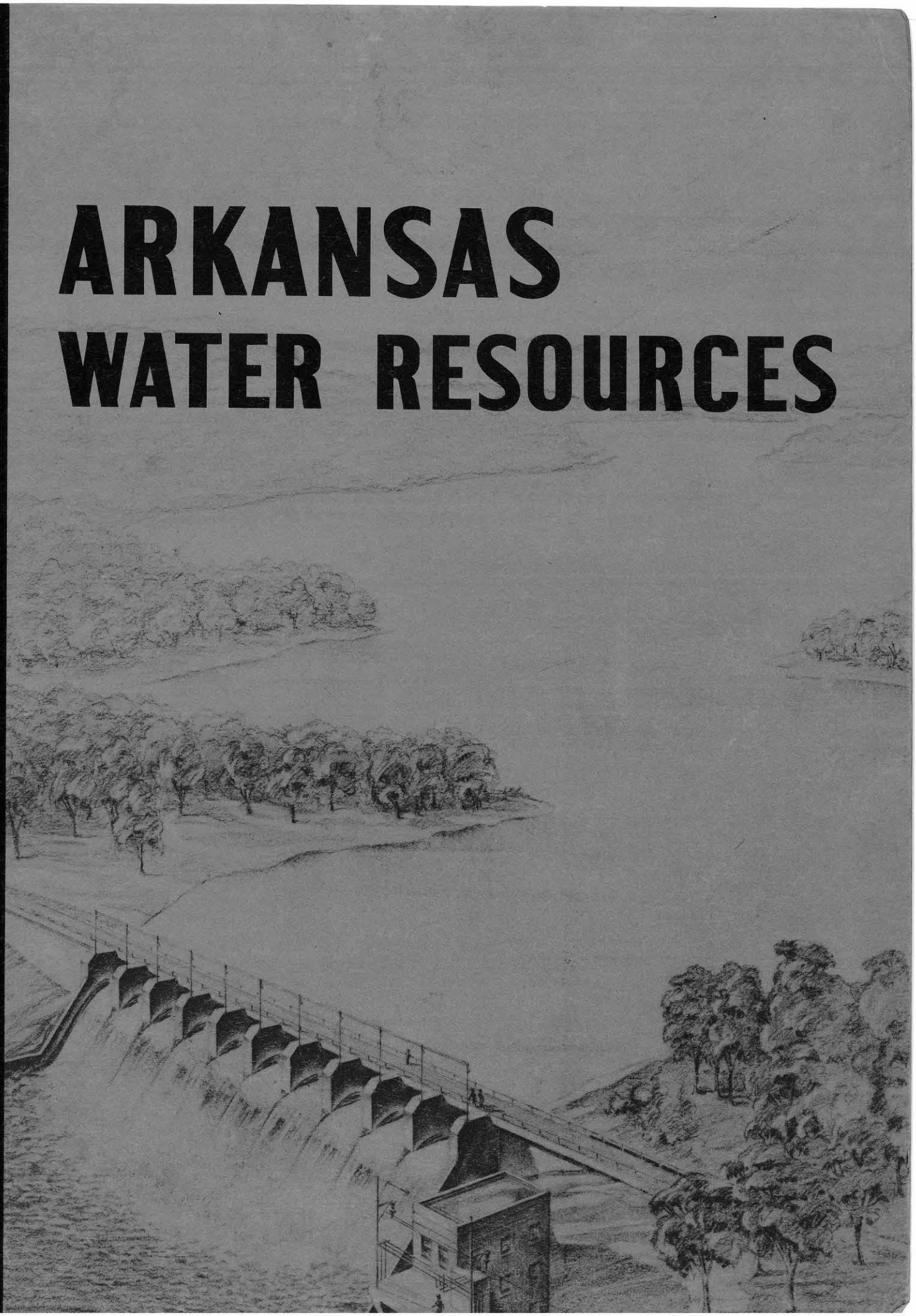
REPORT BY STATE PLANNING BOARD – 1939

ARKANSAS WATER RESOURCES



ARKANSAS
Water Resources

REPORT BY
ARKANSAS STATE
PLANNING BOARD

June, 1939

STATE CAPITOL
LITTLE ROCK, ARKANSAS

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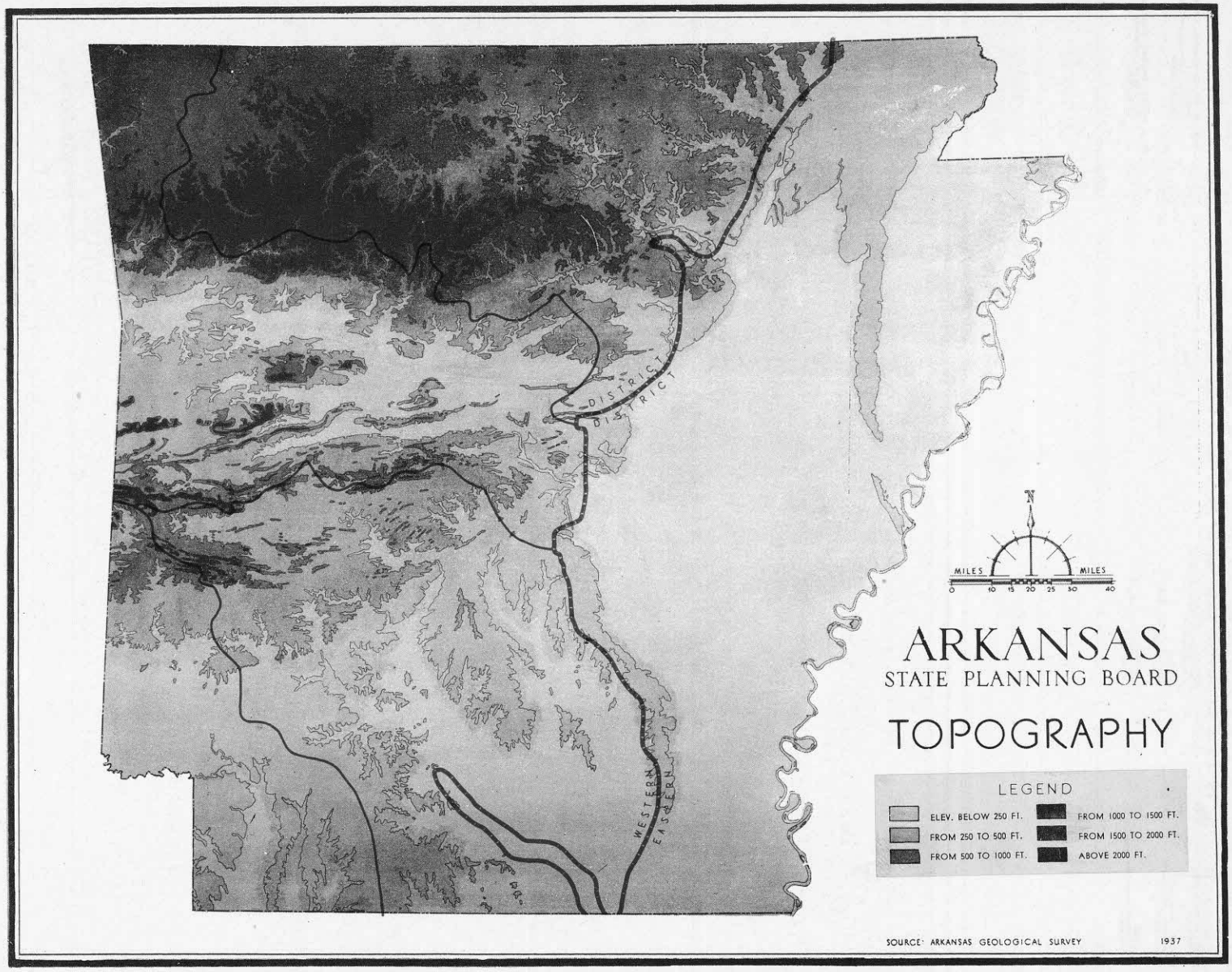

DISTRICT
DISTRICT
WESTERN
EASTERN
N
MILES
MILES
0 10 15 20 25 30 40
ARKANSAS
STATE PLANNING BOARD
TOPOGRAPHY
LEGEND
ELEV. BELOW 250 FT.
FROM 250 TO 500 FT.
FROM 500 TO 1000 FT.
FROM 1000 TO 1500 FT.
FROM 1500 TO 2000 FT.
ABOVE 2000 FT.
SOURCE: ARKANSAS GEOLOGICAL SURVEY
1937

Honorable Carl E. Bailey
Governor of Arkansas
State Capitol
Little Rock, Arkansas

Dear Governor Bailey:

I have the honor to hand you herewith the report of the State Planning Board, "Arkansas Water Resources". The report, which has been in course of preparation since 1937, is the work of the Board's Water Resources Committee, and represents the first attempt of any state agency to assemble data on all phases of the State's water resources and to discuss the subject in a comprehensive manner. The Committee also attempts to coordinate the water planning of the State with that of other states concerned through cooperation with representatives of the National Resources Committee.

It is to be hoped that this report will lay the foundation for a more complete understanding of the great value of our water resources, and the need for far-sighted planning for their most advantageous use. It is further apparent that in the future the State should follow one of two plans with respect to the administration of a program for water use and control. Either, (1) it should broaden the scope of the duties of one of the existing state agencies, charged with the administration of some phase of the water program to include all phases of water use and control; or, (2) a new agency should be created, the function of which is to administer all phases of the State program. In either case, the agency concerned should be provided with adequate funds.

Respectfully submitted,

Chas. L. Thompson

Charles L. Thompson
Chairman

July 1, 1939

CLT:c

ARKANSAS

STATE PLANNING BOARD

WATERSHED OF THE

MISSISSIPPI RIVER & TRIBUTARIES

DESCRIPTIVE · · · NOTE

MISSISSIPPI RIVER WATERSHED INCLUDES, WHOLLY OR PARTLY, THIRTY-ONE STATES AND PARTS OF TWO CANADIAN PROVINCES, REACHING FROM A POINT IN PENNSYLVANIA 250 MILES FROM THE ATLANTIC OCEAN ON THE EAST, TO A POINT IN IDAHO 500 MILES FROM THE PACIFIC OCEAN ON THE WEST. AREA EMBRACES APPROX. 1,250,000 SQ. MILES, OR 40 PERCENT OF THE 3,026,789 SQ. MILES IN THE UNITED STATES. TOTAL LENGTH OF RIVER IS 2,486 MILES. FALL IN ELEVATION FROM SOURCE TO MOUTH IS APPROX. 850 FEET.

SOURCE: NATIONAL RESOURCES COMMITTEE REPORT

PLATE 2

TABLE OF CONTENTS

LIST OF ILLUSTRATIONS

Foreword

The members of the State Planning Board have been in entire agreement as to the economic and social importance of Arkansas's water resources to the people who live in the State, since the creation of the Board in 1935. The Board has also recognized that there was a serious lack of basic data with which to support recommendations for many needed projects for water use and control. As is well known, there has never been any single State agency which devoted its entire time to the comprehensive study of the subject of water conservation. For example, stream gaging is now being carried on in Arkansas by the United States Geological Survey in cooperation with the Arkansas Geological Survey and the State Highway Department, and stream pollution studies are a small part of the work of the State Board of Health. The Corps of Engineers, United States Army, acting through five different offices, is the only reliable agency from which much of the essential data required for a study of water problems, can be secured. Since the project reports of the Corps of Engineers are not available to the public until published by Congress, it frequently happens that much valuable data is not accessible to State agencies for many months after they are collected.

The National Resources Committee (name changed on July 1, 1939, to National Resources Planning Board) and its predecessors, the National Resources Board and the National Planning Board, has, since early in 1934, emphasized the need for a more thorough study of water use and the development of plans based on the principle of coordinated use. The State Planning Board, therefore, is glad to contribute a State study of water resources at the time when the nation-wide study undertaken by the National Resources Committee is in progress. Much of the data used in this report have been obtained in connection with the State's cooperation with the National agencies in basin-wide studies under the direction of the National Resources Committee.

This report, begun in 1937, has been made under the direction of the Board's Water Resources Committee, under the chairmanship of George C. Branner, State Geologist. The Committee has had the benefit of the services of Mr. W. W. Horner a hydrologic engineer of St. Louis, assigned to the Board by the National Resources Committee. Mr. Earl O. Mills, Planning Counselor for the National Resources Committee has advised the Committee and the staff. The services of the engineers, L. W. Lenhart, Dane M. Greer, and M. Z. Bair were employed in assembling the necessary data. The preparation of the technical data used in the report, by the Planning Board staff, was directed by L. A. Henry. The text was written by Marion L. Crist, whose services were donated by the Little Rock Municipal Waterworks Commission.

This report is essentially a statement of progress, consisting, as it does, of an interpretation of all available data on hand which can be used as a basis for a program of water use and control. It is in no sense a final plan for water development. Present data, in the hands of State governmental agencies, are entirely too meager to make possible the preparation of a complete plan, and this deficiency has been indicated at several places in this report.

A tentative project list has been included with each basin chapter. Only those projects have been listed which have received sufficient investigation to cause the Committee to feel that they merit serious consideration. The total number of projects in these lists is 275 and the aggregate of the preliminary estimates of cost is $65,845,000.

The report has placed much emphasis on the present status of water engineering in Arkansas. It brings out forcefully the need for State government participation in water development through some official water agency, having a full time engineering staff, devoted to the solution of problems of water use and control.

Acknowledgment is gratefully extended to the Board's Water Resources Committee, the National Resources Committee, the United States Army Engineers, United States Soil Conservation Service, National Forest Service, State Department of Public Utilities, Arkansas Geological Survey, State Flood Control Commission, Little Rock Municipal Waterworks Commission, and to many other agencies and individuals whose cooperation has made possible the preparation of the report

CHAPTER I

SYNOPSIS, FINDINGS AND RECOMMENDATIONS

The people of Arkansas are prone to underestimate the great value of the water resources of their State consisting, as they do, of thousands of square miles of bountifully watered fertile lands and timbered mountains. Occasionally through the occurrence of a major flood the menace of the larger streams is brought forcefully to the public attention, or again the financial difficulties of a drainage district temporarily accentuates another of the State's water problems; but, unlike in the semi-arid western states, little serious thought is given to the true worth of this resource with which Arkansas is so richly endowed, and with respect to which it is pre-eminent in the whole Southwest. The proper utilization of these water resources might properly be the major interest of the people of Arkansas for the next generation.

National water planning became a reality only as recently as 1935, when the Water Resources Committee of the National Resources Committee was instructed to make a nationwide study of drainage basins for the purposes of: determining the nation's major water problems; outlining in general terms an integrated plan of water development; and presenting specific projects in the priority of their importance, to solve the basic problems and outline an integrated plan.

While the need for state planning in connection with a resource as important as water has long been apparent, it has become even more imperative with the advent of regional planning. To insure that Arkansas's interests are fairly recognized in any national plan requires intimate knowledge of the State's water problems and resources and competent representation of the State's interests.

This report has been prepared, therefore, in an effort to outline both the water problems and resources of the State, and to suggest legislation, procedures, and projects, which will assist in the coordinated solution of the one and the development of the other.

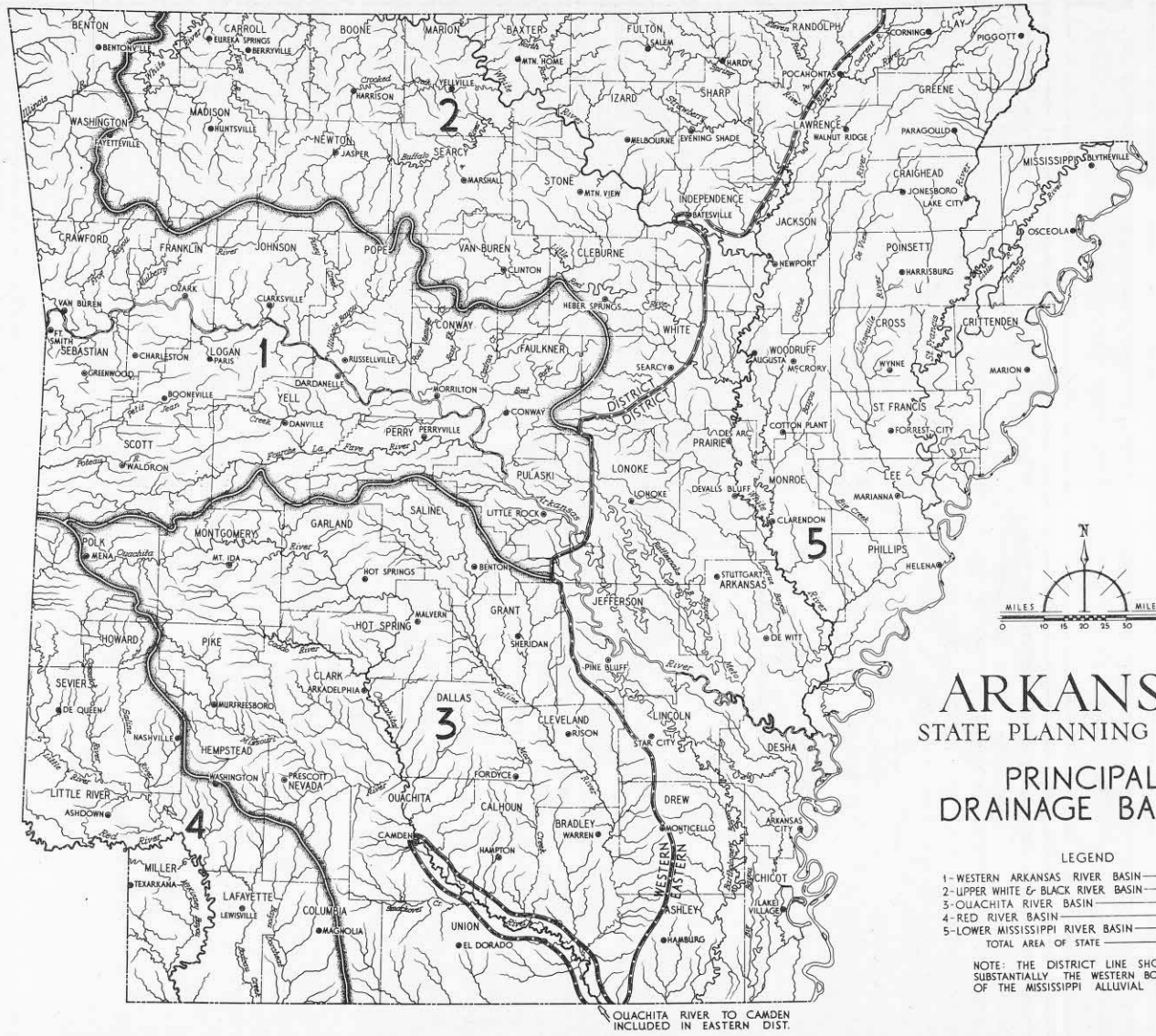
For the purpose of this report the State has been divided into five drainage basins governed by topography as shown on Plate 1 and following as closely as possible the geographical divisions used by the National Water Resources Committee. These basins, shown on Plate 3, comprise generally areas with specific water problems peculiar to each basin, and more or less distinct from those of other basins. The five basins are: the Western Arkansas, the Upper White and Black, the Ouachita, the Red, and the Lower Mississippi.

The Western Arkansas Basin, including all of the drainage area of the Arkansas River and its tributaries above the eastern Pulaski County line, is a mountainous region, almost equally divided into northern and southern portions by the river, with its broad rolling valley. Well watered, but subject to wide variations in stream flow, the chief water problem of the basin is that of stream flow regulation. Through the elimination of floods which frequently inundate much of the superior soil, agricultural development will be stabilized and stimulated. Increased low stream flows, particularly for the smaller streams, will assist in eliminating and preventing pollution, and will be of material value also to the Arkansas River itself should that stream be made navigable.

A complete restudy of the entire problem of flood control and stream regulation in the Western Arkansas Basin is suggested as urgently necessary, because of major changes in economic considerations since the last comprehensive study made about 1932. Expansion of National Forests, recreational development, and the more common use of impounded surface water for domestic supplies are all reasonable and in keeping with the needs of this basin.

The Upper White and Black River Basin, extending from Fayetteville on the west along the Arkansas-Missouri line to Searcy and Batesville on the east, is the scenic wonderland of the State. This region offers two great potentialities. Its steep forested mountains with their narrow valleys and swift-flowing clear mountain streams offer possibilities for important hydro-electric development that should no longer be overlooked. They also offer an opportunity for the development of a great playground area for the millions of people in the corn-belt states to the north, the semi-arid states to the west, and the lowland states to the south, southeast and southwest.

For this basin a complete study of power markets, both existing and possible of develop-



ARKANSAS

STATE PLANNING BOARD

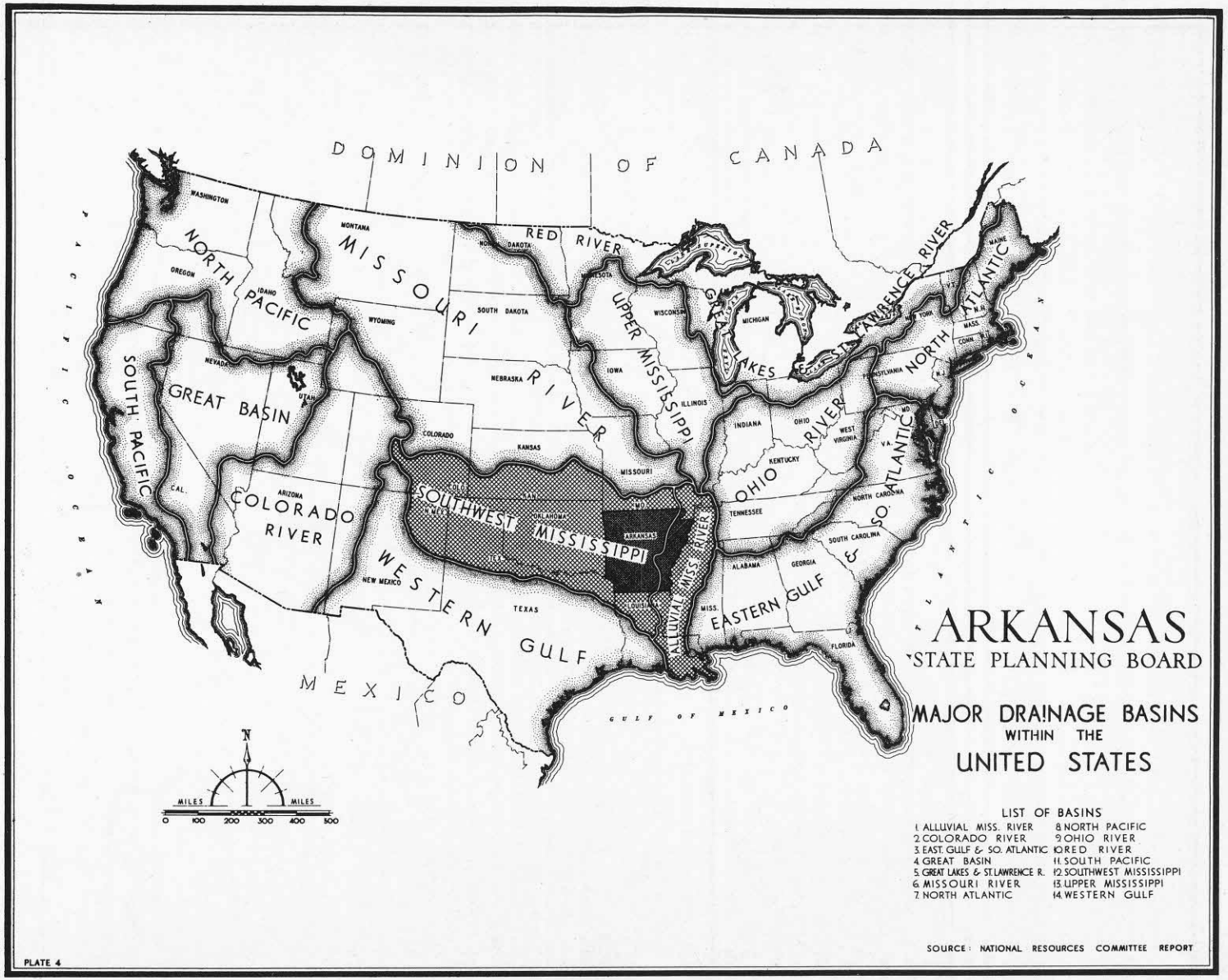
PRINCIPAL DRAINAGE BASINS

LEGEND

1-WESTERN ARKANSAS RIVER BASIN	10,461 SQ.MI.
2-UPPER WHITE & BLACK RIVER BASIN	9,830 SQ.MI.
3-OUACHITA RIVER BASIN	11,517 SQ.MI.
4-RED RIVER BASIN	4,522 SQ.MI.
5-LOWER MISSISSIPPI RIVER BASIN	17,005 SQ.MI.
TOTAL AREA OF STATE	53,335 SQ.MI.

NOTE: THE DISTRICT LINE SHOWN IS SUBSTANTIALLY THE WESTERN BOUNDARY OF THE MISSISSIPPI ALLUVIAL VALLEY

PLATE 3



ARKANSAS
STATE PLANNING BOARD

MAJOR DRAINAGE BASINS WITHIN THE UNITED STATES

LIST OF BASINS

1. ALLUVIAL MISS. RIVER
2. COLORADO RIVER
3. EAST. GULF & SO. ATLANTIC
4. GREAT BASIN
5. GREAT LAKES & ST. LAWRENCE R.
6. MISSOURI RIVER
7. NORTH ATLANTIC
8. NORTH PACIFIC
9. OHIO RIVER
10. RED RIVER
11. SOUTH PACIFIC
12. SOUTHWEST MISSISSIPPI
13. UPPER MISSISSIPPI
14. WESTERN GULF

SOURCE: NATIONAL RESOURCES COMMITTEE REPORT

PLATE 4

ment, and a detailed study of power generating costs should be made, immediately, by an agency interested solely in the development of the State. Included in this study should be an exhaustive analysis of the possibility of utilizing the potential hydro-electric energy in the mining and processing of local minerals.

The development of recreational facilities on a broad scale, with ample publicity for the scenic beauty of this basin, appears immediately justifiable. Such development should be planned and executed under the direction of a state agency in order to achieve the greatest ultimate value.

The Ouachita River Basin includes about one-third of the gulf coastal plain of the State, and a portion of the Ouachita Mountain area. Well watered like the remainder of the State, and in the mountain division, composed of steep impervious slopes, the streams of the Ouachita Basin are subject to wide variation in flow. Flood damage is localized, but low flows intensify the effect of stream pollution from oil field wastes and domestic sewage. Erosion has been heavy.

The further development of hydro-electric power in this basin, and the possibility of its use in the local manufacture of aluminum offers promise for the future economic development of the State. This subject is discussed in detail in Chapter VII of this report. The principal commercially developed deposit of bauxite in the nation lies within and adjacent to this Basin, but ore from this deposit is now being shipped outside of the State for manufacture, chiefly because of the lack there of cheap electrical energy. For the welfare of the State it appears mandatory that exhaustive analyses be made of all power possibilities. This should be done by competent authorities interested in the State's welfare.

Recreational development within this basin is well advanced. Hot Springs National Park, with its attractive surroundings, is the chief tourist mecca of the State. Expansion of recreational facilities to include much of the Ouachita Mountain portion of the basin is desirable. The program of the Ouachita National Forest includes development of various recreational facilities. This work is well advanced.

Other minor problems of this basin, which would affect or be affected by the solution of the primary problems, are: localized flood control; improvement of low-water stream flows; elimination of pollution; and proper land management to reduce erosion.

The Red River Basin, in the southwest portion of the State, also includes areas of the Ouachita Mountains and the gulf coastal plain. Its problems are not greatly unlike those of the Ouachita Basin except that flood control is of greater importance; the possibility of hydro-electric development, though present, is limited to fewer and smaller installations; and the need for the rehabilitation and refinancing of drainage districts is great.

In view of the fertility of the lands now subject to inundation by floods, and of contemplated flood reduction projects on the headwaters of the Red in other states, it is recommended that there be made a supplementary study to that of 1931, of the flood control problem in this basin. It is suggested, also, that a coordinated plan of land drainage be evolved under experienced direction, utilizing and rehabilitating existing projects in so far as possible, and that present malaria control measures be continued and expanded. With adequate flood reduction works, land drainage and malaria control, the Red River Basin will afford a vast acreage of alluvial lands for resettlement of families now living on land of low productivity.

The lower Mississippi Basin, comprising all of the alluvial plain of the Mississippi and small portions of the gulf coastal plain, is now the substantial agricultural section of the State. Possessed of deep fertile soils, of a long growing season, and of ample rainfall, this basin will undoubtedly remain predominantly agricultural. Its chief water problem is protection from occasional tremendous floods created by water from beyond the bounds of the basin, which in extreme high water inundates nearly half of the total area. Next to the flood problem the financial difficulties of the numerous drainage and levee districts and their refinancing on a sound economic basis, is of greatest urgency. Other problems include: Supplementing the present well water supplies for rice irrigation in the Grand Prairie region; further control of malaria and water borne diseases; and the coordination of game refuges with such natural flood retarding basins as study indicates should be retained in their present state for flood control.

It is recommended that appropriate Arkansas agencies be adequately provided with funds to advise and assist in the working out of a comprehensive plan of flood control within the lower Mississippi Basin. It is recommended, also, that drainage and levee districts be refinanced and rehabilitated under proper State guidance in order to achieve an integrated land

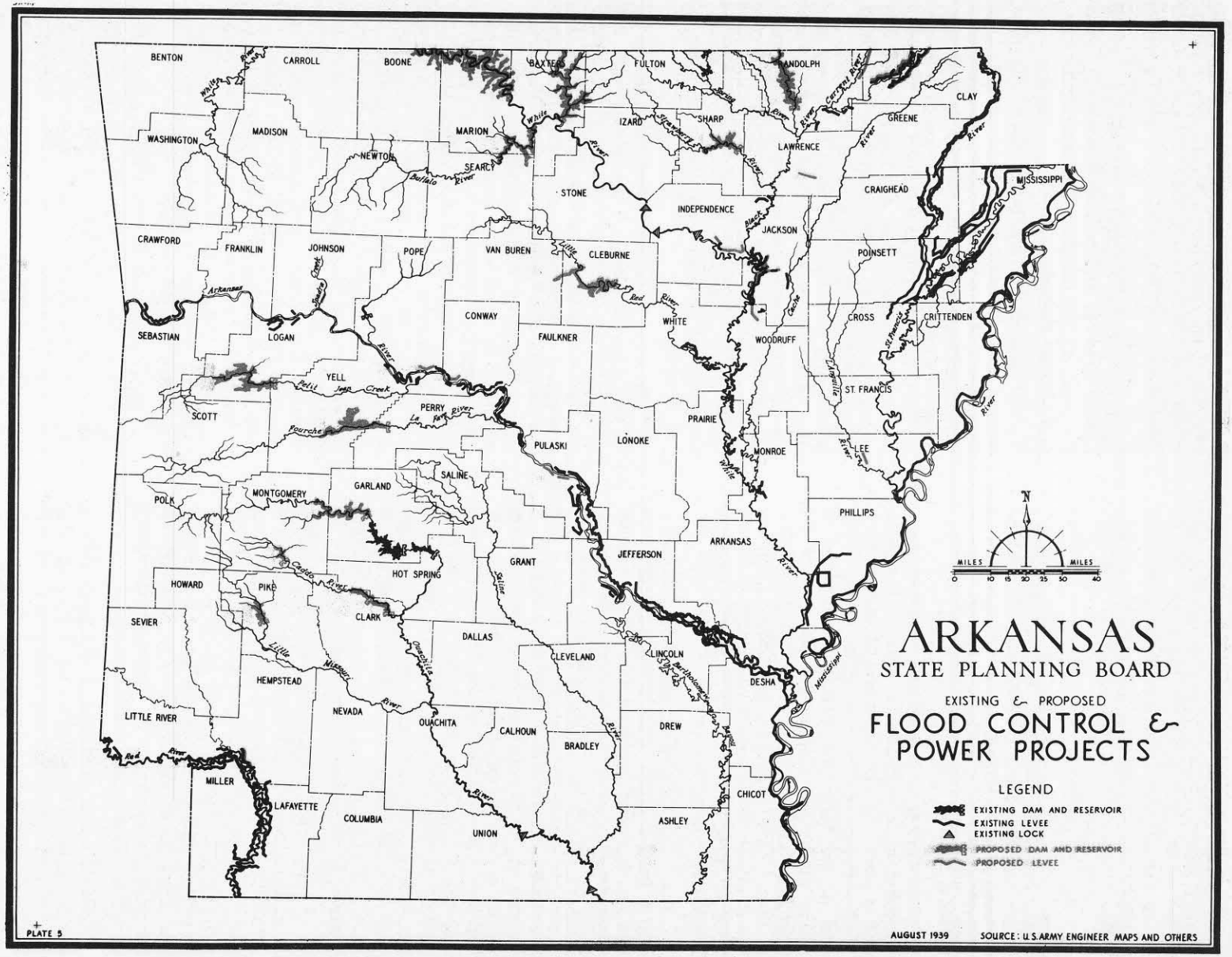
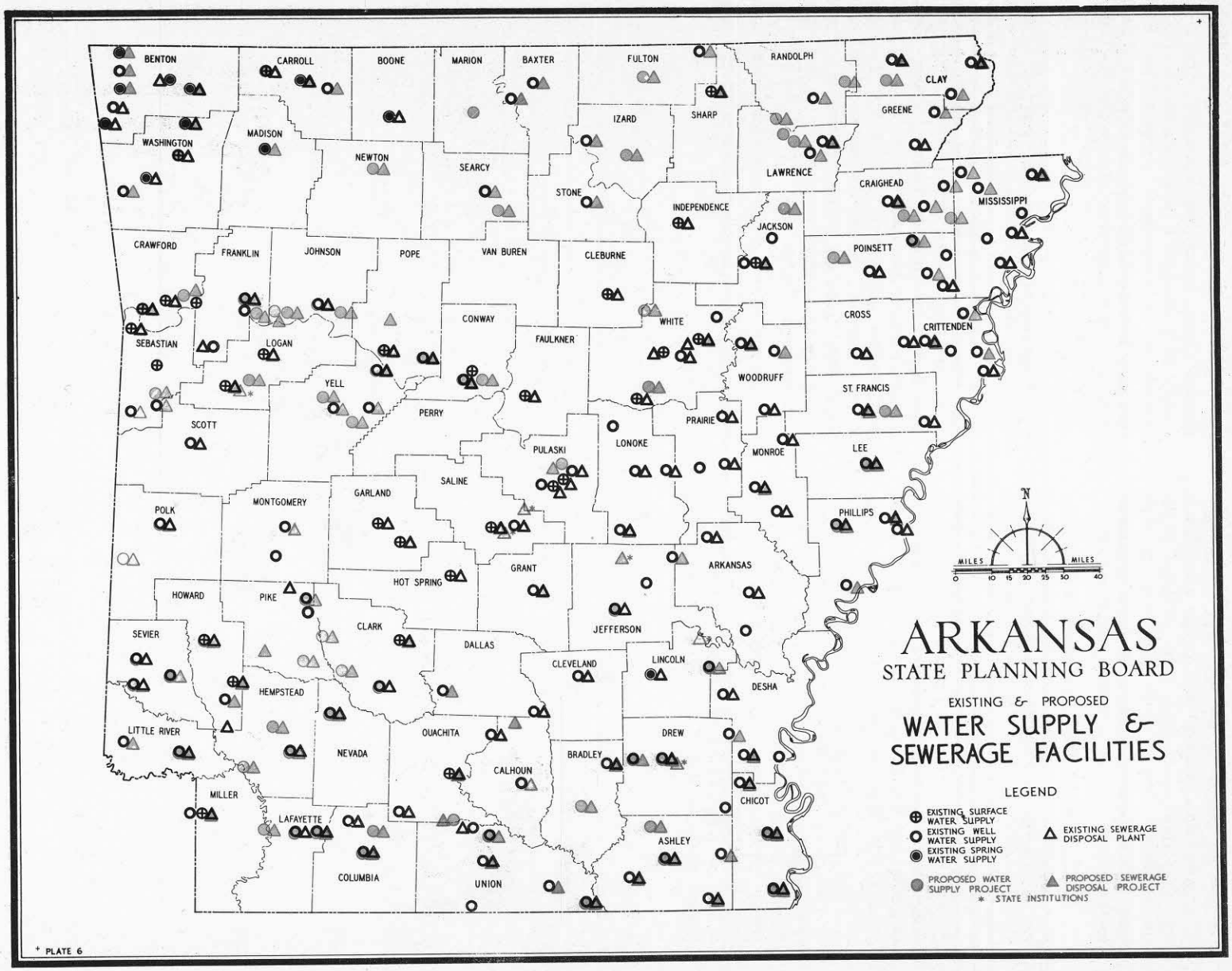


PLATE 5

AUGUST 1939 SOURCE: U.S. ARMY ENGINEER MAPS AND OTHERS



ARKANSAS

STATE PLANNING BOARD

EXISTING & PROPOSED

WATER SUPPLY & SEWERAGE FACILITIES

LEGEND

- EXISTING SURFACE WATER SUPPLY
- EXISTING WELL WATER SUPPLY
- EXISTING SPRING WATER SUPPLY
- EXISTING SEWERAGE DISPOSAL PLANT
- PROPOSED WATER SUPPLY PROJECT
- PROPOSED SEWERAGE DISPOSAL PROJECT
- * STATE INSTITUTIONS

+ PLATE 6

drainage plan, adjusted to the statewide interest. And, finally, it is suggested that detailed studies be made of the cost and advantages of augmenting present well water supplies in the rice producing area from surface water impounded in small local reservoirs, as compared to importing such water over a considerable distance from a single major project.

Each of these basins is discussed in detail in succeeding chapters, and for each basin a list of specific projects is suggested. The projects so proposed are believed to be the most logical ones in the light of present knowledge and the probable future development of these different basins. Plates 5 and 6 show the location of all principal existing and proposed projects for flood control and power, water supply and sewage facilities.

For the welfare of people of Arkansas it is necessary that the State government take a more active technical part in the future solution of water problems, and the planning of water development, than has been possible with the limited finances of the past. In order to secure a just share of future Federal Aid on water projects the State of Arkansas must properly determine and submit plans for solution of its water problems. To prevent the lands reclaimed and protected by drainage and levee districts from becoming bankrupt under the weight of overlapping assessments, careful coordination of individual projects by State authority is necessary. To remove the element of doubt from the solution of many of the State's water problems, sound basic information is essential.

It is recommended that there be established, by the State, a permanent Water Resources Commission, consisting of thoroughly qualified, technical men who can coordinate and direct the solution of the State's water problems to the best interest of her citizens. Such a Commission should consist of recognized engineering authorities, in the various fields to be covered. It should be provided with legal and financial advisors, and with funds necessary to conduct its work in an intelligent and efficient manner.

Only through such organized, intelligent planning efforts, can the State of Arkansas hope to perfect its unique gift of nature—its water resources.

Photos by Frank Newell

Scenes Along White and Cache Rivers During 1937 Flood

CHAPTER II

NEED OF STATE WATER PLANNING

Water planning in the past has been largely of two types: either strictly local planning by local organizations seeking to solve specific problems, or Federal planning by agencies of the Federal Government, solving problems from the national viewpoint. Both of these types are essential, but they are not sufficient in themselves to insure that the people of Arkansas will obtain the maximum value from their water resources.

The various difficulties that have developed in the drainage and levee districts of the State are examples of the faults and limitations of localized planning. Overlapping assessments on the same lands for different projects have pyramided beyond the ability of the landowners to pay. Consideration of these projects from a broader viewpoint in advance of construction would have prevented many of the present difficulties and much wasteful expenditure.

On the other hand, planning by National agencies without full state participation may overlook potential values of local character, and seriously handicap the development of certain localities. For example, flood control on the Mississippi may seem to require the retention of certain natural flood retarding basins in Arkansas in their present natural condition. These basins are composed of fertile, deep soils capable of agricultural development, however, and their potential value as an asset to the State should be fully considered before any flood control plan requiring their abandonment is accepted. For another example, a major flood control reservoir on the Arkansas River at Little Rock may be of great value in preventing floods on the lower Mississippi, but it would flood much of the superior soil in the Western Arkansas Basin, disrupt the highway and railroad systems in the central portion of the State, and might by inundating a vast area in the heart of Arkansas, actually do more damage than benefit. Only through state planning of water resources, properly recognizing the interests of other states, can such problems of vital importance to the future welfare of this State be reasonably solved.

Certain projects for hydro-electric power developments in the White and Ouachita river basins are now under consideration; it is essential that these projects be so planned that this use of the waters be coordinated with other possible important uses. Pulp and textile industries moving southward expect to find reasonable legislation regarding stream pollution and proper facilities for water supply and waste disposal.

Much has been written in recent years as to the need of "Resettlement" in the United States. It is proposed that a part of the population now engaged in agriculture under unsatisfactory conditions be moved to other lands where they may become more self-sufficient. Invariably such proposals lead to the discussion of adequate water supply and soil moisture. From the Dakotas, families are moving to the Pacific Northwest where water is being led to some arid lands at tremendous cost.

Arkansas possesses a great acreage of highly fertile low land, ready for cultivation whenever it can be freed from the hazard of frequent inundations from floods.

There is therefore exceptional opportunity for resettlement, not only for some of the people of Arkansas, but for many from surrounding states who are now trying to eke out a living on worn out and eroded hill farms.

Such possibilities exist not only along the lower Mississippi, but in the Arkansas Valley and to an important degree on the frequently flooded lowlands along the Red River.

Arkansas, with nearly one-fifth of its total area subject to flood inundation, should share heavily in future Federal flood control projects. Effective preparation for this can only be achieved by thorough planning through State agencies.

Much valuable basic planning has already been done. The War Department through the Corps of Engineers has been and is the National authority on flood control of the major streams. Its reports on the Arkansas and its tributaries, and on the White, Red and Ouachita rivers, generally referred to as the "308 Reports," are based on studies prior to 1932. They were limited in scope by the authorizing legislation, but were of great value, and contain a major portion of the basic information available on flood control in these basins. The changed

economic conditions of the last seven years and additional data which have become available undoubtedly render some of the original conclusions invalid as to many proposals and projects.

The Mississippi River Commission has jurisdiction with respect to flood control on the Lower Mississippi River. It has developed basic information on the behavior of the Mississippi in flood.

Comprehensive data on land drainage in Arkansas are meager. Each drainage and levee district is a separate organization for the construction of projects of local interest. The lack of coordination of these projects is evidenced by many overlapping assessments and resulting heavy delinquencies. The most complete information available on the present financial conditions of drainage and levee districts is contained in the records of the Federal Land Bank of St. Louis. Very little specific information is available on the condition of the physical works in many of these districts. This problem is too local for Federal planning, but it is too broad for strictly local planning. It can be properly solved only by assistance of State agencies.

Hydro-electric power possibilities have been studied by the Corps of Engineers at a number of sites on Arkansas rivers, and this information is available in their "308" and other reports. In addition thereto, information on hydro-electric power companies and applications for licenses is available from the State Department of Public Utilities and the Federal Power Commission, and a number of reports have been prepared on the subject by individuals. Little has been done toward the detailed evaluation of potential power markets in the mining and processing of the mineral resources of the State, or toward the possible development of these markets. A study of these opportunities should be carried forward by the State in order to secure earliest economic development.

Stream pollution has not been studied extensively. Some information is available in the records of the State Board of Health, but will require amplification in order to make it sufficiently comprehensive to indicate the extent of pollution or the measures needed to abate it.

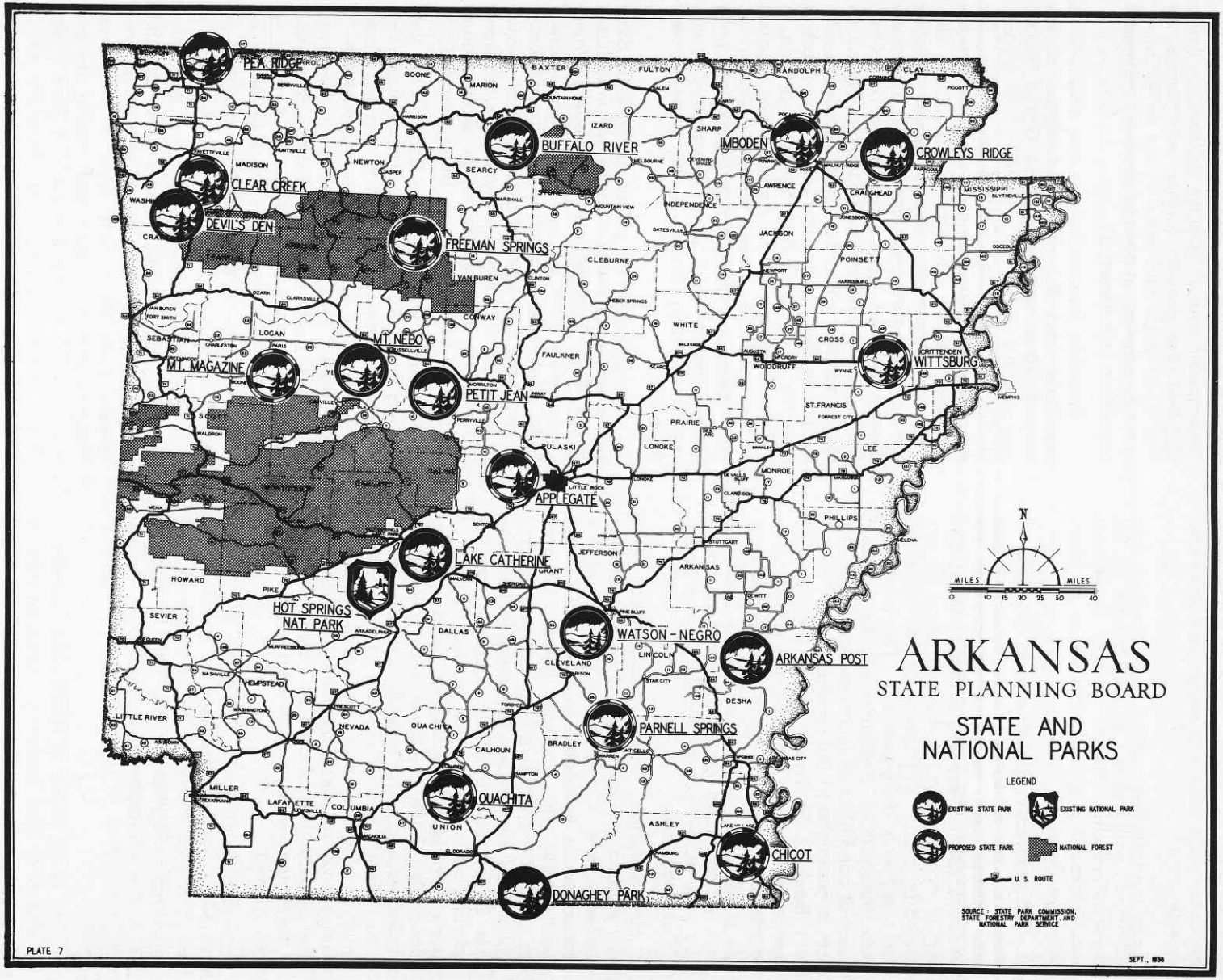
The State Board of Health has records of the chemical and bacterial characteristics of most of the urban water supplies of the State. A valuable survey of ground water quality is now being undertaken as an Arkansas Geological Survey, W.P.A. Project, which will result in further information on the character of urban ground water supplies and farm wells. To properly correct existing pollution of water supplies and prevent further occurrences, as well as to guide and assist in the development of future supplies, statewide surveys and proper regulation are essential.

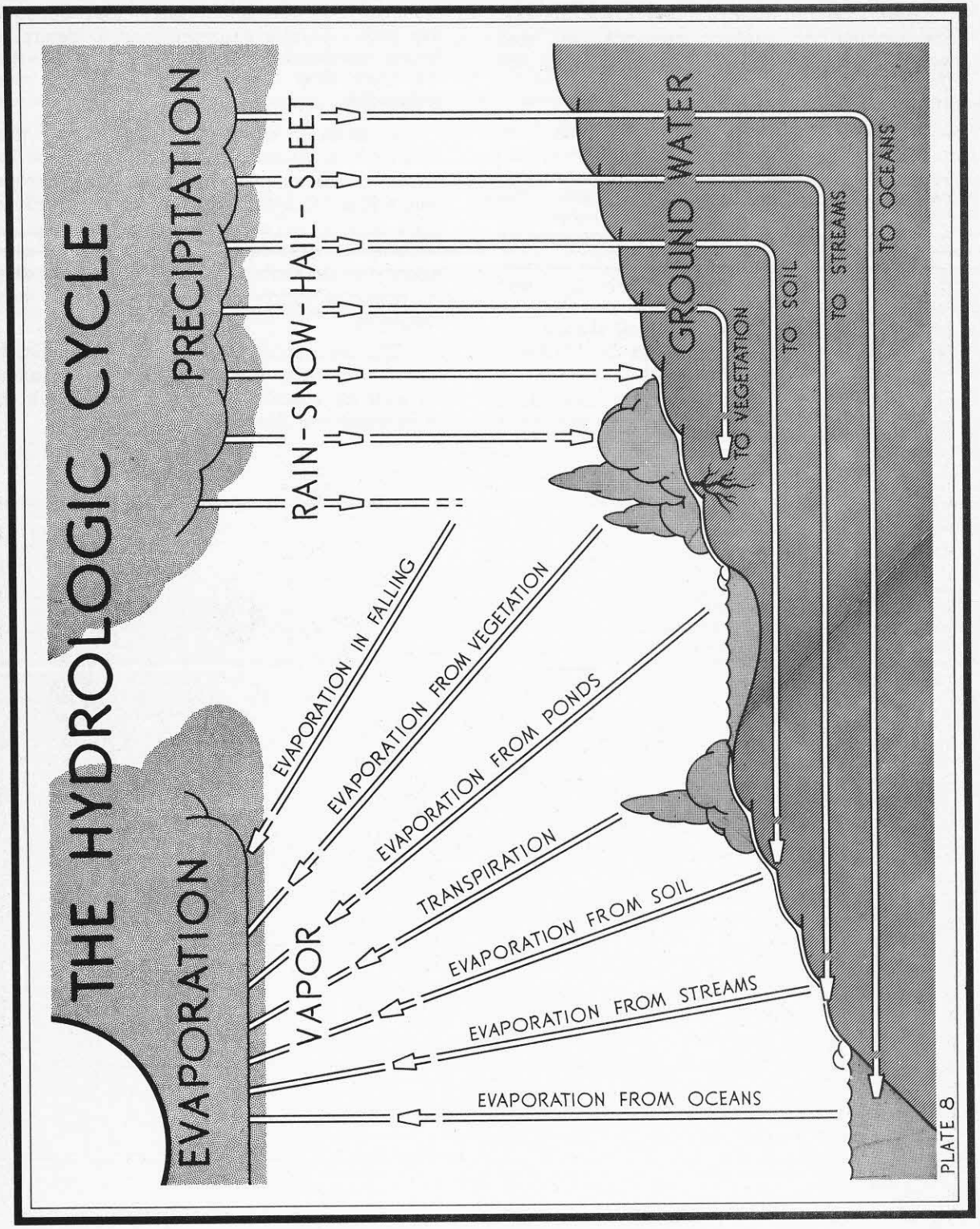
Valuable information on rice irrigation in the State, and the rate of depletion of the ground water supplies in the Grand Prairie rice growing region are available from records of the United States Geological Survey, the Arkansas Geological Survey, and the Rice Experiment Station, College of Agriculture, University of Arkansas. Ground water supplies are now being supplemented to an increasing degree by small local impounding reservoirs. A proposal for further supplementing the ground water supply which has had serious consideration is the construction of an impounding reservoir on the Little Red River with a canal to the Grand Prairie area. Ample water supplies for rice irrigation is very largely a State problem. Adequate studies of all possibilities by a State agency, and proper legislation with regard to water rights in this area appear desirable.

Navigation on the major rivers of the State has been or is being studied by the United States Army Engineers, by the Federal Power Commission, and by several civic organizations. Valuable information from these sources is available, but marked differences of opinion as to the significance of navigation with respect to the future development of the State suggest the need of further study by State agencies.

Valuable work is being done in the field of land management and control of erosion by the Soil Conservation Service and the Forest Service of the United States Department of Agriculture. Few published data are available particularly on the prevention of erosion, because this work has been undertaken so recently. The donation of State lands for experimental use in these studies and State coordination and assistance is desirable.

Recreational development and the advertising of the beautiful Ozark and Ouachita mountain playground areas should be very largely both State and local undertakings. Effective work has been done during the past few years in the development of State parks. These areas are becoming generally recognized as of great importance as tourist attractions. Integrated planning of public and private development and proper State publicity will


PEA RIDGE
BUFFALO RIVER
IMBODEN
CROWLEYS RIDGE
CLEAR CREEK
DEVIL'S DEN
FREEMAN SPRINGS
MT. NEBO
MT. MAGAZINE
PETIT JEAN
WITTSBURG
APPLEGATE
LAKE CATHERINE
HOT SPRINGS NAT. PARK
WATSON - NEGRO
ARKANSAS POST
PARNELL SPRINGS
QUACHITA
CHICOT
DONAGHEY PARK
BAXTER
FULTON
RANDOLPH
CLAY
BOONE
MARION
IZARD
SHARP
MADISON
NEWTON
SEARCY
LAWRENCE
CRAIGHEAD
MISSISSIPPI
INDEPENDENCE
JACKSON
CLEBURNE
POINSETT
IVAN BUREN
CONWAY
WHITE
CROSS
LOGAN
FAULKNER
WOODRUFF
CRITTENDEN
ST. FRANCIS
PRAIRIE
LONOKE
PULASKI
LEE
MONROE
PHILLIPS
JEFFERSON
ARKANSAS
HOWARD
PIKE
SEVIER
DALLAS
LINCOLN
DESHA
HEMPSTEAD
LITTLE RIVER
NEVADA
OUACHITA
CALHOUN
BRADLEY
MILLER
LAFAYETTE
COLUMBIA
UNION
ASHLEY
N
MILES
0 10 15 20 25 30 40
ARKANSAS
STATE PLANNING BOARD
STATE AND NATIONAL PARKS
LEGEND
EXISTING STATE PARK
EXISTING NATIONAL PARK
PROPOSED STATE PARK
NATIONAL FOREST
U. S. ROUTE
SOURCE: STATE PARK COMMISSION, STATE FORESTRY DEPARTMENT, AND NATIONAL PARK SERVICE
PLATE 7
SEPT., 1936


THE HYDROLOGIC CYCLE
PRECIPITATION
RAIN - SNOW - HAIL - SLEET
EVAPORATION
VAPOR
EVAPORATION IN FALLING
EVAPORATION FROM VEGETATION
EVAPORATION FROM PONDS
TRANSPIRATION
EVAPORATION FROM SOIL
EVAPORATION FROM STREAMS
EVAPORATION FROM OCEANS
GROUND WATER
TO VEGETATION
TO SOIL
TO STREAMS
TO OCEANS
PLATE 8

assist in securing increased revenue from this source.

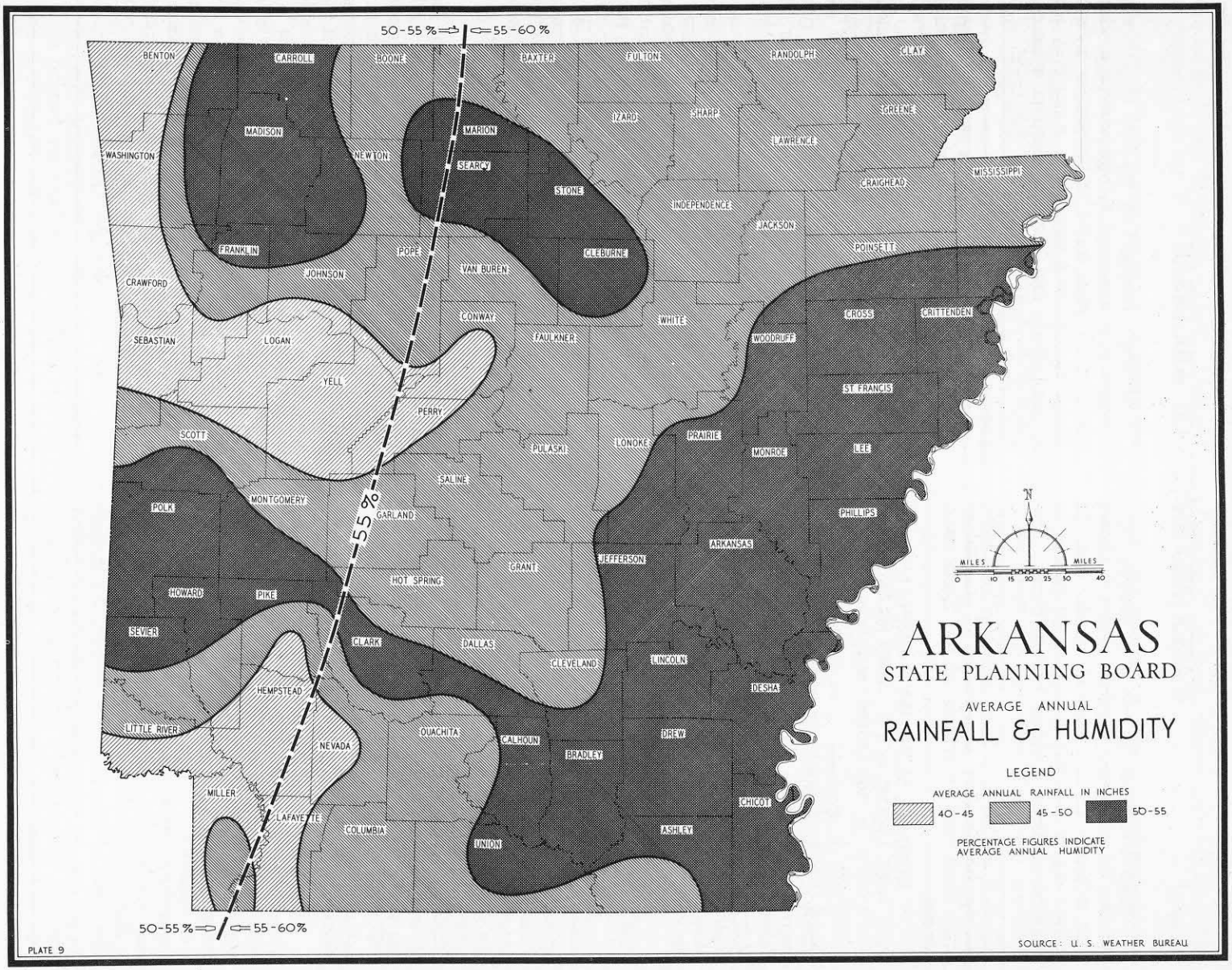
The status of malaria control and information concerning present methods are well known. Some of the early studies by the United States Public Health Service and by industries had their origin in Arkansas.

The Arkansas State Game and Fish Commission, the United States Biological Survey and the National Forest Service have contributed to the preservation of the State's wildlife. The numerous state and federal refuges, hatcheries, and preserves are evidence of the effective effort that has gone into this work. The increasing recognition of Arkansas as a fishing and hunting center for the east and middle west proves conclusively that this work should continue and be expanded to realize the full benefit from this natural endowment.

While much valuable work has been done on the various water problems, there are many problems yet unsolved; in their solution the State government must not only lend its guidance and assistance, but must take a constructive part. This is essential, first to determine which developments are in the best interest of the State and second to bring about their realization.

In order to coordinate strictly local projects such as drainage, malaria control, or irrigation problems, as well as to insure proper recognition of the State's interest in National flood control and navigation problems, the legislature of Arkansas should create a State agency or delegate powers and funds to existing agencies which will endeavor to solve these problems.

This report will attempt to outline the State's major water interests and to suggest solutions as well as specific projects which should be undertaken by State initiative.



ARKANSAS

STATE PLANNING BOARD

AVERAGE ANNUAL

RAINFALL & HUMIDITY

LEGEND

AVERAGE ANNUAL RAINFALL IN INCHES

40-45 | 45-50 | 50-55

PERCENTAGE FIGURES INDICATE AVERAGE ANNUAL HUMIDITY

PLATE 9

SOURCE: U. S. WEATHER BUREAU

CHAPTER III

WATER RESOURCES OF ARKANSAS

Arkansas receives what is usually considered on abundant rainfall. Plate 9 shows that average annual rainfall varies from 55 inches along the Mississippi to 40 inches in extreme western portions of the State. The average annual rainfall for the State as a whole is about 50 inches. The following table shows the monthly distribution of rainfall at Little Rock and is typical of the State as a whole:

NORMAL MONTHLY RAINFALL
AT LITTLE ROCK, ARKANSAS
U. S. WEATHER BUREAU

Month	Average Inches	Month	Average Inches
January	4.91	July	3.44
February	3.7	August	3.54
March	4.54	September	3.11
April	4.93	October	2.79
May	4.74	November	4.02
June	3.66	December	4.22

Annual average for 58-year period ending 1937—47.6 inches.

Normal rainfall is so great and so well distributed that even in years of great deficiency calamitous conditions do not occur. Serious droughts are relatively rare, although the droughts of 1930, 1934, and 1936 were damaging in Arkansas there was sufficient agricultural production in the alluvial valleys of the State to prevent human suffering and wide spread loss of livestock. Thus the greatest single water resource of the State is its well distributed rainfall, assuring well sustained agricultural production and making possible the ultimate restoration of the forests.

From the rainfall over the State, augmented by rainfall outside of its boundaries, grow the other water resources. As precipitated moisture reaches the earth's surface, it may, through the process of infiltration, become a part of the soil moisture. Infiltration varies greatly with the texture of the soil, the slope of the ground, and the character of vegetal covering. Thus in flat, sandy soils, well covered with vegetation, most of the rainfall is held on the surface until it can be taken into the ground by infiltration. In bare steeply sloping areas, of tight clay or dense rock, the rainfall is absorbed so slowly that most of it runs off and becomes stream flow.

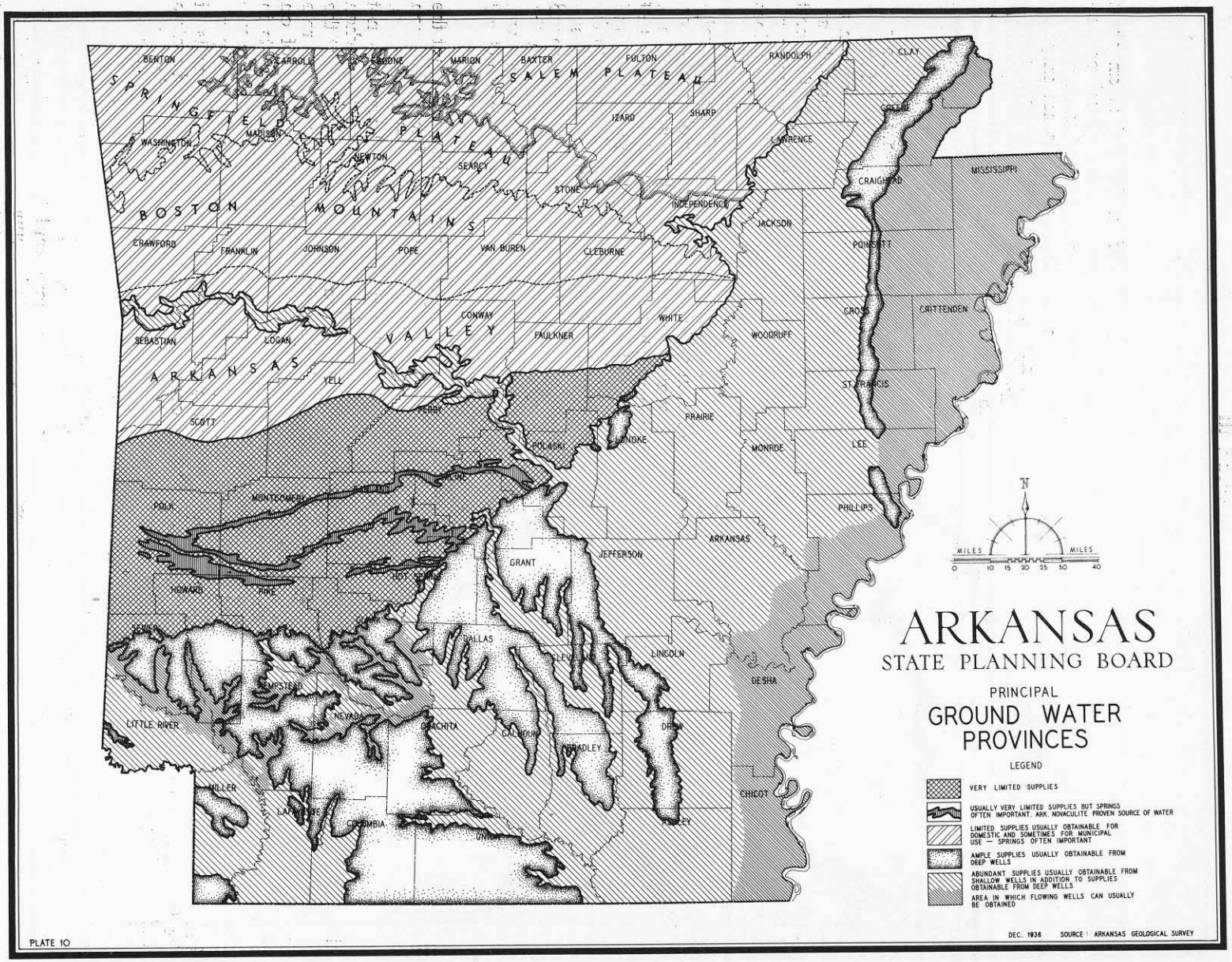
Moisture retained in the soil is an asset because it is essential to agricultural production and all other forms of vegetative growth. Water which flows off rapidly is not only lost to agricultural use, but may become a serious liability through erosion and the creation of damaging floods.

Thus, it is apparent, that the first opportunity to use more of the State's ample rainfall lies in its consumption near the point where it falls. All measures which retard the flow of water over the surface will increase infiltration and consequently soil moisture, in addition to reducing damages which occur through excessive run-offs. They will increase that part of the precipitation that is truly a water resource and reduce that part which is a loss and possibly a menace.

Exceeded in value only by the ample rainfall from which it results, the State's next greatest water resource is that of soil moisture. When precipitation filters into the soil, part of it is used by plants, some of it evaporates, and the remainder percolates more deeply into the ground and becomes a part of the true sub-surface water commonly referred to as ground water. This deep seepage is retained in the pores of the rocks, and may reappear at lower elevations as springs, or may be pumped out through wells for the uses of man.

It must be remembered, however, that the percolation and transmission of water through the soil and rocks is a very slow process. Therefore, the supply of ground water is not unlimited and care must be exercised when using ground water for a long period, that the rate of withdrawal does not exceed the rate of replenishment. A striking example of an overdraft on a ground water supply exists in Grand Prairie, Arkansas, where excessive use of well water for rice irrigation is slowly reducing ground water levels in some parts of the area. The economic use of ground waters requires the most accurate possible determination of the rate at which they are replenished.

Plate 10 shows the Ground Water provinces of the State. In general, the mountainous portion of the State by reason of the steep slopes there, and the impervious soils, offers only limited ground water supplies from wells except near the major streams where



ARKANSAS

STATE PLANNING BOARD

PRINCIPAL

GROUND WATER PROVINCES

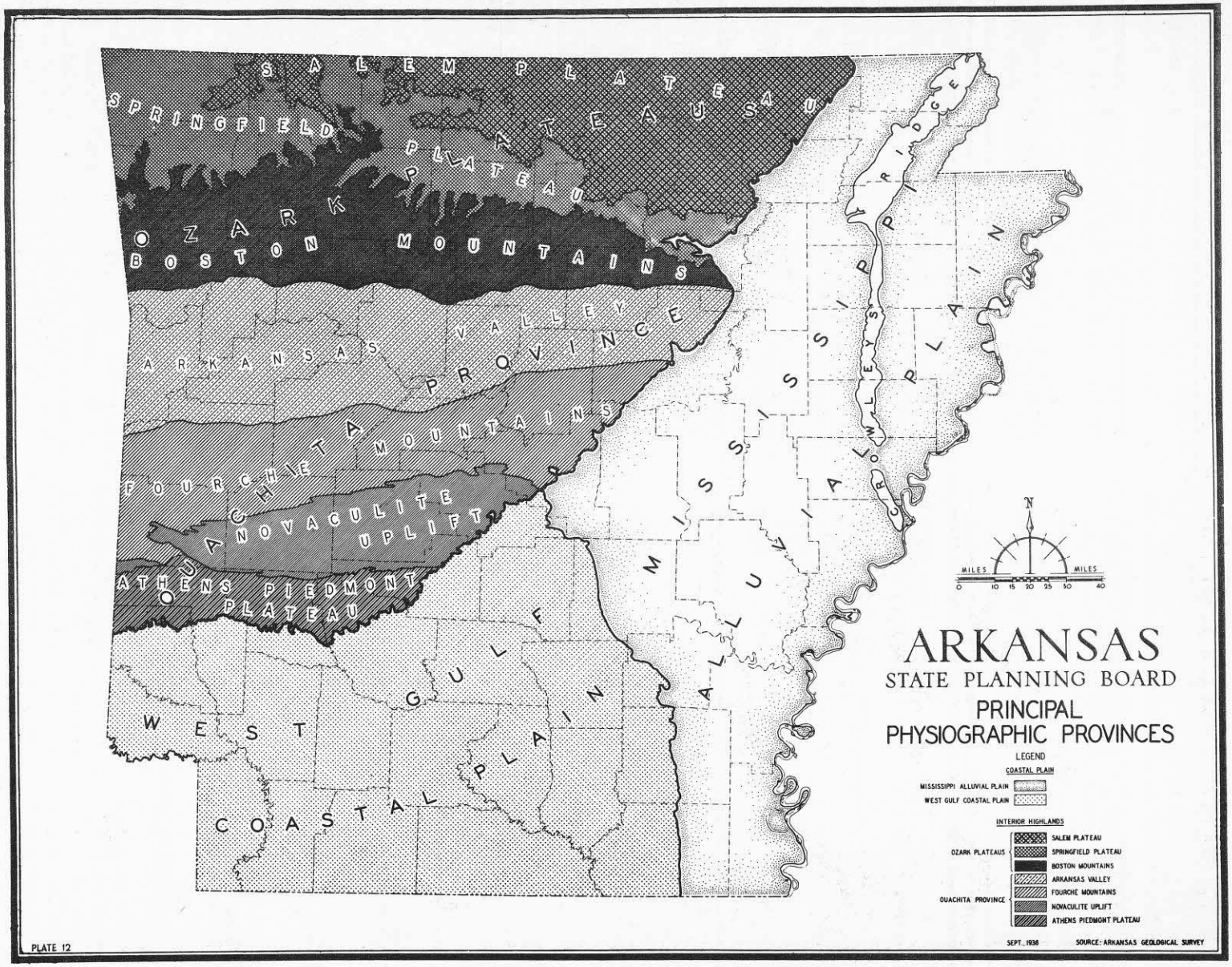
LEGEND

- VERY LIMITED SUPPLIES
- USUALLY VERY LIMITED SUPPLIES BUT SPRINGS OFTEN IMPORTANT. ARK. NOVACULITE PROVEN SOURCE OF WATER
- LIMITED SUPPLIES USUALLY OBTAINABLE FOR DOMESTIC AND SOMETIMES FOR MUNICIPAL USE — SPRINGS OFTEN IMPORTANT
- AMPLE SUPPLIES USUALLY OBTAINABLE FROM DEEP WELLS
- ABUNDANT SUPPLIES USUALLY OBTAINABLE FROM SHALLOW WELLS IN ADDITION TO SUPPLIES OBTAINABLE FROM DEEP WELLS
- AREA IN WHICH FLOWING WELLS CAN USUALLY BE OBTAINED

DEC. 1936 SOURCE : ARKANSAS GEOLOGICAL SURVEY

PLATE 10


ELEVEN POINT RIVER
BARDLEY, MO.
CURRENT RIVER
VAN BUREN, MO., 94 MI.
WHITE RIVER
BRANSON, MO.
525 MILES
BUFFALO RIVER
30 MILES
SPRING RIVER
SLOAN CREEK-8 MI.
BLACK RIVER
2 MI. ABOVE MENGO, MO.
219 MILES
ST. FRANCIS RIVER
WAPPAPELLO, MO.
338 MILES
ARKANSAS RIVER
FT. GIBSON, OKLA.
465 MILES
CADRON CREEK
2 MILES
PETIT JEAN RIVER
25 MILES
FOURCHE LA FAVE RIVER
27 MILES
LITTLE RED RIVER
BEE ROCK
36 MILES
L'ANGUILLE RIVER
MARIANNA – 9 MILES
LITTLE RIVER
2 MILES
BLACKFISH BAYOU
6 MILES
LITTLE RIVER
84 MILES
LITTLE MISSOURI RIVER
25 MILES
SALINE RIVER
TURTLE BAR
117 MILES
OUACHITA RIVER
180.9 MILES
417.3 MILES IN ALL
RED RIVER
188.9 MILES
558 MILES IN ALL
BARTHOLOMEW BAYOU
BAXTER — 134 MILES
BENTON
CARROLL
BOONE
BAXTER
FULTON
RANDOLPH
CLAY
GREENE
MISSISSIPPI
CRAIGHEAD
WASHINGTON
MADISON
NEWTON
MARION
IZARD
SEARCY
STONE
SHARP
LAWRENCE
INDEPENDENCE
JACKSON
POINSETT
CRITTENDEN
CROSS
WOODRUFF
ST. FRANCIS
CRAWFORD
FRANKLIN
JOHNSON
POPE
VAN BUREN
CLEBURNE
CONWAY
FAULKNER
WHITE
SEBASTIAN
LOGAN
SCOTT
PERRY
YELL
PRAIRIE
PULASKI
LONOKE
MONROE
LEE
PHILLIPS
SALINE
GARLAND
MONTGOMERY
POLK
ARKANSAS
GRANT
JEFFERSON
HOT SPRING
HOWARD
PIKE
CLARK
SEVIER
DALLAS
CLEVELAND
LINCOLN
DESHA
HEMPSTEAD
LITTLE RIVER
OUACHITA
CALHOUN
BRADLEY
DREW
NEVADA
MILLER
LAFAYETTE
COLUMBIA
UNION
ASHLEY
CHICOT
N
MILES
MILES
0 10 15 20 25 30 40
ARKANSAS
STATE PLANNING BOARD
NAVIGABLE STREAMS
LEGEND
MILEAGE GIVEN FROM MOUTH
TO HEAD OF NAVIGATION
NAVIGABLE PORTION OF STREAM
PLATE 11
SOURCE: U.S. ARMY ENGINEERS


SALEM PLATEAU
SPRINGFIELD PLATEAU
OZARK PLATEAUS
BOSTON MOUNTAINS
ARKANSAS VALLEY
OUACHITA PROVINCE
FOURCHE MOUNTAINS
NOVACULITE UPLIFT
ATHENS PIEDMONT PLATEAU
MISSISSIPPI ALLUVIAL PLAIN
CRANDALL'S RIDGE
WEST GULF COASTAL PLAIN
N
MILES
0 10 15 20 25 30 40
ARKANSAS
STATE PLANNING BOARD
PRINCIPAL
PHYSIOGRAPHIC PROVINCES
LEGEND
COASTAL PLAIN
MISSISSIPPI ALLUVIAL PLAIN
WEST GULF COASTAL PLAIN
INTERIOR HIGHLANDS
OZARK PLATEAUS
SALEM PLATEAU
SPRINGFIELD PLATEAU
BOSTON MOUNTAINS
OUACHITA PROVINCE
ARKANSAS VALLEY
FOURCHE MOUNTAINS
NOVACULITE UPLIFT
ATHENS PIEDMONT PLATEAU
SEPT. 1938
SOURCE: ARKANSAS GEOLOGICAL SURVEY
PLATE 12

saturated river bottom gravels can usually be found. In the mountainous portion, which includes the Ozark Plateaus and the Ouachita Province, as shown on Plate 12, springs, some of them quite large, occur in the Salem and Springfield Plateaus which are underlain with limestones. Some of these springs are subject to pollution. Springs are also common within the Novaculite Uplift in the Ouachita Province. Elsewhere in the highlands, wells are usually capable of supplying only a few families, and most wells are incapable of producing more than 100 gallons per minute. Well water in the mountainous section may be expected to be hard and to contain iron.

In the West Gulf Coastal Plain ground water is usually ample for both domestic and municipal supply. Wells are often drilled to a depth of 1,000 feet or more, and water is of good quality, although it sometimes contains iron. In Clark County flowing wells are common.

Throughout the Mississippi Alluvial Plain ample ground water supplies are obtainable from both shallow and deep wells. Bordering the Mississippi River is an area in which flowing wells are frequently capable of delivering from one to several hundred gallons per minute at the surface of the ground. Wells equipped with pumps are sometimes capable of delivering 2,500 gallons per minute. Most municipal supplies are drawn from deep wells ranging from 400 to 1,200 feet in depth. The water is soft, but frequently contains iron.

In the Grand Prairie region, which is a part of the Mississippi Alluvial Plain, more than 1,000 wells have been drilled to obtain water for use in rice irrigation. Most of these are shallow wells ranging from 85 to 100 feet in depth. The capacities of these wells usually range from 300 to 2,500 gallons per minute.

The following table gives estimates of the consumption and value of well and spring water consumed in the State. In connection with this table, it should be noted that in 1936, when these data were compiled, 32 Arkansas cities, with a population of 189,446 were supplied with surface water. The quantity of this water used for domestic purposes was 2,210,678,490 gallons, valued at $917,060; and for industrial purposes, 555,083,910 gallons valued at $129,123; making a total of 2,765,762,400 gallons, valued at $1,046,183.

Estimates of the consumption and value of well and spring water used by cities and towns and for irrigation purposes in Arkansas, 1936 [1]

	Use	No. of Cities Served	Population Served	Production (gallons) Domestic	Industrial	Total
1.	Municipal Supply					
	a. Spring	10	17,618	208,597,120	52,325,460	260,922,580
	b. Well	127	304,989	3,666,390,400	918,941,010	4,585,331,410
2.	Independent industrial supply	—	—	—	2,500,000,000	2,500,000,000
3.	Bottled water supply	—	—	1,230,000	—	1,230,000
4.	Irrigation of rice district	—	—	—	109,900,000,000	109,900,000,000
	TOTAL	137	322,607	3,876,217,520	113,371,266,470	117,247,483,990

	Continued	Value (dollars) Domestic	Industrial	Total Value
1.	a.	$ 104,299	$ 14,058	$ 118,357
	b.	1,756,505	226,309	1,982,814
2.		—	700,000	700,000
3.		123,000	—	123,000
4.		—	1,455,000	1,455,000
	TOTAL	$1,983,804	$2,395,367	$4,379,171

[1] Arkansas Geological Survey.

That part of the precipitation that is not absorbed by the soil, as well as the portion of the ground water which escapes through natural springs, will if it does not evaporate ultimately reach the streams and become what is termed "stream flow". Because of the bountifulness of its rainfall Arkansas is well provided with rivers and small streams. Bisected by the Arkansas, drained in the north and east by the White River system, and to the south by the Red and Ouachita, and bounded on the east by the Mississippi, it is a land of flowing water. Although most of its large streams are subject to wide variations in flow, which results in the creation of flood hazards at high flows and of pollution and navigation problems at low flows, few of these streams dry up entirely, as do the streams of the semi-arid west. In addition there are many small streams that have little or no flow during the driest part of

Arkansas Power and Light Company Photo

Hydro-Electric Power Development on the Ouachita River

the year. Seventeen of the large streams, as shown on Plate 11, are classed as navigable by the War Department.

It is important to note that the most advantageous development of the larger streams will involve the reduction of flood flows, to the greatest extent economically justifiable; as such reduction will not only eliminate damaging floods, but will also conserve valuable water which would otherwise be wasted. Such flood flows can be reduced somewhat by soil and water conservation practices which permit a greater part of the rainfall to enter the ground. They can be further reduced through the construction of dams and the actual storing of the flood water at satisfactory sites along the streams.

Stored floodwaters can be made to add to the aggregate value of water resources in numerous ways. They may be, in part, retained permanently as artificial lakes useful for recreation and the conservation of fish and wild fowl. They may be used to generate hydroelectric power. They may be withdrawn gradually during the dry season to maintain stream flow to the advantage of navigation, or the greater dilution of contaminating wastes. And, finally, they may be used for irrigation or to meet municipal or domestic water requirements.

Of the streams originating largely within the State, the Ouachita River has probably been put to the greatest beneficial use. Its flow furnishes water supplies for five towns and permits the dilution of treated sewage and other wastes. The stream flow from its upper reaches furnishes the water needed for navigation below Camden. It has important recreational value. On it are now located the most important hydro-electric developments within the State. The proposed additional storage reservoir at Blakely Mountain will further develop its hydro-electric possibilities and improve its value for all of the other uses enumerated.

The Mississippi River has long been a great artery of transportation. After falling into relative disuse, its transportation facilities are again coming into competent use. Its value to the State of Arkansas and its importance in any State water plan are apparent.

Neither the Arkansas River nor the Red in their present condition can be considered a material asset to the State. Both carry damaging flood waters at high stages, and are shallow streams of little social or economic value at low stages. Except for their function of providing diluting water for domestic and industrial wastes and for limited local transportation they have little present value. Their greatest potential value lies in the possibility of developing navigation on them. This is discussed in later chapters.

The White River system offers great promise for the development of power and recreational facilities that will become real State assets. It offers also some possibility of providing a means for navigation, if development in its basin becomes extensive.

Arkansas need never want for water. Its water resources are ample. Its problem is one of the control and utilization of an abundant natural endowment.

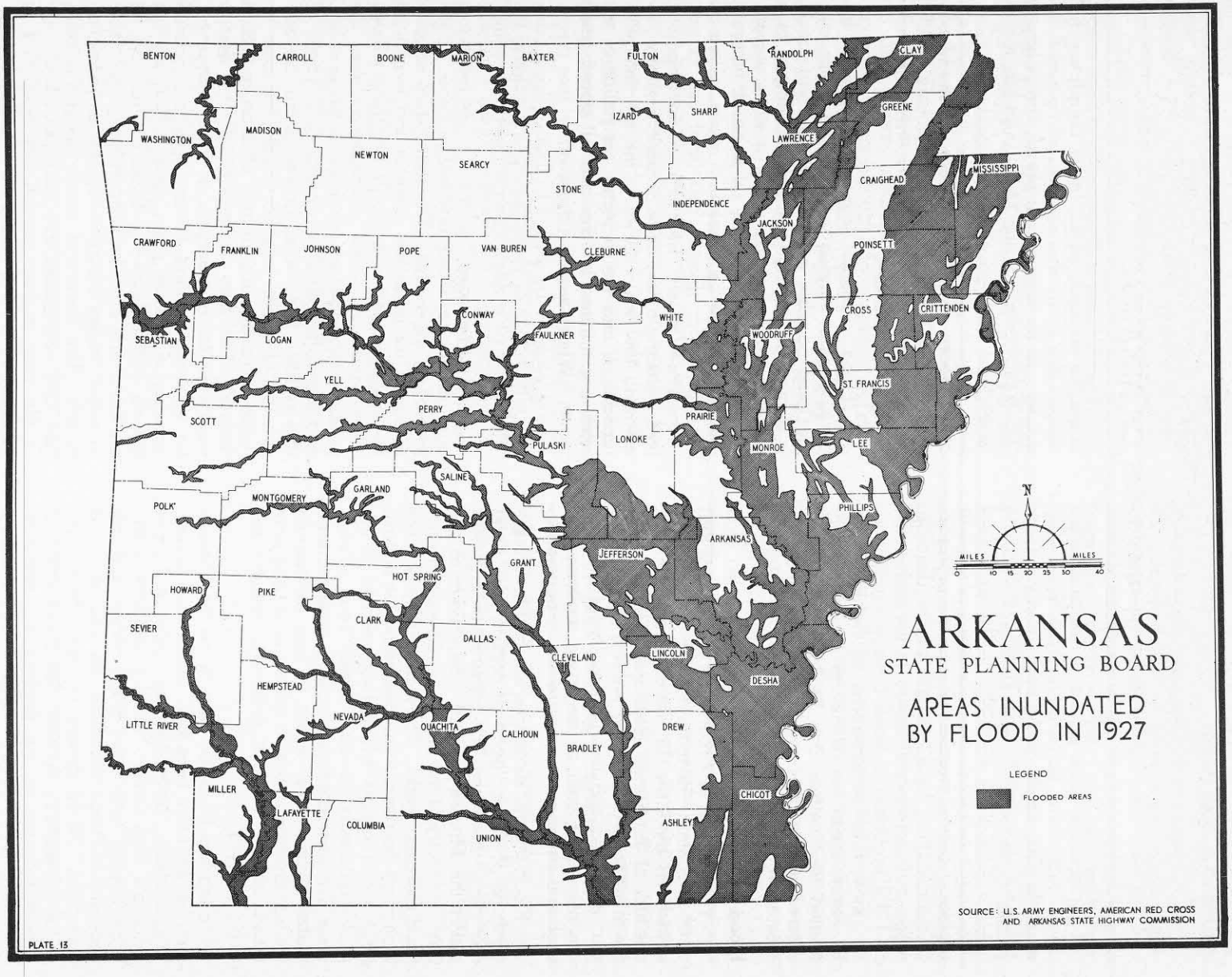

BENTON
CARROLL
BOONE
MARION
BAXTER
FULTON
RANDOLPH
CLAY
WASHINGTON
MADISON
NEWTON
SEARCY
IZARD
SHARP
GREENE
LAWRENCE
STONE
INDEPENDENCE
CRAIGHEAD
MISSISSIPPI
JACKSON
CRAWFORD
FRANKLIN
JOHNSON
POPE
VAN BUREN
CLEBURNE
POINSETT
CONWAY
WHITE
CROSS
CRITTENDEN
SEBASTIAN
LOGAN
FAULKNER
WOODRUFF
YELL
ST. FRANCIS
PERRY
PRAIRIE
SCOTT
LONOKE
PULASKI
MONROE
LEE
SALINE
GARLAND
MONTGOMERY
POLK
PHILLIPS
ARKANSAS
JEFFERSON
GRANT
HOT SPRING
HOWARD
PIKE
CLARK
SEVIER
DALLAS
CLEVELAND
LINCOLN
DESHA
HEMPSTEAD
LITTLE RIVER
NEVADA
OUACHITA
CALHOUN
BRADLEY
DREW
MILLER
LAFAYETTE
COLUMBIA
UNION
ASHLEY
CHICOT
N
MILES
MILES
0 10 15 20 25 30 40
ARKANSAS
STATE PLANNING BOARD
AREAS INUNDATED
BY FLOOD IN 1927
LEGEND
FLOODED AREAS
SOURCE: U.S. ARMY ENGINEERS, AMERICAN RED CROSS
AND ARKANSAS STATE HIGHWAY COMMISSION

PLATE 13

CHAPTER IV

WATER PROBLEMS OF ARKANSAS

Arkansas's water problems are as different as the mountains surrounding Fayetteville are from the flat lands of Ashley County. Plate 1 shows topography and Plate 2 shows the four Physiographic Provinces of the State and their major subdivisions. Generally, the water problems divide themselves into the problems of reforestation, hydro-electric power development, and recreational usage, in the highlands; and the problems of flood control, navigation, drainage and reclamation, in the lowlands. However, these two divisions are so closely related that neither can be intelligently considered without thorough knowledge and consideration of the other.

Flood Control.

The greatest of Arkansas's problems is that of flood control. Its magnitude is convincingly evidenced by Plate 13, which shows roughly one-fifth of the State's total area inundated by the great flood of 1927. When it is remembered that this area consists principally of the productive fertile soil of the river bottoms the problem assumes even greater proportions.

Flood control measures fall into the classifications of either "flood protection" or "flood reduction" measures. The construction of levees along the Mississippi and other rivers in the State is strictly of the first type. Levees are not flood reducing works. They are purely barriers to prevent the rivers from inundating the natural back water basins which have served in the past temporarily to store excess flood waters. Thus, by their confining action, levees create higher river stages, which in turn necessitate the construction of higher levees until programs based strictly on such protection become extremely costly.

Such has been the case along the Mississippi. Levees have been built higher and higher. The programs have become more and more elaborate and costly. Finally, quite recently, flood control authorities have recognized the necessity of "flood reduction" as well as "flood protection." Thus, present plans for the control of the Mississippi involve: the construction of floodways such as the Eudora; the retention of certain of the natural flood overflow basins in their present state, as temporary storage basins for excess water until the main crest of a flood is past; and making cut-offs, and doing the dredging necessary to straighten and shorten the main channel and so reduce flood stages. In its most recent phase, the policy of "flood protection" on the Mississippi has recognized the value and necessity of "flood reduction" by artificial reservoirs. With the advent of the theory of "flood reduction" in the Mississippi Valley, many projects previously considered as not economically justifiable are now being recommended.

"Flood protection" involves merely the passing on of surplus water to the ocean with the least possible damage to adjacent lands. It eliminates damage, though sometimes in a costly manner, but the water itself is wasted. "Flood reduction", on the other hand, where it involves temporary storage of water, offers an opportunity for diverse beneficial use of part of the stored water. Recreational development, hydro-electric power development, irrigation, increasing low water flows to the advantage of navigation and the reduction of pollution, all offer possibilities for the use of stored flood water. Where feasible, these other uses create a new value to be added to that of flood damage elimination or reduction in ascertaining the full benefit of a flood control reservoir project.

"Flood reduction" in the form of reservoirs has another marked advantage over "flood protection" measures. The latter were usually designed as protection against the maximum flood ever expected to occur because a levee or a flood wall, once overtopped, may be severely damaged or cut through by washing, and may often involve a major catastrophe or loss of life. Reservoirs, however, can be constructed of either large or small size and so made to render any degree of flood reduction desired. This fact makes it possible to design reservoirs for a reduction in flood frequency, for example limiting floods from an annual occurrence to once in ten years. Thus, by this means, some degree of flood control can be provided and may be economically justifiable in cases where complete control or protection is not. The design of storm sewers in cities has long recognized this principle. It is only in the very highest valued city districts that justification is ever found for designing storm sewers to carry the run-off from maximum rains. Usually sewers are designed to take the run-off from rains of certain intensity only, and be-

yond that point the streets and adjacent buildings flood. A similar economic adjustment is now applied to flood control projects.

Flood control planning is beginning and in the future will doubtless involve exhaustive studies of every possible beneficial use of stored flood water, and of varied degrees of control. It inevitably follows that studies made prior to the time when this principle of the multiple use of flood water was being applied may not have reached the same conclusions as would be reached at the present.

In addition to changed practices in flood control work there have been important changes in recent economic theories relating to such projects. Early studies considered the benefits of flood control programs to be the value of past damages which would be eliminated. Obviously, upon such a basis as this, no drainage project, for instance, would ever be justified. There would be no justification for draining good land, heretofore uncultivated if only its past unproductiveness was considered. In fact, no new development of any kind would be justifiable upon this basis. Nevertheless, only recently economic thought has come to recognize this fact in connection with flood control, and so to consider in addition to past damages, future increases in values which will occur by reason of the elimination of floods. Certainly a larger expenditure for flood control for certain frequently flooded lands appears justifiable if it can be shown that substantial agricultural values will accrue from the development of the lands protected, than if consideration is given only to the fact that past floods have done little or no damage because the lands are undeveloped.

Therefore, there exists an urgent need for the re-study of many of the flood control problems of Arkansas. Such re-studies should be made in all cases where previous studies were made before the advent of modern theory and practice in flood control work. They should include full consideration of multi-purpose reservoir projects, of different degrees of flood control, and of future as well as past values. This applies specifically to the following basin studies: (1) Western Arkansas, (2) Upper White and Black, (3) Ouachita, (4) Red, and (5) the Lower Mississippi.

In Chapter II the various studies which have been made of flood control problems in Arkansas are mentioned. In spite of the fact that the entire economic future of the State is definitely and vitally dependent upon the proper solution of these problems, State agencies have contributed only a very minor part to these previous studies. It is of great importance that in the future these agencies participate directly and materially in any studies made.

The flood control problems of each of the five basins in the State are discussed in succeeding Chapters on those basins. Here, it is sufficient to merely summarize these problems from a statewide viewpoint and to mention certain factors outside the State affecting them.

Within the Western Arkansas Basin, floods occur almost annually on the major streams, flooding much of the most fertile soil in the basin. Studies by the Corps of Engineers found comprehensive flood control in this basin to be unjustifiable, but these studies were made before the principles of multiple use of reservoir projects and the reduction of flood frequencies were given serious consideration, rather than the principle of complete protection.

It is now both logical and desirable from the viewpoint of the people of Arkansas that flood control in the Western Arkansas River Basin be re-studied as a part of a program for flood control in the valley of the Arkansas River as a whole. The ideal plan is that which will secure the greatest aggregate benefit for the three states of Arkansas, Oklahoma and Kansas, and at the same time will solve the problems of the Western Arkansas Basin as well as improving the situation along the Lower Arkansas in the Lower Mississippi Basin.

Past investigations by the Corps of Engineers have resulted in recommendations for the construction of reservoirs in Arkansas and Eastern Oklahoma which would probably solve the flood problem in Arkansas to a reasonable degree. These projects include the Blue Mountain, Nimrod, Wister, Eufala, Hulah, Oolagah, Pensacola, Fort Gibson, Markham's Ferry and Tenkiller reservoirs. The Pensacola project is now under construction though some consideration is being given, at the present time, to the elimination of storage capacity which would materially reduce its effectiveness in the control of floods in Arkansas. Authorized projects at Fort Supply and Optima on the Canadian River in Oklahoma may have some slight effect on the flood stages of the Arkansas River in Arkansas. The Blue Mountain and Nimrod projects have been authorized and appropriations made to start construction.

There are, however, many details in connection with all of these reservoirs, as well as comparisons with other possible sites more in keeping with the desires and needs of states other than Arkansas, yet to be worked out. For example, the reservoir at Eufala may not

be in accord with a reasonable plan of water development in Oklahoma and Kansas where the conservation of water at points upstream from Eufala, in the tributary valleys, is desirable. Others of the original sites have been or are being re-studied by the Corps of Engineers for smaller capacities than originally recommended. It appears quite possible that a group of smaller reservoirs than originally recommended for Eastern Oklahoma, if supplemented by upstream storage on the tributaries, may not only provide effective flood reduction, but will also provide greater concurrent benefits.

It is believed, therefore, that a new, over-all investigation of flood control in the Arkansas Valley should be undertaken with a view to developing a coordinated plan of multi-purpose reservoirs to which all of the affected states can agree and which will, in all probability, on a valley-wide basis, be found to be economically justifiable. Such a re-investigation should be properly undertaken by the Federal Government, but it should be supported and adequately participated in by Arkansas representatives, and also representatives of Oklahoma and Kansas. At the same time Arkansas representatives should assist in the solution of problems bearing on the complete protection of highly valued districts in this Basin through the construction of sea walls and levees, the design of which should be properly coordinated with the general plan for flood reduction.

In the Upper White and Black River Basins flood control is not of primary importance except as it affects floods in the eastern lowlands along the lower reaches of these streams. The proper evaluation of this element with relation to hydro-electric development is extremely important and of interest primarily to the State of Arkansas.

Lowlands in the Ouachita Basin are subjected to frequent flooding. A greater measure of protection of these areas should be provided in the future. On the basis of actual damage within the flood plains justification has been hard to establish as they are largely undeveloped. Flood control in this basin should be considered along with the development of hydro-electric power.

Floods in the Red River Basin are both damaging and of frequent occurrence. The lands flooded have deep fertile soils. Extensive levee construction, largely by private enterprise, has been carried on but the levees do not provide adequate protection. Studies by the Corps of Engineers indicate that complete protection by levees is not justifiable. In these same studies detention reservoirs for the Red River system were considered, but not with reference to the multiple use of stored waters.

A large reservoir project near Denison, Texas, has recently been re-studied for flood control and the development of hydro-electric power and appears to be justified. However, this project will not in itself solve the flood problem on the Red River in Arkansas, because most of the serious floods, for example that of 1938, originate below Denison.

The flood control problem in the Red River Basin is, therefore, unsolved. The fertility of the soils and the extent of the area inundated justify an immediate re-study of this problem with full consideration of multiple use of stored waters. While this study should logically be made by the Federal Government, Arkansas representatives should participate and assist, and a plan should be evolved which is mutually acceptable to the States of Texas, Oklahoma, Louisiana and Arkansas.

In the lower Mississippi Basin the flood problem assumes tremendous proportions. It naturally divides itself into floods occasioned by backwater from the Mississippi and floods produced by headwater from the St. Francis, Black, White, Arkansas, and Ouachita Rivers.

Protection from the Mississippi under the Jadwin-Markham plan is nearing completion. Of the various parts of this plan in Arkansas only the Eudora Floodway remains to be undertaken. There are, however, serious differences of opinion as to the adequacy of this plan. On the one hand it is contended that dredging and cut-offs in the Mississippi channel below the mouth of the Arkansas River will sufficiently reduce flood crests so that the Eudora Floodway will be unnecessary. On the other hand, it is the opinion of equally experienced authorities, that the 1937 flood made the use of computations upon which this plan is founded illogical, and that the whole plan including the Eudora Floodway is inadequate. On this, the item of the floodway alone, there is obviously need for additional basic information and additional analyses in which the State of Arkansas, because of its vital interest, should be responsibly represented.

The solution of headwater flood problems in the Lower Mississippi Basin will undoubtedly call for the construction of reservoirs in the mountainous portion of Arkansas and in other States. The problem is already well on the way to solution on the St. Francis with the construction of the Wappapello Reservoir, and with

concurrent levee construction in Arkansas. In the Upper White and Black River Basin, as well as the Ouachita River Basin, flood control reservoirs have been authorized by Congress, initial appropriations have been made and construction will be started this year. These will be combined with hydro-electric development.

Hydro-Electric Power.

The Arkansas Department of Public Utilities reports show that during the years 1936, and 1937, over half of the electrical energy used in the State was imported. The following table shows total electricity consumed in the State as well as production and net importations for 1935, 1936 and 1937.

USAGE AND PRODUCTION OF ELECTRICITY IN ARKANSAS
(1000 KWH)

Year	1935	Per Cent	1936	Per Cent	1937	Per Cent
Total Consumption	407,499	100.0	482,190	100.0	533,448	100.0
Production in State	223,045	54.7	127,392	26.4	243,385	45.7
Net Importation	184,454	45.3	354,798	73.6	290,063	54.3

The importations have come from the Sterlington Plant of Louisiana Power & Light Co., in Louisiana, from the Tennessee Valley Authority, and from steam generating plants at Tulsa and Oklahoma City. While it is difficult to tell exactly where this imported power is consumed, because of the interconnected transmission systems and the transfers of power between operating companies, its consumption is widespread. The load center for the State, as a whole, is not far south of Little Rock. Undoubtedly much of the imported power is consumed closer to potential hydro-electric sites in Arkansas than to the present source of generation.

The foregoing table shows that the use of electricity is growing rapidly—an increase of 31 per cent from 1935 to 1937 in total consumption—the average annual consumption per residential customer during 1937 was approximately 700 K.W.H. This is far below the corresponding figure 1100 K.W.H. for two neighboring states as well as the national average of 800 K.W.H.

Industrial electric consumption is similarly low although there appears to be a considerable potential market in connection with the mining and processing of the State's minerals. It would seem reasonable to assume that Arkansas, with much the most important deposits of bauxite in the United States, should profit in some way from the processing or the reduction of that mineral. All of the bauxite of metallic grade produced in Arkansas is shipped first to East St. Louis for manufacture into aluminum oxide, and then reshipped to one of four hydro-electric plants in the East for reduction. The major reason for this is that the conversion of bauxite into metallic aluminum or aluminum products requires great quantities of electricity. The reduction plants are, therefore, located where cheap electricity is available and Arkansas loses much of the benefit of one of its major mineral resources, because such electricity is not available within the State.

A further potential market for electricity exists in the mining and processing of other of the State's minerals, including manganese, and zinc. If electricity can be made available in quantity and at low enough cost the development of certain of these may become economically feasible. Therefore, to claim that no further electrical development should be made because no market exists is to confuse the result with the cause. The present market is limited because electricity has not been available at reasonable rates, but the State has a rapidly growing market and a much greater market will require service, just as it did in the Tennessee Valley, when cheap electricity was made available.

The numerous hydro-electric sites in the State will probably play an important part in making electricity cheap. Because of their proximity to the points of usage it seems highly probable that certain contemplated hydro-electric developments could be operated as base-load plants. Hydro-electric development on the Ouachita, for instance, would be readily available to the bauxite mines in that basin and similar development in the Upper White and Black River Basins could serve the manganese, zinc and other mines located there. Other developments could probably best be used to carry the peak loads on systems the primary generation of which was by steam plants. Certainly, however, with the rapidly growing electrical demand in the State, with potential power markets awaiting development, and with the gradual exhaustion of cheap fuel supplies, more and more hydro-electric power will be utilized.

Specific projects are suggested in the various Basin Chapters. The Upper White and Black River Basin, the Ouachita Basin and perhaps tributaries of the Red offer the most important power development possibilities. Investigation of potential markets and an accurate portrayal of the need for these projects is definitely a State function. Certainly other states are, at most, only indirectly interested in Arkansas's hydro-electric projects and the development of its natural resources and the Federal Government merely reflects demands made upon Congress. Therefore, if the people of Arkansas are to secure needed development, they must first, through proper State agencies, demonstrate the existence of a market for hydro-electric power, and the social and economic need for hydro-electric projects and then assist in the development of plans for multiple purpose projects consistent with the best interests of the State.

Drainage.

Under the laws of Arkansas, drainage districts may be organized for the purpose of building levees or drainage works separately or in combination. A total of 8,826,733 acres of land is now being assessed in the State for the support of 304 such districts. The total assessed benefits against these lands in 1930 was $88,393,906.69.

The districts were organized as separate projects to solve specific local problems. Little or no thought was given to coordinating neighboring drainage problems or to working out the assessments so that lands benefiting from two or more districts would not be over-burdened. As a result, a total of approximately 3,467,583 acres of land are assessed in two or more districts.

Taxes are levied against the assessed benefits to pay both interest and principal on bonds, and the operation and maintenance expenses of the districts. Where the assessments have pyramided from two or more districts, the taxes frequently exceed the land owner's ability to pay, occasioning tax delinquencies and necessitating higher taxes the following year. Thus, the increasing taxes rise further and further beyond the land owner's ability to pay, bringing more lands into the delinquent list and necessitating further increases in taxes. This vicious circle has continued until, as shown in Appendix "A," tax delinquencies of 50 per cent to 80 per cent are quite common and a large number of the districts have defaulted on bonds.

Since Arkansas is primarily an agricultural state and the lands referred to usually lie in the more productive sections of the State, the financial difficulties of the drainage districts are of serious consequence to the economic structure of Arkansas. New drainage projects often cannot be financed, regardless of their merit, and agricultural activity in eastern Arkansas is often severely handicapped. The State as a whole thus suffers because of improper coordination and planning of drainage and levee district projects.

Some districts have undertaken to solve their problems by negotiating loans from the Reconstruction Finance Corporation. Certainly the problem of refinancing and rehabilitating existing drainage districts and the coordinated planning of future projects is properly a State undertaking. Neglect of this important function can only result in the retardation of the State's development.

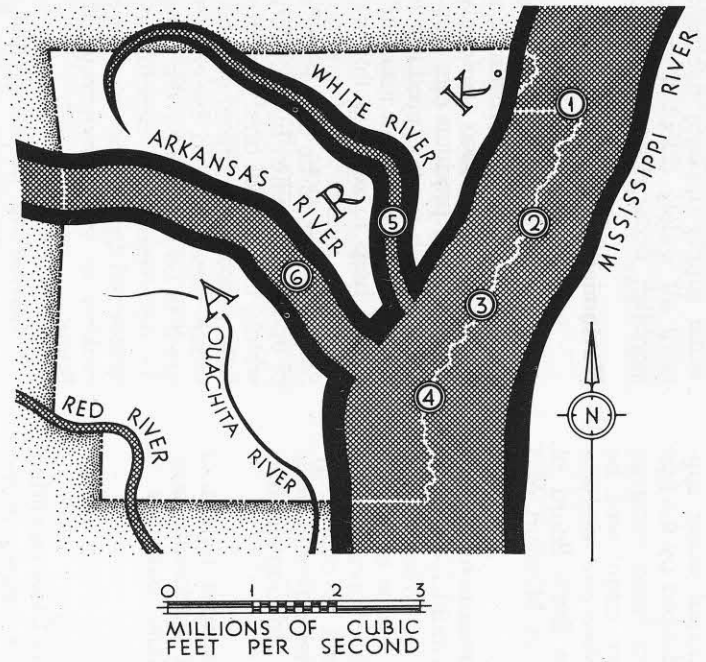
Pollution.

In general Arkansas's pollution problems are as yet far less serious than in many other states. The Arkansas River water is too heavily impregnated with natural salt from its western tributaries to be suitable for human consumption during low water stages. This condition has been aggravated by oil field wastes from Oklahoma and Kansas, but without these wastes it would still be heavily saline during low stages. The most serious example of domestic and industrial waste pollution is in the Ouachita Basin where Malvern, Arkadelphia and Camden discharge incompletely treated sewage into the Ouachita River. In addition, wastes from one paper plant at Camden, the titanium washing mill at Magnet Cove and the Smackover oil field reach the Ouachita River. Future development, however, particularly in industrial fields will normally bring new pollution problems.

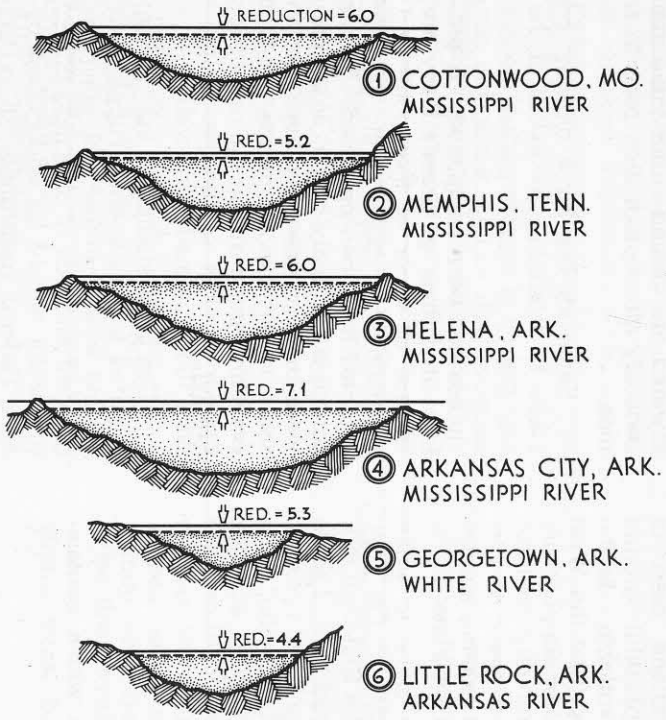
Arkansas may well benefit by the experience of other states and prevent pollution problems before they arise. The prosecution of basic studies to definitely establish existing degrees of pollution and remedial measures, followed by proper legislation, will prove far simpler and less expensive than permitting serious pollution to occur and then attempting correct it. The beauty of many of Arkansas's streams and their abundant fish life justify the adoption of positive measures to protect the recreational values of such streams.

Domestic Water Supplies.

Most of the mountainous portion of the State offers only very limited ground water supplies. In this section the development of surface supplies in impounding reservoirs seems



OVERALL WIDTH OF SHADED AREA REPRESENTS 1927 FLOOD DISCHARGE . . . . . BLACK PORTION SHOWS ESTIMATED REDUCTION



APPROXIMATE CHANNEL CROSS-SECTIONS
SOLID LINE REPRESENTS 1927 FLOOD CREST
BROKEN LINE REPRESENTS ESTIMATED REDUCTION

DISCHARGE OF 1927 FLOOD

SHOWING ESTIMATED POSSIBLE REDUCTION IN DISCHARGE OF A SIMILAR FLOOD BY A TYPICAL PLAN OF RESERVOIRS

ARKANSAS STATE PLANNING BOARD

PLATE 14

SOURCE: U.S. ARMY ENG'RS.

the logical procedure for urban populations and to a somewhat lesser degree for rural population as well. An exception to this is in the Springfield Plateau limestone area of Northern Arkansas, where plentiful ground water supplies are usually available. In the alluvial plain of the Mississippi and the West Gulf Coastal Plains ground water supplies are usually adequate, and will probably continue to be the common source for domestic and industrial water. The sources of existing municipal water supplies are shown on Plate 4.

More attention should be given to water quality than has been the case in the past. Most of the ground waters of the State are iron bearing, many of them are corrosive, and some are hard. Yet several small municipal systems, for example at Portland and Leachville, have been recently installed utilizing well supplies but without provision for iron removal or other treatment. These systems are now adding treatment plants to make the water usable. The collection of data on ground water quality by the Arkansas Geological Survey will serve as a guide for municipalities which contemplate the installation of ground water supply systems.

Bacterial content of municipal water supplies is well controlled as evidenced by the fact that no water borne epidemics have occurred in recent years. Consideration might well be given to frequent routine sampling and analysis of all urban supplies by the State Board of Health, such as is practiced in Missouri and other states.

Some relaxation in the regulations regarding the recreational use of municipal water supply lakes appears justifiable. Where water is treated in modern filtration plants and properly sterilized controlled recreational use of lakes may be permissible and is commonly permitted. It may actually be advantageous in preventing excessive fish propagation and pollution from that source.

Domestic water supply should remain a local problem, but continued guidance, regulation and assistance by State agencies is most important.

Irrigation.

Rice is the only crop in the State requiring irrigation, and its production is largely in the Grand Prairie Region of the Lower Mississippi Basin. However, it is one of the State's most valuable crops—its value averaging about $7,500,000 annually, and its continued production is important to the residents of Eastern Arkansas.

Irrigation water for the rice fields has been obtained almost entirely from shallow wells in the past, but overdrafts on these wells have lowered the ground water table sufficiently to seriously affect production costs in some localities.

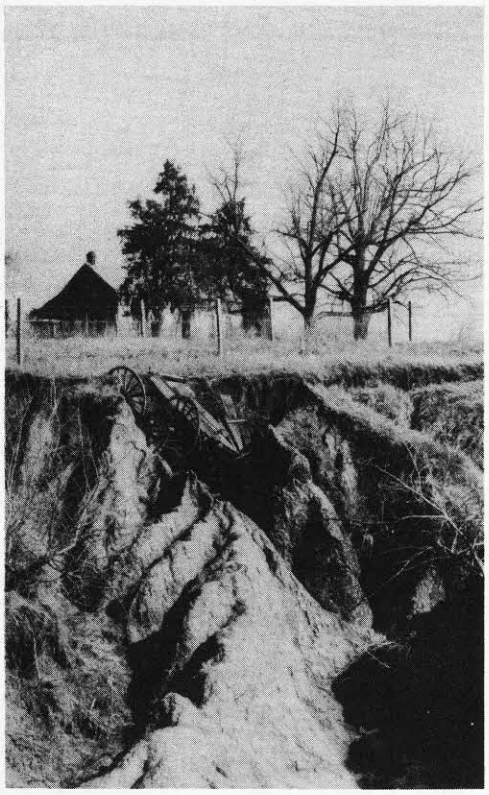
Some studies have already been undertaken to determine the extent of the overdraft and means of supplementing the ground water supplies with surface water, but none of these studies has been completed: A project on the Little Red River at Greer's Ferry involving the storage of water at that point and its transportation by canals to the rice lands to be irrigated has been proposed. Water from this source is relatively costly, however; and in the meantime private initiative has constructed some twenty small surface reservoirs for impounding water during the rainy season, which appear to offer a cheaper source of supply than that obtained from wells.

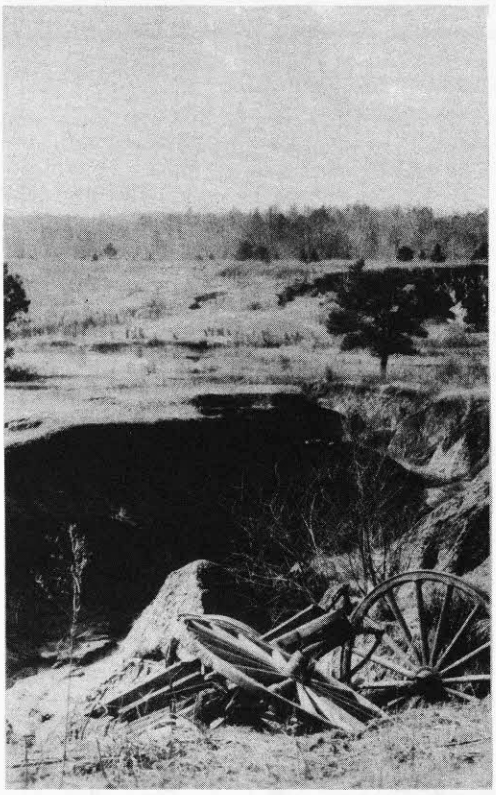
Complete studies of the amount of water required to permanently supplement available ground water together with comparisons of the different methods of obtaining this supplementary water should be undertaken by the State with Federal assistance. If a local surface water supply appears sufficient, and this plan is at all widely adopted proper legislation to establish water rights should be initiated.

Navigation.

The value of the navigation of streams to the State of Arkansas can be demonstrated in several ways. The growth of many Arkansas industries has been seriously handicapped because their products can only be sold in competition with similar products from areas with more favorable freight rates. River navigation would help to remove this inequality. However, the feasibility of navigation within the State appears to be subject to much difference of opinion. Studies by the Corps of Engineers, which, in the final analysis, are the most carefully prepared technical studies that have been made, generally find the cost of navigation too great to be justified by the benefits. That they do not expect this conclusion to be final is evidenced by the fact that they are even now making a traffic resurvey of the Arkansas River.

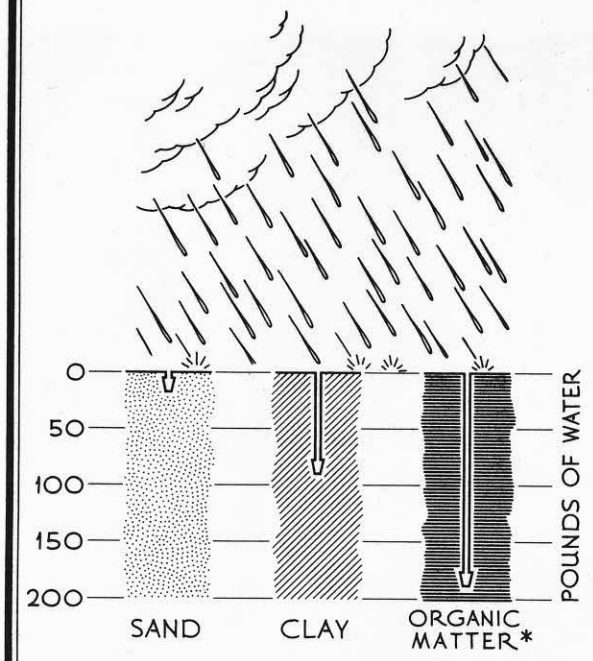
Navigation on the White River, at least as far as the mouth of the Black, could be provided and maintained without great expense, because of the relatively uniform flow of this stream. The present demand for navigation on this stream is not great, but development of the natural resources of the Upper





U. S. Soil Conservation Service Photos

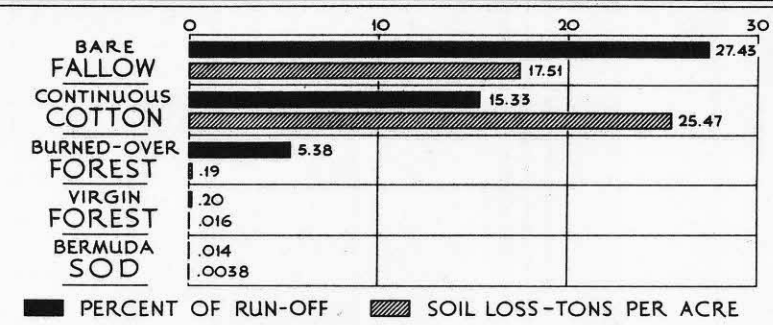
Examples of Severe Gulleying



WATER HOLDING CAPACITIES PER 100 POUNDS OF SOIL

OCTOBER, 1934
AUBURN, ALABAMA

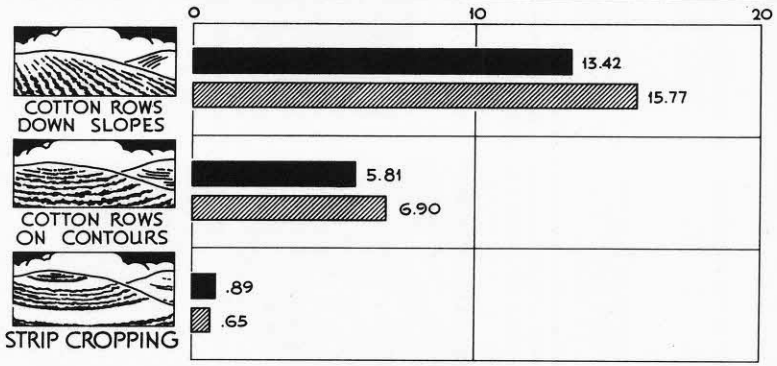
*ORGANIC MATTER CONSISTS OF PARTIALLY DECOMPOSED PLANT REMAINS



RUN-OFF AND SOIL LOSS

WITH VARIOUS CROPS OR TREATMENTS

ANNUAL AVERAGE FOR 5 YEAR PERIOD – GUTHRIE, OKLA.



RUN-OFF AND SOIL LOSS

STRIP CROPPING COMPARED TO OTHER TYPES OF CULTIVATION (3½% SLOPES)

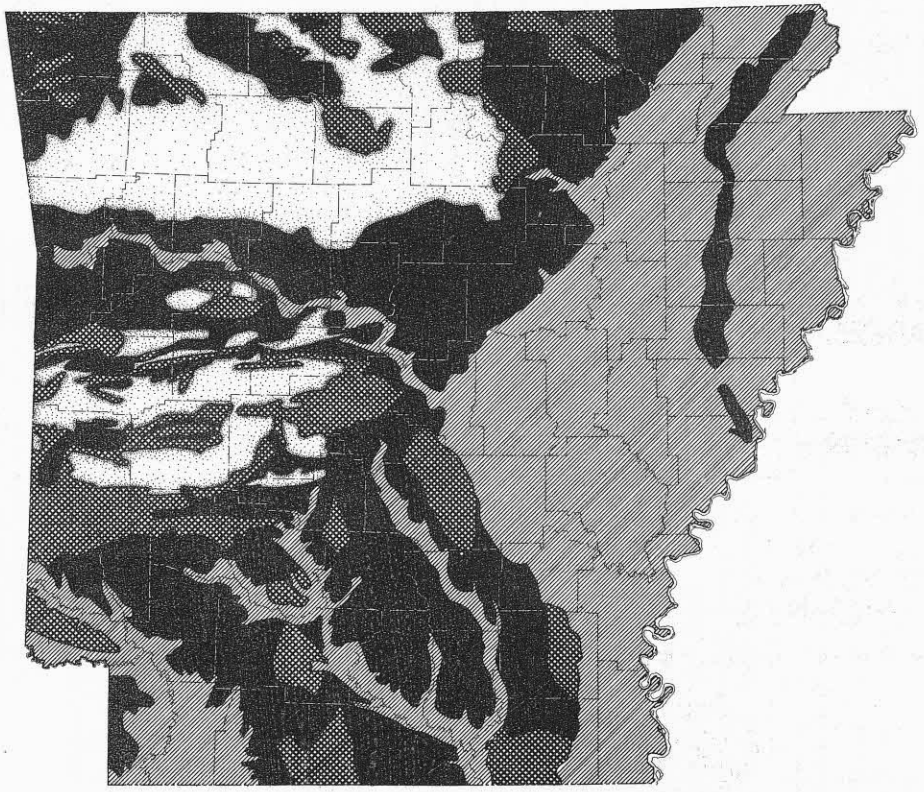
ANNUAL AVERAGE FOR 5⅔ YEAR PERIOD – TEMPLE, TEXAS

ARKANSAS STATE PLANNING BOARD

PLATE 15

LAND FACTORS AFFECTING WATER RUN-OFF & SOIL LOSS

DATA FROM SOIL CONSERVATION SERVICE



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MILES 0 10 20 30 40 50 MILES

ARKANSAS
STATE PLANNING BOARD

EXTENT OF
SOIL EROSION

LEGEND

- PRINCIPALLY NON-AGRICULTURAL
- SLIGHT EROSION AREA
- MODERATE EROSION AREA
- DOMINANT EROSION AREA

SOURCE: UNIVERSITY OF ARKANSAS
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

PLATE 16

White and Black River Basin would greatly increase this demand.

Because of the long periods of low flows of the Arkansas River, navigation even as far upstream as Little Rock would be costly. It's economic justification probably depends upon the finding of potential river traffic additional to that previously reported. The same appears true of the Ouachita River above Camden.

The investigation of existing and potential traffic, and the sponsoring of new industries which would contribute additional traffic, with a view to establishing the need of navigation beyond question, are primarily State functions.

Erosion and Land Management.

It is difficult to determine a definite line of demarcation between those problems of erosion and of land management, which should be classed as water problems and those which should be classed as land problems. Erosion is occasioned by water flow and in that sense is a water problem. The resulting silt which the streams carry away may be deposited in reservoirs and in this way reduce their capacity or it may form bars to the detriment of navigation. Finally, proper land management does have a beneficial effect on flood control and stream flow, although the exact extent of the effect is subject to some question. Thus, within reasonable limits, some discussion of these problems is fittingly a part of any complete consideration of the water problems of the State.

Unquestionably the denuding of land surfaces of forest or other vegetal cover does facilitate rapid run-off and increase erosion. Wider variations in stream flow occur and the increased silt loads of the streams tend to choke and reduce the depth of the channels. The preservation of natural forest litter and the restoration of vegetation tends to hold some of the precipitation at the point where it falls thus delaying run-off and increasing soil moisture. Plate 15 shows the effect of various soil covering on both erosion and run-off from data developed by the U. S. Soil Conservation Service.

Some engineers and hydrologists believe that forest cover has very little effect upon the major floods, all of which occur only at rare intervals from extraordinary rains. They contend that these rains so thoroughly saturate the ground and its covering that the tiny reservoirs provided by the covering are of no moment. Generally, though, opinion seems to indicate that such cover has a marked retentive effect upon ordinary rains which create the more frequent minor floods.

These same views appear to hold also in connection with improved agricultural practices such as contour cultivation, strip cropping, and terracing. By overtopping the small, artificial dikes heavy rains nullify the effectiveness of these devices though they may be quite beneficial in less intense storms.

The fact remains, however, that the widespread elimination of forest cover by the increase in the total quantity of cultivated land has materially reduced low stream flows, and materially increased the silting up of channels that once were clean and deep. Reforestation will serve to retard run-off and prevent further erosion.

Plate 16 shows the extent and degree of erosion in Arkansas. Much of the severely eroded land in the mountainous portion of the State is of relatively low fertility. Restoration of the natural forest cover on this land will not only be of substantial importance in the regulation of stream flow but will prevent continued erosion, and will perhaps restore some lands to economic productivity.

Recreation.

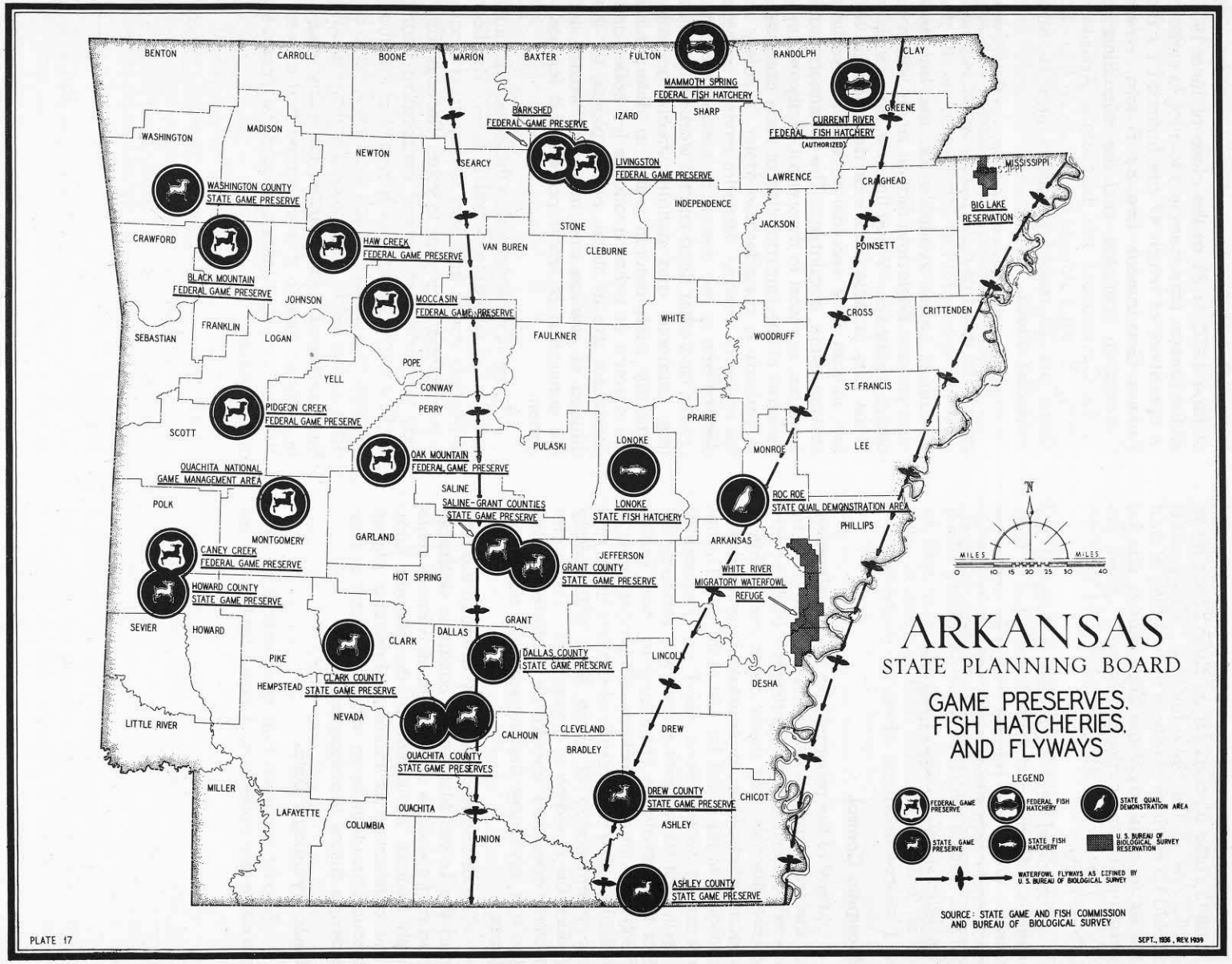
With 23,000,000 people within 250 miles of the Arkansas boundary and 53,000,000 within 500 miles, living for the most part in the hot corn belt states or the southern plains states, Arkansas is becoming one of the recreational centers for this vast population. The streams, lakes and relatively cool summers in the Ozark Plateaus and the Ouachita Mountains are gradually drawing an ever increasing throng of fishermen, hunters, and vacationists from the surrounding lowlands.

The proper development of all of the recreational areas within the State; the development of purely recreational lakes and the provision for the recreational use of lakes primarily designed to serve other purposes; the proper publicizing of this remarkable asset, should be undertaken without further delay by a competent State agency.

The recreational charm of Arkansas Mountains is far too great to be as little known as it is. Expansion or greater development of state parks is justifiable. Serious thought should be given to the planning and control of private development, and a carefully prepared program of publicity should be initiated.

Wildlife.

Preservation of fish life and waterfowl and proper regulation of fishing and hunting will add to the State's importance as a recreational center. Arkansas is one of the good fishing and hunting areas in the United States which


BENTON
CARROLL
BOONE
MARION
BAXTER
FULTON
RANDOLPH
CLAY
MAMMOTH SPRING
FEDERAL FISH HATCHERY
BARKSHED
FEDERAL GAME PRESERVE
IZARD
SHARP
GREENE
CURRENT RIVER
FEDERAL FISH HATCHERY
(AUTHORIZED)
WASHINGTON
MADISON
NEWTON
SEARCY
LIVINGSTON
FEDERAL GAME PRESERVE
LAWRENCE
CRAIGHEAD
MISSISSIPPI
BIG LAKE
RESERVATION
WASHINGTON COUNTY
STATE GAME PRESERVE
INDEPENDENCE
JACKSON
POINSETT
CRAWFORD
STONE
VAN BUREN
CLEBURNE
HAW CREEK
FEDERAL GAME PRESERVE
BLACK MOUNTAIN
FEDERAL GAME PRESERVE
JOHNSON
MOCCASIN
FEDERAL GAME PRESERVE
WHITE
CROSS
CRITTENDEN
FRANKLIN
SEBASTIAN
LOGAN
FAULKNER
WOODRUFF
POPE
YELL
CONWAY
ST. FRANCIS
PERRY
PRAIRIE
PIDGEON CREEK
FEDERAL GAME PRESERVE
SCOTT
PULASKI
LONOKE
MONROE
LEE
OAK MOUNTAIN
FEDERAL GAME PRESERVE
QUACHITA NATIONAL
GAME MANAGEMENT AREA
SALINE
SALINE-GRANT COUNTIES
STATE GAME PRESERVE
LONOKE
STATE FISH HATCHERY
ROC ROE
STATE QUAIL DEMONSTRATION AREA
POLK
PHILLIPS
MONTGOMERY
GARLAND
ARKANSAS
CANEY CREEK
FEDERAL GAME PRESERVE
JEFFERSON
GRANT COUNTY
STATE GAME PRESERVE
WHITE RIVER
MIGRATORY WATERFOWL
REFUGE
HOT SPRING
HOWARD COUNTY
STATE GAME PRESERVE
GRANT
SEVIER
HOWARD
CLARK
DALLAS
DALLAS COUNTY
STATE GAME PRESERVE
LINCOLN
PIKE
CLARK COUNTY
STATE GAME PRESERVE
DESHA
HEMPSTEAD
NEVADA
CALHOUN
CLEVELAND
DREW
LITTLE RIVER
QUACHITA COUNTY
STATE GAME PRESERVES
BRADLEY
MILLER
DREW COUNTY
STATE GAME PRESERVE
CHICOT
LAFAYETTE
OUACHITA
ASHLEY
COLUMBIA
UNION
ASHLEY COUNTY
STATE GAME PRESERVE
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ARKANSAS
STATE PLANNING BOARD
GAME PRESERVES,
FISH HATCHERIES,
AND FLYWAYS
LEGEND
FEDERAL GAME PRESERVE
FEDERAL FISH HATCHERY
STATE QUAIL DEMONSTRATION AREA
STATE GAME PRESERVE
STATE FISH HATCHERY
U. S. BUREAU OF BIOLOGICAL SURVEY RESERVATION
WATERFOWL FLYWAYS AS DEFINED BY U. S. BUREAU OF BIOLOGICAL SURVEY
SOURCE: STATE GAME AND FISH COMMISSION
AND BUREAU OF BIOLOGICAL SURVEY
PLATE 17
SEPT., 1936, REV. 1939

is readily accessible to population centers. Its picturesque mountain streams are given high rating by experienced bass fishermen, and hunters come from as far as New York City to participate in the duck hunting. Every effort should be made to conserve the wildlife, so that the exceptional favor the State enjoys can be permanently maintained. Plate 17 shows the game preserves, fish hatcheries and flyways of the State.

Continued and expanded activity of the Arkansas Game and Fish Commission is justifiable. Water fowl refuges should be expanded and made coincidental with natural floods retarding basins which may be necessary along the Mississippi. Serious thought may well be given to State controlled hunting areas in order to preserve adequate areas for public use.

Mosquito Control.

Many of the programs for the development of the water resources of the State involve increasing existing water surfaces. In these programs the fact that these areas are within a region susceptible to infestation by malarial mosquitoes must not be lost sight of. The increase of water areas need not necessarily mean that such development will seriously affect the prevalence of malaria in these areas. Such measures as stocking with proper forms of fish life, oiling and dusting of shallow areas and the maintenance of shore lines will greatly reduce the breeding of mosquitoes. These protective measures should be included in all projects involving the increase of water surfaces.

The drainage of swampy areas in the Red and the Lower Mississippi Basins is desirable and might well be undertaken on a broad scale with Federal assistance at the present time. The elimination of mosquito breeding places through drainage is an important factor in considering future drainage projects.

Basic Hydrologic Data.

Steady progress has been made in Arkansas in the collection of basic hydrologic information. The number of stream gaging stations in the State maintained by the U. S. Geological Survey increased from 17 at the end of June 1937, to 32 at the close of June 1938. At the present time there is a total of 75 stations in operation, of which 47 are financed by the Federal Government, five by Federal Power Commission licensees, and the remaining 23 by the Government and the State of Arkansas jointly. Existing stations are shown on Plate 18. There are 29 recording gages and 46 non-recording gages.

Stream flow records are valuable in many ways. In the design of public water supplies they not only provide information as to the amount of water available for use, but they also provide basic information upon which to design spillways. When the new water supply of the City of Little Rock was designed, no actual stream flow records on small Arkansas streams were available. The engineers had, therefore, to resort to theoretical analyses, and, because of the uncertainties of such analyses, to embody a considerable factor of safety in the spillway design. Material savings in such designs and in the design of bridges, culverts, levees, and other flood control works will result from authentic and definite stream gagings. Similarly such records assist in determining the amount of water available for boiler and condensor use in steam power plants, for the dilution of sewage and industrial wastes, for the generation of water power, and for navigation.

To be of material value these records must cover a considerable period of time. The flow of streams varies from day to day, from month to month, and from year to year. Records show that, for periods of several consecutive years, the flow may average much greater or less than the long time mean. Much work remains to be done in this field. The present stations should be maintained and operated for many years. In addition thereto it is estimated that at least 10 new gaging stations should be installed and operated.

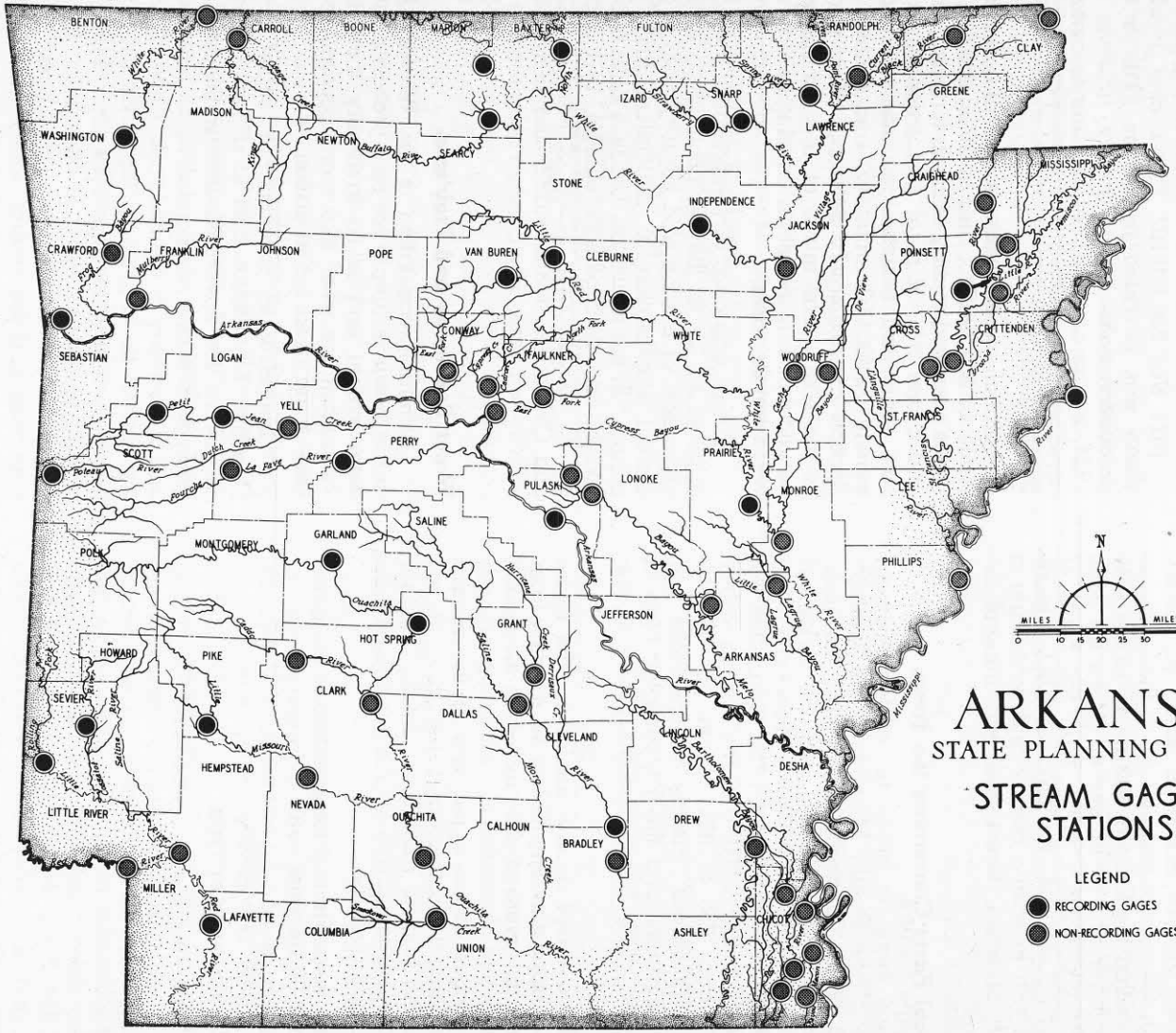


PLATE 18

SOURCE: U.S. GEOLOGICAL SURVEY, MAY 1939

CHAPTER V

WESTERN ARKANSAS BASIN

General Description.

The Western Arkansas Basin, as considered in this report, includes all of the drainage area, within the State of Arkansas, of the Arkansas River and its tributaries above the eastern Pulaski County line. It is the heart of Western Arkansas—an area of 9,865 square miles, rich in scenic beauty and containing a wealth of water, forest, soil and mineral resources.

Physical Facts Concerning the Basin.

This basin is made up of the southern flanks of the Boston Mountains, the northern ridges of the Ouachita Mountains, the intervening Arkansas Valley, and the Arkansas River flood plain. The Boston Mountains reach an elevation of 2,400 feet. The Ouachitas are generally below 2,000, and the central valley ranges from 250 to 800. Plate 12, "Physiographic Provinces", clearly depicts these four major divisions, and the Topographic Map of the State, Plate 1 indicates the range in elevations.

The average annual rainfall for the entire basin is approximately 47 inches, ranging from a maximum average of 55 inches in the Boston and Ouachita Mountains to a minimum average of 40 inches at the upper end of the central valley. Plate 9, "Rainfall and Humidity," shows the distribution of rainfall in detail. Annual rainfall records indicate erratic departures from the normal average.

The mean annual temperature of the basin is about 60 degrees, with a January mean of 32 degrees, and an August mean of 92 degrees. The climate is typically of the humid continental long summer type.

Within this area of wooded hills, rolling valleys, and flat flood plains, approximately 360,000 people live. Roughly, 60 per cent of this population is rural. The urban population includes three cities with over 20,000 population, Little Rock, North Little Rock, and Fort Smith, and about sixty towns with populations between 1,000 and 6,000. Plate 20 indicates that the total population has continued to increase, largely due to growth of the cities.

In 1930, slightly less than one-half of the population was engaged either directly in agriculture or in some vocation dependent upon it. The annual value of agricultural production in 1924 was $38,110,187, 75 per cent of which value was provided by cotton. The annual production value varies greatly, however. In 1934, it was only $10,220,735, due to curtailed acreage under cultivation, lower prices, and a severe drought.

Manufactured products in 1919 had a total value of $53,790,746, and in 1929, $58,872,145. These consisted mainly of brick, furniture, glass, and cotton oil. Mineral production including coal, gas, and bauxite amounts to approximately $2,000,000 annually, and timber production approximately $450,000. This portion of the State, like much of the remainder is handicapped in industrial development by adverse freight rates.

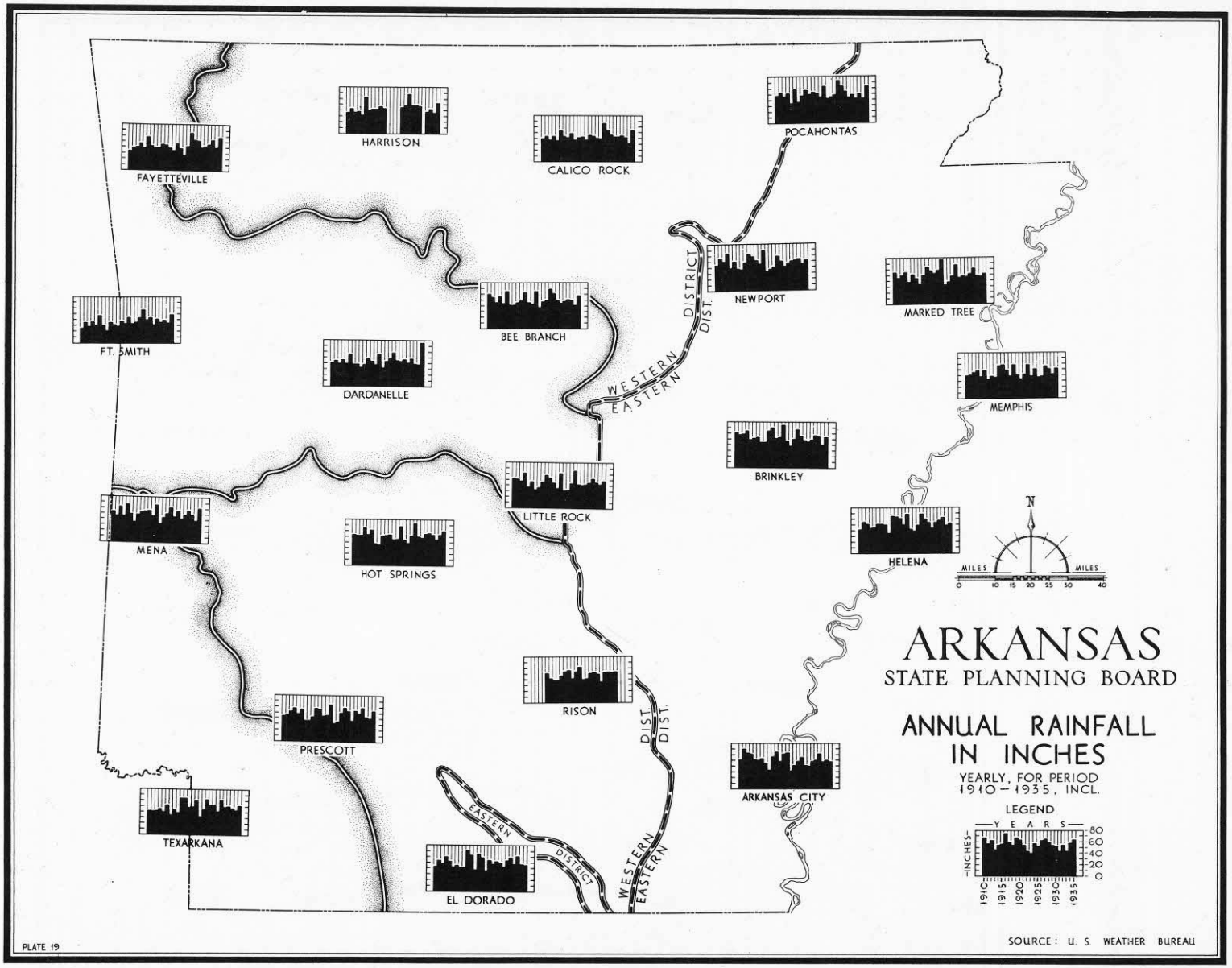
Future economic development of the basin appears to lie in the direction of a gradual expansion of mining and industry with a concurrent stabilization of agriculture and lumbering. In the future too, because of its natural beauty and its moderate climate, in comparison to the adjacent states of Kansas, Texas and Oklahoma, tourist traffic and recreational activity will probably become of increasing importance.

Water Resources and Problems.

Annual precipitation in the Western Arkansas Basin is ample for any probable future development and is so favorably distributed throughout the year that there appears to be little or no need for irrigation.

Ground water supplies are limited in the Ouachita Mountains, and to a slightly lesser degree in the Boston Mountains because the steep slopes are not conducive to infiltration, and the porosity of the bed rock is often low. In the central flood plain of the Arkansas River ample ground water is usually available. The quality of ground water is often poor, for domestic and industrial purposes, both in the highlands and the central valley. Many supplies contain iron and carbon dioxide in objectionable amounts.

The flows of surface streams vary between wide limits. With the exception of spring fed streams in the Boston Mountains, the smaller


HARRISON
POCAHONTAS
FAYETTEVILLE
CALICO ROCK
NEWPORT
MARKED TREE
BEE BRANCH
FT. SMITH
DARDANELLE
WESTERN DIST.
EASTERN DIST.
MEMPHIS
BRINKLEY
LITTLE ROCK
MENA
HOT SPRINGS
HELENA
N
MILES
0 10 15 20 25 30 40
MILES
ARKANSAS
STATE PLANNING BOARD
ANNUAL RAINFALL
IN INCHES
YEARLY, FOR PERIOD
1910 - 1935, INCL.
LEGEND
YEARS
INCHES
0 20 40 60 80
1910 1915 1920 1925 1930 1935
RISON
PRESCOTT
ARKANSAS CITY
TEXARKANA
EASTERN DISTRICT
WESTERN DIST.
EASTERN DIST.
EL DORADO
PLATE 19
SOURCE: U. S. WEATHER BUREAU


BENTON
CARROLL
BOONE
MARION
BAXTER
FULTON
RANDOLPH
CLAY
WASHINGTON
MADISON
NEWTON
SEARCY
IZARD
SHARP
GREENE
LAWRENCE
STONE
CRAIGHEAD
MISSISSIPPI
INDEPENDENCE
JACKSON
CRAWFORD
FRANKLIN
JOHNSON
POPE
VAN BUREN
CLEBURNE
POINSETT
CONWAY
WHITE
CROSS
CRITTENDEN
SEBASTIAN
LOGAN
FAULKNER
WOODRUFF
YELL
ST. FRANCIS
SCOTT
PERRY
PRAIRIE
PULASKI
LONOKE
MONROE
LEE
SALINE
POLK
MONTGOMERY
GARLAND
PHILLIPS
ARKANSAS
JEFFERSON
GRANT
HOT SPRING
HOWARD
PIKE
CLARK
SEVIER
DALLAS
CLEVELAND
LINCOLN
DESHA
HEMPSTEAD
NEVADA
OUACHITA
CALHOUN
BRADLEY
DREW
LITTLE RIVER
MILLER
LAFAYETTE
COLUMBIA
UNION
ASHLEY
CHICOT
N
MILES
MILES
0 10 15 20 25 50 40
ARKANSAS
STATE PLANNING BOARD
POPULATION TRENDS
IN COUNTIES
BY DECADES 1880-1930
LEGEND
GAIN
LOSS
75,000
50,000
25,000
0
25,000
1880
1890
1900
1910
1920
1930
HEAVY BOUNDARIES INDICATE
PRINCIPAL DRAINAGE BASINS
PLATE 20
SOURCE: U.S. CENSUS 1930

streams are intermittent—flashing up to high flood flows as storms occur, then dwindling away with the storms to a series of pools through the dry summer months. The larger tributaries to the Arkansas in this area—the Fourche La Fave and Petit Jean Rivers—are typical flashy mountain streams, and there is a variation of stage on the Arkansas itself of 37.33 feet at Little Rock.

The water problems of the basin fall distinctly into those of the highlands and those of the main valley. Inspection of the Soil Erosion map, Plate 16, and of the Soil Productivity map, Plate 21, suggests that the major problem in the upland areas is that of the control of soil erosion, where the natural forest growth has been cleared to provide areas for crop cultivation. The only superior soil in the basin is in the lowlands, but much of this lies within the flood plain of the Arkansas, and its larger tributaries. Inasmuch as the fertility of the upland soils does not justify and cannot sustain substantial agricultural development, these lowlands will, for a long time to come, bear the main burden of agriculture production. It follows that since a major percentage of the basin's population is engaged in agriculture, adequate flood control is imperative.

Other minor problems include isolated cases of stream pollution in the uplands and the salt pollution of the main river, while the desirability of navigation on the Arkansas is suggested by existing unfavorable freight rates.

In general, however, the adequacy of rainfall; the limited quantity of ground water over much of the area, and its quality; the wide variation of stream flow; and other minor factors, suggest that the need of stream flow regulation is the primary problem of the basin.

Floods and their Control.

Rain storms of high intensity occur rather frequently over the Western Arkansas basin. Because of the characteristics of the drainage area these rains cause damaging floods. Minor floods occur on the Poteau about three times a year, moderate floods about once in five years and major floods about once in twenty-five years. Most of the area flooded by the Poteau is in Oklahoma, but the discharges of these floods are added to the floods of the Arkansas.

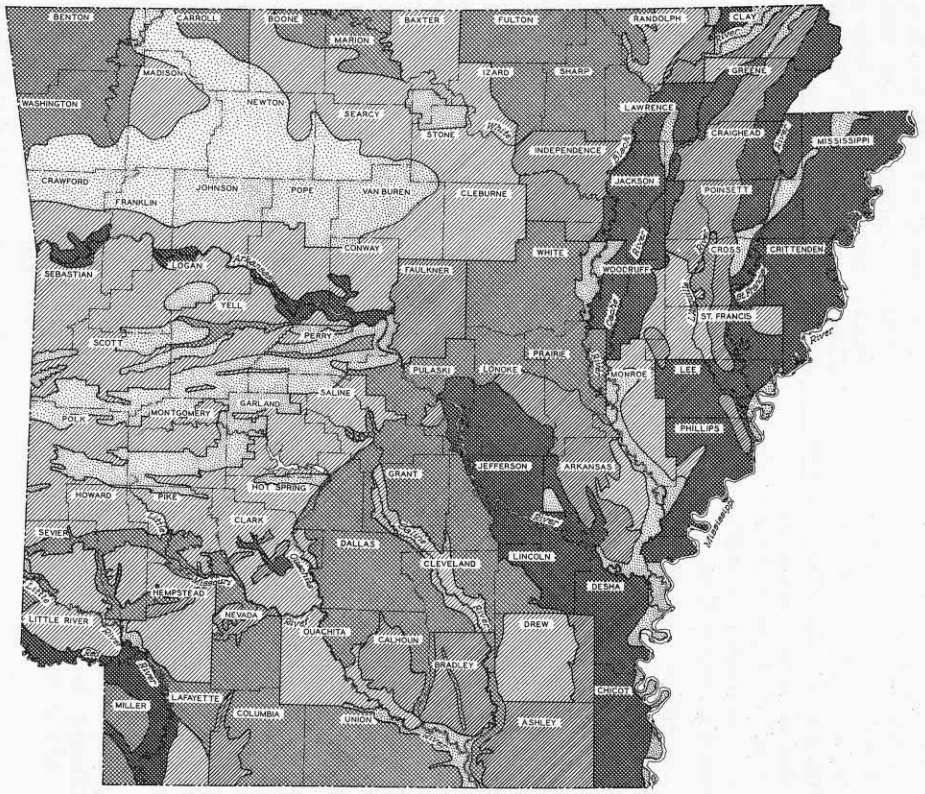
On the Petit Jean, overbank flows occur several times a year, moderate floods every five years and major floods once in fourteen years. On the average 24,200 acres are flooded annually. The Fourche La Fave overflows nearly every year, has moderate floods once in three years, and major floods once in thirty years. Its flood plain includes 65,100 acres. Similar floods occur on the other tributaries, though generally with less frequency than on the streams mentioned.

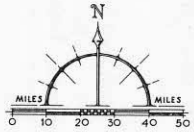
Flood frequencies on the Arkansas River at Little Rock are estimated by the Corps of Engineers as once in thirty years for major floods, once in ten years for moderate floods, and once in one and two-tenths years for floods of all magnitudes. The flood plain of the Arkansas within the basin includes 323,000 acres.

More than 70 per cent of the lands flooded by the streams mentioned is improved agricultural land. The actual loss occasioned by floods is estimated at $487,300 annually, but this figure does not take into account the tremendous increment in the value of products which would accrue if floods were not of nearly annual occurrence. The total value of lands within the flood plains was estimated by the Corps of Engineers in 1932 as being approximately $42,000,000. It is not uncommon for agricultural land in this basin to double in value when flood protection is provided. The annual loss therefore is undoubtedly far in excess of the estimate mentioned.

Existing flood control facilities on the main river in this basin consists of 26 levee districts including an aggregate of approximately 780 miles of levee. While these levees are considered effective against moderate floods, all that were constructed failed to provide protection in the great flood of 1927 and again in 1935. Additional levees for the protection of high value districts, including Little Rock and North Little Rock, have been authorized by Congress, and are partially completed. There are no existing flood control facilities on the Poteau or the Fourche La Fave, and but one small levee has been constructed on the Petit Jean near its mouth. Local interests have constructed a few disconnected levees to protect small, local areas, many of which were severely damaged by the 1927 flood. Under Section 7 of the 1928 Flood Control Act, the Federal Government has spent several hundred thousand dollars for repairs and damages on these levee systems. Since 1936, under the "Omnibus Flood Control Act" of that year, the Federal Government has undertaken the construction of additional levees also, some of which are completed and others under construction.

In their "308 Reports" of 1936, the Corps of Engineers have reported upon rather complete studies of floods in this area. It is noteworthy that they find the major floods on the





ARKANSAS
STATE PLANNING BOARD

SOIL PRODUCTIVITY

LEGEND

- NON-AGRICULTURAL
- POOR
- AVERAGE
- GOOD
- SUPERIOR

SOURCE: UNIVERSITY OF ARKANSAS
COLLEGE OF AGRICULTURE
AGRICULTURAL EXPERIMENT STATION

PLATE 21

Arkansas River originating from storms within the Verdigris, Grand (Neosho), Illinois, Poteau, Petit Jean and Fourche La Fave watersheds. They consider other tributaries west of these streams as "rarely or never" major contributing factors to the Arkansas River floods.

From these studies the Corps of Engineers reached the conclusion that no method of general flood prevention could be set up in the Arkansas Valley of which the cost would not exceed the benefits. They, therefore, suggested the construction of levees and retaining walls only to protect the highest valued districts, particularly at Little Rock and North Little Rock, where these were found to be economically justifiable. In these studies the Corps of Engineers were permitted by the law under which they functioned, to consider only single purpose reservoirs. All of the cost of the reservoirs they studied, therefore, had to be charged to flood control with no thought given to other concurrent benefits. At that time, too, the benefits of flood control were computed from the damages past floods had caused without considering the tremendous appreciation in value of products and lands which would result from the elimination of frequent floods. Finally, there was a tendency to provide against extreme maximum floods in all flood control works, and little consideration was given to plans for the partial protection through the reduction of flood frequencies, by the construction of relatively small reservoirs.

Therefore, the conclusion that no economically justifiable general plan of flood control for the Arkansas Valley can be found, is now subject to serious question. It is not only possible, but highly probable that a combined program of reservoir construction to reduce the flood frequency over large areas together with levee construction to completely protect high value districts would result in benefits far exceeding the cost.

It appears, therefore, that there is an urgent need for a complete re-study of the whole problem of flood control on the Arkansas River in Arkansas. Reconsideration of this problem from a wider economic viewpoint may, and in many cases will, result in the economic justification of projects heretofore considered unjustifiable.

Such a re-study should consider all of the possible benefits which might result from the construction of all types of flood control works in the light of developments since 1936, and new methods of attack in the flood control field. It should take into consideration the effect of work now proposed and under construction on the tributaries of the Arkansas in Eastern Oklahoma and the benefits which might accrue to the Lower Mississippi from these and concurrent projects in the Western Arkansas Basin. It is only by such complete evaluation that the true economics of flood control projects can be determined.

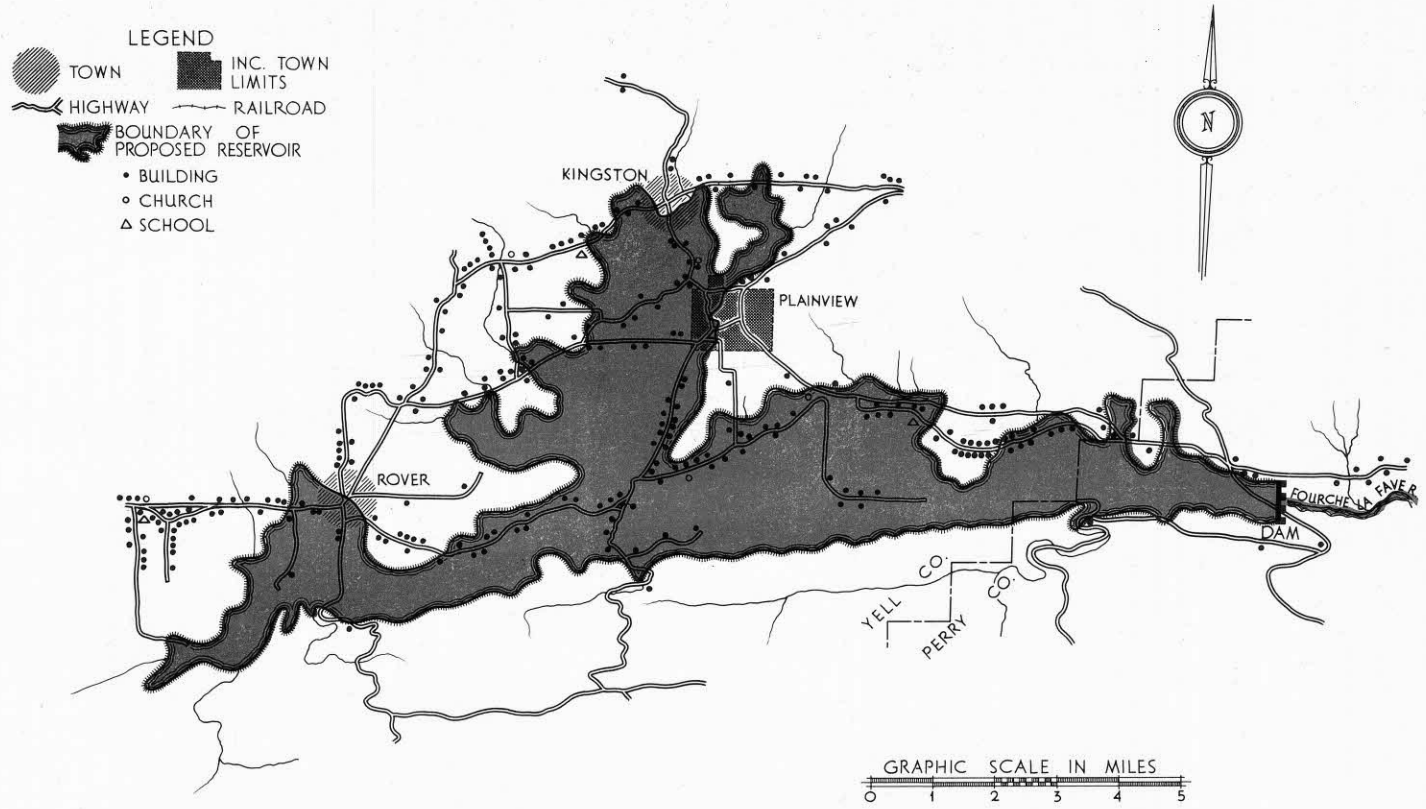
It is improbable that this re-study would result in indicating that any present construction of levees and flood walls is economically unjustifiable or that plans for any contemplated flood retention reservoirs should be abandoned. More probably it would result in the expansion of the reservoir program and possibly in some adjustment in the priority of projects. It might even indicate the economic feasibility of zoning against human occupancy that portion of the valley now affording only partial protection.

The National Resources Committee's Drainage Basin Committee for the Lower Arkansas in its meeting in Hot Springs in October 1937, made a strong recommendation for the re-study suggested above. This recommendation has been approved by water committee of the National Resources Committee. The study should be made as rapidly as basic information can be obtained.

In addition to such a coordinated study of the entire basin the value of at least two specific reservoir sites, the use of which, as retention reservoirs, has already been favorably reported upon by the Corps of Engineers and authorized by Congress in 1938, and initial appropriations for construction were made by Congress in 1939, should be studied in detail. These are the Nimrod Reservoir on the Fourche La Fave about three miles above the town of that name in Perry County, and the Blue Mountain Reservoir on the Petit Jean River near the Logan-Yell County line. These sites are shown on Plates 22 and 23 respectively. It is probable that some degree of improvement of low water flow on the Arkansas and considerable recreational benefit could be derived from these reservoirs in addition to their primary function as flood retention basins. All of these factors should be considered in the detailed study.

Hydro-electric Power.

Because of the large storage required for stream control in most of the suggested reservoirs in this basin the development of hydro-electric power in quantity is probably not feasible. The possibility of constructing a power reservoir on the Arkansas immediately north of Little Rock is reported upon in the "308 Reports" of the Army Engineers. It is estimated that this site is susceptible to the development

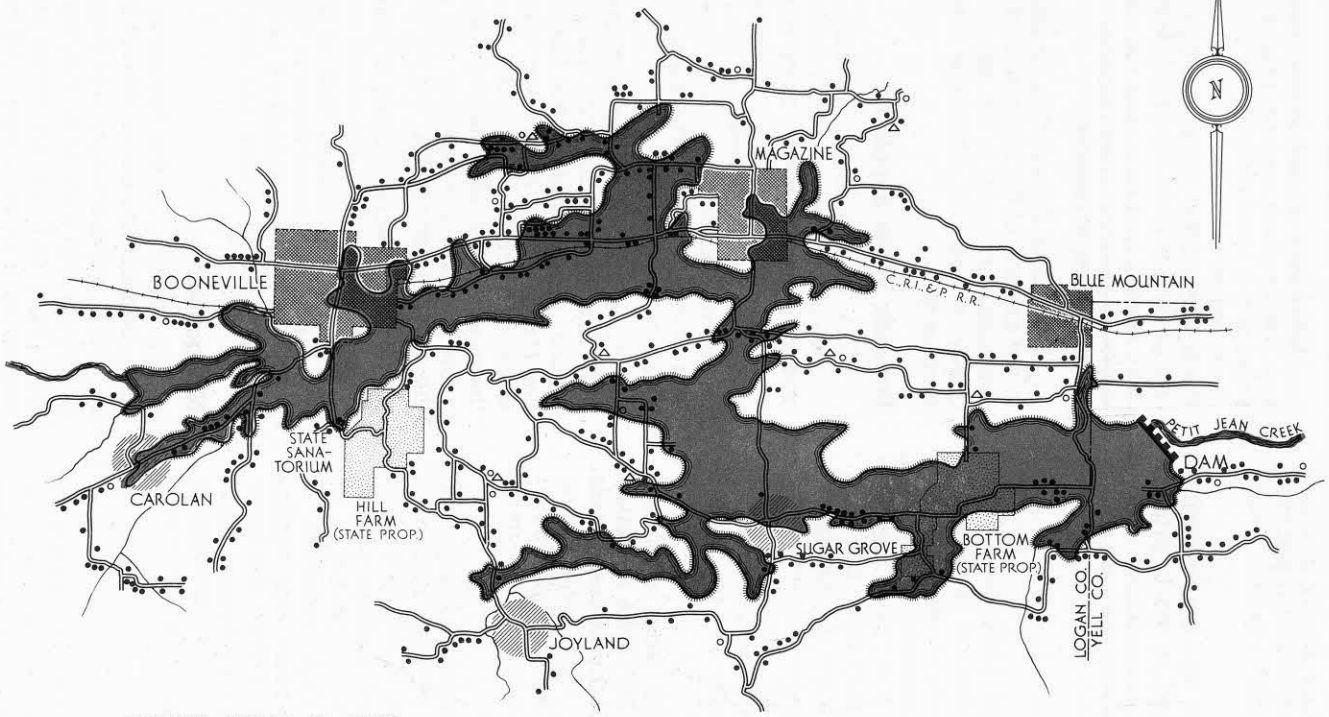


MAP OF PROPOSED
NIMROD
RESERVOIR

DR. AREA = 695 SQ. MI. RUN-OFF - 17 IN.
ELEV. = 400 FT. CAPACITY = 640,000 A.F.

ARKANSAS STATE PLANNING BOARD
1937

PLATE 22



MAP OF PROPOSED
BLUE MOUNTAIN
RESERVOIR

DR. AREA = 500 SQ. MI.	RUN-OFF = 15 IN.
ELEV. = 434 FT.	CAPACITY = 400,000 A.F.

LEGEND

- TOWN
- INC. TOWN LIMITS
- HIGHWAY
- RAILROAD
- BOUNDARY OF PROPOSED RESERVOIR
- • BUILDING
- o CHURCH
- △ SCHOOL

ARKANSAS STATE PLANNING BOARD
1937

PLATE 23

SOURCE: U. S. ARMY ENGINEERS, U.S. GEOLOGICAL SURVEY & OTHER AVAILABLE DATA

of 614 million K.W.H. of primary and 686 million K.W.H. of secondary power, at a cost of 19.3 mills per K.W.H. for primary power. This cost is in excess of the cost of power generated in a steam plant of equal capacity unless the load factor is below 19.6 per cent. The project as proposed is therefore economically unsound and is also subject to serious objection because of the value of the land that would be submerged.

While the possibility of hydro-electric power should be considered in each project studied, it is probable that development in this basin will be limited to relatively few and small installations.

Drainage.

Between Fort Smith and Little Rock there are 34 levee and drainage districts in the main valley, comprising a total area of about 178,000 acres. These districts are scattered throughout the length of the basin. With the exception of those in Pulaski County they have not been successful, principally because of inadequate levees. Much damage occurred to the levees in these districts in the 1927 flood, some of which have been repaired with the assistance of the Federal Government under Section 7 of the "Flood Control Act of 1928."

These drainage districts were organized under the provisions of Act 279 of the Arkansas General Assembly, 1909. Many of the districts are in financial difficulties. Many overlapping assessments exist which can be eliminated only by a consolidation of these districts and a general plan of refinancing.

If the frequency of moderate floods on the Arkansas can be reduced by such means as discussed in the section on Flood Control of this chapter, then agricultural pursuits can be stabilized and these districts can probably be satisfactorily refinanced. Such reduction in flood frequency will at the same time require less expensive works and so lighten the financial burden. Without a comprehensive plan these districts are at best local attempts to solve a basin-wide problem, and the results speak for themselves.

Stream Pollution.

The Arkansas River has an extremely high sodium chloride content, at low flows, contributed largely by the natural salt pollution of the river in its western reaches and augmented by salt water waste from oil fields in Oklahoma and Kansas. The water is unfit for human consumption during low stage, and Little Rock has recently provided for an expensive impounded supply to replace the Arkansas River as its source of water supply. Ft. Smith likewise has replaced the Poteau River supply which was obtained near the mouth of that river and frequently was affected by back water from the Arkansas River.

Elsewhere in the basin, stream pollution has not reached serious proportions with the exception of local pollution by coal mine wastes in the extreme western portion. However, Little Rock, North Little Rock and Fort Smith all discharge raw sewage into the Arkansas, and with increasing population and the development of industry, pollution may become a more serious problem than at present.

Studies of the existing degree of pollution in the streams of the basin should be made and consideration given to the effect of growing industry in order to anticipate serious pollution problems.

Domestic Water Supplies.

The abundance of rainfall and suitable storage sites, combined with the limited amount and frequency of poor quality of ground water over much of the basin, all suggest the use of impounded surface water as the proper supply for urban populations. Little Rock, Fort Smith, and other smaller towns have already developed such supplies.

To a limited extent impounded supplies may also be desirable for use by rural populations, particularly in the higher portions of the basin where experience has proved that wells are seriously affected by drought. In the main valley, well supplies are usually adequate for rural consumption and the quality of the water is somewhat above the average.

Domestic water supply is normally a local problem and should be solved as such, except that there is a marked lack of information on the quality of ground water in this basin. The subject is now being studied by the State Geological Survey for local use and guidance.

Navigation.

Navigation on the Arkansas, which is the only stream in the basin offering any possibility of water transportation, has been studied by numerous agencies with varying conclusions. The Corps of Engineers made rather detailed studies as a basis of their "308 Report" on the subject, and reached the conclusion that a 9-foot channel 200 feet wide from the Mississippi to Tulsa, Oklahoma, was not economically justifiable and could not be maintained in prolonged drought periods.

Arkansas State Publicity Department Photo

A Small, Artificial Stock Pond

The water Transportation Advisory Committee of the Arkansas State Planning Board has submitted a specific description of the advantages of navigation as follows:

"Navigation on the Arkansas River will serve the commercial needs of the three largest cities in the State, namely, Little Rock, Fort Smith and Pine Bluff. Also it will serve the 187,574 people of Tulsa and 66,424 people of Muskogee, Oklahoma. It would provide low-cost transportation rates for many articles which at the present time are not marketed because of the competition of products from regions better served with lowest transportation. The development of navigation on the Arkansas River is a large project in the Arkansas Basin which will provide an enduring benefit to the cities along the entire length of the navigable stream."

A re-survey of the tonnage that would be transported on the river is now being made by the Army Engineers and will be submitted as a supplementary report to their previous study.

Since there is a wide diversity of opinion as to the feasibility of the project, and the justification for the expenditure of the funds necessary to improve and maintain the Arkansas River as a navigable stream, further information and study are essential before final conclusions can be reached.

Erosion and Land Management.

Where forest land has been cleared to permit crop production in much of the highland area of the Western Arkansas Basin, soil erosion has taken a severe toll. Plate 16 indicates the seriousness of this situation. In at least one case serious reduction in storage capacity in an impounded domestic water supply has resulted from the rapid deposition of silt.

Much of this highland is of doubtful value for agricultural production and is becoming more so as erosion continues. The logical long-range program would appear to call for the retirement of many of the tracts from cultivation together with concurrent reforestation. Contour cultivation, strip cropping, and terracing should be practiced where the fertility of the soil justifies continued agricultural use.

This plan will result in the ultimate re-development, on a commercial scale, of forests on these lands. It will reduce soil erosion and the consequent silting of downstream reservoirs. It will tend to regulate stream flow and reduce peak run-offs. It will restore the native beauty of these uplands and render them more attractive for recreational development. The further extension of the Ouachita and Ozark National Forests can logically be continued as being distinctly in harmony with all of the above objectives. The experimental work of the Soil Conservation Service in determining rates of silt deposition in reservoirs is of value and might well be supplemented by state agencies.

Recreation.

The wooded beauty of the Ouachita and Boston Mountains strongly suggests their exceptional recreational possibilities. In addition to the two National Forests within the basin, Plate 7 shows three state parks in the Western Arkansas Basin already under development. Most of the vast area of forest covered mountains and wooded valleys, flanking the Arkansas River on both sides throughout the length of the basin, have been made readily accessible by automobile through the construction of a network of roads by the Civilian Conservation Corps.

Although rainfall is ample and streams are numerous there are no stored winter snows to maintain stream flow in the summer and fall, and water becomes noticeably deficient. Many feasible reservoir sites exist, the development of which will adequately correct this deficiency. Nature has richly endowed this area with climate and scenic beauty which command attention. There remains only the planned development of recreational lakes to make it a wonderland playground, especially for the people of Kansas, Texas and Oklahoma, whose native states are not so richly endowed.

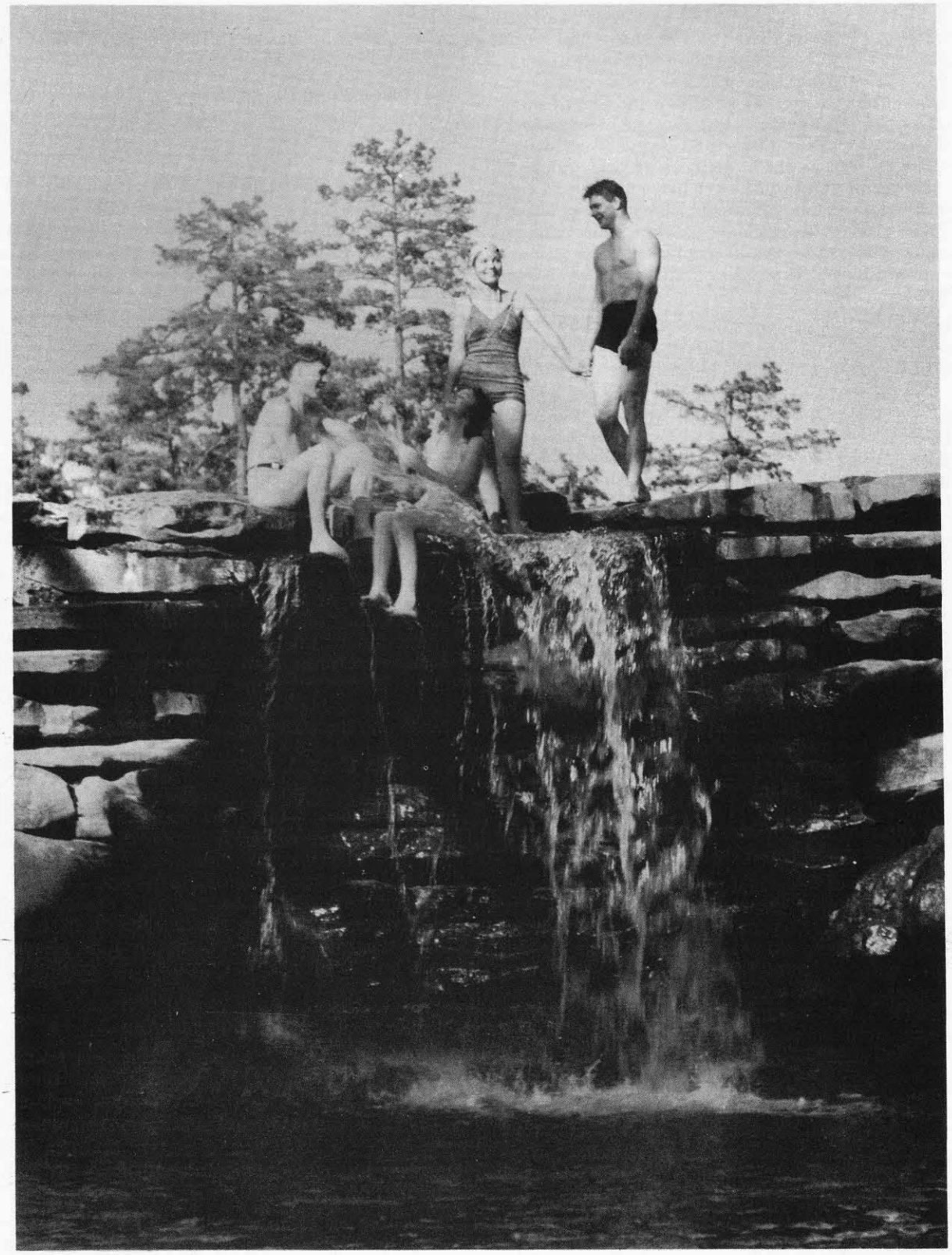
Mosquito Control.

Full recognition should be given in any water development to the fact that this basin lies within the malarial region of the United States. However, its altitude and topography reduce the malarial problem to one of much less importance than it assumes in the lowland portion of the State. Improvement of land drainage and control of stream flow should both be effective in assisting in the control of malaria.

Conclusions and Recommendations.

The western Arkansas Basin has ample precipitation to meet its present and future water requirements. The chief water problem within the basin is that of stream control, including both the reduction of floods or their frequency and the increasing of dry weather stream flow.

There exists an urgent need for a complete re-study of the flood control problem in the



Arkansas State Publicity Department Photo

Swimmers at Petit Jean State Park

Arkansas Valley occasioned by major changes in the practice of flood control, and in the manner of computing flood control benefits since the last comprehensive study was made in 1932. Such a re-study should be undertaken as rapidly as basic data can be assembled. Detailed studies of the Nimrod and Blue Mountain reservoir sites for stream flow regulation and recreational uses should be undertaken immediately, inasmuch as the effectiveness of these reservoirs as flood storage basins is reasonably well established.

A study of the status and problems of the levee and drainage districts in the basin should be made with a view to consolidating many of these districts and solving both their physical and financial problems.

Existing degrees of pollution in the streams of the basin, particularly the Arkansas, should be ascertained in order to anticipate any pollution problems of the future, and provide relatively inexpensive remedies before these problems become acute.

Basic information on the quantity and quality of the ground waters of the basin is largely lacking and might well be assembled to serve as a guide in the development of future municipal and domestic water supplies.

Navigation on the Arkansas, while desirable and of great economical value to the State, is a subject concerning which there is a wide divergence of opinion as to feasibility. Additional studies are essential before any final conclusions are possible.

Extension of the Ozark and Ouachita National Forests is in complete harmony with any sound plan for the reforestation of unfertile uplands to prevent soil erosion and silting of reservoirs. Basic work such as the Soil Conservation Service is doing in determining the rates of siltation of reservoirs is of value and should be continued and extended.

Recreational use of the Boston and Ouachita Mountains will doubtless assume an ever increasing importance. Their major deficiency as recreational areas is lack of water in drought periods. Available recreational reservoir sites should be studied and developed as rapidly as possible.

A list of projects recommended by the Water Resources Committee of the State Planning Board, providing for investigation and construction within the Western Arkansas River Basin, follows. The list contains those items for which sufficient reliable data are available at present to make the Water Resources Committee reasonably certain of their economic and social justification. Necessarily, this list will require revision and change from time to time as additional information becomes available.

FLOOD CONTROL AND POWER PROJECTS

No.	Name	Description and Location	Authorized	Estimated Cost	Status
1.	Arkansas River and Fourche Bayou	Survey and investigation near Little Rock, Pulaski County	Yes	Not available	In progress
2.	Crawford County Levee District	Investigation, strengthening and heightening levees, Crawford County	Yes	Not available	In progress
3.	Big Mulberry Creek	Survey and investigation reservoir and levees, Franklin County	Yes	Not available	In progress
4.	Petit Jean Creek	Survey and investigation reservoir and levees, Yell, Logan and Scott Counties	Yes	Not available	In progress
5.	Point Remove Creek	Survey and investigation, reservoir, levees, and channel rectification, Conway and Pope Counties	Yes	Not available	In progress
6.	Palarm Creek	Survey and investigation, reservoir, levee, flood gate and channel improvement, Pulaski and Conway Counties	Yes	Not available	In progress
7.	Six Mile Creek	Survey and investigation, reservoir, levees, and channel rectification, Logan and Franklin Counties	Yes	Not available	In progress
8.	Cadron Creek	Survey and investigation, reservoirs, Conway and Faulkner Counties	Yes	Not available	In progress
9.	South bank of Arkansas River	Investigation — levees — Pulaski and Jefferson Counties	Yes	Not available	In progress
10.	Arkansas River	Hydro-electric studies, Arkansas River and tributaries	Yes	Not available	In progress

FLOOD CONTROL AND POWER PROJECTS

No.	Name	Description and Location	Authorized	Estimated Cost	Status
11.	Conway Levee and Drainage District	Investigation, levees, right bank, Arkansas River, Conway County	Yes	Not available	In progress
12.	Arkansas River, left bank	Improvements to existing levees west of Morrilton, Conway and Pope Counties	Yes	$ 581,000	Pending acquisition of right-of-way
13.	Arkansas River, south bank	Improvements to levees, Dardanelle, Yell County	Yes	175,000	Pending acquisition of right-of-way
14.	Arkansas River, south bank	Construction of levees, Little Rock, Pulaski County	Yes	708,000	Pending acquisition of right-of-way
15.	Spadra creek, right bank	Construction of levee, Johnson County	Yes	70,000	Pending acquisition of right-of-way
16.	Blue Mountain Reservoir, Petit Jean River	Construction of dam, Logan County	Yes	5,900,000	Construction not started, Initial allotment made
17.	Nimrod Reservoir, Fourche La Fave	Construction of dam, Perry and Yell Counties	Yes	2,888,000	Construction not started, Initial allotment made

POLLUTION CONTROL PROJECTS

No.	Location	Nature of Project	Recommended	Estimated Cost
1.	Arkansas	Basin-wide study	Yes	$ 30,000
2.	Altus	Sewerage system	Yes	
3.	Belleville	Sewerage system	Yes	
4.	Coal Hill	Sewerage system	Yes	
5.	Danville	Sewerage system	Yes	
6.	Dover	Sewerage system	Yes	
7.	Dyer	Sewerage system	Yes	
8.	Hartford	Sewerage system	Yes	
9.	Hartman	Sewerage system	Yes	
10.	Huntington	Sewerage system	Yes	
11.	Lamar	Sewerage system	Yes	
12.	Levy	Improvements	Yes	
13.	Magazine	Sewerage system	Yes	
14.	Mansfield	Sewerage system	Yes	
15.	Ola	Sewerage system	Yes	
16.	Plainview	Sewerage system	Yes	
17.	Plumerville	Sewerage system	Yes	
18.	Atkins	Improvements	Yes	
19.	Booneville	Improvements	Yes	
20.	Clarksville	Improvements	Yes	
21.	Dardanelle	Improvements	Yes	
22.	Ft. Smith	Improvements	Yes	
23.	Morrilton	Improvements	Yes	
24.	Ozark	Improvements	Yes	
25.	Paris	Improvements	Yes	
26.	Russellville	Improvements	Yes	
27.	Van Buren	Improvements	Yes	
28.	Decatur	Sewerage system	Yes	
29.	Gravette	Sewerage system	Yes	
30.	Lincoln	Sewerage system	Yes	
31.	Sulphur Springs	Sewerage system	Yes	
32.	Rogers	Improvements	Yes	
33.	Springdale	Improvements	Yes	
34.	Sanatorium	Improvements	Yes	
35.	McRae	Improvements—Negro sanatorium	Yes	
36.	Cummins	Sewerage System—Cummins State Penal Farm	Yes	
37.	Tucker	Sewerage System—Tucker State Penal Farm	Yes	
38.	Greenwood	Sewerage system	Yes	
			Total	$1,642,000

WATER SUPPLY PROJECTS

No.	Location	Nature of Project	Recommended	Estimated Cost
1.	Little Rock	Study and plans for supplementary water supply on Fourche LaFave River	Yes	$ 15,000
2.	Altus	Water Supply	Yes	30,000
3.	Belleville	Water Supply	Yes	30,000
4.	Coal Hill	Water Supply	Yes	40,000
5.	Dyer	Water Supply	Yes	30,000
6.	Hartman	Water Supply	Yes	40,000
7.	Huntington	Water Supply	Yes	35,000
8.	Lamar	Water Supply	Yes	35,000
9.	Magazine	Water Supply	Yes	30,000
10.	Plainview	Water Supply	Yes	35,000
11.	Plumerville	Water Supply	Yes	35,000
12.	Atkins	Improvements	Yes	5,000
13.	Clarksville	Improvements	Yes	10,000
14.	Camp Pike	Improvements	Yes	5,000
15.	Dardanelle	Improvements	Yes	10,000
16.	Morrilton	Improvements	Yes	25,000
17.	Russellville	Improvements	Yes	25,000
18.	Van Buren	Improvements	Yes	35,000
19.	Ozark	Improvements	Yes	15,000
20.	Siloam Springs	Improvements	Yes	20,000
21.	Springdale	Improvements	Yes	10,000

Arkansas State Publicity Department Photo

Mountain Streams of Arkansas Provide Excellent Game Fishing

CHAPTER VI

UPPER WHITE AND BLACK RIVER BASIN

General Description.

This basin includes all of the Ozark highland portion of the State north of the Western Arkansas Basin. Drained by the White River and the lower western tributaries of the Black, its 9,436 square miles extend along the Arkansas-Missouri line from Fayetteville on the west to Searcy, Batesville and Imboden on the east. Within its bounds lie the greater part of the Ozark Mountains. South of the White River the Boston Mountain escarpment rises abruptly —a bold wall-like front 500 to 700 feet above the river—to maximum elevations of 2,400 feet. The escarpment is deeply eroded by short, steep southern tributaries of the White. North of the river less precipitous slopes extend to the Springfield and Salem plateaus, generally below elevations of 1,400 feet and with undulating surfaces. The basin is largely a wooded land of swift, clear mountain streams, flowing out upon the flat alluvial valley of the Mississippi which extends along its eastern edge.

Geologically it is an interesting region. The Ozark uplift is one of the oldest in the United States. The rock beds now at the surface were originally deeply buried. Slow erosion for countless centuries has exposed the beds now on the surface. The major portion of the basin is underlaid by beds of limestone and dolomite which contain numerous caves, and carry some subterranean drainage.

The average annual precipitation in the basin is 51 inches, a very small percentage of which occurs as snow. The average annual temperature is about 61 degrees with a winter average of about 50 degrees and a summer maximum average of 88 degrees. Because of its altitude this basin has cooler summers than any of its bordering basins.

The total population of the basin in 1930 was 218,655, of which more than 90 per cent was rural. There are but three towns in the entire area whose population exceeds 2,500. They are Fayetteville, with a population of 7,394, Batesville, with 4,484, and Harrison, with 3,626. Of the remaining population 3,029 people live in incorporated towns with populations less than 2,500. Plate 20 showing population trends indicates that the population of the basin as a whole has decreased since 1900.

Approximately 70 per cent of those gainfully occupied in the basin are engaged in agriculture. Cotton is the highest valued crop and corn is second. Fruit is grown extensively in the northwestern portion with apples and grapes predominating. The total value of agricultural products produced annually ranges from $6,000,000 to $28,000,000, of which the value of cotton is usually more than one-third. The annual value of the lumber production varies from $300,000 to $600,000, and mineral production is normally about $300,000. Chief among the mineral products are manganese, glass-sand and marble. The total value of manufactured products ranges from $5,000,000 to $9,000,000 annually. The most important industry is the manufacture of lumber and other wood products, followed by canning, stone quarrying, and mining.

While complete data on tourist traffic are not available, such traffic is becoming of ever greater importance in this basin. It has increased the market for local products, and augmented the income from the basic industries. This trend should continue to an increasing degree for many years to come.

Agricultural production will probably not increase materially in the future, as the fertility of the soil is low over much of the area. Mining, quarrying and manufacturing may be expected to expand, and service to those who visit the recreational areas will become of greater importance.

Water Resources and Problems.

In this basin, as in the Western Arkansas, rainfall is ample for any reasonable future development, and is so distributed throughout the growing season that there is little or no need for irrigation. Intense storms of short duration are common, causing sudden floods in the steep, swift mountain streams.

Ground water at considerable depth is generally available in ample quantities, except in the extreme western portion of the basin. The underlying limestones, with their characteristic caves and underground channels, retain considerable quantities of ground water and springs are numerous. Mammoth Spring, with its maximum flow of 335 cubic feet per second, is one of the large springs of the United States.

Shallow wells and the smaller surface springs are affected by draught periods. Ground water quality is generally good. Although hardness is usually present there is no extensive portion of the area in which ground water is so highly mineralized as to be nonpotable, and some of the spring water is quite soft. Both springs and wells are frequently subject to some pollution requiring the sterilization of drinking water, a condition which may become more severe with extensive recreational development.

The principal streams in the basin are: the White with its tributaries, Kings River, Long Creek, Crooked Creek, Buffalo Fork and North Fork; the tributaries of the Black, Eleven Point River, Spring River, and Strawberry River; and the Little Red River.

In the highlands these streams are classed as swift flowing, and sometimes show white water. In general the fall in the larger streams is three or four feet per mile. Because of the prevalence of springs and the distribution of rainfall, stream flows are reasonably well maintained through the driest months. Though subject to frequent flashy floods the streams do little damage in the mountains, because of the narrowness of their flood plains.

The three major water resources are: (1) hydro-electric power sites, (2) flood control reservoir sites, and (3) water for recreational use. Their integrated development is the basin's fundamental water problem.

Hydro-Electric Power.

The White River and its tributaries have long been considered a potential source of hydro-electric power. Some forty different sites have been studied by the Corps of Engineers, and the results of their studies are available in House Document 102, Seventy-third Congress, First Session, 1935. Congress has authorized the construction of six reservoirs in this basin, namely Norfork on the North Fork, Lone Rock on the Buffalo, Greers Ferry on the Little Red, Bell Foley on Strawberry, Water Valley on Eleven Point and Clear Water on Black River in Missouri. These reservoirs are authorized primarily for flood control but the installation of penstocks are required by the Act.

There are two additional sites not yet authorized which are larger to offer great promise for flood control and hydro-electric development. These are Table Rock in Missouri and Wild Cat Shoals near Yellville in Arkansas. The army engineers are now engaged in a study of these projects and will report their findings to Congress.

Yet the records of the Arkansas Department of Public Utilities show that during the two-year period of 1936 and 1937 over half of the electrical energy used in Arkansas was imported from surrounding states, and that the annual consumption per customer is about 700 K.W.H., in comparison to about 1,100 K.W.H. per customer in two neighboring states, and approximately 800 K.W.H. for the national average. These importations are in part occasioned by both the existence of cheap fuel in Oklahoma and Louisiana, and by the lack of the development of industrial power use within Arkansas. Relatively low consumption is also the result of past and present high domestic and commercial rates for electricity. Both of these conditions would be materially improved by a substantial increase in hydro-electric development within the state. It is estimated that of the 425,600 H.P. of available hydro-electric power within the Upper White and Black basin, only 1,300 H.P. or .3 of 1 per cent is now developed.

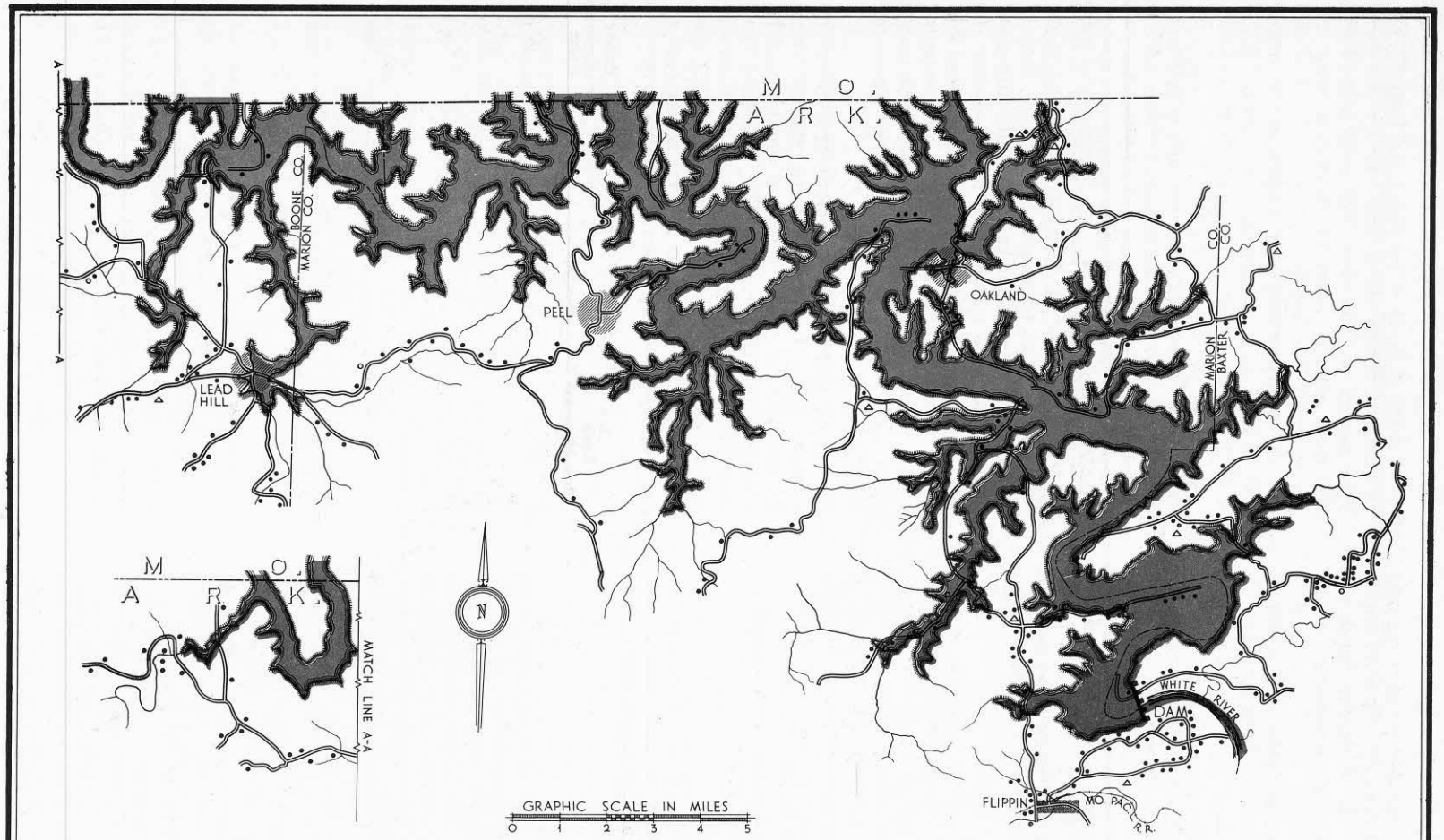
The eventual development of mineral industries in this basin itself may offer a market for much of the primary power which could be economically developed. The following table from Governor Bailey's report to the Corps of Engineers, indicates the potential use for electric energy for the development of mineral resources within and adjacent to the basin:

Basic Raw Material	Product	Yearly Consumption KWH
Bauxite	Metallic Aluminum	210,000,000
	Aluminous abrasives	56,200,000
Zinc Ore	Metallic zinc	56,790,000
Manganese Ore	Metallic manganese	[1]
Phosphate rock	Pulverized fertilizer	75,000
Glass sand	Glass wool	[1]
Limestone	Portland cement	425,000
	Calcium carbide	6,000,000
	Crushed rock	16,650
	Rock wool	[1]
Dolomite	Crushed rock	30,000
Sandstone	Crushed rock	30,000
		329,566,550

It seems highly probable that the development of the feasible hydro-electric power sites in the immediate vicinity of this potential demand would correct this deficiency and, to quote from the 1936-37 Report of the Arkansas Department of Public Utilities, "Would bring rapid growth of industry to this section."

Aside from this potential development, however, approximately twenty-three million

[1] Information regarding power requirements not available.



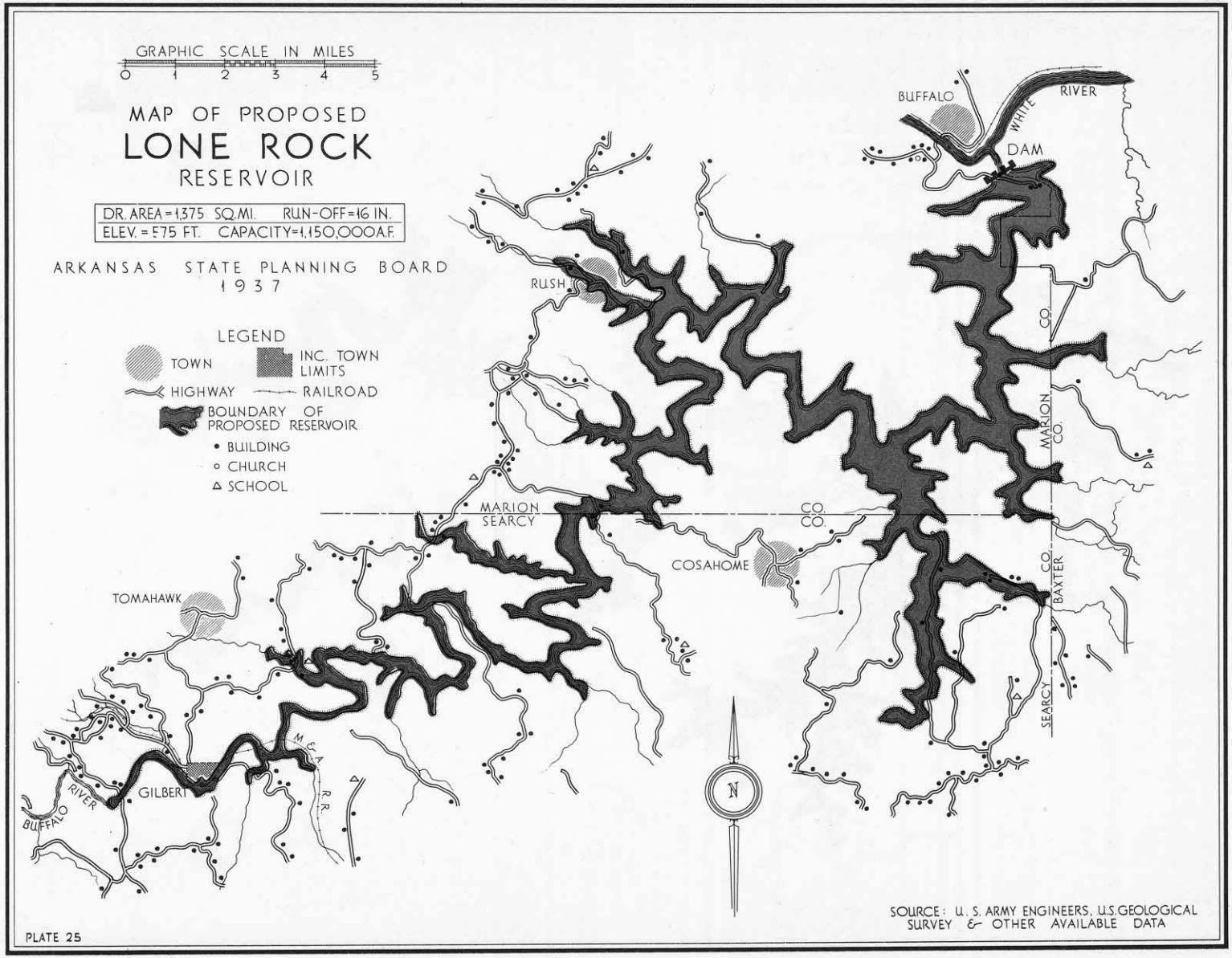
MAP OF PROPOSED
WILD CAT SHOALS
RESERVOIR

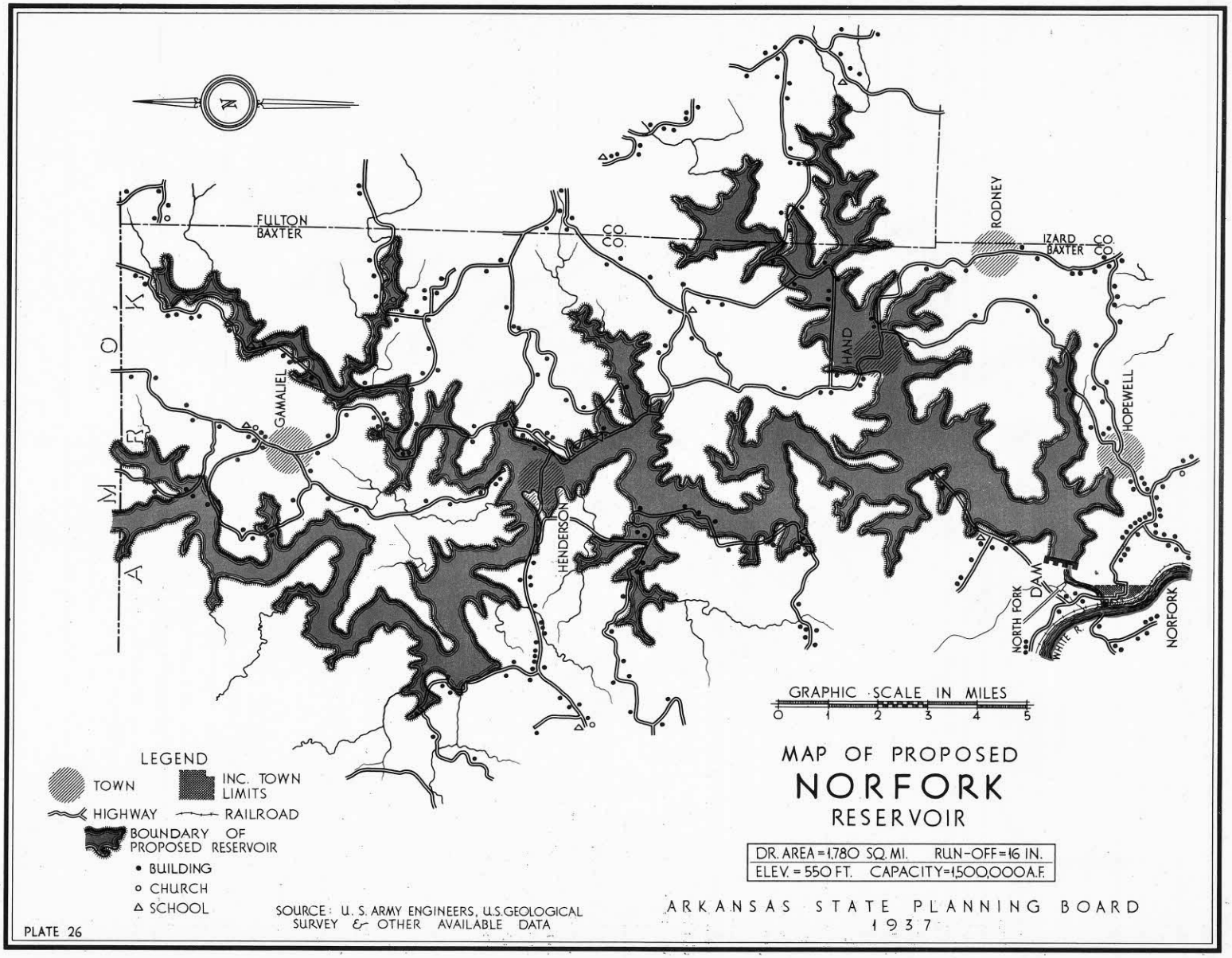
DR. AREA = 5,935 SQ. MI.	RUN-OFF = 11 IN.
ELEV. = 650 FT.	CAPACITY = 3,400,000 A.F.

ARKANSAS STATE PLANNING BOARD
1937

SOURCE : U. S. ARMY ENGINEERS, U.S. GEOLOGICAL SURVEY & OTHER AVAILABLE DATA

PLATE 24


GRAPHIC SCALE IN MILES
0 1 2 3 4 5
MAP OF PROPOSED
LONE ROCK
RESERVOIR
DR. AREA = 1,375 SQ. MI. RUN-OFF = 16 IN.
ELEV. = 575 FT. CAPACITY = 1,150,000 A.F.
ARKANSAS STATE PLANNING BOARD
1937
LEGEND
TOWN
INC. TOWN LIMITS
HIGHWAY
RAILROAD
BOUNDARY OF PROPOSED RESERVOIR
• BUILDING
o CHURCH
△ SCHOOL
BUFFALO
WHITE RIVER
DAM
RUSH
CO.
MARION CO.
MARION
SEARCY
CO.
CO.
COSAHOME
CO.
BAXTER
SEARCY
TOMAHAWK
M. & A. R.R.
GILBERT
BUFFALO RIVER
N
SOURCE: U. S. ARMY ENGINEERS, U.S. GEOLOGICAL SURVEY & OTHER AVAILABLE DATA
PLATE 25



MAP OF PROPOSED NORFORK RESERVOIR

DR. AREA = 1,780 SQ. MI.	RUN-OFF = 16 IN.
ELEV. = 550 FT.	CAPACITY = 1,500,000 A.F.

SOURCE: U. S. ARMY ENGINEERS, U.S. GEOLOGICAL SURVEY & OTHER AVAILABLE DATA

ARKANSAS STATE PLANNING BOARD
1937

PLATE 26

people live within a distance of three hundred miles of these power sites, and this market is constantly growing. Further, as fuel slowly becomes less plentiful, and, therefore, more costly, more and more hydro-electric generation will be brought into use.

Therefore, a detailed study of both present and potential power markets should be made by a state agency, interested primarily in the economic development of Arkansas. This study should consider fully the possibility of industrial development within and immediately adjacent to this basin as well as the possibility of sales of power to more distant metropolitan centers to meet peak loads on systems whose primary generation is by steam plants. It should involve, also, a detailed re-study of construction and operation costs, and the accurate determination of power production costs, thus insuring a fair consideration of Arkansas's projects as compared to those in neighboring states.

In the meantime, expensive permanent development in the areas to be flooded by power dams should be avoided. These areas should be selected as soon as possible.

Flood Control.

An extensive flood control program in this basin for benefits within the basin is unnecessary and economically unjustifiable. The steep narrow flood plains though frequently flooded, are neither extensive nor valuable enough to justify flood control for their own protection.

Flood control is of importance only because of the effect that retention reservoirs would have on floods in the lower reaches of these streams and in the Lower Mississippi Basin. This effect should, therefore, be the primary object of study in planning any major reservoir project within the basin.

Pollution.

Stream pollution is uncommon, and quite localized in this basin largely because of the small number of cities. Ground water, both from springs and wells, is often polluted to a degree requiring sterilization for domestic use. With either industrial or recreational developments pollution problems will arise, and study may well be given to planning which will anticipate and prevent the occurrence of these problems.

Domestic Water Supplies.

Most of the urban water supplies in this basin come either from deep wells or springs. Some of the springs are extremely soft. At Berryville the hardness of the spring supply is approximately twenty-five parts per million. In general, however, as might be expected in limestone country, hardness ranges from 150 parts per million to 350 parts per million.

Rural water supplies also usually come from these same beds though the wells are shallower, and it is sometimes difficult to obtain adequate supplies.

The fact that well water often requires sterilization, and that it is generally found at considerable depth, combined with the fact that suitable sites are available in the narrow valleys for impounded supplies suggest that future domestic supplies both rural and urban may come more and more from small surface reservoirs. However, the numerous springs, where available, will probably continue to serve as supplies. Additional data on both quality and quantity of ground water, as well as coordination of existing data, would be of great value in solving specific problems in the future.

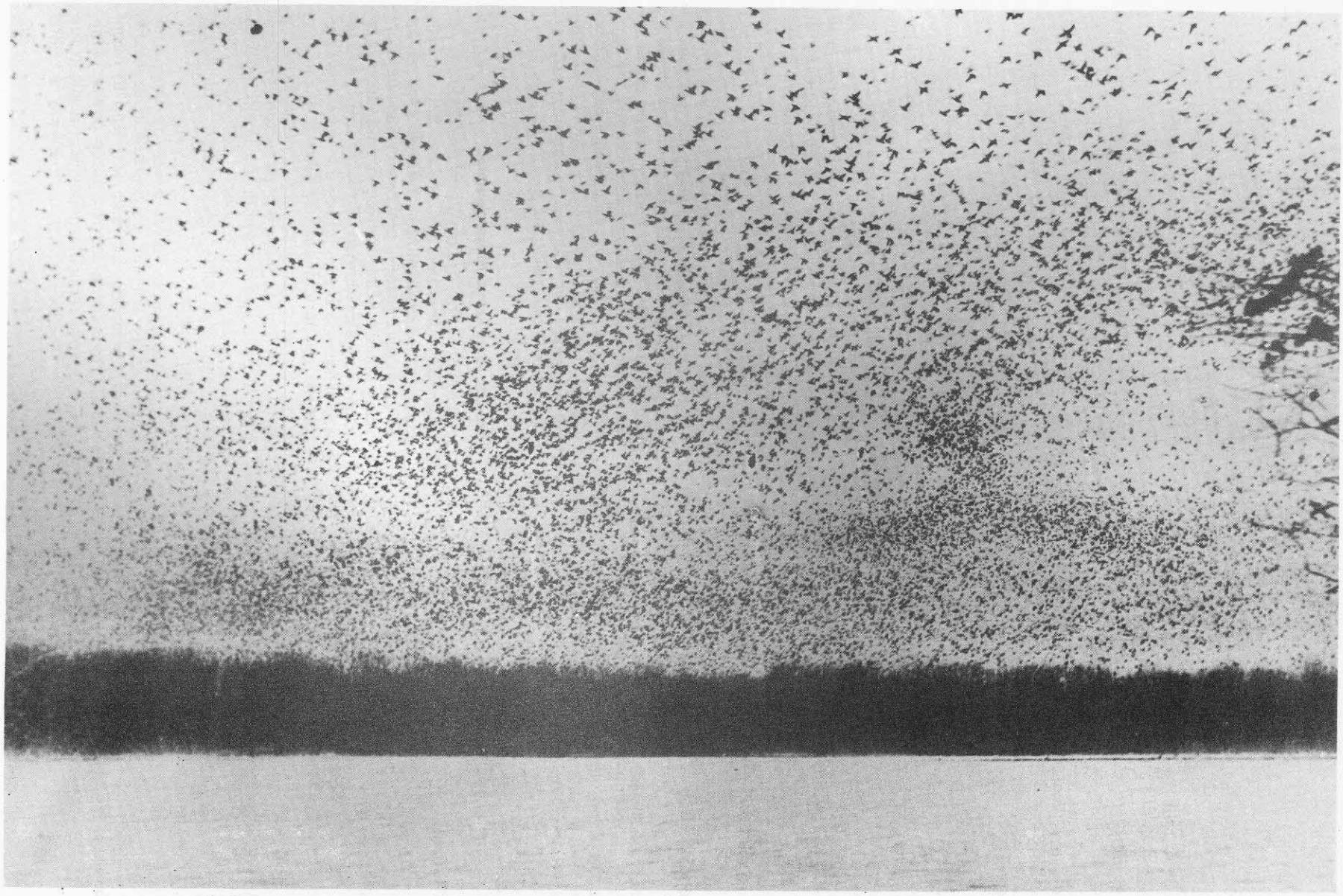
Navigation.

The Upper White and Black Rivers and a short length of the Buffalo and Little Red Rivers, are classed by the War Department as navigable streams. The tonnage moved on these rivers is small and consists mainly of logs moved over relatively short distances. Flood control or power dams on the upper reaches of these streams would tend to improve navigation below, as indicated in House Document 102, 73rd Congress, First Session.

Erosion and Land Management.

Much of the Upper White and Black River basin is shown in Plate 16, the Soil Erosion map, as non-agricultural. Nevertheless, in the northern and eastern portions of the basin are many square miles of cleared land classed as "Dominant Erosion Area." Here, as in the Western Arkansas Basin, where the land has been cleared for agricultural use serious erosion occurs. Since much of the soil is of submarginal fertility, and since there will be increased recreational development within the basin, agriculture use of land will probably decrease within the area, and some reforestation will doubtless take place.

Restoration of forest cover on steep, unfertile slopes will not only result in profitable timber production, but also will tend to retard runoffs, increasing the available power of the streams, and reducing deposition of silt in reservoirs. The increase in the acreage of public



Arkansas Game and Fish Commission Photo

Flight of Ducks Along Lower White River

lands in state and national forests is in keeping with a balanced basin water program, as well as with recreational development, and should be continued.

Recreation.

Readily available to the millions of people in the central and southern corn belt and containing some of the most picturesque scenery of the Ozark Mountains this basin is certain to become a recreational center of real importance. Fishermen who know the Ozark streams compare them most favorably with other fishing streams in the country. For large and small mouthed bass they are unexcelled. Swimming, boating, riding and hiking can all be found in surroundings that leave little to be desired.

Buffalo River State park with 1,500 acres of picturesque Boston Mountain terrain is now undergoing development, and many interesting recreational areas are to be found in the Ozark National forests. These are easily accessible by improved, well maintained mountain trails.

Small mountain lakes can be created in numerous attractive basins. With numerous bridle paths and foot-trails and with beaches and boating facilities, the charm of these lakes will draw a never ending throng from the nearby cities.

The people of Arkansas should profit greatly from the development of this great playground area. Every effort should be made to plan its development upon comprehensive lines, so that the greatest value can be achieved. This planning is primarily a state function and should be immediately undertaken by the agencies concerned.

Wildlife.

Coincidental with the recreational development of the Ozarks, additional game refuges and fish hatcheries should be established and maintained to insure the perpetuation of the present abundance of game and fish, and their extent and location should be planned for as recreation demands.

Conclusions and Recommendations.

The swift mountain streams of the Upper White and Black River Basin constitute a threefold valuable resource in their hydro-electric power, flood control and recreational possibilities.

Power markets, both existing and potential, should be thoroughly studied by an agency interested primarily in the economic development of Arkansas. The cost of power development should be carefully re-studied by a similar agency to insure fair consideration of the Arkansas projects, together with those in neighboring states.

The use of retention reservoirs on the White River and its tributaries as part of the flood control program of the lower White and Lower Mississippi is of great importance and should be studied by State agencies in conjunction with power and recreational studies.

Recreational development offers great possibilities and comprehensive planning to this end should be immediately undertaken by proper State agencies, and its execution should follow as rapidly as economically justifiable.

Pollution possibilities, while now offering no particular problem, should be watched and legislative and administrative authority granted in order to solve pollution problems before unplanned development creates them.

General studies of water quantity and quality are needed to assist in solving present and future domestic and industrial water supply problems.

The expansion of the amount of publicly owned lands with concurrent reforestation appears to be part of a logical long-term water plan for the basin.

A list of projects recommended by the Water Resources Committee of the State Planning Board, providing for investigation and construction within the Upper White and Black River Basin, follows. The list contains those items for which sufficient reliable data are available at present to make the Water Resources Committee reasonably certain of their economic and social justification. Necessarily, this list will require revision and change from time to time as additional information becomes available.

FLOOD CONTROL AND POWER PROJECTS

No.	Name	Description and Location	Authorized	Estimated Cost	Status
1.	Little Red River, Greer's Ferry	Construction, dam and reservoir, Greer's Ferry, Cleburne County	Yes	$ 7,179,000	No allotment made
2.	White River—Wild Cat Shoals	Construction, dam and reservoir, Baxter and Marion Counties	No	Not available	Investigation in progress

FLOOD CONTROL AND POWER PROJECTS

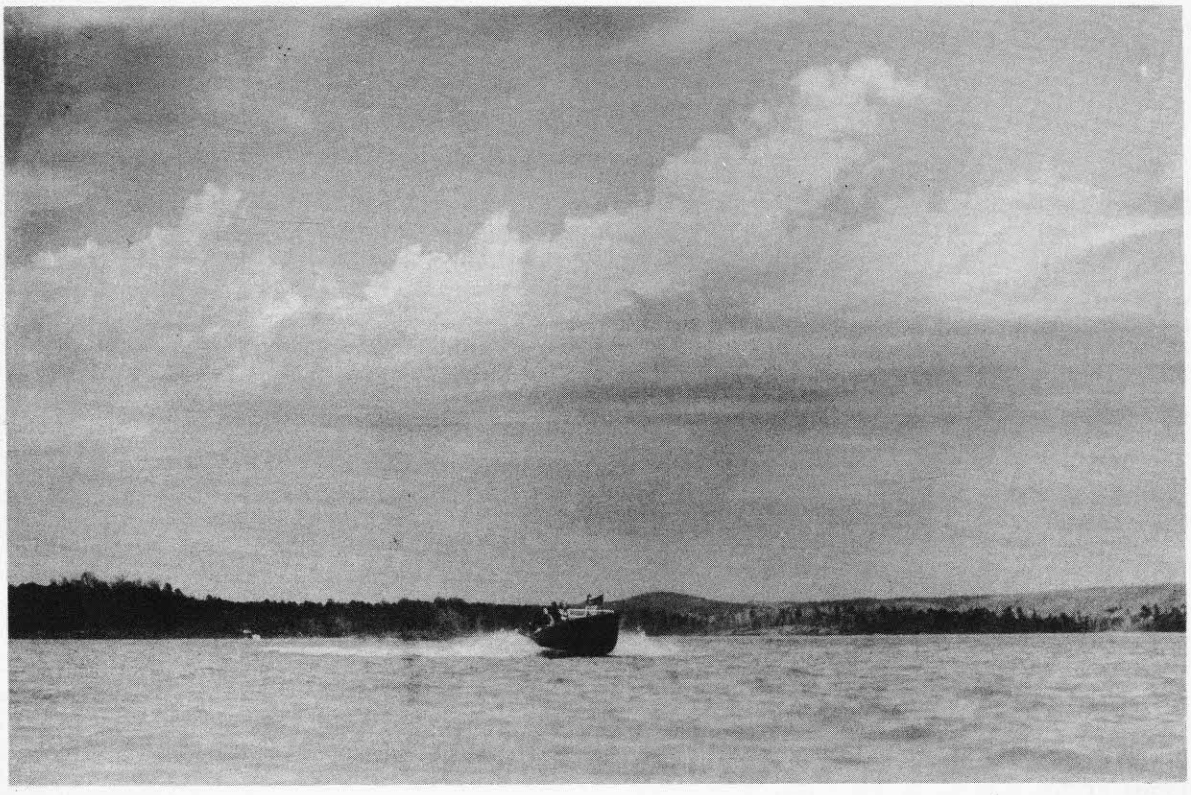
No.	Name	Description and Location	Authorized	Estimated Cost	Status
3.	White River, Buffalo Fork Lone Rock	Construction, dam and reservoir, Marion and Searcy Counties	Yes	11,422,000	No allotment made
4.	White River—North Fork	Construction, reservoir, Baxter County	Yes	11,327,000	Construction not started, Initial allotment made
5.	Eleven Point River—Water Valley Reservoir	Construction, Water Valley Reservoir, Randolph County	Yes	9,069,000	Construction not started, Initial allotment made
6.	Strawberry River, Bell Foley Reservoir	Construction, Bell Foley Reservoir, Sharp County	Yes	5,363,000	Construction not started, no allotment made
7.	Black River	Examination and report for flood control, Missouri and Arkansas	Yes	Not available	In progress
8.	Little Black River	Construction of levees, Clay and Randolph Counties	Yes		Pending acquisition of right-of-way
9.	White River near mouth of Black River	Big Bottom levees, Independence County	Yes		Pending acquisition of right-of-way

POLLUTION CONTROL PROJECTS

No.	Location	Nature of Project	Recommended	Estimated Cost
1.	Arkansas	Basin-wide study	Yes	
2.	Calico Rock	Sewerage system	Yes	
3.	Cotter	Sewerage system	Yes	
4.	Green Forest	Sewerage system	Yes	
5.	Hardy	Sewerage system	Yes	
6.	Huntsville	Sewerage system	Yes	
7.	Imboden	Sewerage system	Yes	
8.	Jasper	Sewerage system	Yes	
9.	Leslie	Sewerage system	Yes	
10.	Melbourne	Sewerage system	Yes	
11.	Mammoth Springs	Sewerage system	Yes	
12.	Marshall	Sewerage system	Yes	
13.	Mountain Home	Sewerage system	Yes	
14.	Mountain View	Sewerage system	Yes	
15.	Pangburn	Sewerage system	Yes	
16.	Salem	Sewerage system	Yes	
17.	Berryville	Improvements	Yes	
			Total	$ 672,000

WATER SUPPLY PROJECTS

No.	Location	Nature of Project	Recommended	Estimated Cost
1.	Various	Small Dams and Reservoirs	Yes	$ 500,000
2.	Fayetteville	Improvements	Yes	40,000
3.	Harrison	Improvements	Yes	50,000
4.	Eureka Springs	Improvements	Yes	20,000
5.	Huntsville	Water Supply	Yes	46,000
6.	Imboden	Water Supply	Yes	40,000
7.	Jasper	Water Supply	Yes	20,000
8.	Leslie	Water Supply	Yes	38,000
9.	Melbourne	Water Supply	Yes	25,000
10.	Pangburn	Water Supply	Yes	37,000
11.	Salem	Water Supply	Yes	30,000
12.	Yellville	Water Supply	Yes	40,000



Arkansas State Publicity Department Photos

Motor-Boating on Lake Hamilton

CHAPTER VII

OUACHITA RIVER BASIN

General Description.

The area included in the Ouachita Basin, in this report comprises all of the drainage area of the Ouachita River and its tributaries in Arkansas, except the immediate valley of the main river below Camden and the drainage area of Bayou Bartholomew.

Two-thirds of the 12,820 square miles included within the basin lies in the coastal plain area of the state, which is a gently rolling to hilly country, ranging in elevation from 200 to 500 feet above sea level. The area was originally covered with pine forests merging into gum and oak along the streams, but much of the timber has been cut and heavy erosion has occurred in some areas.

The other third of the basin lies in the Ouachita Mountains, which includes about two-thirds of the Ouachita National Forest. It also contains Hot Springs National Park. The ridges in this portion of the basin have steep slopes, and as a rule have heavy forest cover. The higher crests range up to elevations of 2,000 feet.

The average annual rainfall in the basin is approximately fifty inches, the season of greatest rainfall being from December through May. The normal annual temperature is 66 degrees, ranging from a January mean of 43 degrees to a July mean of 83 degrees. Winter months are interspersed with warm sunny days that make out-of-door activities pleasant the year around.

The population of the basin in 1930 was 339,956, of which somewhat over three-fourths was rural. Plate 20 indicates that the population as a whole is increasing. Though the rural population is decreasing, urban centers have grown since 1900, and with greater rapidity from 1920 to 1930, because of the discovery of oil in Union and Ouachita Counties, and the resultant growth of El Dorado and Camden.

Slightly over half of the basin's population is engaged in agriculture, but this percentage is diminishing and the basin cannot be considered predominately agricultural, because of the value of its mineral and manufactured products. Annual agricultural production varies between values of $10,000,000 and $26,000,000. Timber production averages approximately $20,000,000 annually, and normal mineral production is valued at about $18,000,000 annually. The latter consists principally of oil, bauxite, gas and clay. Ninety-two percent of the bauxite production of the United States comes from this basin. The annual value of manufactured products ranges from $20,000,000 to $64,000,000. Manufactured products are principally gasoline, lubricating oil, lumber, furniture, paper, brick, pottery, tile, textile and hydro-electric power.

The basin is well served by railways and highways. There is no commercial navigation though the Ouachita is navigable below Camden. This portion is included in the section on the Lower Mississippi River Basin.

Because much of the soil is poor it may be gradually retired from cultivation, as more profitable employment becomes available. Agricultural activity will, over a period of years, probably continue to diminish. Stock raising will probably become of greater importance, however, as abandoned cultivated fields are turned into pastures, and better breeds of stock become more common. Industrial growth will probably continue. More complete local processing of bauxite, continuous yield lumbering operations, and the expansion of markets due to more favorable freight rates can result in material expansion. Tourist traffic and recreational activity will doubtless increase in importance.

Water Resources and Problems.

The Ouachita River flows for 250 miles through this basin. The upper 115 miles of the river in the Ouachita Mountains has an average fall of 12 feet to the mile, and drops to 3 feet per mile across the coastal plain. Its chief tributaries are the Caddo, the Little Missouri, and the Saline rivers. Because of its steep slope, the high rainfall of the basin, the narrow valleys, and the presence of suitable dam sites in water gaps, the north one-third of the basin offers definite hydro-electric power possibilities which have been only partly developed.

Ground water is scarce and of poor quality in most of the mountainous portion of the basin. In the remainder of the basin ground water is usually available in ample quantity and, ex-

cept for the common occurrence of iron and some hardness, is of good quality.

Annual rainfall while ample for usual requirements is somewhat more seasonable than in other portions of the State. This, combined with the comparatively high runoff rate of the Ouachita Mountain portion of the basin, creates extreme variation in stream flow. Resulting floods do much damage to the cultivated lowlands, and Hot Springs has an acute local problem. More widespread and perhaps of equal importance to floods is the problem created by low stream flows. Pollution from the oil fields, from sewage and from industrial wastes becomes severe during prolonged periods of drought. This constitutes one of the major problems of the basin.

The further development of water power with due regard to the other problems of the basin, which are affected thereby, and the increasing of recreational facilities constitute the other two major water problems. Soil management to reduce erosion, reforestation of submarginal lands, and protection of fish life from over pollution are inter-related problems the solution of which will be accomplished or simplified by the solution of the major problems.

Flood Control.

Although floods occur frequently both on the Ouachita and its major tributaries, the damage to agricultural lands has not heretofore appeared sufficient to justify comprehensive flood control. Nevertheless, power projects on both the main river and its tributaries may have a value for flood control which should be considered. Included in the proposed Blakely Mountain Project is an element of flood control which will protect some 24,000 acres of land between Malvern and the mouth of the Caddo River, and partially protect another 8,000 acres below that point. Similar power projects on the Caddo and the Little Missouri can also be made to include flood control if investigation indicates economic justification.

Investigations should be made of the proper protection of high value districts, such as Hot Springs, with local projects and some channel improvement of the main river between Malvern and Camden to increase channel capacity.

Hydro-Electric Power.

As indicated in House Document 196 of the 73rd Congress, Second Session, 1935, several feasible power dam sites exist in this basin. The Blakely Mountain project on the main stream is one of these which is now authorized and ready for construction by the Arkansas Power & Light Company, with a contribution by the Federal Government in exchange for the right to use specified amounts of storage for flood control. That other development will doubtless take place is indicated by the fact that a major portion of the electric power consumed in the state is now imported, and by the possible industrial development within this basin.

The economic justification for shipping dried bauxite to distant points to be manufactured into aluminum products lies in the fact of the existence of an aluminum oxide plant in East St. Louis and the absence of sufficient local supply of cheap electricity. The Federal Power Commission in their publication, "Power Requirements in Electrochemical, Electrometallurgical, and Allied Industries," point out that all metal grade raw bauxite from Arkansas is shipped by rail, first to East St. Louis where it is reduced to aluminum oxide, and then to one of four reduction plants in the East. The Commission mentions that, "Each of these reduction plants is situated advantageously with respect to the fabrication and marketing of the metal and especially with respect to the availability of low cost hydro-electric power." Realizing that the raw product is now shipped by rail with two handlings intermediate between mining and manufacturing, and that the cost of shipping metallic aluminum would be less than the cost of shipping the raw material, it becomes evident that the availability of low-cost power in large amounts in Arkansas could result in the processing of bauxite and the manufacture of aluminum within the State.

It would, therefore, seem advisable that an investigation should be made of the minimum cost at which power in large quantities can be produced or imported into the basin by an agency interested solely in the economic development of the State. Concurrently investigations should be made of the possibility of the development of a large power market through the local production of metallic aluminum, aluminum chemicals and aluminous abrasives. The investigation of power markets should include, also, full consideration of the field of rural electrification and increased domestic comsumption which would result from extensive industrial development.

The successful development of this program would be a matter of great importance to the economic development of the State. Bauxite is Arkansas's one major commercial product and is one which is not produced in

substantial quantities anywhere else in the United States. Its full industrial utilization within the state would have an important bearing on the economic structure of the State.

Pollution.

Pollution within this basin is already rather severe, and will probably become more so. Malvern, Arkadelphia and Camden all discharge sewage into the Ouachita with only partial treatment. At low river flows the oxygen supply of the river water is sufficiently depleted to affect fish life and bacterial pollution is heavy.

A titanium washing plant at Magnet Cove discharges sufficient quantities of clay into a small tributary of the Ouachita so that clarification of the river water at Malvern is difficult. Oil wastes from the Smackover field reach the main river through Smackover Creek. A paper plant at Camden discharges sulphite waste into the Ouachita River and a paper pulp mill at Crossett discharges its waste into a tributary.

Although some study has already been given the pollution problem by the State Board of Health, many facts are lacking regarding present conditions, and further investigations, and possibly some legislation, are necessary to plan and execute an adequate solution. Stream flow regulation through power development will tend to increase low flows, and will be of assistance in reducing pollution.

Domestic Water Supplies.

Both urban and the larger rural domestic water supplies in the Ouachita Mountain portion of the basin must come from impounded surface water, because of the limited quantity of ground water. Many sites suitable for this use are available.

In the coastal plain portion of the basin, where ground water is usually ample, wells may become even more commonly used than at present, because of the growing pollution of surface streams. Additional information on ground water quality is needed to permit intelligent planning for future water supplies. Several existing water plants need refinement in order to improve water quality and iron removal facilities will be required in most new urban systems.

Erosion and Land Management.

As indicated on Plate 16, serious erosion has occurred over much of the area of this basin. Plate 21 shows that most of the soil in the mountainous portion is poor or non-agricultural. Gradual retirement from cultivation of the poorest farm lands in this portion is both logical and desirable. Reforestation of these lands will retard runoffs and improve the power characteristics of the streams, in addition to producing valuable timber.

Soil in the coastal plain portion of the basin ranges from average to poor except for the good soils in Calhoun, Bradley, and Ashley Counties. In the coastal plain, also, the poorest sub-marginal lands should be retired and reforested, to reduce the silt load of streams, stabalize lumbering, and improve stream characteristics. Contour farming and terracing is desirable where soil fertility justifies continued cultivation of hilly lands, and grazing should be so controlled as to prevent the complete destruction of vegetative cover on pasture lands.

Recreation.

With the State's one National Park, the Ouachita National Forest, Lakes Catherine and Hamilton and Lake Catherine State Park, within the basin, recreational activity is already well established. Recreational value will result from the development of additional hydroelectric projects in the basin both directly from the reservoirs and indirectly from the stabilization of stream flows. Other purely recreational lakes should be developed as the need justifies. Continued expansion and development of the State Park System within this basin is desirable.

Mosquito Control.

Bordering on the Lower Mississippi River Basin with its serious mosquito control problem, the Ouachita Basin also has a definite problem. Those in control of all water storage projects within the basin should recognize this fact.

Wildlife.

The extent to which fishing is carried on, at present, in Lake Hamilton and Lake Catherine indicates the importance that this activity will assume in the lakes and reservoirs which may be constructed. Hatcheries to maintain fish life, and the provision of fish ladders and breeding ponds at all dams are desirable. Continued maintenance of an adequate acreage of wild game refuges is most important.

Conclusions and Recommendations.

Though rainfall is ample in the Ouachita Basin, seasonal variation and steep impervious water sheds create extreme variations in stream flow.

A comprehensive flood control program may be found to be justified in connection with

present practices of multiple use reservoirs and local levies, and such a program should be considered as part of any hydro-electric projects, and included to the extent that studies indicate it to be justifiable. Localized flood problems in high value districts should be solved by local protective works.

The development of hydro-electric power, if possible at low cost, would materially aid the economic development of this basin and the State as a whole. Immediate studies should be made of the true minimum cost at which such power could be developed by an agency interested solely in the economic development of the State. Investigations should be made also of the possibility of a large power market for the local manufacture of aluminum, aluminum chemicals and aluminous abrasives, and of future domestic markets. This is one of the most important of the economic problems of the State in which water resources play a part.

Detailed studies of the already severe pollution problem on the Ouachita River and its tributaries should be made in order to improve present conditions and prevent future difficulties.

The expansion of the recreational activities of this basin should be encouraged by the continued development of Lake Catherine State Park and other public lands.

A list of projects recommended by the Water Resources Committee of the State Planning Board, providing for investigation and construction within the Ouachita River Basin, follows. The list contains those items for which sufficient reliable data are available at present to make the Water Resources Committee reasonably certain of their economic and social justification. Necessarily, this list will require revision and change from time to time as additional information becomes available.

FLOOD CONTROL AND POWER PROJECTS

No.	Name	Description and Location	Authorized	Estimated Cost	Status
1.	Blakely Mountain Dam—Ouachita River	Cooperative project with Power Company, west of Hot Springs, Garland County	Yes	$2,000,000 for flood control features	Pending final agreements
2.	Ouachita River	Review report, Ouachita River and tributaries improvements	Yes	Not available	Studies in progress
3.	Ouachita and Red Rivers	Review report—to determine if joint or separate improvements for flood control navigation and irrigation is advisable	Yes	Not available	Board appointed to make studies
4.	DeGray Dam, Caddo River	Arkadelphia	No	Not available	Preliminary studies in progress
5.	Lenox Dam	Caddo River, Arkadelphia	No	Not available	Preliminary studies in progress
6.	Caddo Gap Dam	Caddo River, Montgomery County	No	Not available	Preliminary studies in progress
7.	Narrows Dam	Little Missouri River, Murfreesboro	No	Not available	Preliminary studies in progress

POLLUTION CONTROL PROJECTS

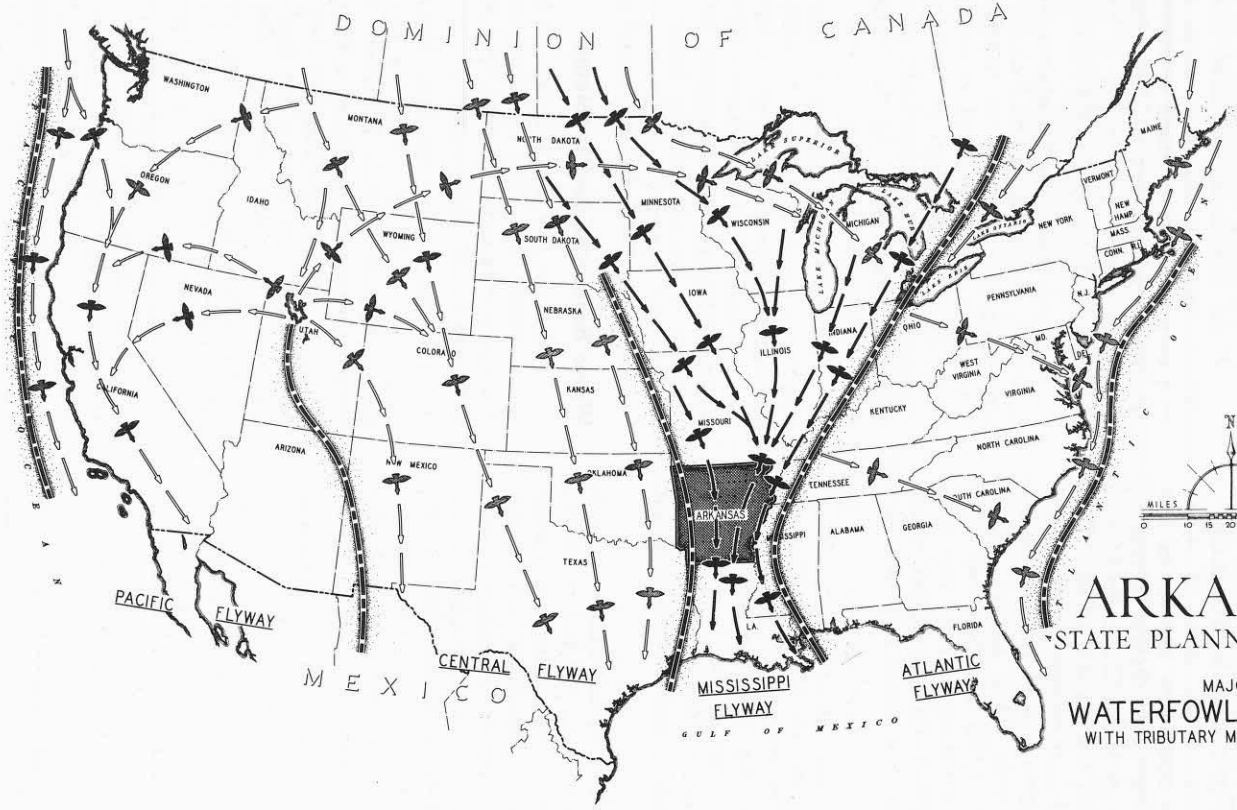
No.	Location	Nature of Project	Recommended	Estimated Cost
1.	Arkansas	Basin-wide study of Industrial pollution	Yes	
2.	Murfreesboro	Sewerage system	Yes	
3.	Sparkman	Sewerage system	Yes	
4.	Arkadelphia	Improvements	Yes	
5.	Benton	Improvements	Yes	
6.	Benton	Improvements—State Hospital	Yes	
7.	Monticello	Sewerage system—A & M College	Yes	
8.	Camden	Improvements	Yes	
9.	Crossett	Sewerage system	Yes	
10.	El Dorado	Improvements	Yes	
11.	Huttig	Sewerage system	Yes	
12.	Louann	Sewerage system	Yes	

POLLUTION CONTROL PROJECTS

No.	Location	Nature of Project	Recommended	Estimated Cost
13.	Mena	Improvements	Yes	
14.	Mt. Ida	Sewerage system	Yes	
15.	Monticello	Improvements	Yes	
16.	Norphlet	Sewerage system	Yes	
17.	Prescott	Improvements	Yes	
18.	Sheridan	Improvements	Yes	
19.	Warren	Improvements	Yes	
20.	Delight	Sewerage system	Yes	
21.	Fountain Hill	Sewerage system	Yes	
22.	Graysonia	Sewerage system	Yes	
23.	Hampton	Sewerage system	Yes	
23.	Hermitage	Sewerage system	Yes	
24.	Okolona	Sewerage system	Yes	
25.	Rosboro	Sewerage system	Yes	
26.	Strong	Sewerage system	Yes	
27.	Thornton	Sewerage system	Yes	
28.	Wilmar	Sewerage system	Yes	
			Total	$1,100,000

WATER SUPPLY PROJECTS

No.	Location	Nature of Project	Recommended	Estimated Cost
1.	Delight	Water Supply	Yes	$ 25,000
2.	Fountain Hill	Water Supply	Yes	15,000
3.	Okolona	Water Supply	Yes	25,000
4.	Rosboro	Improvements	Yes	35,000
5.	Graysonia	Water Supply	Yes	40,000
6.	Hermitage	Water Supply	Yes	25,000
7.	Wilmar	Water Supply	Yes	35,000
8.	Huttig	Improvements	Yes	15,000
9.	Louann	Improvements	Yes	15,000
10.	Mena	Improvements	Yes	110,000
11.	Monticello	Improvements	Yes	15,000
12.	Norphlet	Improvements	Yes	20,000
13.	Prescott	Improvements	Yes	15,000
14.	Gurdon	Improvements	Yes	20,000



ARKANSAS
STATE PLANNING BOARD

MAJOR
WATERFOWL FLYWAYS
WITH TRIBUTARY MIGRATION ROUTES

SOURCE : U. S. BUREAU OF BIOLOGICAL SURVEY - 1934, REV. 1939

PLATE 27

CHAPTER VIII

RED RIVER BASIN

General Description.

For the purpose of the present discussion the Red River Basin includes all of the drainage area of the Red River, and its tributaries in Arkansas. Consisting of an area of 4,522 square miles in the southeast corner of the State, the basin includes two distinct physical subdivisions—in the north the Ouachita Mountains, and in the south the coastal plain. The northern division is forest covered and mountainous. The mountains are characterized by long fin-like ridges with steep slopes which range in height from 1,500 to 2,500 feet. To the south the country is rolling to hilly with pine forest cover, interspersed with cultivated clearings. The elevations are generally between 250 and 500 feet.

The average annual rainfall of the basin is approximately 46 inches ranging from 40 inches in the southern portion of the coastal plains to 55 inches in the southern part of the mountain area. The mean annual temperature ranges from 60 degrees in the north to 66 degrees in the south, with a basin mean of about 63 degrees.

The total population of the basin according to the 1930 census was 136,462 of which 80 per cent was rural. The urban population lives in five towns with populations in excess of 2,500, the largest being Texarkana with 10,764. Included with the rural populations are 33 towns with populations of less than 2,500. Plate 20 indicates that the population of the basin, as a whole, is increasing, though the rural population is decreasing.

Although more than twice as many people were engaged in agriculture in 1930 in this basin than in all other occupations combined, the value of the agricultural products are not greatly in excess of that of the manufactured products. In 1934 the total value of all agricultural production was $6,286,892, two-thirds of which was cotton value. Mineral production in that year was valued at $482,124, mainly in oil; timber produced was valued at $305,374; and the total value of manufactured products was $7,061,193. Ten years earlier, in 1924, the value of agricultural production was $14,507,210, timber $172,814, minerals $489,353 and manufactured products $10,459,343. Since 1934 the mineral producing and the manufacturing industries have recovered more rapidly than agriculture.

While cotton is the chief crop and corn second, peaches and other fruits, nuts, melons and vegetables are raised commercially. The principal minerals are oil, clay, and limestone. Industries consist principally of brick, tile, cement and furniture manufacturing.

The southern coastal plain division is well served by railroads and highways. Navigation was once of importance on the Red River, but the river is no longer used for that purpose, because of the silting up of the channel. The mountain division is partially served by rail, and is accessible by roads, though many of them are unpaved.

The most probable future development of this basin would appear to call for: retirement of the poorest submarginal lands from cultivation and their reforestation; flood protection where justifiable, and improvement of drainage facilities in the rich bottom lands; and the expansion of industry, particularly by the development of the extensive chalk deposits.

Water Resources and Problems.

Although the annual rainfall in this basin is somewhat less than in other portions of the State it is adequate for present needs, and the expected future development.

In addition to the Red River itself the main streams in this basin are the Little River, Bayou Bodeau, Bayou Dorcheat, and Sulphur River. Of these, Little River, with its tributaries, drains a part of the Ouachita Mountains and consequently has more of the flashy characteristics of a mountain stream. The Red has a broad, fertile, flat valley and its tributaries, other than the Little River, are relatively sluggish streams. The flow of the Red below Fulton ranges from 1,000 cubic feet per second to as much as 260,000 cubic feet per second. Throughout the basin the main stream flows through an over flow plain six to twelve miles wide in a sandy channel varying from 1,000 feet to 1,500 feet in width. The average slope is 1 foot per mile above Fulton and 0.5 feet per mile below.

Ground water is available in ample quantities throughout the coastal plain division of

the basin though sometimes it is of poor quality. In the mountain division, however, it is quite limited and for other than small rural supplies reliance is placed on surface water.

The chief water problems of the basin are: Protection of the fertile lowlands from floods to the greatest extent practicable; retirement and reforestation of the poorest submarginal lands; rehabilitation and refinancing of drainage districts; the possibilities of hydro-electric power development; and the employment of proper mosquito control measures.

Flood Control.

Floods occur in the main valley of the Red River on an average of two years out of every three. More than 700,000 acres are inundated by major floods. The Little River floods approximately 50,000 acres annually, and in the 1927 flood 236,000 acres were submerged. Bayou Bodeau and Bayou Dorcheat flood smaller areas. While a relatively small percentage of the lands subject to frequent flooding are now under cultivation, most of them lie within the area shown on Plate 21 as having superior soil. Their ultimate reclamation and protection from frequent floods is therefore essential.

There now exist approximately 80 miles of levee on the east side of the main stream and 72 miles on the west side, affording some protection to 225,000 acres of land. These levees were constructed by local levee and drainage districts without Federal aid above Fulton and with Federal aid below that point. Although the Federal Government has assisted somewhat in the maintenance of levees they are now usually in bad condition. Many of the levees on the east side of the river are too close to the channel, thus constricting the stream and increasing flood stages.

Exhaustive studies of complete flood control in the Red River Valley have been made by the War Department and their conclusions are contained in the "308 Reports" of the Corps of Engineers. Levee and detention reservoir plans were studied separately, and in combination, to protect all lands from maximum floods of record on each section of the main stream and each tributary. Here, as in the case of the Western Arkansas Basin, a comprehensive program could not be justified. When the cost of these projects was compared to the damages which floods had done in the past such cost was found to be entirely too high for economic justification.

If, however, less complete protection is now considered, that is, protection which would not suffice for all time maximum floods, but which could be depended upon to reduce flood frequencies over large areas, and if consideration is also given to the substantial increase in the value of lands which would occur through such reduction in flood frequency, quite a different conclusion would probably result.

Most of the reservoir construction to prevent floods or reduce their frequency on the Red River in Arkansas will, of necessity, lie outside of the State in Oklahoma and Texas. Probably the only reservoir sites of possible value for this purpose, within the State, are on Rolling Fork and Cossatot River, tributaries of Little River. Therefore, control of floods on the Red is a matter of more than State interest, but it is one in which Arkansas is vitally interested by reason of the hundreds of thousands of acres of rich bottom lands now of low value because of periodic overflow.

Thus, a complete re-study of flood control in the Red River system appears desirable. This study should include consideration of both reservoirs and existing and proposed levees. In determining benefits full credence should be given to increases in land value which would result, as well as to possible multiple uses of reservoirs. Serious study should also be given to the better coordinated planning of levees.

Hydro-Electric Power.

At present there is no hydro-electric development within the basin. The availability of cheap fuel has resulted in steam power development almost exclusively in the past. With a constantly growing demand for electricity, which may be augmented materially by possible industrial development in this basin, and in the Ouachita Basin to the east, and with the gradual depletion of cheap fuel supplies, hydro-electric development can be confidently expected. Therefore, storage reservoir sites which are also potential power sites should, if possible, be so developed that their power possibilities are not lost. Re-study of the De Queen flood control project on Rolling Fork and the Geneva flood control project on the Cossatot should include a consideration of power possibilities.

Drainage.

There are 11 drainage district within the basin, including a total area of 137,020 acres. Most of these district are in serious financial difficulties. In a few instances land has been drained which is not suitable for crop raising, but, more often, the drainage facilities provided are inadequate. Coordinated rehabilitation

and refinancing of these districts should be undertaken under experienced direction.

Mosquito control, combined with reclamation of rich lands, may justify expansion of drainage projects, particularly if reasonable flood control projects are undertaken in the upper streams. Such expansion should be undertaken, however, only after a coordinated and completed plan has been evolved following a thorough investigation.

Pollution.

Definite information on the extent of pollution is entirely lacking. All but three of the towns in the basin have sewage treatment in some form, and industrial development has apparently not yet created serious problems. To anticipate problems which will develop, more information on existing conditions is desirable.

Domestic Water Supplies.

Urban water supply is obtained almost entirely from deep wells. Ample water is available from this source in the coastal plain area, but supplies frequently contain iron and carbon dioxide in objectionable amounts. In the mountain division, ground water is definitely limited. Improvement in treatment plants and their operation is necessary in several cases.

Rural supplies come largely from shallow wells which are adequate except in the northern portion of the basin.

Available information on water quality is very meager. Surveys to correct this deficiency are desirable and would be of benefit in the planning for future water supplies.

Navigation.

Because of the bar-building and the channel shifting tendency of the Red River, open river navigation is impossible even with complete stream control. Various plans of canalization have been studied by the Corps of Engineers, but they are costly in both operation and construction. It would appear that greatly increased industrial development of the basin must be assured before plans for making the Red River navigable can be seriously considered.

Erosion and Land Management.

Plate 16 indicates that erosion is severe only on the edges of this basin. The flat broad valley of the main stream is not seriously affected. Retirement of the poorest submarginal lands from cultivation, and planning for its reforestation or use as pasturage is desirable both from the standpoint of preventing erosion and providing a means for preventing too rapid runoffs. Contour cultivation, strip cropping and other preventative measures should be encouraged where the soil fertility justifies continued farming of hillsides.

The silt loads of streams in the basin are relatively light except in the main river which transports most of its silt from points lying outside of the State.

Recreation.

Except for the oxbow lakes along the Red, recreational water facilities in this basin are meager. The development of flood control and power reservoirs in the upper basin should provide permanent pools for recreational use. Expansion of the Ouachita National Forest in the northern mountainous portion is desirable from the standpoint of recreation.

Mosquito Control.

Mosquito control is an important problem in this basin. Relief agencies have undertaken by drainage to eliminate mosquito breeding places, but much remains to be done. The value of drainage as a mosquito control measure, considered separately or combined with land drainage problems, is recognized and will justify considerable expenditures.

Reservoir development should be planned wtih mosquito control measures in mind, and studies of drainage projects should include studies of the mosquito problems.

Conclusions and Recommendations.

The fertility of the Red River Basin overflow lands makes flood control definitely desirable. A re-study of the flood control problem should be undertaken from the standpoint of partial protection, and should give full consideration to the value of reclaimed lands.

The refinancing of drainage districts and the rehabilitation of their levees and ditches is necessary for sound economic development. Some expansion of drainage projects may be justifiable if flood control measures are undertaken on the upper river. A coordinated plan of land drainage should be evolved after a thorough investigation has been completed.

Data on the existing pollution of surface water, and the quality of ground water are meager and should be supplemented by surveys.

The cost of rendering the Red River navigable appears to be too great to be justifiable,

at least until the much greater development of tributary lands becomes assured.

Erosion is not serious in the flat, bottom lands, but should be controlled in the higher lands by proper preventative measures or retirement of poorer lands in favor of forests or pastures. Reforestation and the extension of the Ouachita National Forest are in keeping with the need for recreational development within the Basin.

Adequate mosquito control can be achieved, in part, by giving full recognition to its importance in planning reservoir projects. Drainage and flood control measures should also be planned with the need for such control in mind.

A list of projects recommended by the Water Resources Committee of the State Planning Board, providing for investigation and construction within the Red River Basin, follows. The list contains those items for which sufficient reliable data are available at present to make the Water Resources Committee reasonably certain of their economic and social justification. Necessarily, this list will require revision and change from time to time as additional information becomes available.

FLOOD CONTROL AND POWER PROJECTS

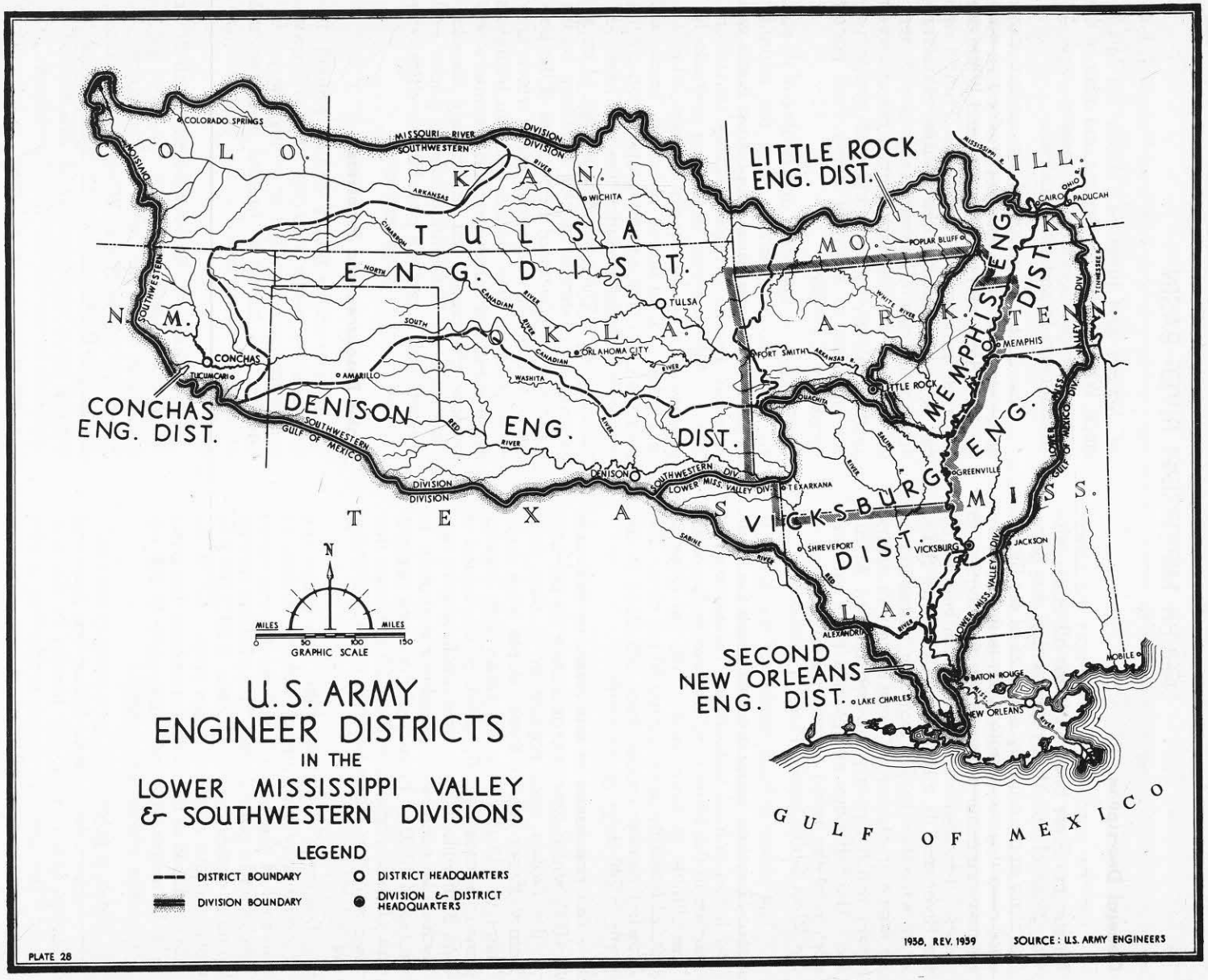
No.	Name	Description and Location	Authorized	Estimated Cost	Status
1.	Red River, Fulton	Improvements to levees—Garland to Fish Lake—Hempstead County Improvement District	Yes	Not available	No appropriation
2.	Red River	Review report, Red River, to determine if improvements for navigation, flood control and irrigation are advisable at this time	Yes	Not available	Studies in progress
3.	Ouachita and Red Rivers	Review report—study considering the joint or separate improvements to Ouachita and Red Rivers	Yes	Not available	Board of Review appointed

POLLUTION CONTROL PROJECTS

No.	Location	Nature of Project	Recommended	Estimated Cost
1.	Arkansas	Basin-wide survey of pollution	Yes	
2.	Ashdown	Improvements	Yes	
3.	Hope	Improvements	Yes	
4.	Magnolia	Improvements	Yes	
5.	Nashville	Improvements	Yes	
6.	Texarkana	Improvements	Yes	
7.	Cove	Sewerage system	Yes	
8.	Dierks	Sewerage system	Yes	
9.	Foreman	Sewerage system	Yes	
10.	Fulton	Sewerage system	Yes	
11.	Garland	Sewerage system	Yes	
12.	Horatio	Sewerage system	Yes	
13.	Lockesburg	Sewerage system	Yes	
14.	McNeil	Sewerage system	Yes	
15.	Mineral Springs	Sewerage system	Yes	
16.	Stamps	Sewerage system	Yes	
17.	Washington	Sewerage system	Yes	
			Total	$ 825,000

WATER SUPPLY PROJECTS

No.	Location	Nature of Project	Recommended	Estimated Cost
1.	Miller and Sevier Counties	Rural water supply study in Miller and Sevier Counties	Yes	$ 10,000
2.	Cove	Water Supply	Yes	27,000
3.	Fulton	Water Supply	Yes	33,000
4.	Garland	Water Supply	Yes	20,000
5.	Horatio	Water Supply	Yes	57,000
6.	McNeil	Water Supply	Yes	25,000
7.	Washington	Water Supply	Yes	25,000
8.	Ashdown	Improvements	Yes	20,000
9.	Ashdown	Improvements	Yes	25,000
10.	Dierks	Improvements	Yes	25,000
11.	Hope	Improvements	Yes	20,000
12.	Lewisville	Improvements	Yes	25,000
13.	Magnolia	Improvements	Yes	20,000
14.	Stamps	Improvements	Yes	20,000
15.	Lockesburg	Improvements	Yes	12,000
16.	Miller and Sevier Counties	Construction	Yes	100,000


COLO.
COLORADO SPRINGS
MISSOURI RIVER DIVISION
SOUTHWESTERN DIVISION
KANS.
WICHITA
ARKANSAS RIVER
CIMARRON RIVER
TULSA ENG. DIST.
NORTH CANADIAN RIVER
SOUTH CANADIAN RIVER
TULSA
OKLA.
OKLAHOMA CITY
WASHITA RIVER
N. M.
SOUTHWESTERN DIVISION
CONCHAS
TUCUMCARI
AMARILLO
CONCHAS ENG. DIST.
DENISON ENG. DIST.
RED RIVER
SOUTHWESTERN DIVISION
GULF OF MEXICO DIVISION
DENISON
TEXAS
LITTLE ROCK ENG. DIST.
MISSISSIPPI RIVER
ILL.
CAIRO
OHIO RIVER
PADUCAH
MO.
POPLAR BLUFF
TENNESSEE RIVER
MEMPHIS ENG. DIST.
WHITE RIVER
ARK.
MEMPHIS
FORT SMITH
ARKANSAS RIVER
LITTLE ROCK
OUACHITA RIVER
TEXARKANA
SOUTHWESTERN DIV.
LOWER MISS. VALLEY DIV.
VICKSBURG ENG. DIST.
GREENVILLE
LOWER MISS. VALLEY DIV.
GULF OF MEXICO DIV.
MISS.
SHREVEPORT
VICKSBURG
JACKSON
SABINE RIVER
RED RIVER
LA.
ALEXANDRIA
SECOND NEW ORLEANS ENG. DIST.
LAKE CHARLES
BATON ROUGE
NEW ORLEANS
MOBILE
GULF OF MEXICO
N
MILES
MILES
0
50
100
150
GRAPHIC SCALE
U.S. ARMY
ENGINEER DISTRICTS
IN THE
LOWER MISSISSIPPI VALLEY
& SOUTHWESTERN DIVISIONS
LEGEND
DISTRICT BOUNDARY
DIVISION BOUNDARY
DISTRICT HEADQUARTERS
DIVISION & DISTRICT HEADQUARTERS
1938, REV. 1939
SOURCE: U.S. ARMY ENGINEERS
PLATE 28

CHAPTER IX

LOWER MISSISSIPPI RIVER BASIN

General Description.

For the purpose of this report the Lower Mississippi River Basin includes all of the alluvial plain of the Mississippi within the State. Covering approximately one-third of the State's total area this vast fertile plain is the most extensive agricultural region of the State. In general it consists of alluvial lands built up by the River and its tributaries. Crowley's Ridge is an exception to this, however, persisting as an erosional remnant of beds largely of marine origin which formerly covered Eastern Arkansas. The only other exception is in the southern portion of the basin where a small section of the West Gulf Coastal Plain is included.

The mean annual rainfall of the basin is about 52 inches, being greatest along the River. The mean annual temperature ranges from 64 degrees in the south to 62 degrees in the north. The climate is warm and moist, the average annual humidity approaching 60 per cent. The growing season ranges from 205 days in the north to 240 days in the south.

The population of this basin in 1930 was 714,000, which was approximately 39 per cent of the State's total population at that time. Nearly 85 per cent of these people were rural. There are 18 towns in the basin with populations in excess of 2,500 of which the largest is Pine Bluff with 20,760. Next are Jonesboro and Blytheville each with populations slightly in excess of 10,000. In spite of the large percentage of rural population Plate 20 indicates that the population of the basin is steadily increasing.

Economic activities within the basin are predominantly agricultural with more than 65 per cent of the gainful workers therein being employed in agriculture. The average annual value of agricultural production is $122,076,836. Cotton is the most valuable crop. All of the rice produced in the State comes from this basin and Arkansas was the fourth state in the nation in rice production in 1937.

There is practically no mining in the basin, and much of the original timber has been cut, although great tracts still remain in the lowlands. The average timber production is now valued at about $6,377,010 annually. The total value of manufactured products is normally $63,295,220 per year consisting of cotton-seed oil, lumber and furniture. Along the Mississippi, White, Black, St. Francis and other of the larger streams commercial fishing and fur trapping are important industries.

The basin is traversed by several navigable streams. The Mississippi along its eastern boundary, and the Ouachita and White are the most important, while the St. Francis and the Arkansas offer some degree of navigation possibilities. Railroad and highway service is good, the northern portion being served most completely by both, and south central portion adjacent to the river being most poorly served by highways.

Because of the depth and fertility of its soil, the long growing season, and the bountiful rainfall, the Lower Mississippi River Basin will probably remain a predominantly agricultural region. Advancement in farming methods, improvement of water supply for rice irrigation, and additional drainage of bottom lands and swamps all combined with proper flood control will tend to stabilize agriculture and raise economic levels. The prevailing system of tenant farming has been a serious handicap to the welfare of a substantial percentage of the people of this basin. Its modification which may come about in time should result in improved living standards. Industry and commerce will increase principally as agricultural development permits. The manufacture of paper, and pressed wall board are possibilities which offer promise of future development.

Water Resources and Problems.

In spite of the heavy annual rainfall, the extraordinary water demand of rice growing makes irrigation for that crop necessary. Except for rice, however, rainfall is ample and sufficiently distributed for all other requirements.

In addition to the Mississippi which flows along the eastern boundary the other major streams of the basin are: the St. Francis; the Cache; the Lower Black, White and Arkansas; and Bayou Bartholomew. Of these all but the last are large streams, and all are classed as navigable in part by the War Department. The Mississippi is, of course, subject to tremendous floods from various sources within its far-flung water shed. It, in turn, inundates the lower

flood plains of the tributaries with back water, and these floods are sometime augmented by concurrent flows of head water. Thus, the primary problem of this basin is control of the flood water which originates outside of the basin.

The Mississippi is the greatest inland waterway of the nation. Up and down its broad surface ply river boats carrying the water commerce from both North and South. The larger tributaries within the basin all add in some small measure to this water traffic, though in periods of low flow their contribution is necessarily limited by poor channel conditions. The desirability of improved navigation on these tributaries is unquestioned, but its economic feasibility has been subject to much difference of opinion.

The streams referred to above offer ample diluting water for all present industrial and domestic wastes. The basin, therefore, has no serious pollution problem.

Ground water is avilable in large quantities throughout the basin. There are no cases of inadequacy among the urban water supplies in the northern portion of the basin. Deep wells, in excess of a thousand feet, are frequently artesian. Water from shallow wells is usually obtainable throughout the basin. Most of the water is soft, particularly in the northern artesian portion, but it frequently contains iron in objectionable quantities and is often corrosive. Nevertheless, with proper treatment satisfactory domestic water supplies are available.

In the Grand Prairie region the extraordinary draft of the rice irrigation water demand is, in some areas, steadily lowering ground water levels. In view of the importance of rice production this is a serious problem, requiring early solution.

Much of the basin was originally low, semi-swamp land, the native fertility of which has justified the undertaking of extensive drainage projects. These drainage projects, which are organized as districts, like other district activities in the State have been in financial difficulties with many overlapping assessments, and long lists of delinquencies. There has been much refinancing of individual districts through the facilities of the Reconstruction Finance Corporation. The continuation of coordinated refinancing of these districts and the rehabilitation of their properties constitute another major problem.

Other problems of the basin are: Control of mosquitoes on the numerous lakes, and within great areas of swampy bottom lands along the rivers; and the proper development of game refuges, particularly for water fowl.

Flood Control.

The magnitude of the flood control problem of this basin is indicated by Plate 13. This plate shows that during the 1927 flood approximately one-half of the total area of the basin was inundated. This was an extreme flood, but a considerable area of the deep rich soil of the lower lands are flooded annually. While much has already been done, the welfare of the residents of this basin, and to a great extent the rest of the State, requires that these floods be further controlled.

Levee building in the Mississippi Valley began early in the 18th century by private enterprise. The first Federal funds for flood control became available in 1917, but it was not until after the disastrous flood of 1927 that Congress, by Act of May 15, 1928, actually placed the Federal Government on record as recognizing flood control in this valley to be a national problem. Since that time, under the direction of the Mississippi River Commission, most of the work contemplated in the Act of 1928 has been completed, and other projects authorized by the Acts of June 15 and June 22, 1936, have been undertaken.

In the Lower Mississippi Basin, as considered in this report, this construction has consisted of a main river levee, thought to be high enough to afford protection against maximum floods expected to occur, combined with dredging and the construction of cutoffs to steepen, shorten, and straighten the channel. Provision has been made, also, for a floodway, (The Boeuf Floodway was provided for in the May, 1928 Act, and the Eudora Floodway substituted in the June, 1936 Act), below the mouth of the Arkansas, into which it has been contemplated that all flows in excess of 2,000,000 cubic feet per second would be diverted.

The completion of thirteen cut-offs and the dredging of the main channel has accomplished much. It is estimated by the Mississippi River Commission that the safe flood-carrying capacity of the River between the mouth of the Arkansas and Natchez has been increased by approximately 20 per cent and this conclusion, in part, was substantiated by the behavior of the stream during the 1937 flood.

Other projects authorized and contemplated under the flood control acts of 1936 are the further strengthening and raising of levees, additional channel work, and the substitution of the Eudora Floodway for the Boeuf.

There is, however, much difference of opinion among qualified authorities as to the effectiveness of present measures and the propriety of contemplated plans. The Sub-Committee of the Water Resources Committee of the National Resources Committee on the Ohio-Lower Mississippi River Basin in their progress Report of October 1937, not only question present measures, but doubt the advisability of further general construction until additional basic studies have been made, particularly of main stream and close-in tributary reservoirs. In addition further coordination of the general plan is urged.

In addition to completing the control of the main river, much work remains to be done on vast areas at the mouth of the St. Francis, the White and the Arkansas, which are subject to overflow from backwater from the Mississippi River, and also on great areas subject to floods from headwater of these streams. The economic protection of these areas is somewhat more localized in character, but this work also is covered in part by Congressional authorization. Contemplated projects call for extension of existing levees, channel dredging and diversion of flood water within the basin.

The problem of flood control within the basin in question is therefore of far greater scope, and is not alone an Arkansas problem. It is contemplated that out of the present differences of opinion will ultimately evolve a unified complete plan, but the people of Arkansas are vitally interested, not only in seeing this plan worked out as quickly as possible, but also in decisions with respect to many details. For example, the large tracts of land now normally subject to backwater from the Mississippi at high stages, serve as natural retarding basins, and are, therefore, natural flood control agencies. The most good to the greatest number will require that at least some of these areas continue to serve in this capacity. Nevertheless, they are potentially valuable as State assets, if reclaimed, and the people of Arkansas are definitely interested in seeing that their potential value is fully recognized by those formulating plans for the future. State assistance in collecting fundamental data and State representation in all determinations involving comprehensive flood control on the Mississippi are essential to a just and acceptable plan for this basin.

Drainage.

Drainage has offered a means of reclaiming many of the low alluvial lands of the basin, and has usually been a part of the levee building program. Combined drainage and levee districts or separate ones for the two purposes have been the means of reclaiming portions of these lands. Vast sums have been raised through assessments to construct, maintain and operate the projects within these districts. Overlapping assessments, resulting partly from improper coordination of the separate projects, and excessive costs have resulted in heavy tax delinquencies and several of the districts have been seriously in default.

Large swamp areas remain undrained. For the most part these are timbered and produce cypress and other hardwoods. Their utilization as waterfowl refuges or as natural flood retention basins may necessitate leaving some of these areas in their present state, but mosquito control and the productiveness of the soil will justify draining others.

A coordinated plan of further refinancing and rehabilitation of existing districts and the planning of future ones from a broader view point than employed heretofore must become effective if heavy financial losses and future unplanned expenditure for drainage are to be avoided.

Pollution.

Because population is not concentrated in large cities and industry is as yet limited, pollution of surface waters has not become a serious problem in this basin. Further, since most water supplies are obtained from wells and the streams are sufficiently large to offer high dillution it is improbable that much difficulty of this character will arise for some time in the future.

Nevertheless, the importance of fishing and the recreational use of the streams and lakes suggest the wisdom of constant vigilance, in order to prevent the creation of new industrial wastes or other sources of pollution which would affect fish or game life.

Domestic Water Supplies.

The adequacy of ground water within the Basin will result in continued use of wells as the common source of water supply both rural and urban. In the future, however, full recognition should be given to the iron-bearing and corrosive tendencies of these ground waters and water treatment plans should be provided where necessary. Too often, in the past, well water has been considered as above question if the supply proved ample, and the result has sometimes been that many small towns have water supplies that are unsuited for domestic consumption. Simple and relatively inexpensive treatment will correct this situation and

Arkansas State Publicity Department Photo

Plowing Along Contours Retains Soil and Water

U. S. Soil Conservation Service Photo

Plowing Down Slopes Causes Excessive Run-Off and Soil Loss

this should be planned in advance before future supply systems are installed.

Irrigation.

In a region where the annual rainfall exceeds 50 inches irrigation would seem entirely unnecessary. However, the rice which is grown extensively on the Grand Prairie, requires approximately 30 inches of water during a 90-day period which is normally the driest time of year.

Several years of observation and study of the Grand Prairie area have been made by the Arkansas Geological Survey, the College of Agriculture, University of Arkansas and the United States Geological Survey and Federal Land Bank. These studies reflect valuable information concerning conditions of the area.

Irrigation water has been obtained from approximately 1,000 wells which in the aggregate have produced water during the irrigating season at a rate exceeding the minimum flow of the Arkansas River. This tremendous draft on ground water has lowered the water table from a few feet in some areas to 35 feet or more in others. Such lowering of the ground water table has increased pumping charges and thus increased the production cost of rice. The cost of well water per acre of rice irrigated is now approximately $12.00 annually in the areas of average pumping lift. Continued lowering in these areas may, in time, make rice production unprofitable if no other source of water is made available.

Two sources of supplementary water have been suggested. One is the storage of water on the Little Red River by the construction of a dam at Greer's Ferry, and an extensive canal system to carry this stored water to the points of use. This plan is complex and expensive and, while apparently feasible, and perhaps of ultimate value, does not appear to be the best immediate solution.

Another plan which is now coming into common use is the storing of water from the winter rains in small reservoirs within the rice district and using it to serve a few farms. These reservoirs may be elevated above or below the lands to be irrigated, and they are filled either from surface runoff or by pumping water into them from the adjacent bayous during the winter and spring. They are formed usually by building a levee entirely around a low-lying, flat piece of land. This source of water supply is proving cheaper than the original wells. The yield of rice per acre seems to be increased materially through the use of reservoir water, and considering this factor, the net cost of reservoir water becomes only a fraction of the cost of well water. The duck hunting rights on these reservoirs is also profitable to the owners. Therefore, it is likely that the continued and increased use of small, local reservoirs is assured. It is probable that out of this use will grow a problem of water rights along the bayous of the Grand Prairie from which costly litigation and wasted construction may come. Proper legislative action, in due time, should provide authority for the establishment of legal water rights. Further investigation is also desirable in order to establish the overall sufficiency of this source of supply and its bearing on the project at Greer's Ferry on the Little Red River.

Navigation.

The mileage of navigable waterways in this basin is greater than in any equal area in the United States. See plate 11. On the Mississippi 2,000 ton steel barges, assembled in tows of from 6 to 12 and propelled by a single towboat, carry as much as 8 to 16 freight trains of 50 loaded cars each. On the tributaries small fishing craft and lumber rafts comprise the bulk of traffic.

Little work is required to maintain a suitable navigation channel on the Mississippi below Memphis. Above that point some dredging during the low-water season is necessary. On the tributaries, channels are not maintained of sufficient depth to permit navigation of importance during low-water periods.

There has been much discussion and wide divergence of opinion concerning the feasibility of navigation on the Arkansas River. Its desirability from the standpoint of the economic welfare of the State is unquestioned. According to J. C. Murray, of the Little Rock Chamber of Commerce, "Justification through public savings and through prospective economic development may be shown in the preliminary survey now being made by the Corps of Engineers."

Navigation on the White River below the mouth of the Black is possible throughout the year with boats of not more than 3-foot draft except for the bar at its mouth where only 18 inches to 2 feet is available when both the White and the Mississippi are at low stages. A 6-foot depth is available through this reach of the stream for 6½ months of the year. Because the White has a more uniform flow than the Arkansas, and does not carry as heavy a silt load, year around navigation on it could be provided and maintained at less cost than on the Arkansas.

The St. Francis River, while classed as navigable, is of such variable flow that commer-

cial navigation is possible only in its lower reaches. Year around navigation on the St. Francis appears less necessary commercially, because it lies between the Mississippi, which is already used, and the White which has a larger and more uniform flow.

The need for navigation on the St. Francis and lesser tributaries of the Mississippi, therefore, is subject to question. Extension of navigation to other tributaries is extremely desirable because of existing high and discriminatory freight rates.

Recreation.

Recreation consists mainly of fishing on the numerous old-channel lakes adjacent to the rivers in the summertime, and the hunting of ducks, geese, deer, turkey and quail in the winter time. Other interesting forms of recreation can and should be provided. The enlargement of wild fowl refuges is desirable in order to protect a valuable asset to the State. Such expansion is also in keeping with the possible retention of natural flood retarding basins along the Mississippi.

Wildlife.

Plate 27 shows a concentration of waterfowl flyways in this basin such as exists nowhere else in the United States. The hunting of waterfowl and other game offer attractions to many visitors. Firms from as far away as New York lease lakes and reservoirs in the Basin for the hunting season. Hunting thus offers a material source of revenue to the people of the basin and to the State.

Expansion of refuge areas should be combined with possible flood control projects involving the continuation of the use of natural flood retention basins in their present wild state.

Mosquito Control.

The control of malaria is a more serious problem in this basin than in any other basin in the State. The low-lying, swampy lands and the moist warm climate are ideal for breeding mosquitoes. Drainage of such areas is desirable, and the value of this procedure as a malaria control measure will often justify projects not otherwise jusifiable. The taxpayers of Arkansas may well take advantage of Federal Aid now available through work relief to forward this work as rapidly as is consistent with long term planning and State finances.

Conclusions and Recommendations.

The development of Eastern Arkansas is dependent largely upon agriculture for which it is ideally fitted. Such development is severely retarded by frequently re-occurring floods. Flood control is therefore of primary importance to this basin and although much has been accomplished through local government organizations and Federal aid, there remains much to be done toward providing an adequate plan of development. In order to protect the resources of this basin, so far as compatible with proper flood control, the people of Arkansas should assist and direct the working out of the ultimate plan.

Promiscuous drainage projects, constructed under the drainage and levee district laws of the State, have resulted in heavy and overlapping assessments which leave many districts in serious financial difficulty. More definite planning from a statewide viewpoint and further sound refinancing and rehabilitation of physical works is necessary.

In the planning of domestic water supplies, the fact should be recognized that ground water in this basin is ample but usually must be treated for iron or corrosive qualities.

Adequate rice irrigation can only be maintained by augmenting the present well supplies with surface water supplies which must either be imported from a major project or stored locally in small reservoirs. The latter plan has not been adequately studied and its benefits compared to those of the former. A major problem as to water rights may develop in the rice producing area and should be anticipated by regulatory legislation.

According to J. C. Murray of the Little Rock Chamber of Commerce: "Navigation on the Arkansas and White Rivers is desirable and is recommended if found economically feasible and in order to reduce transportation costs from and into Arkansas to a level which will be favorable to the development of its economic resources and the marketing of its products in markets now closed to those products by reason of present high transportation costs."

The mosquito problem is a serious one in the basin. Malaria control will help to justify new drainage works and the reclamation of swampy lands.

Additional recreational facilities should be planned for this basin.

Reasonable expansion of wildlife refuges is desirable as an aid to the perpetuation of the splendid hunting opportunities which can now be enjoyed. This expansion program should be combined with a plan for the retention of natural flood retarding basins in their wild state for the control of floods.

A list of projects recommended by the Water Resources Committee of the State Planning Board, providing for investigation and construction within the Lower Mississippi River Basin, follows. The list contains those items for which sufficient reliable data are available at present to make the Water Resources Committee reasonably certain of their economic and social justification. Necessarily, this list will require revision and change from time to time as additional information becomes available.

FLOOD CONTROL AND POWER PROJECTS

No.	Name	Description and Location	Authorized	Estimated Cost	Status
1.	L'Anguille River	Levee project, Big Creek, L'Anguille River	Yes	Not available	No funds available—inactive
2.	Bayou Meto	Examinations and Survey, Bayou Meto Basin, Pulaski and Lonoke Counties	Yes	Not available	In progress—need additional funds
3.	Black River	Floodway west side of Black River, Clay County	Yes	Not available	Not available
4.	White River, Newport	Enlargement of existing levees and flood walls	Yes	Not available	Construction will start soon
5.	White River, Village Creek	Construction of levees on east bank of White River, Jackson and Woodruff Counties	Yes	Not available	Construction will start soon
6.	Black River	Preliminary examination—report for flood control	Yes	Not available	Not available

POLLUTION CONTROL PROJECTS

No.	Location	Nature of Project	Recommended	Estimated Cost
1.	Arkansas	Survey and investigation	Yes	
2.	Biggers	Sewerage system	Yes	
3.	Eudora	Improvements	Yes	
4.	Forrest City	Improvements	Yes	
5.	Gould	Sewerage system	Yes	
6.	Hamburg	Improvements	Yes	
7.	Lake Village	Improvements	Yes	
8.	Marvell	Improvements	Yes	
9.	Tillar	Sewerage system	Yes	
10.	Weiner	Sewerage system	Yes	
11.	Augusta	Improvements	Yes	
12.	Bald Knob	Improvements	Yes	
13.	Blytheville	Improvements	Yes	
14.	Clarendon	Improvements	Yes	
15.	Dermott	Improvements	Yes	
16.	Earle	Improvements	Yes	
17.	England	Improvements	Yes	
18.	Jonesboro	Improvements	Yes	
19.	Marianna	Improvements	Yes	
20.	McGehee	Improvements	Yes	
21.	Newport	Improvements	Yes	
22.	Walnut Ridge	Improvements	Yes	
23.	West Helena	Improvements	Yes	
24.	Caraway	Sewerage system	Yes	
25.	Elaine	Sewerage system	Yes	
26.	Hoxie	Sewerage system	Yes	
27.	Humphrey	Sewerage system	Yes	
28.	Knobel	Sewerage system	Yes	
29.	Lake City	Sewerage system	Yes	
30.	Leachville	Sewerage system	Yes	
31.	Madison	Sewerage system	Yes	
32.	Manilla	Sewerage system	Yes	
33.	Marked Tree	Sewerage system	Yes	
34.	McCrory	Sewerage system	Yes	

POLLUTION CONTROL PROJECTS

No.	Location	Nature of Project	Recommended	Estimated Cost
35.	McRae	Sewerage system	Yes	
36.	Monette	Sewerage system	Yes	
37.	Nettleton	Sewerage system	Yes	
38.	Pocahontas	Sewerage system	Yes	
39.	Portland	Sewerage system	Yes	
40.	Portia	Sewerage system	Yes	
41.	Rector	Sewerage system	Yes	
42.	Swifton	Sewerage system	Yes	
43.	Trumann	Sewerage system	Yes	
44.	Turrell	Sewerage system	Yes	
45.	Wilmot	Sewerage system	Yes	
46.	Marion	Sewerage system	Yes	
47.	Corning	Improvements	Yes	
48.	Piggott	Improvements	Yes	
49.	Marmaduke	Sewerage system	Yes	
			Total	$2,185,000

WATER SUPPLY PROJECTS

No.	Location	Nature of Project	Recommended	Estimated Cost
1.	Biggers	Water Supply	Yes	$ 25,000
2.	Eudora	Improvements	Yes	20,000
3.	Gould	Improvements	Yes	15,000
4.	Hamburg	Improvements	Yes	20,000
5.	Lake Village	Improvements	Yes	20,000
6.	Marvell	Improvements	Yes	25,000
7.	Trumann	Improvements	Yes	15,000
8.	Weiner	Water Supply	Yes	30,000
9.	Black Rock	Water Supply	Yes	41,000
10.	Caraway	Water Supply	Yes	24,000
11.	Knobel	Water Supply	Yes	27,000
12.	Madison	Water Supply	Yes	35,000
13.	McRae	Water Supply	Yes	25,000
14.	Nettleton	Water Supply	Yes	42,000
15.	Portia	Water Supply	Yes	23,000
16.	Swifton	Water Supply	Yes	27,000
17.	Pine Bluff	Improvements	Yes	30,000
18.	Marianna	Improvements	Yes	20,000

MISCELLANEOUS PROJECTS

Lower Mississippi River Basin

No.	Name	Description and Location	Authorized	Estimated Cost	Status
1.	Felsenthal Canal	Construction of canal—Felsenthal to Ouachita River	Yes	Not available	Pending acquisition of right-of-way and terminal facilities
2.	Arkansas River	Preliminary examination and report for navigation of Arkansas River	Yes	Not available	Inactive pending appropriation of funds for surveys
3.	White River	Preliminary examination and report for navigation	Yes	Not available	Inactive pending appropriation of funds for surveys
4.	Prairie County	Construct port and terminal at De-Vall's Bluff	No	Not available	Preliminary

APPENDIX "A"

Data on Drainage and Levee Districts in Arkansas,
as of January, 1939.

DATA ON DRAINAGE AND LEVEE DISTRICTS

Name of District	County	Basin	Areas in Acres		Assessed Benefits		Bonds			Bond Int.& Taxes		
			Assessed	Improved	Total	Av.per Acre	Issued	Out-Standing	In Default	Rate In %	Year	% Delingt. Pct.
Big Gum D.D.	Clay	Lower Miss	33060	16500	$ 186942	$ 5.65	$170000	$ 42000	$ 29000	9½	1937	52
	Greene	"										
Central Clay D.D.	Clay	"	106000	44000	698359	6.60	500000	12200	12200		1933	
St. Francis D.D.	Clay	"	122095	97600	1321008	10.80	575000	27000	20000	3.0	1937	42
	Greene	"										
Subsidiary Dist. #10	Clay	"	18888	14700	268698	14.20	72500	62500	None	4.0	1937	63
	Greene	"										
" " #11	Clay	"	18455	12500	143788	7.78	25500	25500	None	3.5	1937	60
	Greene	"										
" " #20	Clay	"	29117	17500	233357	8.00	97000	92000	None	3.5	1937	85
	Greene	"										
" " #21	Clay	"	6880	5900	75234	10.92	25800	23000	None	3.5	1937	61
" " #22	Greene	"	4666	4000	44363	9.50	16000	16000	None	4.3	1937	63
" " #23	Clay	"	26333	22100	224135	8.54	99000	98000	None	4.0	1937	42
Western Clay D.D.	"	"										
Sub District #1	"	"	19296	13200	124592	6.46	100000	30000	30000	7.0	1933	
" " #2	"	"	19675	11400	163842	8.33	130000	32000	32000	5.0	1935	
" " #3	"	"	17234	12400	52865	3.07	50000	11000	11000	6.0	1936	
" " #4	"	"	5793	3000	37280	6.44	29500	7500	6000	10.0		
" " #5	"	"	14686	5580	140257	9.55	110000	53500	43000	8.0	1937	52
Beaver Dam D.D.	Greene	"	21886	4400	210540	9.26	191000	168000	117000	10.0	1937	86
	Randolph	"										
Cache River D.D. #1	Greene	"	25840		90142	3.49						
" " " #2	"	"	40558	14500	646537	15.94	550000	514000	372000	9.5	1937	92
Eight Mile D.D. #2	"	"	18228	12758	52324	2.87	51000	None	None			
" " " #3	"	"	3673	2754	27784	7.56	12000	None	None			
Fox Creek D.D. #1	"		1000		11421	11.42		None				
Greene-Lawrence D.D.	"	"	81500	32400	498500	6.12	228000	None	None	None		
	Lawrence	"										
Hurricane Creek D.D.#1	Greene	"	14077	11262	29877	2.12	30000	None	None	None		
Johnson Creek D.D. #1	"	"	4040	3070	14046	3.47	14000	None	None	None		
Locust Creek D.D. #1	"	"	8160	4895	32783	4.00	30000	None	None	None		
" " " #2	"	"	3020	1330	18500	6.12	16472.13	None	None	None		
Mud Slough D.D.	"	"	9440	4960	79708	8.45	50000	33000	6000	6.5		30
Swan Pond D.D. #1	"	"	17600		48651	2.76	50000	None	None	None		
" " " #2	"	"	9857	5657	49728	5.04	24000	None	None	None		
Village Creek D.D.	"	"	4940	3775	51514	10.42	25000	None	None	None		
Carson Lake D.D. #8	Mississippi	"	54917		704321	12.85	276000	20500	20500	None	1937	
Sub District #1 Carson Lake D.D. #8	"	"	54684	51385	1217807	22.00	389522	406522	None	2.5	1937	3
Dead Timber D.D. #13	"	"	25480	18296	426840	16.75	120000	None	None	None		
Drainage District #16	"	"	58400	54370	899688	15.90	181000	182000	None	2.75	1937	12
" " #17	"	"	151250	94000	4680000	30.33	1669500	1759400	None	4.25	1937	20
Golden Lake D.D. #11	"	"	30427	24609	441466	14.20	155000					
Grassy Lake Tyronzo D.D.#9	"	"	168156	118000	3615801	21.05	373500	None	None	0.8	1937	6
Sub District #3	"	"	162230	135119	3761151	23.05	1074372	1097372	None	2.0	1937	5
" " #4	"	"	40334	33200	489438	12.05	154000	154000	None	2.0		4
" " #1												
Osceola D.D. #12	"	"	10600	7800	155568	16.00	76000	71000	None	3.75		16
Drainage District #1	Craighead	"	3500									
" " #2	"	"	18000				15500	None	None			
" " #3	"	"	36700		286517.48		77500					
" " #6	"	"	9560				22000	None	None			
" " #9	"	"	37860	34000	666541	16.80	225000	2000	2000	None	1937	13
" " #10	"	"	12500		133217	9.67	40000	300	300	None		
" " #12	"	"	12032	11500	200441	16.60	75000	10000	None	3.65	1937	17

Drainage District #14	Craighead	Lower Miss	7863	4200	51332	6.53	25000	4000	4000	6.0	1937	36
Big Creek D.D. #15	"	"	51400	12300	801789	15.60	77500	77500	None	6.6	1937	59
Sub District #1 Big Creek D.D. #15	"	"	3378	1000	7112	2.11						
Drainage District #16	"	"	14000	2000	211554	15.20	130000	118000	58000	6.25	1937	98
" " #17	"	"	6317	4350	262570	41.40	59700	59700	None	1.5	1937	50
" " #18	"	"	28740	20000	769225	26.60	350000	120000	None	3.0	1937	25
Sub Dist. #1 D.D. #18	"	"	1360		27133	20.00				4.0	1937	12
Whaley-Ark Slough D.D.#19	"	"	6116	2000	71670	11.10	13500	13000	None	4.0	1937	75
Little Boy and Whitman Creek D.D. #20	"	"	22454	10180	287702	11.75	59000	57000	None	2.8	1937	34
Drainage District #21	"	"	3045	2100	26039	8.68	20000	4000	4000	2.5	1932	
" " #24	"	"	14500		204995	1	None					
" " #25	"	"	15777	11300	160481	9.75	56000	56000	None	3.3	1937	14
Cane Island D.D. #25	"	"	9674	8600	189749	19.30	73000	61000	None	4.0	1937	41
Drainage District #27	"	"	8647	3000	75277	8.70	18500	13500	None	4.5	1937	50
" " #28	"	"	10978	4460	121374	11.06	20500	17000	None	4.0	1937	76
Bay St. Francis D.D.#29	"	"	44279	31150	613803	13.55	294000	291000	None	4.0	1937	24
Jonesboro Storm Sewer D.D. #30	"	"	6494	4185	269830	10.67	132000	129500	None	3.5	1937	30
Drainage District #31	"	"	7719	3100	29346	3.75	14000	9500	None	5.0	1937	36
" " #32	"	"	2360	1350	28800	12.20	7200	4100	None	4.5		
Bonahan Slough D.D.	"	"	3613	2000	18200	5.00	3750	2250	None	5.0	1937	68
	Greene	"										
First Slough D.D.	Craighead	"	11334	6700	85087	7.48	17000	14500	None	3.0	1937	62
	Greene	"										
Old Cache River D.D.	Craighead	"	111432	31300	983490	8.37	135000	135000	None	3.25		
	Lawrence	"										
	Jackson	"										
Drainage District #1	Poinsett	"	10100	7570	45000	4.46	45000	None	None	None		
" " #3	"	"	81240	20300	397485	4.89	245000	3500	3500	None		
" " #4	"	"	34768	13900	176009	5.06	110000	10750	10750	3.38	1937	77
" " #5	"	"	62956	14500	329970	5.15	205000	164000	123000	6.08	1937	94
" " #6	"	"	12444	9650	70114	5.63	70000	None	None	None		
" " #7	"	"	148965	99000	5313581	34.00	1874500	1784500	None	3.0	1937	36
" " #8	"	"	24526	7400	254161	10.09	203500	203500	128000	7.5		
Spear Lake D.D.	"	"	6290	5660	35107	5.58	17000	3500	None	5.5		
Blackfish Bayou D.D.	Crittenden	"	1558	1231	26205	13.10	13000	760	760	None	None	
Council Chute D.D.	"	"	8664	3812	165026	19.08	64000	62000	12000	3.6	1936	72
	Lee	"										
	St. Francis	"										
Drainage District #2	Crittenden	"	86791	61412	956489	10.86	202500	197500	None	4.0	1936	24
" " #3	"	"	38093	24425	440479	11.57	275000	23000	None	3.3	1936	20
" " #5	"	"	18052	9691	199332	10.99	130000	8000	8000	6.5	1936	1
" " #6	"	"	26913	19406	404324	14.32	170000	None	None	None	1936	23
" " #7	"	"	36414	19220	648771	17.61	200000	9500	9500	1.75	1936	33
" " #8	"	"	12007	7952	272016	22.65	135000	1900	1900	None	1936	25
Proctor Drain. Dist.	"	"	1573	347	62920	40.00	32000	32000	None	3.7	1936	100
Tri County Drain. Dist.	"	"	54218	26041	752702	13.52	400000	39000	39000	6.0	1934	19
	Cross	"										
	St. Francis	"										
Bayou De View	Cross	"	47241	10751	689460	14.60	59000	51000	None	1.3		
	Jackson	"										
	Woodruff	"										
Brushy Lake Bayou D.D.#1	Cross	"	28007	13500	378615	13.16	25000	20000	None	1.0		
Drainage District #3	"	"	47264	7000	948592	19.50	31000	31000	None	1.25		
" " #6	"	"	32718	2950	416993	12.74	200000	177000	None	4.7		
Sub. #1 D.D.	St. Francis	"	5120	1475	76800	15.00	45000	4000	4000	6.0	1935	60
Drainage District #3	" "	"	1742		14035	8.06	7000	None	None		1933	46
Black Swamp D.D.	Lee	"	17200	13100	186776	10.68	114000	64000	26500	6.5	1934	90
Flag Lake D.D.	"	"	1603	1260	20000	12.47	10000	6500	4500	3.0		
Hog Tush D.D.	"	"	11395	8550	48854	4.26	32500	32500	6000	4.5	1934	75
Larkins Creek D.D.	"	"	7140	5140	87210	12.21	46500	14000	14000	6.5	1934	65

DATA ON DRAINAGE AND LEVEE DISTRICTS

Name of District	County	Basin	Areas in Acres		Assessed Benefits		Bonds			Bond Int.& Taxes		
			Assessed	Improved	Total	Av.per Acre	Issued	Out-Standing	In Default	Rate In %	% Delinqt. Year	Pct.
Cotton Belt L.D. #1	Phillips	Lower Miss	136700	73250	$1112296	$ 7.31	$470000	$ 154000	$ None	4.5	1930	22
Beaver Bayou D.D.	"	"	56225	28700	448061	7.97	172000	38000	38000	None		
Green-Briar D.D.	"	"	30580	9745	301680	9.87	120000	98000	29000	4.6	1934	92
	Lee	"										
Helena Imp. Dist. L.D.	Phillips	"	450	450	2047842	20.00	635000	223000	51500	0.61		
Lee-Phillips D.D.	"	"	40000	35500	401441	9.84	285000	167500	74000	7.3	1934	73
	Lee	"										
Little Cypress D.D.	Phillips	"	21647	11000	178792	8.06	120000	95000	32000	6.5	1934	96
Laconia L.D.	"	"	60701	24900	690755	10.19	440000	250000	107000	5.0	1934	88
Phillips County D.D.#1	"	"	8395	3000	755540	90.00	309000	277000	69000	3.8	1934	100
Clarendon L.D.	Monroe	"	750	All city prop.	100000		50000	32000	5000	5.0		
Drainage District #2	"	"	15840	3300	120100	7.58	63500	48900	4900	6.5		
Piney D.D.	"	"	49200	17500	233452	4.74	65000	None	None	None		
St. Francis L.D.	Craighead	"	111733		26705.53	.23)						
" " "	Crittenden	"	338923		84667.26	.24)						
" " "	Cross	"	128610		32152.24	.25)						
" " "	Lee	"	113586		10882.91	.09)	Taxes based on an arbitrary charge per unit of land					
" " "	Mississippi	"	467068		112809.77	.24)	and per mile of utility facilities, rather than					
" " "	Poinsett	"	183416		44308.55	.24)	assessed benefits					
" " "	St. Francis	"	174011		38496.95	.22)						
Little Running Water D.D.	Randolph	"	13151		66015	5.01	40000	None	None			
North Running Water D.D.	"	"	6491	5970	36012	5.55	29000	16000	2500	10.00	1937	17
Running Lake D.D.	"	"	21578	10790	114764	5.42	85000	1500	1500	None		
Running Water L.D.	"	"	47422	41600	179422	3.80	11000	1000	None	1.0	1937	14
	Lawrence	"										
Tupelo D.D.	Randolph	"	5040	3760	12053	2.39	12411.80	None	None	None		
	Lawrence	"										
Village Creek D.D.	Randolph	"	8520	4685	77945	9.15	30000	24000	None	3.0	1937	3
Beaver Dam-Duck Pond D.D.	Lawrence	"	6964	1700	36380	5.03	25000	23000	10000	7.5	1937	57
Black Spice D.D.	"	"	5655	3000	72612	11.38	31500	17500	16000	5.3	1937	62
Caney Creek	"	"	3095	1200	41570	13.43	27000	None	None	None		
Lee-Kellow Ditch No.23	Lawrence	"	10000	2500	56920	5.69	20000	None	None	None		
Lower Running Water D.D.	"	"	8804	3500	47500	5.38	25000	None	None	None		
New Flat Creek-War Pond D.D.	"	"	4500	1800	34157	7.53	18000	7500	7500	6.0	1936	83
Rabbit Roust D.D.	"	"	2640	2600	40256	15.25	16000	500	500	None		
Robinson D.D.	"	"	2640	2400	16410	6.22	10000	None	None	None		
Running Water D.D.	"	"	27780	23891	77267	2.78	34000	None	None	None		
Swan Pond D.D.	"	"	3410	3000	22879	6.72	18000	8000	None	10.0	1937	26
Village Creek D.D.	"	"	70320	32000	671661	7.30	148000	148000	None	3.0	1937	65
Bateman L.D. #3	Jackson	"	3500	2155	103114	29.52	64000	55000	37500	3.5	1937	78
Cook Slough D.D.	"	"	8099	5260	153495	18.43	40000	11393	11393	2.9	1937	78
Cow Lake D.D.	"	"	25318	10600	233367	9.21	26000	23000	None	1.0		
Drainage District #4	"	"	4183	2090	22616	5.40	13000	None	Nome	None		
" " #8	"	"	18579	10000	151485	7.70	56339	54000	None	3.0	1937	34
" " #9	"	"	1320	1125	18472	13.84	8000	2500	None	5.0	1937	13
" " #10	"	"	5901	4839	94344	15.95	37000	None	None	None		
" " #11	"	"	7244	4635	79397	10.91	22000	22000	None	2.0		
" " #12	"	"	24324	9050	308445	12.70	41000	39000	None	1.0		
" " #13	"	"	6357	4060	45120	7.10	25000	21000	6500	6.0	1937	35
" " #15	"	"	3175	2285	36800	11.59	13000	6500	None	3.5	1937	27
" " #16	"	"	4697	3335	49686	10.58	20500	15500	None	4.5	1937	27
Jackson Part L.D. #2	"	"	2652	2275	105838	28.51	10000	None	None	None		

Maple Slough D.D.	Jackson	Lower Miss	9731	7400	153489	14.74	70000	12929	12929	4.0	1937	54
Mayberry D.D.	"	"	10053	4220	47491	4.57	23000	500	500			
Overcup Slough D.D.	"	"	20273		278727	13.78	100000	None	None	None		
	Woodruff	"										
New Cache River D.D.	Jackson	"	113520		700535		42000	None	None	None		
	Poinsett	"										
Newport L.D.	Jackson	"	2191	2080	897939	14.00	449000	199500	28500	4.0	1937	14
Village Creek-White River L.D.	"	"	21067	11580	260169	12.35	39500	36500	None	4.0	1937	19
Curia Creek D.D.	Independence	Up. White	15229	2520	128849	8.46	34500	2300	2300	3.6		
Drainage District #2	"	and Black	2863	2200	50255	17.55	20000	None	None	None		
" " #3	"	"	2981	1595	25328	8.50	12500	None	None	None		
Judsonia D.D.	White	"	17569	5450	317781	18.09	120000	117500	81000	2.5	1935	92
Little Red Riv.L.D. #1	"	"	15602	2652	267654	12.00	101500	5000	None	1.5		
" " " " #2	"	"	14960	3500	330350	22.08	145000	132500	105500	4.3	1936	93
Gibson L.D.	Woodruff	Lower Miss	11428	6000			10000	None	None	None		
Turkey Creek D.D.	"	"	4300	3000	62512	14.54	18000	2500	2500	3.0	1931	69
	Monroe	"										
White River L.D.	Woodruff	"	109420	32000	1748648	15.98	365500	365500		3.5		
	Monroe	"										
	Prairie	"										
Arkansas D.D. #18	Arkansas	"	6160	6090	69528	10.71	40500	18000	None	6.0	1937	22
" " #19	"	"	1058	1058	14060	11.20	9000	None	None	None		
Big Island D.D. #8	"	"	7821	7400	100060	7.39	25000	None	None	None		
Buffo D.D. #7	"	"	4403	3732	37405	6.75	18000	None	None	None		
Cherry Creek D.D. #2	"	"	3791		5101	13.25		None	None	None		
Crandall D.D. #16	"	"	3568	3568	31329	7.65	21500	None	None	None		
Crocketts Bluff D. D. #5	"	"	6680	6680	50630	6.34	20000	None	None	None		
Fish Lake D.D. #14	"	"	6724	6196	65770	9.78	28000	8000	None	3.0	1937	3
Gillette D.D. #11	"	"	4430	4230	35975	6.46	17000	None	None			
Humphrey-Dry Bayou D. D.#2	"	"	1321	1321	20086	5.46	10000	None	None	None		
Mill Bayou D.D. #12	"	"	6257	6257	33295	5.32	33000	7000	None	4.5	1937	5
" " " #20	"	"	3365	3264	46050	11.34	31000	6500	1000	5.6	1937	8
Murrell D.D. #17	"	"	880	880	11088	15.53	9000	None	None	None		
Olena D.D. #1	"	"	2492	2492	24919	8.75	36000	None	None	None		
Stuttgart-Kings Bayou D. D. #6	"	"	19411	18085	221130	9.41	95000	None	None	None		
Tarleton D.D. #15	"	"	8114	7740	66514	7.72	17500	2500	None	2.25		
Wulf D.D. #4	"	"	20857	18710	106880	5.00	55000	None	None	None		
Drainage District #2	Prairie	"	13688	12530	38022	2.78	25000	12000	3000	11.00	1933	42
Crawford L.D. #1	Crawford	Western	15203	13700	264825	15.77	200000	42136	42136	4.0		
Whiteside Lake D.D.	"	Arkansas	920	920	9976	10.85	7000	1350	1350	4.0		
Drainage District #5	Sebastian	"	625	625	5010	8.02	None	None	None	None		
Cedar Bottoms L.D. #1	Logan	"	730	730	5121	7.00	None	None	None	None		
Logan County D.D. #1	"	"	1300	1300	3900	3.00	None	None	None	None		
" " L.D. #1	"	"	9660	9600	25000	2.59	None	None	None	None		
McLean Bottoms L.D. #3	"	"	9660	9600	25042	2.59	None	None	None	None		
Drainage District #1	Pope	"	2560	2060	56360	22.01	21000	None	None	None		
" " #3	"	"	920	920	9260	10.06	7250	None	None	None		
" and Levee Dist.#1	"	"	2468	2400	10089	4.08	7800	None	None	None		
Gum Log D.D. #2	"	"	2040	1600	46061	22.58	28000	16500	16500	None		
Holly Bend L.D. #1	"	"	3580	3500	32273	9.01	7500	100	100	None		
" " " #2	"	"	3200	2720	None		None	None	None	None		
Joyner Pond D.D.	"	"	1007	920	9022	8.95	7800	6300	3900	6.0	1937	37
	Conway	"										
Garden Bottom D.D. #2	Yell	"	4858	4858	81710	16.81	33000	8850		4.0		
Dardenelle D.D.	"	"	6837	6300	63636	9.32	40000	39188	8688	9.0	1937	41
Yell County L.D. #1	"	"	3940		Ad val.		10000	4188	2688	None		
Drainage District #2	Conway	"	15211	7000	169045	11.11	50000	1350	1350	None	1932	37
" " #3	"	"	613	613	3721	6.07	None	None	None	None		
" " #4	"	"	7136	5000	55630	7.08	None	None	None	None		
Levee & Drain.Dist.#1	"	"	2491	1800	10243	4.11	6500	4200	None	8.0	1937	7
" " " #2	"	"	954	700	None	None	None	None	None	None		

DATA ON DRAINAGE AND LEVEE DISTRICTS

Name of District	County	Basin	Areas in Acres		Assessed Benefits		Bonds			Bond Int. & Taxes		
			Assessed	Improved	Total	Av.per Acres	Issued	Out-Standing	In Default	Rate In %	% Delinqt. Year	% Delinqt. Pct.
Levee District #1	Conway	Western	8982	7475	$ 52205	$ 5.82	$ 18000	$ 9500	$None	5.0	1937	17
" " #2	"	Arkansas	4225	4100	26676	6.55	14500	500	None	None	1937	1
" " #3	"	"	5166	4900	48757	9.44	None	None	None	None		
" " #6	"	"	1953	1953	26451	13.54	10000	1500	1000	3.0		
" " #7	"	"	2593	2593	16219	6.25	7500	500	500	None		
" " #8	"	"	3688	1700	10322	2.00	None	None	None	None		
" " #1	Faulkner	"	8649	6790	86831	10.04	32500	13000	500	4.4		
" " #2	"	"	1910	1640			24000	None	None	None		
Tupelo Swamp D.D.	"	"	7607	4050	41179	5.41	20000	None	None	None		
Cypress D.D.	Perry	"	18218	9200	123194	5.62	110000	50000	29000	8.0	1937	29
	Conway	"										
Ross D.D.	Clark	Ouachita	24545	12041	433349	17.60	120000	120000	None	2.5	1936	2
Baucum D.D.	Pulaski	Western	10000	6000	None		5000	5000	None			
Clear Lake D.D.	"	Arkansas	1063	983	60302	56.73	10000	7000	None	0.5	1937	6
Drainage District #1	"	"	3124	3124	127551	40.60	49300	49300	None	2.75	1937	62
Faulkner Lake D.D.	"	"	15612	10500	159362	10.21	112000	92500	None	5.5	1937	9
Fouche L.D.	"	"	10900	8150	108645	9.97	75000	None	None	None		
Old River D.D.	"	"	6241	6241	58999	9.27	36000	9500	None	6.0	1937	1
	Lonoke	Lower Miss										
Pocket Cypress D.D.	Pulaski	Western Ark	9315	5600	235364	25.30	94500	56000	None	4.0	1937	7
	Jefferson	Lower Miss										
Pulaski-Lonoke D.D.	Pulaski	Western Ark	15807	5050	238719	11.58	30000	26500	None	2.0	1937	85
	Lonoke	Lower Miss										
Roland D.D.	Pulaski	Western	6854	3830	None		None	None	None	None		
Woodson L.D.	"	Arkansas	5821	5240	192900	32.28	75000	135000	None	3.0	1937	61
Bayou Meto D.D.	Lonoke	Lower Miss	85382	28260	606365	7.80	237500	237500	None	3.5	1937	52
	Prairie	"										
	Arkansas	"										
Drainage District #2	Lonoke	"	2007	1420	9384	4.35	6000	3500	1500	7.2	1937	23
" " #3	"	"	3856	2770	32565	8.34	18600	None	None	None		
" " #5	"	"	28981	17785	294322	10.12	80500	75500	None	1.8	1937	21
Subd. A. D.D. #5	"	"	1649	1349	23720	14.38	17800	3500	None	6.75	1937	11
" B. " "	"	"	670	500	4315	6.44	2800	None	None	None		
" C " "	"	"	1756		6750	3.84	5700	None	None	None		
Drainage District #6	"	"	8139	6100	104132	12.36	35000	9063.46	3563.46	3.15	1937	23
" " #7	"	"	8695	8250	75650	8.70	50000	22109.17	9610.10	5.4	1937	24
" " #9	"	"	2401	2160	18963	7.69	5500	None	None	None	1937	100
" " #11	"	"	6857	6100	43245	6.31	20500	20500	None	2.5	1937	55
Indian Bayou D. D. #1	"	"	42803	32745	463428	10.83	147000	None	None	None	1937	17
" " " #2	"	"	10046	8300	123470	11.70	22500	19500	None	1.8	1937	10
Keo. England D.D. #4	"	"	13866	11239	146144	9.68	23500	19500	None	1.0	1937	11
North Bayou D.D. #10	"	"	5343	4570	48107	8.91	12500	4000	None	3.6	1937	24
Bradley Slough D.D.	Jefferson	"	10321	9070	32969	3.27	16000	None	None	None		
Subd. #1 Bradley												
Slough D. D.	"	"	9235	7090	49741	5.19	25000	16500	None	6.0	1937	20
Cousart Bayou D.D.	"	"	46573	32550	625096	13.27	172000	81500	None	3.0	1937	25
	Lincoln	"										
Drainage District #2	Jefferson	"	20185	13440	81675	3.22	37000	3000	None	4.0	1937	48
Subd. #1 D.D. #2	"	"	19889	13440	216544	10.87	34000	26000	None	1.0	1937	16
Drainage District #3	"	"	22048	9200	100895	4.58		None	None	None		
" " #4	"	"	5245	2460	39337	7.50	20000	1200	1200	5.0	1937	45
" " #5	"	"	14382	5800	101407	7.06	35000	3000	3000	None		
" " #6	"	"	12242	4100	96581	7.89	23000	3000	2000	2.3	1937	34
" " #7	"	"	7986	4730	69058	8.61	30500	9000	9000	2.3	1937	47
" " #8	"	"	440	440	5807	9.65	3500	None	None	None		

Drainage District # 9	Jefferson	Lower Miss	5319	4116	102395	19.13	35000	3000	None	3.5	1937	43
" " #10	Jefferson	Lower Miss	1269	1085	31930	25.17	15000	2500	1500	4.0	1937	65
Farelly Lake D.D.	"	"	100096	24640	1866188	18.48	1642000	1636000	364000	3.5	1937	98
	Arkansas	"										
Five Forks D.D.	Jefferson	"	15197	6080	105132	6.92	47000	None	None	None		
Flat Bayou D.D.	"	"	18432	12993	208490	11.25	128000	25000	4500	6.0	1937	46
Frenchtown L.D.	"	"	28582	22500	130546	3.09	40000	5000	None	2.0	1937	32
Grady D.D.	Jefferson	"	17976	13000	230402	12.50	135500	55500	13500	3.0	1937	25
	Lincoln	"										
Kersh Lake D.D.	Jefferson	"	29716	25000	293192	9.67	181500	61655	61655	6.5	1937	79
	Lincoln	"										
	Desha	"										
Levee District #3	Jefferson	"	10545	5390	207524	18.55	1000	None	None	None	1937	13
Linwood Auburn L.D.#2	"	"	41798	31500	Ad Val.		100000	None	None	None		
Long Lake D.D.	"	"	15797	10850	227664	14.38	132500	31800	17800	4.8	1937	37
	Lincoln	"										
New Gascony L.D. #1	Jefferson	"	17083	11860	218552	11.43	74000	48500	None	3.5	1937	14
Plum Bayou L.D.	"	"	251000	188812	1963609	6.61	400000	276000	None	2.5	1937	19
	Lonoke	"										
	Pulaski	Western Ark										
Salt Bayou D.D.	Jefferson	Lower Miss	50194	16640	777559	15.46	430000	290456	80614	5.2		
	Arkansas	"										
Sub. #1 Salt												
Bayou D.D.	Jefferson	"	2040	1700	21000	10.30	16500	10500	None	7.0	1937	26
Tucker Lake L & D.D.	"	"	3261	2755	240938	73.88	46500	46500	None	1.8	1937	14
Upper Grassy Lake D.D.	"	"	740	695			4000	None	None	None		
Villmonte L.D. #4	"	"	18743	4670	176670	8.67	40000	3500	3500	None		
Waterloo D.D.	"	"	34600	29270	520000	15.03	160000	None	None	None		
Cypress Creek D.D.	Desha	"	266316	121990	5292726	18.35	487126.67	520726.67	33600	1.5	1937	30
	Lincoln	"										
	Chicot	"										
Drainage District #4	Desha	"	23981	9616	428664	15.00	100000	28500	16500		1932	62
" " #5	"	"	14760	12323	118316	8.00	100000	None	None	None	1932	32
Laconia Circle												
Special L. & D.D.	"	"	11310	6570	300336	25.00	12500	12500	None	1.5	1932	89
Laconia L.D.	"	"	40734	11095	299725	7.36	101000	101000	None	4.0	1932	96
Cummins D.D.	Lincoln	"	15212	10750	292874	18.45	83500	36000	15000	4.2	1937	53
Drainage District #1	"	"	6984	5360	114542	15.64	46000	10000	3500	3.0	1938	8
" " #2	"	"	640	473	3000	4.69	None	None	None	None		
Grassy Lake D.D.	"	"	3880	3000	21935	5.65	12000	None	None	None		
Tarry D.D.	"	"	1280		24700	19.30	None	None	None	None		
Southeast Ark. L.D.	"	"	728458	316575	Ad Val.		2900000	2413500	253500		1932	83
	Desha	"										
	Chicot	"										
Levee District #1	Hempstead	Red River	4847	2760	68105	5.68	30000	30000	None	6.0	1937	35
Ozan D.D. #1	"	"	2014		30075	14.75	15000	None	None	None		
" " #2	"	"	7603		103860	13.65	56000	None	None	None		
Long Prairie D.D.	LaFayette	"	31125	17575	448440	14.41	104500	99500	None	3.0	1936	28
" " L.D.	"	"	31656	18000	585587	18.50	199500	172000	None	3.2	1936	19
Red River L.D. #1	"	"	30045	14500	178226	5.93	422000	158000	None	9.0	1937	1
Spirit Lake D.D.	"	"	5949	4600	28309	4.76	10000	None	None	None		
Drainage District #2	Little River	Red River	10892	7292	111425	10.15	37000	35000	None	2.7	1937	7
Levee District #3	"	"	520				10000	10000	6000			
Ogden L.D.	"	"	2259	1720	18585	7.17	25000	22500	22500	5.0		
Orton L.D.	"	"	11784	4950	257775	21.70	34000	31500	5000	1.5	1937	62
Drainage District #1	Miller	"	10863	7720	220330	20.00	58700	None	None	None	1937	6
" " #4	"	"	3360	1850	67200	20.00	40000	18406	6406	6.0	1937	54
" " #5	"	"	5721	1660	121050	21.16	68000	27052	13052	6.0	1937	65
" " #6	"	"	15206	7500	221041	14.34	125000	89000	16000	6.0	1937	31
" " #9	"	"	5133	3400	36700	7.11	16000	12500	None	5.5	1937	2
Garland L.D.	"	"	43071	14600	237195	5.51	267500	90000	87000	8.0	1937	32
Homan D.D.	"	"	14946		124206	8.18	55000	12000	None	4.0	1937	6
McKenney Bayou D.D.	"	"	31726	10000	1028425	32.42	450000	317013	226937	3.75	1937	81

DATA ON DRAINAGE AND LEVEE DISTRICTS

Name of District	County	Basin	Areas in Acres		Assessed Benefits		Bonds			Bond Int.& Taxes		
			Assessed	Improved	Total	Av.per Acres	Issued	Out-Standing	In Default	Rate In %	% Delinqt. Year	Pct.
Miller County L.D.#2	Miller	Red River	88108	46700	$ 779611	$ 6.55	$ 650000	$ 210000	$30000	6.0	1937	7
Bayou Macon D.D. #3	Chicot	Lower Miss	5959	4430	89385	14.95	30000	30000	None		1932	39
Chicot County D.D.	"	"	147794	68030	2095533	14.18	193500	193500				
" " L & D.D.	"	"	15000									
Dermott D.D.	"	"	73740	23580	495356	6.72	190000	75745	75745		1932	86
	Ashley	"										
	Drew	"										
Eudora Western D.D.	Chicot	"	120964	36290	2248116	18.59	685000	648000	87000		1932	100
Middle Slough D.D.	"	"	4074	1817	73260	17.98	18000	18000	None		1932	86
Drainage District #1	Ashley	"	20680	17890	107465	4.77	60000	1000	1000	None		
TOTALS			8826733		$88393906		$34084943	$21439764	$3482826			