ARKANSAS STATE WATER PLAN

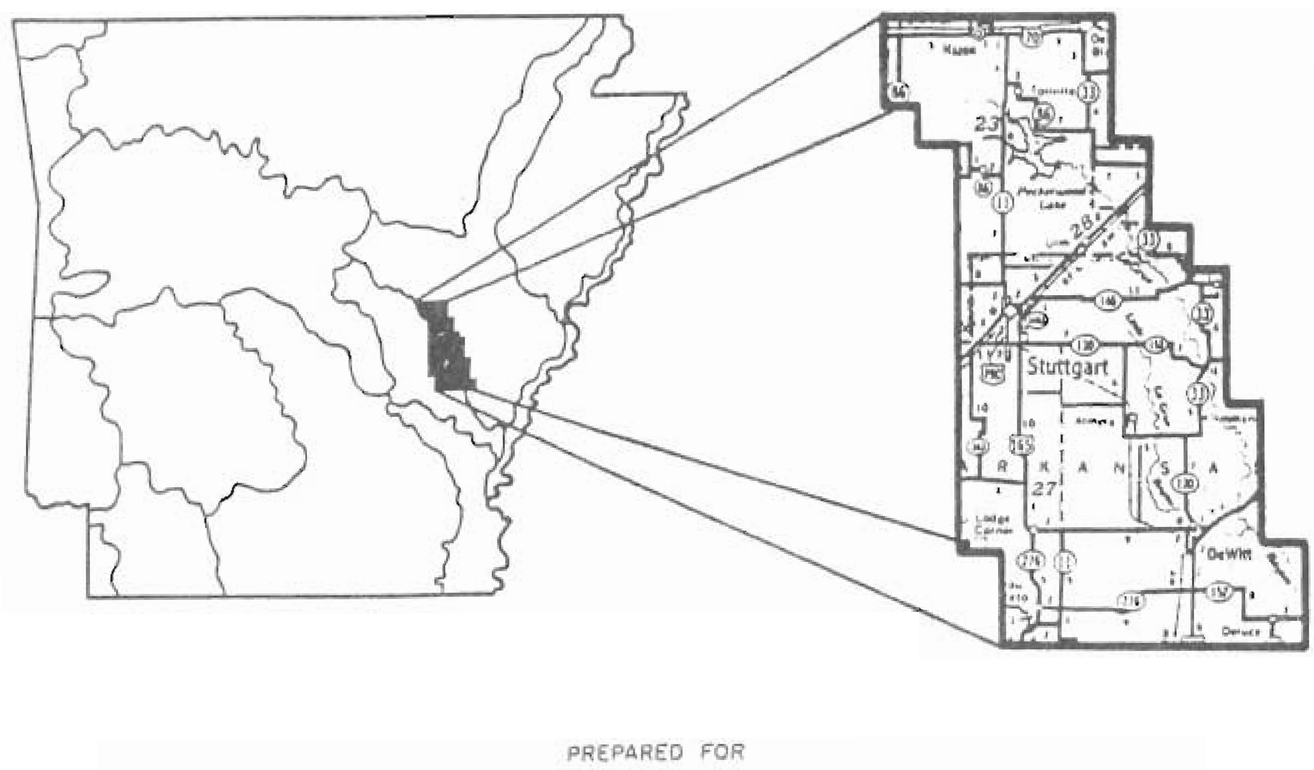
SPECIAL REPORT

IN THE

GRAND PRAIRIE

AGRICULTURAL WATER SUPPLY

INTERBASIN TRANSFER
LOWER WHITE TO BAYOU METO



PREPARED FOR

ARKANSAS SOIL AND WATER CONSERVATION COMMISSION

BY

US Army Corps
of Engineers

VICKSBURG DISTRICT

IRRIGATION WATER SUPPLY STUDY
EASTERN GRAND PRAIRIE REGION

Table of Contents

LIST OF TABLES

Table of Contents (Cont)

LIST OF TABLES (Cont)

LIST OF FIGURES

LIST OF PLATES

IRRIGATION WATER SUPPLY STUDY
EASTERN GRAND PRAIRIE REGION

INTRODUCTION

1. The Eastern Grand Prairie area, as identified on Plate 1, is located in the east-central portion of Arkansas. The study area is primarily agricultural land and the principal crops grown are rice, soybeans, cotton, and wheat. Much of the area relies heavily on irrigation. The need to investigate using surface water to satisfy irrigation needs has resulted from diminishing ground-water sources. This study deals with the economic feasibility of pumping water from the White River for irrigation purposes in the Eastern Grand Prairie area. However, no investigations have been made as to the availability of White River water to meet the identified irrigation water needs.

STUDY AUTHORITY

2. This study is being performed in response to a request by the Arkansas Soil and Water Conservation Commission (ASWCC). The authority for the study is provided under Section 22 of Public Law 93-251, Planning Assistance to States Program, which authorizes the Chief of Engineers (OCE) to cooperate with states in the preparation of comprehensive plans for the development, utilization, and conservation of the water and related land resources of drainage basins located within the boundaries of the states.

SCOPE OF THE STUDY

3. This study is being conducted to determine if the currently authorized Corps of Engineers Grand Prairie project can economically meet the agricultural irrigation water needs in the various areas of the Grand Prairie region. More specifically, the study will identify those farmlands that can most economically be irrigated from waters of the White River.

HISTORY

4. Irrigation water in the Grand Prairie area is obtained from shallow wells, deep wells, surface reservoirs, and natural streams. The greater part of the water required for irrigation is pumped from shallow wells. Under natural conditions water supplies are adequate for general agricultural production. Sources of water other than the Quaternary aquifer, where the ground water is found, must be expanded or water must be transported from some outside source into the area. Furthermore, the importation and control of supplemental agricultural water appear necessary to restore ground-water tables which have progressively diminished due largely to heavy demands of rice cultivation. Since the Quaternary aquifer is not of uniform thickness, the lowering of the underground water surface is much more serious in some localities than in others.

5. A project to provide supplemental water supply to the eastern portion of the Grand Prairie region was authorized by the Flood Control Act of 1950,

House Document No. 255. 1/ This project was put in a "deferred" study status on 28 March 1980 because of a lack of a legally constituted local sponsor capable or willing to provide the required assurances of local support. In 1982, local interests formed the White River-Grand Prairie Irrigation District to provide sponsorship for the water supply project.

6. In 1983, the Arkansas House of Representatives passed a resolution directing the ASWCC to conduct studies to determine the feasibility of diverting water for agricultural irrigation purposes throughout the Grand Prairie Region to include diversions from the Arkansas and White Rivers. This directive requires the state agency to provide a report on their findings to the Arkansas Legislature in the 1985 session. Subsequently, the ASWCC requested the Little Rock District to investigate both the Arkansas and White Rivers. Little Rock District proposed using Section 22, Planning Assistance to States, funds to accommodate this request. They also requested the Vicksburg District to do the eastern part because of the work done in this area on the old authorized project.

7. In conjunction with this, ASWCC has contracted the University of Arkansas, Agricultural Engineering Department, to conduct studies relating to conjunctive-use water management in both the eastern and western Grand Prairie areas. These studies are under the direction of Dr. Richard Peralta.

STUDY PARTICIPANTS AND COORDINATION

8. Two separate studies, Eastern Grand Prarie Region and the Western Grand Prairie Region, are being performed by the U. S. Army Corps of Engineers as shown on Plate 1. The Little Rock District is investigating the feasibility of supplying Arkansas River water via a gravity flow canal to the western portion of the Grand Prairie region, which includes the Plum Bayou and Bayou Meto drainage basins. Existing streams and drainage ditches would be used as laterals and distributaries. The Vicksburg District studies involve a review of the previously authorized project to supply White River water via a pumping station at DeValls Bluff, Arkansas, to the eastern portion of the Grand Prairie region by a main canal and several laterals as shown on Plate 2.

9. These studies were done with the cooperation of and in coordination with several Federal, state, and local agencies such as the U. S. Army Corps of Engineers, Little Rock and Memphis Districts; the ASWCC; the Soil Conservation Service; the U. S. Geological Survey; and the University of Arkansas.

PRIOR STUDIES AND REPORTS

10. A list of previous reports on the subject is provided in Table 1.

1/ House Document No. 255, 81st Congress, 1st Session, "White and Arkansas Rivers and Tributaries, Grand Prairie Region, Arkansas." July 1949.

TABLE 1

REPORTS ON THE GRAND PRAIRIE REGION

1. "Review of Reports, Grand Prairie Region and Bayou Meto Basin, Arkansas," Corps of Engineers, Vicksburg District, July 1948.

2. House Document No. 255, 81st Congress, 1st Session, "White and Arkansas Rivers and Tributaries, Grand Prairie Region, Arkansas," July 1949.

3. House Document No. 308, 88th Congress, 2d Session, "Mississippi River and Tributaries, Grand Prairie Region and Bayou Meto Basin, Arkansas," Annex P, October 1959.

4. "Hydrogeology of a Part of the Grand Prairie Region, Arkansas," U. S. Geological Survey Water Supply Paper 1615-B, Department of the Interior, Washington, D. C., 1964.

5. "Lower Mississippi Region Comprehensive Study," Appendix F, Land Resources, 1974.

6. "Final Watershed Plan and Environmental Impact Statement, Plum Bayou Watershed, Flat Bayou Portion," U. S. Department of Agriculture, Soil Conservation Service, Little Rock, AR, 1981.

7. "Assessment of Arkansas River Water Quality and Potential Quantities Required for Irrigation in the Bayou Meto Basin," R. C. Peralta and P. W. Dutram, Agricultural Engineering Department, University of Arkansas, Fayetteville, AR, September 1982.

8. "Potential Use of Arkansas River Water for Irrigation in the Plum Bayou Watershed." R. C. Peralta and P. W. Dutram, Agricultural Engineering Department, University of Arkansas, Fayetteville, AR, February 1983.

9. "A Survey of Soils Irrigated with Arkansas River Water," J. T. Gilmour, H. D. Scott and R. E. Baser, Publication No. 96, Arkansas Water Resources Research Center, University of Arkansas, Fayetteville, AR, March 1983.

10. "Estimated Potential Water Needs for the Eastern Grand Prairie Region by Irrigation Scheduling," R. C. Peralta and P. W. Dutram, Agricultural Engineering Department, University of Arkansas, Fayetteville, AR, December 1983.

11. "Using Target Levels to Develop a Sustained Yield Pumping Strategy in Arkansas, a Riparian Rights State," Richard C. Peralta and Ann W. Peralta, Appendix to the State Water Plan, May 1984.

12. "Paper No. 5021 - Optimizing Conjunctive Use Under Sustained Yield Constraints," R. C. Peralta, P. Killian, and W. D. Dixon, American Society of Agricultural Engineers, St. Joseph, Michigan, June 1984.

DESCRIPTION OF THE STUDY AREA

11. This section of the report describes the study area and the existing conditions.

STUDY AREA

12. The study area is located in the east-central portion of the State of Arkansas in Prairie, Monroe, and Arkansas Counties and is shown on Plate 2. For purposes of this report it is bounded on the west by the Bayou Meto Basin, by the White River on the east, by Highway 70 to the north, and the Arkansas River on the south.

WATER QUALITY AND AVAILABILITY

13. To evaluate and determine the quality of the waters which may potentially be required for irrigation, past and present water quality data were collected in the project area so a comparison could be made between the data collected and the established water quality criteria. The data were retrieved from the water quality control information system known as Storet. A list of the stations sampled with the period of record is contained in Table 2.

TABLE 2
INFORMATION ON SITE LOCATIONS

Site No.	Description of Locations	Period of Record: Beginning Date	Period of Record: Ending Date
	White River at:		
28	DeValls Bluff, AR	74/04/03	82/09/14 a/
29	Charendon, AR	71/10/21	82/11/02 a/
30	St. Charles, AR	77/09/07	82/08/23 a/
31	St. Charles, AR	74/05/15	83/09/06 a/

a/ Period of record is approximate.

14. For evaluating the suitability of water for irrigation, the following parameters were analyzed: conductance, sodium absorption ratio, chloride, sulfate, bicarbonate, alkalinity, pH, and heavy metal content. Water quality standards for each of these parameters were compiled by Peralta and Dutram 2/ as shown in Table 3 with a summary of the results shown in Table 4. The following classifications were paraphrased from the Department of Agriculture Handbook 60:

2/ R. C. Peralta and P. W. Dutram, "Assessments of Arkansas River Water Quality and Potential Quantities Required for Irrigation in the Bayou Meto Basin," Agricultural Engineering Department, University of Arkansas, September 1982.

TABLE 3
WATER QUALITY STANDARDS

Parameter	Salinity			
	Low	Medium	High	Very High
Conductivity a/ (EC X 10^6) (micromhos/cm)	< 250	250 - 750	750 - 2,250	> 2,250
Sodium adsorption ratio a/ (SAR)	< 6	6 - 10	10 - 18	> 18
Chloride b/ c/				
(meg/l)	< 5	5 - 10	> 10	
(mg/l)	< 177	177 - 355	> 355	
Sulfate c/				
(meg/l)	< 10	10 - 20	> 20	
(mg/l)	< 480	480 - 961	> 961	
Bicarbonates d/ (HC_3)				
(meg/l)	< 3		> 3	
(mg/l)	< 183		> 183	
Alkalinity d/ ($CACO_3$)				
(meg/l)	< 3		> 3	
(mg/l)	< 150		> 150	
pH e/	< 8.5		> 8.5	
Heavy Metals f/ *				
(mg/l)	< 10		> 10	

* Al + As + Ba + Cd + Cr + Cu + Fe + Pb + Li + Mn + Hg + Mo + Ni + Ag + U + Zn

a/ U. S. Salinity Laboratory Staff, 1954. Diagnosis and Improvement of Saline and Alkali Soils. USDA Handbook 60.

b/ H. J. Harper and O. E. Stout, Salt Accumulation in Irrigation Soils. Oklahoma Agricultural Experiment Station, Bulletin No. B-360 (October 1950).

c/ Anon, Water Resources of California. California State Water Resources Board, Bulletin No. 1 (1951).

d/ Personal communication, John T. Gilmour, University of Arkansas, Fayetteville, AR.

e/ J. E. McKee and H. W. Wolf (ed.). Water Quality Criteria. California State Water Quality Control Board Publication No. 3-A (1963).

f/ R. F. Gondey, Developing Standards for the Protection of Groundwater. Journal A.W.W.A. 39, 1010 (1947).

TABLE 4
SUMMARY OF RESULTS

Parameter	White River
Conductivity	low
Sodium Adsorption	low
Chloride	low
Sulfate	low
Bicarbonate	low
Alkalinity	good
pH	good
Heavy metals	low

a. Low conductance or salinity water (< 250 mmhos/cm, cl) can be used for irrigation with most crops on most soils.

b. Low sodium absorption ratio (< 6) can be used for irrigation with most crops on most soils.

c. Low chlorides and sulfates are excellent to good and suitable for most plants and soils.

d. Low bicarbonate concentrations are considered good for irrigation purposes.

e. Alkalinity as $CaCO_3$ at concentrations less than 150 mg/l is also considered good for irrigation purposes.

f. pH level between 6.0 and 8.5 is considered good to prevent harmful effects.

g. Heavy metal content of less than 10 mg/l is considered satisfactory.

15. By comparing Tables 3 and 4, it can be seen that the White River water is normally suitable as a source for irrigation water. During a "dry year," below normal rainfall, salinity is often high during a large portion of the growing season. For example, in 1980 the state experienced its worst drought in 25 years, and the average conductivity values during this period jumped from low to medium.

16. In 1980 the riverflow rates were extremely low and barely sufficient to maintain navigation on the river. Presently, the Memphis District, Corps of Engineers, is trying to maintain a 5-foot navigation channel in the White River along the reach including DeValls Bluff. During some years, the White River will provide adequate water for both navigational needs and for the maximum potential water demand scenario for irrigation, but in other years, inadequate runoff during the irrigation season will provide conflicts between irrigational and navigational needs.

17. Several studies presently in the active status for this area are the Eastern Arkansas Region Comprehensive Study, the White River Navigation Project, and the White River, Arkansas and Missouri, Authorized Report (the constructon of four reservoirs for water supply and navigation).

TOPOGRAPHY

18. Somewhat more than one-half of the Grand Prairie region lies on a wide ridge or terrace that was once a part of the flood plain of the Mississippi and Arkansas Rivers. This terrace extends in a southeasterly direction from the foothills of the Ozark Mountains for a distance of about 75 miles. It lies between the White River on the east and Bayou Meto on the west and is about 25 miles wide at the widest point. The terrace rises some 30 to 60 feet above the present flood plain of the White River and 10 to 30 feet above that of the Arkansas River and Bayou Meto. The land surface is generally flat to undulating with an average elevation of about 235 feet, National Geodetic Vertical Datum (NGVD), in the northwest corner and sloping to about 180 feet, NGVD, at the southeastern extremity. Along the eastern boundary, tributary streams in their descent to the White River have eroded deep and narrow valleys. Streams to the west have far less slope and their valleys are not so pronounced. This terrace land, most of which is cleared, contains the principal rice growing area of the Grand Prairie region.

GEOLOGY

19. The region is underlain by Pleistocene alluvium consisting of clay, sands, and gravels, which range from 85 feet to nearly 200 feet in thickness. The materials are not uniformly deposited but, in general, vary from fine clays near the surface to water-bearing sands and gravels at the base. The water-bearing strata are the source of all the shallow-well ground supply of irrigation water in the Grand Prairie region. Prior to heavy pumping of water from these sands the water was confined under artesian pressure by the overlying clays. At present, a free water table exists over most of the region as a result of pumping in excess of the recharge inflow. Above the Pleistocene sands lie thick strata of impervious clays, sands and silt, consisting partly of Recent alluvium and partly deposits of Pleistocene origin. The impervious clays (hard-pan) prevent inflow of surface water into the Pleistocene sands, except that a limited inflow along the White River and perhaps along the lower reaches of Bayou Meto is indicated by records of water levels in the shallow wells. The Pleistocene formations rest unconformably on sediments of Tertiary age. Water-bearing horizons within the Tertiary sediments are tapped by the deep wells at depths ranging from 450 to 1,200 feet.

CLIMATOLOGY

Temperature

20. The Grand Prairie region has a humid, subtropical climate with long, warm summers and short, moderately cold winters. The mean annual temperature is 61 degrees F at Stuttgart, with a mean of 76 degrees F for the months of May

through September. Snowfall is generally light and usually melts in a few days. The ground seldom freezes to a depth greater than 2 inches.

Precipitation

21. The distribution of rainfall is fairly uniform over the region, with an average annual total of approximately 48.7 inches with 17.9 inches occurring from May through September. A breakdown for the irrigation season is as follows:

May	- 4.3 inches
June	- 3.2 inches
July	- 3.6 inches
August	- 3.1 inches
September	- 3.7 inches

Evaporation

22. An evaporation station has been maintained by the Rice Experiment Station near Stuttgart since 1929. These records indicate that the average annual evaporation from reservoirs and other water surfaces is about 37.4 inches with 23.3 inches occurring from May through September. It should be noted that the average evaporation exceeds the average rainfall for the months of May through September by 5.4 inches.

ENVIRONMENTAL CONSIDERATIONS 3/

23. The Grand Prairie region is unique within the State of Arkansas. Aside from its value to agriculture, the region contains natural lakes, bayous, manmade lakes, both large and small drainage ditches, irrigation reservoirs, fishing reservoirs, large acreages of water devoted to aquaculture, large acreages of seasonally flooded reservoirs for duck hunting, and the large (37,000 acres) Bayou Meto Wildlife Management Area. Primary crops are rice, soybeans, wheat, and corn. Cotton is diminishing in importance as well as acreage. This diversity of land use provides diverse habitats for all forms of wildlife, particularly waterfowl, shorebirds, fur bearers, and both sport and commercial species of fish. Endangered and threatened species such as the American alligator and the bald eagle, both with water-dependent life stages, do well in these habitats.

24. Terrestrial vegetation consists mainly of remnants of the once prevalent bottom-land hardwood forest of which only two large tracts, the Bayou Meto Wildlife Management Area and the White River National Wildlife Refuge, remain. Small remnants along some of the natural waterways have survived.

3/ "Irrigation Water Supply Study, Western Grand Prairie," Corps of Engineers, Little Rock District, 1984.

Much of the disturbed area is now covered with willows, sweetgum, cottonwoods, and numerous smaller shrubs. The sloughs and shallow water bodies contain willows, bald cypress, tupelo gum, buttonbush, and a variety of aquatic vegatation.

25. Fish life in the natural waterways includes catfish, largemouth bass, white crappie, several species of sunfish, bowfin, carp, buffalo, gar, and numerous species of native minnows. Species propogated for financial gain in the aquaculture industry include catfish, golden shiners, fatheads, grass carp (white amur), and some game fish such as crappie.

26. Game species of wildlife include squirrels, rabbits, deer, turkey, bob-white quail, mourning dove, and fur-bearing species such as raccoon, mink, muskrat beaver, and others. Both sport and commercial waterfowl hunting is well established in this region, with the Stuttgart area touted as a duck hunting capitol. Frog hunting is a favorite seasonal sport.

27. Commercial fishing for catfish, buffalo, carp, and gar provides employ-ment for individuals in the region. Most of this fishing is done on the Arkansas and White Rivers and their associated flood plain lakes.

28. There are many acres of wetlands, both natural and created, in the Grand Prairie region. The nature of the land use is such that minor fluctuations in acreage occur yearly, but the trend is toward a gradual increase in acreage.

29. Prime farmlands abound in the region. The only lands not considered prime are used for urban and built-up areas, are too steep to be considered prime, or experience excessive flooding during the growing season. Surface water quality is considered to be a problem in the region. Water quantities range from a deluge of water in the spring and early summer, most of which is highly turbid, to a scarcity of water in midsummer when water in the streams consists of water drained from rice fields. This "rice water" is clear and is of a higher quality than the waters in the early spring. Turbidity and sedi-mentation are problems associated with the current land uses.

PROBLEM IDENTIFICATION, PLANNING OBJECTIVES, AND CONSTRAINTS

PROBLEM IDENTIFICATION

30. Over the past 20 years, total water use, particularly ground-water use, in eastern Arkansas has increased dramatically. The economy is based almost exclusively on agriculture. Agricultural production in turn is dependent on the availability of large quantities of ground and surface water for irriga-tion of rice, wheat, and soybeans. This, coupled with withdrawals due to increases in population and greater recreational, industrial, and aquacultural water demands, has resulted in a decline of the region's water table. Water use for 1981 is shown in Table 5. Large quantities of water are pumped each year from the Mississippi River alluvial aquifer or quaternary aquifer to meet these needs. Withdrawals from the aquifer have increased from 1 million gallons per day (mgd) in 1960 to 4.6 mgd in 1980. Declining water levels,

TABLE 5
WATER USE FOR ARKANSAS, PRAIRIE, AND MONROE COUNTIES
1981 a/

County	Total Use (mgd)	Irrigation mgd	Irrigation Percent	Aquaculture (mgd)	Irrigation and Aquaculture (% of total)
Arkansas	408	379.57	93.0	23.88	98.9
Prairie	252	203.29	80.7	46.26	99.0
Monroe	187	152.72	81.7	32.88	99.3

a/ "Water Use in Arkansas, 1981," Water Resources Investigations Report No. 84-4070, Department of the Interior, U. S. Geological Survey, 1984.

coupled with shortages of surface water during the crop season, have resulted in significant crop losses and severe financial hardships for area farmers and businesses. If current trends continue, the alluvial aquifer will continue to be dewatered in these areas reducing the saturated thickness to a level which can no longer sustain the needs of the area.

PLANNING OBJECTIVES

31. The major objective of this analysis is to estimate the volume of ground and surface water which can be used conjunctively to satisfy the maximum potential agricultural irrigation needs as estimated by Dr. Richard Peralta in his report, "Estimated Potential Water Needs for the Eastern Grand Prairie Region by Irrigation Scheduling." The authorized plan calls for a pumping plant at DeValls Bluff to pump water from the White River. The water would be pumped into a main canal and would flow by gravity to lateral canals, as shown on Plate 2. A siphon will be needed to pass the canal flow under LaGrue Bayou where the two intersect.

PLANNING CONSTRAINTS

32. Planning constraints which have been recognized during the course of this study include the following:

a. This report is limited in scope to the area designated as the Eastern Grand Prairie Region and more specifically the currently authorized Grand Prairie project.

b. The ASWCC wanted the analysis based on the potential water needs as derived by Dr. Peralta for the State of Arkansas.

c. Reservoirs, whether private, state or Federally owned, are not included in the calculations for the amount of water available for irrigation. Only water from the White River is used.

d. Since this report deals only with the amount of water needed for irrigation and not the amount of water available from the White River and other sources, more in-depth studies would have to be conducted.

e. No consideration was given to transporting irrigation water from the canal or laterals to each individual user. It is assumed that some additional ditch network will be required to allow irrigation water to enter all desired areas. A gated control structure will be needed at the inlet to these ditches to regulate water coming from the water supply canals.

f. The canal system crosses numerous natural streams and ditches, some of which carry significant flows. Future studies should address solutions to blocked drainage problems and ways to pass irrigation flows around these natural streams.

FORMULATION AND REEVALUATION OF AUTHORIZED PLAN

POTENTIAL IRRIGATION DEMAND

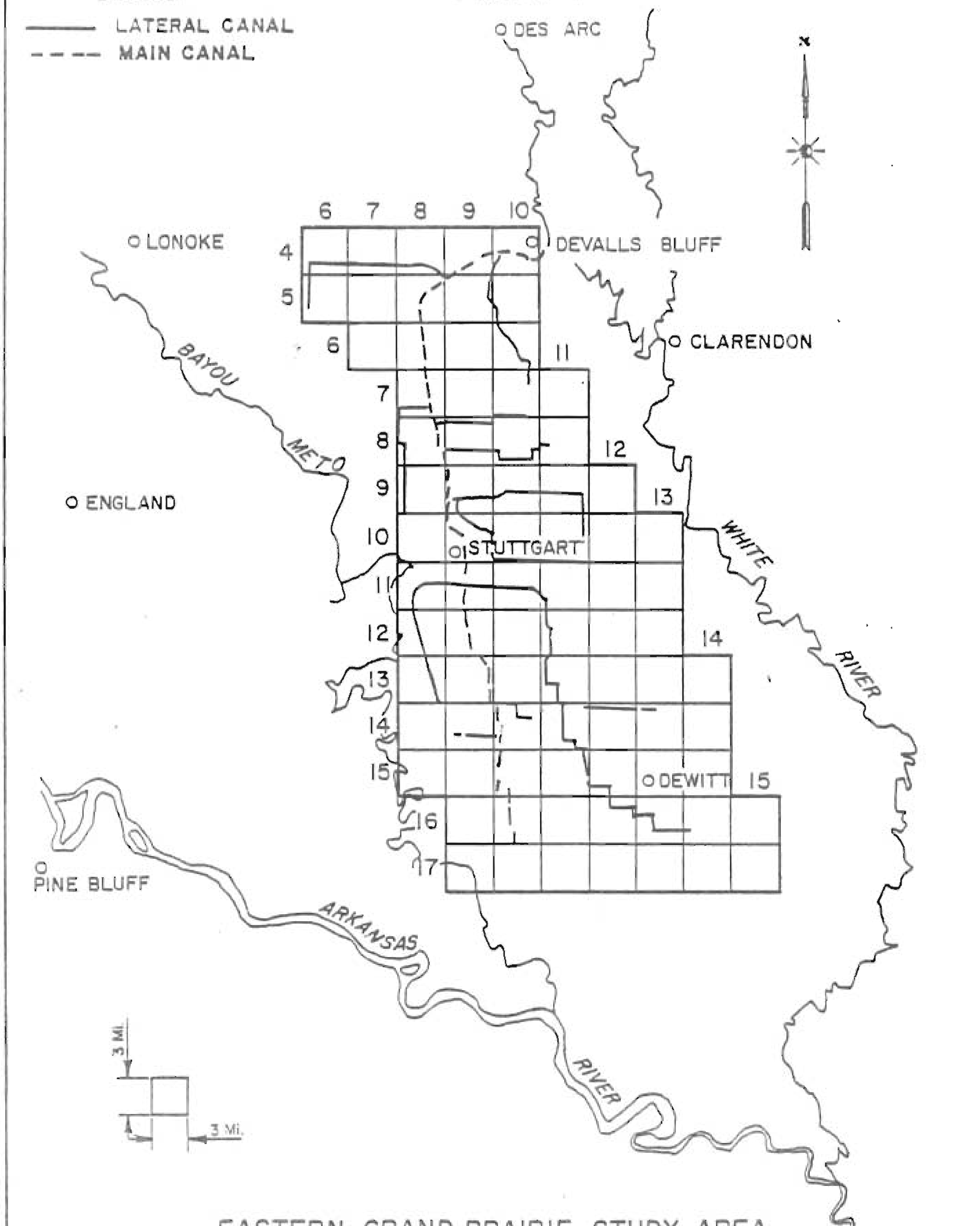
33. The authorized project calls for the building of a pumping plant at DeValls Bluff on a loop of the White River which has been cut off by the main stream but which is still connected thereto at both the upper and lower ends of the loop. This station would have a total capacity of 2,750 cfs and would be comprised of a number of smaller pump sizes. The water would be pumped into a main canal and would flow by gravity to lateral canals.

34. To estimate the irrigation water needs for the study area, a 3- by 3-mile grid system was established by the Agricultural Engineering Department, University of Arkansas, Fayetteville. 4/ (See Figures 1 and 2) The potential crop usage of each 3-mile square was determined based on soil designations from the 1977 Arkansas Resource Data Information System (RIDS) study and crop recommendations from the Soil Conservation Service's county soil surveys. 5/ The water supply canal network was designed based on the required irrigation needs of the area plus an estimate of losses which were assumed to be 15 percent of the total flow (see Table 6). This would require a pumping plant with a capacity of 5,370 cfs. Location of the main canal and each lateral was based on servicing the largest possible area. Each lateral terminates at a nature stream enabling all excess flows to evacuate the system. In general, the project investigated for this report would be much larger than the presently authorized Grand Prairie irrigation project.

4/ "Project Completion Report - Grand Prairie Water Supply Project - Phase I," R. C. Peralta and R. V. Arce, Agricultural Engineering Department, University of Arkansas, Fayetteville, Arkansas, 1983.

5/ "Estimated Potential Water Needs for the Eastern Grand Prairie Region by Irrigation Scheduling," R. C. Peralta and P. W. Dutram, Agricultural Engineering Department, University of Arkansas, Fayetteville, Arkansas, December 1983.

FIGURE 1



EASTERN GRAND PRAIRIE STUDY AREA

FIGURE 2

I \ J	6	7	8	9	10	11	12	13	14	15
4	NO. 2	NO. 2	NO. 2	MAIN	MAIN					
5	NO. 2A	NO. 2A	MAIN	MAIN	NO. 1					
6		NO. 2	MAIN	MAIN	NO. 1					
7			NO. 3	NO. 4	NO. 4	NO. 1				
8			NO. 3	NO. 5	NO. 5	NO. 5				
9			NO. 3	NO. 6	NO. 6	NO. 6	NO. 6			
10			NO. 3	MAIN	NO. 6A	NO. 6A	NO. 6	NO. 1		
11			NO. 7	NO. 7	NO. 9	NO. 9	NO. 6A	NO. 1		
12			NO. 7	MAIN	MAIN	NO. 9	NO. 6A	NO. 1		
13			NO. 7	NO. 7	NO. 8A	NO. 9	NO. 6A	NO. 10	NO. 1	
14				NO. 11	MAIN	NO. 8A	NO. 6A	NO. 6A	NO. 1	
15				NO. 11	MAIN	NO. 8A	NO. 9	NO. 9	NO. 1	
16					MAIN	NO. 8A		NO. 9	NO. 9	NO. 1
17					MAIN			NO. 9	NO. 9	NO. 1

MAIN AND LATERAL CANALS SUPPLYING WATER TO EACH 3 MILE BY 3 MILE CELL.

TABLE 6
IRRIGATION DEMANDS a/

Name	Accumultive Demand Acre-Feet per Week	Accumultive Demand cfs per Day	Accumulative Loss (cfs per Day)	Accumulative Total Demand (cfs per Day)
Main Canal	64,845	4,669	700	5,369
Lateral #1	4,198	302	45	347
Lateral #2	4,035	291	44	335
Lateral #2A	1,877	135	20	155
Lateral #3	3,753	270	41	311
Lateral #4	1,591	115	17	132
Lateral #5	3,016	217	33	250
Lateral #6	12,966	934	140	1,074
Lateral #6A	8,302	598	90	688
Lateral #7	5,276	380	57	437
Lateral #8A	4,753	342	51	393
Lateral #9	10,223	736	110	846
Lateral #10	1,025	74	11	85
Lateral #11	2,370	171	26	197

a/ Based on the peak weekly potential irrigation water needs from Dr. Peralta's report, "Estimated Potential Water Needs for the Eastern Grand Prairie Region by Irrigation Scheduling."

CANAL SIZE CALCULATIONS

35. The canal system originates at the pumping plant and extends as a concrete flume for approximately 3,300 feet. Downstream from this point, it is a canal with a trapezoidal cross section. Through most of the system, levees are necessary to confine the flow. It is assumed that levee grades will provide a 2-foot freeboard over the maximum computed water surface. At the headworks, the canal has a capacity of 5,370 cfs. Table 7 contains the general design information on the water supply canals. Beginning at mile 3.55, laterals intercept the main canal as necessary to supply the area with required water. Hence, the size of the main canal and each lateral is reduced in size in accordance with the decrease in flow as you descend downstream. Water is delivered into each lateral by way of a gated control structure to allow complete regulation for flows up to its design capacity. At the outlet to each lateral, a minimum gated control structure was designed to allow drainage of each lateral and to prevent any water in the laterals from entering the natural stream into which each one was tied, if desired. Where the water supply canals cross natural streams, a siphon or some type of gated control structure will be needed. A list of the structures and pumps required is shown on Table 8.

TABLE 7

GENERAL DESIGN INFORMATION ON CANAL SYSTEM

Item	Amount
General	
Area to be served (acres)	426,240+
Maximum quantity of water available for irrigation (cfs)	4,670
Capacity of pumping plant (cfs)	5,370
Main Canal	
Length (miles)	45.8
Capacity at intake (cfs)	5,370
Water surface at intake (feet, NGVD)	226.5
Average slope (feet per mile)	0.22
Freeboard (feet)	2
Bottom width (feet)	15 to 135
Mean velocity (feet per second)	2.7
Concrete siphons (number)	1
Drop structures (number)	3
Gated controls to distribution system (number)	12
Maximum depth of water (feet)	16.5
Channel side slope	1V on 2H
Levee side slope	1V on 3H
Lands required (acres)	1,228
Laterals	
Length (miles)	114.8
Capacity at inlet (cfs)	85 to 1,075
Control structures (number)	11
Drop chutes (number)	9
Pumps (number)	2
Freeboard (feet)	2
Bottom width (feet)	2 to 40
Average slope (feet per mile)	0.11 to 0.29
Maximum depth of water (feet)	6.0 to 16.1
Channel side slope	1V on 2H
Levee side slope	1V on 3H
Lands required (acres)	1,565

TABLE 8

REQUIRED STRUCTURES AND PUMPS

Name	Mileage	Type	Quantity and Size
Main Canal	0.00	Pump	One 5,370-cfs
	10.10	Siphon	10 feet high by 90 feet wide
	30.65	Drop structure	7-foot drop
	38.65	Drop structure	8-foot drop
	45.65	Drop structure	8-foot drop
	47.20	Gated box structure	One 6- by 6-foot
Lateral #1	0.00	Gated culvert	Two 60-inch CMP
	5.00	Drop structure	6-foot drop
	8.50	Drop structure	6.5-foot drop
	9.25	Gated culvert	One 60-inch CMP
Lateral #2	0.00	Gated culvert	Two 60-inch CMP
	10.45	Gated culvert	One 60-inch CMP
Lateral #2A	0.00	Gated culvert	Two 54-inch CMP
	3.55	Gated culvert	One 42-inch CMP
Lateral #3	0.00	Gated Culvert	Three 60-inch CMP
	6.00	Drop structure	6.5-foot drop
	8.00	Drop structure	6.5-foot drop
	12.03	Gated culvert	One 60-inch CMP
Lateral #4	0.00	Gated culvert	One 54-inch CMP
	5.40	Gated culvert	One 42-inch GMP
Lateral #5	0.00	Gated culvert	Three 66-inch CMP
	8.00	Gated culvert	One 60-inch CMP
Lateral #6	0.00	Gated box structure	Three 8- by 8-foot
	11.90	Gated culvert	Three 60-inch CMP
Lateral 6A	0.00	Gated box structure	Two 7- by 8-foot
	7.50	Gated culvert	Two 60-inch CMP
Lateral #7	0.00	Gated box structure	Two 6- by 6-foot
	1.50	Drop structure	6.4-foot drop
	2.50	Drop structure	6.4-foot drop
	10.20	Gated culvert	One 60-inch CMP
Lateral #8A	0.00	Gated box structure	Two 7- by 7-foot
	2.50	Drop structure	7.5-foot drop
	3.15	Gated culvert	One 60-inch CMP

TABLE 8 (Cont)

Name	Mileage	Type	Quantity and Size
Lateral #9	0.00	Gated box structure	Three 8- by 8-foot
	4.50	Drop structure	4-foot drop
	13.00	Drop structure	4-foot drop
	28.00	Gated culvert	Three 60-inch CMP
Lateral #10	0.00	Pump	One 85-cfs
Lateral #11	0.00	Pump	One 200-cfs

36. The land required for the main canal and each lateral was held to a minimum while channel grades were kept flat so that velocities would be low enough to prevent erosion from occurring. By combining various channel bottom widths and overbank flow widths, canal thalwegs were then established. Where needed, drop structures were located to keep the ground elevations above the channel thalwegs. Some assumptions made and used include: Mannings' "n" value for channels was 0.035 and for overbank flow was 0.075; vertical distance between the upstream and downstream thalwegs at any drop structure was limited to a maximum of 8 feet; and the channel grade was kept around 0.2 foot per mile. Required land acreages, channel excavation, and levee fill quantities are shown in Table 9.

TABLE 9
REQUIRED LAND ACREAGES, CHANNEL EXCAVATION,
AND LEVEE FILL QUANTITIES

Name	Required Land a/	Channel Excavation	Levee Fill b/
	(acres)	(cubic yards)	(cubic yards)
Main Canal	1,228	8,681,189	2,829,584
Lateral #1	113	637,087	187,790
Lateral #2	110	1,562,596	22,525
Lateral #2A	32	477,890	0
Lateral #3	120	1,321,958	49,577
Lateral #4	55	123,554	125,029
Lateral #5	92	145,660	231,601
Lateral #6	149	900,923	110,765
Lateral #6A	135	769,206	220,795
Lateral #7	156	534,677	723,375
Lateral #8A	55	49,862	211,334
Lateral #9	492	2,420,246	699,395
Lateral #10	16	59,253	20,150
Lateral #11	40	21,349	163,363
Total	2,793	17,705,450	5,595,283

a/ Between landside toes of levees.
b/ Assumes 2 feet of freeboard.

COST DATA

37. The following tabulation shows a summary of costs and economic benefits for this plan based on a ±25 percent contingency and the current Federal interest rate of 8-1/8 percent.

Summary of Costs

Required structures and pumps (Table 8)	$78,617,580.00	
Contingency at ±25%	19,654,420.00	
Subtotal	$98,272,000.00	
Required land acreages, channel excavation, and levee fill quantities (Table 9)	$21,667,371.00	
Contingency at ±25%	5,416,829.00	
Subtotal	$27,084,200.00	
TOTAL COST		$125,356,200.00

Summary of Economic Benefits

Weighted average productivity per acre (Future with project) (Tables 10 and 11)	$156.41 a/
Weighted average productivity per acre (Future without project) (Tables 12 and 13)	85.08
Weighted average benefit per acre	$ 71.33

Annual benefit
426,240 acres (Table 7) X $71.33 = $ 30,403,699.20

Annual benefit/interest rate = $363,029,244.20

Annual cost - over 10-year period = $ 12,535,620.00

Benefit-cost ratio - 2.43

a/ Based on with-project benefits calculated from distribution of crops found in "Estimated Potential Water Needs for the Eastern Grand Prairie Region by Irrigation Scheduling," by R. C. Peralta and P. W. Dutram, December 1983.

TABLE 10
WATER SUPPLY DISTRICT
NET RETURNS TO CROPLAND
GRAND PRAIRIE, ARKANSAS
(PROJECTED WITH PROJECT)
(Current Normalized prices - 1983 Price Levels)

Crop	Yield	Unit Price	Crop Value	Distribution	Weighted Cost
		($)	($)	(%)	($)
Cotton					
lint lbs	675	0.74	499.50	0	0
Corn					
bu	50	0	0	0	0
Rice					
cwt	52	11.15	579.80	46	266.71
Soybeans					
bu	35	6.87	240.45	48	115.42
Wheat					
bu	35	3.88	135.80	6	8.15
Pasture					
lbs beef	340	69.46	236.16	0	0
Idle				0	0
Other				0	0
Total				100	
Weighted crop value per acre					390.28
Less weighted crop cost per acre				233.87	
Weighted net return					156.41

TABLE 11
COST OF PRODUCTION
GRAND PRAIRIE, ARKANSAS
(WITH PROJECT)

Crop	Yield	Cost of Production a/	Distribution	Weighted Cost
		($)	(%)	($)
Cotton lint lbs	675	0	0	0
Corn bu	50	0	0	0
Rice cwt	52	356.48	46	163.98
Soybeans bu	35	131.68	48	63.21
Wheat bu	35	111.38	6	6.68
Pasture lbs beef	340		0	0
Idle			0	0
Other			0	0
Total			100	233.87

a/ Updated to 1983 price levels using "prices paid farmers." Economic Indicators, Council of Economic Advisors.

TABLE 12
WATER SUPPLY PROJECT
NET RETURNS TO CROPLAND
GRAND PRAIRIE, ARKANSAS
(PROJECTED WITHOUT PROJECT)

Crop	Yield	Unit Price a/	Crop Value	Distribution	Weighted Value
		($)	($)	(%)	($)
Cotton					
lint lbs	465	0.74	344.10	2	6.89
Corn					
bu	0	0	0	0	0
Rice					
cwt	52	11.15	579.80	10	57.98
Soybeans					
bu	25	6.87	171.75	20	34.35
Wheat					
bu	23	3.88	89.24	10	8.92
Pasture					
lbs beef	260	69.46	180.60	44	79.46
Idle				10	0
Other				4	0
Total				100	
Weighted crop value per acre					187.60
Less weighted crop cost of production					102.52
Weighted net return					85.08

a/ Current normalized prices. 1983 price levels.

TABLE 13
COST OF PRODUCTION
GRAND PRAIRIE, ARKANSAS
(WITHOUT PROJECT)

Crop	Yield	Cost of Production a/	Distribution	Weighted Cost
		($)	(%)	($)
Cotton lint lbs	465	295.10	2	5.90
Corn bu	0	0	0	0
Rice cwt	52	356.48	10	35.65
Soybeans bu	25	98.05	20	19.61
Wheat bu	23	73.34	10	7.33
Pasture lbs beef	260	77.33	44	34.03
Idle			10	0
Other			4	0
Total			100	102.52

a/ Updated to 1983 price levels using "prices paid farmers." Economic Indicators, Council of Economic Advisors.

CONCLUSION

38. This report was based on Dr. Peralta's study on the Eastern Grand Prairie Region using the irrigation needs for the maximum potential water demand scenario. Available water sources such as private- and government-owned reservoirs, and private wells were not taken into consideration. The maximum need of 5,370 cfs at DeValls Bluff pumping plant could be reduced when these are taken into account.

39. Based on the benefit-cost ratio, the project is economically feasible. Further studies will be needed to determine whether or not the project can be successfully implemented.

40. In general, the project investigated for this report would be much larger than the presently authorized Grand Prairie irrigation project; i.e., pump plant size and channel size. This would in all likelihood require additional Congressional authorization for Federal construction.

RECOMMENDATIONS

41. It is recommended that any future studies made be coordinated with the persons and agencies working on the following: White River Navigation Project; the White River, Arkansas and Missouri, Authorized Report; and the Eastern Arkansas Region Comprehensive Study.

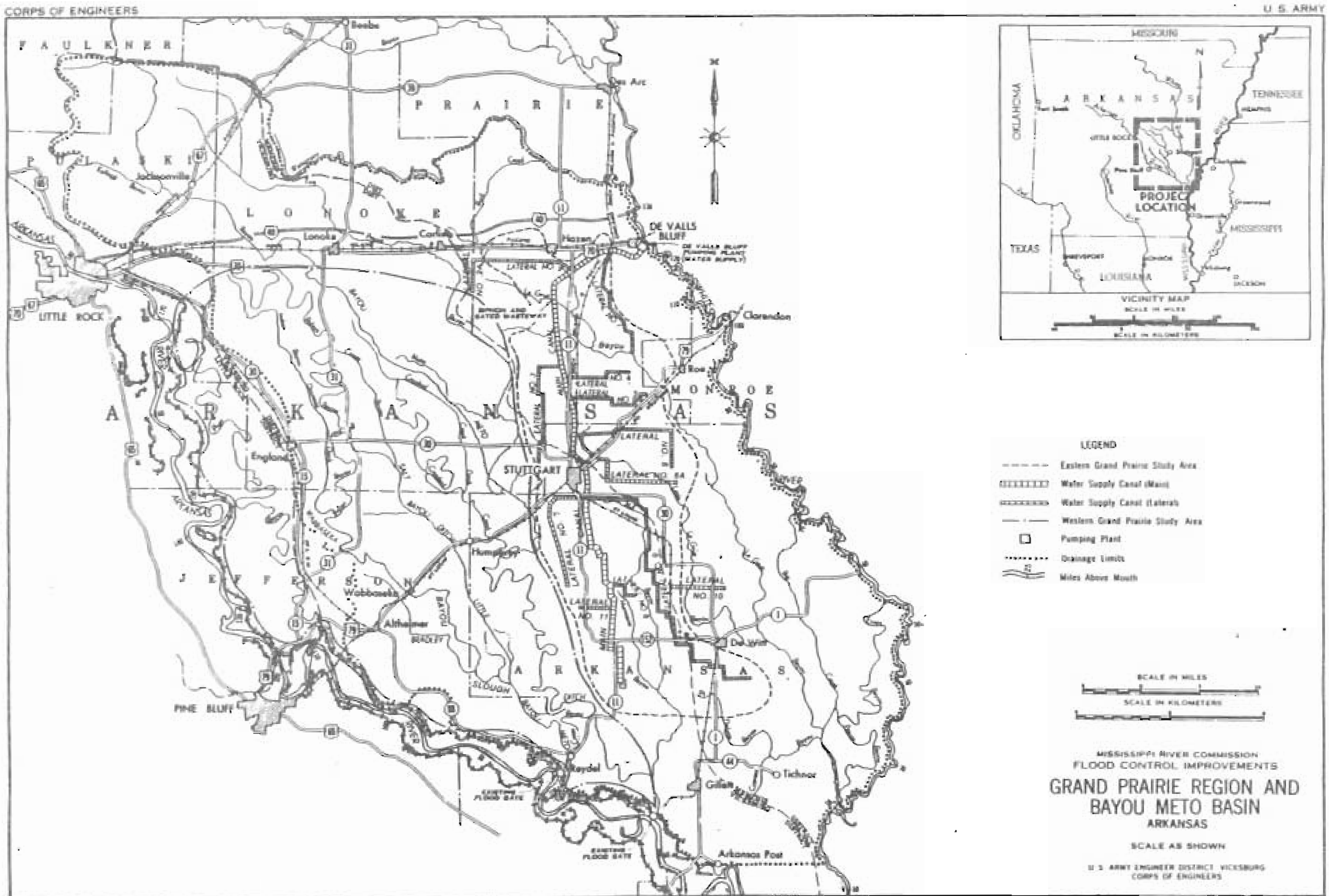
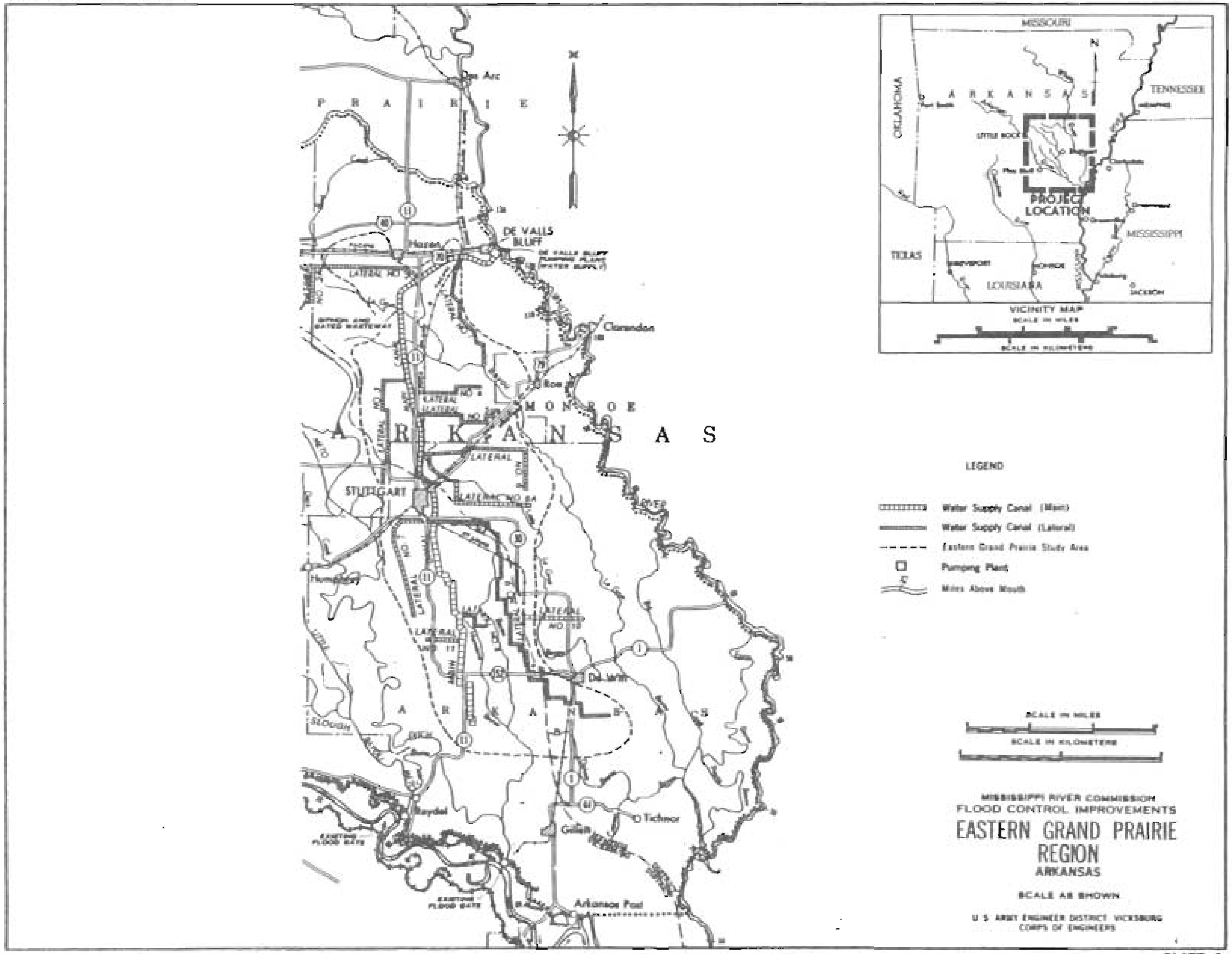

CORPS OF ENGINEERS
U.S. ARMY
FAULKNER
PULASKI
LONOKE
PRAIRIE
MONROE
JEFFERSON
ARKANSAS
Beebe
Des Arc
Jacksonville
Lonoke
Carlisle
Hazen
DE VALLS BLUFF
DE VALLS BLUFF PUMPING PLANT (WATER SUPPLY)
Clarendon
Roe
LITTLE ROCK
England
STUTTGART
Humphrey
Wabbaseka
Altheimer
PINE BLUFF
Reydel
Gillett
Tichnor
Arkansas Post
De Witt
EXISTING FLOOD GATE
LATERAL NO. 84
VICINITY MAP
SCALE IN MILES
SCALE IN KILOMETERS
PROJECT LOCATION
MISSOURI
OKLAHOMA
TENNESSEE
MISSISSIPPI
TEXAS
LOUISIANA
LEGEND
Eastern Grand Prairie Study Area
Water Supply Canal (Main)
Water Supply Canal (Laterals)
Western Grand Prairie Study Area
Pumping Plant
Drainage Limits
Miles Above Mouth
SCALE IN MILES
SCALE IN KILOMETERS
MISSISSIPPI RIVER COMMISSION
FLOOD CONTROL IMPROVEMENTS
GRAND PRAIRIE REGION AND
BAYOU METO BASIN
ARKANSAS
SCALE AS SHOWN
U.S. ARMY ENGINEER DISTRICT, VICKSBURG
CORPS OF ENGINEERS

PLATE 1



MISSISSIPPI RIVER COMMISSION
FLOOD CONTROL IMPROVEMENTS

EASTERN GRAND PRAIRIE REGION
ARKANSAS

SCALE AS SHOWN

U S ARMY ENGINEER DISTRICT VICKSBURG
CORPS OF ENGINEERS

PLATE 2