficient unless there were overriding reasons to the contrary; they provided the greatest amount of benefits in excess of costs; and, to the extent practicable, there was no less costly way of meeting the needs.

(2) Alternative solutions to problems were considered, coordinated between interests involved, and wherever possible resolved to what appeared to be the most satisfactory solution from the broad comprehensive viewpoint.

(3) Utmost consideration was given to determining the effect of projects and programs on the environmental quality of the basin.

(4) Development of water and related land resources for a single purpose should recognize and consider the alternative uses of the resources for other purposes.

(5) Because of the limited number of large multiple-purpose reservoir sites, consideration was given to development of reservoir sites on main streams and major tributaries to their full physical capacities to meet foreseeable needs where economically justified.

(6) An important consideration in planning watershed protection and flood prevention programs was the physical and economical suitability of sites to store water to meet the needs of the area as determined by investigations. Also, compatibility of the structures with downstream main stem or major tributary reservoirs was carefully evaluated.

(7) Investigations would include all potential solutions for flood control and flood prevention.

(8) Planning for water quality control would recognize the pollution problems associated with existing and future development, and standards would be in accordance with control established by the States and the Federal Water Pollution Control Administration.

(9) Upstream watershed planning would consider land treatment measures as a solution for flood and sediment reduction and enhancement of the land for recreation use and fish and wildlife habitat.

(10) Main stem and major tributary reservoir sites would be screened for potential conventional and pumped-storage hydroelectric installation. Sites adjacent to reservoirs would also be screened for potential pumped-storage installations.

(11) Consideration was given in planning for providing plentiful, high quality water supplies for municipal, industrial, and agricultural uses.

(12) Navigation planning would be on the basis of compatibility with the interconnecting inland waterways system of the United States.

(13) The increasing need for sport fishing, hunting, and recreational opportunities would be carefully considered.

(14) The need for conservation of fish and wildlife resources and areas of archeological, historic, and scenic values would be considered.

38. DEVELOPMENT OF THE PLAN

a. Studies. Studies to develop the plan considered (1) the timely development and management of water and related land resources as essential aids to the orderly economic growth of the region and Nation; (2) the preservation of resources, in appropriate instances, to insure that they will be available for their best use as needed; and (3) the well-being of all the people as the overriding determinant in the planning. Framework studies identified the foreseeable short- and long-range water and related land resource needs of the basin and indicated the relative urgency for action necessary to meet these needs.

b. Projects and programs considered. The following types of water and related land resource projects and programs were considered for meeting the basin needs.

(1) Watershed protection or land treatment measures on all areas where such measures are needed to conserve and promote productivity and protect the land.

(2) Floodwater retardation structures in upstream areas where flood problems exist and sites for structures are available. Where needed, sites were investigated for multiple-purpose development of municipal and industrial water supply, water quality control, recreation and fish and wildlife enhancement, and irrigation.

(3) Numerous main stem and major tributary dam and reservoir sites for flood control, hydroelectric power, municipal and industrial water supply, water quality control, and recreation and fish

and wildlife enhancement. Consideration was also given to conventional and adjacent type pumped-storage facilities for production of hydroelectric power.

(4) Improvement of the lower White River for navigation.

(5) Levees for protection of low-lying areas along the major streams where considerable flood damage would continue to be experienced even with reservoir regulation.

(6) Channel improvement and other drainage facilities for flood control and drainage on lands which are too wet for farming or where production is reduced by wetness.

(7) Flood plain management programs as alternatives for other flood prevention measures as appropriate.

(8) Provision of water to irrigate land which can profitably use additional water for crop production and is physically suited to irrigation was considered.

(9) Developments to meet the needs for water and related land resource recreational opportunities in the basin and area of influence. These included main stem and major tributary reservoirs; upstream reservoirs; preservation of streams; preservation of archeological, historic, and scenic values; national scenic rivers; development of additional recreation lakes and the acquisition of additional land within national forests; enlargement of the existing National Wildlife Refuge and existing fish hatcheries; regulation of tailwater temperatures and access to the tailwaters below large reservoirs; provision of access to fish and wildlife habitat within leveed areas; public lakes for fishing and hunting; stream access; municipal impoundments; farm ponds; and land acquisition for wildlife management.

c. Procedures.

(1) Ad hoc work groups composed of representatives within the various Federal and State agencies involved in the study identified water and related land resource needs in excess of those being met by existing, under construction, authorized, and proposed projects and programs and determined the areal extent of these unsatisfied needs. The individual agencies participating in the study then made preliminary or reconnaissance type investigations to determine possible solutions for meeting the unsatisfied needs within the field for which they have authority. The multiple-purpose aspects of all possible solutions were considered in order to develop a balanced plan. Each agency also determined a tentative priority and timing for their projects and programs.

(2) It was recognized that close coordination and cooperation among the various Federal and State agencies involved in the study would be required in formulating a comprehensive plan for development and use of the water and related land resources of the White River Basin. Therefore, a Plan Formulation Work Group was established to study and evaluate agency proposals for meeting the basin needs and, where necessary, to resolve conflicting proposals. The work group also reached conclusions as to the urgency of meeting the water and related land resource needs of the basin and designated priorities for more detailed studies. The Plan Formulation Work Group was composed of representatives from participating Federal agencies and the States.

d. Time-phased categories of the plan.

(1) Existing, under construction, and certain of the authorized and proposed projects were a necessary part of the comprehensive plan to help meet future needs. Because of the location of these projects and their limited capacity and functional purposes, they are unable to meet all present and future needs of the basin. For this reason additional projects and programs were considered by participating agencies for inclusion in the plan. The proposed and additional projects and programs selected for the comprehensive plan by the Plan Formulation Work Group were divided into two time-phased categories based on the urgency of meeting the needs. One category, an early action plan, contains projects and programs which should be initiated within the next 10 to 15 years. A second category, the long-range plan, contains other projects and programs which for one reason or another are not so urgently needed. Individual agencies made detailed engineering and economic studies for those projects and programs included in the 10- to 15-year plan.

(2) Because of various interests and responsibilities of the many agencies and the States participating in the study, there were diverse views on some of the elements considered in developing the plan. Most of the conflicts were resolved. However, the long-range plan contains some alternative projects and programs which could be developed in the future if certain projects and programs in the 10- to 15-year plan are not initiated.

SECTION VIII - COMPREHENSIVE PLAN OF DEVELOPMENT

39. INTRODUCTION OF PLAN

a. The coordinated comprehensive plan for the White River Basin includes water and related land resource projects and programs that would contribute to meeting the needs projected to the year 2020.

b. The existing, under construction, and certain authorized and proposed projects are a necessary part of the plan to help meet these needs. Existing, under construction, and authorized projects are discussed in Section IV and are listed on Tables 5 through 8. Authorized projects not included in the comprehensive plan are discussed below.

(1) Lone Rock Dam and Reservoir on the Buffalo River, Arkansas, was authorized for flood control in 1938. The Secretary of the Army has recommended to the Public Works Committee of the United States Senate that the project not be constructed.

(2) Water Valley Dam and Reservoir on the Eleven Point River, Arkansas, was authorized for flood control in 1938 and subsequently approved to provide for future power facilities. The Secretary of the Army has informed the Public Works Committee of the United States House of Representatives that the project is in a deferred status pending new authorizing legislation.

(3) Bell Foley Dam and Reservoir on the Strawberry River, Arkansas, was authorized for flood control in 1938. Early in this investigation it was determined that the project should be restudied for possible inclusion of other water resource purposes. The modified project is discussed further in subsequent paragraphs and sections of this report.

c. "Proposed projects," as used above, means those projects on which authorizing legislation is pending. Projects in this status include Crooked Creek, at and in the vicinity of Harrison, Arkansas; the Buffalo National River; and the Eleven Point National Scenic River. These projects are included in the 10- to 15-year plan and are discussed briefly in the following paragraphs.

(1) The Corps of Engineers and Soil Conservation Service formulated a joint plan for Crooked Creek Basin that would meet the flood control and water supply needs at and in the vicinity of Harrison, Arkansas. The plan includes land treatment measures, the construction of 19 flood retarding structures, one multiple-purpose reservoir located on the East Fork of Crooked Creek, and raising the existing urban renewal levee and floodwall within the city. The Soil Conservation Service part of the plan has been approved for planning and construction. The Secretary of the Army has recommended to the

Public Works Committee of the United States Senate that the Corps part of the joint plan be authorized for construction.

(2) The Buffalo National River was proposed by the National Park Service in a report dated April 1963 and legislation has been introduced in both houses of the Congress to implement the Park Service proposal. The area proposed for development and administration by the National Park Service would comprise about 103,000 acres of land adjacent to the Buffalo River and would extend from its mouth approximately 128 miles upstream to the present boundary of the Ozark National Forest near Boxley, Arkansas. Adjacent lands would be acquired in fee title or controlled by scenic easements for development of recreation facilities and preservation of scenic areas. Partial rights or scenic easements might be acquired on lands having a high agricultural value as a means of maintaining the agricultural productivity of these areas and at the same time preserving their beauty and scenic attractiveness. Development would include hiking, and nature study trails; horseback riding, and camping trails; camping, and picnicking grounds; and preservation of scenic, archeological, and historical values.

(3) The Eleven Point River was studied by the National Wild River Team of the Departments of Agriculture and the Interior for possible inclusion in the National Scenic and Wild Rivers System. Several bills have been introduced in the Congress which would designate parts of the Eleven Point River as a National Scenic River Area. The upstream limit of the proposed Scenic River would be at Thomasville, Missouri. The downstream limit of the proposed Eleven Point Scenic River has been somewhat controversial with some bills proposing the lower end of the Scenic River at Missouri Highway 142. This would include 48 miles of the river. Other bills propose that the Scenic River extend to the mouth of the stream in Arkansas, about 42 miles downstream from Missouri Highway 142. Adjacent lands would be acquired in fee title or controlled by scenic easements for development of recreation facilities and preservation of scenic areas.

d. Additional projects and programs in the 10- to 15-year plan include:

(1) Five main stem or major tributary reservoirs;

(2) Addition of two 42,500-kilowatt hydroelectric generating units to the existing Norfork project;

(3) A reregulation structure below the existing Greers Ferry project for recreation and fish and wildlife enhancement;

(4) Seventy-nine watershed protection and flood prevention projects which include land treatment measures and numerous multiple-purpose dam and reservoir projects;

(5) Expansion of national forest holdings, construction of 10 single-purpose recreation reservoirs, and development of recreation and access facilities on national forest lands;

(6) Twelve levee and channel improvement projects for local flood protection, and one major flood and drainage outlet;

(7) A national recreation area;

(8) Expansion of an existing national wildlife refuge;

(9) Expansion of the National Scenic Riverways by inclusion of the lower 20 miles of the Current River within the Mark Twain National Forest in Missouri;

(10) Established water quality control standards should be implemented and maintained for protection of fish and wildlife resources and other purposes.

(11) A pumped-storage hydroelectric project; and

(12) Improvement of the lower White River for navigation.

e. In the case of the pumped-storage hydroelectric project and navigation on the lower White River, this report recognizes the need for both projects within the next 10 to 15 years and recommends that separate studies be made on both projects to verify economic justification.

f. Also included in the 10- to 15-year plan are numerous fishing, hunting, game management, stream preservation and stream access projects and programs proposed for implementation by the States of Arkansas and Missouri and the private sector.

g. Projects and programs in the long-range plan were studied in sufficient detail to determine only their general applicability in meeting foreseeable needs and their compatibility with other projects and programs in the area. The long-range plan includes the following:

(1) Flood prevention projects which include 280 single-purpose floodwater retardation structures, 3 floodwater retardation and municipal and industrial water supply structures, 6 floodwater retardation and recreation structures. Of these projects, 36 floodwater retardation structures and 1 floodwater retardation and recreation structure are alternatives for major tributary reservoirs which are in the 10- to 15-year plan.

(2) Five upstream reservoirs on Forest Service lands for recreation.

(3) Eleven main stem or major tributary reservoirs. Five of these reservoirs are alternatives for other projects or programs included in the 10- to 15-year plan.

(4) The addition of 24,000 kilowatts of hydroelectric capacity to the privately owned Ozark Beach project located downstream from Table Rock Dam on the White River near Forsyth, Missouri.

(5) A pumped-storage hydroelectric power development of about 600,000 kilowatts.

(6) Three levees with a total length of about 28 miles.

(7) A channel improvement project on Flat Creek to operate in conjunction with upstream reservoirs in providing flood protection at Cassville, Missouri.

(8) Recreation and fish and wildlife measures consisting of preservation of additional Ozark streams, stream access, preservation of high-quality wildlife habitat, and additional impoundments for fishing.

(9) Continued implementation and maintenance of the established water quality control standards for protection of fish and wildlife and other purposes.

(10) Augmentation of low flow for certain Ozark streams to increase flows for float fishing and other recreational purposes.

h. The projects and programs in the comprehensive plan of development for the White River Basin are presented in Table 21. Implementation of established water quality control standards and other supporting programs are not shown on the table. A further discussion of the supporting programs is presented in paragraph 46. The comprehensive plan is shown in general on Plate 2.

i. Even though the existing, under construction, authorized, and proposed projects and programs described previously are important and necessary elements of the comprehensive plan, only those new projects and programs or additions to existing projects in the 10- to 15-year category will be discussed further in this section of the report.

TABLE 21

COMPREHENSIVE PLAN OF DEVELOPMENT
WHITE RIVER AND TRIBUTARIES

MAIN STEM AND MAJOR TRIBUTARY RESERVOIRS
CORPS OF ENGINEERS

Project	Stream	Mile	Total drainage area (square miles)	Total storage capacity (acre-feet)	Purpose
	Existing Reservoirs				
Beaver	White River, Ark.	609.0	1,186	1,952,000	FC,P,WS
Table Rock	White River, Mo.	528.8	4,020	3,462,000	FC,P
Bull Shoals	White River, Ark.	418.6	6,036	5,408,000	FC,P
Norfork	North Fork River, Ark.	4.8	1,806	1,983,000	FC,P
Greers Ferry	Little Red River, Ark.	79.0	1,146	2,844,000	FC,P
Clearwater	Black River, Mo.	257.4	898	413,000	FC
	Recommended Additions for Inclusion in 10- to 15-year Plan				
County Line	James River, Mo.	107.8	153	282,000	FC,WS,WQ, R,F&W
Wolf Bayou	White River, Ark.	311.4	10,796	619,000	FC,P,R,F&W
Norfork, Power Units 3 and 4	North Fork River, Ark.	4.8	-	-	P (addition)
Myatt Creek	Myatt Creek, Ark.	2.2	142	140,000	FC,R,F&W
Wild Horse	South Fork of Spring River, Ark.	14.9	296	345,000	FC,R,F&W
Bell Foley (1)	Strawberry River, Ark.	27.2	519	518,000	FC,R,F&W
Quarry (Reregulation)	Little Red River, Ark.	64.3	1,210	7,400	R,F&W

Footnote is shown at end of table.

TABLE 21 (con.)

LEVEES AND CHANNEL IMPROVEMENTS
CORPS OF ENGINEERS

Project	Stream	Mile	Length (miles)	Area benefited (acres)	Purpose
Existing, Under Construction, and Authorized					
Poplar Bluff and East Poplar Bluff, Mo.	Black River	-	4.4	(2) 720	FC (Levee)
Black River, Poplar Bluff, Mo., to Knobel, Ark. (Ark. Portion)	do	140-173	37.5	71,040	FC (Levee & pump station)
Skaggs Ferry, Black River east of Pocahontas, Ark.	do	94-104, 81-84	8.8	13,931	FC (Levee)
Newport, White River, Ark.	White River	257.6	8.5	(2) 2,000	Do.
Village Creek, White River and Mayberry Levee Districts, Ark.	do	231.5-255	20.2	33,400	Do.
Augusta to Clarendon Levee, White River, Ark. (3)	do	108-197	39.4	217,000	Do.
Des Arc, Ark.	do	147.3	1.5	(2)	FC (Levee & pump station)
DeValls Bluff, Ark.	do	125.0	0.1	(2)	Do.
Clarendon City Levee, Ark.(4)	do	100.6	6.0	(2)	FC (Levee)
White River Backwater Levee, Ark.	do	-	40.0	145,500	FC (Levee & pump station)
Village Creek, Jackson and Lawrence Counties, Ark.	Village Creek	-	-	-	FC (Channel improvement)
Village Creek, White River and Mayberry Levee Districts, Ark.	White River	-	-	-	FC (Channel improvement & pump station)
Clarendon to Laconia Circle, Ark.	do	-	48.5	287,600	FC (Levee)
Cache River Basin, Ark.	Cache River and Bayou DeView	-	-	-	FC (Channel improvement)
Big Creek and L'Anguille River, Ark.	Big Creek & L'Anguille River	-	3.3	60,000	FC (Levee)
Big Creek and Tributaries, Ark.	Big Creek and Tributaries	-	-	-	FC (Channel improvement)

Footnotes are shown at end of table.

TABLE 21 (con.)

Project	Stream	Mile	Length (miles)	Area benefited (acres)	Purpose
Recommended Additions for Inclusion in 10- to 15-year Plan					
Black River-Cane Creek, Butler County, Mo., and Clay County, Ark.	Black River	158-211	62.8	75,000	FC (Levee & channel improvement)
	Cane Creek	3-18			
Little Black River, Butler & Ripley Counties, Mo., & Clay and Randolph Counties, Ark.	Little Black R.	0-32	21.4	37,500	FC (Levee)
Current-Little Black Rivers, Ripley County, Mo., Clay County, Ark.	Current R.	28-35	14.3	5,800	Do.
	Little Black R.	1-15			
Black-Current-Fourche Rivers, Randolph County, Ark.	Current R.	0-28	30.7	20,400	Do.
	Black R.	93-96			
	Fourche R.	0-6			
Flat Creek, Lawrence County, Ark.	Black River	51-66	15.2	6,000	FC (Levee & channel improvement)
Clover Bend, Lawrence, Jackson, and Independence Counties, Ark.	Black River	25-54	33.1	17,000	Do.
	Big Running Water Cr.	0-14			
Black-Strawberry Rivers, Lawrence & Independence Counties, Ark.	Black River	33-44	14.1	9,000	Do.
	Strawberry River	0-9			
	Curia Creek Ditch	0-3			
Curia Creek, Independence County, Ark.	Black River	7-33	20.8	20,700	FC (Levee)
	Dota Creek	0-2			
	Curia Creek Ditch	0-3			
Oil Trough to Hurricane Lake, Independence, Jackson, & White Counties, Ark.	White River	199-282	45.1	55,000	FC (Levee & channel improvement)
Jacksonport, Jackson County, Ark.	White River	258-265	6.0	2,400	FC (Levee)
	Black River	0-1			
Taylor Bay to Augusta, Woodruff County, Ark.	White River	203-232	15.9	19,300	FC (Levee & pumping sta.)
Little Red-White Rivers, White and Prairie Counties, Ark.	Little Red River	0-15	33.3	29,000	FC (Levee & channel improvement)
	White River	164-182			
	Raft Creek	0-15			
Bayou Des Arc, Prairie and White Counties, Ark.	Bayou Des Arc	4-22	13.0	36,000	FC (Channel improvement)

TABLE 21 (con.)

OTHER PROJECTS
CORPS OF ENGINEERS

Project	Stream or location	Status	Purpose
		Authorized	
Grand Prairie Region, Ark.	Grand Prairie Region, Lower White River Basin	Authorized by Flood Control Act of 1950; no works of improvement completed	Supplemental irrigation water to area of critical water shortage.
	Recommended in Prior Report (10- to 15-year Plan)		
Crooked Creek, at and in the vicinity of Harrison, Ark.	Crooked Creek	Pending congressional action	Reservoir on East Fork for flood control, water supply, and recreation; improvements to existing levee and floodwall at Harrison.
	Recommended for Further Study (10- to 15-year Plan)		
Navigation	White River, mouth to Batesville, Ark.	Separate study authorized by Senate Public Works Committee Resolution adopted 25 May 1967	Year-round 9-foot navigable channel.
Optimus, Pumped-Storage	White River, adjacent to Wolf Bayou Reservoir, river mile 348	Separate study recommended to verify engineering feasibility and economic justification	Approximately 500,000 kilowatts of pumped-storage hydroelectric power.

TABLE 21 (con.)

LAND TREATMENT PROGRAM
DEPARTMENT OF AGRICULTURE

Basin	Watershed area (acres)	Land treatment areas				
		Cropland (acres)	Grassland (acres)	Woodland (acres)	Recreation (acres)	Wildlife (acres)
	Existing and Authorized for Installation in PL 566 Program					
White River	1,235,000	252,200	139,700	88,500	8,100	12,310
	Recommended Additions for Inclusion in 10- to 15-year Plan					
White River	16,534,400	3,388,000	4,051,700	928,800	18,090	510,980

TABLE 21 (con.)

UPSTREAM WATERSHED PROJECTS
SOIL CONSERVATION SERVICE

Project	Watershed: Number	Watershed: area (acres)	Structural measures: Detention (number)	Recreation and M & I water supply (number)	Multiple-purpose (number)	Channel improvement (miles)
Public Law 566 Projects Authorized for Construction						
Upper Crooked Creek	28	56,320	19	-	-	-
Mud Creek	46	18,560	1	-	-	29.9
Big Running Water Ditch	69	80,000	-	-	-	82.2
Flat Creek	80	23,680	5	-	1	10.2
Cooper Creek	86	40,320	9	-	-	3.8
Upper Culotches Bay	116	39,040	-	-	-	50.2
Big Creek-Bayou DeView	117	72,960	22	-	-	8.8
Lee-Phillips	126	83,200	-	-	-	110.0
White River Backwater	131	145,920	-	-	-	165.0
Public Law 566 Projects Authorized for Planning						
Little Black River	65	247,680	39	-	-	61.4
Fourche Creek	67	199,040	24	-	-	30.1
Tri-County	87	228,480	31	-	-	57.3
Upstream Watershed Additions Recommended for Inclusion in 10- to 15-year Plan						
Upper White River	1	174,720	30	-	1	-
West Fork of White R.	3	78,080	11	-	3	-
Richland Creek	4	94,080	13	-	1	-
War Eagle Creek	6	209,920	21	-	1	-
Upper Kings River	8	106,880	13	-	1	-
Lower Kings River	9	135,040	-	1	-	-
Dry Fork-Kings River	10	33,280	5	-	-	-
Osage Creek	11	104,960	5	-	1	-
Lower James River	15	193,920	31	-	-	-
Flat Creek	16	200,960	8	-	-	-
Indian Creek	18	40,320	2	-	-	-
Long Creek	19	99,200	8	-	1	-
Yokum-Dry Creeks	20	88,320	10	-	-	-
Bull-Swan Creeks	22	241,920	-	1	-	-

TABLE 21 (con.)

Project	Watershed: Number	Watershed: area (acres)	Structural measures: Detention (number)	Recreation and M & I water supply (number)	Multiple-purpose (number)	Channel improvement (miles)
Upstream Watershed Additions Recommended for Inclusion in 10- to 15-year Plan (con.)						
White River-Bull Shoals Dam to below mouth of Crooked Cr.	27	71,040	1	-	-	-
Big Richland Creeks	32	243,200	12	-	-	-
Middle Buffalo River	33	208,000	6	-	1	-
Upper North Fork R.	35	136,320	-	1	-	-
Lower North Fork R.	36	227,840	-	1	-	-
Lower Norfork Reservoir Tributaries	40	208,000	22	-	-	-
Salado Creek & Main Stem Laterals	44	111,360	15	-	3	(5) 7
Polk Bayou & Main Stem Laterals	45	140,800	10	-	-	-
Upper Black and Clearwater Laterals	47	249,600	-	2	-	-
West Fork of Black R.	48	102,400	-	1	-	-
Black River-Clearwater Dam to Poplar Bluff	51	222,080	47	-	1	-
North Inter-River Drainage District	52	99,200	-	-	-	161
Cane Creek & Black River Main Stem	53	219,520	31	-	2	190
Corning Ditches	55	62,080	-	-	-	165
Upper Current River	56	241,280	7	-	-	-
Current River-Akers to Jacks Fork	57	196,480	-	3	-	-
Spring Valley Creek	58	92,800	5	-	-	-
Upper Jacks Fork	59	120,960	9	-	-	-
Pike Creek	62	92,800	25	-	-	-
Current River-Van Buren, Mo., to Buffalo Creek	63	207,360	10	-	-	-
Lower Current River	64	120,320	8	-	-	-
Black Creek	66	26,880	-	-	-	38
Little Running Water Ditch	68	12,800	-	-	-	41
Upper Spring River	70	165,760	36	-	1	-

Footnote is shown at end of table.

TABLE 21 (con.)

Watershed			Structural measures			
Project	Number	Watershed area (acres)	Detention (number)	Recreation and M & I water supply (number)	Multiple-purpose (number)	Channel improvement (miles)
Upstream Watershed Additions Recommended for Inclusion in 10- to 15-year Plan (con.)						
Myatt Creek & Middle Spring River	71	179,840	23	-	-	-
South Fork Spring R.	72	210,560	25	-	1	-
Lower Spring River	73	221,440	35	-	2	-
Upper Eleven Point R.	74	199,680	32	-	1	-
Middle Eleven Point R.	75	53,120	15	-	1	-
Eleven Point River-Alton Reach	77	155,520	22	1	1	-
Eleven Point Laterals	78	102,400	25	-	1	-
Lower Eleven Point R.	79	28,160	6	-	-	-
Big Cypress Creek	81	27,520	1	-	-	-
Lower Black River Main Stem	82	26,880	-	-	-	25
Upper Strawberry River	83	151,680	28	-	1	-
Piney Fork-Strawberry River	84	75,520	20	-	-	-
North Big Creek-Strawberry River	85	122,880	1	-	-	-
Upper Village Creek	88	106,880	-	-	-	121
Lick Pond Ditch	89	27,520	-	-	-	43
Village Creek-Swan Pond Reach	90	67,840	-	-	-	74
Lower Village Creek (Mayberry)	91	83,200	-	-	-	73
Departee Creek & White River Laterals	92	224,000	15	-	3	68
Middle Fork-Little Red River	94	188,800	22	-	4	-
Big Creek and Main Stem, Little Red R.	100	204,800	14	-	1	-
Indian Creek-Little Red River	101	96,000	12	-	2	-
Overflow Creek-Little Red River	102	39,040	2	-	-	16
Cypress Bayou	103	154,240	4	-	-	90
Bull Creek	104	100,480	17	-	1	46
Upper Des Arc Bayou	105	124,160	7	-	-	55
Lower Des Arc Bayou	106	116,480	-	-	-	36

TABLE 21 (con.)

Project	Watershed		Structural measures			
	Number	Watershed area (acres)	Detention (number)	Recreation and M & I water supply (number)	Multiple-purpose (number)	Channel improvement (miles)
Upstream Watershed Additions Recommended for Inclusion in 10- to 15-year Plan (con.)						
White River-DeValls Bluff to St. Charles	108	162,560	-	-	-	15
Upper Cache River (Ditch No. 1)	109	175,360	44	-	-	179
Lower Cache (Ditch No. 1)	110	160,640	33	-	-	183
Cache River-Egypt to Light	111	102,400	9	-	-	140
Cache River-Amagon to Egypt	112	106,240	-	-	-	152
Cache River-Patterson to Amagon	113	117,120	-	-	-	166
Overcup Ditch	114	22,400	-	-	-	32
Cache River-Clarendon to Patterson	115	127,360	-	-	-	138
Bayou DeView-Flag Slough Reach	118	121,600	-	-	-	116
Lower Bayou DeView	119	210,560	-	-	-	189
Cow Lake	120	28,160	-	-	-	40
Possum Creek	121	10,880	-	-	-	18
Dials Creek	122	30,080	-	-	-	54
Big Slash	123	21,120	-	-	-	35
Big Creek-Flat Fork Reach	124	106,240	-	-	-	110
Big Creek-Piney Fork Reach	125	179,200	-	-	-	211
Lower Big Creek	127	181,760	-	-	-	133
Big Cypress-Big Creek	128	85,120	-	-	-	124
Lower White River Tributaries	130	192,000	-	-	-	49
Big Bayou LaGrue	132	163,840	-	-	-	106
Little Bayou LaGrue	133	86,400	-	-	-	55
Dismal Swamp	B	44,800	-	-	-	23

TABLE 21 (con.)

RECREATION AND FISH AND WILDLIFE IMPROVEMENTS

Project	Location	Water		Land	Access sites	Activity
		Miles	Acres	(acres)	(number)	
Recommended Additions for Inclusion in 10- to 15-year Plan						
	Federal					
National Scenic Rivers:						
Current	Missouri	20	-	4,000	3	R,F&H,WP
Buffalo	Arkansas	128	-	103,000	13	Do.
Eleven Point	Missouri & Arkansas	90	-	29,000	10	Do.
National Recreation Area-1	do	-	-	-	-	Do.
National Forests:						
(Mark Twain & Clark)	Missouri					
Land acquisition	(Includes consolidation of holdings for preservation of six scenic areas)			285,300	-	R,H,WP
Recreation lakes - 10		-	880	-	10	R,F
Stream preservation:						
North Fork River		30	-	4,800	4	R,F,H
Beaver Creek		37	-	5,900	4	Do.
Little North Fork River		20	-	3,200	3	Do.
Roaring River		5	-	800	1	R,F
Hiking and saddle trails - 3		-	-	-	-	R
Scenic drives - 5						R
(Ozark-St. Francis)	Arkansas					
Land acquisition	(Includes consolidation of holdings for preservation of one scenic area)			73,000	-	R,H,WP
Scenic drive - 1		-	-	-	-	R
National Wildlife Refuge:						
(White River Refuge)	Arkansas					
Land acquisition		-	-	4,000	-	F,H,WP
Large Impoundments: (6)						
County Line	Missouri	-	5,010	830	5	R,F&H,WP
Myatt Creek	Arkansas	-	1,350	640	2	Do.
Wild Horse	do	-	4,240	2,150	5	Do.
Bell Foley	do	-	6,700	3,200	6	Do.
Wolf Bayou	do	-	11,760	5,410	9	Do.
Quarry	do	-	1,000	-	3	R,F

Footnote is shown at end of table.

TABLE 21 (con.)

RECREATION AND FISH AND WILDLIFE IMPROVEMENTS

Project	Number	Administrative agency	Land (acres)	Water (acres)	Activity
		Existing, Under Construction, and Authorized			
		Federal			
Ozark National Scenic Riverways	1	National Park Service	86,924	-	R, F
National Forests	3	U. S. Forest Service	1,207,665	-	R, H, WP
National Wildlife Refuge	1	U. S. Fish and Wildlife Service	112,653	3,517	F, H, WP
Federal Fish Hatcheries and Experimental Stations	4	do	-	-	FP
		State			
Public Hunting Areas	8	Ark. Game & Fish Commission	97,900	15,600	F, H, WP
	6	Mo. Conservation Commission	107,895	900	Do.
Wildlife Management Areas	5	Ark. Game & Fish Commission	6,980	-	WP
	5	Mo. Conservation Commission	37,217	40	F, WP
Public Fishing Lakes	8	Ark. Game & Fish Commission	100	2,389	F
	3	Mo. Conservation Commission	190	86	F&H
State Fish Hatcheries	3	Mo. Conservation Commission (Trout production)	-	-	FP
Trout Management Areas	7	Ark. Game & Fish Commission	-	42,210	F
	7	Mo. Conservation Commission	-	2,255	F
Public Access Areas	21	Ark. Game & Fish Commission	80	-	F
	5	Mo. Conservation Commission	641	-	F
Public Parks	7	Ark. Publicity and Parks Commission	3,844	20	R, F, WP
	7	Mo. State Parks Board	12,983	100	R, F, WP
		Municipal or Local			
City Fishing Lakes	4	Municipality	2,881	1,465	R, F
City Parks	43	do	4,506	824	R
Total			1,682,459	69,406	

TABLE 21 (con.)

Project	Location	Water		Land	Access sites	Activity
		Miles	Acres	(acres)	(number)	
		Federal (con.)				
Tailwater Regulation:						
Myatt Creek	Arkansas	(Cold water release)			1	R,F
Wild Horse	do	(Warm water release)			1	R,F
Bell Foley	do	(do)			1	R,F
Wolf Bayou	do	(do)			1	R,F
Quarry	do	(Reregulation structure - cold water release)			1	R,F
County Line	Missouri	(Water quality control releases)			1	R,F
Small Impoundments (Watershed program)						
Multiple-purpose - 9	Missouri	-	1,379	-	9	R,F,H
Multiple-purpose - 10	Arkansas	-	2,090	-	10	R,F,H
		State				
Recreation Information Centers	Missouri & Arkansas	-	-	-	-	-
Stream Preservation:						
James River	Missouri	26	-	4,420	5	R,F,WP
Upper Black River	do	34	-	5,400	4	Do.
Bryant Creek	do	36	-	5,800	4	Do.
Bull Creek	do	10	-	1,600	2	Do.
Swan Creek	do	13	-	2,100	2	Do.
Kings River	Arkansas	40	-	6,400	5	Do.
War Eagle Creek	do	30	-	4,800	3	Do.
Spring River	do	25	-	4,000	3	Do.
Bear Creek	do	20	-	3,200	2	Do.
Archey Fork of Little Red River	do	32	-	5,120	4	Do.
Middle Fork of Little Red River	do	40	-	6,400	5	Do.
North Sylamore Creek	do	14	-	2,240	2	Do.
Big Creek above Bell Foley Reservoir	do	18	-	2,880	2	Do.
Richland Creek	do	24	-	3,840	3	Do.
Salado Creek	do	26	-	4,160	3	Do.

TABLE 21 (con.)

Project	Location	Water		Land	Access sites	Activity
		Miles	Acres	(acres)	(number)	
	State (con.)					
Public Lakes:						
Shannon County	Missouri	-	150	-	1	R,F
Douglas County	do	-	150	-	1	R,F
Greene County	do	-	150	-	1	R,F
Montauk Park	do	-	150	-	1	R,F
Black River	Arkansas	-	800	-	2	R,F,H
Bayou DeView	do	-	300	-	2	Do.
Hurricane	do	-	800	-	2	Do.
Holman Creek	do	-	350	-	2	Do.
Spider Creek	do	-	150	-	1	R,F
Scenic Drives - 2	do	-	-	-	-	R
Trout Hatchery:						
Montauk Expansion	Missouri	-	-	-	-	FP
Wildlife Management Areas:						
Reach No. 20	Arkansas	-	-	8,000	-	H,WP
Reach No. 22	do	-	-	12,000	-	Do.
Reach No. 23	do	-	-	4,000	-	Do.
Other Access Facilities:						
Streams	Missouri	-	-	-	30	F
Do	Arkansas	-	-	-	43	F
	Municipal or Local					
Small Impoundments - 13	Arkansas	-	1,237	-	-	R,F
	Private Sector					
Service Industries	Missouri & Arkansas	-	-	-	-	R
Ozark Scenic Railway	do	-	-	-	-	R

TABLE 21 (con.)

Project	Location	Water		Land	Access sites	Activity
		Miles	Acres	(acres)	(number)	
	Private Sector (con.)					
Small Impoundments:						
Farm Ponds	Missouri	-	1,300	-	-	F
Do	Arkansas	-	5,400	-	-	F
FWR Structures - 321	Missouri	-	5,638	-	-	F&H
FWR Structures - 492	Arkansas	-	9,649	-	-	F&H
Irrigation Reservoirs - 5	do	-	634	-	-	R,F
Fish Farming	do	-	39,180	-	-	FP
Total		718	100,447	611,590	238	

TABLE 21 (con.)

MAIN STEM AND TRIBUTARY RESERVOIRS
CORPS OF ENGINEERS

Project	Location		Approximate total available storage (acre-feet)
	Stream	Mile	
	Long-range Plan		
Grandview, Ark.	Kings River	34.6	301,000
Kinser Bridge, Mo.	James River	96.7	136,000
Finley Creek, Mo.	Finley Creek	19.0	110,000
Galena, Mo.	James River	50.2	846,000
Crooked Creek, Ark.	Crooked Creek	26.0	250,000
Piney Creek, Ark.	Piney Creek	2.0	210,000
Polk Bayou, Ark.	Polk Bayou	5.0	80,000
Harviell, Mo.	Cane Creek	17.6	54,000
Fairdealing, Mo.	Little Black River	37.4	77,000
Doniphan, Mo.	Current River	55.0	(7) 0
Janes Creek, Ark.	Janes Creek	9.2	107,000

Footnote is shown at end of table.

TABLE 21 (con.)

LEVEES AND CHANNEL IMPROVEMENTS
CORPS OF ENGINEERS

Project	Location	Approximate length (miles)	Approximate acres benefited
	Long-range Plan		
Fayetteville, Washington County, Ark.	West Fork of White River at Fayetteville	3	200
Cassville, Barry County, Mo.	Flat Creek at Cassville	5	200
Big Bottom, Independence County, Ark.	Black and White Rivers at their confluence	22.2	18,000
Clinton, Van Buren County, Ark.	Archey Fork of Little Red River at Clinton	1	40
Clarendon to Laconia Circle (8)	White River below Clarendon	48.5	287,600

Footnote is shown at end of table.

TABLE 21 (con.)

UPSTREAM WATERSHED PROJECTS
SOIL CONSERVATION SERVICE

Watershed			Structural measures			
Project	Number	Watershed area (acres)	Detention (number)	Recreation and M & I water supply (number)	Multiple-purpose (number)	Channel improvement (miles)
		Long-range Plan				
Upper James River	12	172,800	36	-	1	-
Finley Creek	14	171,520	37	-	1	-
Beaver Creek	23	247,680	39	-	1	-
Little North Fork Laterals	26	236,800	19	-	-	-
Lower Crooked Creek	29	241,920	38	-	3	-
Big Richland Creeks	(9) 32	243,200	-	2	-	-
Upper North Fork River	35	136,320	9	-	-	-
Lower North Fork River	36	227,840	8	-	-	-
Upper Norfork Dam Tributaries	37	211,200	6	-	-	-
Upper Bryant Creek	38	218,240	11	-	-	-
Lower Bryant Creek	39	154,240	7	-	-	-
White R-North Fork R. to Sylamore Creek	41	226,560	24	2	-	-
Sinking Creek	49	54,400	14	-	-	-
Logan Creek	50	168,320	30	-	1	-
Pike Creek	(9) 62	92,800	-	1	-	-
Archey Fork & Laterals-Little Red River	97	104,320	2	-	2	-
Prairie Cypress-Big Creek	129	21,760	-	-	-	34
Lower White River Tributaries (9)	(10) 130	192,000	-	-	-	-

Footnotes are shown at end of table.

TABLE 21 (con.)

HYDROELECTRIC POWER

Project	Owner or agency	Stream and location	Remarks
		Long-range Plan	
Ozark Beach	The Empire District Electric Company	White River	Modification of existing project by addition of 24,000 kilowatts generating capacity.
Millers Point	Corps of Engineers	Little Red River adjacent to Greers Ferry Reservoir	Approximately 600,000 kilowatts pumped storage.

(1) Previously authorized for flood control only.
(2) Affords protection to property within city and adjacent area.
(3) Complete except for 6.6-mile section; information on area benefited based on completed project.
(4) Enlargement authorized by Flood Control Act of 1965.
(5) 6 miles of flood prevention; 1 mile flood prevention and water management.
(6) Includes lands acquired for other project purposes suitable for wildlife management.
(7) Major tributary floodwater retarding structure with no permanent pool.
(8) Levee project listed under authorized, but placed in long-range plan because of lack of local interest.
(9) Watershed listed in 10- to 15-year plan.
(10) 13 miles of irrigation canals with pumping station.

LEGEND:
FC - Flood control
P - Hydroelectric power
WS - Municipal and industrial water supply
WQ - Water quality control
R - Recreation
F&W - Fish and wildlife
F - Fishing
H - Hunting
FP - Fish production
WP - Wildlife production

40. MAIN STEM AND MAJOR TRIBUTARY RESERVOIRS

a. General. Pertinent data for the main stem and major tributary reservoirs of the Corps of Engineers which should be initiated in the next 10 to 15 years (10- to 15-year plan) are presented on Table 22. The locations of these projects are shown on Plate 2.

b. County Line Dam and Reservoir.

(1) The County Line Dam site is located about 10 miles east of the city of Springfield, Missouri, at river mile 107.8 on James River in Webster County. The project would provide flood control, municipal and industrial water supply, water quality control, recreation, and fish and wildlife benefits.

(2) The 144-foot high earth embankment dam would provide for a reservoir with a total capacity of 282,000 acre-feet. There would be 71,000 acre-feet of flood control storage which is equivalent to 8.7 inches of runoff from the 153 square miles of drainage area upstream from the site. This storage would afford a high degree of flood protection downstream to the vicinity of Springfield. About 75 percent of the average annual flood losses would be prevented by the project in the 41-mile reach from the dam site to Finley Creek. Downstream from Finley Creek the average annual flood losses prevented would be small.

(3) The project would have 190,000 acre-feet of conservation storage which would develop the full yield of the drainage area during the most critical drought period of record for the area. This volume of storage would provide 37.4 million gallons of water per day for municipal and industrial use, and 27.4 m.g.d. to augment downstream flows for water quality control.

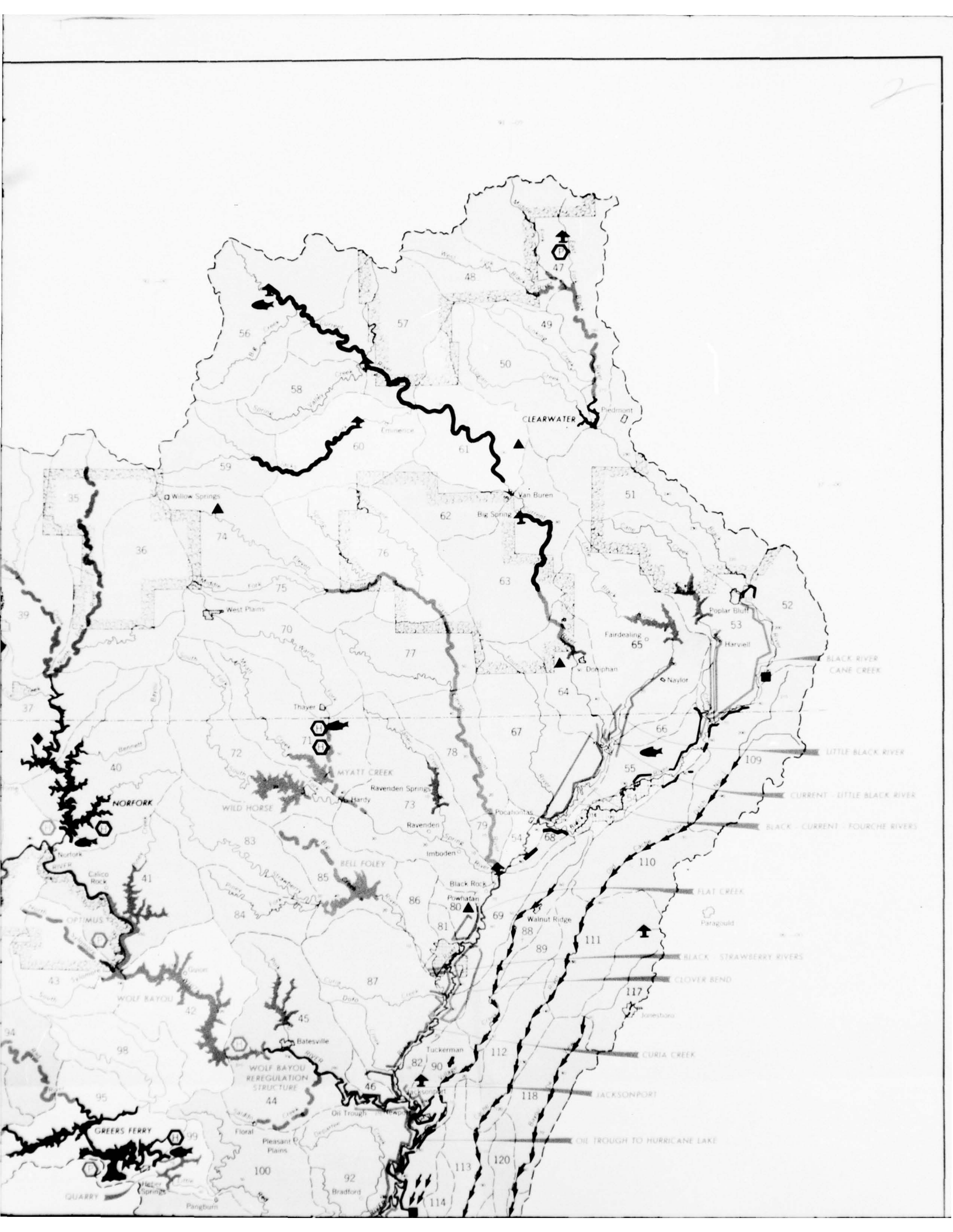
(4) It is estimated that the conservation pool and adjacent project lands would be used to the extent of 446,000 recreation days and 125,000 man days of fishing by 1980. It is expected that the annual use of these facilities will increase as the economy of the market area grows. Facilities would be provided in the project for warm water releases to maintain the existing downstream fishery.

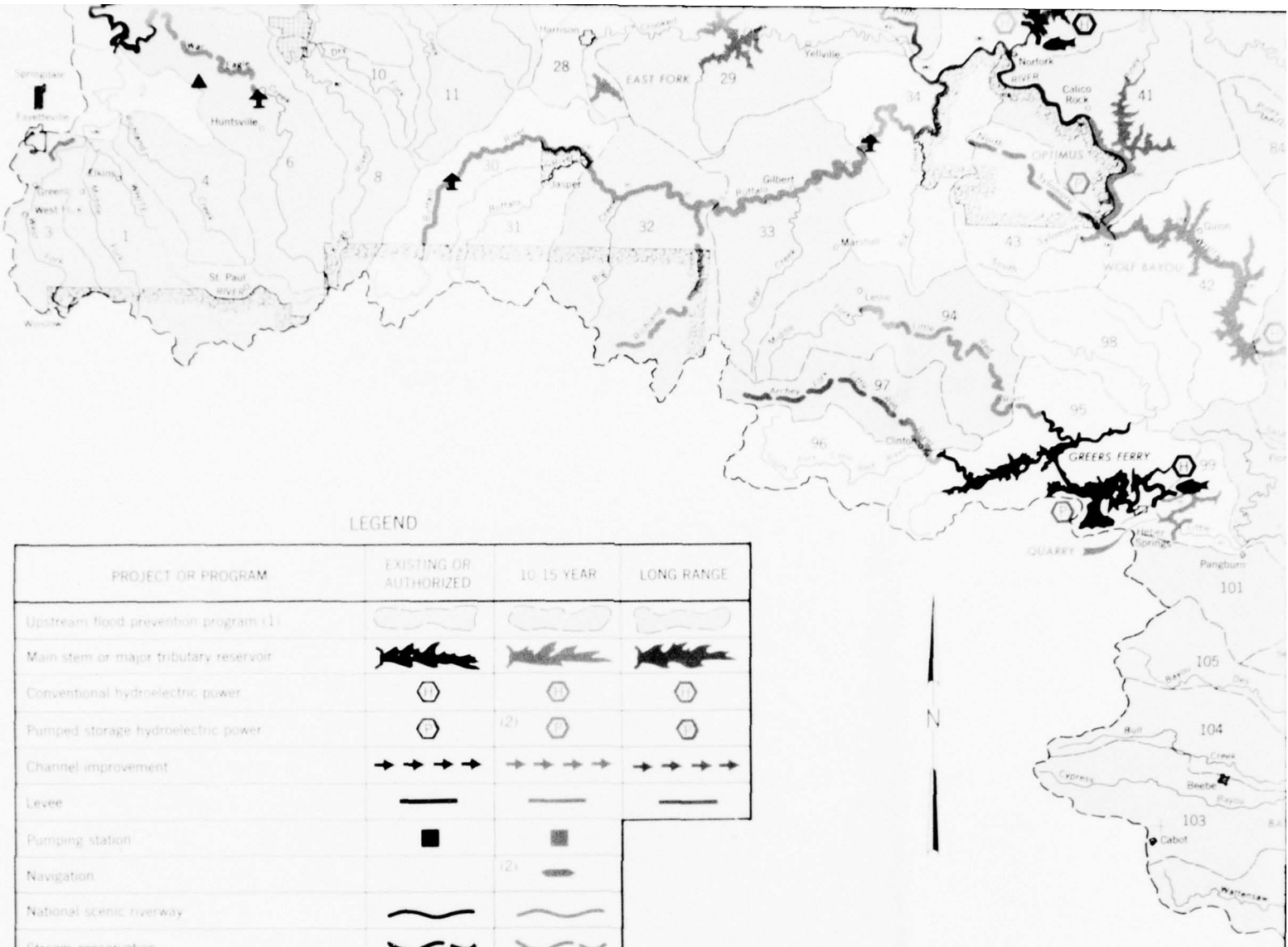
c. Wolf Bayou Dam and Reservoir.

(1) The Wolf Bayou Dam site is located at river mile 311.4 on the White River about 10 miles west of Batesville, Arkansas, in Independence County. The White River enters the Coastal Plain a short distance downstream from this site and it is the furthermost downstream site on White River at which a high or median height dam could be constructed. At full pool the reservoir would extend upstream into Stone, Izard, and Baxter Counties, Arkansas. The project would provide flood control, hydroelectric power, recreation, and fish and wildlife benefits.

VICINITY MAP

LEGEND


CLEARWATER
Piedmont
Willow Springs
Van Buren
Big Spring
West Plains
Poplar Bluff
Harviell
Fairdealing
Doniphan
Naylor
Thayer
MYATT CREEK
Ravenden Springs
Hardy
NORFORK
WILD HORSE
Ravenden
Pocahontas
Norfork
Calico Rock
BELL FOLEY
Imboden
Black Rock
Powhatan
Walnut Ridge
Paragould
OPTIMUS
WOLF BAYOU
Batesville
Tuckerman
Jonesboro
WOLF BAYOU REREGULATION STRUCTURE
Jacksonport
Oil Trough
GREERS FERRY
Floral
Pleasant Plains
Heber Springs
QUARRY
Pangburn
Bradford
BLACK RIVER
CANE CREEK
LITTLE BLACK RIVER
CURRENT - LITTLE BLACK RIVER
BLACK - CURRENT - FOURCHE RIVERS
FLAT CREEK
BLACK - STRAWBERRY RIVERS
CLOVER BEND
CURIA CREEK
JACKSONPORT
OIL TROUGH TO HURRICANE LAKE



LEGEND

PROJECT OR PROGRAM	EXISTING OR AUTHORIZED	10-15 YEAR	LONG RANGE
Upstream flood prevention program (1)			
Main stem or major tributary reservoir			
Conventional hydroelectric power			
Pumped storage hydroelectric power		(2)	
Channel improvement			
Levee			
Pumping station			
Navigation		(2)	
National scenic riverway			
Stream preservation			
Irrigation facilities			
National Forest			
National Wildlife Refuge			
State hunting area			
State Wildlife Refuge			
State park			
State fishing lake			
Federal or State fish hatchery			

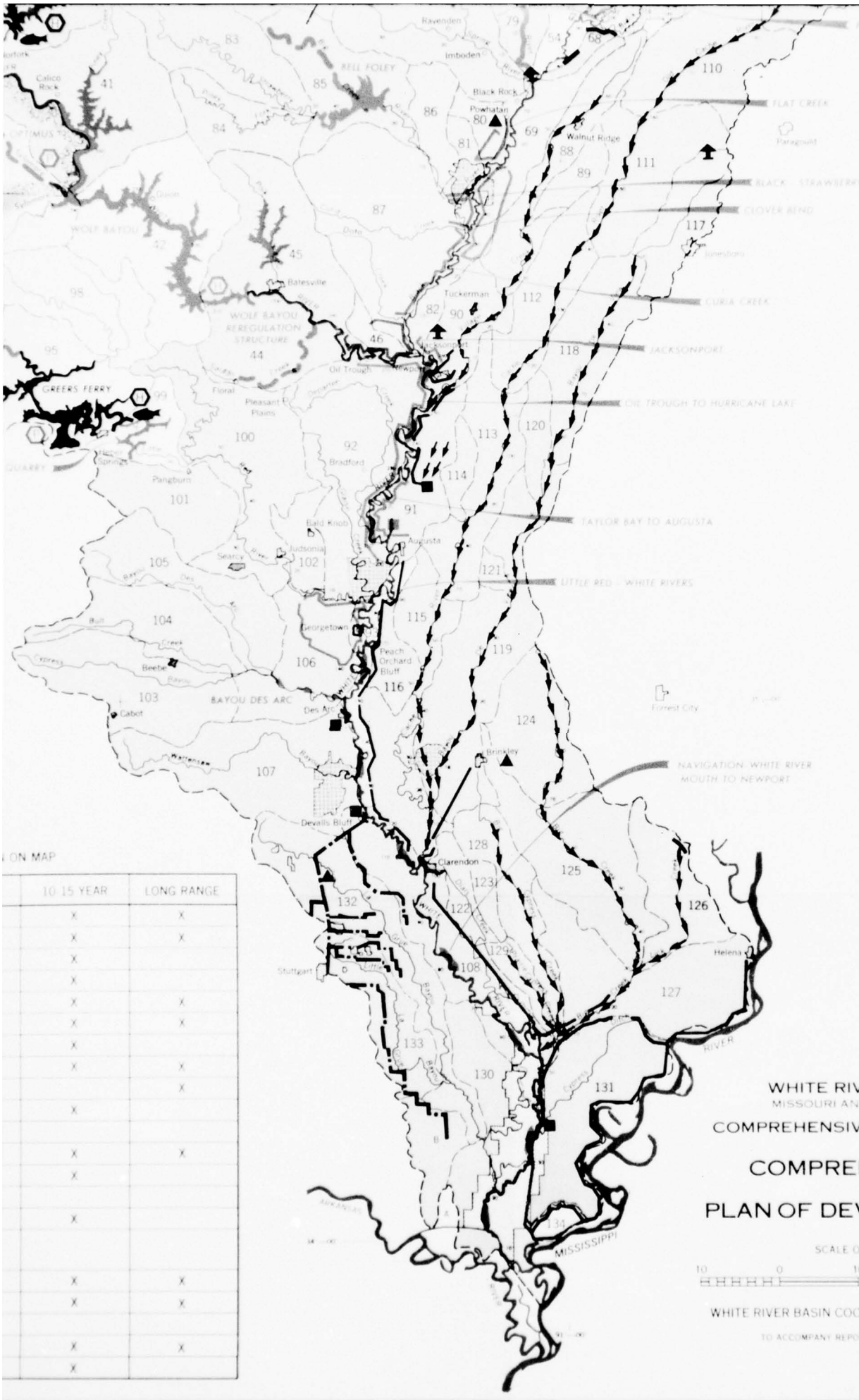
(1) Watershed protection measures have been planned or installed on existing and authorized watersheds. Measures planned for installation on all remaining watersheds are included in the 10-15 year plan.

(2) Subject to further studies.

Watershed area and No. 1

PROJECTS OR PROGRAMS NOT SHOWN ON MAP

PROJECT OR PROGRAM	EXISTING	10-15 YEAR	LONG RANGE
National Forest land acquisition		X	X
National Forest development program	X	X	X
National Wildlife Refuge lands		X	
National Recreation Area		X	
State hunting and wildlife management areas		X	X
State fishing lakes		X	X
Fish hatchery		X	
Stream access systems	X	X	X
Stream preservation			X
Ozark scenic railway		X	
City parks	X		
Small municipal impoundments	X	X	X
Private fuel-electric power plants	X	X	
Private levees and channel improvements	X		
Private irrigation structures and facilities	X	X	
Private water related recreation, hunting, and fishing facilities	X		
Fish farming	X	X	X
Farm ponds	X	X	X
Natural lakes	X		
Archeologic historic, and scenic points of interest	X	X	X
Hydrologic network	X	X	



ON MAP

	10-15 YEAR	LONG RANGE
	X	X
	X	X
	X	
	X	
	X	X
	X	X
	X	
	X	X
		X
	X	
	X	X
	X	
	X	
	X	X
	X	X
	X	X
	X	

WHITE RIVER BASIN

MISSOURI AND ARKANSAS

COMPREHENSIVE BASIN STUDY

COMPREHENSIVE PLAN OF DEVELOPMENT

SCALE OF MILES

10 0 10 20 30

WHITE RIVER BASIN COORDINATING COMMITTEE

TO ACCOMPANY REPORT DATED JUNE 1968

4

PLATE 2

(2) The 137-foot high dam would be a concrete-gravity and earth-embankment structure with a total reservoir capacity of 619,000 acre-feet. There would be 289,000 acre-feet of flood control storage in the reservoir which is equivalent to 1.8 inches of runoff from the 2,954 square mile uncontrolled drainage area lying between the existing Bull Shoals and Norfork projects and the Wolf Bayou Dam site. The small amount of flood control storage in the reservoir necessitates a detention-type operation which would greatly reduce peaks of floods that have a frequency of up to about once in 5 years. This storage would be less effective in reducing floods of a greater magnitude. However, the project would prevent about 45 percent of the average annual flood losses along the White River in the reach from the dam site to the mouth of the Black River and about 15 percent of the losses along the White River below the mouth of the Black River.

(3) The project would have installed hydroelectric capacity of 180,000 kilowatts and a conservation pool of 330,000 acre-feet. Estimated average annual power generation at the project is 420 million kilowatt-hours. The project would operate as a run-of-the-river hydroelectric plant making advantageous use of large power releases from upstream projects. A downstream reregulation structure would be provided to minimize the river stage fluctuation that would result from power releases. The project would have a relatively stable conservation pool and tailwater downstream from the reregulation structure which would have a beneficial effect on recreation and fishery use. The design of the reregulation structure was based on a minimum release from the Wolf Bayou project of 4,000 acre-feet per day over weekends and holidays.

(4) It is estimated that the conservation pool and adjacent project land would be used to the extent of 942,000 recreation days and 110,000 man days of fishing by 1980. Included in this estimate of fishing use are 12,000 days of downstream warm water fishing. It is expected that the annual use of these facilities will increase as the economy of the market area grows. Provision would be made in the dam to release the warmest water in the reservoir through the turbines. This would result in a benefit to the downstream warm water fishery.

(5) The full potential of the site would not be developed with a dam having a height of 13.7 feet. In formulating a project for the site the following constraints were recognized.

(a) With the construction of Bull Shoals and Norfork projects and the resulting cold water releases, a valuable trout fishery has been developed in the White River below these projects. Trout fishing and the resulting service industries are of major economic importance to the area. The trout fishery extends downstream to the vicinity of the Wolf Bayou site, but it is considered only fair below the town of Calico Rock which is near the upstream limit of the conservation pool. Fishery interests have not objected to the project formulated in this study.

(b) Chemical-grade limestone quarries are located in the bluffs adjacent to the White River about midway between the dam site and Calico Rock. A large silica sand-mining operation is located at Guion. Maximum reservoir development would require extensive and expensive relocation of facilities for these mining operations. However, the project formulated in this study will allow operations to continue with minor relocation of facilities. They would continue to be served by the Missouri Pacific Railroad with minor relocation of spur tracks.

(c) The portion of the Missouri Pacific Railroad which follows White River from Batesville to Calico Rock, Arkansas, would be affected by project construction. Relocation outside the valley would preclude the railroad from servicing the chemical-grade limestone and silica sand industries. Relocation outside the valley with provision for servicing traffic points in the valley would be more costly than a relocation within the valley. Constructing the road bed at higher elevations in the valley along the many vertical rock cliffs would be difficult and expensive. By cut and fill construction the railroad can be relocated in the valley with no major disruption in traffic or increase in grade at a feasible cost for the project formulated in this study.

(d) Three State highways, a few county roads, and the towns of Calico Rock and Guion would be affected by development of a project to the maximum physical height at the Wolf Bayou site. For the project formulated in this study, Calico Rock and the State highways would be unaffected, the town of Guion could be economically protected by levees, and county road relocation requirements would be relatively minor.

(6) The project would be designed so that the capacity of the flood control pool could be increased if some of the constraints which limit the height of the dam are removed in the future. Because of the magnitude of the spillway design flood and the site topography, the project would be designed with a considerable amount of freeboard above the top of the flood control pool.

d. Myatt Creek Dam and Reservoir.

(1) The Myatt Creek Dam site is located at river mile 2.2 on Myatt Creek in Fulton County, Arkansas, about 5.0 miles northwest of Hardy. The project would provide flood control, recreation, and fish and wildlife benefits.

(2) The 146-foot high earth embankment dam would provide for a reservoir with a total capacity of 140,000 acre-feet. There would be 106,000 acre-feet of flood water storage which is equivalent to 14 inches of runoff from the 142 square mile drainage area upstream from the site. This comparatively large flood control storage is needed to

provide long-period holding capacity to reduce flooding on the downstream Spring and Black Rivers where flood control storage is at a minimum. The Myatt Creek Dam and Reservoir would reduce average annual flood loss by 8, 5, and 3 percent, respectively, on the Spring, Black, and White Rivers.

(3) It is estimated that the conservation pool and adjacent lands would be used to the extent of 108,000 recreation days and 23,000 man days of fishing by 1980. It is expected that the annual use of these facilities will increase as the economy of the market area grows. Facilities would be provided in the project for cold water releases to maintain the downstream Spring River cold water fishery which presently extends to the mouth of the South Fork of the Spring River.

e. Wild Horse Dam and Reservoir.

(1) The Wild Horse Dam site is located at river mile 14.9 on the South Fork of the Spring River in Fulton County, Arkansas, about 7 miles west of Hardy. The project would provide flood control, recreation, and fish and wildlife benefits.

(2) The 142-foot high concrete-gravity and earth embankment dam would provide a reservoir with a total capacity of 345,000 acre-feet. There would be 217,000 acre-feet of flood control storage which is equivalent to 13.7 inches of runoff over the 296 square mile drainage area upstream from the site. Like Myatt Creek Dam and Reservoir, this amount of storage is sufficient and necessary to store flood runoff until floodwaters on the downstream Spring and Black Rivers recede. The project would reduce average annual damages on the Spring, Black, and White Rivers by 15, 9, and 5 percent, respectively.

(3) It is estimated that the conservation pool and adjacent project lands would be used to the extent of 340,000 recreation days and 85,000 man days of fishing by 1980. It is expected that the annual use of these facilities will increase as the economy of the market area grows. Facilities would be provided for a warm water release to maintain the existing warm water fishery on the Spring River downstream from the mouth of the South Fork.

f. Bell Foley Dam and Reservoir.

(1) The Bell Foley Dam site is located at river mile 27.2 on the Strawberry River in Sharp County, Arkansas, about 15 miles west of Powhatan. The present dam site is in the same general location as the authorized Bell Foley project discussed in Section IV. The project would provide flood control, recreation, and fish and wildlife benefits.

(2) The 136-foot high concrete-gravity and earth embankment would provide for a reservoir with a total capacity of 518,000 acre-feet. There would be 318,000 acre-feet of flood control storage which is

equivalent to 11.5 inches of runoff over the 519 square mile drainage area upstream from the dam site. The project, with its large holding capacity, is particularly important for flood prevention along the Black River downstream from the mouth of the Strawberry River. It is also a key project along with Wolf Bayou in helping to reduce the frequent flooding on the lower White which originates from uncontrolled runoff areas downstream from the existing projects. The project would reduce average annual flood losses on the Strawberry, Black, and White Rivers by 57, 20, and 8 percent, respectively.

(3) It is estimated that the conservation pool and adjacent project lands would be used to the extent of 537,000 recreation days and 121,000 man days of fishing by 1980. It is expected that the annual use of these facilities will increase as the economy of the market area grows. A warm water release for the downstream warm water fishery would be provided.

g. Quarry Dam and Reservoir.

(1) The Quarry Dam site is located at river mile 64.3 on the Little Red River in Cleburne County, Arkansas, about 4 miles east of Heber Springs. It is about 15 river miles downstream from the existing Greers Ferry Dam. The Quarry project would provide recreation and fish and wildlife benefits.

(2) During hydroelectric generating periods, the existing Greers Ferry multiple-purpose project releases considerable cold water. As a result of these releases a cold water fishery has been developed by stocking trout in the Little Red River. Regulation of the cold water power releases by the Quarry project would create a 1,000-acre conservation pool and would extend the existing cold water fishery an additional 25 miles downstream to the vicinity of Searcy, Arkansas. The use of the conservation pool, adjacent project lands, and downstream areas is estimated to be 54,000 recreation days and 30,000 man days of specialized trout fishing by 1980. These amounts are net increases over use of the existing cold water stream fishery. It is expected that the annual use of these facilities will increase as the economy of the market area grows.

h. Norfork Units 3 and 4. The existing Norfork Dam and Reservoir is located in Baxter and Fulton Counties, Arkansas, and Ozark County, Missouri. The dam is at mile 4.8 on the North Fork River about 4 miles northeast of Norfork, Arkansas. The project was authorized for flood control and hydroelectric power. Two 35,000-kilowatt generating units have been installed and are in operation. During initial construction provision was also made for the installation of two additional units. The addition of two 42,500-kilowatt generating units would give the project a total installed capacity of 155,000 kilowatts.

TABLE 22

PERTINENT DATA
CORPS OF ENGINEERS MAIN STEM AND MAJOR TRIBUTARY RESERVOIR PROJECTS

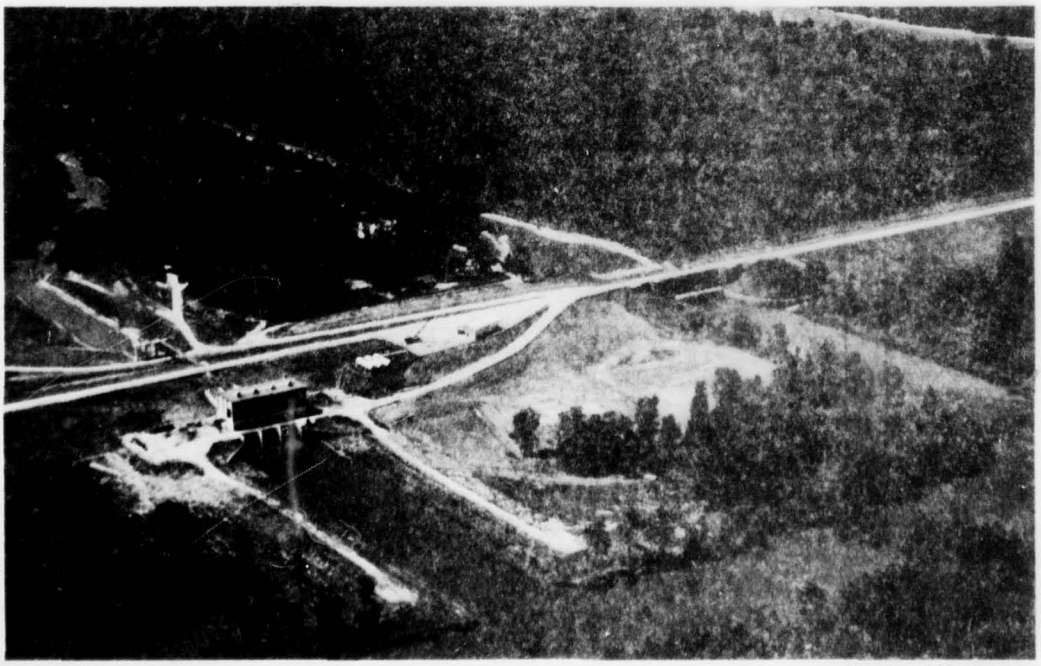
Item	County Line	Wolf Bayou	Myatt Creek	Wild Horse	Bell Foley	Quarry	Norfork Units 3 & 4
General:							
Purpose	FC,WS,WQ,R,FW	FC,P,R,FW	FC,R,FW	FC,R,FW	FC,R,FW	R,FW	P
Stream	James River	White River	Myatt Creek	South Fork of Spring River	Strawberry River	Little Red River	North Fork River
River mile	107.8	311.4	2.2	14.9	27.2	64.3	4.8
State	Missouri	Arkansas	Arkansas	Arkansas	Arkansas	Arkansas	Arkansas
Drainage area, sq. mi.	153	10,796	142	296	519	1,210	-
Dam:							
Type	Earth embankment	Conc. & earth emb.	Earth embankment	Conc. & earth emb.	Conc. & earth emb.	Conc. & earth emb.	-
Spillway	Sadile	Gated	Side channel	Gated	Gated	Uncontrolled	-
Ht. above streambed,ft.	144	137	146	142	136	60	-
Spillway Length, ft.	120	800	150	160	240	300	-
Power available:							
Installed capacity, kw.	-	180,000	-	-	-	-	85,000
Number of units	-	4	-	-	-	-	2
Elevation, ft. above m.s.l:							
Top of dam	1,365	375	543	587	403	282	-
Top,flood control pool	1,343	340	515	575	390	-	-
Top,conservation pool	1,332	320	468	540	356	264	-
Pool area, acres:							
Top,flood control pool	7,020	17,300	3,350	8,540	12,450	-	-
Top,conservation pool	5,850	11,760	1,350	4,240	6,700	1,000	-
Storage, acre-feet:							
Flood control	71,000	289,000	106,000	217,000	318,000	-	-
Conservation	211,000	330,000	34,000	128,000	200,000	7,400	-
WS & WQ	(190,000)	-	-	-	-	-	-
R & FW	(1)	(1)	(34,000)	(128,000)	(200,000)	(7,400)	-
Power	-	(2)	-	-	-	-	-
Inactive	(21,000)	-	-	-	-	-	-
Total	282,000	619,000	140,000	345,000	518,000	7,400	-

(1) No specific storage for recreation and fish and wildlife enhancement.
(2) Wolf Bayou would be a "run-of-the-river" project with no specific storage for power and only small weekly fluctuations in the conservation pool elevation.

NOTES: FC - Flood Control
WQ - Water Quality
WS - Water Supply
P - Power
R - Recreation
FW - Fish and Wildlife Enhancement

Corps of Engineers

Because of their large holding capacity, reservoirs such as the one formed by Clearwater Dam, shown above, afford regulation during prolonged flood periods. This project is located on the Black River, Missouri, and controls the runoff from an area of 898 square miles.



Corps of Engineers

Graham Burke Pumping Plant, Little Island Bayou Floodgate, and White River Backwater Levee protect 145,500 acres of rich agricultural lands in Phillips County, Arkansas, from flooding by backwater of the Mississippi River.

41. LEVEE AND CHANNEL IMPROVEMENT PROJECTS

a. The 10- to 15-year plan includes 12 levee projects for local flood protection and one major channel-improvement project for flood control and agricultural water management. These Corps of Engineers projects would be located in the Mississippi Alluvial Plain along the Black River and tributaries downstream from Poplar Bluff, Missouri, and along the lower White River and tributaries downstream from Oil Trough, Arkansas. Pertinent data relating to these projects are shown on Table 23.

b. The primary objective of the levee and channel improvement projects would be to provide protection against a flood having a recurrence interval of once in 50 years for rural areas and Standard Project Flood protection for urban areas if the studies maximizing excess benefits showed this degree of protection to be reasonable and practicable. Standard Project Flood as used herein is a technical term used to describe a large flood that may be expected to occur from the most severe combination of meteorologic and hydrologic conditions that are considered reasonably characteristic of the geographical region involved. In project formulation for the 8 levee projects in the Black River Basin maximization of net benefit studies were made. On this basis it was decided with one exception that a 50-year design discharge would be used for design of the projects in the Black River Basin. The exception was for that part of the Black River-Cane Creek project within and adjacent to the city of Poplar Bluff, Missouri, which was designed for Standard Project Flood protection.

c. In maximizing excess benefits for the levee projects on the lower White River it was found that the levees should be designed to a flood having a more frequent occurrence. The three levee projects, Oil Trough to Hurricane Lake, Taylor Bay to Augusta, and Little Red-White Rivers, are designed for 30-year flood protection. Because the Jacksonport Levee would provide protection to the town of Jacksonport, Standard Project Flood protection would be provided.

d. The Bayou Des Arc project would be a major flood control and agricultural water management outlet for upstream watershed protection and flood prevention projects of the Soil Conservation Service. About 13 miles of channel work would be required in the channel below the confluence of Cypress Creek and Bayou Des Arc. The channel would be designed to discharge a once-in-2-year flood without overflow during low stages on the White River.

42. WATERSHED PROTECTION AND FLOOD PREVENTION PROJECTS

a. Structural measures.

(1) The Soil Conservation Service made an inventory of all potentially feasible watershed protection and flood prevention projects

TABLE 23

PERTINENT DATA
CORPS OF ENGINEERS LEVEE AND CHANNEL IMPROVEMENT PROJECTS

Name	Location		Length of improvement (Miles)	Average height of levee (Feet)	Area benefited (Acres)
	Stream	Mile			
Black River-Cane Creek, Butler Co. Mo., and Clay Co., Ark.	Black River	158-211	62.8	13.4	75,000
	Cane Creek	3-18			
Little Black River, Butler and Ripley Cos., Mo., and Clay and Randolph Cos., Ark.	Little Black River	0-32	21.4	13.4	37,500
Current-Little Black Rivers, Ripley Co., Mo., and Clay Co., Ark.	Current River	28-35	14.3	14.6	5,800
	Little Black River	1-15			
Black-Current-Fourche Rivers, Randolph Co., Ark.	Current River	0-28	30.7	12.7	20,400
	Black River	93-96			
	Fourche River	0-6			
Flat Creek, Lawrence Co., Ark.	Black River	51-66	15.2	12.5	6,000
Clover Bend, Lawrence, Jackson, and Independence Cos., Ark.	Black River	25-54	33.1	14.7	17,000
	Big Running Water Creek	0-14			
Black-Strawberry Rivers, Lawrence and Independence Cos., Ark.	Strawberry River	0-9	14.1	15.5	9,000
	Black River	33-44			
	Curia Creek Ditch	0-3			
Curia Creek, Independence Co., Ark.	Black River	7-33			
	Dota Creek	0-2	20.8	20.3	20,700
	Curia Creek Ditch	0-3			
Oil Trough to Hurricane Lake, Independence, Jackson, and White Cos., Ark.	White River	199-282	45.1	17.4	55,000
Jacksonport, Jackson Co., Ark.	White River	258-265	6.0	21.9	2,400
	Black River	0-1			
Taylor Bay to Augusta, Woodruff Co., Ark.	White River	203-232	15.9	19.2	19,300
Little Red-White Rivers, White and Prairie Cos., Ark.	Little Red River	0-15			
	White River	164-182	33.3	19.5	29,000
	Raft Creek	0-15			
Bayou Des Arc, White and Prairie Cos., Ark.	Bayou Des Arc	4-22	13.0	-	(1)36,000

(1) Major outlet for Soil Conservation Service Watershed Nos. 103, 104, and 105.

TABLE 24

STRUCTURE DATA - SOIL CONSERVATION SERVICE WATERSHED PROJECTS

FLOODWATER RETARDING STRUCTURES

Watershed Nos.	Structural Measures and Purpose 1/	Drainage Area Controlled	Surface Area							Storage									Remaining Storage	Volume of Fill
			Sediment Pool 50-Yr.	Flood Prevention Pool	Recreation Pool	Municip.& Indust. Pool	Fish & Wildlife Pool	Irrigation Pool	Water Qual. Control Pool	Sediment Pool 50-Yr.	Total Sediment 100-Yr.	Flood Prevention Pool	Recreation Pool	Municipal & Ind. Pool	Fish & Wildlife Pool	Irrigation Pool	Water Qual. Control Pool	Total		
Subwatershed Projects		(Sq.Mi.)	(Acres)							(Acre-Feet)									(Cu. Yd.)	
1	30 FWR, 1 FWR&M-I	155	577	2,277	-	100	-	-	-	3,549	7,543	47,034	-	499	-	-	-	55,076	114,850	5,039,000
3	11 FWR, 1 FWR&WQ, 2 FWR&M-I	57	149	1,026	-	65	-	-	245	818	2,721	17,999	-	710	-	-	6,885	28,315	37,150	3,089,000
4	13 FWR, 1 FWR&I	87	199	1,528	-	-	-	195	-	1,284	4,225	25,833	-	-	-	2,000	-	32,058	27,225	1,791,000
6	21 FWR, 1 FWR&M-I	151	534	2,508	-	325	-	-	-	4,002	8,714	45,027	-	2,000	-	-	-	55,741	974,100	4,544,000
8	13 FWR, 1 FWR&F.W.	74	209	1,282	-	-	340	-	-	1,732	3,934	21,267	-	-	3,996	-	-	29,197	72,300	2,387,000
10	5 FWR	12	52	231	-	-	-	-	-	275	623	3,315	-	-	-	-	-	3,938	17,300	471,000
11	5 FWR, 1 FWR&M-I	58	128	731	-	36	-	-	-	1,292	3,119	16,643	-	500	-	-	-	20,262	5,000	1,472,000
15	31 FWR	87	309	1,743	-	-	-	-	-	2,031	4,612	22,986	-	-	-	-	-	27,598	20,700	2,747,000
16	8 FWR	28	227	883	-	-	-	-	-	678	1,578	8,277	-	-	-	-	-	9,855	4,000	1,222,400
18	2 FWR	10	43	138	-	-	-	-	-	233	460	2,897	-	-	-	-	-	3,357	4,900	251,000
19	8 FWR, 1 FWR&M-I	58	154	887	-	70	-	-	-	985	2,915	19,134	-	970	-	-	-	23,019	32,700	1,723,200
20	10 FWR	51	212	816	-	-	-	-	-	1,253	2,482	15,479	-	-	-	-	-	17,961	45,400	1,575,000
27	1 FWR	2	8	34	-	-	-	-	-	46	104	551	-	-	-	-	-	655	2,700	59,000
32	12 FWR	75	267	1,213	-	-	-	-	-	1,566	3,609	22,492	-	-	-	-	-	26,101	94,900	2,131,000
33	6 FWR, 1 FWR&M-I	51	75	642	-	133	-	-	-	497	2,536	14,115	-	2,000	-	-	-	18,651	36,100	1,221,500
40	22 FWR	91	226	1,335	-	-	-	-	-	1,755	4,188	22,527	-	-	-	-	-	26,715	74,900	2,008,500
44	15 FWR, 1 FWR&R, 1 FWR&M-I, 1 FWR&F.W.	84	197	2,230	190	42	300	-	-	866	3,654	25,484	4,946	507	1,581	-	-	36,172	89,800	1,955,500
45	10 FWR	20	84	543	-	-	-	-	-	396	841	4,397	-	-	-	-	-	5,238	13,300	783,000
51	47 FWR, 1 FWR&R	144	648	3,995	455	-	-	-	-	2,737	7,965	39,337	2,100	-	-	-	-	49,002	85,050	4,042,000
53	31 FWR, 2 FWR&R	113	572	2,960	77	-	-	-	-	2,867	5,605	30,099	651	-	-	-	-	36,355	66,100	2,701,000
56	7 FWR	185	429	2,101	-	-	-	-	-	3,549	8,161	46,707	-	-	-	-	-	54,868	53,400	2,168,000
58	5 FWR	16	107	468	-	-	-	-	-	352	680	3,924	-	-	-	-	-	4,604	11,600	366,000
59	9 FWR	66	193	1,232	-	-	-	-	-	1,443	2,778	18,454	-	-	-	-	-	21,232	17,100	1,321,000
62	25 FWR	69	316	1,401	-	-	-	-	-	1,124	2,694	17,620	-	-	-	-	-	20,314	66,300	1,578,000
63	10 FWR	112	306	1,642	-	-	-	-	-	2,155	4,370	30,027	-	-	-	-	-	34,397	118,000	2,365,000
64	8 FWR	31	119	609	-	-	-	-	-	585	1,188	7,711	-	-	-	-	-	8,899	35,400	787,000
70	36 FWR, 1 FWR&R	193	698	3,426	68	-	-	-	-	4,894	10,133	44,296	750	-	-	-	-	55,179	62,500	3,341,000
71	23 FWR	119	527	2,249	-	-	-	-	-	3,097	6,199	30,128	-	-	-	-	-	36,327	48,200	2,373,000
72	25 FWR, 1 FWR&R	149	513	3,409	420	-	-	-	-	2,936	7,602	40,845	2,000	-	-	-	-	53,447	60,400	3,507,000
73	35 FWR, 2 FWR&R	202	767	4,309	228	-	-	-	-	4,911	10,440	53,406	4,256	-	-	-	-	68,102	79,400	5,366,000
74	32 FWR, 1 FWR&R	89	491	2,342	74	-	-	-	-	2,298	4,852	24,273	424	-	-	-	-	29,549	59,200	2,347,000
75	15 FWR, 1 FWR&R	41	217	975	59	-	-	-	-	1,052	2,297	9,775	346	-	-	-	-	12,418	48,300	934,000
77	22 FWR, 1 FWR&R	83	354	1,867	86	-	-	-	-	2,136	4,562	22,610	617	-	-	-	-	27,789	53,800	2,364,000
78	25 FWR, 1 FWR&R	96	412	2,187	140	-	-	-	-	2,262	5,508	25,903	1,003	-	-	-	-	32,414	50,500	2,806,000
79	6 FWR	17	93	449	-	-	-	-	-	315	1,015	4,503	-	-	-	-	-	5,518	11,100	597,000
81	1 FWR	13	166	430	-	-	-	-	-	948	1,625	3,861	-	-	-	-	-	5,486	-	114,000
83	28 FWR, 1 FWR&R	125	575	3,034	256	-	-	-	-	3,726	6,890	34,189	5,309	-	-	-	-	46,388	120,700	3,362,000
84	20 FWR	64	384	1,706	-	-	-	-	-	2,023	4,044	16,495	-	-	-	-	-	20,539	46,700	1,699,000
85	1 FWR	6	27	120	-	-	-	-	-	169	341	1,688	-	-	-	-	-	2,029	8,000	235,000
92	15 FWR, 2 FWR&I, 1 FWR&M-I	111	292	2,651	-	68	-	344	-	2,202	5,706	37,706	-	1,001	-	2,621	-	47,034	70,000	2,838,000
94	22 FWR,1 FWR&R,1 FWR&M-I,2 FWR&I	168	357	2,396	155	71	-	95	-	3,716	6,712	51,329	4,160	974	-	1,512	-	64,687	187,900	6,253,000
100	14 FWR, 1 FWR&R	138	306	2,662	315	-	-	-	-	3,374	5,618	49,490	3,583	-	-	-	-	58,691	54,900	4,782,700
101	12 FWR, 1 FWR&R, 1 FWR&M-I	76	138	1,395	204	36	-	-	-	2,375	3,330	22,295	2,433	502	-	-	-	28,560	38,900	2,198,000
102	2 FWR	14	55	465	-	-	-	-	-	238	484	3,982	-	-	-	-	-	4,466	-	202,000
103	4 FWR	24	107	910	-	-	-	-	-	493	910	8,043	-	-	-	-	-	8,953	18,400	383,000
104	17 FWR, 1 FWR&R	72	340	2,223	102	-	-	-	-	1,608	2,956	23,404	2,000	-	-	-	-	28,360	83,900	2,408,000
105	7 FWR	37	122	629	-	-	-	-	-	824	1,601	12,214	-	-	-	-	-	13,815	41,700	1,065,000
109	44 FWR	44	1,046	2,584	-	-	-	-	-	5,247	2/5,247	12,180	-	-	-	-	-	17,427	-	1,966,500
110	33 FWR	31	752	1,735	-	-	-	-	-	3,680	2/3,680	8,387	-	-	-	-	-	12,067	-	1,320,600
111	9 FWR	11	208	441	-	-	-	-	-	1,435	2/1,435	3,425	-	-	-	-	-	4,860	-	403,200
	TOTAL	3,810	15,287	79,051	2,829	946	640	634	245	94,229	194,086	1,073,763	37,578	9,663	5,577	6,133	6,885	1,333,685 3/	2,364,775	102,693,100

1/LEGEND: FWR - Floodwater Retarding, R - Recreation, M-I - Municipal & Industrial Water Supply, F.W. - Fish & Wildlife, I - Irrigation, WQ - Water Quality Control.

2/100-year sediment quantities, except for watersheds 109, 110, and 111 where 50-year sediment was used.

3/Includes surcharge acre-feet.

TABLE 25
STRUCTURE DATA
SOIL CONSERVATION SERVICE WATERSHED PROJECTS
MULTIPLE-PURPOSE CHANNELS

	Channel Improvement (Miles)	Drainage Area (Sq. Mi.)	Structures for Water Control		Channel Improvement Cost	Structures for Water Control
111	140	160	-	-		
112	152	166	-	-		
113	166	183	-	-		
114	32	35	-	-		
115	138	199	-	-	2,211,000	
116	116	190	-	-	2,987,000	617
119	189	329	-	-	5,219,500	896
120	40	44	-	-	1,429,500	182
121	18	17	-	-	392,000	76
122	54	47	-	-	1,825,200	290
123	35	33	-	-	1,027,600	179
124	110	166	-	-	2,664,300	502
125	211	280	-	-	5,047,100	874
127	133	284	-	-	2,718,700	525
128	124	133	-	-	2,153,600	449
130	49	300	-	-	2,119,500	284
132	106	256	-	-	10,693,200	539
133	55	135	-	-	3,067,900	312
B	23	70	-	-	690,000	146
TOTAL	3,511	6,310	443	5,281	100,867,800	14,058

in the White River Basin. Table 24 shows information on floodwater retarding structures, and Table 25 shows information on multiple-purpose channels included in the 10- to 15-year plan. There are 849 floodwater retarding structures, including 36 multiple-purpose, planned in 50 watersheds. In 10 of these watersheds there would be 968 miles of multiple-purpose flood prevention and agricultural water management channels and 6 miles of single-purpose flood control channels. In addition, 2,543 miles of multiple-purpose channels were planned in 29 other watersheds.

(2) Floodwater detention storage in the 849 structures in the 10- to 15-year plan ranges from about 4.3 to 7.5 inches over the estimated 3,810 square mile area above the dam sites and averages about 5.2 inches. All structures, with allowance for a 15 cubic feet per second per square mile floodwater release rate, would store the 25-, 50- or 100-year frequency runoff volumes or intermediate volumes between the 25- to 100-year volumes, depending upon structure classification and importance. These storage volumes are based on regional analysis of gaged runoff.

(3) Total storage capacity of the 849 structures included in the 10- to 15-year plan is 1,333,685 acre-feet. Storage by purposes is as follows: 194,086 acre-feet for sediment accumulation over a 100-year period; 1,073,763 acre-feet for floodwater detention; 9,663 acre-feet for municipal and industrial water supply; 6,133 acre-feet for irrigation; 6,885 acre-feet for water quality control; 37,578 acre-feet for recreation; and 5,577 acre-feet for fish and wildlife.

(4) There are 596 structures in the 10- to 15-year plan which have not been developed to full site potential. If these sites were developed fully an additional 2,364,775 acre-feet of storage could be otained. The full site potential is limited by a legal constraint of 25,000 acre-feet of total capacity in any one structure.

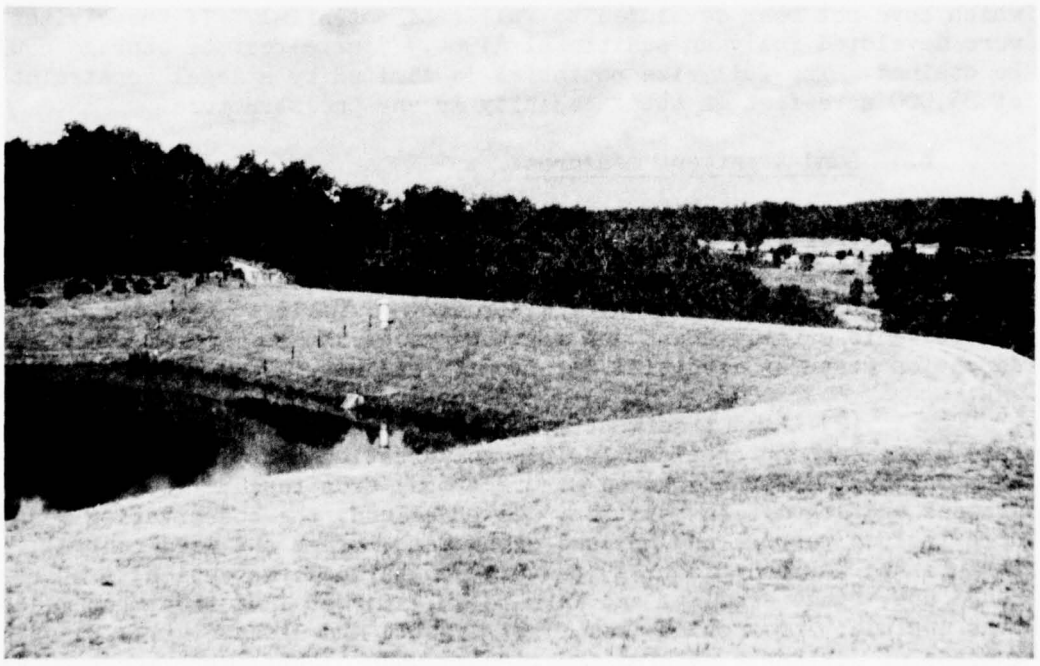
b. Land treatment measures.

(1) An effective conservation program, based upon the use of each acre of land within its capabilities and its treatment in accordance with its needs, is necessary for a sound flood prevention and water management program in the White River Basin. Basic to reaching this objective is establishment and maintenance of those soil and water conservation measures essential for proper land use.

(2) Land treatment measures that are associated with proper land management on cropland include conservation cropping system, contour farming, cover and green manure crops, crop residue use, and grasses and legumes in rotation. On grassland, the conservation measures include pasture and hayland management, brush and weed control, pasture and hayland planting, pasture and hayland renovation, proper range use, range seeding, and farm ponds. Forest land treatment measures include: protection from fire, insects and disease; tree planting; release of desirable natural and planted understory; improvement cuts;

Soil Conservation Service

Farmland drainage by ditching is widely employed in the Coastal Plain Province of the White River Basin.



Soil Conservation Service

Upstream watershed flood losses are reduced by dams and reservoirs.

Arkansas Forestry Commission

State operated nurseries provide forest tree seedlings to landowners at or near cost.

U. S. Forest Service

National Forest lands are administered by the U. S. Forest Service under a broad multiple use policy.

and control of woodland grazing. Recreation measures include recreation area planting and related development. Measures for wildlife include habitat preservation and development by establishing suitable plants for food and cover. A tabulation of land treatment measures included in the 10- to 15-year plan is shown by watersheds and reaches in Table 26. The limits of the "Reaches" are shown on Plate H-46 of Appendix H.

43. IRRIGATION

a. With the exception of the irrigation storage provided in upstream watershed multiple-purpose structures which are discussed in the following paragraph, the foreseeable irrigation needs of the basin can be met by the authorized Grand Prairie project, stream diversions, and ground water.

b. Irrigation storage is provided as a purpose in five of the upstream floodwater retarding structures planned by the Soil Conservation Service and included in the 10- to 15-year plan. Upland areas considered for irrigation were found to be unsuitable for the development of a surface irrigation system because of topography or other physical conditions. Therefore, water stored for irrigation would be released as needed and distributed to the irrigable land with sprinkler systems. These systems will be used generally to irrigate truck crops, corn, silage, and alfalfa. Table 27 lists the planned structures which include irrigation storage.

TABLE 27

UPSTREAM MULTIPLE-PURPOSE STRUCTURES WITH IRRIGATION STORAGE

Watershed number & name	Structure (no.)	Drainage area (sq.mi.)	Irrigation storage (ac.-ft.)	Irrigable area (acres)	Area irrigated (acres)(1)	Irrigation pool (acres)
4 - Richland Cr.	10	35.10	2,000	1,672	1,000	195
92 - Departee Cr.	8	3.30	528	331	264	54
92 - Departee Cr.	12	15.70	2,093	1,311	1,046	290
94 - Middle Fork Little Red R.	13	7.50	1,000	640	500	63
94 - Middle Fork Little Red R.	18	3.84	512	329	256	32

(1) Acres on which project benefits were calculated.

44. RECREATION AND FISH AND WILDLIFE

a. National Scenic Rivers. In addition to the existing and proposed national scenic rivers administered by the National Park Service, the comprehensive plan of development includes in the 10- to 15-year category 20 miles of the Current River from the downstream limit of the

TABLE 26
PROPOSED LAND TREATMENT MEASURES
DEPARTMENT OF AGRICULTURE

Water-shed No.	Reach and Watershed Name	Watershed Area (Acre)	Proposed Land Treatment Measures: Cropland (Acre)	Grassland (Acre) 1/	Forest Land(Ac)	Recrea-tion(Ac)	Wildlife (Acre)	Estimated Cost Total (Dollar) 2/
	REACH NO. 1							
	White River-Source to Beaver Reservoir							
1	Upper White River	174,720	16,100	87,800	23,500	130	2,400	1,308,900
2	White River-Brush Creek Reach	61,440	6,600	32,300	5,100	60	900	510,300
3	West Fork of White River	78,080	10,400	42,600	11,600	90	1,300	937,100
4	Richland Creek	94,080	7,400	50,400	9,500	50	1,200	617,700
5	Beaver Reservoir Laterals	140,800	9,400	55,700	12,000	40	3,400	636,700
6	War Eagle Creek	209,920	18,300	125,200	12,600	100	3,000	1,006,800
	REACH TOTAL	759,040	68,200	394,000	74,300	470	12,200	5,097,200
	REACH NO. 2							
	White River-Beaver Res.to Below Mouth Kings R.							
7	White R-Beaver Res.to Below Mouth Kings River	160,000	14,300	43,600	7,300	70	1,900	543,300
8	Upper Kings River	106,880	6,800	58,000	7,900	50	1,400	375,700
9	Lower Kings River	135,040	10,100	43,600	12,100	70	2,100	479,900
10	Dry Fork-Kings River	33,280	3,100	19,100	8,500	20	500	206,000
11	Osage Creek	104,960	16,000	60,900	9,700	60	1,600	442,400
	REACH TOTAL	540,160	50,300	225,200	45,500	270	7,500	2,047,300
	REACH NO. 3							
	James River-Source to Below Mouth of Flat Creek							
12	Upper James River 2/	172,800	-	-	5,500	-	-	63,500
13	Middle James River 2/	129,920	500	1,500	3,900	-	-	142,500
14	Finley Creek 2/	171,520	500	1,100	11,300	-	-	309,400
15	Lower James River 2/	193,920	24,500	52,600	9,300	10	130	1,504,100
16	Flat Creek 2/	200,960	33,900	80,300	12,700	80	1,800	1,717,600
	REACH TOTAL	869,120	4/ 96,400	4/ 86,100	42,700	4/ 100	4/ 3,000	4/ 3,821,100
			155,800	221,600		190	5,930	6,625,200
	REACH NO. 4							
	White River-Below Mouth Kings R. to Table Rock Dam							
17	Table Rock Laterals(excl. James River)2/	176,640	11,400	21,900	3,000	10	250	580,800
18	Indian Creek	40,320	2,100	21,000	1,900	20	400	211,300
19	Long Creek	99,200	19,100	63,300	3,800	20	1,600	713,000
20	Yokum-Dry Creeks	88,320	10,300	62,300	6,000	50	1,400	363,100
	REACH TOTAL	404,480	4/ 700	4/ 800	14,700	4/ 10	4/ 200	4/ 24,300
			43,600	169,200		110	3,850	1,892,400
	REACH NO. 5							
	White R-Table Rock Dam to Mo-Ark Line(R.M.477.4)							
21	Taneycomo Laterals 2/	208,000	1,100	3,900	14,800	-	40	524,300
22	Bull-Swan Creeks 2/	241,920	1,200	2,600	11,200	-	-	437,800
23	Beaver Creek 2/	247,680	-	-	21,500	-	-	464,500
	REACH TOTAL	697,600	4/ 22,300	4/ 96,700	47,500	4/ 120	4/ 1,460	4/ 2,426,000
			32,600	92,200		120	1,500	3,628,700
	REACH NO. 6							
	White River-Mo-Ark Line(R.M.477.4)toBullShoalsDam							
24	Upper Bull Shoals Laterals 2/	119,040	-	-	4,800	-	120	189,800
25	Lower Bull Shoals Laterals 2/	236,800	18,500	123,300	22,500	30	2,700	1,664,300
26	Little North Fork Laterals 2/	236,800	1,600	12,400	15,600	80	700	519,900
	REACH TOTAL	592,640	4/ 19,800	4/ 21,600	42,900	4/ 90	4/ 1,400	4/ 782,100
			38,900	159,300		200	4,820	3,056,100
	REACH NO. 7							
	White R-Bull Shoals Dam to Below Mouth Crooked Cr							
27	White R-Bull Shoals Dam to Below Crooked Creek	71,040	8,900	62,800	7,300	200	2,500	572,900
29	Lower Crooked Creek	241,920	33,100	156,700	29,600	70	3,700	2,058,100
	REACH TOTAL	312,960	42,000	219,500	36,900	270	6,200	2,631,000
	REACH NO. 8							
	White River-Below Mouth of Crooked Creek to Below Mouth of Sylamore Creek							
30	Big Buffalo River	140,160	3,400	41,300	3,600	80	1,400	296,100
31	Little Buffalo River	90,240	2,500	37,500	3,600	50	900	229,400
32	Big-Richland Creeks	243,200	5,100	73,400	7,250	100	1,800	459,200
33	Middle Buffalo River	208,000	1,700	9,700	7,200	10	400	264,700
34	Lower Buffalo & White River Laterals	248,320	2,700	37,000	20,250	280	3,200	1,014,300
41	White River-North Fork River to Sylamore Creek	226,560	15,600	70,000	24,600	230	10,500	1,260,500
43	Sylamore Creek	142,080	11,700	56,200	15,800	120	1,200	1,327,800
	REACH TOTAL	1,298,560	42,700	325,100	82,300	870	20,100	4,922,000
	REACH NO. 9							
	North Fork River-Source to Norfork Dam							
35	Upper North Fork River 2/	136,320	400	1,200	7,000	-	4,500	497,300
36	Lower North Fork River 2/	227,840	-	-	6,000	-	-	197,800
37	Upper Norfork Dam Tributaries 2/	211,200	4,900	46,900	16,000	280	1,900	804,700
38	Upper Bryant Creek 2/	218,240	-	-	12,000	-	-	204,700
39	Lower Bryant Creek 2/	154,240	-	-	6,000	-	-	99,900
40	Lower Norfork Dam Tributaries 2/	208,000	16,900	119,100	15,000	290	4,900	1,337,900
	REACH TOTAL	1,155,840	4/ 66,900	4/ 116,000	62,000	4/ 1,120	4/ 3,000	4/ 3,132,400
			89,100	283,200		2,100	14,200	6,134,700
	REACH NO. 10							
	White River-Below Mouth of Sylamore Creek to Below Mouth of Wolf Bayou							
42	White R-Sylamore Creek to Below Wolf Bayou	222,720	15,400	80,500	22,800	60	6,700	1,616,200

TABLE 26 (Con.)

Water-shed No.	Reach and Watershed Name	Watershed Area (Acre)	Proposed Land Treatment Measures: Cropland (Acre)	Grassland (Acre) 1/	Forest Land (Ac.)	Recreation (Ac.)	Wildlife (Acre)	Estimated Cost Total 2/ (Dollar)
	REACH NO. 11							
	White River-Below Mouth of Wolf Bayou to Above Mouth of Black River							
44	Salado Creek + Mainstem Laterals	111,360	16,000	45,700	13,700	50	1,700	921,200
45	Polk Bayou + Mainstem Laterals	140,800	29,300	76,800	5,500	60	4,200	1,432,600
	REACH TOTAL	252,160	45,300	122,500	19,200	110	5,900	2,353,800
	REACH NO. 12							
	Black River-Source to Clearwater Dam							
47	Upper Black & Clearwater Laterals 3/	249,600	10,500	11,800	2,600	90	6,400	322,800
48	West Fork of Black River	102,400	6,800	7,800	2,700	20	4,400	200,300
49	Sinking Creek	54,400	3,800	4,300	3,500	10	2,300	136,200
50	Logan Creek	168,320	10,200	12,800	3,200	30	7,200	320,800
	REACH TOTAL	574,720 4/	31,300 4/	36,700 4/	12,000 4/	150 4/	20,300 4/	980,100
			35,100	41,400		172	21,000	1,152,300
	REACH NO. 13							
	Black River-Clearwater Dam to Poplar Bluff							
51	Black River-Clearwater Dam to Poplar Bluff	228,080	25,800	13,100	8,100	4,500	4,800	1,451,200
	REACH NO. 14							
	Black R-Poplar Bluff to Below Mouth of Cane Cr.							
52	North Inter-River Drainage District	99,200	60,700	8,200	200	2,200	1,300	3,466,200
53	Cane Creek + Black River Mainstem	219,520	66,000	19,700	12,100	4,200	3,700	4,062,400
	REACH TOTAL	318,720	126,700	27,900	12,300	6,400	5,000	7,528,600
	REACH NO. 15							
	Black River-Below Mouth of Cane Creek to Above Mouth of Spring River							
54	Black River-Pocahontas Reach	74,240	26,900	8,400	-	10	3,100	164,200
55	Corning Ditches	62,080	53,500	2,000	-	30	4,300	530,300
61	Current River-Jacks Fork to Van Buren, Mo.	166,400	3,400	12,700	5,100	-	14,700	479,300
62	Pike Creek	92,800	6,700	5,500	5,100	-	6,500	264,300
63	Current River-Van Buren, Mo. to Buffalo Creek	207,360	7,800	16,900	15,300	-	6,700	671,000
64	Lower Current River	120,320	23,400	18,900	950	-	3,000	629,200
66	Black Creek	26,880	19,500	900	-	105	1,700	290,500
68	Little Running Water Ditch	12,800	11,400	200	-	-	200	121,300
	REACH TOTAL	762,880	152,600	65,500	26,450	145	40,200	3,150,100
	REACH NO. 16							
	Current River-Source to Below Mouth Jacks Fork							
56	Upper Current River	241,280	4,800	61,100	18,500	-	56,500	2,122,100
57	Current River-Akers to Jacks Fork	196,480	2,900	24,700	9,700	-	33,100	837,900
58	Spring Valley Creek	92,800	3,100	17,100	8,200	-	13,320	656,300
59	Upper Jacks Fork 3/	120,960	900	29,000	15,500	-	17,900	1,055,400
60	Lower Jacks Fork	159,360	2,000	15,100	10,200	-	20,100	685,800
	REACH TOTAL	810,880 4/	3,600 4/	4,900	62,400	-	4/ 200 4/	132,500
			16,300	151,900			141,120	5,430,000
	REACH NO. 17							
	Eleven Point River-Source to Mouth							
74	Upper Eleven Point River 3/	199,680	40	240	18,500	-	320	295,900
75	Middle Fork Eleven Point River 3/	53,120	-	-	9,000	-	-	190,700
76	Eleven Point River-Greer Spring Reach 3/	226,560	300	9,900	14,600	-	13,100	653,400
77	Eleven Point River-Alton Reach 3/	155,520	200	400	24,800	-	100	614,900
78	Eleven Point Laterals 3/	102,400	700	32,000	10,100	10	1,100	468,300
79	Lower Eleven Point River	28,160	4,300	5,400	2,600	-	300	181,600
	REACH TOTAL	765,440 4/	4,760 4/	62,160	79,600 4/	2.0 4/	2,000 4/	1,760,200
			40,300	116,100		210	16,920	4,165,000
	REACH NO. 18							
	Black River-Above Mouth of Spring River to Above Mouth of Strawberry River							
70	Upper Spring River 3/	165,760	-	-	25,000	-	-	250,000
71	Hyatt Creek & Middle Spring River	179,840	7,000	29,400	23,000	10	3,300	771,400
72	South Fork Spring River	210,560	14,800	99,100	18,000	20	4,200	1,124,400
73	Lower Spring River 3/	221,440	38,700	71,700	24,000	10	11,300	1,505,500
81	Big Cypress Creek	27,520	4,800	13,400	1,100	-	800	198,400
	REACH TOTAL	805,120 4/	21,600 4/	40,500	91,100 4/	160 4/	1,500 4/	1,654,300
			66,900	254,100		200	21,100	4,944,000
	REACH NO. 19							
	Black R-Above Mouth of Strawberry to White River							
82	Lower Black River Mainstem	26,880	15,100	6,100	-	-	2,200	249,000
83	Upper Strawberry River	151,680	33,900	114,400	13,900	30	7,400	1,567,700
84	Piney Fork-Strawberry River	75,520	23,800	47,800	4,600	20	5,100	877,200
85	North Big Creek-Strawberry River	122,880	22,800	41,000	7,000	10	3,300	637,600
	REACH TOTAL	376,960	95,600	209,300	25,500	60	24,000	3,331,500

TABLE 26 (con.)

Water-shed No.	Reach and Watershed Name	Watershed Area (Acre)	Proposed Land Treatment Measures					Estimated Cost Total 2/ (Dollar)
			Cropland (Acre)	Grassland (Acre) 1/	Forest Land(Ac.)	Recreа. (Acre)	Wildlife (Acre)	
	REACH NO. 20							
	White River-Above Mouth of Black to Above Mouth of Little Red River							
88	Upper Village Creek	106,880	62,700	16,000	-	-	3,900	787,700
89	Lick Pond Ditch	27,520	21,100	10,800	-	-	900	290,400
90	Village Creek-Swan Pond Reach	67,840	49,300	2,500	-	-	5,200	552,500
91	Lower Village (Mayberry)	83,200	74,600	5,500	-	-	5,800	574,600
92	Departee Creek + White River Laterals	224,000	90,100	76,000	11,400	30	7,300	1,864,000
102	Overflow Creek-Little Red River	39,040	20,900	13,800	1,600	-	620	255,700
	REACH TOTAL	548,480	318,700	124,600	13,000	30	23,720	4,324,900
	REACH NO. 21							
	Little Red River							
94	Middle Fork-Little Red River	188,800	16,100	103,000	10,600	70	1,600	1,026,700
95	Greers Ferry Laterals-Little Red River	220,160	8,800	70,300	6,000	150	1,700	640,100
96	Upper South Fork-Little Red River	92,800	6,900	73,400	1,300	-	300	448,500
97	Archey Fork + Laterals-Little Red River	104,320	7,600	75,700	500	10	400	645,300
98	Turkey-Beech-Raccoon Creeks	128,000	3,000	24,800	3,500	50	1,400	371,600
99	Red River-Greers Ferry to Pangburn	51,200	7,900	14,400	6,300	70	700	343,500
100	Big Creek + Mainstem Little Red River	204,800	31,800	59,200	18,000	80	3,000	1,155,200
101	Indian Creek-Little Red River	96,000	11,700	42,400	3,100	60	1,500	346,000
	REACH TOTAL	1,086,080	93,800	463,200	49,300	490	10,600	4,976,900
	REACH NO. 22							
	Cache River and Bayou DeView							
109	Upper Cache River (Ditch #1)	175,360	99,500	13,600	10,100	680	11,200	1,952,800
110	Lower Cache - Ditch #1	160,640	82,800	21,900	7,900	60	5,400	1,066,900
111	Cache River-Egypt to Light	102,400	91,800	13,600	2,900	30	3,800	1,077,300
112	Cache River-Amagon to Egypt	106,240	75,600	7,200	-	10	6,000	871,600
113	Cache River-Patterson to Amagon	117,120	57,100	12,000	-	-	7,900	691,500
114	Overcup Ditch	22,400	13,000	2,600	-	-	1,500	145,900
115	Cache River-Clarendon to Patterson	127,360	69,800	6,300	-	10	4,900	708,500
118	Bayou DeView-Flag Slough Reach	121,600	102,900	3,500	-	30	4,200	1,283,800
119	Lower Bayou DeView	210,560	139,300	6,100	-	10	-	1,347,800
120	Cow Lake	28,160	16,800	2,300	-	-	2,000	234,100
121	Possum Creek	10,880	4,700	200	-	-	700	88,300
	REACH TOTAL	1,182,720	753,300	89,300	20,900	830	47,600	9,411,200
	REACH NO. 23							
	Bayou Des Arc							
93	White River-Augusta to DeValls Bluff	49,280	18,500	2,700	-	-	1,700	262,400
103	Cypress Bayou	154,240	79,800	60,600	17,100	50	7,500	938,400
104	Bull Creek	100,480	38,400	17,600	7,300	-	1,500	583,400
105	Upper Des Arc Bayou	124,160	15,500	30,000	5,200	-	1,700	394,500
106	Lower Des Arc Bayou	116,480	62,900	10,000	1,700	10	2,400	803,400
	REACH TOTAL	544,640	215,100	120,900	31,300	60	14,800	2,982,100
	REACH NO. 24							
	Wattensaw Bayou							
107	Wattensaw Bayou and White River Laterals	188,800	83,100	31,000	5,600	40	8,100	1,340,200
	REACH NO. 25							
	Big and Dials Creeks							
122	Dials Creek	30,080	20,700	800	-	-	200	296,700
123	Big Slash	21,120	13,700	500	-	-	100	196,800
124	Big Creek-Flat Fork Reach	106,240	79,000	2,400	-	20	4,800	840,900
125	Big Creek-Piney Fork Reach	179,200	114,800	6,400	-	30	6,400	1,084,400
127	Lower Big Creek	181,760	119,900	7,400	450	70	7,000	1,394,500
128	Big Cypress-Big Creek	85,120	57,900	1,900	-	10	600	860,600
129	Prairie Cypress-Big Creek	21,760	5,900	500	-	-	20	91,400
	REACH TOTAL	625,280	411,900	19,900	450	130	19,120	4,764,300
	REACH NO. 26							
	Lower White River							
108	White River-DeValls Bluff to St. Charles	162,560	26,200	6,400	-	10	2,900	504,200
130	Lower White River Tributaries	192,000	82,200	5,000	-	20	12,200	1,111,000
132	Big Bayou Lagrue	163,840	94,800	13,000	-	10	5,400	1,463,400
133	Little Bayou Lagrue	86,400	72,400	3,200	-	-	4,500	901,400
134	Laconia Circle Watershed	11,520	10,300	500	-	10	700	200,200
	REACH TOTAL	616,320	285,900	28,100	-	50	25,700	4,180,200
	BASIN TOTAL	16,534,400	3,388,000	4,051,700	928,800	18,090	510,080	103,677,400

1/Includes woodland grazed.
2/Includes State matching funds for technical assistance to Forest and ACP cost sharing.
3/Data on cropland and grassland could not be broken down to a watershed basis (see footnote 4).
4/Extrapolation of land treatment by reaches in areas where detailed basic data was not available.

Ozark National Scenic Riverways to the southern boundary of the Mark Twain National Forest. This would provide almost complete preservation of the Current River in Missouri. Adjacent lands would be acquired in fee or by scenic easements in order to preserve and develop the natural environment for scenic values, float fishing, hunting, and other types of outdoor recreation use. This project, as well as other features of the fish and wildlife and recreation plan, is shown in Table 21.

b. Stream preservation. The unique value of clear free-flowing Ozark-type streams is recognized. Preservation of segments of 9 such streams in Missouri and 10 in Arkansas is included in the 10- to 15-year plan. Preservation would be accomplished by acquisition of minimum acreage of adjacent lands in fee or scenic easements. Fee acquisition would be primarily at access points. Certain segments of the streams would be developed for intensive use while others would be left alone to exemplify a primitive environment. The streams would serve both recreation and fish and wildlife purposes.

c. Large impoundments. As discussed under "Main Stem or Major Tributary Reservoirs," the five multiple-purpose reservoirs and the Quarry regulation project in the 10- to 15-year plan would provide facilities for both recreation and fish and wildlife purposes. A surface area of 30,900 acres would be provided by the conservation pools when they are full. These reservoirs would enhance the distribution of warm-water fishery and trout habitat in the basin. Outlet structures at Wolf Bayou, County Line, Wild Horse, and Bell Foley would be designed to release the warmest water in the reservoirs to complement the warm-water fishery downstream. The outlet structures at Myatt Creek and Quarry would be designed to release the colder water to sustain and possibly enhance and extend existing downstream trout habitat. Development of recreational and access areas downstream from the dams would provide considerable increases in outdoor recreational opportunities.

d. Small impoundments.

(1) The Soil Conservation Service multiple-purpose impoundments included in the 10- to 15-year plan and presented in Table 24 would provide 20,581 acres of water surface for recreation and fish and wildlife uses. Of this total 15,287 acres would be the sediment pools, 946 acres would be the municipal and industrial water supply pools, 245 acres would be the water quality control pools, 634 acres would be the irrigation pools, and the acres in the various pools specifically for recreation and fish and wildlife would be 2,829 and 640, respectively. In addition, there would be other Soil Conservation Service single-purpose impoundments that would provide 920 acres of water surface for recreational uses. Of this total 880 acres would be in Watershed Numbers 22, 35, 36, 47, 48, 57 and 77 specifically for recreation, and 40 acres would be a municipal and industrial water supply pool in Watershed Number 9. If full utilization of these small impoundments is achieved, adequate access and public use facilities must be developed.

(2) The States of Arkansas and Missouri propose 9 lakes in the 10- to 15-year plan. These lakes would have a combined surface area of about 3,000 acres and would be used primarily for fishing.

(3) The small impoundments would alleviate local needs for lake fishing especially in the southern part of Missouri and northeastern Arkansas.

e. Stream access. Stream access sites are proposed for the streams included as national scenic rivers, stream preservation, and numerous other streams. More than 100 sites are included in the 10- to 15-year plan. Some sites would be developed for intensive use while others would provide for only limited use in order to preserve natural environmental conditions.

f. Land acquisition.

(1) It is proposed in the 10- to 15-year plan to increase land holdings in the Mark Twain, Clark, and Ozark-St. Francis National Forests. Primarily, this would involve consolidation of holdings within proclamation boundaries and acquisition of marginal lands along selected streams, scenic environmental areas, and areas to provide for public use. There are seven areas of special scenic, geological, and botanical interest included in the acquisition plan. They are Blanchard Springs Caverns, Piney Creek Scenic Area, Peck Hollow Outdoor Lab, Glades Scenic Area, Panther Springs Geologic Area, Tupelo Gum Pond Botanical Area, and the Irish Wilderness. The location of these special areas is shown on Figure 5, Appendix J. The area included in the plan is about 285,300 acres in Missouri and 73,000 acres in Arkansas. Principal developments would be swimming, camping, picnic facilities, and hiking trails.

(2) The 10- to 15-year plan includes the acquisition by the Federal Government of 4,000 acres adjacent to the White River National Wildlife Refuge. The area would be used chiefly to provide winter feeding habitat for Canada geese.

(3) The Arkansas Game and Fish Commission has included in the 10- to 15-year plan the acquisition by the State of 24,000 acres of bottomland hardwood areas in the lower reaches of the White River Basin. These areas are needed to reserve some of the highly productive wildlife habitat being rapidly lost to farm production.

g. Other recreation and fish and wildlife features. Other features included in the 10- to 15-year category of the Comprehensive Plan of Development that are pertinent to recreation and fish and wildlife are as follows:

(1) The expansion of the Montauk State Fish Hatchery in Missouri to increase production from 96,000 to 150,000 pounds of trout per year.

(2) Control structures at the mouth of Departee and Glaise Creeks and in the Glaise Creek drainage ditch to facilitate better water control in Hurricane Lake Wildlife Management Area. The structure at the mouth of Departee Creek would allow for diversion of water from White River to flood the area. These structures have been included as mitigation measures in the Oil Trough to Hurricane Lake local protection project presented in Table 23.

(3) Private water development projects including 5,400 and 1,300 acres of farm ponds in Arkansas and Missouri, respectively; 1,380 acres of municipal and industrial water supply lakes; fee-fishing lakes; and access and other commercial facilities.

(4) A national recreation area for the Beaver, Table Rock, Lake Taneycomo, Bull Shoals, and Norfork reservoir complex. These reservoirs and associated areas attract millions of visitors from throughout the Nation annually. The natural beauty of the area together with such a large amount of water for recreational use and its national popularity make it ideal for a national recreational area. This feature of the plan should be given further consideration by a separate study.

(5) Eight scenic drives all in national forests, with the exception of Arkansas State Highway 7 south from Harrison, Arkansas, to the basin boundary. These would make some of the most outstanding scenic values of the basin accessible to the public.

(6) Three hiking and saddle trails in the Mark Twain National Forest.

(7) Ozark Scenic Railway from the southern basin boundary near Cabot, Arkansas, to Newport, thence generally along the White River to Branson, Missouri, and thence northward to Springfield, Missouri. This existing railroad would, by provision of scheduled passenger trains especially during the summer months, offer a means by which people who, for various reasons prefer this mode of transportation, could visit and enjoy the picturesque beauty of the basin.

(8) Tourist information centers. There are many varied recreational centers available, and the public should be informed of them.

(9) Preservation of significant and important areas of archeological, historical, and natural science value.

h. Intangibles.

(1) Other investments may well achieve monetary returns comparable with or in excess of those expected from investments proposed in this recreation plan. The real value of much of this plan lies in the realm of intangible benefits.

(2) The development of land and water resources in this Nation is essential to produce material benefits. However, material wealth is not the sum total of our existence and the "fiscal yardstick" cannot measure all of our needs and desires. Material things alone do not provide a satisfactory and complete life for many people. The quality of our existence includes the diversity and preservation of beauty as well as the use of our resources to produce material wealth. Escape from the pressures and complexities of modern living by returning to segments of a world which nurtured the spiritual thoughts and aspirations of our ancestors is among our aesthetic and cultural determinants and provides unique types of recreation not provided by manmade developments. The need for preserving unspoiled nature is part of the satisfaction of our spiritual and social needs.

(3) The implementation of the Buffalo National River proposal and the preservation of the Eleven Point River, an additional segment of the Current River, and other selected rivers and streams in Missouri and Arkansas will help satisfy a need for the enjoyment of nature's ribbons of life. Likewise, the establishment of scenic areas, special areas and complexes, and hiking and saddle trails all help fill the need for people to remove themselves from the fast pace of everyday living and to enjoy a natural environment. They will also fill the need for higher quality recreation, with "quality" defined as the degree to which the recreation experience differs from the ordinary - also the degree to which it stirs our higher senses, our feelings about the beauty of the natural world.

(4) All of these thoughts become more significant when it is realized that 70 percent of the Nation's population now live in cities, and this increase in urbanization is expected to continue. Intangible values are not readily quantifiable, yet they are increasing in importance in our complex urban society.

45. ALTERNATIVE CONSIDERATIONS

a. General.

(1) In developing the comprehensive plan for the White River Basin, alternative projects and programs were considered in many locations throughout the basin. In those cases where information was available, a comparison of excess benefits over costs was made for the alternatives. However, in selecting the appropriate project or program to include in the comprehensive plan, consideration was also given to other factors such as scope of improvements, desires of local interests, position of the States, and pending Federal legislation relating to the basin.

(2) It was recognized early in the study that many of the people and some of the participating agencies desired to preserve

several scenic rivers in the White River Basin in their present state. It was also recognized that stream preservation would preclude construction of large multiple-purpose reservoirs on the reach of the river to be preserved and that the benefits relating to the purposes served by these projects would be foregone. It was the opinion of some conservationists that preservation of a stream should also preclude upstream watershed detention reservoirs, because of their effect on the ecology of the stream. The Coordinating Committee concluded that these aspects of plan formulation should be discussed in this report.

(3) In formulating the comprehensive plan it was the consensus of the representatives of applicable agencies that the effects of upstream detention type storage on downstream ecology are unknown, but it was believe that it would be generally compatible with National Scenic River and stream preservation programs. During preconstruction planning, additional studies may be necessary.

b. National Scenic Rivers and alternative development.

(1) Two National Scenic Rivers are included in the comprehensive plan for development in the next 10 to 15 years. These are the Buffalo National Scenic River and the Eleven Point National Scenic River.

(2) Development of the Buffalo River as a National Scenic River would forego development of dam and reservoir projects at the Lone Rock and Gilbert sites for flood control, hydroelectric power, and recreation and fish and wildlife. Survey report studies made in 1964 indicate that the benefits foregone from non-development would be 654,000 acre-feet of flood control storage, 193,000 kilowatts of hydroelectric generation capacity with an annual energy production of about 277 million kilowatt hours, and an initial annual visitation of 900,000 with the potential of an optimum development for 3,100,000 visitors for recreation and fish and wildlife uses. At that time the Governor of the State of Arkansas preferred that the Buffalo be developed as a National Scenic River.

(3) The Buffalo River Basin also contains two potential pumped-storage hydroelectric power projects which would be foregone by development of the National Scenic River. These are the Compton site adjacent to the Buffalo River and the Point Peter site adjacent to Richland Creek. Preliminary studies indicate that about 1,700,000 kilowatts of power could be developed at these two projects.

(4) Development of the entire lower 90 miles of the Eleven Point River as a National Scenic River would preclude construction of a project at the Water Valley site. Survey report studies made in 1964 indicate that a project with a total capacity of 1,729,000 acre-feet and a hydroelectric power installation of 44,000 kilowatts could be

constructed at the site. Annual recreation visitation at a project such as this is estimated to be 1,587,000 initially and 5,973,000 for an optimum development.

c. Other alternatives for selected projects and programs.

(1) The projects and programs in the comprehensive plan for flood control were selected, insofar as practicable, on the basis of providing the maximum benefit to the greatest number of people. The different structural methods of obtaining flood control that were considered included upstream watershed protection projects of the Soil Conservation Service; main stem and major tributary reservoirs and levee projects of the Corps of Engineers; and channel improvements of both agencies. In most cases the adopted plan for an area contained a combination of two or more types of improvements.

(2) In most instances, a single project or a combination of flood control alternatives cannot be implemented without foregoing certain benefits that could result from alternative development of other single or combination improvements. Flood control effects of the different alternatives considered are not always comparable, and selection on the basis of maximum excess benefit over cost was difficult. Also, economic analysis cannot evaluate the desires of the local people, which was one of the basic objectives for all project development.

(3) To account for uncertainties that could develop in the future, several projects have been included in the long-range plan as alternatives to various flood control elements of the 10- to 15-year plan. These alternatives include major tributary multiple-purpose projects at the Fairdealing site on the Little Black River, Harviell site on Cane Creek, and Janes Creek site on Janes Creek. These three projects are economically justified at the present time, but their construction would inundate agricultural areas and thereby eliminate the need for all or part of the upstream watershed protection projects which also offer protection to areas upstream from the multiple-purpose projects. These major tributary projects have been left in the long-range plan of development in the event that the upstream watershed projects do not develop as planned.

(4) On other tributaries of the Black River, multiple-purpose dam and reservoir projects on Myatt Creek, South Fork of Spring River, and Strawberry River were selected over upstream watershed protection projects. The larger reservoirs were selected because they would provide benefits on their parent streams and because their large flood control capacities would allow them to withhold releases until flows on the Black River returned to within banks. Operation of the projects in this manner would result in the maximum benefit to the people in the Black River flood plain and the White River flood plain downstream from the mouth of the Black River. Upstream watershed

projects are included in the 10- to 15-year plan for these three areas. However, in each watershed where the major tributary reservoirs are located, it was necessary to eliminate some flood water retardation structures.

(5) The multiple-purpose County Line Dam and Reservoir project on James River was selected for the 10- to 15-year plan over an upstream watershed project and two downstream major tributary dam and reservoir projects which were studied as alternatives. The two downstream sites were eliminated in favor of County Line on the basis of excess benefits over costs. The upstream watershed project could not furnish a comparable water supply yield or flood control benefits for the area because of inability to control as much drainage area as the County Line project. Construction of County Line project would preclude construction of the upstream watershed project in the next 10 to 15 years because the reservoir would inundate a considerable portion of the area to be protected by the upstream watershed project. The upstream watershed project has been left in the long-range plan in case the County Line project is not constructed.

(6) Galena Dam and Reservoir, on the James River, and Grandview Dam and Reservoir were included in the long-range plan because they were not economically justified at this time and they would conflict with the stream preservation programs of the two States and upstream watershed protection projects supported by local interests. The two projects would furnish additional flood control, hydroelectric power, and water-oriented recreation.

46. SUPPORTING PROGRAMS AND ADDITIONAL STUDIES

a. Hydrologic network and studies.

(1) General.

(a) The rapidly expanding development of the water resources in the White River Basin as recently experienced and as proposed by this plan of development, makes it imperative that all agencies involved, State and Federal, continue to strengthen the coordination of their efforts in the collection of hydrologic data. The importance of adequate hydrologic data cannot be overstated. The orderly development, control, and use of the water resources of the basin must be founded on a background of physical facts as well as sound engineering practices. It is important that records of streamflow, ground water, quality of water, sediment, precipitation, evapotranspiration, and associated scientific data be collected, analyzed, evaluated, interpreted, and compiled in such a manner as to be readily usable.

(b) In appraising the hydrologic networks and studies for the White River Basin, consideration was given to the adequacy of the present state of information essential for general hydrologic coverage; operating and evaluating existing and proposed water management and pollution abatement programs in the basin; refining detailed plans for water development projects proposed in the 10- to 15-year plan; and preliminary planning of projects in the long-range plan of water and land resource developments.

(2) Adequacy of existing network and studies.

(a) At present, information on quantity and quality of surface water is generally adequate for many planning, development, and management purposes for the main stem and principal tributaries of the White River. However, much information is lacking or has been collected for only short periods of time on small tributary streams where developments are proposed. Information on the quantity and quality of ground water is generally of reconnaissance type for most of the basin -- generally adequate in the Coastal Plain part of the basin, but spotted or inadequate in the Interior Highlands part of the basin.

(b) Information on the availability of streamflow data is contained in Appendix C with information on the surface and ground-water resources of the basin given in detail in Appendix D. Precipitation, evaporation, humidity, temperature, wind and solar radiation are widely used in planning and management of the water resources of the basin. Information on availability of hydroclimatic data is contained in Appendix C.

(3) Needed additions to the hydrologic network.

(a) The needed additions to the hydrologic instrumentation network in the basin are discussed in the paragraphs below in general terms. Specific locations of needed stations are given in Section VI of Appendix C.

(b) Six stream-gaging stations are needed in the basin for areal hydrology and reservoir inflows. For water management and basin accounting, 5 outflow and reservoir content stations are needed for the 5 multiple-purpose reservoirs of the Corps in the 10- to 15-year plan. Plans for other major reservoirs in the long-range plan should include provisions for the stations. One station is needed on the James River for water management in connection with pollution monitoring.

(c) Chemical quality stations are needed for 5 locations in the basin for collection of daily records for pollution

monitoring and temperatures. Stations are needed at 21 additional locations for periodic collection of these same data.

(d) Sediment stations are needed at 9 locations in the basin for collection of daily sediment records for purposes of computing suspended sediment yields of the major streams. Partial records of sediment should be collected at 16 additional stations in the basin.

(e) The low flow partial record station network is considered adequate for present needs. However, network coverage should be adjusted or additional stations operated if future problem areas are identified or needs develop that require intensive study of specific areas or reaches in the White River Basin.

(f) Annual peak discharges are being determined at an adequate number of stations. It is now apparent that in order to define flood frequency characteristics of small drainage areas within a reasonable length of time, flood hydrographs and concurrent rainfall records must be obtained in addition to data now being collected. Flood hydrographs and rainfall records are now being collected at two small area stations in the Arkansas part of the basin. It is proposed that similar data be collected at about 30 of the 41 sites at which crest stage partial record gages are now being operated.

(g) The existing network of ground-water observation wells should be strengthened to monitor more adequately the regional aquifers for better definition of long-term trends in ground-water levels. A program to obtain periodic pumpage inventories and water samples for water quality monitoring is needed to complement information obtained from the observation well network.

(4) Special surface water and ground-water hydrologic studies.

(a) There is a need for collection of seasonal temperature, chemical, and biological data from waters of the existing major reservoirs to provide information for a periodic (5-year) analysis of trends in the quality environment. Provision should be included also to initiate collection and analysis of similar data from waters of new major reservoirs after initial filling.

(b) A cost-benefit study should be made to determine whether a test-drilling program should be initiated to delineate the southward extension of the deep aquifers, such as the Roubidoux and

Gunter, in the sparsely settled counties in the southern two-thirds of the Interior Highlands part of the basin in Arkansas, or whether surface-water supplies are more economical and feasible.

(c) An inventory and data on quantity and quality variability of large springs in the Arkansas part of the basin are needed to identify possible sources of public supplies.

(d) Channel gain-and-loss studies in relation to geology should be made to help determine areas of ground-water recharge and discharge and improve the knowledge of the relationship between ground and surface water in each sub-basin.

(e) A test-drilling program should be initiated to map materials of Tertiary and Cretaceous age as possible sources of water supply in the Coastal Plain part of the White River Basin in Arkansas. This is needed especially in the area between the Fall Line and Crowley's Ridge north of Independence County.

(f) Wells to a maximum depth of 200 feet in and around densely populated and industrialized areas should be monitored to detect sources of ground-water pollution. The weathered and highly fractured limestones and dolomites at and near the surface are especially subject to contamination.

(g) A quality-of-water study should be made to determine possible sources and extent of high manganese content of water in deposits of Quaternary age in the Walnut Ridge area in Arkansas. The high manganese content creates a problem in water treatment.

(h) A study is needed to delineate more closely the fresh and salt water interface in the acquifers of the Coastal Plain part of the basin.

(i) More quantitative data are needed, particularly with respect to the "hard rock" aquifers, such as the Roubidoux Formation and the Gunter Sandstone, to determine their ultimate supply potential.

(j) A study is needed in the Springfield area to determine whether polluted water in the Mississippian age limestones is descending through inadequately cased wells to deeper aquifers presently used by municipalities. The study should include test drilling to determine head differences between aquifers and relative yields of aquifers.

(k) A study is needed to analyze the water budget of the sub-basins to determine what part of the water loss is evapotranspiration, and what part is underflow. This work in conjunction with peizometric mapping would help in understanding the direction of ground water-surface water movement and identification of areas or sources of pollution.

(l) A quality-of-water study should be made to determine the source and extent of high nitrate content of ground water in the Interior Highlands section of the basin. These high nitrate areas are generally indicative of pollution in the ground-water body by surface water.

(m) Information from the large reservoirs is needed to further document and publish long-term sediment yields, to determine the distribution and density of deposits within the reservoirs, and to provide information needed for proper operation of the reservoirs. Records of sediment outflow from selected reservoirs are needed as one element in determining trap efficiencies and for use in connection with channel studies below the reservoirs. Information from the small reservoirs and retarding structure pools is needed to supplement information from small-area sediment-load stations.

(n) Comprehensive water-use studies should be made at periodic intervals to provide information on the source, type, and magnitude of water use.

(o) Consideration should be given to the need for hydrologic studies as related to the urban environment in the White River Basin.

b. Flood plain management.

(1) To encourage the prudent use of urban flood plains, Congress in the Flood Control Act of 1960 authorized a National program of flood hazard studies. Under this authority, the Corps of Engineers will provide to local State and Federal agencies flood plain information and technical assistance needed to plan and manage flood plains for their best use.

(2) Flood plain management is essentially a measure for controlling the use of flood plains by prevention of encroachment; by regulating the use of the flood plain, by modification of structures in it to withstand flood hazards; by making the public aware of the flood hazard in the areas; and by development of flood prediction systems, warning systems, and evacuation plans.

(3) Flood plain management was considered as a means for flood damage reduction in all urban areas subject to flooding. However, other methods of flood prevention were determined to be better solutions because these methods would prevent agricultural as well as urban losses and would provide a more satisfactory degree of protection. A flood plain information study has been completed for Pocahontas, Arkansas. One is under way for Springfield, Missouri, and studies will probably be made at other locations in the basin which will have flood problems even with the comprehensive plan functioning. These studies

will aid local interests in planning and managing flood plains to reduce residual flood damages where other measures included in the comprehensive plan are only partially effective or ineffective in preventing such damages.

c. Vector prevention. Vector prevention and control measures should be incorporated into the design, construction, and operational phases of the water resource developments of the White River Basin.

(1) With respect to reservoirs:

(a) Provide for adequate preimpoundment clearing, particularly in the normal summer fluctuation zone;

(b) Provide for adequate depth of water throughout the reservoir to discourage the growth of aquatic vegetation;

(c) Provide for water level management, including a spring surcharge and gradual drawdown (e.g. 0.2 foot for 10-day period) each summer to control vegetation and mosquitoes;

(d) Provide for adequate drainage of borrow pits if they are not inundated permanently; and

(e) Provide for channeling (interceptor channels) to control marshy or seep areas below the dam.

(2) With respect to recreational areas along the shores of the reservoir:

(a) Locate sites in sections where the mosquito potentials are low;

(b) Provide for proper storage, collection, and disposal of refuse for the prevention of flies, wasps, rats, and wild rodents;

(c) Provide for rodent-proofed buildings at recreational areas where rodents may create public health hazards;

(d) Provide for periodic removal of debris, rubbish, and other materials which may serve as harborage for rodents and other animals;

(e) Provide for removal of brush and weeds along paths, trails, and roadways for the prevention of tick infestations; and

(f) Provide for supplemental use of insecticides, herbicides, and rodenticides in situations where adequate vector control is not obtained through source reduction measures outlined above.

(3) In order to define the nature and extent of vector control problems following completion of the improvement projects, provisions should be made for vector surveys of the reservoir and public use areas. Provision should also be made for continuous surveillance of vectors and routine appraisal of control operations.

d. Navigation, pumped-storage hydroelectric power, and national recreation area.

(1) The comprehensive plan for the White River Basin is a combination of projects and programs formulated for land and water resource development to meet the needs of the people. In formulating the plan, three elements were found which required more study than could be included under the scope and the funding available for this report. They were navigation, pumped-storage hydroelectric power, and a national recreation area. Preliminary investigations of these elements indicated that they should be included in the 10- to 15-year plan subject to more studies to verify their economic and engineering feasibility. However, these investigations revealed that these three elements would be compatible with the other projects and programs in the comprehensive plan.

(2) A separate study has been authorized by the Public Works Committee of the United States Senate by resolution dated May 25, 1967, to determine the feasibility of navigation on the White River below Batesville, Arkansas. The Corps of Engineers estimates that this study will cost about $250,000. They also estimate that studies necessary to establish the feasibility of pumped-storage hydroelectric power will cost about $200,000. The Bureau of Outdoor Recreation estimates that it will cost about $150,000 to make the national recreation area study.

e. White River - cold water fishery.

(1) Congress has recognized that values to be realized from water-control structures change with time and that the use and assigned costs of such structures should be reconsidered in certain instances. The cold water fishery in the White River below Bull Shoals and Norfork Dams is such an unforeseen use. It has become a valuable resource and, if determined to be the best use of the water resource, should be protected and enhanced if possible by variable summer operation of the dams to release water to maintain a desirable temperature in an appropriate downstream reach.

(2) The use of reservoir storage for purposes not set out in the documents which were the basis of Congressional authorization, such as the release of water for the cold water fishery, results in project operation problems for the responsible agencies. The solution to such problems appears to be to restudy the reservoirs as the need dictates to determine the best uses in the light of total public needs, taking into full consideration the effect of any proposed change on present authorized functions including any reallocation of reservoir storage and related costs.

SECTION IX - EFFECTS OF THE 10- TO 15-YEAR PLAN

47. GENERAL

A discussion of the water and related land resource needs of the basin that would not be met by the existing, under construction, and certain authorized and proposed projects and programs was presented in Section V of this report. This section presents data and discusses the effects the projects and programs in the 10- to 15-year category of the comprehensive plan will have on these needs.

48. FLOOD CONTROL AND PREVENTION

a. The estimated average annual flood losses that would be prevented by all the flood control and prevention projects in the 10- to 15-year plan are summarized in Table 28. The effects of land treatment on flood losses were not considered in making these estimates. Future economic conditions that are expected without additional water resource investments were considered in estimating the values shown.

TABLE 28

AVERAGE ANNUAL FLOOD LOSSES PREVENTED

Means of prevention	Amount
Major reservoirs	$7,591,000
Floodwater retarding structures	8,162,000
Local flood protection projects	10,218,000
Multiple-purpose channels	8,739,000
Total for basin	34,710,000

b. The areal effects of flood control and prevention have been summarized in Table 29 by three natural and significant sub-basin areas and by physiographic provinces. Also shown are the average annual losses with the existing, under construction, and certain authorized and proposed projects functioning; the average annual losses prevented by the projects included in the 10- to 15-year plan; the remaining average annual losses; and the percent of losses prevented.

c. Areas damaged by floods in the Ozark Plateaus are widely scattered and generally not large enough to justify the cost of the projects required to alleviate the conditions, therefore, the losses that would be prevented are about as great as can be expected. In some watersheds only a very few structures are found to be feasible. The most successful application of the upstream watershed projects was in the Black River area where the topography is not as rugged as in the Upper White River Basin.

TABLE 29

FLOOD CONTROL EFFECTS BY AREAS
(In thousands of dollars)

Area	Average annual flood losses			Percent of base condition losses prevented
	Base condition	Modified by 10- to 15-yr. plan	Prevented by 10- to 15 yr. plan	
Upper White River:				
Ozark Plateaus	$6,527	$4,995	$1,532	23
Coastal Plain	308	177	131	43
Total	6,835	5,172	1,663	24
Black River:				
Ozark Plateaus	6,522	4,384	2,138	33
Coastal Plain	31,601	17,668	13,933	44
Total	38,123	22,052	16,071	42
Lower White River:				
Ozark Plateaus	1,834	1,225	609	33
Coastal Plain	50,328	33,961	16,367	33
Total	52,162	35,186	16,976	33
Subtotals:				
Ozark Plateaus	14,883	10,604	4,279	29
Coastal Plain	82,237	51,806	30,431	37
Basin Total	97,120	62,410	34,710	36

d. In the Coastal Plain area the base condition average annual flood losses amount to $35,785,000 from overflow of the main stems of the lower Black and White Rivers. Major reservoirs and local flood protection projects in the 10- to 15-year plan would reduce these losses by $7,321,000 and $10,218,000, respectively, for a total of $17,539,000 or a 49 percent reduction. Floodwater retarding structures would further reduce these losses along the main stems by about $1,150,000. Total losses prevented by all measures would be $18,689,000 which is about a 52 percent reduction. The remaining losses would occur on the riverside of leveed areas and on low areas in tributary bottoms which are affected by backwater from the main stem of the Black or White Rivers and which are not feasible to protect by levees or reservoirs.

e. In the Coastal Plain area about $46,000,000 of the average annual flood losses are found along tributary streams and are caused by runoff originating in the Coastal Plain. Very little of such runoff can be controlled by reservoirs although several floodwater retarding structures that would be located in the Crowley's Ridge area are in the 10- to 15-year plan and would effect some control. Most of the annual flood control benefits of $8,739,000 attributable to multiple-purpose channels are located along small tributaries in the Coastal Plain area.

49. DRAINAGE

a. There are an estimated 1,646,683 acres of cropland in the basin which are classified as having a wetness hazard. Of this total cropland acreage, 1,589,342 acres are in the Coastal Plain area and 57,341 acres are in the Ozark Plateaus area.

b. Planned channels would provide for the orderly disposal of excess rainfall and would reduce the amount of damage by providing sufficient channel capacity to confine the water to the channel for the designed level of protection. Adequate outlet ditches would also be provided for the extensive system of group and on-farm drainage ditches required in the area for more efficient agricultural water management.

c. Drainage investigations revealed that 3,511 miles of multiple-purpose flood control and agricultural water management channels should be included in the 10- to 15-year plan. Installation of these channels would provide average annual drainage benefits of $9,343,500 to 1,531,848 acres of cropland, or 93 percent of the cropland having a wetness hazard for agricultural production. Channels were planned to benefit only the cropland acreage and those areas which were not subject to frequent overbank flooding.

50. WATERSHED PROTECTION

a. There are about 8,898,000 acres of land throughout the basin not included in existing and authorized Public Law 566 projects that have lost much of their productive capacity due to improper management and exploitation. About 3,388,000 acres are cropland, 4,052,000 are grassland, 929,000 are forest land, 18,000 are recreation, and 511,000 are fish and wildlife habitat. The 10- to 15-year plan provides for proper treatment of this land to rebuild it to a productive state.

b. The primary effects of watershed protection measures are to reduce erosion, retard surface runoff and reduce peak flows from small areas, and improve the soil profile. The establishment of these conservation practices will not reduce the water yield measurably within the White River Basin.

c. Reducing erosion keeps the soil on-site, thus building deeper and more productive soil profiles. This prevents sediment from entering waterways and improves drainage conditions. It also helps keep streams clear which makes them better habitat for fish and more attractive for recreation. Deep soils contain more humus and are easier tilled than shallow soils. They also retard surface runoff and thus reduce peak flows from small areas, especially for small storms occurring when the soil is unsaturated.

d. Watershed protection measures on forest lands also benefit recreation by providing improved ground cover and forests for more aesthetically desirable sites and terrain. These measures improve wildlife habitat by providing increases in both food and cover.

e. Studies on many small watersheds show that the application of watershed protection measures increase total benefits resulting from Public Law 566 watershed protection and flood prevention programs by about 3 percent. These benefits were not used in the evaluation of projects in this report.

51. WATER AVAILABILITY

a. Available supplies of water in the White River Basin are adequate to satisfy all present and foreseeable future needs when considering the basin as a whole. There are some localized areas in the upstream portions of the basin where some cities or communities are now or will experience water shortages if facilities are not expanded. In most cases, the present shortages are due to inadequate facilities rather than an unavailable supply of water.

b. The 10- to 15-year plan would provide future water supply for the city of Springfield, Missouri, from the multiple-purpose County Line Dam and Reservoir on the upper James River. Also in this plan are 11 multiple-purpose projects in the Public Law 566 program and one single-purpose upstream project that would provide water supply for a like number of small towns and communities in the basin.

c. The major withdrawal use of water in the future will be for irrigation. In 1965, approximately 564,000 acres of land were irrigated with by far the largest majority of these acres being located in the Coastal Plain portion of the basin. It is expected that small tracts of land in the upland portions of the basin will be irrigated in the future. Generally these upland areas will be irrigated by sprinkler systems with water to be provided by 5 multiple-purpose upstream watershed projects that are in the 10- to 15-year plan.

d. A diminishing ground-water aquifer will make the planned diversion of White River water to the Grand Prairie area (a part of which is in the White River Basin) an economic necessity if the area is to continue to grow rice as it has in the past. The authorized Grand Prairie agricultural water supply project included a canal with a capacity of 2,200 c.f.s. from the White River at DeValls Bluff to project lands southwest of the point of diversion. The irrigation needs estimated for this study indicate that a diversion of 4,520 c.f.s.

will be required by 1980 in the DeValls Bluff reach of the White River with the major portion of this going to the Grand Prairie. When advance planning funds are made available for the authorized project, consideration will be given to these additional water requirements.

e. Additional irrigation will develop in the Coastal Plain area, but it is expected that development will be by individual or private cooperatives. Because of the available supply of water in the Black and White Rivers, these additional requirements will be met from these sources.

f. To determine the adequacy of the water supply available in the future, a supply-demand comparison was made. This comparison was limited to Coastal Plain reaches of the Black and White Rivers, as the County Line project and upstream watershed projects would meet the needs of the water shortage areas in the upland reaches. It has been assumed that the future available supply will be the flows with the existing and 10- to 15-year reservoir projects in operation. Demand is the total expected streamflow diversions for rural, municipal, and industrial water supply, irrigation, fish-farming, and other uses. For purposes of this supply-demand study, consumptive use, return flow, and re-use factors were not evaluated. The supply-demand comparison is shown in Table 30.

g. Except for the large diversion of irrigation water from the White River in the vicinity of DeValls Bluff, withdrawals from streamflow are minor when compared to low flow. It should be further noted that only a portion of withdrawals are actually consumptive use, and that usually a greater part of withdrawals return to the parent stream and can be re-used if necessary. In the White River Basin the principal re-use of water would be for generation of hydroelectric power or navigation on the lower White River. Total expected withdrawals above existing and planned hydroelectric plants in the basin are small. Actual streamflow depletion above these plants, due to consumptive use, would be insignificant. It is noted further that, except for the small amount of evaporation losses that might result from storage in a forebay reservoir, generation of power by pumped-storage projects is not a consumptive use of water.

h. The diversion at DeValls Bluff for irrigation would have a material effect on open channel navigation below that point. The supply-demand comparison indicates that from 7,000 to 8,000 c.f.s. would remain in the channel below the DeValls Bluff diversion. Only a portion of the water diverted at this point would return to the White River as it is expected that much of the return flow will enter tirbutaries

TABLE 30

WATER SUPPLY-DEMAND COMPARISON
(Flows in c.f.s. and m.g.d.)(1)

Period	Black River											
	Corning, Ark.						Black Rock, Ark.					
	Available supply		Demand		Flow in excess of demand		Available supply		Demand		Flow in excess of demand	
	c.f.s.	m.g.d.	c.f.s.	m.g.d.	c.f.s.	m.g.d.	c.f.s.	m.g.d.	c.f.s.	m.g.d.	c.f.s.	m.g.d.
1980	314	201	46	29	268	171	1,965	1,260	68	41	1,897	1,216
2000	314	201	64	41	250	160	1,947	1,248	90	58	1,857	1,190
2020	314	201	77	49	237	152	1,934	1,240	106	68	1,828	1,172
	White River											
	Newport, Ark.						DeValls Bluff, Ark.					
	Available supply		Demand		Flow in excess of demand		Available supply		Demand		Flow in excess of demand	
	c.f.s.	m.g.d.	c.f.s.	m.g.d.	c.f.s.	m.g.d.	c.f.s.	m.g.d.	c.f.s.	m.g.d.	c.f.s.	m.g.d.
1980	10,254	6,573	125	80	10,129	6,493	12,548	8,043	4,657	2,985	7,891	5,058
2000	10,166	6,517	157	100	10,009	6,416	12,428	7,967	4,780	3,064	7,648	4,902
2020	10,084	6,464	175	112	9,909	6,352	12,328	7,902	4,950	3,173	7,378	4,729

(1) Cubic feet per second and million gallons per day.

of the Arkansas River to the south of the Grand Prairie area. The 7,000 to 8,000 c.f.s. is insufficient flow, in this reach, to maintain a desirable navigable depth in the channel. This situation would not materially improve after the irrigation season, because at that time upstream hydroelectric power operations are reduced, thereby reducing outflow from the reservoirs. Flow in the lower White is then limited to these releases plus the runoff from the intervening drainage area below the reservoirs. Flows in the White River Basin are generally at their lowest during the late summer or early fall months.

i. If the reservoir projects included in the 10- to 15-year plan are constructed with proper utilization of ground water, return flows, and pollution control measures, sufficient water resources will be available to meet all foreseeable water supply needs to the year 2020.

52. WATER QUALITY CONTROL

a. The 10- to 15-year plan provides for reservoir storage for pollution abatement in two Federal projects in the upper basin -- the multiple-purpose County Line Reservoir of the Corps of Engineers on the James River and the multiple-purpose Soil Conservation Service reservoir in Watershed No. 3 of the West Fork of the White River. Supplemental and regulated flow releases from the County Line Reservoir would maintain uniform flows and also improve water quality by assimilating municipal and industrial effluents and pollution from other sources in the James River from the dam site east of Springfield, Missouri, to the headwaters of Table Rock Reservoir. The Soil Conservation Service reservoir would provide the same benefits in the reach of the White River from the Fayetteville, Arkansas, area to the headwaters of Beaver Reservoir.

b. The two projects will assure adequate flows in the receiving streams to properly assimilate treated waste discharges from the two largest cities and industrial areas of the basin. Higher dissolved oxygen levels will be maintained which are essential for the propogation of fish and wildlife. By providing reservoir releases during summer months when water quality control needs are most severe, sufficient flow of acceptable quality will be maintained in the streams to permit higher species of game fish to live in the area and to protect and enhance use of the streams and the headwaters of the reservoirs for sport fishing. Assured water quality will provide favorable conditions for general recreation use of the streams, particularly by those living in and near the two metropolitan areas. The riparian property owners and all other users of the stream will enjoy improved aesthetics, clean surface waters, and a satisfactory public health water environment.

c. Except in specific areas described in Appendix N where supplemental flows and other pollution-control measures have been proposed, waste discharges resulting from municipal and industrial development are not expected to be of the magnitude or type to measurably deteriorate stream quality. Even the low flows of the White River and its major tributaries are sufficient to assimilate all anticipated future waste discharges, adequately treated, without any significant quality degradation.

53. HYDROELECTRIC POWER

The amounts of hydroelectric power capacity that could be used in the Federal Power Commission Coordination Area K on the peak August load to effect a balanced system with other types of power generation, in addition to the capacity of existing and scheduled facilities, are 4,240,000 kilowatts by 1980, 14,240,000 kilowatts by 2000, and 29,640,000 kilowatts by 2020. The amounts of these capacities that could be in adjoining pumped-storage facilities were estimated to be 2,670,000, 6,920,000, and 13,540,000 kilowatts in 1980, 2000, and 2020, respectively. The 10- to 15-year plan provides for the installation of 265,000 kilowatts of conventional hydroelectric capacity and 500,000 kilowatts of pumped-storage capacity in the White River Basin. Some of the hydroelectric power needs may be met by conventional and pumped-storage projects in other river basins in Area K. The conventional hydroelectric power sites that could be developed to supply the estimated demand in Federal Power Commission Coordination Study Area K are far inadequate for meeting the needs. However, the extent to which this inadequacy can be supplied by the pumped-storage potential development has not been fully determined.

54. FISH AND WILDLIFE

a. The Corps of Engineers reservoir projects will satisfy the additional demand for warm water type fishing on large impoundments beyond the year 2020 in Arkansas and up to the year 2000 in the Missouri part of the basin. Additional local needs for fishing on small impoundments can be adequately satisfied in both Arkansas and Missouri throughout the period of analysis (2020) by the Soil Conservation Service, State, and private sector projects included in the 10- to 15-year plan. Trout-fishing opportunities will be increased sufficiently to satisfy demand up to the year 2000 as a result of habitat improvement and the anticipated increase in the trout-stocking program. Improved water-quality-control standards will enhance fishery-habitat conditions in many of the natural lakes and streams in the basin. Future demand for fishing on Ozark streams cannot be sufficiently satisfied beyond 1980 because of the limited supply and irreplaceable nature of this type of resource habitat. However, increased use of these streams for

fishing will be realized by expansion of the access system on these and other major streams in the basin, which is a part of the 10- to 15-year plan.

b. Future hunting demand can be satisfied only through intensive wildlife management, habitat improvement, and access to the public and privately owned lands. Public lands acquired in fee-title or by easements for other project and program purposes, and made available for hunting, could satisfy approximately 35 percent and 60 percent of the hunting needs anticipated by 1980 in Arkansas and Missouri, respectively. By 2000 the public lands are expected to furnish 17 percent of the total supply needed in Arkansas. Publicly owned lands in Missouri could satisfy 28 percent of the hunting demand by 2020. Land-use conversion and loss of high-quality wildlife habitat on private sector lands will reduce the capacity for wildlife production below the level required to satisfy the continued increase in hunting after the year 2000 in Arkansas, and the year 2020 in Missouri. Continued pressure exerted on the wildlife resources beyond these dates will result in lowering the quality of hunting.

c. Protection and preservation of unique and scenic environmental areas associated with the Ozark streams, National Forest lands, State wildlife management areas, and other developments included in the 10- to 15-year plan, will provide additional opportunities for bird-watching and wildlife photography throughout the basin. Conditions for protecting rare and endangered species and other unusual forms of wildlife will be greatly enhanced, and the continued importance of the intangible values will be safeguarded in future years.

d. Continued growth of commercial fish-farming operations and increased harvest of commercial fishery products from natural streams and lakes and impounded waters in the basin will provide considerable economic gain in future years. For example, if the estimated market requirements for 1980 are met, commercial fish-farming production would be valued at approximately $18 million, based on current prices. Additional economic importance will accrue from the increased harvest of commercial fishery products in other waters of the basin.

e. There would be losses in upland game-hunting opportunities resulting from loss of habitat that would be inundated by the projects if these losses are not mitigated. The loss would amount to about 6,300 man days on 25,900 acres inundated by the Corps of Engineers reservoirs and 5,500 man days on 21,501 acres inundated by the Soil Conservation Service small impoundments. Justifiable mitigation measures will be included in Corps of Engineers projects. In view of the fact that the land required for small impoundments will remain in private ownership, the Soil Conservation Service will encourage the owners to mitigate the losses attributable to the small impoundments.

55. RECREATION

a. Recreational projects and facilities in the Comprehensive Plan of Development are generally of two types -- those for aesthetic and physical enjoyment, and those of historical or cultural interest. For both of these types, the plan includes expansion or improvement of existing facilities and the development of new areas to meet the needs of the wilderness visitor and the vacationer, as well as the growing number of urban dwellers who seek relaxation close to home from the pressures of everyday life in a variety of outdoor activities.

b. The recreation features of the 10- to 15-year plan are estimated to supply about 8,255,500 recreation days. This is 87 percent of the 1980 needs for the four major outdoor recreation activities -- boating, swimming, camping, and picnicking. The needs satisfied by the establishment of free-flowing streams, scenic drives, scenic areas, hiking and saddle trails, and from recreational development by the private sector, are not included in this estimate.

c. The need for recreation facilities in the years after 1980 are expected to increase as the population and their incomes increase. A portion of this increased demand may be satisfied by expansion of both existing facilities and the facilities included in the 10- to 15-year plan.

d. The plan would meet a large part of the demand for recreational activities and enhance the area tourist industry. Implementation of the recreational parts of the plan would also enhance the basin land and water resources and encourage their continued use and appreciation.

SECTION X - ECONOMIC EVALUATION OF PROJECTS IN 10- TO 15-YEAR PLAN

55. GENERAL

a. The evaluation and justification of projects and programs included in the 10- to 15-year plan have been in accordance with authority, policy, and procedures of the agency that would be responsible for implementing the applicable features of the plan. Monetary evaluations of tangible costs and benefits have been made for main stem and major tributary reservoirs, local protection levee and channel improvement projects, and upstream watershed projects. However, intangibles were given full consideration in formulating these projects. Other features of the plan such as national scenic rivers; stream preservation; archeologic, historic, and natural science values; and other specific recreation and fish and wildlife proposals, have been evaluated on the basis of tangible and intangible values. It has been assumed that these projects and programs have benefits at least equal to their costs. The primary responsibility for development of these measures, except for the Fish and Wildlife Service and the United States Forest Service, is with the States, municipalities, and private sector, and they are responsible for the final decisions concerning economic justification. Economic evaluation of the land treatment program is not required by existing legislation.

b. The following standards were guidelines in the formulation of projects in the 10- to 15-year plan:

(1) The project must provide a practical and economic solution of fulfilling an existing or prospective need;

(2) Each project purpose considered must provide benefits at least equal to the cost of including that purpose in the plan;

(3) The total evaluated benefits to be obtained from the project must exceed total economic costs;

(4) There is no more economical means evaluated on a comparable basis of accomplishing the same purpose, which would be precluded from development if the project were undertaken;

(5) Where other considerations do not limit scale of development the project selected should provide for a maximum excess of benefits over costs; and

(6) The selected projects must be compatible with the overall comprehensive plan of development of the White River Basin.

56. COSTS

a. Project costs are the value of labor, goods, and services that would be required to implement, operate, and maintain a project. Market prices are assumed to be an adequate measure of the value of the labor, goods, and services.

b. Estimated investment costs involved in economic evaluation of projects include first costs, interest during construction, and the present value of facilities to be added at a future date. Cost estimates for Corps of Engineers projects were based on July 1967 price levels, and cost estimates for Soil Conservation Service projects and programs were based on 1965 average price levels. These estimates include all costs that would be incurred in the implementation of the projects such as for structures, appurtenant facilities, lands and rights-of-way, relocation and alterations, fish and wildlife mitigation measures where applicable, and other appropriate items.

c. Annual costs include interest and amortization on the investment costs, annual operation and maintenance costs, and the annual equivalent cost of major replacements. Interest and amortization for Corps of Engineers projects are based on an interest rate of 3-1/4 percent and a project economic life of 100 years. These items for Soil Conservation Service projects and programs are based on an interest rate of 3-1/8 percent and a 100-year period. The 3-1/4 percent interest rate change occurred too late to be reflected in Soil Conservation Service project costs included in the plan. If the projects and programs are authorized for implementation, applicable interest rates will be used in connection with preconstruction planning. In those instances where the estimated annual net profit from land production was larger than the annual equivalent of the purchase price of lands, the excess was used as an economic cost. This will be referred to as a "loss of production" cost.

57. EVALUATED BENEFITS

a. Types of benefits. The ultimate aim of resource projects and programs, in common with all other productive activity, is to satisfy human needs and desires. Goods and services are produced to achieve this end. These goods and services have value in accordance with the demand for them and their availability. There are two general categories of benefits, primary and secondary. Primary benefits are the increases in the value of goods or services directly resulting from a project, less all associated non-project costs incurred in their realization. Primary benefits are evaluated at the earliest stage for which estimated market prices are considered applicable. Secondary benefits are the increases in net income in activities stemming from or induced by the project. Secondary benefits were not evaluated in connection with Corps of Engineers projects. Area Redevelopment benefits, stemming from wages and salaries generated locally from construction, operation,

and maintenance of projects in areas classified as having persistent unemployment or underdevelopment by the Economic Development Administration, were considered only to show how they would improve the economic justification.

b. Evaluation period. Benefits which would accrue to the 10- to 15-year projects have been estimated on the basis of a useful and economic life of 100 years. Benefits expected to accrue from developments in the area at varying times in the future were reduced to an average annual equivalent value by compound interest methods. The Corps of Engineers and Soil Conservation Service used interest rates of 3-1/4 percent and 3-1/8 percent, respectively.

c. Flood control and prevention.

(1) Flood control and prevention benefits that are expected to result from the main stem and major tributary reservoirs and the upstream impoundments, consist of flood losses that would be prevented on present and future developments and increased utilization benefits.

(2) Flood losses prevented were computed as the difference between losses with the base condition projects functioning and losses with the reservoirs or impoundment projects in the 10- to 15-year plan functioning together with the base condition projects. These losses prevented were based on a system analysis of all the reservoirs and impoundments in the 10- to 15-year plan that have flood control as a purpose. Each of these projects received its proportionate share of system benefits in areas of common influence. System benefits were distributed on the basis of each project being considered in first position in the system.

(3) Increased utilization benefits result from changed or intensified use of the flood plain lands. Because most of the land in the flood plains of White River and its major tributaries is already cleared and developed, or will be cleared and developed without additional flood protection, no increased utilization benefits have been credited to Corps of Engineers projects.

(4) Adjusted normalized prices were used in estimating flood control and prevention benefits.

d. Drainage. Drainage benefits were estimated on the basis of increased yields on present cropland resulting from removal of wetness hazards and the net income from these yields based on adjusted normalized prices. It was assumed that there would be no increase in allotted or price-supported crop acreage, total crop acreage, or changed land use. The benefits were discounted by 25 percent to allow for expected incomplete participation in the installation of on-farm drainage systems. They were further discounted 20 percent to allow

for ineffective maintenance of on-farm drainage systems. The benefits thus obtained were credited to drainage and flood prevention on a 50-50 basis.

e. Municipal and industrial water supply. Municipal and industrial water supply benefits were determined on the basis of the cost of obtaining water of equal quality and quantity from the cheapest alternative source.

f. Water quality control.

(1) Water quality control benefits for the one Corps of Engineers project in the 10- to 15-year plan with storage for that purpose were determined on the basis of the least costly alternative. The least costly alternative for this project was advance waste treatment facilities.

(2) The water quality control benefits for the one Soil Conservation Service project in the 10- to 15-year plan were computed by the alternative cost method using a dual-purpose flood detention and storage project as the least costly alternative.

g. Hydroelectric power. Hydroelectric power benefits were based on annual capacity and energy values furnished by the Federal Power Commission. These values are based on the alternative costs of producing fuel electric power by means of an investor-owned-and-financed, large, efficient thermal plant and federally financed transmission facilities.

h. Irrigation. Irrigation benefits are based on the increase in net income of agricultural production that would result from an increase in soil moisture content through the application of water. No increase in allotted crop acreages was used, and impacts outside the immediate irrigated area were not evaluated.

i. Recreation. Recreation benefits were based on the estimated annual use in recreation days expected at each project and an estimated value per recreation day. This value was determined on the basis of the project location with respect to population centers, location of alternative recreation areas, the quality of facilities to be provided at each project, and other factors. The value ranges from $0.50 to $1.25 which is within the range of values presented in Supplement 1 to Senate Document No. 97.

j. Fish and wildlife. Fish and wildlife benefits were based on the annual man days of use expected at each project and an estimated value per day. The estimated number of fisherman days is expected to increase after the initial installation at some projects and remain constant at others. The estimated value per day ranges from $0.50 to $4.00 depending on the type fishery, the lower values being for small

privately controlled impoundments and the higher values for tailwater trout fishery downstream from some of the larger reservoirs. These values are within the range of those presented in Supplement 1 to Senate Document No. 97. Hunting benefits which would accrue to projects were judged to be incidental and therefore were not used in project economic analysis.

k. Navigation. This report does not include an estimate of the benefits that would accrue from making the lower White River navigable. However, the navigation benefits used in screening studies were the savings to shippers who would use the waterway. These studies indicate that substantial benefits would result from a navigation project on the White River. However, further study, which has been authorized, will be necessary to firmly establish the economics of this feature of the 10- to 15-year plan.

58. SUMMARY OF COSTS AND BENEFITS

a. A summary of first costs, annual costs, and average annual benefits for Corps of Engineers reservoir and levee and channel improvement projects is given in Table 31 and Table 32, respectively. Costs and benefits data for the Soil Conservation Service upstream watershed projects are given in Table 33. Costs of watershed land treatment measures are shown on Table 26.

b. The cost of the stream preservation program in the State of Missouri is given in Table 34. The Federal costs shown are for portions of streams within National Forest boundaries. The cost of these programs in the State of Arkansas and the private sector programs has not been estimated. As stated previously, the primary responsibility for development of such measures is with the States, municipalities, and private sector.

TABLE 31

ESTIMATED COSTS AND BENEFITS
CORPS OF ENGINEERS MAIN STEM AND MAJOR TRIBUTARY RESERVOIR PROJECTS
(In thousands of dollars)

Item	County Line	Wolf Bayou	Myatt Creek	Wild Horse	Bell Foley	Quarry	Norfork Units 3 & 4
First cost of construction	$15,800	$123,000	$8,480	$18,700	$24,100	$4,200	$12,900
Interest duting const (1)	770	13,991	414	1,215	1,175	136	600
Present value of future recreation facilities (2)	167	228	18	98	124	64	-
Investment cost	16,737	137,219	8,912	20,013	25,399	4,400	13,500
Annual cost							
Interest & amortization (3)	567	4,649	302	678	860	149	458
Operation & maintenance (4)	117	447	55	108	147	30	80
Major replacements	1	116	1	4	6	-	33
Total	685	5,212	358	790	1,013	179	571
Average annual benefits							
Flood control	128	2,557	851	1,700	2,355	-	-
Recreation	1,090	1,830	210	660	1,280	72	-
Fish & wildlife enhancement	143	278	28	106	151	120	-
Power	-	3,852	-	-	-	-	1,411
Water supply	426	-	-	-	-	-	-
Water quality control	282	-	-	-	-	-	-
Total	2,069	8,517	1,089	2,466	3,786	192	1,411

(1) Based on 3-1/4 percent of first cost for 1/2 the estimated construction period.
(2) It is estimated that additional facilities to accomodate increased future recreational use will be developed uniformly over the first 20 years of project life.
(3) 100-year economic life and 3-1/4 percent interest rate.
(4) Includes present value of operation and maintenance for future recreational facilities.

TABLE 32

ESTIMATED COSTS AND BENEFITS

CORPS OF ENGINEERS LEVEE AND CHANNEL IMPROVEMENT PROJECTS

(In thousands of dollars)

Projects	Investment Cost (1)			Annual Cost						Average annual benefit
				Federal	Non-Federal					
	Federal	Non-Federal	Total	Total (2)	Interest & amortization	Operation & maintenance		Total	Total annual cost	
Black River-Cane Creek, Butler Co., Mo., and Clay Co., Ark.	$7,640	$2,730	$10,370	$280	$92	$6		$98	$378	$1,746
Little Black River, Butler and Ripley Cos., Mo., and Clay and Randolph Cos., Ark.	2,200	300	2,500	82	10	2		12	94	725
Current-Little Black Rivers, Ripley Co., Mo., and Clay Co., Ark.	1,210	220	1,430	46	7	2		9	55	444
Black-Current-Fourche Rivers, Randolph Co., Ark.	2,000	480	2,480	78	16	3		19	97	1,300
Flat Creek, Lawrence Co., Ark.	1,020	250	1,270	40	8	2		10	50	470
Clover Bend, Lawrence, Jackson, and Independence Cos., Ark.	2,950	1,140	4,090	111	39	6		45	156	1,390
Black-Strawberry Rivers, Lawrence and Independence Cos., Ark.	1,800	420	2,220	66	14	2		16	82	583
Curia Creek, Independence Co., Ark.	3,160	230	3,390	114	8	2		10	124	1,680
Oil Trough to Hurricane Lake, Independence Jackson, and White Cos., Ark.	5,870	1,070	6,940	214	36	7		43	257	400
Jacksonport, Jackson Co., Ark.	970	140	1,110	35	5	2		7	42	47
Taylor Bay to Augusta, Woodruff Co., Ark.	3,350	250	3,600	119	9	(3)14		23	142	608
Little Red-White Rivers, White and Prairie Cos., Ark.	4,370	660	5,030	159	22	3		25	184	710
Bayou Des Arc, White and Prairie Cos., Ark.	2,900	360	3,260	98	12	4		16	114	124

(1) Includes interest during construction on projects with estimated construction periods longer than 2 year

(2) Includes interest and amortization of investment cost and estimated annual cost of emergency levee repai authorized by Public Law 99, 84th Congress, approved 28 June 1955.

(3) Includes $2,500 for major replacement.

AD-A043 948 WHITE RIVER BASIN COORDINATING COMMITTEE F/G 8/6
COMPREHENSIVE BASIN STUDY. WHITE RIVER BASIN, ARKANSAS AND MISS--ETC(U)
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TABLE 33

ESTIMATED COSTS AND BENEFITS
SOIL CONSERVATION SERVICE UPSTREAM WATERSHED PROJECTS

Watershed No.	Structural Measures and Purpose	Project Installation Costs 1/			Annual Costs			Annual Benefits (Dollar)	Benefit-Cost Ratio
		Federal	Non-Federal	Total	Amortiza'n of Installation Costs	Operation and Maintenance Costs	Total Annual Costs		
		(Dollar)							
1	30 FWR, 1 FWR&M-I	5,866,200	367,500	6,233,700	204,200	3,900	208,100	264,000	1.3:1
3	11 FWR, 1 FWR&W., 2 FWR&M-I	4,196,100	428,500	4,624,600	151,500	3,400	154,900	170,700	1.1:1
4	13 FWR, 1 FWR&I	2,036,400	122,000	2,158,400	70,700	2,400	73,100	136,700	1.9:1
6	21 FWR, 1 FWR&M-I	5,116,400	447,400	5,563,800	182,300	2,800	185,100	228,200	1.2:1
8	13 FWR, 1 FWR&F.W.	3,359,000	255,500	3,614,500	118,300	3,600	121,900	174,400	1.4:1
9	1 M-I	-	372,500	372,500	12,200	1,000	13,200	18,800	1.4:1
10	5 FWR	644,000	12,100	656,100	21,500	900	22,400	29,600	1.3:1
11	5 FWR, 1 FWR&M-I	1,649,700	219,700	1,869,400	61,200	1,200	62,400	95,500	1.5:1
15	31 FWR	3,805,200	265,600	4,070,800	133,400	5,700	139,100	172,500	1.2:1
16	8 FWR	1,698,700	118,100	1,816,800	59,500	1,600	61,100	80,600	1.3:1
18	2 FWR	323,400	9,200	332,600	10,900	400	11,300	17,900	1.6:1
19	8 FWR, 1 FWR&M-I	2,514,200	214,600	2,728,800	89,300	2,500	91,800	94,900	1.0:1
20	10 FWR	2,223,200	77,700	2,300,900	75,400	2,000	77,400	76,300	1.0:1
22	1 R	763,300	-	763,300	25,000	500	25,500	25,500	1.0:1
27	1 FWR	82,600	3,300	85,900	2,800	200	3,000	5,800	1.9:1
32	12 FWR	2,574,700	122,900	2,697,600	88,400	2,400	90,800	96,100	1.1:1
33	6 FWR, 1 FWR&M-I	1,507,000	237,300	1,744,300	57,100	1,800	58,900	102,600	1.7:1
35	1 R	774,500	-	774,500	25,400	500	25,900	25,900	1.0:1
36	1 R	141,700	-	141,700	4,600	200	4,800	4,800	1.0:1
40	22 FWR	2,639,200	106,400	2,745,600	90,000	4,400	94,400	134,200	1.4:1
44	15 FWR, 1 FWR&M-I, 1 FWR&F.W., 1 FWR&R, 7 Mi. CI 2/	2,393,950	430,050	2,824,000	92,600	7,300	99,900	248,500	2.5:1
45	10 FWR	929,600	47,600	977,200	32,000	1,800	33,800	67,900	2.0:1
47	2 R	1,518,700	-	1,518,700	49,800	1,000	50,800	50,800	1.0:1
48	1 R	695,600	-	695,600	22,800	500	23,300	23,300	1.0:1
51	47 FWR, 1 FWR&R	6,226,400	297,200	6,523,600	213,700	9,600	223,300	1,184,600	5.3:1
52	161 Mi. CI	1,537,500	1,241,800	2,779,300	91,000	65,700	156,700	685,200	4.4:1
53	31 FWR, 2 FWR&R, 190 Mi. CI	7,069,550	1,631,350	8,700,900	285,000	135,700	420,700	1,034,100	2.5:1
55	165 Mi. CI	1,690,900	926,600	2,617,500	85,700	73,800	159,500	705,800	4.4:1
56	7 FWR	2,618,000	163,500	2,781,500	91,100	20,000	111,100	402,500	3.6:1
57	3 R	2,458,800	-	2,458,800	80,600	1,500	82,100	82,100	1.0:1
58	5 FWR	481,600	41,500	523,100	17,200	1,000	18,200	54,400	3.0:1
59	9 FWR	1,799,000	105,200	1,904,200	62,400	1,800	64,200	176,400	2.7:1
62	25 FWR	2,186,800	124,300	2,311,100	75,700	3,900	79,600	204,200	2.6:1
63	10 FWR	2,648,800	105,900	2,754,700	90,200	2,600	92,800	264,000	2.8:1
64	8 FWR	956,200	47,800	1,004,000	32,900	1,700	34,600	96,100	2.8:1
66	38 Mi. CI	480,400	242,600	723,000	23,700	20,900	44,600	248,100	5.6:1
68	41 Mi. CI	183,400	107,600	291,000	9,500	8,100	17,600	38,600	2.2:1
70	36 FWR, 1 FWR&R	4,608,400	409,300	5,017,700	164,400	7,800	172,200	457,000	2.7:1
71	23 FWR	3,175,200	208,900	3,384,100	110,900	4,500	115,400	194,900	1.7:1
72	25 FWR, 1 FWR&R	4,269,300	341,500	4,610,800	151,100	6,300	157,400	264,300	1.7:1
73	35 FWR, 2 FWR&R	6,839,200	623,600	7,462,800	244,500	8,900	253,400	469,500	1.9:1
74	32 FWR, 1 FWR&R	3,269,800	262,700	3,528,500	115,600	6,200	121,800	324,200	2.7:1
75	15 FWR, 1 FWR&R	1,341,600	108,900	1,450,500	47,500	3,200	50,700	167,100	3.4:1
77	22 FWR, 1 FWR&R, 1 R	3,693,400	267,700	3,961,100	129,800	5,000	134,800	276,900	2.1:1
78	25 FWR, 1 FWR&R 3/	3,736,000	235,700	3,971,700	130,100	5,100	135,200	253,000	1.9:1
79	6 FWR 3/	814,800	39,800	854,600	28,000	1,200	29,200	38,600	1.3:1
81	1 FWR	146,100	40,800	186,900	6,100	200	6,300	20,000	3.1:1
82	25 Mi. CI	231,100	100,700	331,800	10,900	10,000	20,900	84,900	4.1:1
83	28 FWR, 1 FWR&R	4,246,600	476,900	4,723,500	154,800	6,400	161,200	231,200	1.4:1
84	20 FWR	2,252,600	178,900	2,431,500	79,700	3,600	83,300	97,400	1.2:1
85	1 FWR	280,000	13,100	293,100	9,600	200	9,800	22,600	2.3:1
88	121 Mi. CI	1,371,200	868,400	2,239,600	73,400	59,800	133,200	977,400	7.3:1
89	43 Mi. CI	526,700	347,500	874,200	28,600	22,900	51,500	267,500	5.2:1
90	74 Mi. CI	736,400	487,500	1,223,900	40,100	32,100	72,200	514,100	7.1:1
91	73 Mi. CI	676,800	384,300	1,061,100	34,800	29,500	64,300	668,700	10.4:1
92	15 FWR, 1 FWR&M-I, 2 FWR&I, 68 Mi. CI	5,215,300	1,293,600	6,508,900	213,200	81,500	294,700	531,200	1.8:1
94	22 FWR, 1 FWR&M-I, 2 FWR&I, 1 FWR&R	7,760,100	629,100	8,389,200	274,800	7,000	281,800	276,800	1.0:1
100	14 FWR, 1 FWR&R	6,978,100	405,300	7,383,400	241,900	3,100	245,000	211,800	0.9:1
101	12 FWR, 1 FWR&M-I, 1 FWR&R	2,610,600	281,700	2,892,300	94,800	4,400	99,200	247,200	2.5:1
102	2 FWR, 16 Mi. CI	819,300	196,100	1,015,400	33,300	14,400	47,700	185,400	3.9:1
103	4 FWR, 90 Mi. CI	2,576,300	1,316,600	3,892,900	175,500	93,000	268,500	400,400	1.5:1
104	17 FWR, 1 FWR&R, 46 Mi. CI	4,137,100	796,000	4,933,100	185,700	36,900	222,600	272,200	1.2:1

TABLE 33 (con.)

Watershed No.	Structural Measures and Purpose	Project Installation Costs 1/			Annual Costs			Annual Benefits (Dollar)	Benefit-Cost Ratio
		Federal	Non-Federal	Total	Amortiza'n of Installation Costs	Operation and Maintenance Costs	Total Annual Cost		
		(Dollar)							
105	7 FWR, 55 Mi. CI	2,437,100	683,100	3,120,200	135,700	42,700	178,400	233,200	1.3:1
106	36 Mi. CI	447,000	287,500	734,500	24,100	19,500	43,600	57,400	1.3:1
108	15 Mi. CI	228,000	171,700	399,700	13,100	9,900	23,000	78,100	3.4:1
109	44 FWR, 179 Mi. CI	4,171,000	1,433,000	5,604,000	299,600	131,600	431,200	799,600	1.9:1
110	33 FWR, 183 Mi. CI	3,674,000	1,398,300	5,072,300	233,600	124,800	358,400	590,600	1.6:1
111	9 FWR, 140 Mi. CI	2,170,200	895,100	3,065,300	173,400	105,600	279,000	881,100	3.2:1
112	152 Mi. CI	1,700,400	843,100	2,543,500	160,400	91,300	251,700	985,800	3.9:1
113	166 Mi. CI	1,742,300	891,800	2,634,100	143,600	88,700	232,300	666,000	2.9:1
114	32 Mi. CI	442,900	204,900	647,800	30,300	21,300	51,600	108,000	2.1:1
115	138 Mi. CI	1,285,700	705,300	1,991,000	135,400	70,800	206,200	546,300	2.6:1
118	116 Mi. CI	1,537,200	885,600	2,422,800	195,800	92,800	288,600	1,522,100	5.3:1
119	189 Mi. CI	2,586,200	1,449,800	4,036,000	224,900	133,300	358,200	1,062,200	3.0:1
120	40 Mi. CI	615,600	298,600	914,200	42,900	29,700	72,600	151,600	2.1:1
121	18 Mi. CI	199,000	117,700	316,700	15,500	9,800	25,300	49,500	2.0:1
122	54 Mi. CI	920,000	473,000	1,393,000	45,600	40,000	85,600	236,200	2.8:1
123	35 Mi. CI	507,700	240,300	748,000	24,500	22,100	46,600	202,200	4.3:1
124	110 Mi. CI	1,460,100	768,800	2,228,900	260,900	57,300	318,200	893,400	2.8:1
125	211 Mi. CI	2,723,100	1,294,600	4,017,700	377,100	79,200	456,300	1,685,500	3.7:1
127	133 Mi. CI	1,452,900	694,600	2,147,500	140,000	35,800	175,800	585,000	3.3:1
128	124 Mi. CI	1,253,900	646,800	1,900,700	151,100	40,200	191,300	672,900	3.5:1
130	49 Mi. CI	1,036,300	565,000	1,601,300	52,500	45,000	97,500	465,400	4.8:1
132	106 Mi. CI	4,253,300	2,179,700	6,433,000	210,700	184,700	395,400	1,773,400	4.5:1
133	55 Mi. CI	1,413,800	796,100	2,209,900	72,400	61,400	133,800	871,100	6.5:1
B	23 Mi. CI	400,400	270,400	670,800	32,200	19,700	51,900	52,500	1.0:1
TOTAL		188,756,800	37,402,700	226,159,500	8,814,000	2,408,700	11,222,700	30,145,000	2.7:1

LEGEND:
FWR - Floodwater Retarding
M-I - Municipal & Industrial Water Supply
R - Recreation
F.W. - Fish & Wildlife
WQ - Water Quality Control
I - Irrigation
CI - Channel Improvement

1/Price Base - 1965.

2/Six miles of channel improvement for flood prevention only.
One mile of multipurpose channel.

3/To be considered if Water Valley Dam is eliminated.

Table 34

COST OF STREAM PRESERVATION PROGRAMS
IN MISSOURI

Project	Installation Cost	
	Federal	Non-Federal
James River	-	$211,200
Upper Black River	-	253,500
Bryant Creek	-	271,500
Bull Creek	-	76,800
Swan Creek	-	99,450
Beaver Creek	$590,000	-
Little North Fork River	320,000	70,000
North Fork River	480,000	59,050
Roaring River	80,000	-
Total	1,470,000	1,041,000

c. Acquisition of 373,000 acres of additional land within the National Forests is estimated to cost $37,300,000. This includes the $1,470,000 shown in Table 34 above as a part of the cost of stream preservation.

d. The cost of facilities required for development of the National Recreation Area are estimated at about $6,000,000. In addition, paved access roads required would cost about $50,000 per mile. Detailed studies necessary to establish definite site plans would cost about $150,000.

e. Land acquisition for the Buffalo National River will cost approximately $9,200,000, and development of the area for optimum use as presently proposed by the National Park Service would cost about $8,100,000.

f. Costs and benefits for a pumped-storage hydroelectric project at the Optimus site and navigation on the White River from the mouth to Newport, Arkansas, were not determined for this report because of insufficient funds to make the required detailed analysis. Preliminary evaluations of both projects indicated a need for them and probable justification. For this reason, and also as a basis for planning other features of the basin plan, they were included in the 10- to 15-year plan.

g. Both of these projects will require separate studies to verify their economic justification. A resolution of the U. S. Senate Public Works Committee adopted May 25, 1967, authorized a separate study for the lower White River from its mouth to Batesville, Arkansas. The estimated cost of the study is $250,000. No separate study for the pumped-storage hydroelectric project has been authorized at this time. A preliminary estimate of the study cost is $200,000.

59. ECONOMIC JUSTIFICATION

A summary of data relating to economic justification of Soil Conservation Service projects is presented in Table 33. Data relating to the economic justification of the Corps of Engineers reservoir projects and levee and channel improvement projects are presented in Table 35 and Table 36, respectively.

TABLE 35

PROJECT EVALUATION
CORPS OF ENGINEERS MAIN STEM AND MAJOR TRIBUTARY RESERVOIR PROJECTS
(In thousands of dollars)

Project	Annual Cost			Average Annual Benefits			Benefit-Cost Ratio	
	Financial	Loss of production	Economic	Without area redevelopment	Area redevelopment	With area redevelopment	Without area redevelopment	With area redevelopment
County Line, Mo.	$685	$63	$748	$2,069	$67	$2,136	2.8	2.9
Wolf Bayou, Ark.	5,212	149	5,361	8,517	509	9,026	1.6	1.7
Myatt Creek, Ark.	358	22	380	1,089	37	1,126	2.9	3.0
Wild Horse, Ark.	790	53	843	2,466	81	2,547	2.9	3.0
Bell Foley, Ark.	1,013	77	1,090	3,786	104	3,890	3.5	3.6
Quarry, Arkansas	179	13	192	192	20	212	1.0	1.1
Norfork Units 3 & 4, Arkansas	571	0	571	1,411	41	1,452	2.5	2.5

TABLE 36

PROJECT EVALUATION
CORPS OF ENGINEERS LEVEE AND CHANNEL IMPROVEMENT PROJECTS
(In thousands of dollars)

Project	Annual Cost			Average Annual Benefits			Benefit-Cost Ratio	
	Financial	Loss of production	Economic	Without area redevelopment	Area redevelopment	With area redevelopment	Without area redevelopment	With area redevelopm
Black River-Cane Creek, Butler Co., Mo., and Clay Co., Ark.	$378	$15	$393	$1,746	$0	$1,746	4.4	-
Little Black River, Butler and Ripley Cos., Mo., and Clay and Randolph Cos., Ark.	94	5	99	725	10	735	7.3	7.4
Current-Little Black Rivers, Ripley Co., Mo., and Clay Co., Ark.	55	3	58	444	5	449	7.7	7.8
Black-Current-Fourche Rivers, Randolph Co., Ark.	97	9	106	1,300	9	1,309	12.2	12.3
Flat Creek, Lawrence Co., Ark.	50	2	52	470	6	476	9.0	9.2
Clover Bend, Lawrence, Jackson, and Independence Cos., Ark.	156	6	162	1,390	15	1,405	8.6	8.7
Black-Strawberry Rivers, Lawrence and Independence Cos., Ark.	82	5	87	583	9	592	6.7	6.8
Curia Creek, Independence Co., Ark.	124	4	128	1,680	13	1,693	13.1	13.2
Oil Trough to Hurricane Lake, Independence, Jackson, and White Cos., Ark.	257	14	271	400	22	422	1.5	1.6
Jacksonport, Jackson Co., Ark.	42	1	43	47	4	51	1.1	1.2
Taylor Bay to Augusta, Woodruff Co., Ark.	142	2	144	608	11	619	4.2	4.3
Little Red-White Rivers, White and Prairie Cos., Ark.	184	11	195	710	20	730	3.6	3.7
Bayou Des Arc, White and Prairie Cos., Ark.	114	0	114	124	17	141	1.1	1.2

60. ALLOCATION OF COST AMONG PURPOSES

a. Corps of Engineers projects. The cost of the multiple-purpose reservoirs in the 10- to 15-year plan has been allocated to the purposes applicable to each project by the Separable Cost-Remaining Benefits Methods. This method assures that each purpose shares equitably in the savings of multiple-purpose development and meets the criteria that costs allocated to any purpose do not exceed corresponding benefits; each purpose is assigned its separable cost as a minimum; and separable costs are less than alternative costs. The average annual benefits used in the allocation were exclusive of Area Redevelopment benefits. The least costly alternative for flood control and water supply was an at-site reservoir project. A federally financed steam-electric power development was found to be the least costly alternative for two additional hydroelectric units at the existing Norfork multiple-purpose project and the hydroelectric units in the Wolf Bayou project. Advance waste treatment was the least costly alternative for water quality control storage at the County Line project. An alternative project to serve both recreation and fish and wildlife enhancement was used in the cost allocation studies instead of a separate project for each purpose. Cost allocation data for Corps of Engineers reservoir projects are presented in Table 37.

b. Soil Conservation Service. The cost of multiple-purpose reservoir structures was allocated in such a manner that each purpose would share equitably in the savings resulting from combining two or more purposes in such measures. The Use of Facilities Method was used for this purpose, as it embodies the principle of distributing joint costs in proportion to the storage capacity used for each purpose. Multiple-purpose channel costs were allocated equally to flood protection and drainage. Cost allocation data for Soil Conservation Service projects are presented in Table 38.

c. Use of data. The cost allocation data presented are preliminary and were determined to show the general magnitude of the cost of each project purpose. Cost allocation will be reviewed and brought up to date as appropriate.

61. APPORTIONMENT OF COSTS

a. General.

(1) Costs allocated to the purposes served by a project or program are the basis for cost apportionment. Cost apportionment or cost sharing provides an indication of how much the beneficiaries of the purposes will ultimately pay for particular features of the plan.

TABLE 37

COST ALLOCATION
CORPS OF ENGINEERS MAIN STEM AND MAJOR TRIBUTARY RESERVOIR PROJECTS
(In thousands of dollars)

Item	COUNTY LINE					WOLF BAYOU			
	Flood Control	Water Supply	Recreation: Fish and Wildlife	Water Quality Control	Total	Flood Control	Recreation: Fish and Wildlife	Power	Total
Annual benefits	128	426	1,233	282	2,069	2,557	2,108	3,852	8,517
Annual cost:									
Total	76	181	306	122	685	1,561	1,458	2,193	5,212
Separable	42	18	105	15	180	1,077	277	1,959	3,313
Alternative	443	426	607	282	1,758	1,828	2,171	2,322	6,321
Investment cost (1)	1,505	4,900	7,085	3,247	16,737	43,506	36,187	57,526	137,219
Percent	9.0	29.1	42.7	19.2	100.0	31.7	26.4	41.9	100.0
Operation, maintenance and replacement cost	25	15	66	12	118	87	232	244	563
Percent	21.2	12.7	55.9	10.2	100.0	15.5	41.2	43.3	100.0

Item	MYATT CREEK			WILD HORSE			BELL FOLEY		
	Flood Control	Recreation: Fish and Wildlife	Total	Flood Control	Recreation: Fish and Wildlife	Total	Flood Control	Recreation: Fish and Wildlife	Total
Annual benefits	851	238	1,089	1,700	766	2,466	2,355	1,431	3,786
Annual cost:									
Total	197	161	358	398	392	790	444	569	1,013
Separable	80	66	146	226	220	446	157	283	440
Alternative	292	278	570	570	564	1,134	730	856	1,586
Investment Cost (1)	5,105	3,807	8,912	10,420	9,593	20,013	11,341	14,058	25,399
Percent	57.3	42.7	100.0	52.1	47.9	100.0	44.7	55.3	100.0
Operation, maintenance and replacement cost	24	32	56	45	67	112	60	93	153
Percent	42.9	57.1	100.0	39.8	60.2	100.0	39.2	60.8	100.0

(1) Includes interest during construction and present value of future recreation facilities.

TABLE 38
COST ALLOCATION BY PURPOSES
SOIL CONSERVATION SERVICE UPSTREAM WATERSHED PROJECTS

Watershed Number	Total Structural Measures	Single Purpose				Multiple Purpose							
		Flood Prevention	Recreation	Municipal & Industrial	Total	Flood Prevention	Recreation	Recreation & Fish & Wildlife	Water Quality Control	Municipal & Industrial	Drainage	Irrigation	Total
		(Dollars)											
1	6,233,660	5,672,160	-	-	5,672,160	503,990	-	-	-	57,510	-	-	561,500
2	No Struct.												
3	4,624,600	2,147,600	-	-	2,147,600	1,343,710	-	-	997,790	135,500	-	-	2,477,000
4	2,158,450	1,536,450	-	-	1,536,450	531,150	-	-	-	-	-	90,850	622,000
5	No Struct.												
6	5,563,800	4,903,850	-	-	4,903,850	462,900	-	-	-	197,050	-	-	659,950
7	No Struct.												
8	3,614,500	2,413,500	-	-	2,413,500	734,700	-	466,300	-	-	-	-	1,201,000
9	372,500	-	-	372,500	372,500	-	-	-	-	-	-	-	-
10	656,100	656,100	-	-	656,100	-	-	-	-	-	-	-	-
11	1,869,400	1,693,240	-	-	1,693,240	125,970	-	-	-	50,190	-	-	176,160
12	Long-range												
13	No Struct.												
14	Long-range												
15	4,070,800	4,070,800	-	-	4,070,800	-	-	-	-	-	-	-	-
16	1,816,800	1,816,800	-	-	1,816,800	-	-	-	-	-	-	-	-
17	No Struct.												
18	332,600	332,600	-	-	332,600	-	-	-	-	-	-	-	-
19	2,728,800	1,769,800	-	-	1,769,800	851,600	-	-	-	107,400	-	-	959,000
20	2,300,900	2,300,900	-	-	2,300,900	-	-	-	-	-	-	-	-
21	No Struct.												
22	763,300	-	763,300	-	763,300	-	-	-	-	-	-	-	-
23	Long-range												
24	No Struct.												
25	No Struct.												
26	Long-range												
27	85,900	85,900	-	-	85,900	-	-	-	-	-	-	-	-
28	PL-566												
29	Long-range												
30	No Struct.												
31	No Struct.												
32	2,697,580	2,697,580	-	-	2,697,580	-	-	-	-	-	-	-	-
33	1,744,350	1,096,050	-	-	1,096,050	510,290	-	-	-	138,010	-	-	648,300
34	No Struct.												
35	774,500	-	774,500	-	774,500	-	-	-	-	-	-	-	-
36	141,700	-	141,700	-	141,700	-	-	-	-	-	-	-	-
37	Long-range												
38	Long-range												
39	Long-range												
40	2,745,560	2,745,560	-	-	2,745,560	-	-	-	-	-	-	-	-
41	Long-range												
42	No Struct.												
43	No Struct.												
44	2,823,950	1,470,850	-	-	1,470,850	776,930	301,000	236,600	-	36,800	1,770	-	1,353,100
45	977,200	977,200	-	-	977,200	-	-	-	-	-	-	-	-
46	PL-566												
47	1,518,700	-	1,518,700	-	1,518,700	-	-	-	-	-	-	-	-
48	695,600	-	695,600	-	695,600	-	-	-	-	-	-	-	-
49	Long-range												
50	Long-range												
51	6,523,600	5,169,200	-	-	5,169,200	564,400	790,000	-	-	-	-	-	1,354,400
52	2,779,300	-	-	-	-	1,525,400	-	-	-	-	1,253,900	-	2,779,300
53	8,700,900	3,538,700	-	-	3,538,700	3,208,800	381,700	-	-	-	1,571,700	-	5,162,200
54	No Struct.												

TABLE 38 (con.)

Watershed Number	Total Structural Measures	Single Purpose				Multiple Purpose							
		Flood Prevention	Recreation	Municipal & Industrial	Total	Flood Prevention	Recreation	Recreation & Fish & Wildlife	Water Quality Control	Municipal & Industrial	Drainage	Irrigation	Total
						(Dollars)							
55	2,617,500	-	-	-	-	1,308,750	-	-	-	-	1,308,750	-	2,617,500
56	2,781,500	2,781,500	-	-	2,781,500	-	-	-	-	-	-	-	-
57	2,458,800	-	2,458,800	-	2,458,800	-	-	-	-	-	-	-	-
58	523,100	523,100	-	-	523,100	-	-	-	-	-	-	-	-
59	1,904,200	1,904,200	-	-	1,904,200	-	-	-	-	-	-	-	-
60	No Struct.												
61	No Struct.												
62	2,311,100	2,311,100	-	-	2,311,100	-	-	-	-	-	-	-	-
63	2,754,700	2,754,700	-	-	2,754,700	-	-	-	-	-	-	-	-
64	1,004,000	1,004,000	-	-	1,004,000	-	-	-	-	-	-	-	-
65	PL-566												
66	723,000	-	-	-	-	361,500	-	-	-	-	361,500	-	723,000
67	PL-566												
68	291,000	-	-	-	-	145,500	-	-	-	-	145,500	-	291,000
69	PL-566												
70	5,017,700	4,661,200	-	-	4,661,200	228,060	128,440	-	-	-	-	-	356,500
71	3,384,100	3,384,100	-	-	3,384,100	-	-	-	-	-	-	-	-
72	4,610,750	3,757,750	-	-	3,757,750	528,600	324,400	-	-	-	-	-	853,000
73	7,462,750	6,269,250	-	-	6,269,250	517,550	675,950	-	-	-	-	-	1,193,500
74	3,528,500	3,264,500	-	-	3,264,500	147,900	116,100	-	-	-	-	-	264,000
75	1,450,500	1,241,700	-	-	1,241,700	100,500	108,300	-	-	-	-	-	208,800
76	No Struct.												
77	3,961,100	3,038,800	409,700	-	3,448,500	369,600	143,000	-	-	-	-	-	512,600
78	3,971,650	3,632,950	-	-	3,632,950	236,430	102,270	-	-	-	-	-	338,700
79	854,600	854,600	-	-	854,600	-	-	-	-	-	-	-	-
80	PL-566												
81	186,900	186,900	-	-	186,900	-	-	-	-	-	-	-	-
82	331,800	-	-	-	-	165,900	-	-	-	-	165,900	-	331,800
83	4,723,460	3,813,560	-	-	3,813,560	367,300	542,600	-	-	-	-	-	909,900
84	2,431,510	2,431,510	-	-	2,431,510	-	-	-	-	-	-	-	-
85	293,100	293,100	-	-	293,100	-	-	-	-	-	-	-	-
86	PL-566												
87	PL-566												
88	2,239,600	2,239,600	-	-	2,239,600	-	-	-	-	-	-	-	-
89	874,200	-	-	-	-	437,100	-	-	-	-	437,100	-	874,200
90	1,223,900	-	-	-	-	611,950	-	-	-	-	611,950	-	1,223,900
91	1,061,100	-	-	-	-	530,550	-	-	-	-	530,550	-	1,061,100
92	6,508,860	2,454,300	-	-	2,454,300	2,246,980	-	-	-	107,400	1,540,180	160,000	4,054,560
93	No Struct.												
94	8,389,200	5,978,600	-	-	5,978,600	1,597,550	407,100	-	-	132,200	-	273,750	2,410,600
95	No Struct.												
96	No Struct.												
97	Long-range												
98	No Struct.												
99	No Struct.												
100	7,383,400	5,176,400	-	-	5,176,400	1,635,100	571,900	-	-	-	-	-	2,207,000
101	2,892,300	1,548,300	-	-	1,548,300	1,050,900	204,200	-	-	88,900	-	-	1,344,000
102	1,015,420	660,420	-	-	660,420	177,500	-	-	-	-	177,500	-	355,000
103	3,892,900	542,100	-	-	542,100	1,675,400	-	-	-	-	1,675,400	-	3,350,800
104	4,933,100	2,968,800	-	-	2,968,800	1,051,750	292,400	-	-	-	620,150	-	1,964,300
105	3,120,200	1,544,300	-	-	1,544,300	787,950	-	-	-	-	787,950	-	1,575,900
106	734,500	-	-	-	-	367,250	-	-	-	-	367,250	-	734,500
107	No Struct.												
108	399,700	-	-	-	-	199,850	-	-	-	-	199,850	-	399,700

TABLE 35 (con.)

Watershed Number	Total Structural Measures	Single Purpose				Multiple Purpose							
		Flood Prevention	Recreation	Municipal & Industrial	Total	Flood Prevention	Recreation	Recreation & Fish & Wildlife	Water Quality Control	Municipal & Industrial	Drainage	Irrigation	Total
						(Dollars)							
1/ 109	5,604,000	2,260,300	-	-	2,260,300	1,671,850	-	-	-	-	1,671,850	-	3,343,700
1/ 110	5,072,300	1,530,800	-	-	1,530,800	1,770,800	-	-	-	-	1,770,700	-	3,541,500
1/ 111	3,065,300	438,800	-	-	438,800	1,313,250	-	-	-	-	1,313,250	-	2,626,500
112	2,543,500	-	-	-	-	1,271,750	-	-	-	-	1,271,750	-	2,543,500
113	2,634,100	-	-	-	-	1,317,050	-	-	-	-	1,317,050	-	2,634,100
114	647,850	-	-	-	-	323,930	-	-	-	-	323,920	-	647,850
115	1,991,000	-	-	-	-	995,500	-	-	-	-	995,500	-	1,991,000
116	PL-566												
117	PL-566												
118	2,422,800	-	-	-	-	1,211,400	-	-	-	-	1,211,400	-	2,422,800
119	4,036,000	-	-	-	-	2,018,000	-	-	-	-	2,018,000	-	4,036,000
120	914,200	-	-	-	-	457,100	-	-	-	-	457,100	-	914,200
121	316,700	-	-	-	-	158,350	-	-	-	-	158,350	-	316,700
122	1,393,010	-	-	-	-	696,500	-	-	-	-	696,510	-	1,393,010
123	748,010	-	-	-	-	374,080	-	-	-	-	373,930	-	748,010
124	2,228,950	-	-	-	-	1,114,480	-	-	-	-	1,114,470	-	2,228,950
125	4,017,700	-	-	-	-	2,008,850	-	-	-	-	2,008,850	-	4,017,700
126	PL-566												
127	2,147,480	-	-	-	-	1,073,740	-	-	-	-	1,073,740	-	2,147,480
128	1,900,750	-	-	-	-	950,370	-	-	-	-	950,380	-	1,900,750
129	Long-range												
130	1,601,300	-	-	-	-	800,650	-	-	-	-	800,650	-	1,601,300
131	PL-566												
132	6,433,000	-	-	-	-	3,216,500	-	-	-	-	3,216,500	-	6,433,000
133	2,209,900	-	-	-	-	1,104,950	-	-	-	-	1,104,950	-	2,209,900
134	C.of E. Proj.												
A	No Struct.												
B	670,800	-	-	-	-	335,400	-	-	-	-	335,400	-	670,800
TOTAL	226,159,400	122,546,080	6,700,300	375,120	129,680,880	52,171,760	5,089,360	702,900	997,790	1,050,960	35,941,150	524,600	96,478,520

1/Land Treatment - Critical Areas - Federal

Watershed Number	Total Structural Measures	Flood Prevention	Total
	(Dollars)		
109	115,600	115,600	115,600
110	68,700	68,700	68,700
111	27,000	27,000	27,000
Total	211,300	211,300	211,300

(2) The apportionment of costs between Federal and non-Federal interests is in accordance with general policy expressed in Federal legislation and administrative criteria. However, the costs are subject to additional analysis before the projects and programs are implemented. Therefore, cost allocation and cost apportionment data are shown in this report only to give a general indication of the financial arrangements that will have to be made by non-Federal interests. The non-Federal share of the investment costs of the Corps of Engineers projects in the 10- to 15-year plan is about 10 percent of the total investment costs. The annual non-Federal operation, maintenance, and replacement costs are about 40 percent of the total. Comparable estimates for the Soil Conservation Service upstream watershed projects are 17 percent and 100 percent, respectively.

b. Corps of Engineers. The apportionment of costs between Federal and non-Federal interests for Corps of Engineers reservoir projects is presented in Table 39. The apportionment of cost for the levee and channel improvement was presented previously in Table 32.

c. Soil Conservation Service. The apportionment of costs for Soil Conservation Service projects is shown in Table 40.

TABLE 39

COST APPORTIONMENT
CORPS OF ENGINEERS MAIN STEM AND MAJOR TRIBUTARIES RESERVOIR PROJECTS
(In thousands of dollars)

Item	County Line	Wolf Bayou	Myatt Creek	Wild Horse	Bell Foley	Quarry
Investment cost: (1)						
Federal:						
Flood control	$1,505	$43,506	$5,105	$10,420	$11,341	$0
Recreation	5,633	30,344	2,822	6,207	9,704	825
Fish & wildlife enhancement	739	4,615	378	994	1,145	1,375
Hydroelectric power	0	57,526	0	0	0	0
Water quality	3,247	0	0	0	0	0
Total Federal	11,124	135,991	8,305	17,621	22,190	2,200
Non-Federal:						
Water supply (2)	4,900	0	0	0	0	0
Recreation (3)	630	1,066	535	2,062	2,870	825
Fish & wildlife enhancement	83	162	72	330	339	1,375
Total Non-Federal	5,613	1,228	607	2,392	3,209	2,200
Total investment	16,737	137,219	8,912	20,013	25,399	4,400
Annual Non-Federal operation & maintenance cost:						
Water supply (2)	4	0	0	0	0	0
Recreation (3)	50	132	22	46	60	11
Fish & wildlife enhancement (3)	7	20	3	7	7	19
Total Non-Federal	61	152	25	53	67	30

(1) Includes interest during construction and present value of future recreation facilities.

(2) Non-Federal cost sharing is based on cost apportionment established in the Water Supply Act of 1958 (P.L. 85-500), as amended (P.L. 87-88).

(3) Non-Federal cost sharing is based on cost apportionment established in the Federal Water Project Recreation Act of 1965 (P.L. 89-72).

TABLE 40

COST SHARING BY PURPOSES

SOIL CONSERVATION SERVICE UPSTREAM WATERSHED PROJECTS

Water-shed Number	Total Structural Measures	Federal								Non-Federal							
		Flood Prevention	Recreation	Recrea., Fish & Wildlife	Water Quality Control	Munic. & Indus.	Drainage	Irri-gation	Total	Flood Prevention	Recrea-tion	Recrea. Fish & W/Life	Water Qual. Contr.	Municipal & In-dustrial	Drainage	Irri-gation	Total
									(Dollars)								
1	6,233,660	5,866,160	-	-	-	-	-	-	5,866,160	309,990	-	-	-	57,510	-	-	367,500
2	No Str.																
3	4,624,600	3,286,450	-	-	909,650	-	-	-	4,196,100	204,860	-	-	88,140	135,500	-	-	428,500
4	2,158,450	1,984,530	-	-	-	-	-	51,910	2,036,440	83,070	-	-	-	-	-	38,940	122,010
5	No Str.																
6	5,563,800	5,116,440	-	-	-	-	-	-	5,116,440	250,310	-	-	-	197,050	-	-	447,360
7	No Str.																
8	3,614,500	3,081,150	-	277,850	-	-	-	-	3,359,000	67,050	-	188,450	-	-	-	-	255,500
9	372,500	-	-	-	-	-	-	-	-	-	-	-	-	372,500	-	-	372,500
10	656,100	644,000	-	-	-	-	-	-	644,000	12,100	-	-	-	-	-	-	12,100
11	1,869,400	1,649,730	-	-	-	-	-	-	1,649,730	169,480	-	-	-	50,190	-	-	219,670
12	Long-range																
13	No Str.																
14	Long-range																
15	4,070,800	3,805,200	-	-	-	-	-	-	3,805,200	265,600	-	-	-	-	-	-	265,600
16	1,816,800	1,698,700	-	-	-	-	-	-	1,698,700	118,100	-	-	-	-	-	-	118,100
17	No Str.																
18	332,600	323,400	-	-	-	-	-	-	323,400	9,200	-	-	-	-	-	-	9,200
19	2,728,800	2,514,200	-	-	-	-	-	-	2,514,200	107,200	-	-	-	107,400	-	-	214,600
20	2,300,900	2,223,200	-	-	-	-	-	-	2,223,200	77,700	-	-	-	-	-	-	77,700
21	No Str.																
22	763,300	-	763,300	-	-	-	-	-	763,300	-	-	-	-	-	-	-	-
23	Long-range																
24	No Str.																
25	No Str.																
26	Long-range																
27	85,900	82,600	-	-	-	-	-	-	82,600	3,300	-	-	-	-	-	-	3,300
28	PL-566																
29	Long-range																
30	No Str.																
31	No Str.																
32	2,697,580	2,574,680	-	-	-	-	-	-	2,574,680	122,900	-	-	-	-	-	-	122,900
33	1,744,350	1,507,040	-	-	-	-	-	-	1,507,040	99,300	-	-	-	138,010	-	-	237,310
34	No Str.																
35	774,500	-	774,500	-	-	-	-	-	774,500	-	-	-	-	-	-	-	-
36	141,700	-	141,700	-	-	-	-	-	141,700	-	-	-	-	-	-	-	-
37	Long-range																
38	Long-range																
39	Long-range																
40	2,745,560	2,639,160	-	-	-	-	-	-	2,639,160	106,400	-	-	-	-	-	-	106,400
41	Long-range																
42	No Str.																
43	No Str.																
44	2,823,950	2,128,720	149,650	114,750	-	-	870	-	2,393,990	119,060	151,350	121,850	-	36,800	900	-	429,960
45	977,200	929,600	-	-	-	-	-	-	929,600	47,600	-	-	-	-	-	-	47,600
46	PL-566																
47	1,518,700	-	1,518,700	-	-	-	-	-	1,518,700	-	-	-	-	-	-	-	-
48	695,600	-	695,600	-	-	-	-	-	695,600	-	-	-	-	-	-	-	-
49	Long-range																
50	Long-range																
51	6,523,600	5,436,400	790,000	-	-	-	-	-	6,226,400	297,200	-	-	-	-	-	-	297,200
52	2,779,300	1,022,700	-	-	-	-	514,800	-	1,537,500	502,700	-	-	-	-	739,100	-	1,241,800
53	8,700,900	5,959,500	381,700	-	-	-	728,350	-	7,069,550	788,000	-	-	-	-	843,350	-	1,631,350
54	No Str.																
55	2,617,500	1,052,100	-	-	-	-	638,800	-	1,690,900	256,650	-	-	-	-	669,950	-	926,600

TABLE 40 (con.)

Water-shed Number	Total Structural Measures	Federal								Non-Federal							
		Flood Prevention	Recreation	Recrea., Fish & Wildlife	Water Quality Control	Munic. & Indus.	Drainage	Irri-gation	Total	Flood Prevention	Recrea-tion	Recrea. Fish & W/Life	Water Qual. Contr.	Municipal & In-dustrial	Drainage	Irri-gation	Total
									(Dollars)								
56	2,781,500	2,618,000	-	-	-	-	-	-	2,618,000	163,500	-	-	-	-	-	-	163,500
57	2,458,800	-	2,458,800	-	-	-	-	-	2,458,800	-	-	-	-	-	-	-	-
58	523,100	481,600	-	-	-	-	-	-	481,600	41,500	-	-	-	-	-	-	41,500
59	1,904,200	1,799,000	-	-	-	-	-	-	1,799,000	105,200	-	-	-	-	-	-	105,200
60	No Str.																
61	No Str.																
62	2,311,100	2,186,800	-	-	-	-	-	-	2,186,800	124,300	-	-	-	-	-	-	124,300
63	2,754,700	2,648,800	-	-	-	-	-	-	2,648,800	105,900	-	-	-	-	-	-	105,900
64	1,004,000	956,200	-	-	-	-	-	-	956,200	47,800	-	-	-	-	-	-	47,800
65	PL-566																
66	723,000	298,900	-	-	-	-	181,500	-	480,400	62,600	-	-	-	-	180,000	-	242,600
67	PL-566																
68	291,000	114,100	-	-	-	-	69,300	-	183,400	31,400	-	-	-	-	76,200	-	107,600
69	PL-566																
70	5,017,700	4,536,280	72,120	-	-	-	-	-	4,608,400	352,980	56,320	-	-	-	-	-	409,300
71	3,384,100	3,175,200	-	-	-	-	-	-	3,175,200	208,900	-	-	-	-	-	-	208,900
72	4,610,750	4,085,850	183,400	-	-	-	-	-	4,269,250	200,500	141,000	-	-	-	-	-	341,500
73	7,462,750	6,504,650	334,500	-	-	-	-	-	6,839,150	282,150	341,450	-	-	-	-	-	623,600
74	3,528,500	3,209,300	56,500	-	-	-	-	-	3,265,800	203,100	59,600	-	-	-	-	-	262,700
75	1,450,500	1,288,650	52,950	-	-	-	-	-	1,341,600	53,550	55,350	-	-	-	-	-	108,900
76	No Str.																
77	3,961,100	3,212,800	480,600	-	-	-	-	-	3,693,400	195,600	72,100	-	-	-	-	-	267,700
78	3,971,650	3,685,330	50,650	-	-	-	-	-	3,735,980	184,050	51,620	-	-	-	-	-	235,670
79	854,600	814,800	-	-	-	-	-	-	814,800	39,800	-	-	-	-	-	-	39,800
80	PL-566																
81	186,900	146,100	-	-	-	-	-	-	146,100	40,800	-	-	-	-	-	-	40,800
82	331,800	115,550	-	-	-	-	115,550	-	231,100	50,350	-	-	-	-	50,350	-	100,700
83	4,723,460	3,977,350	269,250	-	-	-	-	-	4,246,600	203,510	273,350	-	-	-	-	-	476,860
84	2,431,510	2,252,600	-	-	-	-	-	-	2,252,600	178,910	-	-	-	-	-	-	178,910
85	293,100	280,000	-	-	-	-	-	-	280,000	13,100	-	-	-	-	-	-	13,100
86	PL-566																
87	PL-566																
88	2,239,600	1,371,150	-	-	-	-	-	-	1,371,150	868,450	-	-	-	-	-	-	868,450
89	874,200	327,700	-	-	-	-	199,000	-	526,700	109,400	-	-	-	-	238,100	-	347,500
90	1,223,900	458,250	-	-	-	-	278,150	-	736,400	153,700	-	-	-	-	333,800	-	487,500
91	1,061,100	421,100	-	-	-	-	255,700	-	676,800	109,450	-	-	-	-	274,850	-	384,300
92	6,508,860	4,334,900	-	-	-	-	808,430	71,900	5,215,230	366,380	-	-	-	107,400	731,750	88,100	1,293,630
93	No Str.																
1/94	8,389,200	7,341,600	226,650	-	-	59,900	-	131,930	7,760,080	234,550	180,450	-	-	72,300	-	141,820	629,120
95	No Str.																
96	No Str.																
97	Long-range																
98	No Str.																
99	No Str.																
100	7,383,400	6,677,650	300,450	-	-	-	-	-	6,978,100	133,850	271,450	-	-	-	-	-	405,300
101	2,892,300	2,509,350	101,250	-	-	-	-	-	2,610,600	89,850	102,950	-	-	88,900	-	-	281,700
102	1,015,420	724,420	-	-	-	-	94,900	-	819,320	113,500	-	-	-	-	82,600	-	196,100
103	3,892,900	1,539,450	-	-	-	-	1,036,850	-	2,576,300	678,050	-	-	-	-	638,550	-	1,316,600
104	4,933,100	3,630,750	144,350	-	-	-	362,000	-	4,137,100	389,800	148,050	-	-	-	258,150	-	796,000
105	3,120,200	1,978,050	-	-	-	-	459,050	-	2,437,100	354,200	-	-	-	-	328,900	-	683,100
106	734,500	278,150	-	-	-	-	168,850	-	447,000	89,100	-	-	-	-	198,400	-	287,500
107	No Str.																
108	399,700	141,850	-	-	-	-	86,150	-	228,000	58,000	-	-	-	-	113,700	-	171,700

TABLE 40 (con.)

Watershed Number	Total Structural Measures	Federal								Non-Federal							
		Flood Prevention	Recreation	Recrea., Fish & Wildlife	Water Quality Control	Munic. & Indus.	Drainage	Irrigation	Total	Flood Prevention	Recreation	Recrea. Fish & W/Life	Water Qual. Contr.	Municipal & Industrial	Drainage	Irrigation	Total
	(Dollars)																
2/109	5,604,000	3,314,800	-	-	-	-	856,200	-	4,171,000	617,350	-	-	-	-	815,650	-	1,433,000
2/110	5,072,300	2,765,150	-	-	-	-	908,850	-	3,674,000	536,450	-	-	-	-	861,850	-	1,398,300
2/111	3,065,300	1,494,800	-	-	-	-	675,400	-	2,170,200	257,250	-	-	-	-	637,850	-	895,100
112	2,543,500	1,058,050	-	-	-	-	642,350	-	1,700,400	213,700	-	-	-	-	629,400	-	843,100
113	2,634,100	1,084,150	-	-	-	-	658,150	-	1,742,300	232,900	-	-	-	-	658,900	-	891,800
114	647,850	275,580	-	-	-	-	167,320	-	442,900	48,350	-	-	-	-	156,600	-	204,950
115	1,991,000	800,000	-	-	-	-	485,700	-	1,285,700	195,500	-	-	-	-	509,800	-	705,300
116	PL-566																
117	PL-566																
118	2,422,800	956,650	-	-	-	-	580,550	-	1,537,200	254,750	-	-	-	-	630,850	-	885,600
119	4,036,000	1,609,050	-	-	-	-	977,150	-	2,586,200	408,950	-	-	-	-	1,040,850	-	1,449,800
120	914,200	383,050	-	-	-	-	232,550	-	615,600	74,050	-	-	-	-	224,550	-	298,600
121	316,700	123,850	-	-	-	-	75,150	-	199,000	34,500	-	-	-	-	83,200	-	117,700
122	1,393,010	572,240	-	-	-	-	347,780	-	920,020	124,270	-	-	-	-	348,720	-	472,990
123	748,010	315,950	-	-	-	-	191,760	-	507,710	58,120	-	-	-	-	182,180	-	240,300
124	2,228,950	911,280	-	-	-	-	548,870	-	1,460,150	203,200	-	-	-	-	565,600	-	768,800
125	4,017,700	1,694,350	-	-	-	-	1,028,750	-	2,723,100	314,500	-	-	-	-	980,100	-	1,294,600
126	PL-566																
127	2,147,480	903,290	-	-	-	-	549,640	-	1,452,930	170,450	-	-	-	-	524,100	-	694,550
128	1,900,750	780,200	-	-	-	-	473,700	-	1,253,900	170,180	-	-	-	-	476,670	-	646,850
129	Long-range																
130	1,601,300	644,750	-	-	-	-	391,550	-	1,036,300	155,900	-	-	-	-	409,100	-	565,000
131	PL-566																
132	6,433,000	2,646,450	-	-	-	-	1,606,850	-	4,253,300	570,050	-	-	-	-	1,609,650	-	2,179,700
133	2,209,900	706,900	-	-	-	-	706,900	-	1,413,800	398,050	-	-	-	-	398,050	-	796,100
134	C. of E. Proj.																
A	No Struct.																
B	670,800	249,150	-	-	-	-	151,250	-	400,400	86,250	-	-	-	-	184,150	-	270,400
TOTAL	226,159,400	158,937,580	9,946,620	382,600	909,650	59,900	18,254,670	255,740	188,756,760	15,780,270	1,905,040	310,300	88,140	1,363,560	17,686,470	268,860	37,402,640

1/Hardship Area.
2/Land Treatment - Critical Areas - Federal Costs:

W/S No.	Total Structural Measures	Flood Prevention	Total
109	$ 115,600	$ 115,600	$115,600
110	66,700	66,700	66,700
111	27,000	27,000	27,000
Total	211,300	211,300	211,300

SECTION XII - LOCAL COOPERATION

62. REQUIRED LOCAL COOPERATION

a. General. The comprehensive plan of development contains numerous Federal developments to be recommended for construction in the next 10 to 15 years which would require local cooperation before the projects can be implemented. These projects include 6 main stem or major tributary dam and reservoir projects, 12 levee and channel improvement projects for local flood protection, 1 flood control and major drainage outlet, 84 upstream watershed projects, and land treatment measures on about 8,897,000 acres of land in the basin. Proposed requirements of local cooperation to be furnished by non-Federal entities are discussed in the following paragraphs.

b. Main stem and major tributary reservoirs.

(1) Water supply. Pay the construction cost, including interest during construction, and the annual maintenance, operation and replacement cost allocated to water supply, as determined by the Chief of Engineers in accordance with the provisions of the Water Supply Act of 1958, as amended.

(2) Recreation and fish and wildlife enhancement. In accordance with the Federal Water Project Recreation Act of 1965 agree to:

(a) Administer project land and water areas for recreation and fish and wildlife enhancement;

(b) Pay, contribute in-kind, or repay (which may be through user fees) with interest, one-half of the separable first cost of the reservoir project allocated to recreation and fish and wildlife enhancement; and

(c) Bear all cost of maintenance, operation, and replacement incurred in connection with recreation and fish and wildlife lands and facilities.

(3) Water quality control.

(a) Exercise, to the full extent of their legal capability, control against removal of streamflow made available for water quality control purposes; and

(b) Through adequate treatment or other methods of controlling waste at its source, contribute to pollution control in the streams for which low flow augmentation is provided.

c. Levee and channel improvement projects.

(1) Provide without cost to the United States all lands, easements, and rights-of-way required for construction of the project, including lands designated for borrow and ponding purposes.

(2) Perform without cost to the United States all utility and other relocations or alterations, except railroad facilities, as required for construction of the project.

(3) Hold and save the United States free from damages due to construction works.

(4) Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army.

(5) Prevent any obstruction or encroachment that would reduce the flood-carrying capacities of the construction works.

(6) If changed land use should result from construction of the project, a cash contribution may be required.

(7) In urban and adjacent areas, agree to consider the degree of protection afforded in connection with future development, including the adoption of regulations or dissemination of basic flood information as may be necessary to insure compatability between development and protection levels provided in the project area.

d. Flood control and major drainage outlets.

(1) Provide without cost to the United States all lands, easements, and rights-of-way required for construction of the project, including lands designated for borrow and ponding purposes.

(2) Perform without cost to the United States all utility and other relocations or alterations, except railroad facilities, as required for construction of the project.

(3) Contribute in cash 50 percent of the project construction cost allocated to major drainage. The cash contribution includes credit for costs incurred by local interests in fulfilling the requirements of items (1) and (2).

(4) Hold and save the United States free from damages due to construction works.

(5) Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of the Army.

(6) Construct and maintain the associated works necessary to realize the benefits made available by the major drainage portion of the project.

(7) Prevent any obstruction or encroachment that would reduce the flood-carrying capacities of the construction works.

e. Flood prevention and watershed protection.

(1) Local organizations would be required to assume the following costs of installing structural works of improvement for which Federal financial assistance is provided.

(a) The cost of acquiring land, easements, or rights-of-way for all works of improvement for purposes other than public fish and wildlife or recreational development.

(b) At least 50 percent of the cost of the land, easements, or rights-of-way to be acquired for works of improvement for public fish and wildlife or recreational development.

(c) The cost of acquiring water rights.

(d) The construction cost allocated to purposes other than flood prevention; the agricultural phases of the conservation, development, utilization, and disposal of water; and public fish and wildlife or recreational development.

(e) At least 50 percent of the construction cost allocated to the agricultural phases of the conservation, development, utilization, and disposal of water; and public fish and wildlife or recreational development.

(f) The cost of engineering and other installation services allocated to purposes other than flood prevention; the agricultural phases of the conservation, development, utilization, and disposal of water; and public fish and wildlife or recreational development.

(g) At least 50 percent of the engineering and other installation services required in connection with minimum basic facilities for public fish and wildlife or recreational development.

(h) The cost of operating and maintaining works of improvement on non-Federal land.

(i) An equitable part of the cost of operating and maintaining works of improvement on Federal land in consideration of the benefits that accrue to non-Federal land.

(2) Local organizations, through individual landowners and operators, would be responsible for the installation and maintenance of land treatment measures on non-Federal land. In carrying out this responsibility they could use any assistance available from existing national programs when financial assistance is not furnished from funds appropriated under authority of the (Watershed Protection and Flood Prevention) Act.

63. INDICATIONS OF LOCAL COOPERATION

a. Two watershed improvement districts have been formed to provide local cooperation for watershed improvements that may be developed in the final work plan. Applications for planning assistance on an additional 35 upstream watersheds included in the 10- to 15-year plan have been received. These indicate assurances of local cooperation.

b. Assurances of local cooperation have been expressed in special meetings with sponsors of specific levee projects. Strong local support of almost all improvements was expressed at the public hearings and in other statements received in response to the notice of public hearings. Letters relating to furnishing local cooperation requirements will be made a part of the agency report that would be the basis for authorization for construction.

c. Letters from the Governor of Arkansas and the Executive Director of the Missouri Water Resources Board expressed the desire that water resource projects being investigated consider recreation as a project purpose. The letters also expressed the opinion that the necessary requirements of local cooperation would be fulfilled.

d. The requirements of local cooperation for including municipal and industrial water supply storage in the County Line project that would be located near Springfield, Missouri, have been discussed with officials of City Utilities at Springfield. At a public hearing at Springfield the Chairman of the Board of Public Utilities, Springfield, which administers the municipally owned and operated electric, gas, water, and bus transportation utilities designated as City Utilities, presented a statement for the record. This statement expressed interest in the development of the County Line project to include water supply storage and respectfully requested that necessary action be taken to bring the project into reality.

SECTION XIII - IMPLEMENTATION

64. GENERAL

Implementation of the comprehensive plan will require the active participation and cooperation of all Federal, State, and local governmental and private interests in sharing the legal and financial responsibilities and obligations for establishment and operation and maintenance of the projects and programs included in the plan.

65. RESPONSIBILITY

a. The States of Arkansas and Missouri, other legal entities, and local interests have the responsibility for initiating many of the projects and programs included in the plan. Even in those fields where a Federal agency normally performs the detailed planning and construction, the impetus for these activities should originate with those benefited by the programs and facilities.

b. Data for projects and programs included in the 10- to 15-year plan are considered to be of the scope required by the applicable agencies for making decisions concerning project selections and engineering and economic feasibility. However, the data must be refined by detailed planning and design studies necessary to establish final design features of the projects and form a basis for final construction plans and specifications. In many cases, studies for projects and programs included in the long-range plan have not been carried beyond the reconnaissance level and thus additional planning would be necessary before these measures could be considered for inclusion in an early action program.

c. Those projects in the 10- to 15-year plan for which the Corps of Engineers has primary responsibility for planning and constructing will be presented in a separate report through regular channels to the Congress for authorization consideration. This is in compliance with the resolution authorizing the study. Upon authorization by the Congress and appropriation of funds, the projects would be planned in detail and then constructed. However, their construction would be contingent upon responsible interests providing local cooperation required by appropriate laws and regulations.

d. Those projects and programs in the 10- to 15-year plan for which the Soil Conservation Service has primary responsibility in planning and assisting will also be presented in an agency report for appropriate implementation. These programs would be constructed when funds are available and the required local cooperation is fulfilled.

e. The United States Forest Service will be primarily responsible for obtaining necessary funds for the acquisition of lands and for

the installation of improvements, including stream preservation, on national forest lands.

f. The Fish and Wildlife Service would be responsible for the acquisition of additional lands at the White River National Wildlife Refuge and would consult with and advise Federal, State, and local interests on implementation of other fish and wildlife features of the plan.

g. The Bureau of Outdoor Recreation will consult with and advise Federal, State, and local interests on the implementation of the recreation features of the plan.

h. The National Park Service will be responsible, in cooperation with appropriate State agencies, for archeological investigations. Legislation introduced in the 90th Congress for authorization of the Buffalo River National Riverway provides that it will be administered by the National Park Service.

i. Administration of the other National Scenic Riverways in the 10- to 15-year plan (the lower Current and Eleven Point Rivers) would be determined by the enabling legislation or departmental agreement.

j. The United States Public Health Service would consult with and advise Federal, State, and local interests in connection with vector problems associated with the water resource development in the basin.

k. The Federal Water Pollution Control Administration will consult with and advise Federal, State, and local interests concerning water quality requirements.

l. The U. S. Geological Survey, in cooperation with appropriate Federal and non-Federal agencies, will be responsible for continued improvement and expansion of the surface and ground-water data collection system and topographic mapping activities.

m. The Southwestern Power Administration would be responsible for marketing the hydroelectric power produced at the projects in the plan that include power generating facilities.

n. The Federal Power Commission would be responsible for providing appropriate data required in connection with further planning of the projects which include hydroelectric power.

o. The Stream Preservation Committees established by the Governors of Arkansas and Missouri will make recommendations to the applicable legislature for implementation of the stream preservation proposals other than those areas administered by National Forest Service.

p. Municipalities and private interests will be primarily responsible for implementation of municipal and industrial water supply lakes and farm ponds.

q. Individuals, private businesses, and local development groups should be encouraged to take timely steps to implement the non-governmental features of the plan which are necessary for realization of its full benefit.

66. ENABLING LEGISLATION

a. Further Federal legislative authority is needed to implement the storage of water in Soil Conservation Service watershed protection projects for multiple-purpose benefits including recreation, fisheries, and water quality control. The plan proposes water quality control storage in the West Fork of White River downstream from Fayetteville, Arkansas, in a Soil Conservation Service reservoir in Watershed No. 3 upstream from Fayetteville.

b. State legislation is needed for implementation of stream preservation proposals. There is no condemnation legislation available for the taking of land in the interest of preservation of areas of unique and unusual scenic value or unique recreational and ecological value.

67. FINANCING

a. The Federal share of the cost of the projects and programs included in the comprehensive plan would be provided in accordance with laws and regulations applicable at the time of financing. Non-Federal costs would be borne by State and local governments and private sources. Funds for financing the non-Federal share could come from such sources as outright grants from government and private sources; revenue bonds; taxes received by government; development authorities, and improvement districts; fees charged for project use; and revenues from the sale of resource products such as water.

b. Where Federal assistance is needed for initial financing of the non-Federal share of project and program costs, reimbursement to the Federal Government would be made by non-Federal interests in accordance with laws and regulations applicable at the time. Repayment and payout schedules would be developed at the time detailed planning and design of the projects and programs are completed.

SECTION XIV - DISCUSSION, CONCLUSIONS, AND RECOMMENDATIONS

68. DISCUSSION

a. The northern and western three-fourths part of the White River Basin is in the Ozark Plateaus. The topography of this area is characterized by rough, dissected plateaus and rugged hills. The remainder of the basin is located in the Coastal Plain where the land is level to gently rolling. Historically, the basin has been oriented to the production of agricultural commodities. Increased mechanization of farming operations and growth of industrial activities have resulted in a more balanced economy in the basin. These changes have resulted in increases in personal income, more leisure time, and a growing use of the outdoors. The ability of the basin to expand its activities and sustain and nourish its future growth will to a major extent depend upon a reasonable and carefully executed plan for the control and use of its water and related land resources. This plan should meet the demands for:

(1) Adequate supply of water for municipal, industrial, and rural domestic uses;

(2) Water quality facilities and controls to assure water of suitable quality for all purposes;

(3) Flood control and prevention measures to protect people, property, and productive lands from flood damages and losses;

(4) Regulation of the use and development of urban flood plains;

(5) Adequate drainage to improve agricultural production;

(6) Land management and conservation, including watershed protection measures;

(7) Hydroelectric power where its provision can contribute advantageously to needed increases in power supply;

(8) Agricultural water supply;

(9) Navigation;

(10) Outdoor recreation and fish and wildlife conservation;

(11) Preservation of areas of unique natural beauty and scenic, historical, and scientific interest.

b. The projects and programs described in the preceding sections of this report comprise the comprehensive plan for the conservation, preservation, and development of the basin land and water resources. The plan recognizes the rights and responsibilities of Federal, State, and local government and non-government interests in the accomplished of this objective.

c. The White River and major tributaries have an abundant supply of good quality water sufficient to meet all foreseeable needs except for a few scattered areas generally in headwater reaches of the Ozark Plateaus. In these areas late summer flows are sometimes inadequate to meet city and community needs and ground water is sometimes difficult or expensive to obtain. With construction of the reservoir projects in the plan and with proper utilization of ground water and return flows sufficient water resources will be available to meet all foreseeable water supply needs to the year 2020.

d. Most of the stream pollution problems are also in the headwater areas. During high flow periods streamflows are more than adequate to assimilate waste effluents, but during low flow periods stream pollution is or will potentially become a problem in the future. The plan provides for supplemental flows in the James River below Springfield, Missouri, and the White River below Fayetteville, Arkansas. Provision of reservoir storage for supplemental flows in other problem areas in the headwaters of basin streams is not considered to be a feasible means of pollution abatement. Therefore, these areas will require high efficiency waste treatment facilities which will furnish at least secondary waste treatment with final sedimentation. In most instances, chlorination of effluents will be needed for bacteriological control.

e. The most serious present-day problem in the Coastal Plain is not a shortage of water but an excess supply during high flow periods. Flooding along the lower Black and White Rivers and their tributaries is frequent and extensive even with the existing flood control projects. Average annual flood losses are extensive and will continue to grow with projected economic development.

f. Flood plain management was considered as a means for flood damage reduction in all urban areas subject to flooding. Other alternatives which would prevent agricultural as well as urban losses were considered to be more practical solutions at this time. If future developments in the basin indicate that flood plain management is necessary it would be compatible with and supplementary to the plan presented in this report.

g. From an agricultural standpoint there are many problems involved with attempting to farm lands that need to be drained. The plan includes provisions for proper agricultural land and water management.

h. There are needs for improvement in land treatment and conservation practices in the basin. Most of the virgin timber in the basin was cut off during the early 1900's. Repeated widespread fires and overgrazing followed which further depleted the forest resources and limited the natural reproduction of desirable species. The national forests in the basin have been successful in restoring a part of the acreage to a productive state. Approximately 8,900,000 other acres of cropland, grassland, woodland, and wildlife habitat need land treatment to some extent. Provisions are included in the plan for the implementation of needed measures which would do much to improve land treatment and conservation practices.

i. Estimates of future power needs indicate that all of the hydroelectric power capacity that could be economically developed in the basin could be utilized in the power market area. The plan includes provision for the installation of 265,000 kilowatts of conventional hydroelectric power capacity and a 500,000 kilowatt adjoining pumped-storage development. However, additional screening and project formulation studies will be required to substantiate the inclusion of the adjoining pumped-storage development in the plan.

j. A considerable part of the Grand Prairie area in the lower White River Basin is now being used to grow rice and other irrigable crops. These lands are now irrigated from ground water and from embankment-type reservoirs constructed in the area by local interests. Intensive use of the ground water for this irrigation and for expanding fish-farming operations has caused a rapid depletion in the ground water table. An agricultural water supply project to meet the needs in this area from diversion of water from the White River has already been authorized by the Congress and is a part of the plan. There is also a need for supplemental irrigation water in other areas of the basin. Much of this need can be met by existing supplies of water on an individual basis. However, the plan includes provision for irrigation storage to meet the need in several upland areas.

k. The flow in the lower White River is not adequate to maintain a year-round navigable channel compatible with other parts of the inland waterway system. No provision is made in the plan to store water to maintain such a channel. Another problem associated with navigation on the lower White River is the crooked channel. To straighten the channel by cutoffs would decrease navigable depths. A year-round navigable channel in the lower White River with a minimum navigable depth of 9 feet and compatible with other water uses in the basin would require construction of a series of locks and dams. Further detailed navigation studies have been authorized by the Public Works Committee of the United States Senate.

l. The scenic beauty of the basin together with its geographic location and potential for development give it a unique opportunity to become a major national recreation center. With the exception of

boating and canoeing the basin currently has a shortage of opportunities for water-enhanced and water-dependent recreational activities. The existing large impoundments in the upper reaches of the White River furnish sufficient water-surface area to meet present day demand for boating. However, this surface area is not well distributed throughout the basin. By 1980 a need is shown for all of the major outdoor-recreation activities associated with surface waters. The plan includes provisions for recreational development and preservation of the natural recreational resources of the basin. Development and preservation have been blended together in a manner so that one complements and enhances the other.

m. Development of impoundments would result in a loss of wildlife habitat and stream fishery. However, where feasible, provisions have been included in the plan to mitigate these losses. Proposed large reservoirs will satisfy the warm water type fishing demand on large impoundments beyond the year 2020 in Arkansas, and up to the year 2000 in the Missouri part of the basin. Local needs for fishing on small impoundments are satisfied. As a result of habitat improvement and the anticipated increases in the trout-stocking program, trout-fishing opportunities will be increased sufficiently to satisfy demand up to the year 2000. Improved water quality control standards will enhance fishery-habitat conditions in many of the natural lakes and streams in the basin.

n. All of the White River Basin except the extreme eastern part is included in the Ozarks Regional Commission (ORC) area. The implementation of the projects and programs included in the 10- to 15-year plan should lay the foundation for an assist in the creation of the vital social services and infrastructure which are necessary parts of the ORC program for the initiation of self-sustaining economic growth in the ORC area. The construction, operation, and maintenance of the various projects and programs included in the plan will create numerous income and employment opportunities for residents of the area. In addition, numerous income and employment opportunities will be created in manufacturing, trade, service, and other industries which as a result of the implementation of the plan will utilize the resources of the basin. This will assist in the narrowing of the income gap of the basin and ORC area residents which is consistent with the national objective of improving the economic well-being of all the people of the United States. However, it is pointed out that the projects and programs in the plan have been formulated from the economic efficiency and environmental preservation viewpoints to meeting the water and related land resource needs of the basin and not for public investments to implement regional growth objectives.

69. COMMENTS OF STUDY PARTICIPANTS

During the preparation of the multiple-agency report and appendixes, study participants were given opportunities to comment on drafts as completed. Comments were taken into account insofar as

practicable by report revisions and modifications. Comments were received from several study participants on the final field draft relative to subject matter and overall content of the report. These comments have been made an integral part of this report and are included as attachments.

70. CONCLUSIONS

In view of the information in this report it is concluded that the plan formulated would generally meet the projected water and related land resource needs of the basin to the year 2020 through the efficient development and utilization of resources within the basin. The plan, to be effective, must be implemented in the form of actual projects and programs. However, because the plan is based on long-range assumptions and projections, and because it must be sufficiently flexible to be adjusted to conform to future unforeseen changes in national, State, and local conditions, it will need periodic reviews to insure that it is properly responsive to changing times and conditions.

71. RECOMMENDATIONS

The White River Basin Coordinating Committee recommends that:

1. The comprehensive plan, as presented in Table 21 and discussed in this report, be used as a guide for the development and beneficial use of the water and related land resources of the basin;

2. The projects and programs in the 10- to 15-year category of the plan be implemented through the appropriate agency;

3. This report be a supporting document for the individual agency reports that would be the basis for authorization of the various parts of the plan;

4. That each of the affected and concerned Federal and State agencies make periodic review of the segments of the plan for which it is or may be, under law, assigned responsibility; and

5. The additional studies discussed in this report be made as soon as practicable.

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

5401 Federal Office Building
Little Rock, Arkansas 72201

June 20, 1968

Colonel Charles L. Steel, Chairman
White River Basin Coordinating
Committee
Post Office Box 867
Little Rock, Arkansas 72203

Dear Colonel Steel:

The Comprehensive Report and appendixes of the White River Basin studies, made under the overall direction of the White River Basin Coordinating Committee, present an excellent comprehensive plan for the orderly development of the basin's water and related land resources, with proper recognition to both the short- and long-term needs in the area.

It is noted that the materials in the report on fish and wildlife, recreation, and stream preservation programs is incomplete in that information parallel to that presented for other project proposals has not been included. I refer specifically to items on the nature of the work to be accomplished, the Federal and non-Federal, and total estimated cost for the proposals. It is believed that the inclusion of these data would have strengthened the report.

We feel that the development of the Report has been achieved through the outstanding cooperation among the State and Federal agencies involved in the study.

Sincerely yours,

William B. Davey, Chairman
Field Advisory Committee, USDA

ATTACHMENT A

U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
WEATHER BUREAU SOUTHERN REGION HEADQUARTERS
FEDERAL OFFICE BUILDING
FORT WORTH, TEXAS 76102

June 18, 1968

IN REPLY REFER TO: WFS2

Colonel Charles L. Steel
Chairman
White River Basin Coordinating Committee
Little Rock District, Corps of Engineers
P. O. Box 867
Little Rock, Arkansas 72203

Dear Colonel Steel:

I wish to commend you and the other District Engineers who have spearheaded the White River Basin Study, as set forth by the Water Resources Council developing a comprehensive plan for this basin through the year 2010.

Although the participation as Department of Commerce representative was minimal due to limited staff and resources, I want you to know that this afforded an opportunity for coordination that will benefit the agencies of Commerce who have an interest and responsibility in water resources in general; namely, Business and Defense Services Administration, Economic Development Administration and Environmental Scientific Services Administration (Coast & Geodetic Survey, Environmental Data Service, Weather Bureau and Maritime Commission).

I wish to especially thank the members of the numerous Work Groups and Ad Hoc Committees which spent many hours preparing the necessary detailed support documents in order that a comprehensive basin development program could be presented for consideration by higher authority in the Departments of Agriculture, Army, Commerce; Health, Education & Welfare; Interior, Power Commission and the states of Arkansas and Missouri.

Sincerely yours,

Richard J. MacConnell
Regional Hydrologist

ATTACHMENT B

PUBLIC HEALTH SERVICE

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
REGIONAL OFFICE
1114 Commerce Street
Dallas, Texas 75202

May 17, 1968

Colonel Charles L. Steel
District Engineer
Little Rock District, Corps of Engineers
Department of the Army
700 West Capitol
Little Rock, Arkansas 72203

Dear Colonel Steel:

The Public Health Service, Region VII, Dallas, Texas, has reviewed the Main Report, Comprehensive Basin Study - White River Basin, Arkansas and Missouri, and pertinent appendixes with respect to health aspects.

The report as presented is acceptable to the Public Health Service field level review. We would, however, recommend that in future studies of this type, coverage of public health considerations be of expanded scope, and that an appendix relating to these considerations be included as an integral part of the report.

Sincerely yours,

Charles W. Northington

Charles W. Northington, P. E.
Regional Program Chief
Water Supply and Sea Resources
Program

ATTACHMENT C

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF THE SECRETARY
SOUTHWEST REGION
FEDERAL BUILDING, P. O. BOX 1467
MUSKOGEE, OKLAHOMA 74402

June 17, 1968

Colonel Charles L. Steel, Chairman
White River Basin Coordinating Committee
Department of the Army
Corps of Engineers
P. O. Box 867
Little Rock, Arkansas 72203

Dear Col. Steel:

I have reviewed the report on the Comprehensive Basin Study, White River Basin, Arkansas and Missouri. Also I represented the Department of the Interior on the Coordinating Committee which conducted the study. The several Interior bureaus with responsibilities in water resources development participated actively in all of the interagency effort.

Your office has served as chairman of the Coordinating Committee very impartially and efficiently and has fostered a spirit of cooperation among the Federal and State participants. I believe that the report reflects that exemplary spirit. It is a good report which presents a well justified early action program for the basin and evaluates the long term needs and opportunities.

Sincerely yours,

Kenneth D. McCall
Regional Coordinator

ATTACHMENT D

UNITED STATES
DEPARTMENT OF THE INTERIOR
FEDERAL WATER POLLUTION CONTROL ADMINISTRATION
SOUTH CENTRAL REGION
1402 ELM STREET, 3RD FLOOR
DALLAS, TEXAS 75202

Your Reference:
SWLED-B
June 11, 1968

Colonel Charles L. Steel
District Engineer
U. S. Army Engineer District, Little Rock
P. O. Box 867
Little Rock, Arkansas 72203

Dear Col. Steel:

As requested by your letter dated April 24, 1968, we have reviewed the final draft of the interagency report, "Comprehensive Basin Study, White River Basin, Arkansas and Missouri."

We feel that the report is well prepared and adequately reflects the extensive work and exemplary spirit of cooperation that existed throughout the study.

The opportunity afforded us to participate in the study and to review and comment on the report is appreciated.

Sincerely yours,

WILLIAM C. GALEGAR
Regional Director

ATTACHMENT E

UNITED STATES
DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE
SOUTHEAST REGION, P. O. BOX 10008
FEDERAL BUILDING, RICHMOND, VA. 23240

IN REPLY REFER TO
L7423 SER(CA)

MAY 28 1968

Mr. Paul E. Adams
Chairman, White River Basin
Inter-Agency Planning Committee
P.O. Box 867
Little Rock, Arkansas 72203

Dear Mr. Adams:

This is in response to your letter of April 24, on the White River Basin Comprehensive Study requesting our comments on the overall content of the multiple agency report.

We are in general agreement with the points of view of the various agencies, especially those agencies which share with us the responsibility for the outdoor recreation aspects of the basin in its entirety. From our point of view, we find no possible conflicts or qualifying conditions. However, comments have not been made on some of the technical appendices, such as Hydrology, Geohydrology and other technical subjects which require specialized studies and treatment of resources not within our responsibilities.

The main report is well edited and appears to contain the essential data which is covered in more detail in the appendices.

We have no comments or recommendations for improvement of this multiple agency report on the White River Basin. This Region certainly appreciates the opportunity of reviewing and commenting on the comprehensive basin study.

Sincerely yours,

Jackson E. Price
Regional Director

ATTACHMENT F

UNITED STATES
DEPARTMENT OF THE INTERIOR
SOUTHWESTERN POWER ADMINISTRATION
POST OFFICE DRAWER 1619
TULSA, OKLAHOMA 74101

IN REPLY REFER TO:

SPA-R

June 10, 1968

AIR MAIL

Chairman, White River Basin
Coordinating Committee
P. O. Box 867
Little Rock, Arkansas 72203

Dear Sir:

In accordance with your letter of April 24, 1968, we have reviewed the Final Review Draft of the White River Basin Report and have furnished our comments pertaining to suggested corrections by a letter of May 24, 1968. The following comments represent the views of this bureau with respect to the study as a whole.

Projects recommended in the ten to fifteen-year plan presented in the report include the multiple-purpose Wolf Bayou Reservoir Project with 180,000 kw conventional hydroelectric capacity on the main stem of the White River; the addition of two 42,500 kw units at the existing Norfork Project; and the development, if subsequently found feasible, of the Optimus pumped storage hydro plant to be located on the Wolf Bayou Reservoir with installed capacity of 500,000 kw. The Norfork and Wolf Bayou hydro facilities could be utilized on peak loads prior to 1980, and the Optimus pumped storage installation shortly thereafter. Therefore, we are in agreement with your recommendation concerning these hydroelectric projects. This concurrence is for use in connection with the comprehensive basin report and should not be construed as a commitment for marketing; and is subject to review at the departmental level.

There is, at present, in the Southwestern Power Administration marketing area fifteen Corps of Engineers' hydroelectric projects completed and eight under construction. Five of the projects in operation (Beaver, Table Rock, Bull Shoals, Norfork, and Greers Ferry) with a total installed capacity of 818,000 kw are in the

ATTACHMENT G

White River Basin. The first of these projects began operation in June 1944. The annual generation from existing White River hydroelectric projects through 1965 is shown in the table below.

	Kwh		Kwh
1945	136,651,400	1956	490,422,200
1946	219,638,800	1957	1,269,544,800
1947	167,511,500	1958	1,001,686,100
1948	148,662,000	1959	542,137,100
1949	200,470,100	1960	854,126,200
1950	270,378,700	1961	1,391,592,500
1951	266,228,200	1962	1,163,533,300
1952	286,579,000	1963	583,935,400
1953	566,262,100	1964	455,306,400
1954	273,502,200	1965	876,204,800
1955	462,929,200	Total	11,627,302,000

The total generation for that period of record is 11,627,302,000 kwh which represents a saving of approximately 5,800,000 tons of coal or the equivalent in other fossil fuels. This represents an unevaluated benefit of hydroelectric power in the White River Basin, and thus is not included in economic analyses.

The average annual generation of the existing hydroelectric facilities, as estimated by the Corps of Engineers, represents a non-consumptive use of approximately 10,600,000 acre-feet per year.

It is noted that the report analyzes the requirements and determines the availability of water for municipal, industrial, irrigation, and water quality control use. Except for some reregulation at the Wolf Bayou Project, the recommended power developments would not improve the present conditions availability of water for such purposes. However, the existing hydroelectric system operates with large power drawdown storages. These power releases, especially in minimum years, are a major contribution to the assured flows available for downstream uses with greater assurance than the natural flow regimen of the White River and tributaries. A coordinated operation for all the water use functions, including power, was not made for the report; and, therefore, the effects of future downstream mandatory water requirements, as well as upstream depletion, could affect the amount of power presently projected to be available for marketing.

The overall report and appendices have accomplished, we believe, the basic purpose of identifying the various needs for water use and control in the White River Basin, and presented economic solutions through the developments in the recommended plan.

After authorization of any project which includes more hydroelectric power, it is recommended that coordination with Southwestern Power Administration be initiated early in the pre-construction planning phase.

The opportunity to participate in preparation of the recommended plan of development, and to comment on your report is appreciated.

Sincerely yours,

Administrator

cc:
Assistant Secretary--Water and Power Development

Arkansas SOIL AND WATER CONSERVATION COMMISSION

TELEPHONE 501 376-3777 ■ STATE CAPITOL ■ LITTLE ROCK, ARKANSAS 72201

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June 19, 1968

Colonel Charles L. Steel, Chairman
White River Basin Coordinating Committee
Federal Office Building
Little Rock, Arkansas 72201

Dear Colonel Steel:

The final review draft for the comprehensive basin study of the White River Basin has been reviewed by the various water related state agencies. All of these agencies are in general conceptual agreement with all aspects of the study as presented in the report.

The report is an exhaustive effort by the Coordinating Committee, and the Arkansas Soil and Water Conservation Commission looks forward to the implementation of the comprehensive plan. In the meantime, the various data contained in the appendices will be helpful as background information and reference in conducting and carrying out day-to-day responsibilities of this office.

As individual projects proposed in the report progress towards final action, this Commission will provide further detailed review and comments, in view of the current situation.

Sincerely,

/s/ S. Keith Jackson

S. Keith Jackson
Executive Director

SKJ:db

ATTACHMENT H

STATE INTER-AGENCY COUNCIL FOR OUTDOOR RECREATION
1203 Jefferson Building
P. O. Box 564
JEFFERSON CITY, MISSOURI 65101
Area Code 314 Telephone 635-3262

ROBERT L. DUNKESON
Executive Secretary

May 22, 1968

Colonel Charles L. Steel
Chairman
White River Basin Coordinating Committee
Federal Office Building
700 West Capital
P. O. Box 867
Little Rock, Arkansas 72203

RE: White River Basin
Comprehensive Study

Dear Colonel Steel:

We have reviewed the final draft of the Main Report and Appendix J of the White River Basin Comprehensive Study. This letter is to indicate general agreement with the plan for development.

It is understood, however, that the long range alternatives in the plan will be reinvestigated and reconsidered in the future.

Thank you for this opportunity for coordination.

Sincerely yours,

Robert L. Dunkeson

Robert L. Dunkeson
Executive Secretary

RLD:pjm

cc: Mr. Joseph Jaeger, Jr.

ATTACHMENT I

STATE PARK BOARD
JOSEPH JAEGER, JR., Director
Inter-Agency Council Chairman

CONSERVATION COMMISSION
CARL K. NOREN, Director
Inter-Agency Council, Vice-Chairman

DEPARTMENT OF PUBLIC HEALTH & WELFARE
WARREN SMITH, Chief, General Engineering

DIVISION OF COMMERCE & INDUSTRIAL DEVELOPMENT
HENRY MADDOX, Director

MISSOURI BOAT COMMISSION
JOHN BUFORD, Executive Secretary

STATE HIGHWAY COMMISSION
MARVIN J. SNIDER, Chief Engineer

WATER POLLUTION BOARD
JACK R. SMITH
Executive Secretary

WATER RESOURCES BOARD
CLIFFORD SUMMERS, Executive Director

DEPARTMENT OF AGRICULTURE
DEXTER DAVIS, Commissioner

UNIVERSITY OF MISSOURI
School of Social & Community Service
MR. ARTHUR W. NEBEL, Dean

DIVISION OF GEOLOGICAL SURVEY & WATER RESOURCES
DR. WILLIAM C. HAYES, State Geologist

MISSOURI DEPARTMENT OF CONSERVATION

North Ten Mile Drive - Jefferson City, Missouri 65101

P. O. Box 180 - Telephone 314 636-8141

CARL R. NOREN, Director

May 15, 1968

Colonel Charles L. Steel, Chairman
White River Basin Coordinating Committee
Federal Office Building
700 West Capital
Post Office Box 867
Little Rock, Arkansas 72203

Dear Colonel Steel:

The Missouri Department of Conservation has completed a review of the "Final Review Draft - White River Comprehensive Basin Study Report". Our questions and comments on these drafts have been supplied to the Missouri Water Resources Board for transmittal to the persons responsible for the particular section of the report concerned.

Participation by our department throughout the entire study permitted us to become familiar with the workings of the various committees, and to better understand why certain conclusions were reached. This knowledge greatly simplified the review process.

The plan does represent the results of a unified broad frontal attack on a complex problem. Although full agreement by all interests could never be reached on all points, the results are generally quite good and forward looking.

It has been our pleasure to assist in this water and land resource planning effort.

Sincerely,

CARL R. NOREN
DIRECTOR

ATTACHMENT J

COMMISSION

JIM TOM BLAIR, Creve Coeur
ROBERT G. DELANEY, Charleston
WILLIAM A. STARK, Bethany
LEWIS D. LINVILLE, Kansas City

THE DIVISION OF HEALTH OF MISSOURI
OF THE DEPARTMENT OF PUBLIC HEALTH AND WELFARE
JEFFERSON CITY, MISSOURI 65101

L.M. GARNER, M.D., M.P.H.
ACTING DIRECTOR OF
THE DIVISION OF HEALTH

ADDRESS ALL COMMUNICATIONS
TO THE DIVISION OF HEALTH

May 20, 1968

Colonel Charles L. Steel
Chairman, White River Basin
Coordinating Committee
Federal Office Building
700 West Capital
P. O. Box 867
Little Rock, Arkansas 72203

Dear Colonel Steel:

The Missouri Division of Health has reviewed the completed portions of the Field Review, White River Basin Comprehensive Study, White River Basin, Arkansas and Missouri, transmitted by Mr. C. L. Summers, Executive Director, Water Resources Board, under Memoranda dated April 26 and May 14, 1968. The review by the Division of Health was particularly concerned with those parts of the report involving public water supply and sanitation aspects of recreation areas.

The Division of Health has no comments to submit at this time.

By the direction of J. P. Russell, M.D., Director, Section of Hospital and Technical Services.

Very truly yours,

L. F. Garber, Director
Bureau of Environmental Services

LFG:dp

cc: Mr. C. L. Summers

ATTACHMENT K

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF OUTDOOR RECREATION
SOUTHEAST REGIONAL OFFICE
810 NEW WALTON BUILDING
ATLANTA, GEORGIA 30303

IN REPLY REFER TO

June 25, 1968

Chairman
Coordinating Committee
White River Basin Committee
White River Basin Comprehensive Study
Post Office Box 867
Little Rock, Arkansas 72203

Dear Sir:

The Bureau of Outdoor Recreation has reviewed the report on the White River Basin Comprehensive Study and generally agrees with the 10 - 15 year comprehensive plan of development as presented in the main report (Volume 1).

The Bureau commenced participation in this study in fiscal year 1965. We have been pleased with the overall conduct of the study and believe it has been very well coordinated.

In studying the White River Basin and its potential to offer recreation opportunities, we have considered both opportunity for development and opportunity for preservation of its many and varied resources. We have placed much emphasis on intangible values as the value of many of the basin's resources cannot be quantified.

The 10 - 15 year recreation plan as presented in the main report recommends both development and preservation of the basin resources. By implementing this plan, demands for mass-type recreation as well as escape-type recreation can be met. Existing facilities can be expanded to accommodate additional use as demand requires. We believe the plan will also enhance the quality of the environment in the basin by promoting an orderly development together with preservation of its resources.

The framework for future planning as set forth in this report provides a sound basis from which continued planning and development to meet public needs and desires can be derived. Conflicts

ATTACHMENT L

between proposals appear in the long-range plan; however, if all phases of the 10 - 15 year plan are implemented, certain conflicts and alternatives will be resolved. In the other cases, additional study will be needed at a later date to further delineate long-range development proposals.

The Bureau will report more fully on individual project features as planning progresses into detailed design studies.

Sincerely yours,

Roy K. Wood
Regional Director

By Acting