FINAL

ENVIRONMENTAL IMPACT STATEMENT
(Draft December 1972)

ST. FRANCIS BASIN PROJECT
ARKANSAS AND MISSOURI

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
MEMPHIS DISTRICT
DECEMBER 1973

St. Francis Basin Project,
Arkansas and Missouri

( ) Draft (X) Final Environmental Statement

Responsible Office: U. S. Army Engineer District, Memphis, Tennessee

1. Name of Action: (X) Administrative ( ) Legislative

2. Description of Action: The project is for flood control and drainage improvements and wildlife, fish, and outdoor recreation enhancement via a reservoir in the Ozark foothills in southeast Missouri and channel improvements, levees, control structures, and pumping plants in the alluvial valley in southeast Missouri and northeastern Arkansas. The project is about 41 percent complete. The proposed action is to continue with the construction of the uncompleted features of the project as authorized, continue with the operation and maintenance of the completed features for which the Federal Government has responsibility, and to assume the operation and maintenance of other project features, which are the responsibility of the Federal Government, as they are completed.

3. a. Environmental Impacts: The frequency and duration of flooding will be reduced from headwater sources on about 819,000 acres of croplands and attendant improvements and from Mississippi River backwater sources on about 532,000 acres. Inundation of low portions of such basin communities as Hayti, Missouri, and Blytheville, Lepanto, Marked Tree, and Parkin, Arkansas, will also be reduced. The economic growth of the basin and region and the general standards and quality of life of inhabitants will be improved. Vector problems and health hazards will be reduced. The quality and quantity of outdoor recreation will be increased by developments at Wappapello Lake, by the water supply and sediment control structures at the upstream and downstream ends of Big Lake, the water control structure below St. Francis Lake, and recreational facilities to be installed in conjunction with construction of the W. G. Huxtable Pumping Plant and Floodgates. Mitigation will be provided for fish and wildlife losses.

b. Adverse Environmental Effects: Completion of the project will cause unavoidable adverse environmental impacts consisting of a temporary increase in turbidity in streams and ditches to be altered, reduction in fishery values and disruption of the benthic community in these same channels, impairment of esthetics and loss of wildlife habitat and wind screens through direct removal of vegetation along streams and induced clearing of other vegetative cover, degradation of waterfowl habitat on private lands, loss of woodlands as a direct result of levee construction activities, temporary increases in erosion of channel and spoil banks and resultant downstream silt deposition immediately following construction, potential increases in agricultural pollutants in streams during certain periods, possible damage to historical sites and archaeological resources, and possible temporary disruptions of ambient air quality.

4. Alternatives: The alternatives to the proposed plan considered include:

a. Additional reservoirs.

b. Floodplain management-zoning, flood proofing.

c. Acquisition of fee title or flowage easements on flood prone lands.

d. No action on unconstructed features.

e. Discontinuance of maintenance on completed features.

Alternative "a" was rejected because of ineffectiveness insofar as the major project purpose is concerned. Alternative "b" was rejected because of basin topography and the present degree of development of the alluvial valley and incompatibility. Alternative "c" is not feasible due to prohibitive costs and adverse impacts to the human environment. Alternative "d" was rejected because of the loss of flood control benefits which would occur and the need for installation of features for protection of fish and wildlife resources. Alternative "e" is not feasible due to the fact that realization of benefits from completed works is partially or wholly dependent on continued maintenance.

5. Comments Received:

Arkansas State Archaeologist
Soil Conservation Service, USDA
Missouri Water Resource Board 1/
East Arkansas Planning and Development District
Dunklin County Sportsman Association
National Wildlife Federation
St. Francis Levee District of Arkansas
Little River Drainage District
Department of the Interior
Environmental Protection Agency
Forest Service, USDA
Division of Soil and Water Resources, Arkansas Department of Commerce 1/
Bootheel Regional Planning Commission
Dr. Clark Hubbs
Drainage District No. 17 of Mississippi County, Arkansas

1/ Responsible for coordination with all state agencies.

6. Draft statement to CEQ 18 June 1971.
Revised draft statement to CEQ 7 February 1973.
Final statement to CEQ 11 December 1973.

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ST. FRANCIS BASIN PROJECT, ARKANSAS AND MISSOURI

Environmental Statement

1. Project Description. The development of the basic comprehensive plan for what was in later years to become the St. Francis Basin Project of the Corps of Engineers was started by the people of the basin through an organization known as the St. Francis Valley Drainage Association organized in 1904. This group was concerned with providing interior flood control and drainage following construction of levees along the Mississippi River, for which local levee districts were organized in the early 1890's. In 1906, Mr. S. H. McCrory, drainage engineer, U. S. Department of Agriculture, Office of Experiment Stations, made an examination of the basin and reported that, while several independent drainage districts had been organized, a comprehensive plan for the entire valley would be required before adequate drainage could be secured. The report covering the U. S. Department of Agriculture study was published 20 January 1911 and proposed construction of floodways between levees to carry the St. Francis and Little River waters above the surface of the ground, and for the most part, outside of the channels they occupied, leaving the channels to assist in carrying the local drainage water. The plan adopted provided for diversion of the hill waters of Little River, which includes Castor River, into the Mississippi River at Cape Girardeau, Missouri. Also included in the plan was an extensive system of ditches in the alluvial portion of the Little River basin in Missouri.

The first report on the basin by the Corps of Engineers, House Document No. 159, 71st Congress, Second Session, was published 26 September 1929. By this time, the local people, through their own efforts, had implemented a large part of the 1911 plan by constructing: the headwater diversion system which diverted the flow from 1,150 square miles of the hill land west and northwest of Cape Girardeau, including the upper reaches of Castor River, into the Mississippi River; a system of drainage ditches in the Little River basin dug in direct lines without regard to former channels and including the five parallel ditches running from the latitude of Kennett, Missouri, to the head of Big Lake, near Hornersville, Missouri; levees along the right (west) bank and about half way along the left (east) bank of the St. Francis River from the highlands near Wappapello, Missouri, to the western side of Crowleys Ridge near the town of St. Francis, Arkansas; a partially completed leveed floodway along the river from south of St. Francis town to the foot of St. Francis Lake; a ring levee around the Elk Chute Drainage District, east of Hornersville, Missouri; a leveed floodway along the Right Hand Chute of Little River extending from the state line south of Hornersville to St. Francis Lake, north of Marked Tree, Arkansas; the Sand Slough floodway from the foot of St. Francis Lake to Steep Gut on the St. Francis River, 15 miles below

the St. Francis River, 15 miles below Marked Tree; the Rivervale culvert which passes water under the Right Hand Chute of Little River at Rivervale; a small navigation lock on the St. Francis River near Marked Tree, which was subsequently filled in 1971; and an extensive system of drainage ditches. The extent of their flood control work is shown on Plate 1. (1)*

Data published in Senate Document No. 11, 90th Congress, 1st Session, showed that the local people, through the various levee and drainage districts, had as of that time spent $154,200,000 on construction and maintenance in the St. Francis Basin. A summary of their expenditures by periods is as follows. (2)

Period	Local People Expenditures	Period	Federal Expenditures
Prior to 1917	$18,900,000		
1917 to 1928	51,300,000		
1928 to 1936	25,500,000	Prior to 1962	$39,653,600
1936 to 1965	58,500,000	1962 to 1965	15,318,800
	$154,200,000		$54,972,400

The total Federal expenditure through 30 June 1973 is $94,647,000.

However, their efforts proved inadequate to protect against the interior floods that occurred almost annually. Therefore, the Congress, in the Flood Control Act of 15 June 1936, Public Law 678-74 (based on recommendations in Flood Control Committee Document No. 1, 74th Congress, First Session), authorized construction of levees, channel diversions and channel enlargements for the purpose of controlling headwater flooding in the basin. The Act further provided that, at the discretion of the Chief of Engineers, the basin project could be modified to include a detention reservoir. Construction of this reservoir, Wappapello Lake, was completed in 1941. The 1936 authorization has been modified and expanded by a number of subsequent acts.

The last overall review of the project was published in House Document No. 308, 88th Congress, Second Session. The project, as presently authorized, is shown on Plate 2. The various elements of the authorized project and their current status are presented in Table 1. To summarize, the major features of the project, as now authorized and partially constructed, consist of a detention reservoir at Wappapello, Missouri; a system of leveed floodways along portions of the St. Francis and Little Rivers; levees along the headwater diversion and above Crowleys Ridge; backwater levees in the lower part of the basin with the Huxtable Pumping Plant and floodgates for interior drainage; and an improved drainage system for flood control.

Also included in the project as authorized are certain measures for mitigation of project induced fish and wildlife losses. These measures

*Numbers in parenthesis following a statement in this text are keyed to numbered references in appendix B.

TABLE 1

STATUS OF PROJECT FEATURES
ST. FRANCIS BASIN PROJECT, ARKANSAS AND MISSOURI

No.	General Area, Name	Authorization (FC Act)	Type of Work	Purpose	Status
	OZARK HEADWATER CONTROL				
1	Wappapello Dam	15 Jun 36	Reservoir	Flood Control	Complete 1/
2	Little River Diversion Levees	17 May 50	Levee	Flood Control	Complete 1/
	ST. FRANCIS RIVER: WAPPAPELLO DAM TO CROWLEYS RIDGE				
3	Inter-River Levee (right bank)	15 Jun 36	Levee	Flood Control	Complete
4	St. Francis River, Wappapello to Crowleys Ridge	15 Jun 36	Channel	Flood Control	Under Construction
5	Mingo Ditch	15 Jun 36	Channel	Flood Control	Not Started
6	Dudley Ditch & Lick Creek	15 Jun 36	Channel	Flood Control	Not Started
7	Ditch 12, Missouri	15 Jun 36	Channel	Flood Control	Under Construction
8	Wilhelmina Bendway	15 Jun 36	Dam	Fish and Wildlife	Not Started
	ST. FRANCIS RIVER: CROWLEYS RIDGE TO FOOT OF ST. FRANCIS LAKE				
9	Right & Left Bank Levees	15 Jun 36	Levee	Flood Control	Complete
10	Big Slough & Mayo Ditch	17 May 50	Channel	Flood Control	Complete
11	Locust Creek	27 Oct 65	Channel	Flood Control	Not Started
12	Big Bay Ditch 1	27 Oct 65	Channel	Flood Control	Not Started
13	Tulot Ditch	15 Jun 36	Channel	Flood Control	Complete
14	Varney River	27 Oct 65	Channel	Flood Control	Not Started
15	Cockleburr Slough	27 Oct 65	Channel	Flood Control	Not Started
16	Buffalo Creek Diversion, Upper Buffalo, Honey Cypress, Ditch 12, Arkansas	27 Oct 65	Channel	Flood Control	Not Started

1/ Recreation facilities are being expanded

TABLE 1 (Cont)

STATUS OF PROJECT FEATURES (Contd)

No.	General Area, Name	Authorization (FC Act)	Type of Work	Purpose	Status
	LITTLE RIVER BASIN TO ARKANSAS LINE				
17	Castor River, Ditches 24, 39	17 May 50	Channel	Flood Control	Not Started
18	Ditches 81, 66, 251	17 May 50	Channel	Flood Control	Complete
19	Lower Ditch 1 & Item 1 Upper Ditch 1	17 May 50	Channel	Flood Control	Complete
20	Ditches 281-9, 290 19, 293	17 May 50	Channel	Flood Control	Not Started
21	Elk Chute Ditch	17 May 50	Channel	Flood Control	Complete
22	Belle Fountain & Ditches 9, Main, New Franklin, 1, 2, 6	13 Aug 68	Channel	Flood Control	Not Started
23	Elk Chute Levees	15 Jun 36	Levee	Flood Control	Complete
	LITTLE RIVER FLOODWAY: MO. LINE TO ST. FRANCIS LAKE				
24	Right and Left Bank Levees	15 Jun 36	Levee	Flood Control	Complete
25	State Line & Big Lake Outlet Ditches	17 May 50	Channel	Flood Control	Complete
26	Ditch 81 Extension	17 May 50	Channel	FC & Fish & Wildlife	Under Construction
27	North End Control Structures	27 Oct 65	Gates	Fish and Wildlife	Not Started
28	South End Control Structure	27 Oct 65	Weir	Fish and Wildlife	Complete
29	Floodway Ditches	17 May 50	Channel	Flood Control	Complete
30	Iron Mines Creek & Ditch 59	17 May 50	Channel	Flood Control	Complete

TABLE 1 (Cont)

STATUS OF PROJECT FEATURES (Contd)

No.	General Area, Name	Authorization (FC Act)	Type of Work	Purpose	Status
	ST. FRANCIS FLOODWAY: ST. FRANCIS LAKE TO MISS. RIVER				
31	Right and Left Bank Levees, Oak Donnick Floodway	15 Jun 36	Levee	Flood Control	Complete
32	Right Bank Levee, Oak Donnic Floodway to St. Francis Bay	17 May 50	Levee	Flood Control	Complete
33	Left Bank Levee, Oak Donnick Floodway to L'Anguille Lake	17 May 50	Levee	Flood Control	Complete
34	Left Bank Fuse Plug L'Anguille Lake to Miss. River Levee	17 May 50	Levee	Flood Control	Under Construction
35	Cross County Ditch	18 Aug 41	Channel	Flood Control	Complete
36	Ditches 9 and 10	27 Oct 65	Channel	Flood Control	Under Construction
37	Straight Slough	17 May 50	Channel	Flood Control	Complete
38	Madison Loop Levee and Pumping Station	17 May 50	Levee & Pump	Flood Control	Not Started
39	St. Francis Lake Control Structures	27 Oct 65	Gates	Fish and Wildlife	Under Construction
40	Central Ditch, Oak Donnick Floodway	27 Oct 65	Channel	Flood Control	Not Started
41	Floodway Channels: Wittsburg, Clarks Corner, Madison-Marianna, L"Anguille	17 May 50	Channel	Flood Control	Complete
	ST. FRANCIS INTERIOR PROTECTED AREA: MO. LINE TO HUXTABLE PUMPING STATION				
42	Ditches 21A, 25, 71, 27, 30, 33, 36, 37, Pemiscot Bayou	13 Aug 68	Channel	Flood Control	Not Started
43	Pumping Plant, Drainage District #17	13 Aug 68	Pump	Flood Control	Not Started

Within these options, there are several methods of accomplishment of the objective. Debris can either be buried below natural ground or simply covered with spoil. Chips can be hauled away, spread, buried, or burned. Either open air or forced air burning methods can be utilized. However, any burning will be required to be in conformance with applicable Federal, state, and local laws and regulations. Methods of debris disposal used for individual items of work depend largely on particular site conditions, but the most commonly used technique is burning. Another alternative is to windrow the debris behind spoil areas.

Construction, maintenance and operation of the project as presently planned was estimated in July 1972 to cost $8,976,400 annually ($8,511,200 Federal cost and $465,200 Non-Federal cost), and provide annual benefits of $21,015,900 with a benefit-cost ratio of 2.3 to 1. The project is scheduled for completion in 1986. Benefits are attributed to prevention of flood damages and emergency costs (evacuation and reoccupation) and to increased land use that will accrue to lands in the floodplain and adjacent table lands through improved drainage made possible by the plan of improvement.

2. Environmental Setting Without the Project. The St. Francis basin, located in northeastern Arkansas and southeastern Missouri, is about 215 miles long with a maximum width of 53 miles. The drainage pattern is generally from north to south and the basin encompasses an area of 8,440 square miles or 5,402,000 acres. The two largest tributaries are the Little River Drainage System, which drains an area of about 2,100 square miles, and the L'Anguille River, draining 940 square miles west of Crowleys Ridge. The L'Anguille, although tributary to the St. Francis River, has historically not been considered as a part of the basin project, and is, therefore, not considered a part of the basin in this environmental statement. The Little River Drainage System is a part of the basin project and is covered in this statement. Major topographic features are the Ozark Highlands above Wappapello Lake; Crowleys Ridge running generally in a southerly arc from above Malden, Missouri, to near Helena, Arkansas; the Commerce Hills south of Cape Girardeau, Missouri; and finally, the alluvial valley.

Above Wappapello Lake, the basin consists of 1,310 square miles of the Ozark Highlands. The terrain is rugged with elevations ranging from over 1,500 feet above mean sea level to the elevation of the conservation pool at Wappapello which is 355 feet above mean sea level. The area is largely forested with agricultural activities generally limited to row crops in the stream bottoms and grazing on the gentler slopes.

Crowleys Ridge extends the length of the basin and is crossed by the St. Francis as the river leaves Missouri and flows into Arkansas. This ridge also forms the divide between the St. Francis River and the L'Anguille River watersheds in the lower basin.

The Commerce Hills lie to the north of the Little River basin, and are remnants of the Ozark plateau. They have crests up to 250 feet above the floodplain.

The alluvial valley occupies about 6,100 square miles or 3,900,000 acres of the basin and is the portion most affected by the project. This part of the basin is very flat and in vast areas almost completely lacks perceptible relief. Average valley slopes vary from 0.5 to 0.7 foot per mile and, consequently, flows are sluggish and during floods drainage boundaries are often non-existent. The basin has experienced 19 major floods since 1935 for an average of about one every other year. The 1937 flood, which is the worst in the basin's history, caused numerous breaks in the locally constructed levees, and if it were to recur under present conditions of development, would cause damages of over $19,700,000 if the flood occurred during the crop season. Damages occur from headwater floods along the St. Francis and Little Rivers and from Mississippi River backwater. Floods may usually be expected during the period from January through May, but

may occur at any time during the year and last over a period of from 7 to 52 days. While most of the damages are to croplands, portions of the communities of Marked Tree, Lepanto, Trumann, Paragould, and Blytheville, Arkansas, are also subject to inundation as well as numerous schools, churches, homes, businesses, roads, and other permanent improvements. In the Blytheville area, both flood and low flows create problems. Flood runoff and the backing-up of flows in Ditch 27 frequently flood the runway at the Blytheville Strategic Air Command Base preventing its use by SAC bombers. This ditch also floods parts of the city of Blytheville and picks up sewage sludge from the old treatment plant. Effluent from the city's new sewage oxidation ponds empties into Ditch 27.

Geologically, the St. Francis basin is underlain by the Jackson, Claiborne, and Wilcox groups and the undifferentiated upper Eocene. At the upper end, the river crosses small sections of the Paleozoic and the upper Cretaceous. Tertiary deposits are exposed only in a few locations along Crowleys Ridge. The recent alluvium ranges in depth from zero at Crowleys Ridge to over 200 feet in the southern part of the basin. Crowleys Ridge is a remnant of old uplands, overlain by a loessial formation and might be considered partly as a remnant of the Ozark Plateau. In geologic time, the alluvial valley portion of the basin has been a meander plain of the prehistoric Ohio and Mississippi Rivers. The valley is characterized by natural levees, abandoned channels, and relics of these abandoned channels. The soils consist of clays, silts, and fine sands which are underlain by coarser sands and gravels, while the abandoned channels are usually filled with fat clays forming the so-called "clay plugs" with depths varying from a few feet to nearly 100 feet in some areas. (13)

The St. Francis Basin was a part of the Louisiana Purchase of 1803. The first permanent white settlers are said to have come from Kentucky and Tennessee and to have settled along the Mississippi River front. Later, the higher interior ridges were also settled. With the construction of the levees along the Mississippi River, first by the local levee districts and later by the Federal Government, and with the interior flood control and drainage works constructed by the various drainage districts, the alluvial valley began to develop until by 1940 it had a population of more than 500,000 out of a total basin population of 625,000. This population was a 40 percent increase over the 1920 census.

The present population of the basin is 346,000 of which about 75 percent is rural. Principal urban centers and their populations in 1970 are: in Missouri: Sikeston (14,500), Kennet (3,800), Caruthersville (7,100), Dexter (5,900), Malden (5,300), Hayti (3,800), New Madrid (2,700), Portageville (3,000), and Poplar Bluff (16,500), and

in Arkansas: Blytheville (24,600), Jonesboro (27,000), Paragrould (10,700), Osceola (7,100), Trumann (5,900), Marianna (6,200), Marked Tree (3,200), West Memphis (25,900), and Piggott (3,100). There are numerous smaller communities within the basin in both states.

The development trend in the St. Francis basin, and particularly in the alluvial valley, has been for agricultural purposes to the extent that by 1940 there were over 3,100,000 acres of the almost 5,400,000 acres in the basin devoted to agriculture. This acreage represented a 60 percent increase from 1920. There has been an attendant increase in development of urban areas and transportation and utility systems to serve them. A dense network of United States and state highways, county roads, railroads, and utility systems crisscross the area.

The data on Table 2 and on Plate 3 shows the present land use in the basin by counties. Cropland accounts for 3,253,000 acres or 67.8 percent of the total basin area. This usage is even more marked in the alluvial valley portion of the basin where cropland accounts for 3,134,000 acres or 81.7 percent of the valley area. This alluvial valley acreage represents 96.3 percent of the total basin cropland. Principal crops grown in the basin consist of soybeans, cotton, corn, wheat and rice.

Of the 894,000 acres of woodlands in the basin, about 580,000 acres or 65 percent are in the Ozark Highlands in the Missouri counties of St. Genevieve, St. Francis, Iron, Washington, Madison, Wayne, Reynolds, Butler, and Bollinger.

The forest lands of this region are characterized by second and third growth hardwoods, with some mature timber. Predominant species are oak, gum, walnut, and hickory, with scattered groups of pine. Shrubs are prolific in both quantity and variety, and include snowberry, coralberry, several varieties of sumac, redbud, and dogwood. The beauty of autumn leaves is an outstanding characteristic of the wooded hills of this section, and in the spring, one of the principal attractions is the abundance of dogwood and redbud in bloom.

Crowleys Ridge also sustains a significant portion of woodlands remaining in the basin. These are primarily upland hardwoods dominated by oak-hickory combinations, and are associated at higher elevations within the bottomlands with terrace hardwoods comprised of post oak-hickory ridges and willow-oak flats.

Bottomland woodlands are limited largely to the area adjacent to the St. Francis River in the reach from Wappapello to Crowleys Ridge; the area between the levees from Crowleys Ridge to the foot of St. Francis Lake near Marked Tree, Arkansas; the area between the levee and Crowleys Ridge in the reach from about the latitude of Wynne, Arkansas to the Mississippi River; to the public lands; and to narrow strips

TABLE 2

LAND USE DATA BY COUNTIES (1969)
ST. FRANCIS RIVER BASIN
Arkansas and Missouri

County - State	Cropland (Acres)	Grassland (Acres)	Woodland (Acres)	Misc Land (Acres)	Water Area (Acres)	Total Area In Basin (1) (Acres)
Ste. Genevieve - Mo.	3,815	4,249	7,430	602	-	16,096
St. Francois - Mo.	26,210	40,082	65,200	9,500	320	141,312
Iron - Mo.	11,570	37,760	130,820	5,400	370	185,920
Washington - Mo.	10	285	650	15	-	960
Madison - Mo.	18,578	52,487	139,530	6,340	985	217,920
Cape Girardeau	24,110	1,220	7,180	2,690	-	35,200
Wayne - Mo.	11,024	62,971	212,540	6,870	11,875	305,280
Reynolds - Mo.	-	16	60	20	-	96
Butler - Mo.	2,402	6,780	11,580	750	1,976	23,488
Bollinger - Mo.	20,972	4,020	12,640	980	1,100	39,712
Scott - Mo.	89,910	8,600	7,400	6,050	40	112,000
Stoddard - Mo.	439,609	30,400	36,960	18,720	4,839	530,528
Dunklin - Mo.	294,085	3,100	14,975	27,905	6,175	346,240
Pemiscot - Mo.	253,890	1,800	1,560	23,550	1,440	282,240
New Madrid - Mo.	271,660	1,300	2,710	26,650	1,680	304,000
Missouri Subtotal	1,467,845	255,070	651,235	136,042	30,800	2,540,992
Clay - Ark.	102,641	10,800	11,168	7,680	505	132,794
Craighead - Ark.	207,382	10,163	25,073	15,207	991	258,816
Crittenden -Ark.	301,139	4,220	12,740	26,724	9,417	354,240
Cross - Ark	135,220	3,827	16,370	10,200	2,703	168,320
Greene - Ark.	131,360	14,120	25,290	10,260	1,120	182,150
Lee - Ark.	73,961	1,490	46,975	4,310	4,464	131,200
Mississippi - Ark.	460,132	4,862	23,300	34,274	10,552	533,120
Phillips - Ark.	1,000	300	12,800	2,000	540	16,640
St. Francis - Ark.	161,531	7,715	38,120	6,225	3,049	216,640
Poinsett - Ark.	210,934	6,442	30,840	15,837	2,955	267,008
Woodruff - Ark.	-	-	-	-	-	-
Arkansas Subtotal	1,785,300	63,939	242,676	132,717	36,296	2,260,928
Basin Total	3,253,145	319,009	893,911	268,759	67,096	4,801,920
Percent of Total Basins	(67.8)	(6.6)	(18.6)	(5.6)	(1.4)	

(1) Excludes the L'Anguille River Basin

along the ditches and scattered low-lying pockets, still too wet to be easily drained. Remaining forests of this type consist of such forest groups as cypress-tupelo gum, overcup oak-bitter pecan, hackberry-elm-ash, sweetgum-water oak, willow, cottonwood, and others associated with the alluvial valley.

All agricultural lands in the project area are within soil and water conservation districts. Conservation practices (land treatment measures) are established by local conservation districts in cooperation with the Soil Conservation Service and others. Practices, essential in reducing soil erosion, sediment, and runoff, include conservation cropping systems, contour farming, crop residue use, row arrangement, cover and green manure crops, pasture and hayland planting and management, wildlife habitat preservation, critical area stabilization and forest stand improvement.

Supplementary to these soil improving measures are such practices as irrigation and drainage land grading, main and laterial drains, field drains, grade stabilization structures, and structures for water control.

The following is a partial listing of conservation practices on the land in the basin.

Practice	Approximate Acres on the Land
Conservation cropping system	2,400,000
Crop residue management	2,500,000
Drainage land grading	72,000
Irrigation land leveling	145,000
Pasture and hayland planting	156,000

These established practices represent only approximately 40 percent of the total needs. Basin-wide, progress in application of these measures is expected to occur at about 2 percent per year.

There are few natural lakes in the basin. However, there are a number of lakes ranging in size from five acres to 6,500 acres as shown in Table 3 and on Plate 4. The natural stream channels, especially those in the Little River watershed, have been extensively altered through channelization and realignment, largely as a result of the efforts of the local people prior to 1936. The extensive conversion of woodlands to cropland, largely for annual row-crop production, results in heavy silt-laden runoff. Sediment, along with other pollutants resulting from extensive fertilization and weed and pest control, results in generally low water quality throughout most of the basin. Domestic water supply needs, however, are obtained from deep wells which are not expected to be affected by the project.

TABLE 3

ST. FRANCIS BASIN

Lakes Larger Than 5 Acres
Location Shown on Plate 4

County	Designation Number: Size in Acres				
		ARKANSAS			
Lee	1:10	6:10	11:50	16:135	21:15
	2:800	7:20	12:80	17:15	22:35
	3:20	8:15	13:10	18:10	23:45
	4:20	9:20	14:10	19:15	24:10
	5:250	10:25	15:10	20:50	
St Francis	25:45	32:65	39:100	46:55	53:10
	26:400	33:34	40:10	47:20	54:8
	27:15	34:100	41:15	48:20	55:400
	28:35	35:40	42:20	49:5	56:15
	29:12	36:60	43:45	50:10	57:5
	30:240	37:20	44:10	51:20	
	31:10	38:14	45:20	52:110	
Crittenden	24:125	66:25	75:5	84:351	93:5
	58:40	67:60	76:8	85:60	94:800
	59:600	68:8	77:25	86:100	95:50
	60:100	69:10	78:1000	87:40	96:15
	61:200	70:7	79:150	88:1800	97:100
	62:1200	71:8	80:40	89:100	
	63:50	72:6	81:50	90:100	
	64:140	73:10	82:250	91:10	
	65:125	74:10	83:100	92:8	
Cross	98:25	101:5	104:18	107:20	110:15
	99:300	102:15	105:40	108:30	111:25
	100:8	103:30	106:20	109:40	112:50
Poinsett	113:550	114:20			
Craighead	115:100	116:6			
Mississippi	117:5	123:26	129:11	135:20	141:300
	118:15	124:7	130:68	136:20	142:6
	119:8	125:13	131:30	137:20	143:12
	120:6	126:11	132:10	138:60	144:6500
	121:15	127:6	133:12	139:10	
	122:20	128:9	134:6	140:40	

TABLE 3 (Cont'd)

ST. FRANCIS BASIN

Lakes Larger Than 5 Acres
Location Shown on Plate 4

County	Designation Number: Size in Acres			
ARKANSAS (Cont'd)				
Greene	145:8	147:120	149:16	151:13
	146:30	148:40	150:160	
Clay	152:12	153:15		
MISSOURI				
Scott	154:120			

Runoff from the basin, based on 1935-1960 records of the St. Francis River gage at Marked Tree, varies from 5.0 inches to 19.8 inches with an average of 15.7 inches. The maximum and minimum combined daily discharge of river and floodway for the period of record is 58,000 cubic feet per second on January 27, 1937, and 63 cfs on October 13, 1941. Average runoff during the normal irrigation season, June through August, is 2.73 inches (749,542 acre-feet) or 17.4 percent of the average annual runoff. The geographical distribution of annual runoff is reasonably uniform. Based on U. S. Geological Survey 1970 analyses of the St. Francis River at St. Francis, Arkansas and at Marked Tree, Arkansas, surface water is of the calcium bicarbonate type, has considerably less dissolved solids than groundwater and is suitable for irrigation.

Water resources are being utilized for numerous purposes serving many interests. The principal categories of use are irrigation, fuel electric power (major withdrawal from Mississippi River adjacent to the basin), recreation and wildlife, self supplied industry, public supply, rural domestic and livestock use, and fish and minnow farming. Tables 5 and 6, based on U. S. Geological Survey data, show estimated water use in the basin, by counties, for 1970. About 37 percent of the basin total was used for irrigation and 97 percent of the irrigation water use was from groundwater sources. Fuel electric power used about 354.2 million gallons per day (mgd), or 34 percent of the basin total. (Withdrawal of 97.5 percent of this water is from the Mississippi River, adjacent to the basin.) Recreation and wildlife uses are about 199 mgd, or 19 percent of the basin total.

About 45 percent of the water used in 1970 was withdrawn from groundwater. The remaining 55 percent, or 573 mgd, came from streams and reservoirs. Of the 573 mgd, about 94 percent came from Phillips and Mississippi Counties, Arkansas and Wayne and Dunklin Counties, Missouri. About 345 mgd of surface water, or 60 percent of the 573 mgd, was withdrawn from the Mississippi River adjacent to the basin in Phillips County, Arkansas for fuel electric power use. There are 12 self-supplied industrial users who own their own water systems. The municipal and industrial water use in the basin for 1970 is shown in Table 4.

TABLE 4

Municipal and Industrial Water Use - 1970

St. Francis River Basin

Water Supply	Total	Groundwater	Surface Water
	------(million gallons per day-mgd)----------		
Municipal & Industrial	28.64	28.64	0
Industrial-Self Supplied	44.86	44.53	0.33
Totals	73.50	73.17	0.33

TABLE 5

ST. FRANCIS RIVER BASIN

Estimated Use of Water in the St. Francis River Basin - 1970
By Principal Use and Source in Million Gallons per Day

County	Public Supply			Self-Supplied Ind.			Rural Use			
							Domestic	Livestock		
	Ground Water	Surface Water	Total	Ground Water	Surface Water	Total	Ground Water	Ground Water	Surface Water	Total
Clay	.48	0	.48	0	0	0	.19	.06	.06	.12
Craighead	3.72	0	3.72	.72	.16	.88	1.05	.11	.07	.18
Crittenden	3.54	0	3.54	.05	0	.05	1.02	.08	.02	.10
Cross	1.04	0	1.04	1.22	.17	1.39	.70	.14	.03	.17
Greene	1.84	0	1.84	.15	0	.15	.60	.13	.09	.22
Lee	.58	0	.58	0	0	0	.44	.07	.05	.12
Mississippi	4.83	0	4.83	6.96	0	6.96	1.13	.10	.03	.13
Phillips	0	0	0	0	0	0	.01	0	.01	.01
Poinsett	1.74	0	1.74	.29	0	.29	.80	.06	.04	.10
St. Francis	1.82	0	1.82	.30	0	.30	.99	.16	.04	.20
Woodruff	.03	0	.03	.01	0	.01	.02	.01	.01	.02
County Totals - Arkansas	19.62	0	19.62	9.70	.33	10.03	6.95	.92	.45	1.37

TABLE 5
ST. FRANCIS RIVER BASIN (Continued)
Estimated Use of Water in the St. Francis River Basin - 1970
By Principal Use and Source in Million Gallons per Day

County	Public Supply			Self Supplied Ind.			Rural Use			
							Dom.	Livestock		
	Ground Water	Surface Water	Total	Ground Water	Surface Water	Total	Ground Water	Ground Water	Surface Water	Total
Bollinger	.01		.01				.04	.01	.03	.04
Butler							.01		.01	.01
Cape Girardeau	.03		.03				.08		.01	.01
Dunklin	1.78		1.78	.06		.06	.56	.03	.07	.10
Iron	.29		.29	10.90		10.90	.16	.01	.05	.06
Madison	.29		.29				.10	.02	.11	.13
New Madrid	.94		.94				.34	.02	.06	.08
Pemiscot	1.97		1.97				.40	.01	.03	.04
St. Francois	1.22		1.22	23.50		23.50	.24	.02	.10	.12
Ste. Genevieve	.03		.03				.02		.02	.02
Scott	1.00		1.00				.19	.04	.10	.14
Stoddard	1.23		1.23	.37		.37	.66	.11	.32	.43
Wayne	.23		.23				.17	.01	.10	.11
County Totals-Missouri	9.02		9.02	34.83		34.83	2.97	.28	1.01	1.29
Basin Totals - mgd	28.64		28.64	44.53	.33	44.86	9.92	1.20	1.46	2.66
Basin Totals - Ac.Ft./Yr.	32,077		32,077	49,873	370	50,243	11,110	1,344	1,635	2,979

TABLE 6

ST. FRANCIS RIVER BASIN (Continued)
Estimated Use of Water in the St. Francis River Basin - 1970
By Principal Use and Source in Million Gallons per Day

County	Irrigation						Fish and Minnow Farms			Recreation and Wildlife Impoundments			Fuel-electric Power			County Total		
	Rice			Other Crops														
	Ground Water	Surface Water	Total	Ground Water	Surface Water	Total	Ground Water	Surface Water	Total	Ground Water	Surface Water	Total	Ground Water	Surface Water	Total	Ground Water	Surface Water	Total
Clay	4.77	0	4.77	.55	0	.55	0	0	0	0	0	0	0	0	0	6.05	.06	6.11
Craighead	12.63	0	12.63	15.87	0	15.87	.23	.10	.33	0	0	0	0	0	0	34.33	.33	34.66
Crittenden	27.98	0	27.98	5.05	0	5.05	.98	.76	1.74	0	0	0	0	0	0	38.70	.78	39.48
Cross	85.99	1.16	87.15	6.63	.77	7.40	2.46	1.34	3.80	0	0	0	0	0	0	98.18	3.47	101.65
Greene	6.80	0	6.80	0	.01	.01	.32	.04	.36	0	0	0	0	0	0	9.84	.14	9.98
Lee	9.88	.29	10.17	2.43	0	2.43	.04	.24	.28	0	0	0	0	0	0	13.44	.58	14.02
Mississippi	3.99	2.01	6.00	.39	.02	.41	1.19	0	1.19	.01	32.14	32.15	0	0	0	18.60	34.20	52.80
Phillips	0	0	0	0	0	0	0	0	0	0	2.93	2.93	.72	345.20	345.92 1/	.73	348.14	348.87
Poinsett	78.44	0	78.44	22.16	0	22.16	.80	.93	1.73	0	.14	.14	0	0	0	104.29	1.11	105.40
St. Francis	41.18	3.19	44.37	8.88	.81	9.69	2.26	1.30	3.56	0	0	0	.38	.90	1.28	55.97	6.24	62.21
Woodruff	2.00	.10	2.10	.08	0	.08	.30	.17	.47	0	0	0	0	0	0	2.45	.28	2.73
County Totals - Arkansas	273.66	6.75	280.41	62.04	1.61	63.65	8.58	4.88	13.46	.01	35.21	35.22	1.10	346.10	347.20	382.58	395.33	777.91

1/Withdrawal is from the Mississippi River outside the basin boundary.

TABLE 6

ST. FRANCIS RIVER BASIN (Continued)
Estimated Use of Water in the St. Francis River Basin - 1970
By Principal Use and Source in Million Gallons per Day

County	Irrigation						Fish and Minnow Farms			Recreation and Wildlife Impoundments			Fuel-electric Power			County Total in Basin		
	Rice			Other crops														
	Ground Water	Surface Water	Total	Ground Water	Surface Water	Total	Ground Water	Surface Water	Total	Ground Water	Surface Water	Total	Ground Water	Surface Water	Total	Ground Water	Surface Water	Total
Bollinger				.02		.02	.08	.04	.12		1.42	1.42				.16	1.49	1.65
Butler							.58	.29	.87		.01	.01				.59	.31	.90
Cape Girardeau							.08	.04	.12		2.98	2.98				.19	3.03	3.22
Dunklin				6.08	.67	6.75	.08	.04	.12	.02	2.46	2.48		7.02	7.02	8.61	10.26	18.87
Iron											1.22	1.22				11.36	1.27	12.63
Madison											1.39	1.39				.41	1.50	1.91
New Madrid	.25	.03	.28	8.45	.94	9.39										10.00	1.03	11.03
Pemiscot	3.00	.33	3.33	1.34	.15	1.49	.08	.04	.12		.55	.55				6.80	1.10	7.90
St. Francois											2.68	2.68				24.98	2.78	27.76
Ste. Genevieve											.38	.38				.05	.40	.45
Scott	.60	.07	.67	4.60	.50	5.10					.28	.28				6.43	.95	7.38
Stoddard	4.54	.50	5.04	14.54	1.62	16.16	.58	.29	.87	.02	2.09	2.11				22.05	4.82	26.87
Wayne							.08	.04	.12		148.56	148.56				.49	148.70	149.19
County Totals-Missouri	8.39	.93	9.32	35.03	3.88	38.91	1.56	.78	2.34	.04	164.02	164.06		7.02	7.02	92.12	177.64	269.76
Basin Totals - mgd	282.05	7.68	289.73	97.07	5.49	102.56	10.14	5.66	15.80	.05	199.23	199.28	1.10	353.12	354.22	474.70	572.97	1047.67
Basin Totals - Ac.Ft./Yr.	315,896	8,602	324,498	108,718	6,149	114,867	11,357	6,339	17,696	56	223,138	223,194	1,232	395,494	396,726	531,664	641,726	1,173,390

Forty-one percent or 31 of the 76 towns with population over 100 in the Missouri portion of the basin have sewage treatment plants. The remaining towns have septic tanks or use some other form of sewage disposal. Five of these towns have plans to expand their present treatment plants and some towns are planning to install treatment plants where there are none. One town has a sewage treatment plant under construction at the present time.

Based on a water pollution control survey made (1965, 1968) by Arkansas Pollution Control Commission the following cities or places have secondary waste treatment facilities: Bay, Blytheville, Agrico Chemical Company, Blytheville Air Force Base, Caraway, Forrest City, Harrisburg, Jonesboro, Lake City, Lepanto, Manila, Marked Tree, Paragould, Piggott, Rector, Trumann, Tyronza, and Wynne. The cities with primary sewage treatment plants are Marianna, Marion, Monette and Parkin. The cities of Hughes, Leachville and Marmaduke have inadequate sewage treatment plants which are being bypassed while the cities of Helena, Luxora, Osceola, West Memphis and Wilson have no treatment facilities and are discharging untreated sewage directly into the receiving streams.

In addition there are twelve sources of industrial wastes which were investigated and sampled during this survey. Of these sources three discharge directly into the Mississippi River, two have waste treatment facilities under construction, one disposes most of its effluent into the city sewer while six have no waste treatment facilities. The industries surveyed were Agrico Chemical Company in Blytheville, Arkansas Grain Corporation at Helena, Blytheville Canning Company at Blytheville, Carroll Packing Plant at Paragould, Colson Company at Jonesboro, Crane Company at Jonesboro, Douglas Lomason Company at Marianna, L. A. Darling Company at Paragould, Nat Buring Packing Plant at Wilson, Paymaster Oil Company at Osceola, Poinsett Lumber Manufacturing Company at Trumann and Randall Company at Blytheville.

Localized water pollution of drainage systems was found generally below large centers of population such as Paragould, Blytheville, Jonesboro, Harrisburg, Wynne, Forrest City and Marianna. The streams effected by discharge from municipal sewage treatment plants and industrial sources are Eight Mile Ditch, Pemiscot Bayou, Whiteman Ditch, Ten Mile Bayou and Crow Creek. The effects, however, were limited in extent. Asher Ditch was not receiving any effluent from the Caraway oxidation pond but survey results indicated some degree of pollution as shown by dissolved oxygen of 2.7 parts per million (ppm) and coliform counts exceeding 5,000 per 100 milliliter (ml). This could be due to the presence of some solid wastes and scrap material on the bank of the stream. Streams with inadequate flow from dilution, such as Big Slough Ditch, Right Hand Chute of Little River, Left Hand Chute of Little River, and St. Francis River showed no significant changes in their water quality beyond the immediate vicinities of the outfalls of the sources of pollution.

All the discharges from the foregoing sources, both municipal and industrial, finally flow into the St. Francis River which receives the drainage of the entire basin. The biological analysis of water samples from this stream showed high coliform bacteria count in the vicinity of Parkin due to direct discharge of the effluent from the primary sewage treatment plant of this city. This count which was in excess of 5,000 per 100 ml shows that the stream is adversely affected by this particular discharge and measures for its abatement are necessary. The chemical water quality tests also showed an increased level of nitrates and of turbidity caused apparently by the extensive agricultural areas draining into this stream. Due to some dilution flow coming from the different tributaries no other significant changes have been found in the water quality of this stream after it enters and before it leaves the state.

Big Slough Ditch receives surface runoffs and final discharges from the sewage treatment plants at Piggott, Rector and Marmaduke. This survey showed no significant adverse effects from these pollution sources and this stream has good water quality before it flows into St. Francis River.

Eight Mile Ditch carries the effluents from the sewage treatment plants and industries in Paragould as well as drainage from surrounding areas including Center Hill which has no adequate sewage disposal system. This stream showed some pollution effects due to these sources as indicated by a coliform bacteria count of more than 10,000 per 100 ml, and some concentrations of nickel, zinc, chromium and copper at a sampling station above its confluence with St. Francis River.

The Left Hand Chute of Little River receives the final waste discharges from municipal and industrial sources located in Blytheville and in Lepanto. Below the outfalls the stream showed heavy pollution effects. However, because of the large drainage area and dilution afforded by its tributaries the survey results show that the effects are mostly dissipated before this stream enters the St. Francis River.

The Right Hand Chute of Little River receives no discharges from any significant source of pollution. Except for some turbidity it has fair water quality.

Whiteman Ditch, Gum Slough Ditch, Little Bay Ditch and Big Bay Ditch which finally flow into drainage Ditch No. 10 and Ditch No. 104 receive the municipal and industrial waste discharges from Jonesboro, Bay and Trumann. Below these outfalls the receiving streams showed some adverse pollution effects. The main sources of pollution for these streams are the run-down Nettleton sewage treatment plant and the untreated wastes from Colson Company, Crane Company and Poinsett Wood Manufacturing Company.

In the smaller streams the pollution effects are localized. Municipal wastes are causing varying degrees of oxygen depletion and increased coliform bacteria count below the outfalls, but this condition is not far reaching in any case.

In general, the results of biologic examination of the waters in the receiving streams show the extent of pollution by sewage or industrial wastes. In most cases results indicate that there is some degree of self-purification of the streams. The comparisons of the different types of both plankton and benthic organisms reflect differences in water quality as affected by the different sources of pollution in the St. Francis River Basin. Some relatively high coliform bacteria counts were obtained below outfalls of primary sewage treatment plants or where treatment plants were being by-passed. Furthermore, untreated toxic industrial wastes, such as those from the metal plating plants in Blytheville, Paragould and Jonesboro adversely affect the biological productivity of the streams in these areas.

Water criteria in the St. Francis Basin as set forth by the Arkansas Pollution Control Commission is as follows:

"1. Temperature - The maximum temperature shall not be elevated above 95° F. in streams. The temperature of a stream as determined by natural conditions shall not be increased or decreased more than 5° F. by discharge thereto.

2. Color - True color shall not be increased to the extent that it will interfere with present usage and projected future use of the stream.

3. Turbidity - There shall be no distinctly visible increase in turbidity due to waste discharges to the stream.

4. Taste and Odor - Taste and odor producing substances shall be limited to concentrations in the stream that will not interfere with the production of potable water by reasonable water treatment processes, or impart unpalatable flavor to food fish, or result in offensive odors arising from the stream, or otherwise interfere with the reasonable use of the water.

5. Solids, Floating Material, and Deposits - The stream shall have no distinctly visible solids, scum or foam of a persistent nature, nor shall there by any formation of slimes, bottom deposits or sludge banks, attributable to waste discharges.

6. Oil and Grease - The stream shall be essentially free of the relatively nonvolatile liquid components that contribute to the formation of oil films, deposits and emulsions.

7. pH - The pH of water in the stream must not fluctuate in excess of 1.0 pH unit, within the range of 6.0 - 9.0, over a period of 24 hours. The pH shall not be below 6.0 or above 9.0 due to wastes discharged to the receiving stream.

8. Dissolved Oxygen (D.O.) - The dissolved oxygen in the stream shall not be less than 4 ppm, and this shall be the critical deficit point of the dissolved oxygen profile. The only exception will be when periodic lower values are of natural origin and therefore beyond control of the water user. For trout stream waters the minimum dissolved oxygen content shall not be less than 5.0 milligrams per liter (mg/l). The dissolved oxygen sample shall be taken at mid-depth and the middle of the stream on the smaller streams and rivers. On the larger rivers the dissolved oxygen shall be determined by the average of concentrations in samples collected at quarter points across the river, and at two-tenths and eight-tenths of the depth at each point.

9. Radioactivity - The Rules and Regulations for the Control of Sources of Ionizing Radiation, of the Division of Radiological Health, Arkansas State Board of Health, shall apply as to the limits established for radiation levels in uncontrolled areas.

10. Bacteria - The Arkansas State Board of Health has the responsibility of approving or disapproving surface waters for swimming and drinking water supply, and it has issued rules and regulations pertaining to such uses. These regulations state that the coliform group shall not exceed 1,000/100 milliliters as a monthly average value (either most probable number or membrane filter count) for waters substantially used for body contact aquatic sports; nor exceed this number in more than twenty percent of the samples examined during any one month; nor exceed 2,400/100 milliliters on any day except during periods of storm water runoff; provided, however, that no fecal contamination is known to be present. In other waters, the coliform bacteria group shall not exceed 5,000/100 milliliters as a monthly average value (either Most Probable Number or membrane filter count); nor exceed this number in more than twenty per cent of the samples examined during any month; nor exceed 20,000/100 milliliters in more than 5% of such samples. Arithmetic averages will be used.

11. Toxic Substances - Toxic materials, organic or inorganic, shall not be present in such quantities as to cause the waters to be toxic to human, animal, plant or aquatic life or to interfere with the normal propagation of aquatic life. For aquatic life and using bioassay techniques, the level of toxic materials in the stream shall not exceed one-tenth (0.1) of the forty-eight (48) hour Median Tolerance Limit.

12. Mineral Quality - Waste discharges shall not affect existing mineral quality so as to interfere with other beneficial uses. Numerical mineral criteria will be set and implemented within the next five years as existing quality and results of the present controls are evaluated." (14)

Water quality data published by the Geological Survey, USDI, containing chemical and biological analyses of samples obtained at five stations in the St. Francis Basin during the water year October 1970 to Septebmer 1971, are shown in Table 7 (28). The maximum and minimum values for seven parameters are shown in Table 8 for data collected since 1967.

Big game species, consisting of white-tailed deer and wild turkeys, range throughout the basin but are concentrated in the Ozark Highlands, Crowleys Ridge, Federal and state wildlife areas and in the backwater area near the mouth of the St. Francis. These areas also support the bulk of the fur bearing animals and other small game. Small game species in the basin include squirrels, raccoon, oppossum, rabbits, fox, beaver, quail, dove, woodcock, snipe, and waterfowl. The highest concentration of small game coincide with those of big game, however, small patches of woods, fence, rows, streambanks, pasturelands, 'set aside' lands, and some croplands also provide important food and cover throughout the basin.

Seasonally flooded lands within the St. Francis Basin and throughout the alluvial valley constitute important nesting and wintering habitat for a large portion of the Mississippi Flyway waterfowl population. (25) Greatest use by waterfowl occurs on flooded bottomlands within the floodways, Wappapello Reservoir, St. Francis Lake and Sunk Lands, and the backwater area of the lower basin. Excellent shooting is afforded under favorable flooding conditions when highest populations are present, usually in late December and January. In recognition of the national significance of basin wetlands, the Bureau of Sport Fisheries and Wildlife has stated that: "In consideration also of the rapid national decrease in waterfowl habitat, and in recognition of the collective effort by the States, the Governments of Canada, Mexico, and the United States, and by private interests in waterfowl resource preservation, the Bureau holds that there is a national obligation to preserve high-value waterfowl habitat wherever and whenever feasible." (29)

Sport and commercial fishing resources in the St. Francis basin range from excellent in the Ozark headwaters to poor throughout most of the alluvial valley. Data provided by the Missouri Department of Conservation indicate that the harvest of fish from Wappapello Lake is equivalent to the catch from lakes in other basins in the area, most of which are considered to be good to excellent sport fisheries. Species which contribute to sport fishing in the basin include large mouth and spotted bass, crappies, bluegill, longear and other sunfishes, grass pickerel, and catfish. Principal commercial species are buffalo fish, catfish, carp, and freshwater drum.

TABLE 7

ST. FRANCIS RIVER BASIN

07040100 ST. FRANCIS RIVER AT ST. FRANCIS, ARK.

LOCATION.--Lat 36°27'20", long 90°08'13", Clay County, at gaging station at bridge on U.S. Highway 62 at St. Francis.

PERIOD OF RECORD.--Chemical analyses: July 1969 to September 1971.

REMARKS.--Discharge obtained from rating curves furnished by Corps of Engineers, Memphis, Tenn. Additional records furnished by Department of Pollution Control and Ecology, Little Rock, Ark.

CHEMICAL AND BIOLOGICAL ANALYSES, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

DATE	DIS-CHARGE (CFS)	DIS-SOLVED SILICA (SIO2) (MG/L)	DIS-SOLVED IRON (FE) (UG/L)	DIS-SOLVED MAN-GANESE (MN) (UG/L)	DIS-SOLVED CAL-CIUM (CA) (MG/L)	DIS-SOLVED MAG-NE-SIUM (MG) (MG/L)	DIS-SOLVED SODIUM (NA) (MG/L)	DIS-SOLVED PO-TAS-SIUM (K) (MG/L)	BICAR-BONATE (HCO3) (MG/L)	CAR-BONATE (CO3) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)
NOV. 17...	1040	5.4	30	40	20	10	3.5	2.5	100	0	12	2.7
JAN. 12...	2170	5.5	0	60	17	9.0	3.6	1.7	80	0	14	4.6
MAR. 10...	1540	5.6	30	80	12	6.1	3.6	1.4	56	0	12	3.5
MAY 05...	216	8.0	30	280	28	11	6.0	1.4	140	0	11	4.2
JULY 15...	309	7.6	30	20	25	12	5.4	1.4	138	0	8.0	4.8
SEP. 09...	200	9.7	0	50	26	12	5.3	2.0	140	0	5.2	8.0

DATE	DIS-SOLVED FLUO-RIDE (F) (MG/L)	NITRATE (NO3) (MG/L)	ORGANIC NITRO-GEN (N) (MG/L)	AMMONIA NITRO-GEN (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)	METHY-LENE BLUE ACTIVE SUB-STANCE (MG/L)	DIS-SOLVED SOLIDS (RESI-DUE AT 180 C) (MG/L)	DIS-SOLVED SOLIDS (TONS PER DAY)	HARD-NESS (CA,MG) (MG/L)	NON-CAR-BONATE HARD-NESS (MG/L)	ALKA-LINITY AS CACO3 (MG/L)
NOV. 17...	.0	.6	.38	.00	.060	.03	115	323	91	9	82
JAN. 12...	.1	6.2	.58	.15	.060	.04	101	592	80	14	66
MAR. 10...	.2	2.8	.66	.07	.38	.01	86	358	55	9	46
MAY 05...	.3	.1	.15	.00	.18	.03	156	91.0	120	0	115
JULY 15...	.0	.6	.31	.01	.060	.05	138	115	110	0	113
SEP. 09...	.0	.5	.38	.00	.060	.04	133	71.8	110	0	115

DATE	PERCENT SODIUM	SODIUM AD-SORP-TION RATIO	SPECI-FIC COND-UCTANCE (MICRO-MHOS)	PH (UNITS)	COLOR (PLAT-INUM-COBALT UNITS)	TEMP-ERATURE (DEG C)	CHEM-ICAL OXYGEN DEMAND (LOW LEVEL) (MG/L)	DIS-SOLVED OXYGEN (MG/L)	PER-CENT SATUR-ATION	FECAL COLI-FORM (COL. PER 100 ML)	STREP-TOCOCCI (COL-ONIES PER 100 ML)
NOV. 17...	7	.2	210	7.8	2	9.5	13	10.2	89	170	--
JAN. 12...	9	.2	195	7.2	40	2.5	12	12.4	91	70	1600
MAR. 10...	12	.2	140	7.9	100	6.5	18	10.0	81	480	1400
MAY 05...	10	.2	260	7.7	2	16.5	8	7.5	76	60	110
JULY 15...	9	.2	235	7.8	50	25.5	18	6.1	74	380	410
SEP. 09...	9	.2	280	7.9	10	25.0	9	6.5	78	60	175

TABLE 7
(Cont'd)

ST. FRANCIS RIVER BASIN

07046500 BIG LAKE OUTLET NEAR MANILA, ARK.

LOCATION.--Lat 35°50'59", long 90°07'39", in sec.10, T.14 N., R.9 E., Mississippi County, at Corps of Engineers gaging station at bridge on State Highway 18, 3.5 miles southeast of Manila, and at mile 23.0.

PERIOD OF RECORD.--Chemical and biological analyses: October 1970 to September 1971.

REMARKS.--Records furnished by Department of Pollution Control and Ecology, Little Rock, Ark.

CHEMICAL AND BIOLOGICAL ANALYSES, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

DATE	00010 WATER TEMP CENT	01045 IRON TOTAL UG/L	01055 MANGNESE MN UG/L	00915 CALCIUM CA MG/L	00925 MGNSIUM MG MG/L	00945 SULFATE SO4 MG/L	00940 CHLORIDE CL MG/L	00620 NITRATE NO3-N MG/L	00650 T PO4 PO4 MG/L	00500 RESIDUE TOTAL MG/L
OCT. 12, 1970	19.	-	-	-	-	-	16.0	-	-	-
OCT. 27.....	19.	-	-	-	-	-	10.0	-	-	-
NOV. 23.....	6.	-	-	-	-	-	16.0	-	-	-
DEC. 7.....	5.	200.	0	44.8	15.80	14.0	14.5	0	0.460	259.
DEC. 28.....	5.	-	-	-	-	-	7.0	-	-	-
JAN. 4, 1971	6.	-	-	-	-	-	12.0	-	-	-
JAN. 19.....	2.	-	-	-	-	-	4.5	-	-	-
FEB. 2.....	2.	440.	100.0	40.8	11.90	12.7	11.0	0.19	0.530	235.
FEB. 16.....	3.	-	-	-	-	-	80.0	-	-	-
MAR. 2.....	8.	-	-	-	-	-	4.5	-	-	-
MAR. 17.....	13.	-	-	-	-	-	5.0	-	-	-
APR. 5.....	13.	-	-	-	-	-	18.0	-	-	-
APR. 21.....	22.	-	-	-	-	-	15.0	-	-	-
MAY 17.....	23.	-	-	-	-	-	14.0	-	-	-
JUNE 2.....	24.	-	-	-	-	-	13.0	-	-	-
JUNE 16.....	27.	-	-	-	-	-	11.0	-	-	-
JULY 22.....	28.	-	-	-	-	-	21.0	-	-	-
AUG. 2.....	25.	-	-	-	-	-	5.0	-	-	-
AUG. 16.....	29.	-	-	-	-	-	16.5	-	-	-
AUG. 31.....	26.	-	-	-	-	-	8.0	-	-	-
SEP. 15.....	24.	-	-	-	-	-	14.5	-	-	-

DATE	00900 TOT HARD CACO3 MG/L	00910 CALCIUM CACO3 MG/L	00410 T ALK CACO3 MG/L	00095 CNDUCTVY AT 25C MICROMHO	00400 PH S U	00080 COLOR PT-CO UNITS	00070 TURB JKSN JU	00310 BOD 5 DAY MG/L	00300 DO MG/L
OCT. 12, 1970	-	-	150.	297.	7.90	-	120.	3.7	8.2
OCT. 27.....	-	-	79.	147.	7.50	-	85.	3.8	6.7
NOV. 23.....	-	-	139.	200.	7.90	-	80.	2.2	9.9
DEC. 7.....	177.	112.0	146.	290.	7.80	5.	45.	2.5	9.5
DEC. 28.....	-	-	40.	101.	6.80	-	180.	2.7	9.2
JAN. 4, 1971	-	-	87.	152.	7.40	-	120.	4.4	10.0
JAN. 19.....	-	-	38.	71.	7.00	-	270.	2.1	11.8
FEB. 2.....	151.	102.0	133.	259.	7.40	20.	45.	1.4	12.1
FEB. 16.....	-	-	88.	179.	6.60	-	300.	2.6	11.9
MAR. 2.....	-	-	43.	83.	7.00	-	370.	1.7	9.2
MAR. 17.....	-	-	115.	243.	7.70	-	20.	2.5	8.7
APR. 5.....	-	-	168.	358.	8.00	-	90.	2.5	9.6
APR. 21.....	-	-	170.	370.	7.80	-	110.	6.3L	6.3
MAY 17.....	-	-	148.	285.	7.90	-	120.	8.9L	8.9
JUNE 2.....	-	-	133.	294.	7.50	-	130.	5.2	5.6
JUNE 16.....	-	-	59.	148.	7.10	-	220.	2.7	3.4
JULY 22.....	-	-	154.	322.	8.10	-	35.	2.6	6.4
AUG. 2.....	-	-	72.	172.	7.30	-	70.	3.3	5.5
AUG. 16.....	-	-	121.	287.	7.70	-	50.	1.9	4.8
AUG. 31.....	-	-	51.	136.	6.80	-	90.	3.0	4.7
SEP. 15.....	-	-	100.	227.	7.20	-	80.	0.9	3.3

DATE	31501 CCLIFORM IMEDENDO MF/100ML	31616 FEC COLI MF-C44.5 MF/100ML	31679 STPCOCCI M-ENTCCS MF/100ML
DEC. 7, 1970	88.	37.	140.
FEB. 2, 1971	50.	4.K	27.
AUG. 2.....	2300.	230.	180.

K Less than.
L Greater than.

TABLE 7
(Cont'd)
ST. FRANCIS RIVER BASIN

07040100 ST. FRANCIS RIVER AT ST. FRANCIS, ARK.--Continued

CHEMICAL AND BIOLOGICAL ANALYSES, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

DATE	00010 WATER TEMP CENT	01045 IRON TOTAL UG/L	01055 MANGNESE MN UG/L	00915 CALCIUM CA MG/L	00925 MGNSIUM MG MG/L	00945 SULFATE SO4 MG/L	00940 CHLORIDE CL MG/L	00620 NITRATE NO3-N MG/L	00650 T PO4 PO4 MG/L	70500 RESIDUE TOTAL MG/L
OCT. 13, 1970	18.	-	-	-	-	-	6.0	-	-	-
OCT. 27.....	18.	-	-	-	-	-	5.5	-	-	-
NOV. 24.....	6.	-	-	-	-	-	6.5	-	-	-
DEC. 7.....	7.	0	0	21.6	15.30	10.2	7.5	0	0.190	163.
DEC. 28.....	5.	-	-	-	-	-	6.5	-	-	-
JAN. 4, 1971	5.	-	-	-	-	-	5.5	-	-	-
JAN. 19.....	2.	-	-	-	-	-	3.5	-	-	-
FEB. 2.....	1.	500.	580.0	19.2	9.30	3.0	4.0	0.19	0.270	139.
FEB. 16.....	3.	-	-	-	-	-	3.0	-	-	-
MAR. 2.....	6.	-	-	-	-	-	4.0	-	-	-
MAR. 17.....	13.	-	-	-	-	-	3.5	-	-	-
APR. 5.....	9.	-	-	-	-	-	5.5	-	-	-
APR. 21.....	19.	-	-	-	-	-	4.5	-	-	-
MAY 17.....	23.	-	-	-	-	-	4.0	-	-	-
JUNE 2.....	25.	-	-	-	-	-	4.0	-	-	-
JUNE 16.....	27.	-	-	-	-	-	6.0	-	-	-
JULY 22.....	24.	-	-	-	-	-	6.5	-	-	-
AUG. 2.....	2.	-	-	-	-	-	4.5	-	-	-
AUG. 16.....	28.	-	-	-	-	-	4.5	-	-	-
AUG. 31.....	25.	-	-	-	-	-	6.0	-	-	-
SEP. 15.....	24.	-	-	-	-	-	7.0	-	-	-

DATE	00900 TOT HARD CACO3 MG/L	00910 CALCIUM CACO3 MG/L	00410 T ALK CACO3 MG/L	00095 CNDUCTVY AT 25C MICROMHO	00400 PH S U	00080 COLOR PT-CO UNITS	00070 TURB JKSN JU	00310 BOD 5 DAY MG/L	00300 DO MG/L
OCT. 13, 1970	-	-	92.	179.	6.30	-	120.	1.8	8.5
OCT. 27.....	-	-	83.	128.	7.50	-	105.	2.3	8.7
NOV. 24.....	-	-	91.	135.	7.90	-	40.	2.5	12.3
DEC. 7.....	117.	54.0	93.	175.	7.90	5.	30.	2.3	11.2
DEC. 28.....	-	-	97.	183.	7.20	-	30.	3.1	12.5
JAN. 4, 1971	-	-	71.	110.	7.40	-	200.	3.2	11.3
JAN. 19.....	-	-	48.	86.	7.00	-	100.	2.8	12.6
FEB. 2.....	87.	48.0	71.	128.	6.50	30.	35.	2.0	12.7
FEB. 16.....	-	-	62.	118.	6.30	-	150.	3.5	13.2
MAR. 2.....	-	-	39.	82.	7.00	-	180.	1.6	10.8
MAR. 17.....	-	-	67.	132.	7.60	-	85.	1.3	10.1
APR. 5.....	-	-	107.	214.	7.80	-	130.	2.3	10.1
APR. 21.....	-	-	94.	193.	7.60	-	45.	2.8	8.7
MAY 17.....	-	-	87.	163.	7.80	-	100.	4.7	9.3
JUNE 2.....	-	-	103.	191.	7.70	-	130.	4.6	9.2
JUNE 16.....	-	-	101.	225.	7.70	-	120.	2.7	7.8
JULY 22.....	-	-	119.	250.	8.10	-	45.	2.7	8.0
AUG. 2.....	-	-	123.	253.	8.20	-	40.	4.2	10.4
AUG. 16.....	-	-	108.	222.	8.00	-	60.	2.0	8.6
AUG. 31.....	-	-	281.	531.	7.60	-	80.	3.9	9.7
SEP. 15.....	-	-	139.	236.	7.80	-	95.	2.2	6.5

DATE	31501 CCLIFORM IMEDENDO MF/100ML	31616 FEC COLI MF-C44.5 MF/100ML	31679 STPCOCCI M-ENTCCS MF/100ML
DEC. 7, 1970	410.	130.	320.
FEB. 2, 1971	58.	13.	34.
AUG. 2.....	300.	170.	67.

TABLE 7
(Cont'd)

ST. FRANCIS RIVER BASIN

07046535 PEMISCOT BAYOU NEAR YARBRO, ARK.

LOCATION.--Lat 35°59'30", long 89°52'26", in NE¼SE¼ sec.23, T.16 N., R.11 E., Mississippi County, at bridge on service road 50 ft downstream from Interstate Highway 55, 2.0 miles northeast of Yarbro, and 4.1 miles downstream from Crooked Lake Bayou.

PERIOD OF RECORD.--Chemical and biological analyses: October 1970 to September 1971.

REMARKS.--Records furnished by Department of Pollution Control and Ecology, Little Rock, Ark.

CHEMICAL AND BIOLOGICAL ANALYSES, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

DATE	00010 WATER TEMP CENT	01045 IRON TOTAL UG/L	01055 MANGNESE MN UG/L	00915 CALCIUM CA MG/L	00925 MGNSIUM MG MG/L	00945 SULFATE SO4 MG/L	00940 CHLORIDE CL MG/L	00620 NITRATE NO3-N MG/L	00650 T PO4 PO4 MG/L	00500 RESIDUE TOTAL MG/L
OCT. 12, 1970	21.	-	-	-	-	-	10.5	-	-	-
OCT. 27.....	19.	-	-	-	-	-	5.0	-	-	-
NOV. 23.....	4.	-	-	-	-	-	7.0	-	-	-
DEC. 7.....	9.	0	370.0	44.0	45.70	12.7	8.0	0	1.560	461.
DEC. 28.....	9.	-	-	-	-	-	7.0	-	-	-
JAN. 4, 1971	6.	-	-	-	-	-	7.5	-	-	-
JAN. 19.....	2.	-	-	-	-	-	7.0	-	-	-
FEB. 2.....	5.	820.	0	43.2	41.70	5.0	4.0	1.50	0.570	393.
FEB. 16.....	8.	-	-	-	-	-	5.0	-	-	-
MAR. 2.....	7.	-	-	-	-	-	5.5	-	-	-
MAR. 17.....	8.	-	-	-	-	-	5.0	-	-	-
APR. 5.....	10.	-	-	-	-	-	11.5	-	-	-
APR. 21.....	20.	-	-	-	-	-	5.5	-	-	-
MAY 17.....	27.	-	-	-	-	-	4.0	-	-	-
JUNE 2.....	28.	-	-	-	-	-	4.0	-	-	-
JUNE 16.....	27.	-	-	-	-	-	7.0	-	-	-
JULY 22.....	26.	-	-	-	-	-	11.0	-	-	-
AUG. 2.....	26.	-	-	-	-	-	6.0	-	-	-
AUG. 16.....	29.	-	-	-	-	-	4.5	-	-	-
AUG. 31.....	30.	-	-	-	-	-	7.5	-	-	-
SEP. 15.....	29.	-	-	-	-	-	9.0	-	-	-

DATE	00900 TOT HARD CACO3 MG/L	00910 CALCIUM CACO3 MG/L	00410 T ALK CACO3 MG/L	00095 CNDUCTVY AT 25C MICROMHO	00400 PH S U	00080 COLOR PT-CO UNITS	00070 TURB JKSN TU	00310 BOD 5 DAY MG/L	00300 DO MG/L
OCT. 12, 1970	-	-	164.	301.	7.30	-	190.	5.3L	5.3
OCT. 27.....	-	-	245.	339.	7.70	-	180.	4.7	6.8
NOV. 23.....	-	-	182.	371.	8.00	-	70.	2.7	11.4
DEC. 7.....	298.	110.0	317.	476.	7.70	0	80.	1.5	10.7
DEC. 28.....	-	-	281.	467.	7.50	-	65.	1.7	8.6
JAN. 4, 1971	-	-	186.	263.	7.60	-	400.	3.9	9.0
JAN. 19.....	-	-	348.	448.	7.70	-	40.	1.4	12.5
FEB. 2.....	280.	108.0	328.	400.	7.50	5.	35.	1.2	13.3
FEB. 16.....	-	-	120.	213.	6.40	-	210.	7.7	9.6
MAR. 2.....	-	-	294.	380.	7.70	-	300.	2.4	9.1
MAR. 17.....	-	-	304.	500.	7.70	-	120.	7.9L	7.9
APR. 5.....	-	-	331.	585.	7.80	-	30.	2.7	11.1
APR. 21.....	-	-	419.	556.	7.50	-	90.	2.9	8.0
MAY 17.....	-	-	305.	474.	7.80	-	200.	7.7L	7.7
JUNE 2.....	-	-	334.	588.	7.70	-	130.	8.9L	8.9
JUNE 16.....	-	-	315.	625.	7.60	-	140.	1.0	7.9
JULY 22.....	-	-	307.	588.	7.90	-	35.	9.2	9.6
AUG. 2.....	-	-	305.	556.	8.10	-	60.	3.1	8.7
AUG. 16.....	-	-	319.	629.	8.00	-	75.	8.6L	8.8
AUG. 31.....	-	-	104.	215.	7.40	-	70.	10.2L	10.2
SEP. 15.....	-	-	323.	546.	7.80	-	80.	2.3	8.2

DATE	31501 CCLIFORM IMEDENDO MF/100ML	31616 FEC COLI MF-C44.5 MF/100ML	31679 STPCOCCI M-ENTCCS MF/100ML
DEC. 7, 1970	130.	50.	82.
FEB. 2, 1971	5.K	4.K	7.
AUG. 2.....	1500.	270.	100.

K Less than.
L Greater than.

Table 7
(Cont'd)

ST. FRANCIS RIVER BASIN

07047500 ST. FRANCIS RIVER AT MARKED TREE, ARK.

LOCATION (revised).--Lat 35°31'20", long 90°25'27", in SE¼NW¼ sec.2, T.11 N., R.6 E., Poinsett County, at gaging station, near left bank on downstream side of bridge on U.S. Highway 63 at Marked Tree, 5.4 miles downstream from Little River, 7.6 miles downstream from dam of Poinsett County Drainage District 7, and at mile 147.0.

DRAINAGE AREA.--5,148 sq mi, includes that of floodway.

PERIOD OF RECORD.--Chemical analyses: October 1945 to September 1946, November 1949 to September 1955, October 1965 to September 1966, October 1967 to September 1971 (1969-71 includes biological).

CHEMICAL AND BIOLOGICAL ANALYSES, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

DATE	DIS-CHARGE (CFS)	DIS-SOLVED IRON (FE) (UG/L)	DIS-SOLVED MAN-GANESE (MN) (UG/L)	DIS-SOLVED CAD-MIUM (CD) (UG/L)	DIS-SOLVED CHRO-MIUM (CR) (UG/L)	DIS-SOLVED COBALT (CO) (UG/L)	DIS-SOLVED COPPER (CU) (UG/L)	DIS-SOLVED LEAD (PB) (UG/L)	DIS-SOLVED NICKEL (NI) (UG/L)	DIS-SOLVED SILVER (AG) (UG/L)	DIS-SOLVED ZINC (ZN) (UG/L)
NOV. 05...	1800	0	90	0	7	3	19	6	14	0	10
DEC. 10...	1470	--	--	--	--	--	--	--	--	--	--
JAN. 14...	824	70	210	0	11	0	6	4	9	--	10
FEB. 18...	1180	--	--	--	--	--	--	--	--	--	--
MAR. 25...	653	--	--	--	--	--	--	--	--	--	--
APR. 29...	1370	40	70	1	0	5	3	6	6	1	30
JUNE 04...	1300	--	--	--	--	--	--	--	--	--	--
JULY 15...	1050	10	60	0	2	0	3	0	1	0	30
30...	1250	--	--	--	--	--	--	--	--	--	--
AUG. 12...	1790	--	--	--	--	--	--	--	--	--	--
SEP. 13...	249	--	--	--	--	--	--	--	--	--	--

DATE	TOTAL MERCURY (HG) (UG/L)	BICAR-BONATE (HCO3) (MG/L)	CAR-BONATE (CO3) (MG/L)	DIS-SOLVED SULFATE (SO4) (MG/L)	DIS-SOLVED CHLO-RIDE (CL) (MG/L)	NITRITE (NO2) (MG/L)	NITRATE (NO3) (MG/L)	TOTAL AMMONIA ORGANIC NITRO-GEN (N) (MG/L)	TOTAL PHOS-PHORUS (P) (MG/L)	HARD-NESS (CA,MG) (MG/L)	NON-CAR-BONATE HARD-NESS (MG/L)	ALKA-LINITY AS CACO3 (MG/L)
NOV. 06...	<.5	208	0	1.8	6.2	.04	.3	.37	.14	190	15	170
DEC. 10...	<.5	240	0	8.4	8.5	.00	.4	.06	.13	210	17	197
JAN. 14...	--	268	0	26	8.7	.04	1.2	.30	.34	230	12	220
FEB. 18...	--	156	0	18	2.8	--	4.8	.75	.85	130	6	128
MAR. 25...	--	276	0	26	5.2	.07	.0	.31	.090	210	0	226
APR. 29...	--	246	0	24	10	.00	.4	.13	.15	210	8	202
JUNE 04...	--	226	0	24	7.8	.05	1.0	.36	.48	190	9	185
JULY 15...	--	238	0	19	9.1	.00	.0	.31	.18	210	22	195
30...	--	200	0	28	8.4	.04	.4	.45	.21	190	24	164
AUG. 12...	--	140	0	24	17	.12	1.1	.50	.25	120	10	115
SEP. 13...	--	292	0	27	15	.05	.2	.38	.11	260	16	239

DATE	SPECI-FIC CONDUCTANCE (MICRO-MHOS)	PH (UNITS)	COLOR (PLAT-INUM-COBALT UNITS)	TOTAL NON-FILT-RABLE RESIDUE (MG/L)	CHEM-ICAL OXYGEN DEMAND (LOW LEVEL) (MG/L)	BIO-CHEM-ICAL OXYGEN DEMAND (MG/L)	IMME-DIATE COLI-FORM (COL. PER 100 ML)	FECAL COLI-FORM (COL. PER 100 ML)	STREP-TOCOCCI (COL-ONIES PER 100 ML)	TUR-BID-ITY (MG/L)
NOV. 06...	369	7.6	3	24	11	2.0	2500	800	180	25
DEC. 10...	414	8.0	10	22	11	2.0	E700	E800	140	300
JAN. 14...	457	8.0	50	52	9	2.0	7400	E6000	--	30
FEB. 18...	293	7.6	9	222	20	2.0	15000	560	480	480
MAR. 25...	472	8.1	20	39	11	3.0	540	420	E48	1
APR. 29...	491	8.1	3	129	8	2.0	--	--	--	75
JUNE 04...	485	8.1	6	96	9	2.6	E8200	840	400	30
JULY 15...	428	7.9	7	116	10	3.1	2100	280	300	180
30...	355	8.0	<10	91	32	--	2800	--	--	40
AUG. 12...	278	7.5	80	97	49	9.0	--	--	--	60
SEP. 13...	514	7.6	15	86	6	4.5	7800	350	540	116

< Less than.
E Estimated.

TABLE 7
(Cont'd)

ST. FRANCIS RIVER BASIN

07047500 ST. FRANCIS RIVER AT MARKED TREE, ARK.--Continued

CHEMICAL ANALYSES, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

FIELD ANALYSES

DATE	TEMPERATURE (DEG C)	SPECIFIC CONDUCTANCE (MICROMHOS)	PH (UNITS)	DISSOLVED OXYGEN (MG/L)	PERCENT SATURATION
NOV. 06...	8.0	390	7.7	10.6	89
DEC. 10...	9.0	384	7.7	9.9	85
JAN. 14...	12.0	459	8.0	8.6	80
FEB. 18...	9.5	292	7.3	9.8	85
MAR. 25...	10.0	485	8.1	10.5	93
APR. 29...	20.5	--	7.9	7.8	87
JUNE 04...	24.5	390	8.1	7.4	88
JULY 15...	30.0	414	7.6	6.4	84
30...	26.0	--	8.2	6.5	79
AUG. 12...	26.5	261	7.0	5.4	67
SEP. 13...	24.0	514	7.6	5.9	69

ANALYSIS OF ADDITIONAL SAMPLES

DATE	ALDRIN (UG/L)	DDD (UG/L)	DDE (UG/L)	DDT (UG/L)	DIELDRIN (UG/L)	ENDRIN (UG/L)	HEPTACHLOR (UG/L)	HEPTACHLOR EPOXIDE (UG/L)	LINDANE (UG/L)
JUNE 23...	.00	.00	.00	.00	.00	.00	.00	.00	.00

DATE	CHLORDANE (UG/L)	PARATHION (UG/L)	METHYL PARATHION (UG/L)	MALATHION (UG/L)	DIAZINON (UG/L)	2,4-D (UG/L)	SILVEX (UG/L)	2,4,5-T (UG/L)
JUNE 23...	.00	.00	.00	.00	.00	.00	.00	.01

DATE	ALDRIN IN BOTTOM DEPOSITS (UG/KG)	DDD IN BOTTOM DEPOSITS (UG/KG)	DDE IN BOTTOM DEPOSITS (UG/KG)	DDT IN BOTTOM DEPOSITS (UG/KG)	DIELDRIN IN BOTTOM DEPOSITS (UG/KG)	ENDRIN IN BOTTOM DEPOSITS (UG/KG)	HEPTACHLOR IN BOTTOM DEPOSITS (UG/KG)	HEPTACHLOR EPOXIDE IN BOTTOM DEPOSITS (UG/KG)
JUNE 23...	<.20	11	14	8.0	36	<.20	<.20	<.20

DATE	LINDANE IN BOTTOM DEPOSITS (UG/KG)	CHLORDANE IN BOTTOM DEPOSITS (UG/KG)	PARATHION IN BOTTOM DEPOSITS (UG/KG)	METHYL PARATHION IN BOTTOM DEPOSITS (UG/KG)	MALATHION IN BOTTOM DEPOSITS (UG/KG)	2,4-D IN BOTTOM DEPOSITS (UG/KG)	SILVEX IN BOTTOM DEPOSITS (UG/KG)	2,4,5-T IN BOTTOM DEPOSITS (UG/KG)
JUNE 23...	<.20	<1.0	<.20	<.20	<.20	<.80	<.30	<.40

< Less than.

TABLE 7
(Cont'd)

ST. FRANCIS RIVER BASIN

07047968 ST. FRANCIS RIVER NEAR WEST HELENA, ARK.

LOCATION.--Lat 34°38', long 90°38', sec.1, T.1 S., R.4 E., Phillips County, near right bank at floating dock approximately 6 miles north of West Helena.

PERIOD OF RECORD.--Chemical and biological analyses: October 1970 to September 1971.

REMARKS.--Records furnished by Department of Pollution Control and Ecology, Little Rock, Ark.

CHEMICAL AND BIOLOGICAL ANALYSES, WATER YEAR OCTOBER 1970 TO SEPTEMBER 1971

DATE	00010 WATER TEMP CENT	01045 IRON TOTAL UG/L	01055 MANGNESE MN UG/L	00915 CALCIUM CA MG/L	00925 MGNSIUM MG MG/L	00945 SULFATE SO4 MG/L	00940 CHLORIDE CL MG/L	00620 NITRATE NO3-N MG/L	00650 T PO4 PO4 MG/L	00500 RESIDUE TOTAL MG/L
OCT. 7, 1970	21.	-	-	-	-	-	7.0	-	-	-
OCT. 21.....	17.	-	-	-	-	-	6.0	-	-	-
NOV. 4.....	15.	-	-	-	-	-	5.5	-	-	-
NOV. 18.....	12.	-	-	-	-	-	14.5	-	-	-
DEC. 2.....	12.	-	-	-	-	-	11.5	-	-	-
DEC. 15.....	11.	0	50.0	30.4	10.00	4.6	6.5	0	0.100	138.
JAN. 12, 1971	3.	-	-	-	-	-	7.0	-	-	-
JAN. 25.....	7.	-	-	-	-	-	4.5	-	-	-
FEB. 9.....	3.	-	-	-	-	-	6.0	-	-	-
FEB. 24.....	8.	-	-	-	-	-	5.5	-	-	-
MAR. 9.....	11.	-	-	-	-	-	3.0	-	-	-
MAR. 23.....	10.	850.	0	33.6	10.90	10.7	6.0	0.25	0.390	255.
APR. 13.....	16.	-	-	-	-	-	7.5	-	-	-
APR. 26.....	20.	-	-	-	-	-	5.0	-	-	-
MAY 26.....	23.	-	-	-	-	-	5.0	-	-	342.
JUNE 22.....	29.	1600.	100.0	29.6	10.00	30.0	5.0	0.20	-	-
JULY 26.....	28.	-	-	-	-	-	8.0	-	-	-
AUG. 10.....	27.	-	-	-	-	-	11.5	-	-	-
AUG. 25.....	28.	-	-	-	-	-	9.0	-	-	-
SEP. 8.....	29.	-	-	-	-	-	9.0	-	-	-
SEP. 21.....	23.	100.	0	48.0	12.60	12.0	8.0	0	1.400	260.

DATE	00900 TOT HARD CACO3 MG/L	00910 CALCIUM CACO3 MG/L	00410 T ALK CACO3 MG/L	00095 CNDUCTVY AT 25C MICROMHO	00400 PH S U	00080 COLOR PT-CO UNITS	00070 TURB JKSN JU	00310 BOD 5 DAY MG/L	00300 DO MG/L
OCT. 7, 1970	-	-	105.	204.	7.30	-	90.	2.4	5.8
OCT. 21.....	-	-	83.	171.	7.50	-	90.	1.5	7.2
NOV. 4.....	-	-	78.	133.	7.30	-	135.	1.7	7.3
NOV. 18.....	-	-	120.	221.	7.60	-	55.	1.7	8.5
DEC. 2.....	-	-	135.	270.	7.70	-	50.	3.2	9.0
DEC. 15.....	117.	76.0	107.	168.	6.60	5.	25.K	4.3	7.2
JAN. 12, 1971	-	-	86.	194.	7.30	-	200.	2.8	12.4
JAN. 25.....	-	-	82.	156.	7.50	-	80.	3.4	10.0
FEB. 9.....	-	-	137.	229.	7.80	-	100.	2.3	11.7
FEB. 24.....	-	-	66.	136.	7.30	-	350.	2.2	9.5
MAR. 9.....	-	-	89.	161.	7.60	-	60.	3.4	11.1
MAR. 23.....	129.	84.0	120.	211.	7.70	40.	110.	3.0	10.4
APR. 13.....	-	-	165.	314.	7.80	-	60.	2.7	9.7
APR. 26.....	-	-	91.	117.	7.30	-	900.	2.5	5.1
MAY 26.....	-	-	97.	215.	7.50	-	190.	3.3	5.0
JUNE 22.....	115.	74.0	103.	218.	7.50	60.	230.	3.4	5.0
JULY 26.....	-	-	-	434.	8.40	-	30.	1.1	7.5
AUG. 10.....	-	-	630.	138.	7.50	-	250.	1.8	5.6
AUG. 25.....	-	-	156.	366.	7.40	-	55.	3.0	6.0
SEP. 8.....	-	-	166.	369.	7.90	-	70.	2.6	7.4
SEP. 21.....	172.	120.0	171.	333.	7.80	10.	25.K	1.8	6.6

DATE	31501 CCLIFORM IMEDENDO MF/100ML	31616 FEC COLI MF-C44.5 MF/100ML	31679 STPCOCCI M-ENTCCS MF/100ML
DEC. 15, 1970	12000.	23.	13.
MAR. 23, 1971	820.	30.	35.
JUNE 22.....	600.	67.	120.
SEP. 21.....	500.	-	560.

K Less than.

TABLE 8

Water Quality Data
All Stations Located in Arkansas

Gaging Station	Year	Temp (OC)		PH (Units)		Desolved Oxygen (MG/L)		Nitrate (MG/L)		Turbidity (MG/L)		Fecal Coliform (MG/100ML)		Strep-Tococci (MF/100ML)	
		Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min
St. Francis River @ St. Francis	1971	28.0	1.0	8.2	6.3	12.4	6.1	6.2	0.1	200	30	170	13	320	34
Big Lake near Manila		29.0	2.0	8.1	6.6	X	X	0.19	0.0	370	20	230	K4	180	27
Pemiscot Bayou near Yarbro		30.0	2.0	8.1	6.4	X	X	1.5	0.0	400	30	270	K4	100	7
St. Francis River @ Marked Tree		30.0	8.0	8.2	7.0	10.6	5.4	4.8	0.0	480	1	E6000	280	540	E48
St. Francis River near West Helena		29.0	3.0	8.4	6.6	X	X	0.25	0.0	900	K25	67	23	560	13
St. Francis Marked Tree	1970	26.0	6.5	7.9	7.4	11.7	6.0	3.6	0.2	160	9	1300	33	2700	140
		28.0	7.0	8.4	7.4	10.8	5.4	5.5	0.3	X	X	650	E30	2000	E10
Marked Tree	1969	29.0	3.0	8.4	7.4	12.2	6.6	1.3	0.0	185	18	770	340	300	34
Marked Tree	1968	31.0	6.0	8.1	7.0	10.9	5.4	1.7	0.0	140	1	X	X	X	X
Marked Tree	1967	X	X	8.1	X	X	X	X	0.0	X	X	X	X	X	X

K= less than
E= estimated
X= data not available

As a result of the generally low quality of alluvial valley streams, and the relatively minor role they play in providing sport and commercial fishing to basin inhabitants, little information concerning the ecology of these waters is available from the respective state game and fish management agencies or other sources. The relative unimportance heretofor attributed to the fishery resource in these streams is attested by the paucity of available water quality data and biological indices. However, four ditches in the Missouri bootheel were sampled for fishery composition and standing crop by representatives of the Missouri Department of Conservation and the Soil Conservation Service, USDA, in August 1972. These ditches are fairly representative of most of the channelized streams in the basin. Results of these collections are shown on Table 9. Many of the cyprinds (minnows) taken in the samples were not identified.

Wappapello Lake provided fishing, hunting, pleasure boating, swimming, camping, hiking, nature study, and other outdoor recreational activity on the 44,000 acres in national ownership for over 1,800,000 visitors during calendar year 1971. This is a 50 percent increase over the 1966 visitation figures. There are presently six multipurpose areas for recreational activities on the lake operated and maintained by the Corps of Engineers. There is one large recreational area operated and maintained by the Missouri State Park Board. In addition, there are numerous small recreation areas on private land adjacent to Government land or on the Federal lands operated by lessees. With increasing demand upon existing facilities, efforts are being made to expand and improve recreational facilities.

Three Federal wildlife refuges have been established in the basin. Big Lake National Wildlife Refuge in Mississippi County, Arkansas, comprises 11,203 acres, Mingo National Wildlife Refuge comprises 21,673 acres in Stoddard and Wayne Counties, Missouri, and Wapanocca National Wildlife Refuge consists of 5,485 acres near the town of Turrell in Crittenden County, Arkansas. The St. Francis National Forest between Helena and Marianna Arkansas comprises 20,600 acres with 19,850 acres (includes 1,045 acres of water) in the St. Francis basin. The Arkansas Game and Fish Commission owns 12,160 acres east of the Big Lake Refuge and has developed green tree reservoirs within that area for managed public waterfowl shooting. By cutting off a low-lying portion of the Big Lake public hunting area, the Commission constructed a 300-acre fishing reservior to complement this state-owned area. Mallard Lake is near the southern boundary of the game area and lies adjacent to the Big Lake Federal Wildlife Refuge. It is accessible from State Highway 18 slightly east of Manila and by State 181 from Blytheville. The area is very fertile and abounds in timber. Primary boat lanes were cut through the timbered areas to benefit anglers, and these lanes also extend around the perimeter of the lake. Access roads have been improved. Access points are under construction, and parking areas with boat launching facilities are planned. Mallard Lake is two miles from Manila and about 15 miles

TABLE 9

Fish Collected with Rotenone from Four Ditches in the Missouri Bootheel Area, August 1972

Common Name	Scientific Name	Percent of Total Catch By Weight	Percent of Total Catch By Number
Spotted gar 2/	Lepisosteus oculatus	0.5	0.3
Gizzard shad 2/	Dorosoma cepedianum	31.0	20.3
Grass pickerel 1/	Esox americanus vermiculatus	0.1	0.3
Carp 2/	Cyprinus carpio	13.4	2.5
Emerald shiner 3/	Notropis atherinoides		
Blacktail shiner 3/	Notropis venustus	1.7	1.3
Carpsucker 2/	Carpiodes sp.	0.1	0.2
Lake chubsucker 1/	Erimyzon sucetta	3.1	14.5
Smallmouth buffalo 2/	Ictiobus bubalus	0.6	0.6
Spotted sucker 1/	Minytrema melanops	0.1	0.1
Northern redhorse 1/	Moxostoma macrolepidotum	1.4	2.1
Black bullhead 1/	Ictalurus melas	2.4	1.8
Yellow bullhead 1/	Ictalurus natalis	8.8	12.2
Channel catfish 1/	Ictalurus punctatus		
Stonecat 3/	Noturus flavus		
Brindled madton 3/	Noturus miurus	0.1	0.1
Flathead catfish 1/	Pylodictis olivaris		
Blackstripe topminnow 3/	Fundulus notatus		
Starhead topminnow 3/	Fundulus notti		
Blackspotted topminnow 3/	Fundulus olivaceus		
Mosquitofish 3/	Gambusia affinis		
Pirate perch 3/	Aphredoderus savanus	2.3	2.8
Rockbass 1/	Ambloplites rupestris	1.0	3.1
Warmouth 1/	Lepomis gulosus	0.3	3.4
Green sunfish 1/	Lepomis cyanellus	1.7	7.1
Bluegill 1/	Lepomis macrochirus	2.1	14.8
Longear sunfish 1/	Lepomis megalotis	1.1	3.4
Spotted sunfish 1/	Lepomis punctatus	4.9	4.3
Spotted bass 1/	Micropterus punctulatus	4.9	1.4
Largemouth bass 1/	Micropterus salmoides	0.9	0.8
White crappie 1/	Pomoxis annularis		
Bluntnose darter 3/	Etheostoma chlorosomum		
Slough darter 3/	Etheostoma gracile		
Cypress darter 3/	Etheostoma proeliare		
Logperch 3/	Percina caprodes	3.0	2.6
Freshwater drum 2/	Aplodinotus grunniens		
Brook silverside 3/	Labidesthes sicculus		

1/ Game fish = 32.8% of total catch by weight;
2/ Nongame fish = 66.1% of total catch by weight
3/ Small forage species were neither weighed nor counted. Weights of these species are negligible. However, since they occur in considerable numbers, a comparison of the numbers of game and non-game species listed in this table is invalid.

from Blytheville in Mississippi County and will service a large, densely populated area. Except for a few Mississippi River lakes, the impoundment offers the only lake fishing in the county. Also, the Missouri Conservation Commission has developed the 6,035 acre Duck Creek Wildlife Management Area adjacent to the Mingo Refuge. In addition to these developments, the Arkansas Game and Fish Commission owns or otherwise controls 16,791 acres of public hunting and fishing lands in St. Francis Lake. Areas in the St. Francis Basin owned or controlled by the State of Arkansas, Missouri and the U. S. Government are listed in Table 10 and shown on Plate 4.

In the five counties in Missouri and the nine counties in Arkansas which comprise the alluvial valley part of the basin, there are 848 known archaeological sites. These are Indian camp sites, villages, towns, and ceremonial centers dating back 8,000 to 10,000 years. Table 11 lists 280 of these sites in the project area that are coded to maps on file in this office. The Parkin Indian Mound and the Wilson Nodena Site in Arkansas are listed in the National Register of Historic Places as having significance from a historic standpoint. The Wilson Site has also been designated as a National Historic Landmark. There are 32 known historic sites in the Arkansas counties of which five may be nominated at a later date for listing in the National Register. These are: Chalk's Bluff Battle Site (Clay County), St. Francis (Clay County), Black Oak (Craighead County), Marked Tree (Poinsett County) and Wittsburg (Cross County). In Missouri, St. Paul's Episcopal Church in Ironton, Fort Davidson near Pilot Knob, the Lilbourn Fortified Village Archeological Site near New Madrid, the Murphy Mound Archeological Site near Caruthersville, the Denton Mound and Village Archeological Site near Steele and the J. M. Wallace Archeological Site (Wardell Mounds) near Wardell are all listed in the National Register. The National Park Service will be requested to investigate and conduct salvage operations of these known sites prior to construction. Additional surveys of the 14-county area by the state archeologists and the state historian for each of the states will very possibly reveal the existence of other sites of either archeological or historic significance. Not all known sites will ultimately appear in the National Register because they may have already been damaged or destroyed by such actions as land forming operations of private landowners, ditch excavation and levee construction activities by both local drainage districts and the Corps of Engineers, activities of artifact hunters, or they may lack adequate significance.

A list of rare and endangered species in the State of Missouri was compiled in 1972 by the Missouri Department of Conservation and the USDA, Soil Conservation Service, with the assistance of a number of individuals having an interest and expertise in this area. Not all of the species listed as rare or endangered in Missouri are so considered elsewhere, since Missouri may be a peripheral part of their native range. Thus, the Missouri list contains fish and wildlife species in addition to those listed by the Bureau of Sport Fisheries and Wildlife in the 1973 edition of their publication,

TABLE 10

ST. FRANCIS BASIN

State Controlled Areas
Location Shown on Plate 4

Designation	Description	Size
	ARKANSAS	
A	Burnt Cane Lake	30.36 Acres
B	St. Francis Sunken Lands and Marked Tree Floodway Project	16,791.91 Acres
C	Big Lake Area	12,160.79 Acres
	MISSOURI	
D	Ben Cash Memorial Wildlife Area	955.85 Acres
E	Armstrong Wildlife Area	548 Acres
F	Reynolds Access Site	200 feet of shoreline
G	Wolf Bayou	203.04 Acres
H	New Madrid Bend Access Site	7.19 Acres
I	Bootheel Fire Protection District	1.00 Acres
J	Bradyville Waterfowl Area	268.51 Acres
K	Fisk Access Site	3.71 Acres
L	Bloomfield Towersite	2.00 Acres
M	Tywappity Community Lake	119.60 Acres
N	Duck Creek Wildlife Management Area	6,035 Acres
O	Yokum School Tract	160 Acres
P	Riverside State Forest (1920 Acres) 15% in the Basin	288 Acres
Q	Vulcan Towersite	377.44 Acres
R	Sam A. Baker State Forest	5,479.32 Acres
S	Coldwater State Forest (4,647 Acres)	2,323.5 Acres

TABLE 10 (Cont'd)

ST. FRANCIS BASIN

State Controlled Areas

Designation	Description	Size
T	Taum Sauk Towersite	83.94 Acres
U	Elephant Rocks State Park	120 Acres
V	Ketcherside Mountain State Forest	2,888.42 Acres
W	Mountain Lake Tract	937.67 Acres
X	Silva Tract	236 Acres
Y	Lake Wappapello State Park	1,864 Acres
Z	Other State Forest Lands	3,000±

U. S. Government Controlled Lands

	ARKANSAS	
	St. Francis National Forest (20,600 Acres)	19,850 Acres
	Wapanocca National Wildife Refuge	5,485 Acres
	Big Lake National Wildlife Refuge	11,203 Acres
	MISSOURI	
	Mingo National Wildife Refuge	21,673 Acres
	Clark National Forest (226,600 Acres) 50% in Basin	113,300 Acres
	Wappapello Lake Area	*44,000 Acres

*Includes Wappapello Lake State Park

TABLE 11

Archeological Sites in St. Francis Basin

MISSOURI

County	Site Designations				
Bollinger	4-Q-1				
Stoddard	4-Q-3	5-Q-6	5-Q-30	5-R-49	6-Q-1
	5-Q-3	5-Q-28	5-Q-31	5-R-51	6-Q-2
	5-Q-4	5-Q-29	5-Q-32	5-R-55	21-K-2
Scott	4-R-14	5-R-28	5-R-35	5-R-42	5-R-52
	4-R-18	5-R-29	5-R-36	5-R-43	5-R-53
	4-R-19	5-R-30	5-R-37	5-R-44	5-R-54
	4-R-20	5-R-31	5-R-38	5-R-45	5-R-60
	4-R-21	5-R-32	5-R-39	5-R-46	23ST-94
	5-R-9	5-R-33	5-R-40	5-R-47	23ST-102
	5-R-16	5-R-34	5-R-41	5-R-48	
New Madrid	5-R-1	5-R-50	5-R-62	21-K-4	23NM-269
	5-R-2	5-R-57	5-R-63	21-K-5	
	5-R-3	5-R-58	6-R-1	23NM-83	
	5-R-8	5-R-59	6-R-7	23NM-101	
	5-R-21	5-R-61	21-K-3	23NM-154	
Mississippi	5-S-19	5-S-20	5-S-25	5-S-28	
Dunklin	6-Q-4	8-O-1	8-P-2	23-J-9	23-K-1
	7-P-7	8-O-2	8-P-3	23-J-13	23-K-2
	7-P-8	8-O-6	21-K-1*	23-J-14	23-K-3
	7-P-9	8-O-8	23-J-1	23-J-17	
	7-P-11	8-O-10	23-J-3	23-J-23	
	7-P-12*	8-O-11	23-J-4	23-J-28	
Pemiscott	7-Q-1	8-Q-4	8-Q-8	8-R-3	
	7-R-3	8-Q-5*	8-R-1*	22-K-1*	
	8-Q-3	8-Q-7	8-R-2	23PM-549	

Site designations are coded to maps on file in this office.

Note: *Denotes sites that may be affected by proposed authorized projects.

TABLE 11 (Cont'd)

Archeological Sites in St. Francis Basin

ARKANSAS

County	Site Designations				
Clay	7-0-3	7-0-8	7-0-14	7-0-19	22-J-2
	7-0-4	7-0-9	7-0-15	7-0-20	22-J-7
	7-0-5	7-0-10	7-0-16	7-P-1	22-J-12
	7-0-6	7-0-12	7-0-17	8-P-1	22-J-17
	7-0-7	7-0-13	7-0-18	22-J-1	
Greene	8-0-12	8-0-16	8-0-20	8-M-1	22-J-8
	8-0-13	8-0-17	8-0-21	9-0-3	22-J-11
	8-0-14	8-0-18	8-0-22	9-0-12	23-I-2
	8-0-15	8-0-19	8-0-23	22-J-6	
Craighead	9-N-2	9-N-9	9-N-16	9-0-11	23-J-9
	9-N-3	9-N-10	9-N-17	9-0-13	23-J-18
	9-N-4	9-N-11	9-0-4	9-0-14	23-J-26
	9-N-5	9-N-12	9-0-7	9-0-15	23-J-27
	9-N-6	9-N-13	9-0-8	9-0-16	24-I-7
	9-N-7	9-N-14	9-0-9	14-M-5	24-I-8
	9-N-8	9-N-15	9-0-15	9-0-10	23-J-8
Mississippi	23-J-1*	23-J-7	24-J-4	24-J-6	24-J-10
	23-J-3	23-J-13	24-J-5	24-J-7	24-J-12
Poinsett	10-M-1	11-M-1	11-M-32	11-M-37	25-J-9
	10-M-2	11-M-4	11-M-33	24-I-9	
	10-M-3	11-M-6	11-M-34	24-J-8	
	10-N-4	11-M-7	11-M-35	24-J-9	
	10-N-5	11-M-8	11-M-36	25-I-9*	
Cross	11-M-2	11-M-16	11-M-26	11-M-42	12-M-3
	11-M-3	11-M-17	11-M-27	11-M-43	12-M-4
	11-M-5	11-M-18	11-M-28	11-M-44	12-M-5
	11-M-9	11-M-19	11-M-29	11-M-45	12-M-6
	11-M-10	11-M-20	11-M-30	11-M-46	12-M-10
	11-M-11	11-M-21	11-M-31	11-M-47	12-M-11
	11-M-12	11-M-22	11-M-38	11-M-48	12-M-12
	11-M-13	11-M-23	11-M-39	11-M-49	12-M-13
	11-M-14	11-M-24	11-M-40	12-M-1	
	11-M-15	11-M-25	11-M-41	12-M-2	
St. Francis	12-M-7	12-M-8	12-M-9	13-M-2	
Lee	13-M-3	14-N-7	14-N-8	14-N-9	14-N-10

NOTE: *Denotes sites that may be affected by the proposed authorized project.

"Threatened Wildlife of the United States." Both the Missouri and Federal lists are tentative since the status of living things is subject to constant change. Without an intensive inventory conducted over a period of years, it is impossible to be sure what species are actually present. This is more true of animals than it is of plants. Table 12 lists those species considered by the state of Missouri as rare or endangered which may occur within the project area. Species which are included in both the State and Federal lists are identified by asterisks.

Although a state list for Arkansas is not yet available, it is logical to assume that most of the species listed as rare or endangered in southeastern Missouri will have a similar status in northeastern Arkansas, particularly within the confines of a commonly-shared watershed such as the St. Francis Basin. Conversely, it is doubtful that the Arkansas portion of the basin contains many rare or endangered forms which are not included in the Missouri list.

TABLE 12

Missouri List of Rare or Endangered Vertebrate Animals Which May Occur in the Study Area

FISH

1.* LAKE STURGEON (Acipenser fulvescens). The occurance of this fish in the St. Francis Basin is highly unlikely. The draft of the preliminary list of rare and endangered species in Missouri states that the lake sturgeon "--- formerly supported a substantial commercial fishery in Missouri, but now (is) taken only occasionally. A similar decline has occurred throughout much of the species range, and appears to have resulted from over-fishing, pollution, and the construction of dams. It is an inhabitant only of the largest Missouri streams, having been recorded from the Mississippi, Missouri, and Osage Rivers."

2.* PALLID STURGEON (Scaphirhynchus albus). This species is also on the Missouri list. It was originally described from the Mississippi River at the mouth of the Illinois River, but is now largely restricted to the mainstem of the Missouri River and the Mississippi River downstream from the mouth of the Missouri. There are no recent records of this fish from Missouri. It is an inhabitant of swift-flowing channels in large, silt-laden rivers and thus is very unlikely to occur in the lower reaches of the St. Francis River in Arkansas.

3. ALLIGATOR GAR (Lepisosteus spatula). This species is rare in Missouri which is the northern edge of its range. It was probably never common in the state. It is recorded in the Mississippi River from St. Louis southward.

4. CYPRESS MINNOW (Hybognathus hayi). Possibly extirpated, this species was formerly common in the lower Black and St. Francis Rivers. Recent attempts to collect it have been unsuccessful. It is an inhabitant of quiet pools and backwaters in lowland streams.

5. PALLID SHINER (Notropis amnis). This species is considered extirpated in Missouri. It was common and widespread in the eastern part of the state some 30 years ago, but has not been collected recently. The pallid shiner is an inhabitant of quiet pools in streams ranging in size from medium-sized creeks to large rivers.

6. TAILLIGHT SHINER (Notropis maculatus). This species is also possibly extirpated and was formerly found in the lower Black and St. Francis Rivers which constitute the northern edge of its range. No specimens have been collected for about 30 years. It is an inhabitant of the sluggish sections of lowland creeks and rivers.

7. PUGNOSE MINNOW (Opsopoeodus emiliae). This species is considered endangered in Missouri. It was formerly common in the lowlands of the southeastern portion of the state, but is now rare. It thrives only in the clear, heavily vegetated waters of lowland lakes and streams.

8. BROWN BULLHEAD (Ictalurus nebulosus). Rare in Missouri, which is the western edge of its range, this species was probably never abundant in the state. It is common in Mingo Swamp, but otherwise known only from a ditch in Stoddard County.

9. GOLDEN TOPMINNOW (Fundulus chrysotus). This fish is possibly extirpated since it has not been collected in Missouri since 1946. It is known from only two localities in Dunklin and Pemiscot Counties. Its habitat is quiet, weedly backwaters and oxbows in lowland streams.

10. BANTAM SUNFISH (Lepomis symmetricus). This is a rare species. It is present in Mingo Swamp, but has never been recorded elsewhere in the state. It is a lowland species, inhabiting clear, quiet water having much aquatic vegetation and standing timber.

11. HARLEQUIN DARTER (Etheostoma histrio). This is considered an endangered species. It is presently restricted to the lower Black and St. Francis Rivers, but was formerly more widespread in southeastern Missouri. It inhabits backwaters in large, lowland rivers.

12.* LONGNOSE DARTER (Percina nasuta). This is an endangered species, formerly present in the White River, but apparently eliminated by construction of large impoundments. It is otherwise known in the state from only two small specimens collected in the St. Francis River. Although reported elsewhere from vegetated backwaters, Missouri specimens were taken from a swift riffle.

MAMMALS

1. SOUTHEASTERN SHREW (Sorex longirostris). This specie is widely distributed in the southeastern United States and northward into northern Illinois. A single specimen is reported from southwestern Missouri. It probably occurs in the southeastern lowlands, which are more typical of its natural habitat, but is otherwise largely peripheral.

2.* WESTERN BIG-EARED BAT (Plecotus townsendi). Although a predominantly western species, it occurs in southwestern and, perhaps, southern Missouri. It utilizes caverns during winter and has suffered from increased human disruption of caves. The race ingens is also called Ozark Big-Eared Bat.

3. EASTERN BIG-EARED BAT (Plecotus rafinesquei). This species occurs predominantly in the eastern and southeastern Unted States. It is believed to occur in limited numbers in southeastern Missouri.

4. LONG-TAILED WEASEL (Mustela frenata). Although this species occupies virtually all of the United States and Mexico, there is evidence of marked decline in its abundance in Missouri since the early 1950's.

5. RIVER OTTER (Lutra canadensis). This species formerly occurred along all major streams in Missouri. Although occasionally reported along the Missouri River and its major tributaries, it is now confined almost entirely to the southeastern portion of the state.

6. SWAMP RABBIT (Sylvilagus aquaticus). This is considered a rare species. It is occasionally reported along the rivers and streams in southwestern and south-central Missouri, but it is primarily found in the Mississippi Lowland zoogeographic region. Marsh drainage and intensive land-use programs have severely restricted its range.

BIRDS

1. MISSISSIPPI KITE (Ictinia misisippiensis). Though listed as rare, this species appears to have increased during recent years. In Missouri, it nests primarily in the southeastern lowlands.

2. SHARP-SHINNED HAWK (Accipiter striatus). This an endangered species whose range includes most of the United States, but is more frequently encountered in the northern states. Its occurance in Missouri is mostly migratory; rarely as a breeder.

3. COOPER'S HAWK (Accipiter cooperii). This hawk is endangered similarly to the sharp-shinned Hawk, but is observed in Missouri even less frequently.

4. RED-SHOULDERED HAWK (Buteo lineatus). This is a rare species formerly common throughout Missouri, but now primarily found in southern and southeastern portions of the state.

5.* BALD EAGLE (Haliaeetus leucocephalus). The southern subspecies H. l. leucocephalus, formerly nested in Missouri. No evidence of nesting has been reported since 1966 and it is considered extirpated in the state. The northern subspecies, H. l. alascensis, is considered rare and winters in Missouri in fair numbers.

6. OSPREY (Pandion haliaetus). This is an endangered species which formerly nested along rivers in southern Missouri. There may still be some nesting, but there are no recent observations. It is seen frequently in the state during migration.

7.* PEREGRINE FALCON (Falco peregrinus). This is a rare species which formerly nested in Missouri, but now is seen only rarely during migration.

8. KING RAIL (Rallus elegans). Formerly distributed statewide, this species is becoming increasingly rare because of the destruction of marsh environments through drainage and channelization programs.

9. BARN OWL (Tyto alba). This bird is widely distributed throughout the state and all of central and eastern United States, but it is uncommon throughout its range. It is considered a permanent resident in Missouri.

10. FISH CROW (Corvus ossifragus). This is a rare species, though locally common along the Atlantic and Gulf Coasts and Mississippi River, north to the Bootheel. Southeastern Missouri is the northernmost extension of its range.

11. SWAINSON'S WARBLER (Limnothlypis swainsonii). This is a rare bird known to exist only in the canebreak understory of mature bottomland hardwoods of the southeastern lowlands.

AMPHIBIANS AND REPTILES

1. WOOD FROG (Rana sylvatica). This species is possibly extirpated in Missouri where it has been considered a relic whose survival is tenuous. It is widely distributed in the eastern United States and southern Canada.

2. ALLIGATOR SNAPPING TURTLE (Macroclemys temmincki). This turtle is the largest in the United States and is rare throughout its range, which is comprised mainly of states bordering the Gulf Coast and Mississippi River. In Missouri it is found in the large turbid streams of the southeastern lowlands.

3. GREEN WATER SNAKE (Natrix cyclopion). This is a rare species, found primarily along the Lower Mississippi Valley and Gulf Coast. Southeastern Missouri is the northern-most extension of its range. It is known to occur in Butler and Dunklin Counties and perhaps elsewhere in the southeastern lowlands.

4. SCARLET SNAKE (Cemophora coccinea). The two known records of this snake in Missouri are from Dunklin and Phelps Counties. Since it is very secretive, it may be more widely distributed than these sightings indicate. The species is rare throughout its range.

* Species also listed in the Bureau of Sport Fisheries and Wildlife's 1973 Edition of "Threatened Wildlife of the United States". (30)

The list of species in Table 13 are classified by Missouri as being of "undetermined" status. In other words, there is not enough information at the present time to determine their status. However, state officials believe that they should be considered rare or endangered until their status is definitely established.

TABLE 13

Species of Undetermined Status in Missouri
(Possibly Occuring in Study Area)

Common Name	Scientific Name
Spotted Skunk	Spilogale putorius
Pigeon Hawk	Falco columbarius
Wood Ibis	Mycteria americana
Virginia Rail	Rallus limicola
Purple Gallinule	Porphyrula martinica
Common Gallinule	Gallinula chloropus
Black-billed Cuckoo	Coccyzus erythrophtalmus
Long-eared Owl	Asio otus
Hooded Warbler	Wilsonia citrina
Mole Salamander	Ambystoma talpoideum
Three-Toed Congo Eel	Amphiuma means tridactylum
Illinois Chorus Frog	Pseudacris streckeri illinoensis
Eastern Spadefoot Toad	Scaphiopus holbrooki

The alluvial valley portion of the St. Francis Basin, over a period of a little more than 100 years, has been almost totally transformed through the removal of essentially all merchantable timber from the "Great Swamp," an immense hardwood forest intermingled with streams, lakes, bayous, and cypress brakes to a highly productive agricultural area. With protection afforded by early flood control and drainage works accomplished by local people and following construction of the levees along the Mississippi River, the transformation from forested wetlands to agricultural uses was hastened. Thus, with the entry of the Federal Government upon the scene in 1936 for the purpose of continuing and improving flood control and drainage works, the natural environment of the basin had already been drastically changed and the alluvial valley was well on its way to becoming a highly productive agricultural area of major importance to the overall economy of the states of Missouri and Arkansas and the Nation.

A metamorphosis of the eastern Arkansas and Missouri delta was initiated with the advent of the first Neolithic Indian in the area. Obviously, the activities of those first farmers were not of a nature to leave the permanent scars as would those of modern settlers. Nevertheless, drastic and continuing changes in the natural character of this rich wilderness were inevitable. With the coming of the white man and his mechanical culture, the process was greatly accelerated. Probably no one single event had more effect on the area than the Swamp Land Act of 1850. By this Act, the swamp lands obtained under the Louisiana Purchase were given to the states, with the provision that money from the sale of these lands be used for reclaiming and developing them. A new impetus was given to drainage and flood control efforts. Too much water, too often, had been the primary inhibiting factor preventing man from adapting the delta to suit his needs and desires. Construction of drainage ditches and levees by local drainage and levee districts and individuals in the St. Francis basin continued unabated with little significant participation by the Federal Government until 1928. The Flood Control Act of 1928 gave the Mississippi River Commission the responsibility to prepare and put into being a flood control plan for the Lower Mississippi River Valley. The strengthening and improvement of main line Mississippi River levees protecting the St. Francis basin from headwater overflows was included in that plan. It was not until the Flood Control Act of 15 June 1936 was passed that the Corps of Engineers began to play an active role in the construction of flood control works within the basin. That Act assigned the Corps the task of taking over major flood control and drainage works and improving, modifying and supplementing them. This work has been progressing ever since and so has the improvement of the tributary drainage system been continued by local people. This explanation is made not as an attempt to minimize the part played by the Federal Government in altering the natural environment of the basin but, rather, to simply point out the difficulty in differentiating between impacts of the federally-implemented flood control works and those resulting from activities of the private landowners. It would be as erroneous to attribute to this project a preponderance of the environmental changes as it would be to pretend it has had no effect.

3. Environmental Impact of the Proposed Action. In the case of the St. Francis Basin Project, the proposed action is: to continue with the construction of the authorized, but not completed, flood control features; the continued maintenance of the completed portions of the project; the continued development of recreation facilities at Wappapello Lake; the continued maintenance of the lake and its associated recreation facilities; purchase of the authorized fish and wildlife mitigation lands; continued construction of the water level control structures in Ditches 60 and 61 at the foot of St. Francis Lake and construction of control structures at the north end of Big Lake; and the plugging of the bendway created by the Wilhelmina Cutoff.

The completion of the authorized channel improvements will reduce the frequency and duration of flooding on about 819,000 acres, including the low-lying portions of such basin communities as Hayti, Missouri, and Blytheville, Lepanto, Marked Tree, and Parkin, Arkansas, adjacent to the ditches authorized for improvement. The improved ditches will provide protection from a 10-year flood except that the Little River Ditches and their attendant tight spoil bank levees will contain a 25-year flood.

Operation of the W. G. Huxtable Pumping Plant, in conjunction with protection afforded by closure of the main line levee, will protect some 532,000 acres in the lower St. Francis basin from a Mississippi River backwater flood having a frequency of once in a hundred years. The pumping plant will consist of ten pumps, each operated by a 3,600 horsepower turbo-charged Diesel engine equipped with an industrial silencer. Operation will be required for an estimated average of 33 24-hour days annually, with maximum operation time estimated at 90 days. Fuel storage tanks for operating the pump engine will be located above ground and will be provided with retaining dikes which will prevent spillage or leakage into the stream. The remoteness of the location of the pumping plant will prevent noise from having a significant effect on the human environment. Water used in the engine heat exchangers will be drawn from the stream and discharged along with the pump effluent. On an average, temperature of cooling water thus circulated will increase 11.8 degrees Fahrenheit and in turn will increase the temperature of the water being pumped by 0.0224 degrees Fahrenheit. This is well within the 5 degrees Fahrenheit allowable for a stream as permitted by water quality criteria for interstate streams in the state of Arkansas. The water circulation and heat exchange systems will be equipped with 1/4-inch mesh screens on the intake lines. The trash racks in the forebay have bars spaced at 5-1/2-inch clear openings. Sanitary sewage from the pumping plant, manager's residence, and restroom facilities associated with adjacent recreational developments will be disposed of through septic tanks and absorption fields which fully comply with rules and regulations of the Arkansas State Department of Health, U.S. Public Health Service, and Environmental Protection Agency. A minimum water level will be maintained in the channel above the pumping plant by a fixed weir at elevation 165.0. About 20,000 acre feet of permanent upstream water storage will be provided by this feature. The width of the

river at 165 msl varies from 400 to 600 feet for the first three miles upstream from the pumping plant. For the next 15 miles, it varies in width from 300 to 500 feet. Over 2,000 surface acres along the main stem and its major tributaries will be accessible by boat at the minimum water level provided by the weir. During periods of heavy runoff when the Mississippi River is at or above 177 feet msl, the surface elevation of the St. Francis River will be permitted to rise to elevation 177 feet msl before pumping is initiated. Pumping will continue until the water surface elevation in the sump has fallen to 175 msl. When the Mississippi River is below 175 msl, normal gravity flow will resume. Extensive landscaping is planned in the vicinity of the pumping plant and the resident manager's area. Also, the picnic area and boat launching area will be appropriately landscaped. All construction areas not reforested will be planted with an appropriate ground cover to eliminate unsightly scars and spoil areas.

Reductions in flooding, whether from headwater or from backwater sources, will reduce loss of crops and damages to residences, businesses, roads, and other public and private improvements. These reductions in losses will benefit not only the individual landowners, residents, and businessmen directly affected by flooding but will also have secondary effects on the incomes of merchants and businessmen who are dependent upon expenditures and products of these individuals for their livelihood. The economic growth of the basin and region and the general standards and quality of life of inhabitants will be considerably enhanced. The median family income in the counties directly affected by the project is only 54 percent of the national average. Reduction in flood threat and damage will contribute to improved farm management and will be reflected in a generally higher quality and better appearance of rural dwellings, farmsteads and urban areas. Increased agricultural income will provide a more equitable sharing of the national well-being.

Improvement of the ditch systems will reduce vector problems and health hazards such as exist at Blytheville, Arkansas, by carrying the effluent from sewage treatment facilities on downstream instead of overflowing lands adjacent to the ditches as it now frequently does.

Continued development of the recreation facilities at Wappapello Lake will improve the quality and quantity of the recreation experience of the people who take advantage of the opportunities afforded by the lake and will provide an opportunity for future generations to enjoy outdoor recreation experiences. The lake and its associated lands provide an opportunity for the people, by participating in outdoor recreation activities, to relax from the tensions of normal daily life.

In addition, construction of the water level control structures, the purchase of the authorized lands, and the other fish and wildlife features of the project will serve both to mitigate losses to this resource and to provide some measure of enhancement in St. Francis Lake, Big Lake, and in the Wilhelmina Cutoff.

A March 31, 1973 report to the Council on Environmental Quality by Arthur D. Little, Inc. analyzed the effects of 42 stream channelization projects, including an assessment of the effects on existing water quality that increased agricultural production and increased use of herbicides, pesticides and fertilizer might have. One of the streams included in this report is in the St. Francis Basin. The following is, therefore, quoted from that report:

> "The physical effects of upstream channel modifications on downstream water bodies divide between effects on flow magnitudes and water quality. The logical assumption and expectation is that widening, deepening and straightening channels speed flows out of channelized areas--as flood control channels are designed to do--thereby contributing to flood peaks and flooding downstream. Similarly, it is logical to suppose that quality constituencies of flows from channel reaches will be transported more quickly and farther downstream than under natural stream conditions. The quality constituencies may be of great variety, but the normal concern is over sediments--dissolved or suspended--and other non-degradable chemicals, such as from herbicides, pesticides and fertilizers. Biodegradable contaminants normally have origins neither directly nor indirectly related to channeling, unlike channel-related sediments and project-induced chemical applications. In any event, they are dealt with by both natural and mechanically accelerated waste-assimilative processes.
>
> Without doubt, these downstream flow and quality effects are real and not imaginary. Unfortunately, we cannot provide precise factual data to confirm or deny these assumptions and expectations. A number of reasons make it virtually impossible to isolate from a host of

contributing factors to downstream conditions those which are detrimental results of upstream channel modifications. The major factors are as follows:

(1) As is often pointed out and as we discuss above, channel alterations may reduce flows in channelized areas and downstream because of lowered water tables and reduced capacities of drained areas to recharge stream flow. Antecedent conditions of bank storage and flow in streams are important influencing factors on the timing, magnitude and duration of flood peaks downstream. Rarely do we find that discussions of adverse downstream effects recognize concomitant beneficial effects of reduced upstream recharge capacity and vice versa. The two issues seem always to be treated separately as though they were unrelated. The same argument may be advanced with respect to water quality. Normal flow conditions may be impeded by reduced stream recharge capacity, hence impeding transport of contaminants downstream, while high flood flows would be expected to dilute, disperse and transport contamination load more quickly.

(2) The contributing sources of downstream flow and water quality often extend beyond the immediate area of influence of channelized areas. Where a direct upstream-downstream relationship can be established, a reasonably reliable assessment can be made. Where the downstream flood hydrograph is strongly influenced by runoff unrelated to channelized reaches, no such assessment is possible. Similarly, under these and even normal flow circumstances, the sources of downstream water contamination cannot be accurately traced.

(3) Flow effects are additionally rendered inconclusive by upstream storage regulation or downstream pumping operations, both often operated in conjunction with channel conveyance operations, and to a lesser degree by upstream land treatment measures and project-induced land use changes, whether detrimental or beneficial with respect solely to runoff.

(4) Quality effects are additionally rendered inconclusive by uncertainty as to pre-project and project-induced land use changes and associated sediment yields and chemical applications.

(5) The physical characteristics of many downstream water systems and their associated uses are such that increments--or decrements--of both flow and quality conditions can be absorbed with negligible impact. That is,

downstream floodplains may be unoccupied and receiving waters may have large capacities to hold flows and dilute contaminants relative to upstream channel project-related contributions.

Therefore, while one may sense intuitively that downstream effects are always adverse, and while we have found circumstances which bear out these widespread expectations, it seems appropriate to recognize some of the uncertainties and unknowns as well as those circumstances which tend to offset or mitigate expected adverse results. In this regard, Wolman's conclusions in 1971 seem most relevaant today and in the light of our own investigations.

> 'The paucity of information and the handful of investigators concerned with evaluating trends in the quality of the rivers of the United States suggest some specified conclusions. First, none of the observational programs were designed specifically to measure the quality of rivers or the river environment. The sampling programs emphasize the measurement of specific characteristics primarily related to water use by industry and municipalities. The new National Water Quality Network should improve on this single objective orientation (52). Few observational programs combine the necessary hydrology with measurements of water quality, river characteristics, and biology. While some long-term observations exist, the lack of coordinate observations makes long-term comparisons virtually impossible. For this reason, one must resort to the selected or case method described here. In addition, as Dworsky and Strandberg (53) emphasize, interpretation is 'the vital part of the task of water quality assessment.' Such interpretation requires the knowledge and skill of analysts familiar both with the data and with the changing characteristics of the land use and economy of the drainage basin. The new emphasis on quality of the environment demands continuing assessment and interpretation.
>
> A second conclusion from the available data suggests that surrogate measures of river and water quality as well as a multiplicity of measurements of easily measured parameters may shed little light on the dynamics of the processes active in river systems and hence such measures may be of limited use in estimating the likelihood of reversing specific observed trends in the absence of a knowledge of their causes. Additional attention must be given to the measurement of parameters related to models of river behavior and to estimates

of inputs based on budgets of material derived from industrial outputs and land use.

> Third, while hydrologists have long been concerned with variability of the flow of natural rivers, because of the difficulty of observation, much less attention has been given to the variability of biological activity as well as physical variability associated with natural variations and cycles in rivers. Many measurements of biological effects are done during low and summer flows where measurement is easy, organisms often flourish, and concentrations of various substances in the flow are high. The effect of winter flow on the growth of slimes on the bottom of rivers, for example, and the special signifiance to the flora and fauna of periodic floods are not well documented. Significantly, however, among the most common trends in river management is the progressive regulation of flow through the provision of storage. Conceivable regulation rather than pollutants alone may have the most far-reaching effects on the character of many river systems. To date, observations have not been designed to measure these effects.
>
> Because the demands on the waters of the rivers of the country are increasing, the concept of threshold and irreversibility must be studied on (i) pristine waters to disclose the nature of the initial, presumably biological, changes which take place and (ii) specific rivers where large scale control or cleanup programs have been initiated. It may well be that observations designed to detect 'polluters,' that is, observations designed to support the enforcement of standards, may not in themselves provide satisfactory measures of thresholds, trends or reversals of trends. If one is to judge the effectiveness of the expenditure of large sums of money, observational tools must be designed to evaluate the response of the rivers to these expenditures.'

Our earlier draft report asserted that this downstream effects issue seemed somewhat over-rated. On careful re-examination of all the data assembled in the course of our 42-project survey, we are still of that belief.

We could speculate on the aesthetic effects of the possible alternatives to channel modification which are discussed more generally in Chapters Eight and Nine. Non-structural alternatives, of course, have no effect. Reservoirs in lieu of channel work displace and change in kind aesthetic damage. Lands upstream of the protected area are inundated, creating a

physical change which often is not particularly unpleasant or severe. Levees leave river untouched, unless material is "borrowed" from the channel, but can have a significant aesthetic effect on adjacent lands. If some structural alternatives are selected, physical change is minimized by clearing and snagging of obstructions rather than excavating and by following the natural alignment of streams, rather than by realigning that cuts off oxbows and creates straight floodways.

The design of the channel modifications influences its extent of physical change materially. Earth channels are less degrading than paved or riprap channels. Excavation from one bank only leaves one bank untouched. Depending on how the excavated bank is vegetated, the untouched bank can be an aesthetic asset or it might produce a peculiarly unbalanced or lopsided effect. Proper smoothing of excavated material also minimizes physical change. Loss of vegetation can be minimized through careful specifications and supervision of construction contracts and maintenance agreements. These measures, and many others, require careful consideration during design and planning, additional effort in construction and maintenance, and the determination of taking areas or rights-of-way.

The long-term physical changes which we have observed or would expect in proposed projects range from negligible to severe. The base from which to consider physical change is of course the pre-existing condition in rural and urban areas. Also, soil and climate have a pronounced influence on the degree to which physical change is permanent. The first listing occurred from what we are reasonably certain were pre-project conditions because they were either ditch restoration projects, or they involved negligible or no realignment of natural watercourses, along which natural or induced revegetation now seems re-established to densities and heights very similar to surrounding natural areas. These projects are:

Pine Bluff
Fish Bayou (St. Francis Basin)
Chicot-Desh-Drew
Grady Gould

NOTE: The above projects are located in Arkansas.

Water Quality

Water quality management is not an intended purpose of channel projects. The most pronounced or readily identifiable effect of channeling on the several parameters by which water quality is measured is that associated with turbidity or suspended sediments. We have observed turbidity conditions of a relatively minor to a highly significant degree in virtually all channels. The condition is associated primarily with the soil conditions unique to each area and more specifically to their erosive qualities generally, rather than to the direct effects of unstable channel bank conditions occasioned by modifications. Also, in several instances it was extremely difficult to isolate the cause of turbidity between internal channel project sources and external activities such as highway construction and housing developments. It is also recognized that turbidity is highly variable over time, and our observations were inconclusive in some

instances of obviously pronounced turbidity because the channel works were observed during periods of intense precipitation and runoff." (15)
This is the end of material quoted from Arthur D. Little, Inc.

In addition to the effects of sediment and chemicals resulting in direct lethalities to aquatic life, there will be indirect impacts resulting in an overall reduction in diversity of the ecosystem. This results in fewer pathways through which materials can cycle and energy can flow. Gross primary productivity of the natural system is thus continually lowered as man increases net primary production on agricultural lands through energy subsides such as cultivation. An example of reduced primary productivity and consequent impact upon food availability is the loss of stream cover (green plants) upon which insects and benthic organisms are dependent, which in turn constitute the food supply for fishes.

Soybeans presently comprise about 59 percent of the basin crop total, and this percentage is expected to increase. Soybeans do not generally require the application of nitrogen fertilizers, in fact good agricultural practices would indicate that, except possibly in the early growing season, nitrogen not be applied since the plants would then use the available free nitrogen rather than fix nitrogen by symbiosis. Phosporous would likely be fixed in the soil and not enter the waterway. Recommended pesticides for soybeans, such as Captan, are non-persistent and biodegradable, and would not be expected to reach the waterways. Increased erosion is common with any row crop, but sediment transport can be controlled to a great extent through on-farm uses of grassed waterways and other recommended land treatment measures.

Cotton is the second most popular crop and the acreage presently being planted is not expected to change drastically. The growing season for cotton is longer than required for soybeans, therefore, the higher elevations are presently being planted to cotton and this trend is not expected to change. The use of herbicides and fertilizers and their effects on adjoining streams will change only as improved farming practices dictate.

Continued maintenance of the completed features will assure that the benefits from the construction expenditures are actually realized by the people of the basin and the nation, and that the productive capability of the alluvial valley lands is available to satisfy a significant portion of the nation's food and fiber need.

The continuation with the construction and maintenance of the project is not expected to cause major shifts of population either into or out of the basin; from rural to urban areas, or vice versa; nor will the project have any effect on any of the historic and archeological sites listed in or proposed for inclusion in the National Register of Historic Places. With the large number of known archeological sites in the counties in the alluvial valley, the construction of the remaining parts of the projects, largely consisting of widening and deepening of existing ditches, will of necessity require that work be accomplished in the vicinity of some of these sites. Care will be exercised in future construction to protect any such sites. In general, camp sites are located on higher grounds and ridges away from stream courses. It is believed that adverse impacts are avoidable in most instances and can be minimized in the remainder. This can be accomplished by seeking the advice of the archeological centers before starting con-

struction and when sites are encountered during construction. Certain of this type of possible adverse impacts can be avoided or minimized by such techniques as enlarging the ditch from one side only or if disruption of an important site cannot be avoided, salvage operations can be undertaken to preserve the data.

In order to quantify the magnitude of the influence of this project on the groundwater of the area, the present hydrologic system must be defined and its operation understood. The geology, physical dimensions of the valley, slope of the valley, thickness of aquifers, soil types, permeability of materials, land use, etc., must be evaluated to adequately determine the factors that influence the groundwater.

Geology. The area of interest for the purpose of this discussion is confined to the recent alluvium, that is, the deposits above the older Tertiary deposits. The Tertiary varies in depths from at or near the ground surface to as much as 200 feet. The elevation of the top of the Tertiary is a result of scouring by the ancient Ohio and Mississippi Rivers during glacial periods when the sea level was lower due to the large continental ice masses. As the ice melted and the sea level rose, deposition started on top of the Tertiary. The deposits, being laid down by water, grade from coarse to finer in a north to south direction, that is, the upstream region where the velocity was greater, larger particles were dropped and in the slower flowing downstream area, the finer sands were deposited. Further complication of the valley geology is evidenced by the presence of abandoned channels filled with fine-grained material and backswamp deposits resulting from floods. The St. Francis basin has been the subject of detailed geologic mapping. This information is contained in the Waterways Experiment Station Technical Report No. 3-6590 "Geological Investigation of the St. Francis Basin" by R. T. Saucier, dated September 1964. The geological maps included in the report are to a large scale (1:62,500) so that relatively small swales and channel refills are readily apparent. This report along with several Geological Survey papers, textbooks, and Dr. Fisk's classic report, "Geological Investigation of the Alluvial Valley of the Lower Mississippi River," dated 1 December 1944 were used to develop the geological setting.

Geometry of the Valley. The alluvial valley has its maximum dimension of 150 miles in the north-south direction. It is bounded generally on the west by Crowleys Ridge and on the east by the Mississippi River, an average distance of about 50 miles. The elevation of natural ground in the valley varies from approximately 350 feet mean sea level at Wappapello Dam in Missouri at the upper end, to approximately 180 feet mean sea level at the site of the W. G. Huxtable Pumping Plant at the lower end. The gradient of the stream is steeper in the northern end of the project and becomes flatter at the lower end.

Soil Types and Properties. The recent alluvium generally consists of fine grained overburden materials of silts and/or clays of limited thickness underlain by fine sand becoming coarser with depth, with occasional gravel layers above the Tertiary. The exception to this is the deep "clay plugs" or channel refills which extend to depths

in excess of 40 feet. The coarser sands are generally found at the northern end of the valley and exhibit a higher permeability than the finer sand deposits of the lower reaches of the valley. Channel refill and backswamp deposits are more numerous in the lower reaches.

Subsurface Water. Subsurface water originates chiefly from infiltration of rain water and from seepage from lakes, streams, ponds, channels, and reservoirs. The upper strata of soil in the zone of aeration contains both air and water in the pore spaces or voids. Water in this zone is called suspended or vadose water, or soil moisture. The depth of this zone varies from ground surface in swamps to several feet in other areas. The water in this zone may be gravity water in larger voids which is percolating downward, capillary water suspended in the small voids, hygroscopic moisture adhered to the soil grains or water vapor. The zone of saturation exists below the zone of aeration. The soil strata in this zone are completely saturated, that is, the voids are filled with water. The interface between the zone of saturation and the zone of aeration is the groundwater table or phreatic surface. Both of the terms define a surface on which the hydrostatic pressure is atmospheric. The water within this saturated zone is the groundwater. It is common in soil testing to define the depth to the groundwater table as the measured depth to the water in a test hole, 24 hours after completing the test hole. Data used in this study were taken in this manner.

The groundwater is in motion, flowing through the voids in the soil structure from areas of high potential to areas of lower head. Since the valley slopes generally from the north to the south, the general direction of groundwater flow is toward the south. The subsurface sands in the valley are analogous to an underground river which would eventually dry up if it were not replenished by surface water in the valley. The level to which it could be depleted is limited by the water level in the Mississippi River, since the valley parallels, and is terminated by, the Mississippi. The majority of the "clay plugs" lie parallel to the gradient of the valley. These features tend to impede lateral movement of water and assist in making the general direction of underground flow in a north-south direction. Groundwater measurements verify that the general direction of flow is in a southerly direction.

The drainage channels planned for this basin are relatively small in comparison to the overall width of the valley. The increased channel depths are to be between 2 and 6 feet, and in many cases the work is limited to simply enlarging the existing ditches. The nature of the soils in the area greatly restrict the depth of excavation possible without costly dewatering schemes. If the depth of channel excavation violates the water table by very much, the phenomenon of piping of material occurs as the gradient increases. That is, as the ground water gradient resulting from the excavation increases, the pore water pressures increase until they exceed the gravity weight of the soil particles and the shear strength of the soil mass. This imbalance of forces results in a progressive sloughing of the side

slopes, hampering or halting further excavation. This action restricts the depth to which it is economically practical to excavate a channel.

Since the streams are small in comparison to the valley width, it would be reasonable to assume an infinite supply of groundwater for design purposes. Once this assumption is made, radii of influence can be established for various soil types encountered in the valley. The radius of influence is defined as the radius of a circle, with a well at the center, beyond which the well has no significant influence on the original groundwater levels. As the channels approach the classical partially penetrating slot of infinite length rather than a single well, the radius of influence is used here to describe a lateral distance from the channel beyond which the channel has no significant influence on the original groundwater level. The larger radii of influence would occur in the more pervious sands. Lowering the water surface 6 feet in a channel would increase the radius of influence by approximately 600 feet in sand of the type encountered in the St. Francis Basin. Where the channel passes through clay, the radius of influence might be only a few feet. In many locations, old channel refills lie adjacent to and generally parallel the existing ditches and streams and interfere with the development of drawdown, reducing the radius of influence. With the exception of localized areas adjacent to deepened channels, the completion of this project would have no effect on the overall water table in the basin.

As the water table is lowered in the near vicinity of a deepened channel, the recharge potential of the surrounding aquifer should be greater. The permeability of a material defines its ability to permit the passage of a fluid by a flow process. The permeability characteristics of the more pervious soils in the valley are such that they differ laterally and vertically. Owing to the layered particle orientation resulting from the method of deposition, the horizontal permeability is approximately four times as great as the vertical permeability. The lowering of a channel grade then increases the vertical area through which water can pass horizontally from the stream to the surrounding aquifer during times of high water. The recharge of the aquifer would then be at a faster rate than if it resulted from ponded water percolating downward in a vertical direction.

Normally following the completion of a project of this nature, agricultural activity increases within the area. The percentage of meteroric water (derived from precipitation) occurring as overland flow will generally increase as a result of the reduction in the forest covered area. Water moving on top of the ground surface enroute to a channel is designated as overland flow. Vegetal cover does increase infiltration (passage of water through the soil surface into the soil) as compared with barren soil because (1) it retards surface flow, giving the water additional time to enter the soil; (2) the root systems make the soil more pervious; and (3) the foliage shields the soil from raindrop impact and reduces rain packing of the surface soil. These effects are more applicable when the barren areas are, as the term implies, void of plant life. This is not always the case with farm land, because several months in a year the land will have plant cover. The significance of rain pack is not as severe either, because the packing effect produced by the rain is interrupted periodically by the farming process (discing,

plowing, planting, etc.). Although farming should tend to make the land more permeable than completely barren land there still should be an increase in overland flow. There also should be a decrease in times of concentration of flood flow and an increase in peak flow as a result of increasing the overland flow which reaches the streams much faster than interflow (or subsurface flow) water which infiltrates the soil surface and moves laterally through the upper soil layers until it enters a stream channel without ever reaching the watertable and groundwater flow (water which percolates downward until it reaches the watertable before entering a stream channel).

Due to the geometry of the valley and the geological features present, it will be difficult to change the direction of groundwater flow with the exception of the immediate vicinity of the new cutoff channels. In the vicinity of the old channels, the direction of flow of groundwater is presently toward or away from the channel. Deepening of the grades will serve only to change the gradient rather than direction of flow.

Summary. The project should not affect the overall water table of the valley. The water table will be lowered slightly in the near vicinity of deepened channels. This is partially offset, however, by an increase in aquifer recharge potential. Changes in the surface water regimen should be, for the most part, beneficial. Time of concentration of flood flow will decrease and high water will pass more quickly through the valley. With the possible exception of some highly localized areas, the direction of flow of the groundwater should remain as before.

There are 475 miles of authorized channel work remaining to be done. In addition to the 475 miles of work remaining and the 729 miles of completed work an additional 46 miles of existing channels will be maintained to insure the design degree of protection for a total of 1,250 miles. Of the 475 miles remaining to be done, 351 miles consist of the rehabilitation of previously channelized streams (clean-out and/or enlargement) or construction of ditches where none presently exist. The remaining 124 miles of authorized work will involve the alteration of streams not previously channelized. The latter streams include realignment and enlargement of 19 miles of the upper St. Francis River, 24 miles of Blackfish Bayou, 35 miles of Castor River, 13 miles of Tyronza River, 10 miles of Fifteen-Mile Bayou, and 23 miles of Big Creek.

The 19 mile segment of the St. Francis authorized for channelization is presently characterized by intermittant bands of forest canopy along the banks ranging generally from 80 to 1,500 feet in width. Construction will require the removal of most of the stream-side cover, while the resulting reduction in frequency of flooding will induce conversion of adjacent woodlands to other uses. The alteration of this segment of stream will undoubtedly have the most adverse environmental effect of any of the remaining authorized works in the St. Francis Basin.

Channelization of other previously unaltered streams listed above

will be less damaging than to the St. Francis River since essentially all streamside cover and forest canopy has already been removed; thus this will be a relatively minor impact of project works. In general, only the meander patterns of these natural streams distinguish them from most of the previously altered channels. Documented effects of channelization on fish populations (Tarplee, et al., 1971, and Hanson and Muncy, 1971) indicate that the removal of stream bank vegetation and forest canopy increases stream temperature and otherwise adversely affects the fishery. Total cover (forest canopy, bank growth, in-stream vegetation, and physical cover characteristics) appears to be the greatest single factor affecting a fish population (Tarplee, et al., 1971). (16 & 17).

Development of natural bendways cut off by channel realignment, along with preservation of forest canopy adjacent to these segments, offers the possibility of ameliorating some of the adverse effects of channelization upon fishery resources.

4. Adverse Environmental Effects Which Cannot be Avoided Should the Proposal Be Implemented. The natural bottomland swamp ecology of the alluvial valley portion of the basin, in particular, has been so totally disrupted by prior flood control and drainage works and agricultural developments that the surface and groundwater regimens and the biotic community, both aquatic and terrestrial, now exist in an artificial state controlled by influences such as increased runoff, high sedimentation and incursion of pollutants. While the continuation of the project will not produce adverse impacts of the magnitude of prior works, this action will nevertheless have unavoidable adverse impacts that will add to what has already transpired. (18, 19, & 20).

Completion of the project will result in the following unavoidable adverse environmental impacts: temporary increase in turbidity in streams and ditches to be altered; reduction in fishery values and disruption of the benthic community in these same channels; impairment of esthetics; and loss of wildlife habitat and wind screens through direct removal of vegetation along streams; loss of an estimated 10,000 annual man-days of hunting opportunity; induced clearing of other vegetative cover; possible increase in stream temperature; degradation of waterfowl habitat on private lands; loss of woodlands as a direct result of levee construction activities; retarded growth rates of riparian woodlands in areas subjected to a reduction in ground water level; temporary increases in erosion of channel and spoil banks and resultant downstream silt deposition immediately following construction; potential increases in agricultural pollutants in streams during certain periods; possible damage to historical sites and archeological resources; and possible temporary disruptions of ambient air quality.

Construction of the remaining portion of the project will require the acquisition of about 34,000 acres of land of which an estimated 11,000 acres are wooded or stream bed lands. Most of these woodlands are relatively narrow strips of trees along the ditches to be improved and a large percent will be removed during construction activities. This effect will not be limited to the streams to be altered as a part of this project. Provision of improved major outlets will result in considerable expansion and improvement of secondary drainage systems by private interests; thus magnifying this loss of vegetative growth along both natural streams and artificial channels. These strips of vegetation which will be altered serve several useful, desirable purposes. They provide pleasant breaks in an otherwise monotonous landscape, furnish food and cover for a variety of small species of wildlife and a few deer, and serve as localized natural windbreaks. The impact of this clearing along channels will be reduced somewhat in reaches where excavation is performed on one bank only. However, at best, this reduces the total loss by half and the remainder on the undisturbed side loses some effectiveness. (21 & 22)

Loss of woodlands will not be restricted to direct removal as a result of construction activities. The reduced frequency and duration of flooding will induce clearing of additional lands for agricultural purposes. It is estimated that approximately 10,000 acres, in tracts ranging in size from 40 to about 1,000 acres, will be cleared outside the project right-of-way as a result of improved drainage. These small scattered tracts are relatively important due to the scarcity of forests in the delta area of the basin. In addition to their value from an esthetic and wildlife viewpoint, they have considerable importance from a cultural standpoint.

Privately-owned areas presently subject to natural flooding, both woodlands and farmlands, are used by migrating waterfowl for feeding and resting during the winter months. Flooding of these areas will be greatly reduced, lessening their attractiveness to waterfowl and contributing to the decline of this portion of the Mississippi Flyway.

Fishery resources which will be damaged by the remainder of the project are limited almost exclusively to the channels to be altered. The fishery in most of these channels is generally limited and of relative low quality. However, the relative scarcity of this resource in portions of the project area lends weight to its significance. Damage to fish habitat will result from several sources. Potholes will be removed or disturbed, resulting in fewer deepwater areas during low flow periods. Trees and other vegetative growth and snags and brush providing natural habitat will be removed. The bulk of the benthic community will in general be severely disrupted, resulting in reduction of both quantity and quality of aquatic life.

The act of channel excavation will temporarily increase turbidity in the ditch or stream during the construction period. Erosion and subsequent turbidity and downstream silt deposition will also occur during a short interval following construction as a result of bank sloughing and denuded banks being exposed to the weather. These banks will stabilize and revegetate within a relatively brief period. Improved secondary drainage systems which will be installed by local interests after construction will contribute further to this temporary increase in erosion and turbidity. Permanent increases in turbidity will result from the indirect effect of converting relatively stable woodlands to more highly erodable cropland.

Pollutants inherent in the construction process will be held to a minimum. Environmental pollution is defined as the presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human life; affect other species of importance to man; or degrade the utility of the environment for aesthetic and recreational purposes. The control of environmental pollution requires consideration of air, water, and land, and involves noise, solid wastemanagement and management of radiant energy and radioactive materials, as well as other pollutants.

Relocation of all pipelines, mains, and utilities will be accomplished in accordance with State and Federal regulations, in a manner to avoid contamination of potable water supplies and discharges of untreated waste water, directly or indirectly, into the surface or underground water resources. Heavy construction equipment at work causes a temporary increase in noise levels, exhaust emissions, and solid wastes requiring disposal. Construction activities and associated noises will frighten wildlife and temporarily exclude some from the immediate area. However, due to the location of the project heavy equipment at work is not expected to cause serious problems.

Where appropriate, sanitary waste facilities will be provided and operated to treat and dispose of domestic waste in conformance with State and Federal water pollution control regulations. Provisions of the Federal Occupational Safety and Health Act of 1970, will be considered.

There may be an increase in agricultural pollutants due to restoration of idle lands and enhancement of poorly cropped lands for more productive agricultural uses, particularly since a considerable amount of these lands are in lower areas adjacent to stream courses. Although additional woodlands will be converted to cropland, increased entry of pollutants will be somewhat offset by reduction in the extent of cropland flooding. (23).

There are 438 miles of levees authorized for the project. All but about 11 miles of these are completed and functioning. About 350 acres of cleared lands and 485 acres of woodlands will be required in connection with construction of these 11 miles. Completion of the remainder will result directly

in physical loss of wildlife habitat through placement of the levees and clearing of some borrow areas. However, borrow areas usually result in a trade-off of dryland for wetland habitat and a net increase in fishery due to the fact that many borrow pits are not self-draining, quite often resulting in creation of excellent quality small lakes when properly constructed. Such borrow pit lakes usually provide good fisheries and are used to some extent by resident and migratory waterfowl.

A major remaining feature of the St. Francis basin project is the W. G. Huxtable Pumping Plant, currently under construction. Completion of this feature will result in inducement of further land clearing for agricultural production and will further reduce the attractiveness of Mississippi backwater areas to migratory waterfowl. Estimates of induced woodland clearing and acreage required for pumping plant construction are included in figures listed previously in the statement which apply to the total basin project. Natural periodic restocking of fish in topographically isolated lakes within the backwater area presently occurs through interchange with seasonal overflows from the Mississippi River. The frequency of this occurrence will be reduced in some areas and eliminated entirely in others. Operation of the pumping plant will contribute to both noise and air pollution in the vicinity of the structure and immediately surrounding area. The remoteness of the plant site reduces the significance of these impacts upon the human environment. However, there will probably be additional negative effect from noise upon wildlife distribution and use. Thermal pollution resulting from the process of cooling the plant's Deisel engines will be insignificant, raising the water discharged through the pumps by 0.0224 degrees Fahrenheit. This impact is even less significant when viewed from the standpoint that the evacuated water will be introduced directly into Mississippi River overflow waters exceeding elevation 175 msl. Trash racks in the forebay to the pump intakes will have bars spaced at 5-1/2-inch clear openings through which fish can pass. Fish which pass through the pumps are generally killed. Since predetermined flows and water velocity are affected by these screens they cannot be decreased in size. Furthermore, smaller openings would increase the potential for the intakes to become clogged with trash. Trash and debris which are removed from the inlet screen and forebay area, and garbage from the manager's residence and public recreation areas will be disposed of by sanitary land fill at a site and in a manner which will comply with Arkansas State Standards and Corps regulations. Esthetic aspects of recreation in areas adjacent to the project will be impaired during periods of pump operation.

Historical sites and archeological resources may be damaged by construction activities in spite of diligent efforts to locate and preserve them. The National Park Service will be requested to investigate and conduct salvage operations of known sites prior to construction. In the event any presently unknown historical or archeological sites are discovered prior to or during construction, a report will be made immediately to the proper authorities to minimize possible damage to the site.

There will be no direct adverse impact upon existing public lands resulting from the uncompleted features of the project. However, such areas will be subjected to increased recreational use as a consequence of diminished woodlands and wildlife habitats on private lands.

When open burning methods are utilized for debris disposal, there may be a temporary disruption of ambient air quality.

5. Alternatives to Proposed Action. The topography of the basin, especially in the alluvial valley, combined with the work accomplished by the local people prior to 1936, greatly restricts the alternatives available for consideration.

Except in the Ozark Highlands above the Wappapello Lake and along the east face of Crowleys Ridge, the basin topography physically precludes the construction of reservoirs. Wappapello Lake effectively controls runoff from the watershed above it, so no appreciable advantage from a flood control or drainage standpoint would be gained by the construction of additional reservoirs in that part of the basin. The sites on the east face of Crowleys Ridge will support small reservoirs of the retardation type. Reservoirs at these sites would control only very small parts of the area draining into the alluvial valley and, thus would have very little effect on flood control and drainage problems in that part of the basin. They could, however, be useful in reducing flooding of communities and farmlands along the streams on which they might be located. Therefore, small reservoirs along Crowleys Ridge would serve to supplement the authorized flood control and drainage work and thus would not be a true alternative to the project.

Because of the flat topography in the alluvial valley, floodplain management to include zoning, floodproofing, etc., is not a reasonable alternative. The benefits from the completed and authorized work in the St. Francis basin are derived primarily from the prevention of flood damages to existing urban development and on existing cleared agricultural lands, and not from the conversion of woodlands into croplands. Floodplain zoning will not prevent or reduce flooding on these lands. Zoning could be useful from a land control standpoint to insure, for example,

preservation of a desirable stand of trees or a swamp area adjacent to a ditch or channel. Such preservation would not be inconsistent with the flood control work. However, zoning, whether for flood control or land use control purposes, is properly an exercise of the police powers of state and local governing bodies and is not a prerogative of the Federal Government or its agencies. Therefore, any zoning program should be implemented by a state agency or by an arm of local government after giving due consideration to any adverse effects which might result from the action. Such effects might consist of reductions in long-term productivity; primary and secondary economic losses throughout the basin, and deterioration of existing channels from reduced maintenance. A result of this latter might be the loss of hardwoods through prolonged inundation and sedimentation. Thus, floodplain zoning should be thought of as complimentary to the completed and authorized parts of the St. Francis Basin Project and not as a true alternative. (18, 19 & 24).

Purchase of the flooded lands in fee and purchasing a flowage easement over them will be treated as a single alternative, since experience has shown that the cost of such an easement is very nearly equal to the full fee value. There are about 819,000 acres adjacent to the uncompleted channel improvements which are subject to headwater flooding. In addition, there are 532,000 acres in the lower part of the basin to be provided protection from Mississippi River backwater. To purchase these 1,351,000 acres in fee would cost approximately $1,055,000,000 compared to $140,075,000 currently estimated cost for the uncompleted work; would take a large acreage off the tax rolls, thus reducing the income needed by local governments to provide needed services; would, since their acreage is about one-third of the agricultural lands in the basin, impact heavily on the entire basin economy; and would accelerate out-migration.

All or portions of the unconstructed features of the project could be abandoned or simply not constructed. These remaining features are required to protect existing developed lands in the basin and are highly desirable from an economic point of view. These unconstructed features will contribute about $4,132,000 in annual benefits, of which $316,000 annually are attributable to the authorized fish and wildlife features. Flood control benefits from individual features range from $56,000 for Big Bay Ditch 1 to $725,000 for the work in the Cockle Burr Slough-Buffalo Creek Ditch area. The flood control benefits from this project are derived almost wholly from the prevention of losses to or the enhancement of the existing developed lands. This estimate does not include the very real benefits to the basin economy resulting from secondary project impacts.

Discontinuance of project maintenance activities is not feasible. Such an action would in time cause large areas of the alluvial valley part of the basin to become unproductive, which in turn would surely result in displacement of a significant portion of the population to urban areas. Therefore, in view of the regional and national concern for the general public good, abandonment is not considered to be a reasonable or desirable alternative. (19)

6. The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity. Periodic flooding characterizes much of the area, subjecting the property owners and improvements to losses. The maintenance and enhancement of the long-term productivity of the cleared lands subject to flooding requires flood control, but by providing this protection some additional forest areas will be cleared for agricultural production because of prospects for short-term gains. This increased agricultural expansion will represent mostly an increase in soybean production. The land use changes will result in losses of timber and its products as well as the forest-type wildlife associated with the area. If improved drainage is not provided, and the prospects for profit diminish through loss of crops by frequent flooding or a drop in prices (especially soybeans), it is expected that marginal lands will be converted to pasture or will revert back to timberlands. Sould drainage be provided, an intensification of farming is anticipated over the foreseeable future.

In order to obtain the benefits offered by the project plan of action, the present generation will be required to commit some lands and related resources to other uses for the life of the project. Specifically, this involves dedication of both cleared and forest lands to project purposes due to increased channel dimensions and the attendant needs for spoil disposal and access areas and to areas which will be occupied by levees and borrow pits. Additionally, some forest lands can reasonably be expected to be converted to agriculture.

The existing native plant and animal life along with any future land uses will be forfeited on the land devoted to levee and channel requirements. Other disruptions and alterations of the existing environmental elements will be caused by the clearing of rights-of-way for access and spoil disposal and borrow areas. These impacts may range from those of a temporary to permanent nature, and are primarily dependent upon the landowner's actions. The conversion of some forest lands into agricultural production will produce impacts to the existing botanical and zoological elements of the project area. The character of portions of the area will undergo a complete change from that of a mixed hardwood forest and its indigenous animal life to an area of intensive agricultural production. Overall, the present generation will sacrifice or trade off the longterm productivity of a variety of renewable natural resources and further narrow the use of the natural environment to that of longterm agricultural uses.

7. Any Irreversible or Irretrievable Commitments of Resources Which Would be Involved in the Proposed Action Should it be Implemented. Changes in land use as a result of implementation of the proposed project will not bring about permanently irreversible and irretrievable commitments of the environmental resources, but the diversity of beneficial uses of remaining resources will be lowered. Areas dedicated to channel enlargement and levee construction will experience irretrievable and irreversible commitments of land and related forest and wildlife products for a period extending over at least the life of the project. It is suspected that this environmental change will become a permanent situation and will not be allowed to return to the natural condition. Environmental commitments associated with spoil disposal and access areas are considered irretrievable only for the time period required for reestablishment of plant and animal life after construction. These losses could become irreversible over the foreseeable future should the landowner elect to reclaim the areas for agricultural production. The conversion of 10,000 acres of mixed hardwood forest to agricultural lands will reduce the availability of the timberlands and its resources as a potential source of outdoor recreation. This commitment is considered irreversible for the present generation. Theoretically, although unlikely, the area could be returned to its natural state over a lengthy period of time for use by future generations. Natural resources sacrificed during the period of agricultural utilization are classified as irretrievable commitments.

Channel fishery commitments relating to habitat destruction, siltation, reduced water quality, and biocides, however temporary, are both irreversible and irretrievable losses to the present generation. As in the case of forest and wildlife resources, the declination of fishery resources could be reversed should the controlling factor-intensive utilization of lands for agricultural production-be eliminated or greatly retarded. Present land use trends do not indicate such a possibility in the foreseeable future.

There are no known commitments of losses to archeological or historical sites. The labor and materials expended on the project construction are classified as irreversible and irretrievable commitments.

Lands to be acquired for maintenance and enhancement of wildlife productivity do not necessarily represent an irreversible or irretrievable commitment of lands which could otherwise be utilized for agriculture, but, as with the reverse commitment of agricultural lands, this can not reasonably be expected to happen in the foreseeable future. The continued need and demand for forest lands and resources will predictably preclude their conversion to agrarian uses once they have been placed in public ownership.

8. Coordination with Others.

a. Public Participation. The first public meeting in connection with this project was held at Memphis, Tennessee, on 27 November 1928 and subsequent public meetings have been held through the years on various project additions. The last public meetings were held at Kennett, Missouri, on 4 February 1969, and at Marked Tree, Arkansas, on 6 February 1969, to obtain the view of interested persons with respect to the need for improvements to the St. Francis River Basin below Wappapello Lake, with particular reference to providing additional improvements in the interest of seepage control, water supply, and other beneficial water uses.

b. Government Agencies. The draft environmental statement (dated December 1972) was sent to the following Governmental agencies requesting their views and comments. The comments received have been reproduced in their entirety to prevent misrepresenting the views expressed. Copies of the replies to both this statement, and one coordinated in April 1971, are included. Also attached is a report prepared by the Bureau of Sport Fisheries and Wildlife and concurrence letter from the Arkansas Game and Fish Commission, recommending alternate sites for the authorized mitigation lands in the Johnson Lake and Frenchman's Bayou-Mud Lake areas.

(1) ENVIRONMENTAL PROTECTION AGENCY

Comment: The responsibility for herbicide control has been assigned to the Environmental Protection Agency (EPA). We suggest that the EPA be substituted for U.S.D.A. in reference to herbicides being used in the maintenance program. The registration number will remain the same.

Response: This change has been made in the final statement.

Comment: A more detailed description of the method of application and effect of the herbicides should be given. This should include the residual after application and the effect on other plants, such as the crops planted along the ditches. EPA has established that the three herbicides are registered for use at or above the water line. The dosage of each herbicide should be given and its application should be controlled so that the water is not contaminated.

Response: Comment Noted: The statement has been revised accordingly. It should be noted that because of varying conditions, the dosage and control of the herbicide is a factor that has to be determined at the time of application.

Comment: The discussion on the use of 2,4-D, should include how the trees are disposed of after they die. Also, why 2,4-D is injected directly into the tree beneath the bark instead of the alternative of cutting the tree down.

Response: The tree is left standing to decompose naturally as this tends to destroy less of the surrounding vegetation than removal. It is also less expensive. The reason for using injection is to prevent overspray onto the surrounding vegetation. This method was last used in the summer of 1969.

Comment: The statement should have a section on the quality and use of the water.

Response: Additional discussion of this item has been added to the final statement.

Comment: The paragraph on benefit-cost ratio should have a brief description as to how the ratio was obtained, including the total cost, the Federal and local cost, and the value of the benefits to be obtained from the project.

Response: Additional information on benefits and costs is included in the final statement.

Comment: We hope the following comments of a general nature will be of help in developing the Final Environmental Impact Statement:

1. Dust and other pollutants inherent in the construction process need to be held to a minimum. All available preventive measures should be discussed.

2. Relocation of all pipelines, mains, and utilities should be accomplished in a manner to avoid contamination of potable water supplies and discharges of untreated waste water, directly or indirectly, into the surface or underground water resources.

3. Measures to prevent the effects of accidental spillages should be incorporated into the design features of the project.

4. Where appropriate, sanitary waste facilities should be provided and operated to treat and dispose of domestic wastes in conformance with state and Federal water pollution control regulations. Provisions of the Federal Occupational Safety and Health Act of 1970 should be considered.

Response: Such measures are a standard part of the specifications for the construction of all Corps projects.

(2) FOREST SERVICE, USDA

Comment: It is noted in Table 1 that recreational facilities are being expanded at Wappapello Dam. Also, on page 4, a reference is made to "management of forest" in connection with operation and maintenance at the lake. The statement should be more explicit about plans for the forestland in this area. Will there be clearing and if so, how much? Will management plans be developed for the non-cleared forestland areas?

Response: ER 1130-2-400 requires that a forest management plan be developed as part of the overall Master Plan for the Wappapello Lake Project. Clearing will be selective to facilitate the management of both forest and wildlife. The Poplar Bluff office of the Clark National Forest, U.S. Forest Service, has provided us with a draft of a Forestry Management Program for use in connection with the pending revision of the reservoir Master Plan. The draft plan does not envision any clearing of forestland areas, except for environmental enhancement.

Comment: On page 22, the statement gives the forest acreage affected; however, information regarding volume and value of forest resources value affected by the project is not provided.

Response: The acres of woodland by county are listed in Table 2 and shown on Plate 3. Of the 893,911 acres of woodland in the basin, approximately 195,000 acres are bottomland hardwood with an average yield of 3,300 board feet per acre. It is estimated that approximately 10,000 acres, in tracts ranging in size from 40 to about 1,000 acres, will be cleared outside the project right-of-way as a result of the project. Using an average of 3,300 board feet per acre and $60 per 1,000 board feet, the 10,000 acres is estimated to have a total value of $1,980,000.

Comment: On page 13, paragraph 3, "Environmental Impact . . ." the effects of completing this project, and of maintaining this project, upon the hydrograph downstream from the project is not described. Sometimes flood control projects such as this cause worsened flooding and drainage

downstream. The remaining valuable bottomland hardwoods in this downstream area will be damaged if their soils are wetter longer than is common.

Response: Any bottomland hardwoods downstream from the project will be entirely within the Mississippi River backwater area. Any increase in the duration, frequency, and magnitude of flooding on the St. Francis River would be completely negligible in this area. Within the project itself, there are areas of both increased and decreased durations of flooding. Below Madison, Arkansas, the project will cause some slight increase in flood durations. This increase is so small, a matter of a few days, as to be considered harmless to the timber. Above Madison, the duration will be decreased.

(3) SOIL CONSERVATION SERVICE, USDA

Comment: All agricultural lands in the project in Arkansas and Missouri occur within soil and water conservation districts. We suggest that recognition be given to past, current, and potential future establishment of conservation practices (land treatment measures) by these local conservation districts in cooperation with the Soil Conservation Service and others. These practices, essential in reducing soil erosion, sediment, and runoff, include conservation cropping systems, contour farming, crop residue use, row arrangement, wildlife habitat preservation, critical area stabilization, and forest stand improvement.

Supplementary to these soil improving measures are such practices as irrigation and drainage land grading, main and lateral drains, field drains, grade stabilization structures, and structures for water control.

The following table is a partial listing of conservation practices on the land in the basin.

Practice	Approximate Acres on the Land
Conservation cropping system	2,400,000
Crop residue management	2,500,000
Drainage land grading	72,000
Irrigation land leveling	145,000
Pasture and hayland planting	156,000

These established practices represent only approximately 40 percent of the total needs. Basin wide, progress in application of these measures is expected to occur at about 2 percent per year.

Response: The statement has been revised to include the above information.

Comment: The lands mentioned on page 4, paragraph 3, which have been cleared, would still be suitable for fish and wildlife mitigation in a few years under public ownership with proper planting and management.

Response: Concur. However, more desirable lands can be obtained that will provide mitigation of fish and wildlife losses without the few years waiting period. See attached report by the Bureau of Sport Fisheries and Wildlife.

Comment: Page 6, paragraph 2; piling the debris outside of the spoil appears to be the most desirable alternative since den sites would be created for coyotes, fox, rabbit, skunk, and small rodents.

Response: Comment noted. This alternative could be used in certain areas; however, this would have to be decided upon at the time the contract plans and specifications were prepared. Usually, the practice is to allow only the clearing necessary to place the spoil. In most cases, the right-of-way is only wide enough to allow the placement of the spoil. In this case, the piling or wind-rowing of debris would require additional clearing behind the spoil and would also necessitate the purchase of additional lands or right-of-way. In other locations, farmlands abut the landside toe of the spoil bank. In these areas, the debris could not be placed on the landside of the spoil.

Comment: Page 10, paragraph 3, the reference to fish samples on page 11, lists the "Missouri Game and Fish and Commission." This should read "Missouri Department of Conservation and the Soil Conservation Service." A table relative to the fish sampling showing species, percent by weight, and percent by number would be more meaningful.

Response: These suggested changes have been incorporated into the statement.

Comment: Page 11, paragraph 3, the Missouri Department of Conservation, Soil Conservation Service, and other interested individuals have recently developed a list of rare and endangered species. Swamp lily and cypress are not on the list. The tupelo gum, referred to in this paragraph, is not the correct identification; rather, it is black gum (*Nyssa sylvatica* var *sylvatica*).

Response: The referenced list has been incorporated into the statement. Swamp lily, Tupelo gum, and cypress were mentioned in the preliminary draft statement as the result of comments received from the Missouri Department of Conservation stating their concern for the disappearance of cypress and Tupelo gum swamps and plants associated with this habitat type.

Comment: We question that statement on page 20, paragraph 3, relative to increase in tilled land resulting in less runoff. Records from more than 10,000 plot years of measurements of rainfall, runoff, and erosion at Federal Conservation Experiment Stations show that more runoff occurs on continuous row cropland than on land with grass or legumes in the rotation, or on grassland. These measurements have been substantiated on larger areas.

Response: This paragraph has been revised.

Comment: Page 23, paragraph 2, denuded cut slopes should not be left bare to revegetate naturally. Plans should specify this denuded area be revegetated as excavation is completed. Seeds should be broadcast within 24 hours of excavation before soils dry out. A mixture of grasses and legumes should be used.

Response: Seeding the cut slopes with grasses and legumes would in some cases provide an earlier and more desirable cover. However, only partial success could be expected because of fluctuations in stream flows and the performance of a portion of the channel work during the non-growing season of the year. Except in special cases, the seeding of the excavated slopes is not believed to be warranted by the minor effect it might have on turbidity of the stream.

Comment: Page 23, paragraph 4, suggest addition of the statement, "when properly constructed" to the end of the fifth sentence to read: ". . . creation of excellent quality small lakes when properly constructed."

Response: Revision made.

(4) U.S. DEPARTMENT OF COMMERCE

Comment: We suggest that the final environmental impact statement include maps of the project area depicting location of project features.

Response: Maps attached to the draft statement have been revised to more clearly show the location of project features (for example, Monterey, Princedale Ditch, St. Francis Lake Control Structure, Marked Tree Siphon and Ditch 61 Extension and Control Structures).

(5) U.S. DEPARTMENT OF THE INTERIOR

Comment: The draft environmental statement does not adequately reflect the impact of the project on fish and wildlife, and archaeological and

historical resources. Loss of fish and wildlife resources from past and future aspects of the project are extremely significant.

Response: Discussions of these have been added to the final statement.

Comment: This draft environmental impact statement is inadequate concerning archaeological and historical resources. While the existence of the extensive cultural materials within the project area is noted in the statement (pages 11-12 list 848 known archaeological sites and 32 known historical sites), no indication was given as to how the legal requirements will be met, as set forth in Executive Order 11593, the National Environmental Policy Act of 1969 (Public Law 91-190), the Historic Preservation Act of 1966 (Public Law 89-665), and the Reservoir Salvage Act of 1960 (Public Law 86-523).

Response: The statement has been revised to include additional archaeological and historical data furnished by the state agencies of Arkansas and Missouri. A map showing the relation of cultural sites to the proposed works was prepared as a part of our evaluation of project impacts on historical works archaeological resources. The map was not included with the impact statement (in compliance with request) by the State Archaeologists of both Arkansas and Missouri. These maps along with a current listing of all sites are kept on file in this office and are used in evaluating the effects of construction and maintenance works. Coordination is maintained as set forth in the above references and every effort will be made to comply with the spirit and intent of the law.

Comment: There is no inventory of cultural resources, no mention of previous archaeological work in the project area, and subsequently no evaluation of the significance of these resources. A number of sites are noted in the draft as being important, but no explanation is given to what these sites contain or why they are important. Known sites of archaeological and historical value must have been recorded as a result of professional work, but no references are cited.

Response: The National Park Service, USDI, the agency responsible by law for providing this information to other Federal agencies, by letter dated 15 April 1971, was requested to provide information on historical and archaeological resources in the St. Francis River Basin. In addition to the information furnished in your letters, data has been furnished by the state agencies in Missouri and Arkansas and incorporated into the statement.

Comment: The draft does not include a map of cultural resources. One should be included to clearly show the relationship of sites to the project boundaries. Such a map is particularly useful in assessing the direct and indirect effects on these significant areas.

Response: A map showing the relation of cultural sites to the project works was prepared as a part of our evaluation of project impacts on historical and archaeological resources. The map was not included with the impact statement as we have been specifically requested by the State Archaeologist in both Arkansas and Missouri not to publish any data which would show the location of archaeological sites.

Comment: A qualified professional archaeologist must survey the entire project area and the final environmental impact statement should cite the resulting report (s) and these must be available for review. The final significance of the archaeological and historical resources found by the survey and give cost estimates and the steps to be taken to mitigate effects of the project on the resources.

Response: See response to comment by Arkansas State Archaeologist.

Comment: In addition to the areas listed in the statement, the following sites, which appear to be in the project area, are listed in the National Register of Historic Places.

1. Sikeston Fortified Village Archaeological Site, 2 miles southeast of Sikeston, New Madrid County, Missouri.

2. E. L. Brown Village and Mound Archaeological Site, 2 miles northeast of Dichlstadt, Scott County, Missouri.

3. Sandy Woods Settlement Archaeological Site, 1-3/4 miles northwest of Diehlstadt, Scott County.

4. Rich Woods Archaeological Site, 2 miles north of Bernie, Stoddard County, Missouri.

5. Hurricane Ridge Site, 3 miles northeast of Catron, New Madrid County, Missouri.

Response: The first three sites listed above are not in the project area. The other two were used in preparing the final statement, and will be kept on file for future references.

Comment: The following locations, which appear to be in the project area, are under consideration and evaluation as potential National Natural Landmarks.

1. Mingo National Wildlife Refuge near Puxico, Stoddard County, Missouri.

2. Ten Mile Pond Area, 4 miles southeast of East Prairie, Mississippi County, Missouri.

3. Big Oak Tree State Park, near East Prairie, Mississippi County, Missouri.

4. Holly Ridge, 4 miles east of Bloomfield, Stoddard County, Missouri.

Response: Two of the above sites, Ten Mile Pond and Big Oak Tree State Park, are not in the project area. Mingo National Wildlife Refuge was discussed in the draft statement. The Holly Ridge site will not be affected by the project as it appears to be 2 to 3 miles from any anticipated Corps work.

Comment: The reference to Lake Wapanocca on page 11, paragraph 2, should instead be referred to as Wapanocca National Wildlife Refuge.

Response: The reference has been corrected in the final statement.

Comment: No adverse environmental impact is anticipated as is related to the geology of the project area. The statement also adequately reveals the significant project effects on the hydrologic system.

Response: Concur.

Comment: Page 17 of the draft environmental statement makes the statement in the first paragraph, "nor will the project have any effect on any of the historic and archaeoligical sites listed in or proposed for inclusion in the National Register or Historic Places". Without benefit of a field examination, we would anticipate an effect on the Parkin Indian Mound National Historic Landmark. We believe the final environmental statement should consider the possible impact on this site that may result from the channelization of Tyronza River and Big Creek in Crittenden County. This channelization project will enter the St. Francis River upstream and in proximity to the National Historic Landmark. It would appear an increased volume of water could severely affect the Parkin Indian Mound. The Parkin Mound is situated extremely close to the edge of the bank of the St. Francis River. This bank is subject to erosion at that point. There could be a possible effect wherein the river could undermine the Parkin Mound and thus impact this historic resource listed on the National Register of Historic Places.

Response: With benefit of a field examination and reference to the site map published in reference (31), it was concluded that the remaining work on Tyronza River and the work on Big Creek will have no affect on the Parkin Indian Mound. The lower 12 miles of Tyronza River were cleaned out in 1966 and the enlargement of 10.5 miles above that was completed in 1968. The site examination showed the stream banks to be stable and there was no indication of significant change since the above work was completed. This analysis was confirmed through discussion with the State Archaeologist for Arkansas.

Comment: The final statement should also address itself to the possible effect of the project within that portion of the Big Lake National Wildlife Refuge which has been recommended for evaluation for the Registry of Natural Landmarks. The Oak-Pine and Southeastern Evergreen Forest regions of the Eastern Deciduous Forest Theme study by Mr. Gary S. Waggoner recommended evaluation of a portion of the Big Lake National Wildlife Refuge for possible inclusion on the Registry of Natural Landmarks. This evaluation is scheduled during the 1973 fiscal year.

Response: Since the National Park Service, which made the above comment, furnished no information on the area being considered other than that contained in their comment, a precise analysis can not be made at this time. The portions of the St. Francis Basin Project in and adjacent to the Big Lake National Wildlife Refuge consist of the extension of Ditch No. 81 along the west side of the refuge; the control structures at the south end of the refuge; and the control structure at the north end of the refuge near the Arkansas-Missouri state line. These project features help to meet needs for maintaining the dedicated fish and wildlife use of not only the Federal refuge but also the adjacent State Public Hunting Area by increasing permanent water area in Ditch 81; diversion of undesirable silt-laden water around the refuge; and allowing regulation of water levels in the refuge during low flow periods. Thus these project features should have a favorable impact on the refuge, and should not interfere with the designation of part of it as a Natural Landmark in the Registry of Natural Landmarks.

Comment: In addition, the final statement should contain evidence of contact with the State Liaison Officer for the State involved and a copy of his comments concerning project effects upon any historical or archaeological sites which may be in the process of nomination to the National Register of Historic Places.

Response: The procedures referred to in the above comment are a standard part of the processing of all impact statements. Page ii of the draft statement listed the State Liaison Officers in both Missouri and Arkansas along with the Department of Interior as receiving copies of the draft for review and comment.

Comment: Page 16, paragraph 2 - The statement,"...pesticides...would not be expected to reach the waterways," should be expanded to state that the presence of persistent pesticides in surface waters are a result of agricultural activities and are already a common problem.

Response: The statement does not intend to imply that the existing waters are free of pesticides. To the contrary analysis of water samples taken at Marked Tree June 23, 1971, and listed in Table 7, show that some pesticides were present. However, the pesticides presently being used on soybeans, are non-persistent and biodegradable and are not expected to reach the stream.

Comment: Page 19, paragraph 3 - The discussion of ditches in relation to ground water levels is incomplete. The average radii of influence should be given in order to give meaning to the statement, "Lowering the water surface six feet in a channel would increase the radius of influence by approximately 600 feet". With the actual radii of influence established, the last sentence

of the paragraph on page 20 would also be more meaningful. Because of the extensiveness of ditching, these localized areas where the water table will be lowered may cumulatively be quite significant. This has a bearing on the productivity of adjacent riparian woodlands since it has been shown that these hardwoods are adapted to the existing water table and also benefit by periodic flooding.

Response: The following empirical relationship was utilized to establish the increase in the radius of influence:

$$R = 3.0\ (H_2 - H_1)\ \sqrt{K}$$

where R = radius of influence in feet
H_2 = water table elevation in feet
H_1 = water level in ditch elevation in feet
K = coefficient of permeability in 10^{-4} cm/sec units

If the water level in the ditch is 6 feet lower than the water table in the ground and the foundation is sand of the size commonly encountered in the St. Francis Basin, then the K value will be 1,000 x 10^{-4} cm/sec and the radius of influence will be about 570 feet.

To further illustrate the increase, consider the case where the original water table was 10 feet above the water level in the ditch. The radius of influence for the original situation would then be $R = 3.0\ (10)\ \sqrt{1,000} = 949$ feet. Now lower the water level in the ditch by an additional 6 feet. Then R becomes: $R = 3.0\ (16)\ \sqrt{1,000} =$ 1,518 feet. The increase is approximately 570 feet for this case also. This is the method that was utilized to establish the 600 feet that was stated in the report. This case represents the most pervious material encountered in the basin and has the largest radius of influence. For clays, the radius of influence would be much less.

Comment: Page 20, paragraph 3 - The discussion of water is confusing in that specific deductions are made while the specific land types are not discussed. Many of the individual statements should be qualified and the increase in peak flows should be more adequately discussed.

Response: This paragraph has been revised.

Comment: Page 21, paragraph 1 - The statements, "In general, only the natural meander patterns of the natural streams distinguish them from most of the previously altered channels authorized for improvements," and "Water quality and overall benthic community and streamside vegetation are virtually the same for both artificial and natural channels," are misleading. While this may apply to a limited number of waterways in the basin due to soil types, it is not true for the basin in general. In almost all cases channelization results in destruction of benthic communities and degradation of downstream water quality.

Response: The statement has been modified to clarify the discussion concerning comparisons of channelized and unaltered streams in the basin. Many previously altered channels are authorized for enlargement. The point of this discussion is to indicate the similarities in adverse impacts which proposed channel alteration will have upon both natural and previously altered streams. Impacts of channelization are enumerated in the second paragraph of Section 4.

Comment: While esthetic, wildlife habitat, and cultural values have been considered, the statement would be significantly strengthened by recognizing the many thousands of man-days of hunting that would be lost annually to the area because of land clearing.

Response The loss of hunting opportunity is implicit to the reduction in wildlife habitat which will result both directly and indirectly from project construction. An estimated 21,000 acres of remaining woodlands will be lost. The Bureau has furnished no estimate of the number of man-days of hunting which are provided by these lands. Based upon estimates of losses to hunting resulting from woodland clearing as contained in previous Bureau reports (Mississippi River and Tributaries Project, printed as House Document No. 308, 88th Congress, 2d Session), man-days of hunting expected to be lost annually as a result of completing the St. Francis Basin Project will be approximately 10,000 (or 0.5 man-days per acre). The estimate has been added to the statement in Section 4.

Comment: Page 22, paragraph 2 - In areas where the only remaining woodlands are in the form of narrow strips, turkeys will usually be totally absent. Turkeys should not be listed as using these areas.

Response: The statement has been revised to eliminate turkeys from the discussion.

Comment: Page 23 of the draft does recognize that damage to the resources may result but does not consider that all of the known and potential sites could be indirectly affected. Nor does the draft clearly state that sites could well be destroyed through the action, as well as just disturbed. The environmental setting of the sites will also be altered, thereby changing specific information potential and significance. Construction is heavily alluviated areas may also expose buried sites of importance. The final statement and later planning should allow for adequate investigation before continuing earthmoving activities.

Response: See response to comment of the Arkansas Archeological Survey.

Comment: Alternatives to the proposed action have not been thoroughly discussed. The only alternative discussed was that of the proposed and ongoing project.

Response: The section of the statement describing alternatives to the proposed action has been expanded. Planning studies which have resulted in the presently authorized project plan have included consideration of numerous alternative methods of solving the basin's flood damage and environmental problems. Many of these alternatives are included in the plan. For example, leveed floodways to control flooding in lieu of large channels is an adopted alternative. Fish and wildlife mitigation measures such as land acquisition and water control structures are adopted alternatives. The entire planning process is a system of considering all feasible alternatives. The project as currently authorized is comprised of a combination of alternatives which have been determined to provide sound and prudent solutions to the problem of perennial flooding, while simultaneously including measures for mitigation and enhancement of fish and wildlife and other environmental amenities. Non-structural alternatives, such as zoning, simply do not provide solutions to the problem of damages to existing developments. However, as the project continues, serious consideration will be given to structural modifications or any additional alternatives which may be determined to best meet the combined objectives of flood control and environmental quality.

Comment: Page 25, paragraph 1 - Periodic inundation of bottomland hardwood areas usually results in an increase in growth of hardwoods and provides benefits to timber production and wildlife.

Response: The adverse impact which disruption of the existing groundwater level may have upon the growth rate of riparian hardwoods is acknowledged in Section 4 of the statement. Woods adjacent to the stream, as stated in a previous Bureau comment, are adapted to the existing water table and also benefit by periodic flooding. Growth rates may be significantly reduced if the water table is dropped below the level of established root systems. On the other hand, growth rates and even survival of the hardwoods may be threatened by conditions of unusually prolonged flooding and silt deposition which frequently accompany permanently obstructed channels.

Comment: Page 25, paragraph 2 - An unrealistic evaluation has been made on this alternative. Not all of the 1,351,000 acres subject to flooding would have to be acquired. Some of this acreage is not in need of flood protection, woodland is benefited by flooding, and some lands are only rarely flooded.

Response: We are in agreement with this statement inasmuch as not all of 1,351,000 acres would have to be purchased for the reasons stated. However, to purchase these lands in fee would cost approximately $1,055,000,000 as compared to $140,475,000 currently estimated to complete the project. The cost of the uncompleted portion of the project is equivalent to less than 15 percent of the fee title value of the total acreage (1,351,000) subject to flooding.

Comment: No consideration is given to preservation of archeological and historical resources for future generations. Long-term productivity is maintained only if a significant and representative sample of the cultural resources based on a cultural province are preserved for future study. Adverse effects on archeological remains reduces this sample and these effects are cumulative. The degree of these effects depends upon the degree to which the sample is diminished, and only through a complete cultural investigation of the proposed project area can this type of problem be evaluated.

Response: See response to comment of the Arkansas Archeological Survey.

Comment: Page 27 states, "There are no known commitments of losses to archeological or historical sites." All archeological and historical sites and materials represent a nonrenewable resource and any impact constitutes an irreversible and irretrievable commitment of those resources.

Response: The statement has been revised to reflect measures which will be taken to investigate and salvage archeological sites which may be subject to unavoidable disturbance by project works. Data on known sites at the present time do not indicate that any are located in areas where their destruction is an inevitable consequence of anticipated project construction.

Comment: In summary, the structural features of the project are approximately 41 percent complete. However, destruction of the natural environment is of a much greater magnitude. The project does not adequately consider fish and wildlife and other associated intangibles. A moratorium on construction should be implemented until there is acquisition of authorized mitigation lands and adequate compensation for other losses.

Response: We agree. Alterations of the original swamp-forest environment of the St. Francis Basin have greatly exceeded, proportionately, the work accomplished by the Corps of Engineers in providing flood control and drainage improvements. In other words, completion of remaining authorized project works will have significantly less impact upon the natural environment than flood control works which have already been completed. A report has recently been forwarded to higher authority seeking Congressional authority to purchase mitigation lands, previously authorized, in alternate locations more suitable to the requirements of fish and wildlife. Recommendations in this report have recently received the endorsement of both the Bureau of Sport Fisheries and Wildlife and the Arkansas Game and Fish Commission. The project, as currently authorized, does not specifically provide for amelioration of esthetic and intangible values associated with the natural environment. However, Corps policy now provides that: "Non-monetary damages, including those impacts affecting the ecosystem and environmental quality, will be described in sufficient detail to support a judgment as to the cost that would be justified to prevent or offset them and will be given

full consideration in formulating recommendations." A major objective of EIS process is to provide information upon which such judgment can be based. It is to this end that the efforts expended in preparing this statement have largely been dedicated.

(6) MISSOURI WATER RESOURCES BOARD

Comment: The Water Resources Board wishes to point out that the letter of the Missouri Department of Conservation dated February 16, 1973, voices opposition to any farther channelization to the St. Francis River in Missouri represents the views of the Missouri Department of Conservation and not the views of the State of Missouri.

Response: This clarification is appreciated.

Comment: We are in agreement with the Department of Conservation position regarding mitigation of wildlife losses that have occurred or are continuing to occur as the result of the St. Francis Basin Project. We are hopeful that authorized studies will correct this situation and permit preservation of certain natural areas in the best interest of the people residing in the area.

of the paragraph on page 20 would also be more meaningful. Because of the extensiveness of ditching, these localized areas where the water table will be lowered may cumulatively be quite significant. This has a bearing on the productivity of adjacent riparian woodlands since it has been shown that these hardwoods are adapted to the existing water table and also benefit by periodic flooding.

Response: The following empirical relationship was utilized to establish the increase in the radius of influence: $R = 3.0 (H_2-H_1) \sqrt{K}$

where R = radius of influence in feet
H_2 = water table elevation in feet
H^2 = water level in ditch elevation in feet
K^1 = coefficient of permeability in 10^{-4} cm/sec units

If the water level in the ditch is 6 feet lower than the water table in the ground and the foundation is sand of the size commonly encountered in the St. Francis Basin, then the K value will be 1,000 x 10-4 cm/sec and the radius of influence will be about 570 feet.

To further illustrate the increase, consider the case where the original water table was 10 feet above the water level in the ditch. The radius of influence for the original situation would then be: $R = 3.0 (10) \sqrt{1,000} = 949$ ft. Now lower the water level in the ditch by an additional 6 feet. Then R becomes: $R = 3 (16) \sqrt{1,000} = 1,518$ feet. The increase is approximately 570 feet for this case also. This is the method that was utilized to establish the 600 feet that was stated in the report. This case represents the most pervious material encountered in the basis and has the largest radius of influence. For clays, the radius of influence would be much less.

Comment: Page 20, paragraph 3 - The discussion of water is confusing in that specific deductions are made while the specific land types are not discussed. Many of the individual statements should be qualified and the increase in peak flows should be more adequately discussed.

Response: This paragraph has been revised.

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Response: This clarification is appreciated.

Comment: We are in agreement with the Department of Conservation position regarding mitigation of wildlife losses that have occurred or are continuing to occur as the result of the St. Francis Basin Project. We are hopeful that authorized studies will correct this situation and permit preservation of certain natural areas in the best interest of the people residing in the area.

Response: The development of authorized mitigation measures is dependent on funding by the Congress, which has not yet been provided.

Comment: The Water Resources Board considers the Draft Environmental Statement dated December 1972 to present an adequate description of the environmental effects of the development to date including construction work now under contract. We suggest that additional and more localized environmental statements be prepared in connection with any future construction work if full compliance with the intent of the Environmental Policy Act is to be accomplished.

Response: See response to similar comment made by the Missouri Department of Conservation.

(7) MISSOURI STATE PARK BOARD

Comment: The State Historical Survey and Planning Office of the Missouri State Park Board has reviewed the St. Francis Basin Project Draft Environmental Statement (Revised Dec., 1972) and finds that several prehistoric sites designated to be listed on the National Register of Historic Places under the National Historic Preservation Act of 1966 (P.L. 89-665; 80 Stat. 915) may be in jeopardy. Furthermore, several prehistoric sites in the area are currently under study for nomination to the National Register.

Response: A map containing all known sites is on file and will be used in planning future work in an effort to preserve these areas. A list of these areas is contained in Table 11.

Comment: On page 21, paragraph 3, lines 11 and 12, we find the statement that "Completion of the project will cause unavoidable adverse environmental impacts consisting of ... probably damage to historical sites and archaeological resources..." Page 23, paragraph 5, states that "Historical and archaeological resources may be damaged by construction activities in spite of diligent efforts to locate and preserve them."

Response: See previous response.

Comment: In light of these aforementioned statements, the State Historical Survey and Planning Office submits the following material to facilitate the "diligent efforts to locate and preserve" these archaeological resources. Each exhibit is correspondingly numbered to the explanation below.

1. Bibliography of Missouri archaeology covering area under consideration. Specific references pertaining to area are marked by check (✓) marks or question (?) marks.

2. Zerox pages of locations and maps of some of the archaeological sites to be disturbed by the St. Francis Basin Project.

A. Hopgood, James F.
1969 An Archaeological Reconnaissance of Portage Open Bay in Southeast Missouri. Missouri Archaeological Society Memoir. #7, p. 36.

B. Williams, Stephen
1954 An Archaeological Study of the Mississippian Culture in Southeast Missouri. Unpublished Ph. D. Dissertation. Yale University. pp. 126, 128, 129.

C. Williams, James Raymond
1971 A Study of the Baytown Phases in the Cairo Lowland of Southeast Missouri. Unpublished Ph. D. Dissertation. Department of Anthropology, University of Missouri-Columbia, pp. 45-46.

D. Williams, Ray
1968 Southeast Missouri Land Leveling Salvage Archaeology: 1967. National Park Service Report. pp. 11-12.

E. Williams, J. Raymond
1972 Land Leveling Salvage Archaeology in Missouri: 1968 National Park Service Report. pp. 8-9.

F. Williams, J. Raymond
1964 A Study of Fortified Indian Villages in Southeast Missouri. Unpublished M. A. thesis. Department of Anthropology, University of Missouri-Columbia. p. 15.

G. Redfield, Alden
1971 Dalton Project Notes. Museum Briefs. Museum of Anthropology, University of Missouri-Columbia. Figs. 4-9, and pp. 22-23.

Response: This additional information is appreciated and it has been included in this statement. The information was most helpful in our analysis of impacts on archaeological resources of the basin.

Comment: A Map of Dunklin, Pemiscot, New Madrid, Mississippi, Stoddard, and Scott Counties showing archaeological sites was included in the Missouri State Park Board's letter. On this map NRHP sites are indicated by green circles. Sites reported by S. Williams and J. R. Williams are indicated in red. Sites reported by J. F. Hopgood are indicated by blue. Only the most pertinent sites listed in the literature are indicated on this map. For information concerning other sites in the area, contact Arch. Survey Office and publications listed on reference sheets.

Specific information on N.R.H.P. sites in area under consideration:

A. The Wilborn-Steinberg Site--Butler Co.
B. Koehler Fortified Village--Butler Co.
C. Trail of Tears State Park--Cape Girardeau Co.
D. Langdon Site--Dunklin Co.
E. Rich Woods Site--Stoddard Co.
F. Beckwith's Fort (Towosahgy State Park)--Mississippi Co.
G. Hoecake Village--Mississippi Co.
H. Crosno Fortified Village--Mississippi Co.
I. O'Bryan Ridge District--Mississippi Co.

J. Hearnes Site--Mississippi Co.
K. Hurricane Ridge Site--New Madrid Co.
L. Lilbourn Fortified Village--New Madrid Co.
M. Sikeston Fortified Village--New Madrid Co.
N. Denton Mound--Pemiscot Co.
O. Murphy Mound--Pemiscot Co.
P. J. M. Wallace Site--Pemiscot Co.
Q. E. L. Brown Site--Scott Co.
R. Sandy Woods Settlement--Scott Co.

Response: The above iformation is appreciated. However, an analysis of the information shows that sites C, F, G, H, I, J, M, Q, and R are not in the St. Francis Basin; sites A and B are above Wappapello Lake thus the remaining work will not affect them; and of the other sites the closest to any authorized work is site K, which is 1 3/4 miles away. Thus we can conclude that the project will not have any impact on these sites.

(8) MISSOURI GEOLOGICAL SURVEY AND WATER RESOURCES

Comment: The only comment we offer concerns an item on page 7 describing Crowleys Ridge. According to the Environmental Statement, Crowleys Ridge is "a loessial formation"; while it is true that loess blankets Crowleys Ridge, the core of the Ridge is a remnant of old uplands, and might be considered partly as a remnany of the Ozark Plateau, the same as Commerce Hills northeast of Crowleys Ridge. Including the statement that Crowleys Ridge is "a loessial formation" would give the impression that the entire Ridge consisted of wind-blown soils, when in fact sedimentary deposits of Tertiary, Cretaceous and Ordovician age lie beneath the surficial loess deposits.

Response: This information has been included in the statement.

(9) MISSOURI DEPARTMENT OF CONSERVATION

Comment: We have reviewed the Revised Draft Environmental Impact Statement of St. Francis Basin Project, Missouri and Arkansas. The effort of the Corps of Engineers' staff to cover the environmental impacts of all the various projects undertaken or planned under the 1936 Flood Control Act in one 27 page statement is an impossible undertaking. The broad brush approach of a superficial statement is not in our opinion in keeping with the disclosure of known environmental impacts as required by the National Environmental Policy Act of 1969, Corps of Engineers' Regulation ER-1105-2-507 (January 1972) and Executive Order 11514. In order that environmental impacts can be adequately identified and considered, the Memphis District must at least write separate environmental statements for those projects identified by the general map as having adverse environmental impacts. In addition, other channelization and ditch cleaning projects should each receive the consideration of a detailed environmental assessment.

Response: While the 1936 Flood Control Act did provide the basic authorization for Federal participation in flood control efforts in the St. Francis Basin, there have been numerous features of the project authorized by subsequent acts of the Congress. These are listed in Table 1 of the statement. Each of the studies which led to these additional authorizations included a review of the

overall comprehensive project plan and its relationship to the particular problem under study. Recommended problem solutions took into account the need for a coordinated, disciplined plan for the entire area. The project has been planned, designed, and is being built and maintained with that philosophy in mind. To break out, piecemeal, individual features of the project and subject them to separate environmental impact studies would destroy or, at least seriously impair, the usefulness of this disciplinary planning approach which has been developed over the years. One could argue that all water resource developments in the United States or possibly the entire Mississippi River and Tributaries Project should be treated in one impact statement. On the other hand, the argument could be made that every identifiable feature of each project, such as a bridge relocation, a mile of levee or channel work, or acquisition of a 10 acre tract, should be the subject of a separate statement. We believe the St. Francis Basin Project represents a practical compromise entity which may reasonably be covered by a single impact statement. This does not preclude the possibility of placing emphasis on particular problem areas within this entity and we have attempted to do so in this statement. The physical scope of this project is, indeed, large encompassing an area some 180 miles long with an average width of about 34 miles, or approximately 3,970,000 acres. However, alluvial valley lands in Missouri and Arkansas encompass about 98 percent of the total project area (essentially all project lands below Wappapello Reservoir). These lands are strikingly uniform in most of their physical characteristics. Likewise, authorized project features are basically the same in any given portion of the alluvial valley, being comprised essentially of a system of ditches for the evacuation of interior drainage and levees to confine high flows. Thus, the bulk of the project area is essentially homogenous physically and environmentally. Lack of diversity resulting from this uniformityof land form and outside forces such as climate and weather thus simplifies the evaluation of impacts resulting from a particular type of development. In other words, the impact of channeling in any particular portion of the alluvial valley will be essentially the same as in another portion. Since a large percent of the project has already been developed over a number of years, there are numerous valid parallels and conclusions which can be applied to further project works, which will certainly simplify and strengthen analysis of these remaining elements. In summary, we cannot concur in the opinion that separate features of this project should receive treatment through individual environmental impact statements. We do not believe the procedural requirements established by the United States Congress in the National Environmental Policy Act of 1969 were ever intended to be interpreted to require such a fragmentary approach.

Comment: As you know, we have expressed our concern with projects such as the channelization of the Platte River and Little Chariton River due to environmental damage. We believe it to be in the best interest of the people of Missouri if we go on record as opposing further channelization of the St. Francis River in Missouri. The Corps of Engineers (Page 21) has identified the importance of the unchannelized St. Francis River as "Only the upper St. Francis has any significant adjacent bottomland forests remaining. The reduction in flooding will make it more feasible to convert these lands to agricultural use". We therefore recommend no further channelization on this part of the St. Francis River.

Response: In view of the overall considerations noted in this statement we cannot concur in this recommendation. The United States Congress has had the benefit of numerous study reports covering problems in the St. Francis Basin.

The overall review of the project published in House Document No. 308, 88th Congress, Second Session, dated 21 May 1964, acted on in the Flood Control Act of 27 October 1965, contains an extensive review of environmental aspects of the project. The Congress and other decisionmakers will have the benefit of the Department of Conservations's views, as well as others, through this statement.

Comment: Page ii - Item 4 - Alternatives - Questions concerning the rejection of Alternatives "b" and "d" center around recent federal direction to evacuate the flood plains and utilize them for compatible uses. If the reference to construction under item "d" concerning installation of mitigation features includes the plugging of Wilhelmina Cutoff, we are somewhat skeptical of enhancement. We believe that fish and wildlife losses should be mitigated before we discuss enhancement.

Response: We are unaware of any recent Federal Directions concerning evacuation of flood plains in the area under consideration here, or in any similar areas elsewhere. The evacuation method of problem solution has been applied mostly in urban areas and simply would not solve the flooding and inadequate drainage problem in this predominantly agricultural area. The Flood Control Act of 27 October 1965 authorized control structures in the Wilhelmina Cutoff to maintain water conditions suitable for fish and wildlife. That Act also specifies that a non-federal sponsor must provide the lands necessary for the work and assume responsibility for the other required local cooperation. As pointed out in paragraph 1 of this statement, we have been unable to obtain the required sponsor. Should a capable non-federal interest come forth to sponsor this job then the Corps of Engineers would be glad to participate in development of Wilhelmina Cutoff. Use of the term "enhancement" in this context was meant to apply from a strictly localized standpoint. The statement has been modified to clarify this issue.

Comment: Page 2 - Inclusion of all federal costs for levee and drainage with local costs would be of value for comparison purposes.

Response: A tabulation showing Federal costs has been added.

Comment: Page 3 - Recommend the Corps discuss their efforts to implement the features outlined on the top of this page and seek federal funding to implement all phases of the project.

Response: The discussion is contained in the succeeding paragraphs. Funding for the uncompleted mitigation features will be periodically requested along with funding for other project features.

Comment: Page 4 - We have tried to initiate better management of the lands to offset unmitigated wildlife habitat losses associated with the Wappapello project. Thus far our efforts have been unsuccessful.

Response: Although the Wappapello Lake feature of the St. Francis Basin Project was initially planned and built primarily for flood control purposes, the lake and surrounding public lands have made available significant opportunities for the public to participate in fishing, hunting, and other outdoor activities. In 1971, over 1,800,000 visitors utilized the lake and the surrounding lands. It is not believed that the public would have had these oppor-

tunities on the same area if this project feature were not a reality. We are also of the opinion that the approximately 37,000 acres of lands above the normal recreational pool provide considerably more wildlife habitat and public hunting than would be the case if these same lands had remained in private ownership. We do not, then, agree with the assertion of unmitigated wildlife habitat losses associated with the Wappapello feature but, rather, strongly believe the net result has been enhancement. In regard to the efforts to initiate better management of the lands, a forest management plan is being prepared in conjunction with the Overall Master Plan for Wappapello Lake. In addition, there are several other factors that must be considered, one of which is the effect on the counties of having funds cut off from the lease lands. Seventy-five percent (75%) of the revenue from these lands around Wappapello Lake is returned to the respective counties.

Comment: Page 6 - No plans are made for vegetation of spoil banks. This no doubt leads to increased erosion and sedimentation.

Response: The statement points out that spoil banks are intentionally revegetated (with selected plants) for a distance of 1,000 feet in either direction from major road crossings. This treatment is limited to these particular 2,000 foot reaches due to the need for beautification in these areas. On the remaining reaches of spoil banks, it has been our experience that natural revegetation takes place in a surprisingly short time, and that deliberate planting does little to accelerate this process.

Comment: Page 10 - We do not understand how Wappapello Reservoir can be included in the "without the project" setting.

Response: The entire paragraph concerning the environmental setting without the project describes the basin as it presently exists.

Comment: Page 12 - Middle Paragraph - As in several other areas, this report low keys the role of the Corps in transforming the "Great Swamp". Old maps and other information indicates a tremendous change in the St. Francis Basin in the 36 years of Corps' involvement.

Response: The information referred to is a statement of facts and is not intended to "low key" the role of the Corps of Engineers. We have never pretended the work prosecuted in connection with this project has not played a substantial role in alteration of the character of the area. We do believe it is necessary to point out there are many other dynamic factors which have contributed significantly towards the changes which have occurred in the natural environment. The paragraph following that referenced in the above comment contains further discussion of this point. A comparison of old and new maps (and other information) does, indeed, indicate a tremendous change in the St. Francis Basin over the 36 year period. So, also, will a comparison of old and new maps of an infinite number of other areas where the Corps has not been involved, show tremendous changes for the same period. The total environment of the world is, and always has been, in a constant state of change and the St. Francis Basin is no exception.

Comment: Page 13 - Middle Paragraph - This paragraph seems to state the Corps economic philosophy for environmental elements. The crux of the paragraph is that only when tiny patches of swamp are left will they be "valuable examples" of what was lost due to the project. Unfortunately, many of the native animals either have been extipated (sic), or will be extipated (sic) by 1986 when the project is completed.

Response: The referenced paragraph, quoted in its entirety, states: "The scarcity of the remaining natural environmental elements in the basin lend weight to their relative value. For example, although scattered patches of wetland hardwood forests may be too small to support significant quantities of plant or animal life, they do provide valuable examples of the past wilderness character of the area".

We disagree with the interpretation of what the reviewer has chosen to be the "crux" of this paragraph. First of all, it contains no reference to or inference of economic values. Secondly, it contains no allusions to what may or may not be a future impact of the project. On the contrary, the statement acknowledges the existing scarcity of natural environmental elements in the basin. It further indicates that the scarcity factor makes these remaining vestiges of wetland hardwood forests especially valuable. It clearly implies that these areas are worthy of preservation even though they may not be large enough to sustain significant amounts of animal or plant life.

Comment: Page 14 - This paragraph relates to the improvement of "farm management" and "agricultural income"; however, it does not face the fact that the poor people will lose their places to fish, hunt and the shady stream bank for relaxation. Those that profit from "improved farm management" and an improved "agriculture income" can already go to Florida to fish and Canada or Alaska to hunt. The importance of a local place to go is completely overlooked.

Response: The same paragraph referred to also states "These reductions in losses will benefit not only the individual landowners, residents, and businessmen directly affected by flooding but will also have secondary effects on the incomes of merchants and business who are dependent upon expenditures and products of these individuals for their livelihood". These benefits are not, of course, limited to only the merchants, businessmen, and landowners, but are passed on to their employees and families in many direct and indirect ways. A vast majority of those who profit from the improved farm management and agricultural income, including quite a few small tenant farmers, would intensely disagree with the inane assertion concerning their ability to go to Florida, Canada, or Alaska to fish and hunt. The comment that the particular referenced paragraph ". . . does not face the fact that the poor people will lose their places to fish, hunt, and the shady stream bank for relaxation". is correct. However, this aspect of the environmental impacts is discussed in numerous other places in the statement. The mitigation and public recreation facilities already included in the project are certainly open to all the public, rich or poor. Additionally, a study of the St. Francis River Basin, Missouri and Arkansas with particular reference to improvements in the interest of fish and wildlife conservation and related recreational use was authorized by resolution of the committee on Public Works of the United States Senate on 20 July 1971. The Congress has not yet provided funding for this study, but when it is undertaken the needs for provision of local recreation areas will be considered.

Comment: Paragraph 4 - Improved land management at Wappapello Reservoir would increase wildlife populations for consumptive and non-consumptive use.

Response: We agree with this statement. This is why both forest management and fish and wildlife management plans are being developed in conjunction with the Wappapello Lake Master Plans. (Also, see the previous response to this same type comment).

Comment: Page 15 - Paragraph 1 - We are not aware of complete mitigation of fish and wildlife habitat losses resulting from any of the various features of this 36 year old project; this is notably true at Wilhelmina.

Response: The referenced paragraph does not state the particular fish and wildlife features will provide "complete" mitigation for overall project losses. The word "mitigation" as used describes the purposes of those features. As noted in response to an earlier comment from the Conservation Department, the Corps is ready to do its share in development of Wilhelmina cutoff, subject only to provision of the local cooperation required by law.

Comment: Paragraph 2 - The Arthur D. Little Report does not apply to conditions in the St. Francis Basin Project. For instance, the Corps requires periodic (3-5 year) maintenance of the new ditches. This precludes redevelopment of habitat.

Response: The entire Arthur D. Little report deals with and assesses environmental, economic, financial, and engineering aspects of channel modifications. Forty-two channel modification projects were evaluated during their study. A large number of these projects were in areas very similar to the St. Francis Basin. In fact of the 42, 1 is Louisiana, 3 are in Tennessee, 2 in North Carolina, 3 in Georgia, 5 in Florida, 1 in Tennessee-Alabama, and 4 in Arkansas (including one in the St. Francis Basin alluvial valley). Their evaluation covered 2,299.5 miles of channel modifications involving 1,177.2 miles of natural streams and 1,122.3 miles of ditch rehabilitation. The St. Francis Project, too, involves modification of both "natural" streams and ditch rehabilitation, although the latter is predominant. For these reasons we consider that the Arthur D. Little Report does apply to conditions in the St. Francis Basin Project. In order for any channel modification works to function as designed some maintenance is required. Generally, the specific portions requiring maintenance is limited to channel banks and some additional area needed for access. Even this does not completely preclude all habitat redevelopment. Some vegetative growth is desirable on both banks and access areas. Most maintenance programs are simply directed at controlling this growth. On the remainder of the berm and spoil areas vegetative regrowth is usually relatively uninhibited.

Comment: Page 16 - (1) The wastes, including chemical pest control agents and fertilizers will travel greater distances and constitute more of a hazard to downstream areas. (2) Even though little fertilizer or other chemicals are used on soybeans, there will be tremendous amounts of herbicides and fertilizers used for each acre of cotton.

Response: We do not consider that all fertilizers reaching streams are a "hazard". In some cases fertilizers may actually enhance plant growth so vital to the aquatic food chain. However, although the project will obviously result in more intensive agricultural use and a concomittant increase in agricultural chemical use, it is not inevitable that more of these chemicals will reach watercourses. Under present conditions there are two primary avenues of transport-rainfall runoff under certain conditions and overbank headwater flows. On open farm lands these overflows often obtain sufficient velocities to pick up residual chemicals and polluted sediments. The frequency of occurrence of this condition will be greatly lessened after the project. So, on balance, there exists a strong possibility that the net result will not be an increase in volume of chemical agents and fertilizers in the waterways.

Comment: Page 20 - Paragraph 2 - The statement "Faster runoff should occur" is of interest. A discussion of what the environmental impacts of this faster runoff should be inlcuded.

Response: A discussion of the probable effects of faster runoff has been added to the statement.

Comment: Page 21 - (1) We discussed the portion of this page dealing with continuing channelization of St. Francis River in our cover letter. It is interesting that in a time of reevaluation of channelization, the Memphis District continues to plan for 475 miles of channelization in the St. Francis River Basin.

Response: The purpose of this EIS is to fully disclose the consequences of this remaining 475 miles of channel construction in the St. Francis basin. This work, already authorized by the Congress, includes 351 miles of rehabilitation of old channels and construction of new ditches, and 124 miles of alteration of natural or previously unchannelized streams. The EIS is not a planning document. Its purpose is to fully disclose the consequences of the proposed action, along with possible alternative actions, upon which informed decisions can be based.

Comment: The very brief mention of Castor River is an example of important resources being lost in the broad brush approach. Such factors lost in this oversimplified statement must be spelled out in individual detailed statements.

Response: See response to the comment by Gaylord Memorial Laboratory concerning Castor River. The matter of "individual" statements was discussed in response to the previous Department of Conservation comment on this subject.

Comment: Paragraph 1 - Last sentence - Oxbows cutoff from the river are very temporary, and although some may furnish better fishing the long term effect of such cutoffs is lost fish and wildlife habitat.

Response: The statement has been modified to clarify the impact of oxbow cutoffs.

Comment: Page 22 - Paragraph 2 - This paragraph seems to disagree with material presented on Page 16, from the Arthur Little Report and the disclaimer

presented on Page 12, Paragraph 2.

Response: We are unable to ascertain any apparent conflict in the material referred to.

Comment: Paragraph 3 - The clearing of an additional 10,000 acres due to drainage improvement is a tremendous impact. Where are these tracts, what is being done to protect environmental values in these areas, and what will be done to mitigate losses? Without answers to these questions, the projects should not be continued.

Response: The statement referred to reads: "It is estimated (emphasis added) that approximately 10,000 acres, in tracts ranging in size from 40 to about 1,000 acres, will be cleared outside the project right-of-way as a result of improved drainage". This is an estimate based on general land use trends in the basin. It is impossible, therefore, to pinpoint these areas. This loss of woodlands is, of course, one of the adverse environmental impacts discussed in this statement and is one for which mitigation measures are being provided. These mitigation measures, including the purchase of 13,500 acres of wildlife lands to be managed for public use, are included in the Project Description Section of the statement. Amplification of this matter is included in the response to the National Wildlife Federation's comment concerning the mitigation plans.

Comment: Page 23 - Paragraph 1 - Once again the "broad brush" leads to misrepresentation. The statement, "Although the fishery in practically all these channels is extremely limited and very poor quality", does not clearly identify the impacts for decision making. We would agree that some ditches may not provide much fish habitat, but there must be individual accounting in order that intelligent decisions can be made. Without complete and accurate impact statements for each project undertaken under the 1936 authorization, good decisions are impossible.

Response: Section 2 of the EIS has been expanded to include quantitative as well as qualitative fishery data from representative channelized tributaries to the St. Francis River. The subject paragraph has been modified to delete subjective evaluation concerning the quality of the fishery. We do not consider that detailed information is required for each channel to make intelligent decisions. Environmental parameters in the basin are characterized more by their similarities than their differences, thus lending reliability to comparative analyses. Furthermore, no individual feature of the project can be accurately assessed separately from associated project features and their relationship to the overall St. Francis Basin project since, hydrologically, the entire system is designed to function as a whole.

Comment: Paragraph 2 - We doubt that there is any comparison between the amount of sediment and turbidity from bottomland forests and the amount from "improved" ditch through cleared, agricultural land. The contribution of sediment, both water borne and wind blown from the cleared agriculture land, will far exceed that from the bottomland forest.

Response: The subject paragraph has been modified to indicate the relationship of woodland and cropland to stream turbidity.

Comment: Paragraph 3 - We disagree; more marginal land will be cleared, and attempts will be made to put the marginal land in crops.

Response: The statement has been modified to clarify the issue.

Comment: Paragraph 5 - We belive the Corps of Engineers should hold off further channelization on the St. Francis River to prevent clearing of the remaining woodland.

Response: Woodland clearing anticipated as the reult of constructing authorized project features is one of the environmental trade-offs which must be considered in weighing beneficial and adverse impacts. It should be recognized, however, that holding off on further channelization will not guarantee the preservation of remaining woodlands. The present economic climate is encouraging extensive clearing of woodlands in areas subject to high flood risk. This can only be prevented by imposing land-use restrictions (such as zoning, easements, or fee acquisition) which might presently fall within the purview of State constitutional authority.

Comment: Page 24 - Paragraph 4 - How many floods have there been since Wappapello was placed to "effectively control the runoff"?

Response: Wappapello Lake was completed in 1941. Since the lake was completed, frequent floods of up to 50,000 and 60,000 cfs at the dam have been stored and released at a substantially reduced rate of 10,000 cfs. Based on a change of the schedule of operations in 1963, the regulated releases are further reduced during crop season to 3,000 - 4,000 cfs depending upon the month.

Comment: Page 25 - Paragraph 3 - We are not completely familiar with the situation in Arkansas, but there must be mitigation before enhancement of fish and wildlife values.

Response: The first reference to enhancement in this paragraph was in the context of discussing authorized project features and their effects on existing developed lands. The statement has been modified to clarify the reference to enhancement of fish and wildlife values.

(10) ARKANSAS DIVISION OF SOIL AND WATER RESOURCES

Comment: The general plan, developed by the Corps of Engineers, for flood control protection and drainage of the St. Francis River Basin appears to be an adequate solution to solving the existing flood control and drainage problems prevailing over extensive areas in the Basin.

Response: Comment noted.

Comment: Completion of this project will certainly result in savings from flood losses of millions of dollars annually thus improving the local economy which will benefit the local people and increase revenues to the Federal and local governments.

Response: Concur.

Comment: The elimination of flooding will result in enhancement and improved environmental conditions necessary for the protection of the health and welfare of residents residing within the project area.

Response: Concur.

Comment: It is emphatically recommended that all lands, now forested, that can be reasonably expected to be cleared as a result of this project, be acquired at project expense as mitigation and preserved as wetlands, wildlife habitat, parks and recreational areas.

Response: A study of the St. Francis River Basin, Missouri and Arkansas, with particular reference to improvements in the interest of fish and wildlife conservation and related recreational use was authorized by resolution of the committee on Public Works of the United States Senate on 20 July 1971, and a study with particular reference to providing additional improvements in the interest of seepage control, water supply and other beneficial water uses was authorized by resolutions adopted by the committees on Public Works of both the United States Senate (27 March 1967) and the United States House of Representatives (19 October 1967). This comment will be given full consideration in both studies and recommendations made accordingly.

Comment: The present plan of cost sharing between federal and local interest for water control facilities for treatment of water for municipal use and waste disposal is essential for present and future area requirements. Improvements to highways and bridges necessitated by project development should be included in project costs at federal expense.

Response: The Corps in this project is not authorized to construct or to participate in the construction of water treatment or waste disposal facilities; or to share in their cost. Thus the first part of this comment is not applicable. Cost for alteration of highways and bridges necessitated by the project are included in the cost of the project and are a federal expense.

(11) ARKANSAS ARCHAEOLOGICAL SURVEY

Comment: It is our opinion that the revised draft environmental impact statement does not include an adequate discussion of the plans to provide for the archaeological and historical resources in the project area. The discussion in Section 3 (page 17) is quite generalized and places an emphasis on consideration of known site locations. While it may be possible to avoid destroying or damaging the known sites, the major problem is the damage to sites who locations are not yet on record. The extent of archaeological research in the project area is not changed over what it was in 1969 when the current state of knowledge was reviewed by Dan F. Morse of the Arkansas Archaeological Survey in a report "Preliminary Report on the Archaeology of the St. Francis and Little River" for the National Park Service (copy enclosed). Given the inadequate state of knowledge concerning the archaeological resources, we can expect adverse effects to take place as a result of this project. A systematic site location survey by a professional archaeologist is needed

to record sites which have not yet been included in our files. There are two aspects to this project which may affect archaeological resources and both should be taken into consideration. The first is the project land alterations including ditches, levee construction, spoil banks and increased channel erosion that may damage or destroy sites. These alterations may cut into sites which are close to the surface and sites which are more deeply buried in the alluvium. The second aspect is the fact that an estimated 10,000 acres of woodland will be cleared of vegetative cover as an indirect result of the project. This will expose previously protected sites to extensive damage and ultimate destruction as a result of the modern agricultural practices that will be employed on this land.

Response: In addition to the sites listed in the above referenced report, Table 11, which contains the work of several archaeologists, has been added to the report. A map containing these sites is on file and will be used in planning and design work. In the event any presently unknown sites are discovered prior to or during construction, a report will be made immediately to the proper authorities to minimize possible damage to the sites. An archeological reconnaissance will be made prior to construction and steps necessary to save or salvage the area will be made.

(12) EAST ARKANSAS PLANNING AND DEVELOPMENT DISTRICT

Comment: It is the conclusion of the planning staff and Technical Review Committee of the East Arkansas Planning and Development District that the environmental impact resulting from proposed improvements within the St. Francis River Basin are consistent with the land use character and present environment of the area.

Response: Concur.

Comment: The short term adverse environmental impacts consist of further reduction in tree stands to accommodate channelization, the disruption of other fish and wildlife habitats, greater erosion in the areas of construction and an increase in water turbidity along the reaches of the St. Francis that will be subject to the new construction. However, over the long term, the benefits that will accrue to the people that live and work in the alluvial plain will be many times greater than the short term losses that are experienced through the adverse environmental impacts associated with the St. Francis River Basin Project.

Response: A good brief evaluation of the project.

Comment: The continuation of the program to the level originally authorized can only add to and strengthen the present environmental

characteristics within the St. Francis River Basin and the alluvial plain that comprise a major part of the basin itself.

Response: Comment noted.

Comment: Efforts to improve the St. Francis River by reducing the extent of the flood plain, and thereby reducing crop and other property damage, as well as increasing the efficientcy of agricultural activities, thereby strengthening the agriculture economy is a major goal and policy statement adopted by the East Arkansas Planning and Development District Board of Directors and included as part of the Areawide Planning Strategies of the District.

Response: (A policy statement which does not require a response.)

(13) BOOTHEEL REGIONAL PLANNING COMMISSION AND ECONOMIC DEVELOPMENT COUNCIL

Comment: Recommend that due to the increased flood and seep water in Dunklin County the existing river channel south of the present dredging operations be cleared, deepened, and widened to accomodate more water.

Response: The proposed work described in the above comment is not a part of this project as it is now authorized nor would the recommended action be an alternative to any part of the project. Therefore, it is not a consideration in this impact statement.

Comment: More impoundments should be built north of present Wappapello reservoir to retain and slow the flood waters and these impoundments be used for recreational facilities -- hunting, fishing, and family parks.

Response: Development of such facilities would undoubtedly contribute to some reduction in flooding along the upper tributaries of the basin as well as provide additional recreational opportunity. However, retention of flood waters above Wappapello would contribute essentially no protection to lands below the lake. Such facilities could not be effectively substituted for currently authorized flood control features downstream from Wappapello Lake.

Comment: The Corps of Engineers should give serious consideration to the construction of future wildlife impoundments outside the floodway of the St. Francis River, improving Wappapello reservoir, developing Ben Cash Wildlife Area, and the possible acquisition and development of the Wilhelmina Cutoff.

Response: The Corps currently is authorized to acquire and develop a total of 13,500 acres of fish and wildlife habitat as mitigation for losses to this resource occasioned by flood control impacts within the Mississippi River backwater portion of the basin. No lands are currently authorized for acquisition within the Missouri portion of the St. Francis basin. However, the Corps is authorized to cost-share with non-Federal public bodies in the enhancement of outdoor recreation and fish and wildlife in conjunction with flood control projects. The basis for this authority is the Federal Water Project Recreation Act, PL 89-72, 89th Congress, S.1229, 9 July 1965. The Corps is prepared to pursue the possibility of such a program with the Bootheel Planning Commission or any other legally constituted non-Federal body.

Discussion related to the Wilhelmina Cutoff and improvement of recreational facilities at Wappapello Lake has been expanded in the statement and specifically addressed in response to the comments of other organizations and individuals.

(14) THE LITTLE RIVER DRAINAGE DISTRICT

Comment: Flood control and drainage projects in the St. Francis Basin were initially started by individual landowners and legally organized drainage and levee districts. Many of the districts were small county court districts, or circuit court districts, and the original construction costs were paid for by these districts.

It was soon realized that the local districts needed Federal aid to give drainage and flood control and to give adequate drainage for agriculture. Not only was the program too large for local interests but as this was a two state problem. The St. Francis Basin originates in Missouri but the outlet for all drainage is through Arkansas, and neither state is financially able to solve the problem.

The residents in both states have invested many millions of dollars in land and industry. The basin is one of the fastest growing areas in the nation. Many industries are located in the area and many miles of Highways have been constructed and more are constructed each year.

Many areas and cities will benefit by a better runoff and this is particularly true of the low areas. While the mosquito problem is not near as bad as it was before drainage, the problem is still here in many areas.

Response: A good brief statement of the history of this project.

Comment: The Basin attracts many visitors outside of the immediate area as there are several recreational areas including Wappapello Lake, Big Lake, and St. Francis Lake.

Response: Concur

Comment: The completion of the project will have little adverse effect of wildlife in the area after a couple of years. In many areas spoil banks along the ditches have been shaped and are used for pasture or row crops and any wildlife in these areas cannot be affected materially. The ditches must be maintained as to give adequate agricultural drainage and very little wildlife can exist there. We believe that fishing, boating and other recreational facilities will not change from what they now are. If any damage is done to wildlife or fishing it will be offset many times by the improvement of farming conditions and health and will provide better chance for industry to come into the area. Better homes, schools and business will result when the plan is complete. This all means more income to local, state and federal agencies due to better income.

Response: A good brief description of the project as it relates to flood control and drainage.

Comment: There are many instances where wildlife habitat and outdoor recreational facilities can be improved that the St. Francis Basin Project will help and not hinder.

Response: Concur

Comment: I am attaching a copy of a newspaper article concerning the Ben Cash Wildlife Area, which if developed, will give a considerable lift to the wildlife and other recreational facilities for the area.

Response: The information furnished is appreciated and we concur in the comment. For a discussion of the Ben Cash Wildlife Area see the response to the Bootheel Regional Planning Commission and Economic Development Council.

Comment: While it is true that the work in the Basin may have a temporary effect on wildlife, the first concern must be the effect on human life. The completion of the project will not be a cure-all, but it will help to create better living conditions and a better opportunity to use the state and national recreational area in the basin.

Response: The project is not intended to be a cure-all but has been designed to provide needed flood protection while giving equal consideration to fish and wildlife conservation with other project features.

(15) DRAINAGE DISTRICT NO. 17

Comment: We believe the environmental aspects in this basin have been well stated, both pro and con. We wholeheartedly believe that construction in the St. Francis Basin project should continue as rapidly as funds will permit in order to alleviate the annual flooding in this fine fertile valley.

Response: Comment noted.

Comment: We believe the construction work enumerated in House Document No. 339, 90th Congress 2d Session should be carried out to completion in Drainage District No. 17 of Mississippi County, Arkansas, substantially as contained in that document.

Response: Comment noted.

(16) ARKANSAS HISTORIC PRESERVATION PROGRAM

Comment: No comments received.

(17) MISSOURI STATE ARCHAEOLOGIST

Comment: No comments received.

(18) ST. FRANCIS LEVEE DISTRICT OF MISSOURI

Comment: No comments received.

(19) DRAINAGE DISTRICT NO. 7 OF POINSETT COUNTY, ARKANSAS

Comment: No comments received.

c. Citizen Groups

(1) NATIONAL WILDLIFE FEDERATION

Comment: The National Wildlife Federation submits the following comments

on the draft environmental impact statement, December 1972, concerning St. Francis Basin, Missouri and Arkansas. We note that on page four the statement is made that the original mitigation plan for this project has been rendered moot by the destruction of the designated mitigation areas. We further note that although a substitute plan is being prepared, there is no such plan presently in existence. I am sure that you are aware that federal courts in both Arkansas and Tennessee has declared as a matter of law that mitigation plans must accompany NEPA statements, and further that appropriations for the mitigation under these plans must accompany requests for appropriations for construction features. We find ourselves unable to comment on the NEPA draft because we have no idea what mitigation plan is proposed or whether, given the recognized serious environmental impact of the project, this plan will be adequate. The National Wildlife Federation therefore is withholding its comments on the draft environmental statement until the statement is supplemented by the proposed mitigation plan.

Response: The project, as authorized, contains several measures for fish and wildlife mitigations. These measures consist of the following project features:

a. Purchase of 13,500 acres of land in the Johnson Lake, Frenchmans Bayou-Mud Lake areas in the lower part of the basin.

b. Water level control structures in Ditches 60 and 61 at the foot of the St. Francis Lake to control the lake level.

c. Plugging of the bendway created by the Wilhelmina Cutoff to maintain suitable water level in the bendway for fish and wildlife purposes.

d. Control structures at the north and south ends of Big Lake to provide flood control, water supply and sedimentation reduction on the Big Lake National Wildlife Refuge and the adjoining state-owned public shooting area, and the extension of Little River Ditch 81, along the west side of Big Lake from the state line to below the foot of the lake, to serve the dual purposes of providing flood control and drainage, and enhancement of the wildlife areas through further reduction in sediment contribution to the area during high water periods.

Of these mitigation measures, the control structure at the south end of Big Lake was completed in 1968, and designs are being prepared on the control structure for the north end. Construction is in progress on the water level control structures in Ditches 60 and 61. Unsuccessful efforts to obtain sponsors for the Wilhelmina bendway development spanned the period February 1966 through March 1969. That is only a few months after being authorized in the Flood Control Act of 1965 and well before the passage of NEPA. The review apparently did not recognize the full scope of the mitigation measures authorized for the project and discussed in the environmental impact statement. The entire mitigation plan has not been rendered moot, as only one of the authorized mitigation measures, the purchase of lands in the Johnson Lake, Frenchmans Bayou-Mud Lake area, has been affected by the actions of local people. Based on reports by the Corps of Engineers and the Fish and Wildlife Service Department of the Interior, contained in House Document No. 308, 88th Congress, 2d Session, the Flood Control Act of 1965 authorized the purchase of 13,500 acres of land for mitigation in connection with the St. Francis

project consisting of 10,000 acres in the Johnson Lake area and 3,500 acres in the Frenchman Bayou-Mud Lake area. However, in June 1968, we were advised by the Fish and Wildlife Service that "Since the time of our Mississippi River and Tributaries project review studies (HD 308/88/2) widespread conversion of forested land to agricultural use has drastically reduced the extent and quality of fish and wildlife habitat remaining in the St. Francis Basin project area. Large-scale soybean farming has expanded through-out the area, and most of the bottom-land forested areas that were in existence at the time of our Mississippi River and Tributaries review studies have been cleared or are in the process of being cleared and converted to agricultural use. In the backwater leveed area (approximately 142,000 acres), the remaining scattered wooded tracts would total little more than 10,000 to 12,000 acres. As a result of the extensive clearing of the forest lands in the Johnson Lake and Mud Lake area, the real estate values of these lands have greatly increased and their suitability for fish and wildlife preservation purposes have been reduced". As a result of the extensive clearing and the consequent increase in land values, the Fish and Wildlife Service concluded that alternative locations for purchase of the authorized mitigation lands should be sought. Because the authorizing report (HD 308/88/2) specified the location of the lands to be purchased that is, the Johnson Lake, Frenchmans Bayou-Mud Lake areas, our authority is limited to these two locations. To be able to purchase the mitigation lands in any other location will require a change through legislative action by the Congress. We are not preparing a mitigation plan for the entire basin, but rather a report to recommend such needed changes in one aspect of the mitigation measures already authorized as an integral part of the St. Francis Basin project. The report prepared by the U.S. Fish and Wildlife Service and concurrence from the Arkansas Game and Fish Commission recommending alternate lands are included in the attached correspondence.

(2) GAYLORD MEMORIAL LABORATORY - UNIVERSITY OF MISSOURI

Comment: During America's development, the clearing of timber and the drainage of swamps were part of the accepted steps toward becoming a modern industrial nation. The present condition of the St. Francis Basin is a prime example that the wilderness has been tamed. This once viable system has become in comparison a biological desert. The contents of this Environmental Statement reflect this old attitude. With the information available in the fields of ecology, sociology, economics, and engineering in 1973, Federal Agencies dealing with natural resources have the responsibility of examining systems rather than isolated aspects of a problem. Man must realize that he is an integral part of this system and must act accordingly.

Response: The first portion of this comment is a rhetorical indictment of man's disruption of natural systems. There is no objective response which can be made to this philosophical observation. The Corps agrees with the remainder of the comment since it is a factual assertion of the responsibilities of the Federal Agencies as mandated by Public Law 91-190.

Comment: This environmental statement is deficient in the following areas:

1. Effects on Fish and Wildlife
   A. Wappapello Reservoir
   B. Castor River
   C. St. Francis River
   D. State and National Wildlife Refuges
2. Mitigation
3. Hydrology
4. Agriculture
5. Cost Benefit Ratios
6. Lack of Systems Approach
7. Quality of Life

Response: These allegations are reiterated individually in the detailed comments which follow, and response is made to each in turn.

Comment: Completion of the project in the lowland areas will be the final demise of the remaining forested habitat either by direct loss due to the project or due to actions by private citizens following completion of the project.

Response: Anticipated effects of future project works upon land use and its impact upon forest habitat are discussed in the statement.

Comment: The table on Land Use is extremely misleading. The watershed should be divided on the basis of uplands and lowlands. Then the forested lowland areas in state and federal ownership should be subtracted from the total lowland areas to give a clear picture of the impact of this project on the lowland forest.

Response: Changes have been incorporated into the statement to distinguish between upland and lowland forests. (See Plate 3).

Comment: To assign any wildlife benefits to this project is misleading. The losses far outweigh any benefits in the Big Lake Area. In addition the statement should provide comments on both consumptive and non-consumptive uses.

Response: Authorized modifications in the Big Lake Area are for the express purpose of improving or enhancing wildlife habitat in that area. There is no assertion in the statement that these improvements compensate for project damages. All references to recreation in the statement, other than hunting and fishing, apply to non-consumptive uses.

Comment: The statement gives a false impression of the benefits at Wappapello. The Corps relates number of people using the site to a quality program when in fact the Memphis District has been mismanaging the reservoir for wildlife. The Missouri Department of Conservation has extremely effective programs on other Missouri reservoirs in cooperation with other Corps Districts. Specifically:

(1) Water is held too high in summer for production of waterfowl food

on moist soil sites.

(2) Water is held so high during the fall migration that aquatic vegetation is unavailable as food to waterfowl.

(3) Upland areas are mismanaged for wildlife.

If these practices continue the value of Wappapello Reservoir for outdoor experiences will continue to decline. This should be indicated in the impact statement.

Response: The allegations contained in this comment have not been substantiated by any supporting data. Nevertheless, problems are recognized in relation to the operation and management of Wappapello Lake. Concerted efforts are being made to resolve differences with other responsible resource agencies arising from disagreements over current management practices. Central to the resolution of conflicting resource management programs is a new Master Plan now in the process of development. There is little doubt that implementation of programs currently being developed for the reservoir will enhance its value for outdoor experiences.

Comment: Castor River is mentioned only once in the report, yet the area along this stream is extremely important for wildlife and the enjoyment of wildlife by area residents for hunting, fishing, and nature study. The impact on this area should be described specifically in the report.

Response: This is an apparent reference to upper Castor River, which has not been a part of the St. Francis Basin since the local people constructed the Little River Headwater Division Channel and Levee prior to 1929. That portion of Castor River, after it leaves the highlands, flows through the diversion channel and enters the Mississippi River just below Cape Girardeau, Missouri. We agree that portion of the Castor is a high quality stream and is relatively important for the purpose mentioned. However, since it is not in the St. Francis Basin, and consequently will not be affected by the project, it is not covered in detail in this statement. The description of the Headwater Diversion System has been modified to clarify this.

The remnant portion of Castor River between the diversion point and the head of the Little River Ditch System is still in the basin and is included as a feature covered by this statement. This reach of stream is similar in physical characteristics to a large number of the other basin streams.

Comment: The St. Francis River below Wappapello Dam provides untold hours of outdoor recreation by hunters, fishermen, and others. The total impact on this resource is not given anywhere in the report. The lowland habitat along the St. Francis River also provides the remaining habitat in private ownership for such unusual species as otter, amphiuma, and siren.

Response: The statement openly addresses the consequences of stream channelization and all of the anticipated adverse impacts resulting from this action. It follows logically that present or potential uses made of the St. Francis River will be reduced proportionately to the impact upon the stream and its associated woodlands. There is no way of quantifying

this impact. Dr. Fredrickson minimizes the recreational benefits attributable to Wappapello Lake, and stresses the abundance of recreation provided by the St. Francis River. Although valuable recreational experiences are furnished by both areas, it must be recognized as a fact that total opportunities afforded by lands in private ownership along the St. Francis River are relatively few in comparison to recreation days provided by public lands at Wappapello Lake.

Comment: State and National Wildlife Refuges. Wildlife areas will indeed be affected by this project. True, channelization will not occur within Mingo or Wappanoca National Wildlife Refuges, but they will be the victims of indirect effects. Citizens seeking outdoor recreation opportunities will be forced (if they have the money) to other areas. These refuges will feel the increased pressure for hunting, fishing, and nature study as will the state wildlife areas in Arkansas and Missouri. These effects must be considered in the impact statement.

Response: The Corps agrees with this observation and it has been included in the discussion of adverse impacts in the statement.

Comment: Mitigation in the lower St. Francis Basin will be extremely difficult because so little habitat remains. For example, if flooded sites are lost, there are no sufficient sites remaining in the basin that have equal quality for wildlife. There is the possibility that mitigation might be satisfactory for some species. For instance, flooded timber used by wintering waterfowl might be mitigated by providing croplands specifically to replace the loss of flooded timber. The cost of land purchase and the operation of such areas is expensive. On the other end of the scale mitigation for the habitat needed by the otter, some fishes, herps, and birds will be extremely difficult. Mitigation is a necessity to protect the few remaining wetlands along the lower St. Francis Basin. Because animal species cannot be moved successfully, habitat lost equals animals killed. Knowing the Corps of Engineers' poor record on mitigation, this impact statement barely touches on this important area.

Response: A report is being finalized and will be submitted to higher authority requesting Congressional approval to acquire mitigation lands at alternate locations to the specific areas presently authorized. The wholesale clearing of lands in the Johnson-Mud Lake areas in the southern portion of the basin has rendered the authorized acquisition areas unsuitable for mitigation. Upon receipt of required Congressional approval, acquisition of lands will be recommended in areas considered most desirable by the Fish and Wildlife management agencies.

Comment: The statement admits that the hydrology of the area is not understood. The project should not be started until the proper studies have been completed.

Response: There is apparently some misunderstanding on the part of the reviewers as the EIS does not intend to make such a statement. The St. Francis Basin Project is relatively complex and has been subjected to many comprehensive hydrologic studies during development of the project.

Comment: Examination of rainfall data from the U. S. Weather Bureau Climatological Data indicates that winter rainfall is uniform over the entire basin. No system of ditches can accommodate heavy rainfall over the entire basin. However, periods of heavy rainfall over widespread areas generally do not occur during the growing season; hence, crops are less likely to be flooded during the growing season anyway. The report also suggests that runoff is less from agricultural lands than from forested lands. Such information is suspect.

Response: The variation of storms within the basin during crop and non-crop season was studied and taken into consideration in the overall design of the project. Additional discussion concerning the runoff from agricultural land has been added to the statement.

Comment: Soybeans may be the major crop in the area, but this report suggests that pesticide treatment on other crop is then nil. In actual practice, cotton is usually treated excessively with persistent pesticides. Treatment of crops other than soybeans should be discussed.

Response: A discussion of the pesticide treatment of crops other than soybeans has been incorporated into the statement.

Comment: The report suggests that erosion should be controlled on the farm with good agricultural practices. Because good soil conservation practices are of primary value to reduce the cost of maintaining the project, what effort is the Corps making to assure that such practices do occur?

Response: Federal assistance to farm owners in connection with soil conservation practices on their land is administered, under existing law, by the Department of Agriculture. Information provided by the Department of Agriculture on these practices have been added to the statement.

Comment: The remaining forested areas contain a reservoir of parasitic insects so necessary to control crop pests. Such values are not discussed in the report.

Response: Though natural control of crop pests may be highly desirable, it is not a practical solution to this problem in the St. Francis Basin as evidenced by the extent to which chemical herbicide and pesticides are relied upon for crop protection.

Comment: The Corps' contention that Wappapello Reservoir controls runoff is open to question. Farms below the dam are often flooded when water is released from the reservoir.

Response: In operation of reservoirs as flood control structures, it is necessary to make limited releases from the reservoir in order to get the maximum use of the reservoir without endangering the structure. The upper St. Francis River channel in the reach that has not been improved has a limited capacity, and floods quite frequently because of this. The reservoir has a substantial effect on floods in the lower St. Francis River, reducing a peak inflow of 80,000 cfs to a controlled release of 10,000 cfs.

Comment: Cost Benefit Ratios.--One has to dig deep to find any mention of this ratio in the statement. Such information should be provided in tabular form with a description of the methods used to determine the stated values.

Response: Costs and benefits have been tabulated and methods of determining values have been described in the statement.

Comment: This impact statement treats the St. Francis Basin as a group of disarticulated entities. The impact statement should examine the Basin as an ecosystem. Only when this is done can a true evaluation of the environmental impact of such a project be determined. This requires integration of engineering, biological, sociological, and economic aspects of this project.

Response: This is a particularly interesting comment in view of the Missouri Department of Conservations criticism of the "broadbrush" approach used in the statement and their contention that impacts must be spelled out in individual detailed statements dealing separately with each item of the project. In its present form the EIS attempts to examine the portion of the basin affected by the project as an environmental entity. The complexity and interdependency of the authorized features of the project makes it impossible to analyze and evaluate them separately.

Comment: Monetary values seem to be equated with quality of life throughout this report. Large water projects in this country have traditionally not added to the quality of human life of the local inhabitants. Quality means much more than money. Such values are not discussed in this impact statement.

Response: Monetary values are discussed in the report to show that the project is economically justified and to indicate what the economic impacts will be. Contrary to Dr. Fredrickson's assertion that large water projects do not add to the quality of life of local inhabitants, the St. Francis Basin project has and will continue to benefit primarily basin residents. While not the sole measurement of environmental quality, monetary impacts must be evaluated so that judgement decisions may take into account the trade-offs between social, environmental, and economic values which will result from project implementation.

Comment: The Corps could provide a better quality of life by switching its expertise from channelization to sewage treatment and to the development of sound land practices to increase water quality.

Response: This is a rhetorical comment which requires no response.

Comment: I am pleased to see that the Corps of Engineers admits that there will be environmental damage in this project. However, these adverse impacts are not examined with the expertise that is now available.

Response: A primary purpose of the review process is to insure that the full spectrum of interdisciplinary expertise is utilized in assessing project impacts.

(3) CLARK HUBBS - UNIVERSITY OF TEXAS

Comment: I note a number of areas where the report should have been

amplified, notably, there is no comparison anywhere in the project of data obtained from channelized regions in the Saint Francis Basin in with those which have had minimal alteration. I would think that such analysis would be a prerequisite to a real understanding of this project. This comparison of local conditions is uniquely available for an understanding of regional conditions. For example, there is a statement on page 21 "The overall benthic community and streamside vegetation are virtually the same for both artificial and natural channels", yet there is no documentation for that allegation. A proper report should have included this documentation. This type of statement is repeated on the bottom of the same paragraph "is that usually the "oxbow" or cut off portions of the old channel furnish a much better fishery than is presently the case in the region involved". Again, no documentation and one would assume that it would be a rather simple procedure to make an analysis of these sections and demonstrate the validity of the allegation.

Response: The sections of the statement referred to by Dr. Hubbs have been expanded to clarify the probable impacts of authorized channelization based on comparisons with previously channelized streams in the basin. All undocumented assertions relating to anticipated adverse or beneficial impacts resulting from channelization have been deleted.

Comment: With regard to stream biota, a standard procedure is to contrast environmental diversity. There are a host of diversity indices available one could use to determine "environmental health" and use of one of these might provide much more insight as to the environmental impact of this statement. Although my information is probably no better than that of the writer of the paragraph on page 21, I would tend to feel that his estimate as reflected on Plate 2 of minor environmental impact on Blackfish Bayou, Castor River, Tyronza River, Fifteen Mile Bayou, and Big Creek are miscalculations. It is difficult to analyze the estimates of changes in Pemiscot Bayou and Ditch Number 6 as these apparently seminatural streams are not listed on page 21, yet they are considered to have a major environmental benefit from the project. Where is the evidence?

Response: Species diversity measurements or indices have not been applied to waters of the St. Francis Basin by either the Corps or to our knowledge by any of the other responsible resource management agencies. It is generally recognized that the quality of surface waters in the alluvial valley range from fair to poor, primarily as a result of sediment, loss of stream cover, and the incursion of agricultural chemicals, fertilizers, and livestock effluents. A study of species diversity would thus serve to confirm what is already generally known. It would also provide some quanitification of the impacts of channelization along the mainstem of the St. Francis River, although such studies would have to be conducted over a considerable period of time to differentiate between temporary and long-term or permanent impacts. Application of this procedure to lateral streams and ditches would yield little information directly related to project impacts since essentially all of these drainages, particularly in the alluvial valley below Wappapello Lake, have already been incrementally altered to varying degrees over a long period of time, thus making it difficult to tie impacts to particular actions. Estimates of the degree of impacts which the project will have upon various

streams as reflected on Plate 2 have been deleted. The discussion of authorized channel work in Section 3 of the statement has been expanded to explain the relative impacts of the project upon these different streams.

Comment: I note an apparent contradiction on page 10 in which it says that there is a problem on eutrophication in the water shed, first paragraph, and a statement that an eutrophic compound, ammonium sulfomate, page 5, will not harm fish or wildlife. If there is a eutrophication problem the addition of nitrogen compounds will exacerbate that matter.

Response: The statement made concerning the existing conditions is not intended to indicate that a eutrophication problem exists in the basin.

Comment: I note what appears to be a curious type of circular logic. The project will result in an increase in flood plain construction based on a 10 year flooding safety factor which in turn could cause major flood damage if a greater flood were to occur. The potentiality of an increase in flood damage from the flood control project seems almost counter productive.

Response: Dr. Hubbs has apparently read into the statement concepts not intended by the writers. We find nothing in the statement to support the conclusion of an increase in flood plain construction.

Comment: Environmental impacts may be direct or indirect. For example, turbidity changes are discussed and the implied impact is direct lethalities to economically valuable organisms. I did not note a discussion of the indirect impact of reduced primary productivity and lowered food availability. I also failed to note any discussion of the impact of turbidity on the feeding efficiency of predators with a primary visual sensory modality in contrast with these chemical sensors as a major element.

Response: A discussion of indirect environmental impacts has been added to the statement. Additional project works in the St. Francis Basin will have no permanent measureable effect on the feeding efficiency of predators which depend primarily upon sight as compared to those which rely more heavily upon "touch" or "smell" in obtaining food. Streams are already turbid and additional channelization will cause considerable temporary increase in this condition, along with some permanent residual effect. In view of prevailing conditions, however, this latter effect will be relatively minor. Species presently occupying basin waters are adapted to the high degree of turbidity which already prevails. Any adverse effect in terms of species composition and numbers resulting from impacts upon "sensory modality" will be insignificant in comparison to the effects of channelization upon cover and other physical characteristics of the streams.

Comment: The listing of fishes is notably incomplete. The major citation, page 11, includes "Minnows and various species were also common to all ditches but no classification by species was attempted". In addition to the complexities of cyprinid interactions overlooked, that statement implies the absence of darters, cyprinodonts, mad toms, etc. that should be important in the food web. This second group is especially significant in that they are a major component in biological control of vectors (page 14).

Response: Sampling which resulted in the species listed in the preliminary statement was conducted primarily to obtain information related to standing crops of sport and commercial species. The list omitted the small forage fishes and others which are significant in the food web, some of which also contribute to control of mosquitos and other vectors. The list has been expanded to include all species which were identified from the samples taken in the Missouri bootheel in August, 1972. Some of the species of cyprinids were not classified, and therefore were not listed. However, the expanded list does indicate that darters, cyprinodonts, mad toms, and other forage fishes are well represented in these channelized streams.

Comment: I failed to note any discussion of the rather complex thermal impacts of channelization and removal of streamside vegetation (the quote on page 15 does not even allude to Q10 impacts). Obviously, the thermal effects of this project will be very significant to the aquatic biota and yet I do not see a mention of that. For the convenience of your staff, I enclose a reprint of a paper of thermal consequences of environmental manipulations of water I wrote last year(32).

Response: A discussion of the thermal impacts of channelization resulting from removal of streamside cover has been added to the statement. The Corps does not believe that the Q10 relationships of fishes of the St. Francis Basin are relevant to an evaluation of water temperature changes which may result from channelization. (Q10 is briefly defined as the factor by which the chemical reaction velocity in fish is increased for a rise in temperature of 10° C.) Q10 values of fishes in a particular temperature range are invalid in other ranges since the velocity of the relevant enzymatic reactions is not a linear function of temperature. Streams of the St. Francis Basin support a fishery adapted to warm waters, particularly in the alluvial valley where stream temperatures often approximate the highest air temperatures. Comparisons of wooded and open streams in the same area in North Carolina (Greene, 1950) indicated that weekly maximum temperatures of the farm stream ranged from 5 to 13 degrees C. above those of the forest stream for an average difference of 6.4 C.(26). Studies made on a stream in England (Gray and Edington, 1969) before and after the removal of streamside woodland indicated an increase of 6.5 degrees C. (27). With the exception of woodlands which remain along the mainstem of the St. Francis River, remaining project works will result in the removal of only limited streamside forest canopy. Dr. Hubb's paper has been read by members of the Corps Staff (32).

Comment: I also fail to note reference to a paper by Professor Emerson in Science, entitled "Channelization, A Case Study"(33). This clearly shows that the impact of channelization is not restricted to the immediate segment, but rather has an indirect impact up and downstream. The problems mentioned in this report obviously pertain to the project.

Response: After review of the subject paper (33), several items need to be discussed. Channelization in this basin is not something new. Most of the ditches and streams have been enlarged and/or dredged several times in the past. The stream cited in this study appears to have been channelized primarily by shortening of the stream. This is not the case in this basin. The streams will be enlarged primarily along the existing alignments. The topography of the land in most of the basin is very flat, thereby making it virtually impossible to increase the gradient in the stream. In most cases the enlargement

consists of simply widening of the existing ditches to accomodate the flood flows.

The channels in this basin have been designed to allow for minor sloughing of the banks in the remote channel reaches. At the bridges the stability of the channel is insured by using higher factors of safety than in the remote regions. Bridge failure has been and will continue to be a minor problem. The use of riprap, increased berm widths beneath bridges, and additional piling length (say 2 to 3 feet) have kept bridge maintenance at a minimum.

Comment: The listing of endangered species omits discussion of the possible occurrence of Acipenser fluvescens (Lake Sturgeon) in the area. This species is listed in the United States Department of Interior Redbook. Similarly, two other species might well be in the area: Scaphirhynchus albus (Pallid Sturgeon), and Percina nasuta (Longnose Darter), both of which are listed as "status undetermined" species in the U.S. Department of Interior Book. I also call your attention to a paper in Transactions of the American Fisheries Society, 1972, entitled "Endangered Fresh Water Fishes in the United States", by Professor Miller, pages 239-252, in which are a large series of rare fishes are mentioned from Missouri including two you mentioned in your account on page 11. I strongly suspect that this project will have an adverse effect on one-third to one-half of that list. An evaluation of each should have occurred. (Common names added).

Response: The statement has been revised to address this comment.

Comment: As you may gather from the above, I find the report omits a discussion of several items I would consider to have been appropriate. It is regretable that in many instances the indirect environmental impact of a development project is not discovered until after the project is completed and the damage is irretrievable. A more thorough analysis might make an evaluation of these probabilities an element of the evaluation of the merits of the project.

Response: Discussion of these items has been incorporated into the report. There are likely to be few direct or indirect impacts from future project developments in the St. Francis Basin which have not already become evident as the result of completed works. The long, documented history of channelization and drainage in the basin presents a clear picture of the consequences of this action. Continuation of the project will be determined by weighing economic and social benefits to basin inhabitants against the costs of environmental trade-offs which future development will impose.

Comment: In summary the statement omits discussion of so many significant environmental factors that it is not only not possible to ascertain the environmental impact but also it is not possible to determine what other factors may apply.

Response: Discussions of the environmental factors listed as significant by Dr. Hubbs have been added to the statement. A primary purpose of distributing a preliminary draft statement for review by other agencies and individuals having environmental expertise is to insure that all significant impacts and viable alternatives are identified and included in the final EIS for the benefit of decision makers.

(4) DUNKLIN COUNTY SPORTMAN ASSOCIATION

Comment: Same comments made by Bootheel Regional Planning Commission and Economic Development Council.

(5) MRS. CAROLYN R. JOHNSON

Comment: No comments received.

(6) THE WILDLIFE SOCIETY

Comment: No comments received.

(7) WILDLIFE MANAGEMENT INSTITUTE

Comment: No comments received.

(8) PEMISCOT COUNTY WILDLIFE AND CONSERVATION CLUB

Comment: No comments received.

(9) DR. LESLIE MACK

Comment: No comments received.

(10) NATIONAL AUDUBON SOCIETY

Comment: No comments received.

(11) FRIENDS OF THE EARTH

Comment: No comments received.

(12) AMERICAN CAMPING ASSOCIATION, INC.

Comment: No comments received.

(13) ST. FRANCIS LAKE RECREATION ASSOCIATION

Comment: No comments received.

(14) DUCKS UNLIMITED

Comment: No comments received.

(15) AMERICAN DUCK HUNTERS ASSOCIATION

Comment: No comments received.

(16) THE NATURE CONSERVANCY

Comment: No comments received.

(17) ARKANSAS WILDLIFE FEDERATION

Comment: No comments received.

(18) ARKANSAS ECOLOGY CENTER

Comment: No comments received.

(19) ENVIRONMENTAL DEFENSE FUND, INC.

Comment: No comments received.

(20) MISSOURI-ARKANSAS SIERRA CLUB

Comment: No comments received.

(21) LOWER MISSISSIPPI VALLEY FLOOD CONTROL ASSOCIATION

Comment: No comments received.

(22) THE GARDEN CLUB OF AMERICA

Comment: No comments received.

(23) GENERAL FEDERATION OF WOMEN'S CLUBS

Comment: No comments received.

(24) THE IZAAK WALTON LEAGUE OF AMERICA

Comment: No comments received.

(25) LEAGUE OF WOMEN VOTERS OF THE U.S., STATE CHAIRMAN

Comment: No comments received.

(26) NATIONAL ASSOCIATION OF CONSERVATION DISTRICTS

Comment: No comments received.

(27) NATIONAL WATERWAYS CONGRESS

Comment: No comments received.

(28) NATIONAL RECREATION AND PARKS ASSOCIATION

Comment: No comments received.

(29) NATURAL RESOURCES COUNCIL OF AMERICA

Comment: No comments received.

(30) OZARK SOCIETY

Comment: No comments received.

(31) ARKANSAS AUDUBON SOCIETY

Comment: No comments received.

(32) SOIL CONSERVATION SOCIETY OF AMERICA

Comment: No comments received.

PERTINENT CORRESPONDENCE
DRAFT DATED DECEMBER 1972

ENVIRONMENTAL STATEMENT

ST. FRANCIS BASIN PROJECT
ARKANSAS AND MISSOURI

The following letters are in response to coordination of the draft environmental statement and are arranged in the order that they are responded to in this statement:

Date	Agency
16 February 1973	Environmental Protection Agency
23 February 1973	Forest Service, USDA
15 February 1973	Soil Conservation Service, USDA
2 March 1973	U.S. Department of Commerce
17 January 1973 & 2 April 1973	U.S. Department of the Interior
22 February 1973	Missouri Water Resources Board
6 February 1973	Missouri State Park Board
30 January 1973	Missouri Geological Survey and Water Resources
16 February 1973 & 16 May 1973	Missouri Department of Conservation
15 March 1973	Arkansas Division of Soil and Water Resources
24 January 1973	Arkansas Archaeological Survey
22 February 1973	East Arkansas Planning Commission and Economic Development Council
13 February 1973	The Little River Drainage District
16 January 1973	Drainage District No. 17
15 January 1973	National Wildlife Federation
9 March 1973	Gaylord Memorial Laboratory - University of Missouri
8 January 1973	Clark Hubbs - University of Texas
-	Dunklin County Sportman Association

ENVIRONMENTAL PROTECTION AGENCY
REGION VI
1600 PATTERSON, SUITE 1100
DALLAS, TEXAS 75201

February 16, 1973

OFFICE OF THE
REGIONAL ADMINISTRATOR

Mr. Gene A. Dodson
Chief, Engineering Division
Memphis District, Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

Re: 06-3-73-AR

Dear Mr. Dodson:

We have reviewed the Draft Environmental Impact Statement (Revised December, 1972) on the St. Francis Basin Project, Missouri and Arkansas. The proposed project is for flood control and drainage improvement and wildlife, fish and outdoor recreation enhancement around an existing reservoir in the Ozark foothills in Southeast Missouri. The project also includes channel improvements, levees, control structures, and pumping plants in the alluvial valley in Southeast Missouri and Northeastern Arkansas. The project is about 41 percent complete. The proposed action is to continue with the construction of the uncompleted features of the project as authorized; continue with the operation and maintenance of the completed features for which the Federal government has responsibility; and to assume the operation and maintenance of other project features which are the responsibility of the Federal government.

We suggest the following comments be considered in the preparation of the Final Environmental Impact Statement:

1. The responsibility for herbicide control has been assigned to the Environmental Protection Agency (EPA). We suggest that the EPA be substituted for U.S.D.A. in reference to herbicides being used in the maintenance program. The registration number will remain the same.

2. A more detailed description of the method of application and effect of the herbicides should be given. This should include the residual after application and the effect on other plants, such as the crops planted along the ditches. EPA has established that the three herbicides are registered for use at or above the

water line. The dosage of each herbicide should be given and its application should be controlled so that the water is not contaminated.

3. The discussion on the use of 2,4-D should include how the trees are disposed of after they die. Also, why 2,4-D is injected directly into the tree beneath the back instead of the alternative of cutting the tree down.

4. The statement should have a section on the quality and use of the water.

5. The paragraph on benefit-cost ratio should have a brief description as to how the ratio was obtained, including the total cost, the Federal and local cost, and the value of the benefits to be obtained from the project.

We hope the following comments of a general nature will be of help in developing the Final Environmental Impact Statement:

1. Dust and other pollutants inherent in the construction process need to be held to a minimum. All available preventive measures should be discussed.

2. Relocation of all pipelines, mains, and utilities should be accomplished in a manner to avoid contamination of potable water supplies and discharges of untreated waste water, directly or indirectly, into the surface or underground water resources.

3. Measures to prevent the effects of accidental spillages should be incorporated into the design features of the project.

4. Where appropriate, sanitary waste facilities should be provided and operated to treat and dispose of domestic wastes in conformance with State and Federal water pollution control regulations. Provisions of the Federal Occupational Safety and Health Act of 1970 should be considered.

These comments classify your Draft Environmental Impact Statement as LO-1. The classification and the date of our comments will be published in the Federal Register in accordance with our responsibility to inform the public of our views on proposed Federal actions, under Section 309 of the Clean Air Act.

Definitions of the categories are provided on the attachment. Our procedure is to categorize our comments on both the environmental consequences of the proposed action and on the adequacy of the impact statement at the draft stage, whenever possible. If you have any questions concerning our categorization procedures, please let us know.

We appreciate the opportunity to review the Draft Environmental Impact Statement. Please send us one copy of the Final Environmental Impact Statement when it is available.

Sincerely yours,

Arthur W. Busch
Regional Administrator

Enclosure

ENVIRONMENTAL IMPACT OF THE ACTION

LO - Lack of Objections

EPA has no objections to the proposed action as described in the draft impact statement; or suggests only minor changes in the proposed action.

ER - Environmental Reservations

EPA has reservations concerning the environmental effects of certain aspects of the proposed action. EPA believes that further study of suggested alternatives or modifications is required and has asked the originating Federal agency to re-assess these aspects.

EU - Environmentally Unsatisfactory

EPA believes that the proposed action is unsatisfactory because of its potentially harmful effect on the environment. Furthermore, the Agency believes that the potential safeguards which might be utilized may not adequately protect the environment from hazards arising from this action. The Agency recommends that alternatives to the action be analyzed further (including the possibility of no action at all).

ADEQUACY OF THE IMPACT STATEMENT

Category 1 - Adequate

The draft impact statement adequately sets forth the environmental impact of the proposed project or action as well as alternatives reasonably available to the project or action.

Category 2 - Insufficient Information

EPA believes the draft impact statement does not contain sufficient information to assess fully the environmental impact of the proposed project or action. However, from the information submitted, the Agency is able to make a preliminary determination of the impact on the environment. EPA has requested that the originator provide the information that was not included in the draft statement.

Category 3 - Inadequate

EPA believes that the draft impact statement does not adequately assess the environmental impact of the proposed project or action, or that the statement inadequately analyzes reasonably available alternatives. The Agency has requested more information and analysis concerning the potential environmental hazards and has asked that substantial revision be made to the impact statement. If a draft statement is assigned a Category 3, no rating will be made of the project or action, since a basis does not generally exist on which to make such a determination.

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Southeastern Area, State and Private Forestry

1940

February 23, 1973

Your: LMMED-PR

Gene A. Dodson, Chief
Engineering Division
Department of the Army
Memphis District - Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

Thank you for the opportunity of reviewing the revised draft environmental statement, "St. Francis Basin Project, Missouri and Arkansas." Our comments are as follows:

It is noted in Table I that recreation facilities are being expanded at Wappapello Dam. Also, on page 4, a reference is made to "management of forest" in connection with operation and maintenance at the lake. The statement should be more explicit about plans for the forestland in this area. Will there be clearing and if so, how much? Will management plans be developed for the non-cleared forestland areas?

On page 22, the statement gives the forest acreage affected; however, information regarding volume and value of forest resources value affected by the project is not provided.

On page 13, paragraph 3, "Environmental Impact ---" The effects of completing this project, and of maintaining this project, upon the hydrograph downstream from the project is not described. Sometimes flood control projects such as this cause worsened flooding and drainage downstream. The remaining valuable bottomland hardwoods in this downstream area will be damaged if their soils are wetter longer than is common.

Frederick W. Hoenig

FOR: AMEL E. LANDGRAF
Area Environmental Coordinator

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
P.O. Box 459, Columbia, Missouri 65201

February 15, 1973

Mr. Gene A. Dodson, Chief
Engineering Division
Memphis District, Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

Dear Mr. Dodson:

The following comments on the December 1972 draft environmental statement of the St. Francis River Basin, Missouri and Arkansas, are submitted in response to your letters of January 2, 1973, to state conservationists in Missouri and Arkansas. This memo includes the comments of the Soil Conservation Service for both states.

All agricultural lands in the project in Arkansas and Missouri occur within soil and water conservation districts. We suggest that recognition be given to past, current, and potential future establishment of conservation practices (land treatment measures) by these local conservation districts in cooperation with the Soil Conservation Service and others. These practices, essential in reducing soil erosion, sediment, and runoff, include conservation cropping systems, contour farming, crop residue use, row arrangement, cover and green manure crops, pasture and hayland planting and management, wildlife habitat preservation, critical area stabilization, and forest stand improvement.

Supplementary to these soil improving measures are such practices as irrigation and drainage land grading, main and lateral drains, field drains, grade stabilization structures, and structures for water control.

The following table is a partial listing of conservation practices on the land in the basin.

Practice	Approximate Acres on the Land
Conservation cropping system	2,400,000
Crop residue management	2,500,000
Drainage land grading	72,000
Irrigation land leveling	145,000
Pasture and hayland planting	156,000

These established practices represent only approximately 40 percent of the total needs. Basin wide, progress in application of these measures is expected to occur at about 2 percent per year.

The lands mentioned on page 4, paragraph 3, which have been cleared, would still be suitable for fish and wildlife mitigation in a few years under public ownership with proper planting and management.

Page 6, paragraph 2; piling the debris outside of the spoil appears to be the most desirable alternative since den sites would be created for coyotes, fox, rabbit, skunk, and small rodents.

Page 10, paragraph 4; the reference to fish samples on page 11, lists the "Missouri Game and Fish Commission." This should read, "Missouri Department of Conservation and the Soil Conservation Service." A table relative to the fish sampling showing species, percent by weight, and percent by number, would be more meaningful.

Page 11, paragraph 3; the Missouri Department of Conservation, Soil Conservation Service, and other interested individuals have recently developed a list of rare and endangered species. Swamp lily and cypress are not on the list. The tupelo gum, referred to in this paragraph, is not the correct identification; rather, it is black gum (Nyssa sylvatica var. sylvatica).

We question the statement on page 20, paragraph 3, relative to increase in tilled land resulting in less runoff. Records from more than 10,000 plot years of measurements of rainfall, runoff, and erosion at Federal Conservation Experiment Stations show that more runoff occurs on continuous row crop land than on land with grass or legumes in the rotation, or on grassland. These measurements have been substantiated on larger areas.

Page 23, paragraph 2; denuded cut slopes should not be left bare to revegetate naturally. Plans should specify this denuded area be revegetated as excavation is completed. Seeds should be broadcast within 24 hours of excavation before soils dry out. A mixture of grasses and legumes should be used.

Page 23, paragraph 4; suggest addition of the statement, "when properly constructed" to the end of the fifth sentence to read; ". . . creation of excellent quality small lakes when properly constructed."

Thank you for giving us the opportunity to review this statement.

Sincerely,

J. Vernon Martin

J. Vernon Martin
State Conservationist

THE ASSISTANT SECRETARY OF COMMERCE
Washington, D.C. 20230

March 2, 1973

Mr. Gene A. Dodson
Chief, Engineering Division
Memphis District, Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

Dear Mr. Dodson:

The draft environmental impact statement for the St. Francis Basin Project, Missouri and Arkansas, which accompanied your letter of January 17, 1973, has been received by the Department of Commerce for review and comment.

The Department of Commerce has reviewed the draft environmental statement and has the following comment to offer for your consideration.

We suggest that the final environmental impact statement include maps of the project area depicting location of project features.

We hope this comment will be of assistance to you in the preparation of the final statement.

Sincerely,

Sidney R. Galler

Sidney R. Galler
Deputy Assistant Secretary
for Environmental Affairs

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

ER-73/94

JAN 17 1973

Dear Mr. Dodson:

This is in regard to your letter of January 2, 1973, requesting the Department of the Interior's review and comments on the draft environmental statement for St. Francis Basin Project, Missouri and Arkansas.

The Department will have comments on the draft statement but will be unable to reply by the date you requested as we have just received your transmittal (January 12, 1973) and we need 30-45 days for our review purposes. Our comments will be available by the end of February 1973.

Sincerely yours,

Bruce Blanchard, Director
Environmental Project Review

Mr. Gene A. Dodson
Chief, Engineering Division
Department of the Army
Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

United States Department of the Interior
OFFICE OF THE SECRETARY
MISSOURI BASIN REGION

BUILDING 67, DENVER FEDERAL CENTER
DENVER, COLORADO 80225

IN REPLY REFER TO:
ER-73/94

April 2, 1973

District Engineer
U.S. Army Corps of Engineers
688 Clifford David Federal Building
Memphis, Tennessee 38103

Dear Sir:

Reference is made to Mr. Gene A. Dodson, Chief, Engineering Division's January 2, 1973 letter to the Assistant Secretary of the Interior, requesting the Department's comments concerning the draft environmental statement for the St. Francis Basin Project, Missouri and Arkansas. These comments are submitted in accordance with provisions of the National Environmental Policy Act of 1969, Public Law 91-190.

The draft environmental statement does not adequately reflect the impact of the project on fish and wildlife, and archeological and historical resources. Loss of fish and wildlife resources from past and future aspects of the project are extremely significant.

The following comments refer to specific points of the statement and should be included in the appropriate section of the final or revised statement.

2. Environmental Setting Without the Project

This draft environmental impact statement is inadequate concerning archeological and historical resources. While the existence of extensive cultural materials within the project area is noted in the statement (pages 11-12 list 848 known archeological sites and 32 known historical sites), no indication was given as to how the legal requirements will be met, as set forth in Executive Order 11593, the National Environmental Policy Act of 1969 (Public Law 91-190), the Historic Preservation Act of 1966 (Public Law 89-665), and the Reservoir Salvage Act of 1960 (Public Law 86-523).

There is no inventory of cultural resources, no mention of previous archeological work in the project area, and subsequently no evaluation of the significance of these resources. A number of sites are noted in the draft as being important, but no explanation is given to what these sites contain or why they are important. Known sites of archeological and historical value must have been recorded as a result of professional work, but no references are cited.

The draft does not include a map of cultural resources. One should be included to clearly show the relationship of sites to the project boundaries. Such a map is particularly useful in assessing the direct and indirect effects on these significant areas.

A qualified professional archeologist must survey the entire project area and the final environmental impact statement should cite the resulting report(s) and these must be available for review. The final environmental impact statement must also include an evaluation of the significance of the archeological and historical resources found by the survey and give cost estimates and the steps to be taken to mitigate effects of the project on the resources.

In addition to the areas listed in the statement, the following sites, which appear to be in the project area, are listed in the National Register of Historic Places.

1. Sikeston Fortified Village Archeological Site, 2 miles southeast of Sikeston, New Madrid County, Missouri.
2. E. L. Brown Village and Mound Archeological Site, 2 miles northeast of Diehlstadt, Scott County, Missouri.
3. Sandy Woods Settlement Archeological Site, 1-3/4 miles northwest of Diehlstadt, Scott County, Missouri.
4. Rich Woods Archeological Site, 2 miles north of Bernie, Stoddard County, Missouri.
5. Hurricane Ridge Site, 3 miles northeast of Catron, New Madrid County, Missouri.

The following locations, which appear to be in the project area, are under consideration and evaluation as potential National Natural Landmarks.

1. Mingo National Wildlife Refuge near Puxico, Stoddard County, Missouri
2. Ten Mile Pond Area, 4 miles southeast of East Prairie, Mississippi County, Missouri.
3. Big Oak Tree State Park, near East Prairie, Mississippi County, Missouri.
4. Holly Ridge, 4 miles east of Bloomfield, Stoddard County, Missouri.

The reference to Lake Wapanocca on page 11, paragraph 2, should instead be referred to as Wapanocca National Wildlife Refuge.

3. Environmental Impact of the Proposed Action

No adverse environmental impact is anticipated as is related to the geology of the project area. The statement also adequately reveals the significant project effects on the hydrologic system.

Page 17 of the draft environmental statement makes the statement in the first paragraph, "nor will the project have any effect on any of the historic and archeological sites listed in or proposed for inclusion in the National Register of Historic Places."

Without benefit of a field examination, we would anticipate an effect on the Parkin Indian Mound National Historic Landmark. We believe the final environmental statement should consider the possible impact on this site that may result from the channelization of Tyronza River and Big Creek in Crittenden County. This channelization project will enter the St. Francis River upstream and in proximity to the National Historic Landmark. It would appear an increased volume of water could severely affect the Parkin Indian Mound. The Parkin Mound is situated extremely close to the edge of the bank of the St. Francis River. This bank is subject to erosion at that point. There could be a possible effect wherein the river could undermine the Parkin Mound and thus impact this historic resource listed on the National Register of Historic Places.

The final statement should also address itself to the possible effect of the project within that portion of the Big Lake National Wildlife Refuge which has been recommended for evaluation for the Registry of Natural Landmarks. The Oak-Pine and Southeastern Evergreen Forest regions of the Eastern Deciduous Forest Theme study by Mr. Gary S. Waggoner recommended evaluation of a portion of the Big Lake National Wildlife Refuge for possible inclusion on the Registry of Natural Landmarks. This evaluation is scheduled during the 1973 fiscal year.

In addition, the final statement should contain evidence of contact with the State Liaison Officer for the State involved and a copy of his comments concerning project effects upon any historical or archeological sites which may be in the process of nomination to the National Register of Historic Places.

Page 16, paragraph 2 - The statement, "... pesticides... would not be expected to reach the waterways," should be expanded to state that the presence of persistent pesticides in surface waters are a result of agricultural activities and are already a common problem.

Page 19, paragraph 3 - The discussion of ditches in relation to ground water levels is incomplete. The average radii of influence should be given in order to give meaning to the statement, "Lowering the water surface six feet in a channel would increase the radius of influence by approximately 600 feet." With the actual radii of influence

established, the last sentence of the paragraph on page 20 would also be more meaningful. Because of the extensiveness of ditching, these localized areas where the water table will be lowered may cumulatively be quite significant. This has a bearing on the productivity of adjacent riparian woodlands since it has been shown that these hardwoods are adapted to the existing water table and also benefit by periodic flooding.

Page 20, paragraph 3 - The discussion of water is confusing in that specific deductions are made while the specific land types are not discussed. Many of the individual statements should be qualified and the increase in peak flows should be more adequately discussed.

Page 21, paragraph 1 - The statements, "In general, only the natural meander patterns of the natural streams distinguish them from most of the previously altered channels authorized for improvement," and "Water quality and overall benthic community and streamside vegetation are virtually the same for both artificial and natural channels," are misleading. While this may apply to a limited number of waterways in the basin due to soil types, it is not true for the basin in general. In almost all cases channelization results in destruction of benthic communities and degradation of downstream water quality.

4. Adverse Environmental Effects Which Cannot be Avoided Should the Proposal be Implemented

While esthetic, wildlife habitat, and cultural values have been considered, the statement would be significantly strengthened by recognizing the many thousands of man-days of hunting that would be lost annually to the area because of land clearing.

Page 22, paragraph 2 - In areas where the only remaining woodlands are in the form of narrow strips, turkeys will usually be totally absent. Turkeys should not be listed as using these areas.

Page 23 of the draft does recognize that damage to the resources may result but does not consider that all of the known and potential sites could be indirectly affected. Nor does the draft clearly state that sites could well be destroyed through the action, as well as just disturbed. The environmental setting of the sites will also be altered, thereby changing specific information potential and significance. Construction in heavily alluviated areas may also expose buried sites of importance. The final statement and later planning should allow for adequate investigation before continuing earthmoving activities.

5. Alternatives to the Proposed Action

Alternatives to the proposed action have not been thoroughly discussed. The only alternative discussed was that of the proposed and ongoing project.

Page 25, paragraph 1 - Periodic inundation of bottom-land hardwood areas usually results in an increase in growth of hardwoods and provides benefits to timber production and wildlife.

Page 25, paragraph 2 - An unrealistic evaluation has been made on this alternative. Not all of the 1,351,000 acres subject to flooding would have to be acquired. Some of this acreage is not in need of flood protection, woodland is benefited by flooding, and some lands are only rarely flooded.

6. The Relationship Between Local Short-Term Uses of Man's Environment and the Maintenance and Enhancement of Long-Term Productivity

No consideration is given to preservation of archeological and historical resources for future generations. Long-term productivity is maintained only if a significant and representative sample of the cultural resources based in a cultural province are preserved for future study. Adverse effects on archeological remains reduces this sample and these effects are cumulative. The degree of these effects depends upon the degree to which the sample is diminished, and only through a complete cultural investigation of the proposed project area can this type of problem be evaluated.

7. Any Irreversible or Irretrievable Commitments of Resources Which Would be Involved in the Proposed Action Should It be Implemented

Page 27 states, "There are no known commitments of losses to archeological or historical sites." All archeological and historical sites and materials represent a nonrenewable resource and any impact constitutes an irreversible and irretrievable commitment of those resources.

Summary

In summary, the structural features of the project are approximately 41 percent complete. However, destruction of the natural environment is of a much greater magnitude. The project does not adequately consider fish and wildlife and other associated intangibles. A moratorium on construction should be implemented until there is acquisition of authorized mitigation lands and adequate compensation for other losses.

Sincerely yours,

John E. Boyd

Field Representative (Acting for)
Missouri Basin Region

THE STATE OF MISSOURI

Water Resources Board

CLIFFORD L. SUMMERS
Acting Executive Director

Department of Business and Administration
JEFFERSON CITY, MISSOURI 65101

P. O. Box 271
Area Code 314
Telephone 635-9251
751-4252

February 22, 1973

Mr. Gene A. Dodson
Chief, Engineering Division
Memphis District, Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

Dear Mr. Dodson:

Material and comments relative to the Draft Environmental Statement St. Francis Project, Missouri and Arkansas, have been assembled by this office and are being forwarded for your consideration at this time.

The Water Resources Board wishes to point out that the letter of the Missouri Department of Conservation dated February 16, 1973 voices opposition to any farther channelization to the St. Francis River in Missouri represents the views of the Missouri Department of Conservation and not the views of the State of Missouri.

We are in agreement with the Department of Conservation position regarding mitigation of wildlife losses that have occurred or are continuing to occur as the result of the St. Francis Basin Project. We are hopeful that authorized studies will correct this situation and permit preservation of certain natural areas in the best interest of the people residing in the area.

The Water Resources Board considers the Draft Environmental Statement dated December 1972 to present an adequate description of the environmental effects of the development to date including construction work now under contract. We suggest that additional and more localized environmental statements be prepared in connection with any future construction work if full compliance with the intent of the Environmental Policy Act is to be accomplished.

The State of Missouri appreciates the opportunity to comment on the Draft Environmental Statement and to provide additional information regarding the archaeological and historical features in the area.

Sincerely,

Clifford L. Summers
Acting Executive Director

CLS:rjk

Encls.

MISSOURI STATE PARK BOARD
P. O. BOX 176 · 1204 JEFFERSON BLDG. · JEFFERSON CITY, MO. 65101 · 751-3332

CHRISTOPHER S. BOND
Governor

JOSEPH JAEGER, Jr.
Director

February 6, 1973

Mr. Clifford L. Summers
Acting Executive Director
Water Resources Board
P.O. Box 271
Jefferson City, Mo. 65101

Dear Sir:

Re: Review of Draft Environmental Statement
(Revised Dec., 1972) St. Francis Basin Project, Arkansas and Missouri

The State Historical Survey and Planning Office of the Missouri State Park Board has reviewed the St. Francis Basin Project Draft Environmental Statement (Revised Dec., 1972) and finds that several prehistoric sites designated to be listed on the National Register of Historic Places under the National Historic Preservation Act of 1966 (P.L. 89-665; 80 Stat. 915) may be in jeopardy. Furthermore, several prehistoric sites in the area are currently under study for nomination to the National Register.

On page 21, paragraph 3, lines 11 and 12, we find the statement that "Completion of the project will cause unavoidable adverse environmental impacts consisting of ...possibly damage to historical sites and archaeological resources ...." Page 23, paragraph 5 states that "Historical sites and archaeological resources may be damaged by construction activities in spite of diligent efforts to locate and preserve them."

In light of these aforementioned statements, the State Historical Survey and Planning Office submits the following material to facilitate the "diligent efforts to locate and preserve" these archaeological resources. Each exhibit is correspondingly numbered to the explanation below.

1. Bibliography of Missouri archaeology covering area under consideration. Specific references pertaining to area are marked by check (✓) marks or question (?) marks.

2. Zerox pages of locations and maps of some of the archaeological sites to be disturbed by the St. Francis Basin Project.

   A. Hopgood, James F.
   1969 An Archaeological Reconnaissance of Portage Open Bay in Southeast Missouri. Missouri Archaeological Society Memoir. #7, p. 36.

   B. Williams, Stephen
   1954 An Archaeological Study of the Mississippian Culture in Southeast Missouri. Unpublished Ph. D. Dissertation. Yale University. pp. 126, 128, 129.

C. Williams, James Raymond
1971 A Study of the Baytown Phases in the Cairo Lowland of Southeast Missouri. Unpublished Ph.D. Dissertation. Department of Anthropology, University of Missouri-Columbia, pp. 45-46.

D. Williams, Ray
1968 Southeast Missouri Land Leveling Salvage Archaeology: 1967. National Park Service Report. pp. 11-12.

E. Williams, J. Raymond
1972 Land Leveling Salvage Archaeology in Missouri: 1968. National Park Service Report. pp. 8-9.

F. Williams, J. Raymond
1964 A Study of Fortified Indian Villages in Southeast Missouri. Unpublished M.A. thesis. Department of Anthropology, University of Missouri-Columbia. p. 15.

G. Redfield, Alden
1971 Dalton Project Notes. Museum Briefs. Museum of Anthropology, University of Missouri-Columbia. Figs. 4-9, and pp. 22-23.

3. A map including: Dunklin, Pemiscot, New Madrid, Mississippi, Stoddard, and Scott Counties.

On this map NRHP sites are indicated by green circles. Sites reported by S. Williams and J.R. Williams are indicated in red. Sites reported by J.F. Hopgood are indicated by blue. Only the most pertinent sites listed in the literature are indicated on this map. For information concerning other sites in the area, contact Arch. Survey Office and publications listed on reference sheets.

4. Specific information on N.R.H.P. sites in area under consideration:

A. The Wilborn-Steinberg Site--Butler Co.

B. Koehler Fortified Village--Butler Co.

C. Trail of Tears State Park--Cape Girardeau Co.

D. Langdon Site--Dunklin Co.

E. Rich Woods Site--Stoddard Co.

F. Beckwith's Fort (Towosahgy State Park)--Mississippi Co.

G. Hoecake Village--Mississippi Co.

H. Crosno Fortified Village--Mississippi Co

I. O'Bryan Ridge District--Mississippi Co.

J. Hearnes Site--Mississippi Co.

K. Hurricane Ridge Site--New Madrid Co.

L. Lilbourn Fortified Village--New Madrid Co.

M. Sikeston Fortified Village--New Madrid Co.

N. Denton Mound--Pemiscot Co.

O. Murphy Mound--Pemiscot Co.

P. J.M. Wallace Site--Pemiscot Co.

Q. E.L. Brown Site--Scott Co.

R. Sandy Woods Settlement--Scott Co.

We are in hopes that these enclosures and exhibits will provide the needed information and that by so doing they may also promote the best interests of all parties concerned with the development and preservation of the St. Francis Basin.

Sincerely,

MISSOURI STATE PARK BOARD

Joseph Jaeger, Jr.
Director of Parks and State Liaison Officer

JJJ/csm

cc: Robert R. Garvey, Jr.
Executive Secretary
National Advisory Council on Historic Preservation
Suite 430
1522 K. Street, N.W.
Washington, D.C. 20005

Dr. Dan F. Morse
Arkansas Archaeological Survey
Drawer 820
State University, Arkansas

Orval L. Henderson, Jr.

MISSOURI GEOLOGICAL SURVEY AND WATER RESOURCES
BUEHLER PARK ROLLA MISSOURI 65401 314-364-1752

WALLACE B. HOWE STATE GEOLOGIST AND DIRECTOR

LARRY D. FELLOWS ASSISTANT STATE GEOLOGIST

January 30, 1973

Mr. Clifford L. Summers
Acting Executive Director
Missouri Water Resources Board
Jefferson City, Missouri 65101

Subject: Review of Draft Environmental Statement (Revised Dec. 1972), St. Francis Basin Project, Arkansas and Missouri

Dear Mr. Summers:

The Survey Environmental Geology Group has reviewed the subject document and we find it to be well written, in our view.

The only comment we offer concerns an item on page 7 describing Crowleys Ridge. According to the Environmental Statement, Crowleys Ridge is "a loessial formation"; while it is true that loess blankets Crowleys Ridge, the core of the Ridge is a remnant of old uplands, and might be considered partly as a remnant of the Ozark Plateau, the same as Commerce Hills northeast of Crowleys Ridge. Including the statement that Crowleys Ridge is "a loessial formation" would give the impression that the entire Ridge consisted of wind-blown soils, when in fact sedimentary deposits of Tertiary, Cretaceous and Ordovician age lie beneath the surficial loess deposits.

Thank you for this opportunity to comment on the Draft Environmental Statement.

Very truly yours,

Jerry D. Vineyard

Jerry D. Vineyard, Chairman
Survey Environmental Geology Group

Prepared for and Approved by:

Wallace B. Howe

Wallace B. Howe
State Geologist and Director

MISSOURI DEPARTMENT OF CONSERVATION
2901 North Ten Mile Drive - Jefferson City, Missouri 65101
P. O. Box 180 - Telephone 314 751-4115
CARL R. NOREN, Director

February 16, 1973

Mr. Clifford L. Summers
Acting Executive Director
Missouri Water Resources Board
308 East High Street
Jefferson City, Missouri 65101

Dear Cliff:

We have reviewed the Revised Draft Environmental Impact Statement for St. Francis Basin Project, Missouri and Arkansas. The effort of the Corps of Engineers' staff to cover the environmental impacts of all the various projects undertaken or planned under the 1936 Flood Control Act in one 27 page statement is an impossible undertaking. The broad brush approach of a superficial statement is not in our opinion in keeping with the disclosure of known environmental impacts as required by the National Environmental Policy Act of 1969, Corps of Engineers' Regulation ER-1105-2-507 (January 1972) and Executive Order 11514.

In order that environmental impacts can be adequately identified and considered the Memphis District must at least write separate environmental statements for those projects identified by the general map as having adverse environmental impacts. In addition, other channelization and ditch cleaning projects should each receive the consideration of a detailed environmental assessment. As you know, we have expressed our concern with projects such as the channelization of the Platte River and Little Chariton River due to environmental damage. We believe it to be in the best interest of the people of Missouri if we go on record as opposing further channelization of the St. Francis River in Missouri. The Corps of Engineers (Page 21) has identified the importance of the

unchannelized St. Francis River as "Only the upper St. Francis River has any significant adjacent bottomland forests remaining The reduction in flooding will make it more feasible to convert these lands to agricultural use". We therefore recommend no further channelization on this part of the St. Francis River.

We have attached page by page detailed comments on other aspects, but our major concerns are (1) The need for detailed impact statements on adverse projects included under the blanket 1936 authorization, and (2) Opposition to continued losses of forests and wildlife due to the channelization of the St. Francis River below Lake Wappapello.

Thank you for the opportunity to comment.

Sincerely,

Larry R. Gale

LARRY R. GALE
ASSOCIATE DIRECTOR

cc: Bureau of Sport Fisheries and Wildlife
Atlanta, Georgia

Bureau of Sport Fisheries and Wildlife
Vicksburg, Mississippi

DETAILED COMMENTS

of the

ENVIRONMENTAL IMPACT STATEMENT

ST. FRANCIS BASIN PROJECT

by the

MISSOURI DEPARTMENT OF CONSERVATION

Page ii - Item 4 - Alternatives - Questions concerning the rejection of Alternatives "b" and "d" center around recent federal direction to evacuate the flood plains and utilize them for compatible uses. If the reference to construction under item "d" concerning installation of mitigation features includes the plugging of Wilhelmina Cutoff, we are somewhat skeptical of enhancement. We believe that fish and wildlife losses should be mitigated before we discuss enhancement.

Page 2 - Inclusion of all federal costs for levee and drainage with local costs would be of value for comparison purposes.

Page 3 - Recommend the Corps discuss their efforts to implement the features outlined on the top of this page and seek federal funding to implement all phases of the project.

Page 4 - We have tried to initiate better management of the lands to offset unmitigated wildlife habitat losses associated with the Wappapello project. Thus far our efforts have been unsuccessful.

Page 6 - No plans are made for the revegetation of spoil banks. This no doubt leads to increased erosion and sedimentation.

Page 10 - We do not understand how Wappapello Reservoir can be included in the "without the project" setting.

Page 12 - Middle Paragraph - As in several other areas, this report low keys the role of the Corps in transforming the "Great Swamp". Old maps and other information indicates a tremendous change in the St. Francis Basin in the 36 years of Corps' involvement.

Page 13 - Middle Paragraph - This paragraph seems to state the Corps economic philosophy for environmental elements. The crux of the paragraph is that only when tiny patches of swamp are left will they be "valuable examples" of what was lost due to the project. Unfortunately, many of the native animals either have been extipated, or will be extipated by 1986 when the project is completed.

Page 14 - Paragraph 2 - This paragraph relates to the improvement of "farm management" and "agricultural income"; however, it does not face the fact that the poor people will lose their places to fish, hunt and the shady stream bank for relaxation. Those that profit from "improved farm management" and an improved "agriculture income" can already go to Florida to fish and Canada or Alaska to hunt. The importance of a local place to go is completely overlooked.

Paragraph 4 - Improved land management at Wappapello Reservoir would increase wildlife populations for consumptive and non-consumptive use.

Page 15 - Paragraph 1 - We are not aware of complete mitigation of fish and wildlife habitat losses resulting from any of the various features of this 36 year old project; this is notably true at Wilhelmina.

Paragraph 2 - The Arthur D. Little Report does not apply to conditions in the St. Francis Basin Project. For instance, the Corps requires periodic (3-5 year) maintenance of the new ditches. This precludes redevelopment of habitat.

Page 16 - (1) The wastes, including chemical pest control agents and fertilizers will travel greater distances and constitute more of a hazard to downstream areas. (2) Even though little fertilizer or other chemicals are used on soybeans, there will be tremendous amounts of herbicides and fertilizer used for each acre of cotton.

Page 20 - Paragraph 2 - The statement "faster runoff should occur" is of interest. A discussion of what the environmental impacts of this faster runoff should be included.

Page 21 - (1) We discussed the portion of this page dealing with continuing channelization of St. Francis River in our cover letter. It is interesting that in a time of reevaluation of channelization, the Memphis District continues to plan for 475 miles of channelization in the St. Francis River Basin.

(2) The very brief mention of Castor River is an example of important resources being lost in the broad brush approach. Such factors lost in this oversimplified statement must be spelled out in individual detailed statements.

Paragraph 1 - Last sentence - Oxbows cutoff from the river are very temporary, and although some may furnish better fishing the long term effect of such cutoffs is lost fish and wildlife habitat.

Page 22 - Paragraph 2 - This paragraph seems to disagree with material presented on Page 16, from the Arthur Little Report and the disclaimer presented on Page 12, Paragraph 2.

Paragraph 3 - The clearing of an additional 10,000 acres due to drainage improvement is a tremendous impact. Where are these tracts, what is being done to protect environmental values in these areas, and what will be done to mitigate losses? Without answers to these questions, the projects should not be continued.

Page 23 - Paragraph 1 - Once again the "broad brush" leads to misrepresentation. The statement, "Although the fishery in practically all these channels is extremely limited and very poor quality", does not clearly identify the impacts for decision making. We would agree that some ditches may not provide much fish habitat, but there must be individual accounting in order that intelligent decisions can be made. Without complete and accurate impact statements for each project undertaken under the 1936 authorization, good decisions are impossible.

Paragraph 2 - We doubt that there is any comparison between the amount of sediment and turbidity from bottomland forests and the amount from "improved" ditch through cleared, agricultural land. The contribution of sediment, both water borne and wind blown from the cleared agriculture land, will far exceed that from the bottomland forest.

Paragraph 3 - We disagree; more marginal land will be cleared, and attempts will be made to put the marginal land in crops.

Page 24 - Paragraph 4 - How many floods have there been since Wappapello was placed to "effectively control the runoff"?

Paragraph 5 - We believe the Corps of Engineers should hold off further channelization on the St. Francis River to prevent clearing of the remaining woodland.

Page 25 - Paragraph 3 - We are not completely familiar with the situation in Arkansas, but there must be mitigation before enhancement of fish and wildlife values.

MISSOURI DEPARTMENT OF CONSERVATION

2901 North Ten Mile Drive - Jefferson City , Missouri 65101

P. O. Box 180 - Telephone 314 751 4115

CARL R. NOREN, Director

May 16, 1973

Mr. Steve Wilson
U. S. Army Engineer District
Memphis Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

Dear Steve:

Attached is a list of Department owned and leased land, most of which is in the St. Francis River Basin. Some of the areas listed are actually along the main stem of the Mississippi River. Available maps of the areas listed are enclosed in order that they can be located. In addition to the information on land ownership I have enclosed two copies of Rare and Endangered Fauna of Missouri dated September, 1972. When the complete list of rare and endangered plants and animals is available, we will send you one.

I hope that the ownership list and the maps will be helpful in completing the St. Francis River Basin map. If you have questions or need any more information, please call me.

Sincerely,

W. H. Dieffenbach

WILLIAM H. DIEFFENBACH
RESOURCE SPECIALIST

WHD:cgl

Enclosures

MISSOURI DEPARTMENT OF CONSERVATION

OWNERSHIP AND LEASE

UNIT	ACREAGE
BUTLER COUNTY	
Fisk Access	3.71
DUNKLIN COUNTY	
Armstrong Wildlife Area	548
Ben Cash Memorial Wildlife Area	955.85
IRON COUNTY	
Sam A. Baker State Forest (area also in Bollinger & Wayne Counties)	60.00
State Forest Land	3,083.11
Taum Sauk Towersite	83.84
Vulcan Towersite	377.44
MISSISSIPPI COUNTY	
Bird's Blue Hole	77
Dorena Access	3.93
NEW MADRID COUNTY	
Bootheel Forest Fire Protection District	1.00
New Madrid Bend Access	7.19
PEMISCOT COUNTY	
Reynolds (S.P.) Access	200'
Twin Borrow Pits Area	20+
Wolf Bayou	203.04
SCOTT COUNTY	
State Forest Land	64.30
Tywappity Community Lake	119.60

STODDARD COUNTY

Bloomfield Towersite	2.00
Bradyville Waterfowl Area	268.51
Duck Creek Wildlife Area (area also in Bollinger and Wayne Counties)	2,381.56

WAYNE COUNTY

Coldwater State Forest	4,647.31
Duck Creek Wildlife Area (area also in Stoddard & Bollinger Counties)	1,434.50
Sam A. Baker State Forest (area also in Bollinger and Iron Counties)	5,419.32
Riverside State Forest	1,920.00
Yokum School Tract	160

MISSOURI STATE PARK BOARD

	Acreage
Big Oak Tree State Park	1,007
Elephant Rocks (Graniteville)	120
Hunter-Dawson (New Madrid)	16
Towosahgy State Park (East Prairie)	64
Total	1,207

Pugnose Minnow	*Opsopoeodus emiliae*	En
Eastern Slim Minnow	*Pimephales tenellus parviceps*	En
Blue Sucker	*Cycleptus elongatus*	R
Brown Bullhead	*Ictalurus nebulosus*	R
Neosho Madtom	*Noturus placidus*	En
Ozark Cavefish	*Amblyopsis rosae*	R
Burbot	*Lota lota*	R
Golden Topminnow	*Fundulus chrysotus*	En or Ex
Plains Killifish	*Fundulus kansae*	R
Mississippi Silverside	*Menidia audens*	R
Pumpkinseed	*Lepomis gibbosus*	En
Batam Sunfish	*Lepomis symmetricus*	R
Arkansas Darter	*Etheostoma cragini*	R
Harlequin Darter	*Etheostoma histrio*	En
Niangua Darter	*Etheostoma nianguae*	R
Goldstripe Darter	*Etheostoma parvipinne*	En
Redfin Darter	*Etheostoma whipplei*	En or Ex
Bluestripe Darter	*Percina cymatotaenia*	R
Longnose Darter	*Percina nasuta*	En

DEFINITIONS

ENDANGERED – An endangered species is one whose prospects for survival within the state are in immediate jeopardy.

RARE – A rare species is one that, although not presently threatened with extirpation, is in such small numbers within the state that it could easily become endangered if its environment worsens.

STATUS UNDETERMINED – A status undetermined species is one that has been suggested as possibly rare or endangered, but about which there is not enough information to determine its status.

EXTIRPATED – An extirpated species is one that formerly occurred in Missouri but at this time is not known to exist within the state.

Information on sightings of rare and endangered species will help in evaluating their relative abundance and aid in planning management programs for their benefit.

If you have information on confirmed sightings of these species please send all available information to:

Missouri Department of Conservation
Game Research
1110 College Avenue
Columbia, Missouri 65201

BIRDS

Water Turkey	*Anhinga anhinga*	Ex
Double-Crested Cormorant	*Phalacrocorax auritus*	En
Black Vulture	*Coragyps atratus*	R
Swallow-Tailed Kite	*Elanoides forficatus*	Ex
Mississippi Kite	*Ictinia misisippiensis*	R
Sharp-Shinned Hawk	*Accipiter striatus*	En
Cooper's Hawk	*Accipiter cooperii*	En
Red-Shouldered Hawk	*Buteo lineatus*	R
Marsh Hawk	*Circus cyaneus*	SU
Golden Eagle	*Aquica chrysaetos*	SU
Bald Eagle	*Haliaeetus leucocephalus*	
	H. l. leucocephalus (Southern)	Ex
	H. l. alascensis (Northern)	R
Osprey	*Pandion haliaetus*	En
Peregrine Falcon	*Falco peregrinus*	En
Pigeon Hawk	*Falco cocumbarius*	SU
Wood Ibis	*Mycteria americana*	SU
Ruffed Grouse	*Bonasa umbellus*	R
Greater Prairie Chicken	*Tympanuchus cupido*	En
King Rail	*Rallus elegans*	R
Virginia Rail	*Rallus limcola*	SU
Black Rail	*Laterallus jamaicensis*	SU
Sandhill Crane	*Grus canadensis*	SU
Purple Gallinule	*Porphyrula martinica*	SU
Common Gallinule	*Gallinula chloropus*	SU
Upland Plover	*Bartramia longicauda*	En
Least Tern	*Sterna albifrons*	R
Black-Billed Cuckoo	*Coccyzus erythrothalmus*	SU
Barn Owl	*Tyto alba*	R
Burrowing Owl	*Speotyto cunicularia*	SU
Long-Eared Owl	*Asio otus*	SU
Saw-Whet Owl	*Aegolius acadicus*	SU
Poor-Will	*Phalaenoptilus nuttallii*	SU
Red-Cockaded Woodpecker	*Dendrocopos borealis*	Ex
Western Kingbird	*Tyrannus verticalis*	R
Cliff Swallow	*Petrochelidon pyrrhonta*	SU
Common Raven	*Corvus corax*	SU
Fish Crow	*Corvus ossifragus*	R
Brown-Headed Nuthatch	*Sitta pusilla*	Ex
Long-Billed Marsh Wren	*Telmatodytes palustris*	SU
Short-Billed Marsh Wren	*Cistothorus platensis*	SU
Swainson's Warbler	*Limnothlypis swainsonii*	R
Bachman's Warbler	*Vermivora bachmanii*	Ex
Hooded Warbler	*Wilsonia citrina*	SU
Bobolink	*Dolychonyx oryzivorus*	SU
Yellow-Headed Blackbird	*Xanthocephalus xanthocephalus*	R
Painted Bunting	*Passerina ciris*	R

Rare and Endangered Fauna of Missouri

September, 1972

Endangered - En	**Extirpated - Ex**
Rare - R	**Status Undetermined - SU**

MAMMALS

Southeastern Shrew	*Sorex longirostris*	R
Indiana Bat	*Myotis sodalis*	En
Small-Footed Myotis	*Myotis leibii*	En
Gray Bat	*Myotis grisescens*	En
Keen's Bat	*Myotis keenii*	R
Western Big-Eared Bat	*Plecotus townsendii*	En
Eastern Big-Eared Bat	*Plecotus rafinesquei*	En
Black Bear	*Euarctos americanus*	SU
Ringtail	*Bassariscus astutus*	R
Least Weasel	*Mustela nivalis*	R
Long-Tailed Weasel	*Mustela frenata*	SU
Spotted Skunk	*Spilogale putorius*	En
River Otter	*Lutra canadensis*	En or Ex
Red Wolf	*Canis niger*	Ex
Mountain Lion	*Felis concolor*	
Franklin's Ground Squirrel	*Citellus franklinii*	
Plains Harvest Mouse	*Reithrodontomys montani*	
Plains Pocket Mouse	*Perognathus flavescens*	
Meadow Jumping Mouse	*Zapus hudsonius*	
White-Tailed Jackrabbit	*Lepus townsendii*	
Black-Tailed Jackrabbit	*Lepus californicus*	
Swamp Rabbit	*Syvilagus aquaticus*	
Nine-Banded Armadillo	*Dasypus novemcinctus*	
Lark Bunting	*Calamospiza melanocorys*	R
Henslow's Sparrow	*Passerherbulus henslowii*	R
Bachman's Sparrow	*Aimophila aestivalis*	R

REPTILES

Alligator Snapping Turtle	*Macroclemys temminckii*	R
Blanding's Turtle	*Emydoidea blandingii*	En or Ex
Green Water Snake	*Natrix cyclopion*	R
Queen Snake	*Natrix septemvittata*	Ex
Western Hognose Snake	*Heterodon nasicus*	En
	H.n. nasicus; H.n. gloydi	
Smooth Green Snake	*Opheodrys vernalis*	R
Scarlet Snake	*Cemophora coccinea*	R
Kirtland Water Snake	*Natrix kirtlandi*	SU
Massasauga	*Sistrurus catenatus*	R
	S.c. tergeminus; S.c. catenatus	
Canebrake Rattlesnake	*Crotalus horridus atricaudatus*	R

AMPHIBIANS

Four-Toed Salamander	*Hemidactylium scutatum*	R
Mole Salamander	*Ambystoma talpoideum*	SU
Grotto Salamander	*Typhlotriton spelaeus*	SU
Three-Toed Congo Eel	*Amphiuma means tridactylum*	SU
Ringed Salamander	*Ambystoma annulatum*	SU
Oklahoma Salamander	*Eurycea tynerensis*	R
Dwarf Salamander	*Manculus quadridigitatus*	En
Northern Crayfish Frog	*Rana areolata circulosa*	SU
Illinois Chorus Frog	*Pseudacris steckeri illinoiensis*	SU
Eastern Spadefoot Toad	*Scaphiopus holbrooki*	SU
Hurter's Spadefoot Toad	*Scaphiopus hurteri*	SU
Wood Frog	*Rana sylvatica*	En or Ex

FISHES

Southern Brook Lamprey	*Ichthyomyzon gagei*	R
American Brook Lamprey	*Lampetra lamottei*	R
Lake Sturgeon	*Acipenser fulvescens*	En
Pallid Sturgeon	*Scaphirhynchus albus*	En
Alligator Gar	*Lepisosteus spatula*	R
Alabama Shad	*Alosa alabamae*	R
Brassy Minnow	*Hybognathus hankinsoni*	R
Cypress Minnow	*Hybognathus hayi*	En or Ex
Sturgeon Chub	*Hybopsis gelida*	En
Sicklefin Chub	*Hybopsis meeki*	En
Pallid Shiner	*Notropis amnis*	En or Ex
Blacknose Shiner	*Notropis heterolepis*	En
Taillight Shiner	*Notropis maculatus*	En or Ex
Sabine Shiner	*Notropis sabinae*	R

JOHN P. SAXTON
DIRECTOR
(501) 371-1611

ARKANSAS

DEPARTMENT OF COMMERCE
DIVISION OF SOIL AND WATER RESOURCES
1920 WEST CAPITOL AVENUE
LITTLE ROCK, ARKANSAS 72201

March 15, 1973

RICHARD W. LONGING
DIRECTOR OF COMMERCE
(501) 371-2231

Gene A. Dodson, Chief, Engineering Division
Memphis District, Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

Re: Draft Environmental Statement - St. Francis Basin Project
Missouri and Arkansas

Dear Mr. Dodson:

The general plan, developed by the Corps of Engineers, for flood control protection and drainage of the St. Francis River Basin appears to be an adequate solution to solving the existing flood control and drainage problems prevailing over extensive areas in the Basin.

Completion of this project will certainly result in savings from flood losses of millions of dollars annually thus improving the local economy which will benefit the local people and increase revenues to the Federal and local governments.

The elimination of flooding will result in enhancement and improved environmental conditions necessary for the protection of the health and welfare of residents residing within the project area.

It is emphatically recommended that all lands, now forested, that can be reasonably expected to be cleared as a result of this project, be acquired at project expense as mitigation and preserved as wetlands, wildlife habitat, parks and recreational areas.

The present plan of cost sharing between Federal and local interest for water control facilities for treatment of water for municipal use and waste disposal is essential for present and future area requirements. Improvements to highways and bridges necessitated by project development should be included in projects costs at Federal expense.

Sincerely,

John P. Saxton
Director

JPS:EDC:cc

PRESERVING THE PAST FOR THE FUTURE

ARKANSAS ARCHEOLOGICAL SURVEY

DIRECTOR • CHARLES R. MCGIMSEY III
STATE ARCHEOLOGIST • HESTER A. DAVIS

Coordinating Office
University of Arkansas Museum
Fayetteville, Arkansas 72701

January 24, 1973

Mr. Gene A. Dodson
Chief, Engineering Division
Memphis District
Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

Dear Sir:

Thank you for your letter of 2 January 1973, reference LMMED-PR, with which you enclosed a draft environmental statement, revised December 1972, on the proposed project "St. Francis Basin Project, Missouri, and Arkansas" for our review and comments. Our review is primarily concerned with the effects of the proposed project on archeological and historical resources in Arkansas.

It is our opinion that the revised draft environmental impact statement does not include an adequate discussion of the plans to provide for the archeological and historical resources in the project area. The discussion in Section 3 (page 17) is quite generalized and places an emphasis on consideration of known site locations. While it may be possible to avoid destroying or damaging the known sites, the major problem is the damage to sites whose locations are not yet on record. The extent of archeological research in the project area is not changed over what it was in 1969 when the current state of knowledge was reviewed by Dan F. Morse of the Arkansas Archeological Survey in a report "Preliminary Report on the Archeology of the St. Francis and Little River" for the National Park Service (copy enclosed). Given the inadequate state of knowledge concerning the archeological resources, we can expect adverse effects to take place as a result of this project. A systematic site location survey by a professional archeologist is needed to record sites which have not yet been included in our files.

There are two aspects to this project which may affect archeological resources and both should be taken into consideration. The first is the projected land alterations including ditches, levee construction, spoil banks and increased channel erosion that may damage or destroy sites. These alterations may cut into sites which are close to the surface and sites which are more deeply buried in the alluvium. The second aspect is the fact that an estimated 10,000 acres of woodland will be cleared of vegetative cover as an indirect result of the project. This will

expose previously protected sites to extensive damage and ultimate destruction as a result of the modern agricultural practices that will be employed on this land.

We hope that close coordination will be maintained with the National Park Service so that the necessary archeological work can be scheduled before projects within the overall plan are initiated.

If we may be of further assistance, please let us know.

Sincerely

Hester A. Davis

Hester A. Davis
State Archeologist

HAD/jg
Enc:
cc Arizona Archeological Center

Preliminary Report on the Archeology of the St. Francis and Little Rivers

Dan F. Morse
Arkansas Archeological Survey
1969

INTRODUCTION

The Arkansas Archeological Survey has been requested to furnish the location of known archeological sites in areas of contemplated United States Army Corps of Engineers work on the St. Francis River below Wappapello Reservoir and the effects any proposed improvements will have on these sites. The present report must necessarily be incomplete, because nowhere in the area concerned has there been a thorough archeological survey. Sites commented upon here are those already on record with the Survey. There are large areas where no sites have been recorded, not because they are not there, but because no one has looked for them yet. In addition, large areas of the region concerned are only now being cleared of trees and brush, so that sites which were completely covered are now becoming available for investigation.

Indians have been living along the waterways of Eastern Arkansas for about 12,000 years. They have lived along the St. Francis and Little Rivers for at least 8-10,000 years. This is demonstrated by a combination of geological, paleontological, and archeological information, although we do not yet have an adequate understanding of population numbers or of specific economic activities.

One major problem we are concerned with is the influence of the New Madrid Earthquake of 1811-12 on archeological evidence of pre-historic occupation in the sunk lands. A preliminary conclusion based upon admittedly scanty evidence is that there was relatively little earthquake influence on the makeup of the sunk lands. Where surveyed, archeological sites appear to be common but of a temporary nature (campsites). More permanent sites exist on high ground adjacent to the sunk lands. Modern ditching tends to destroy the campsites as well as the adjacent permanent sites.

PREVIOUS WORK

Missouri: The work done in southeast Missouri has not extended to areas adjacent to the St. Francis River so far as is known at present (Marshall 1965; Williams 1968).

Arkansas: Almost all of the sites known to be located within or adjacent to the St. Francis sunk lands and adjacent to the Left Hand and Right Hand Chute of the Little River have been recorded by the Survey within the past two years. There has been no concentrated effort to do an archeological survey on any part of the area concerned by this study. During early March of 1968 a partial archeological survey was made within and near the sunk lands at the Craighead -- Poinsett County line. A survey of Hatchie Coon Island by an Explorer Scout group from Harrisburg was not completed.

PIGGOTT QUAD

The northern-most site recorded to date in Arkansas along the St. Francis River is 3CY55. The new channel ditch just barely side-

swiped the site and stops immediately south of the site. Along Chalk Bluff (1¼ to 1½ miles straight south of the state line) a cannon is alleged to be buried in silt. The cannon was left from an attack from Campbell toward Piggott about 1863-64. During 1910-1930 a local informant states that the cannon was still visable but now is buried in river silt. Present attempts to locate the cannon by the owners are being made. A number of Woodland camp and village sites are known south of 3CY55. No Mississippi ceremonial centers or fortified sites are on record (although the Indians inhabiting the approximate 65 sites making up the Powers Phase near Naylor, Missouri, may have entered through the St. Francis gap around A.D. 1300). No Archaic sites are known in the area but such sites may be buried by relatively recent silting.

KENNETT QUAD

No sites have been recorded along this portion of the river. At least one collector from Kennett, however, is reported to have collected artifacts from this area, and there is no doubt that there are sites along this stretch of water.

MARMADUKE QUAD

There are no sites on the southern half of Gum Island but the high ground (several knolls) to the north has not been checked. One party is reported to have sold 2000 points from Indian Hill Island. The alleged site on this island was dug into by untrained persons as late as last winter (1968). The University of Missouri is known to have recorded a

site at the levee directly northwest of Cardwell. Sites have been located by associates of the Survey along lateral No. 2 and lateral No. 3 in Missouri. Site T-89 (made up of 3 units) is apparently at or near where a Pumping Station is planned. There are potential informants in both Cardwell, Missouri, and Paragould, Arkansas, who collect from this area.

LEACHVILLE QUAD

A number of sites, from camps to ceremonial centers, have been located along this portion of the river. The Lawhorn site (3CG1) was partly destroyed by previous ditching (Moselage 1962: Figures 3, 4, and 41). Straightening the present channel might destroy sites such as the one at Jackson Landing. Seepage collecting and ditching might disturb 3GE2, a very important site, and other sites to the south.

MARKED TREE QUAD

Although several sites have been recorded on this quad, one informant has told us that he knows of a very large number of additional sites. Most of the area under consideration is wooded and difficult to search. It appears likely, based upon the map provided, that several sites may be destroyed by channel and seepage ditching, new levees, and by a pumping station. No sites have yet been recorded along the Right Hand Chute of Little River, but an informant states he can guide the Survey to several.

EVADALE QUAD

A number of sites exist near the Left Hand Chute of Little River but many of these are located on earlier meanders. A short note on site 3MS11 has been published (Andrews 1967). If channel improvement involves little or no straightening, then little destruction is expected.

MANILA QUAD

There are no sites known along this protion of the Left Hand Chute of Little River except the Mississippi period town near Roseland. Some sites along the Right Hand Chute of Little River have been located and potential informants for the area are known. Two sites have been tested (Morse 1968) and a third is being more extensively excavated north of Manila by the Survey during the summer of 1969.

SUMMARY

Attached to this report is a table detailing archeological sites known at the present time which may be directly influenced by the project. Before a final statement can be made as to the total affect upon the evidence of prehistoric occupation of the proposed work, a thorough archeological survey will be needed.

Prior reports on the project area are listed in the bibliography. The Survey works closely with many other agencies who are concerned with investigations in the project area. For example, the Vicksburg office of the Corps of Engineers is conducting geological investigations in this area which are helping the Archeological Survey and vice versa. Coordination is always attempted between the Survey and individual

research investigations such as by University faculty and students. In addition there will be cooperation with the University of Missouri concerning areas within Missouri.

Additional data required from the Corps of Engineers include more detailed maps of proposed activity, and access to geological and ecological information gathered by others during the study.

BIBLIOGRAPHY

Andrews, E. Wyllys V

1967 The Gant Site (3MS11), Mississippi County, Arkansas. The Arkansas Archeologist, Vol. 8, No. 2-3. Fayetteville.

Marshall, Richard A.

1965 An Archaeological Investigation of Interstate Route 55 through New Madrid and Pemiscot Counties, Missouri, 1964. University of Missouri Highway Archaeology, Report No. 1. University of Missouri Columbia.

Morse, Dan F.

1968 Preliminary Report on 1968 Archeological Excavations at the Big Lake National Wildlife Refuge. Report prepared for the Department of the Interior, Washington, by the Arkansas Archeological Survey.

Moselage, John H.

1962 The Lawhorn Site. The Missouri Archaeolgoist, Vol. 24. Columbia.

Williams, Ray

1968 Southeast Missouri Land Leveling Salvage Archaeology: 1967. Manuscript prepared for the National Park Service, Midwest Region, by the University of Missouri Archaeological Research Division, Columbia.

SITE NO.	QUADRANGLE	RIVER	LOCATION	COMMENTS
3 CY 55	Piggott	St. Francis		Woodland Camp. Just barely intruded by present ditch.
3 CY 63	"	"	SW/NW/33/T20N/R9E	Woodland and Mississippian camps. West of levee 1.9 mile.
3 CY 62	"	"	NW/SE/9 /T19N/R9E	Mississippian village. West of levee 1.8 mile.
3 CY 61	"	"	SE/SE/33/T20N/R9E	Mississippian village. West of levee 1.4 mile.
3 CY 60	"	"	NW/NW/34/ NE/NE/33/T20N/R9E	Mississippian camp. West of levee 0.9 mile.
3 CY 59	"	"	NE/SW/27/T20N/R9E	Mississippian camp. West of levee 0.6 mile - other sites may be near this one.
3 CY 58	"	"	NE/SW/15/T20N/R9E	Mississippian camp. West of levee 0.1 mile.
3 CY 57	"	"	SE/SE/18/T21N/R8E	Woodland and Mississippian camps. South of St. Francis, Arkansas ¼ mile.
3 CY 56	"	"	NW/SW/ 1/T21N/R8E	Mississippian camp. West of St. Francis River ¼ mile.
3 CY 64	"	"	SW/NE/ 2/T21N/R8E	Archaic-Woodland camps. East of meander line of 1845 0.3 mile and south of State line ½ mile.
---	Kennett			
Indian Hill	Marmaduke	"	E½/28/T17N/R6E	Not visited by Survey but alleged to be very important sit
	"	"	NW/ 5/T16N/R6E	Not visited by Survey.
T-89	"	"	SW/ 8/T16N/R6E	Early Archaic - Mississippi camp. Along lateral No. 2 in Missouri.
T-90	"	"	NE/19/T16N/R6E	Archaic - Woodland camps. Along lateral No. 3 in Missouri.

SITE NO.	QUADRANGLE	RIVER	LOCATION	COMMENTS
3 GE 2	Leachville	St. Francis	Center 34/T16N/R6E	Large Mississippi ceremonial center. ¼ mile west of levee.
3 GE 118	"	"	NE/SE/35/T16N/R6E	Early Archaic camp. ¼ mile NW of ditch.
3 CG 1	"	"	NW/SW/ 5/T15N/R7E	Mississippi village. Cut by seepage ditch.
3 CG	"	"	SW/ 1/T15N/R6E	Camps. Rush Island (site not in Survey records).
3 CG	"	"	SW/ 1/T15N/R6E	Camps. Rush Island (site not in Survey records).
3 CG	"	"	Center E/7/T15N/ R7E	Archaic - Mississippi camps. Jackson Landing (site not in survey records).
3 CG 32	"	"	NE/SE/10/T15N/R6E	Archaic camps. Deasons Lake.
3 CG 154	"	"	SW/SE/10/T15N/R6E	Woodland village. Big Island.
3 CG 272	"	"	SE/SW/14/T15N/R6E	Camps. Newton Island.
3 CG 271	"	"	NW/SW/NE/22/T15N/ R6E	Camps. Big Island.
3 CG 21	"	"	SE/18/T13N/R6E	Mississippi ceremonial center, town. 1/8 mile west of levee.
3 CG	"	"	SW/NE/26/T14N/R6E	Woodland village. Alleged to be under levee (site not in Survey records).
3 CG 309	"	"	SE/NW/26/T14N/R6E	Woodland camp-very scattered. Immediately east of Lake City.
3 CG	"	"	SW/SE/31/T13N/R7E	Woodland & Mississippi camps. ¼ mile east of levee and ¼ mile south of Cockle Burr (site not in Survey records)
3 CG 310	"	"	SW/SW/ 2/T13N/R6E	Woodland & Mississippi camps. Old landing southwest of Rush Island.

SITE NO.	QUADRANGLE	RIVER	LOCATION	COMMENTS
3 CG 28	Leachville	St. Francis	SE?/SE?/12?or7?/ T13N/R6EorR7E?	Within sunk lands, immediately west of levee.
3 CG 64	Marked Tree	"	NW/NE/22/T13N/R6E	Large Middle Mississippi ceremonial center. Large house mounds southeastern corner of Maumelle Prairie; three have been intruded by seepage ditch already.
3 CG 69	"	"	NW/NE/25/T13N/R6E	Early (?) Mississippi camp. Center of Turkey Island.
3 CG 70	"	"	NW/NW/26/T13N/R6E	Early (?) Mississippi camp. Northern end of Hatchie Coon Island. Explorer Scouts found more sites to south but could not record them.
3 CG 202	"	"	NE/NW/26/T13N/R6E	Early (?) Mississippi camp. Northern end of Hatchie Coon Island.
3 PO 69	"	"	SE/NE/ 6/T12N/R7E	Woodland camp. One mile east of levee.
3 PO 70	"	"	Center/ 6/ T12N/ R7E	Mississippi village or town. 5/8 mile east of levee.
3 PO 67	"	"	NW/NE/12/T12N/R6E	Woodland and/or Mississippi village. ¼ mile west of levee, within sunk lands.
3 PO 66	"	"	NE/NW/13/T12N/R6E	Woodland and Mississippi camps or villages. 3/8 mile west of levee, within sunk lands.
3 PO 68	"	"	East center of NW/SW/8/T12N/R7E	1¼ mile east of present levee.
3 PO 46	"	"	SE/32/T11N/R6E	Late Mississippi village. South of U. S. 63 and between Ditch 35 and Sand Slough.

SITE NO.	QUADRANGLE	RIVER	LOCATION	COMMENTS
	Evadale	Left Hand Chute of Little River		
3 MS 11	"	"	SE/NE/35/T13N/R8E	Mississippi village (?). Along present meander, 2 miles east of Etowah and ½ mile north of State 40.
3 MS 48	"	"	SE/NW/36/T13N/R8E	Mississippi town. Along present meander, 2 miles east of Etowah and ½ mile north of State 40.
3 MS 2	Manila	Right Hand Chute of Little River	SW/SE/1/T13N/R8E	Mississippi town. Within floodway.
3 MS 45	"	"	NW/NW/29/T14N/R9E	Woodland & Mississippi villages. ¼ mile west of present levee.
3 MS 24	"	"	SE/SW/9/T14N/R9E	Mississippi village. Within floodway.
3 MS 43	"	"	SE/SE/8/T14N/R9E	Woodland and Mississippi villages. 1/8 mile west of present levee.
3 MS 55	"	Left Hand Chute of Little River	NE/SW/14/T14N/R9E	Mississippi town. 3/4 miles south of Roseland.

Corps

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St. Francis

East Arkansas
Planning & Development District

P. O. BOX 1403 — McADAMS TRUST BUILDING — 416 SOUTH MAIN
JONESBORO, ARKANSAS 72401
AC 501/932-3957

HENRY P. JONES III, EXECUTIVE DIRECTOR

Mr. Gene A. Dodson, Chief
Engineering Division
Department of the Army
Memphis District Corps of Engineers
668 Clifford Davis Building
Memphis, Tennessee 38103

Re: St. Francis River Basin Environmental Staement

Dear Mr, Dodson:

Utilizing policies established by the District and the State Department of Planning concerning Regional Clearinghouse Notification, Review and Comment procedures, we have reviewed the above referenced application.

The Board of Directors of the East Arkansas Planning and Development District at a regular meeting held February 22, 1973, at Jonesboro considered the recommendations of the District Technical Review Committee. The Board voted to concur with the statement. Comments where appropriate are formed on the following attachment.

It is appropriate at this time to submit your formal application to the federal agency involved. This letter and any attachments are to be made a part of the formal application.

It is also necessary that you include as part of your formal application the letter of comment from the State Clearinghouse.

When the formal application is submitted, please provide this office with notification of the date of submittal and to what agency the application has been forwarded.

Cordially,

Henry P. Jones, III
Executive Director

HPJ, III:pjh
enclosure

cc: Mr. Bill Murphy

STAFF REVIEW

St. Francis River Basin Project
Environmental Impact Statement

The Memphis District Corp of Engineers has submitted an Environmental Impact Statement covering proposed work activities within the St. Francis River Basin Area. These activities are continuations of flood control and other measures authorized in the Flood Control Act of 1936.

STAFF RECOMMENDATION

It is the conclusion of the planning staff and Technical Review Committee of the East Arkansas Planning and Development District that the environmental impact resulting from proposed improvements within the St. Francis River Basin are consistent with the land use character and present environment of the area. The current character of the environment in the majority of the delta plain between Crowley's Ridge and the Mississippi River has evolved over the years by farming interests in the delta reclaiming Mississippi backwater and flood plain areas through leveeing, ditching, etc.

The St. Francis River has long lost its wild river characteristics; the broad alluvial plain, known as the Mississippi Delta, has developed into a high agricultural productivity area, as a result of local initiative exercised decades ago when the reclamation process began. Today the use of the land for crop

production emerges as the primary environmental characteristic of this area, with very few sections of the alluvial plain containing natural areas that can be classified as undisturbed.

Continued work within the St. Francis Basin east of Crowleys Ridge provides for a greater and more effective utilization of the alluvial plain for agricultural purposes by establishing better surface drainage, retarding flood water inundation and reducing corp loss and other personal and property damages. The short term adverse environmental impacts consist of further reduction in tree stands to accomodate channelization, the disruption of other fish and wildlife habitats, greater erosion in the areas of construction and an increase in water turbidity along the reaches of the St. Francis that will be subject to the new construction. However, over the long term, the benefits that will accrue to the people that live and work in the alluvial plain will be many times greater than the short term losses that are experienced through the adverse environmental impacts associated with the St. Francis River Basin Project.

The continuation of the program to the level originally authorized can only add to and strengthen the present environmental characteristics within the St. Francis River Basin and the alluvial plain that comprise a major part of the basin itself.

Efforts to improve the St. Francis River by reducing the extent of the flood plain, and thereby reducing crop and other property damage, as well as increasing the efficiency of agricultural activities, thereby strengthening the agriculture economy is a major goal and policy statement adopted by the East Arkansas Planning and Development District Board of Directors and included as part of the Areawide Planning Strategies of the District.

BUTLER AND HICKY
ATTORNEYS AT LAW
FIRST NATIONAL BANK BUILDING
POST OFFICE BOX 830
FORREST CITY, ARKANSAS 72335

TELEPHONE 633-4611
AREA CODE 501

ELDRIDGE J. BUTLER
PHILIP HICKY II

ASSOCIATE
LOUIS B. JONES, JR.

February 2, 1973

Mr. Henry P. Jones, III
Executive Director
East Arkansas Planning & Development District
P. O. Box 1403
Jonesboro, Arkansas 72401

Dear Henry:

This will acknowledge receipt of notice dated February 1, 1973, in compliance with OMB Circular A-95, on the proposed work in the St. Francis River Basin Area. I am opposed to this project at the present time and would like to know alot more about it, before it is brough up for final consideration by East Arkansas Planning and Development District.

Sincerely yours,

E. J. Butler

EJB:dgb

cc: Senator John L. McClellan
Senator J. William Fulbright
Congressman W. V. Alexander

COOPERATIVE EXTENSION WORK
IN
AGRICULTURE AND HOME ECONOMICS
STATE OF ARKANSAS

UNIVERSITY OF ARKANSAS
DIVISION OF AGRICULTURE
AND
UNITED STATES DEPARTMENT OF
AGRICULTURE, COOPERATING

P.O. Box 97
Wynne, Arkansas 72396
February 2, 1973

AGRICULTURAL EXTENSION SERVICE
COUNTY EXTENSION AGENT
AND
EXTENSION HOME ECONOMIST

Mr. Henry P. Jones III
Executive Director,
East Arkansas Planning and
Development District
P.O. Box 1403
Jonesboro, Arkansas 72401

Dear Mr. Jones:

This is in reply to your letter of February 1 regarding the project for flood control and drainage improvements and wildlife, fish, and outdoor recreation enhancement with a reservoir in the Ozark foothills in southeast Missouri and northeastern Arkansas.

We consider this a very worthy project and recommend the approval of the planning and development district board. Farmers in this area have suffered greatly from floods over the past years; therefore, this project would be of great economic value to farmers in the Delta area.

Yours very truly,

Troy S. Jennings
County Extension Agent
Cross County

TSJ/vlw

Bootheel Regional Planning Commission & Economic Development Council

SOLID WASTE PLANNING
INDUSTRIAL DEVELOPMENT
ECONOMIC DEVELOPMENT COUNCIL
LAW ENFORCEMENT ASSISTANCE COUNCIL
REGIONAL PLANNING
PUBLIC SERVICE CAREERS
COMPREHENSIVE HEALTH COUNCIL

P.O. BOX 397 MALDEN, MISSOURI 63863 TELEPHONE 314 276-2242

PAT LEA, CHAIRMAN
PHILIP SHELTON, DIRECTOR

February 12, 1973

Mr. Gene A. Dodson
Chief, Engineering Division
Department of the Army
Memphis District, Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

Dear Mr. Dodson:

At the recommendation of our Chairman, Pat Lea, the Bootheel Regional Planning Commission held a public hearing in our offices concerning the Draft Environmental Impact Statement for the St. Francis Basin Project for Missouri and Arkansas on Thursday, February 1, 1973. The meeting was open to the public and Mr. Fred Ford chaired the meeting.

We have included a list of those Bootheel residents in attendance. The list includes place of residence and each individual's interest in the project. The outline of the meeting is contained in the motion made by Mr. Earl Bramlett and seconded by Dwight Richmond and Roger Wheeler. The motion as indicated, also has the support of the Bootheel Regional Planning Commission and Regional Recreation Committee.

Should you have any questions concerning this meeting or our comments, please contact us.

Sincerely,

Ronald C. Yersak

Ronald C. Yersak
Planning Director

RCY:gw
Encl.

cc: Mr. Philip Shelton

A motion was made by Earl Bramlett that a letter be prepared by the Bootheel Regional Planning Commission stating that as a result of the public hearing the Bootheel Regional Planning Commission and Recreation Committee would like to endorse the Environmental Impact Statement with the following suggestions—

1. Due to the increased flood and seep water in Dunklin County the existing river channel south of the present dredging operations be cleared, deepened, and widened to accommodate more water.
2. More impoundments should be built north of present Wappapello Reservoir to retain and slow the flood waters and these impoundments be used for recreational facilities—hunting, fishing, and family parks.
3. The Corps of Engineers should give serious consideration to the construction of future wildlife impoundments outside the floodway of the St. Francis River, improving Wappapello Reservoir, developing Ben Cash Wildlife Area, and the possible acquisition and development of the Wilhelmina Cut-Off.

Motion seconded by Dwight Richmond and Roger Wheeler.

PUBLIC HEARING

St. Francis Basin Project

Fred Ford	Kennett, Mo.	Businessman
Ted Hauser	Dexter, Mo.	Staff
Kenneth Wiseman	Dexter, Mo.	Staff
Earl Bramlett	Kennett, Mo.	Farmer
Bill Renovich	Jefferson City, Mo.	Planner
Roger Wheeler	Kennett, Mo.	Sportsman
Cecil H. Vaughn, Jr.	Kennett, Mo.	Sportsman
John B. Scott	Dunklin County	Judge (County Court)
Armon Harrison	Dunklin County	Judge (County Court)
Elbert Tweed	Puxico, Mo.	Farmer
Ralph Stropp	Dunklin County	Judge (County Court)
H. C. Woods	Dudley, Mo.	Farmer
Mr. & Mrs. Mansfield	Dudley, Mo.	Farmer
Douglas Mansfield	Dudley, Mo.	Farmer
Bob Hardin	Dudley, Mo.	Farmer
Wayne Cryts	Puxico, Mo.	Farmer
Dwight Richmond	Bell City, Mo.	Farmer
Lottye Ore	Cardwell, Mo.	Mayor
Byron Alsup	Kennett, Mo.	Farmer
Glen Harrison	Poplar Bluff, Mo.	Farmer
Glen Harrison, Jr.	Dexter, Mo.	Farmer
B. F. Medows	Cardwell, Mo.	Marshal
W. M. Cryts, Jr.	Dexter, Mo.	Farmer
Rayburn Brooks	Kennett, Mo.	Game Warden
Charles Redman	Kennett, Mo.	Engineer

The Little River Drainage District

PHONE 335-3439
302 HIMMELBERGER-HARRISON BUILDING—P.O. BOX 159
CAPE GIRARDEAU, MISSOURI 63701

February 13, 1973

Colonel John V. Parish, Jr.
District Engineer, Memphis District
Corps of Engineers, U. S. Army
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

LMMED PR

Dear Colonel Parish:

We have the following comments to make on the environmental statement for the St. Francis Basin Project, Missouri and Arkansas.

Flood Control and drainage projects in the St. Francis Basin were initially started by individual landowners and legally organized drainage and levee districts. Many of the districts were small county court districts, or circuit court districts, and the original construction costs were paid for by these districts.

It was soon realized that the local districts needed Federal aid to give drainage and flood control and to give adequate drainage for agriculture. Not only was the program too large for local interests but as this was a two state problem. The St. Francis Basin originates in Missouri but the outlet for all drainage is through Arkansas, and neither state is financially able to solve the problem.

The residents in both states have invested many millions of dollars in land and industry. The basin is one of the fastest growing areas in the nation. Many industries are located in the area and many miles of Highways have been constructed and more are constructed each year.

Many areas and cities will benefit by a better runoff and this is particularly true of the low areas. While the mosquito problem is not near as bad as it was before drainage the problem is still here in many areas.

The Basin attracts many visitors outside of the immediate area as there are several recreational areas including Wappapello Lake, Big Lake and St. Francis Lake.

The completion of the project will have little adverse effect on wildlife in the area after a couple of years. In many areas spoil banks along the ditches have been shaped and are used for pasture or row crops and any wildlife in these areas cannot be affected materially. The ditches must be maintained as to give adequate agricultural drainage and very little wildlife can exist there. We believe that fishing, boating and other recreational facilities will not change from what they now are. If any damage is done to wildlife or fishing it will be offset many times by the improvement of farming conditions and health and will provide better chance for industry to come into the area. Better homes, schools and business will result when the plan is complete. This all means more income to local, state and federal agencies due to better income.

There are many instances where wildlife habitat and outdoor recreational facilities can be improved that the St. Francis Basin Project will help and not hinder.

I am attaching a copy of a news paper article concerning the Ben Cash Wildlife Area, which if developed, will give a considerable lift to the wildlife and other recreational facilities for the area.

While it is true that the work in the Basin may have a temporary effect on wildlife the first concern must be the effect on human life. The completion of the project will not be a cure-all but it will help to create better living conditions and a better opportunity to use the state and national recreational area in the basin.

Yours very truly,

Earl R. Schultz

Chief Engineer

ERS:ls
Enc.

Daily Dunklin Democrat 1-22-74

Conservation Commission 'Beginning a Report' on Ben Cash Land Possibilities

By DAILY DEMOCRAT
Staff Newsman

Some 10 years or more after the Ben Cash Wildlife Area lands were first acquired, the Missouri Conservation Commission is finally making plans to prepare a "report to look into all possibilities for the area."

The announcement that a report would begin within the next month or two was made over the weekend by the department's chief engineer, Charles Hooker, and was apparently prompted by recent inquiries from State Rep. Lew Maddox, among other Bootheel citizens.

In a telephone interview with Hooker, The Daily Democrat learned that legal difficulties, seepage and lack of development monies may continue to delay any possible plans for the area.

"Let's face it, this has been a real pill from the beginning," Hooker said in response to questions concerning the lack of development to the 844,000 acres located along the St. Francis River between Kennett and Senath.

Hooker said the Ben Cash study now has a "number three priority" with the commission, although he acknowledged it was possible — as in the past — for other projects to be placed ahead of it.

Apparently even the "study" has been delayed since it began last summer, since Hooker said the commission "should be back resuming work on the report within a month or two."

Terming the Ben Cash area a "unique piece of land," Hooker said the commission wanted

(See Cash on Page 7)

CASH

(Continued From Page 1)

to keep a part of the area natural, "because of the native cypress and wildlife."

"We want to make some type of definite plan for its long-term development," Hooker said, "but we've got to go through all the reports and evaluate them before we can make any recommendations."

Despite assurances to the contrary, the Dunklin County land owned by the commission has apparently never been number one in priority, in fact as late as 1971 it stood at number 18, having see-sawed continually since the acquisition.

Specific reasons for the holdup on developing the land have never been given by the commission, although some local observers say the legal difficulties over the river channelization may be the main problem.

Although no exact figures are available, the commission reportedly has an estimated $100,000 invested in the property and has spent a nominal sum on an opening access, the latter undertaken only in recent years.

Hooker acknowledged there has been no tentative date set for the report's completion, or any timetable on any possible development.

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
668 CLIFFORD DAVIS FEDERAL BUILDING
MEMPHIS, TENNESSEE 38103

Daily Dunklin Democrat Kennett, Missouri 16 February 1973

At BEDC Meeting

Recommendations for St. Francis Project Approved

Recommendations resulting from a public hearing on the Corps of Engineers St. Francis River Basin Project were approved last night at the meeting of the Bootheel Economic Development Corporation and Regional Planning Commission in Malden.

Fred Ford, Kennett, read the motion that was drawn up at the hearing and Earl Bramlett suggested that a letter be sent to the Corps endorsing the plan with the following suggestion: Due to the increased flood and seep water in Dunklin County, the existing river channel south of the present dredging operations be cleared, deepened and widened to accommodatte more water;

More impoundments should be built north of the present Wappapello reservoir to retain and slow the floodwaters and these impoundments should be used for recreational facilities, such as hunting, fishing and family parks;

The Corps should give serious consideration to the construction of future wildlife impoundments outside the floodway of the St. Francis River, improving the Wappapello reservoir, developing the Ben Cash Wildlife area and the possible acquisition and development of the Wilhelmina cutoff.

The motion was seconded by Roger Wheeler, Kennett, and unanimously approved by those present.

The hearing was attended by approximately 25 persons, including farmers, businessmen, sportsmen, county judges, game wardens and an engineer.

Bill Wellborn, industrial development specialist with the commission, gave a report on the progress of the regional industrial development brochure and indicated that this brochure should be ready for distribution by the next board meeting which is March 15.

He said the brochure will contain facts and figures and information industrial prospects are interested in when they are looking at municipalities for future location.

He also stressed the importance of the local industrial development authorities in each city being prepared to meet prospects and stated that the commission staff will bring the prospects to the town and then it will be up to the individual cities to "sell the prospect."

He also noted there will be a regional industrial development seminar held this spring with the date to be announced later.

Phil Shelton, executive director of BEDC, reported on the progress of the commission's attempt to establish a community college "without walls" in the Bootheel.

He said several commission members and staff visited What Community College in Ferndale, Wash., which is a similar-type college that the commission hopes to establish in the Bootheel.

Shelton said the commission will try to establish organized classes of a community college nature similar to the Ferndale program in the Boothtel this September.

DRAINAGE DISTRICT NO. 17

MISSISSIPPI COUNTY, ARKANSAS
P. O. BOX 446 — PHONE 762-2261
BLYTHEVILLE, ARK. 72315

January 16, 1973

Mr. Gene A. Dodson
Chief Engineering Division
Memphis District Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

Re: LMMED-PR

Dear Mr. Dodson:

The Board of Commissioners at their regular monthly meeting of January 11, 1973, joined me in reviewing the draft environmental statement for the St. Francis Basin project, Missouri and Arkansas, you recently furnished us.

We believe the environmental aspects in this basin have been well stated, both pro and con. We wholeheartedly believe that construction in the St. Francis Basin project should continue as rapidly as funds will permit in order to alleviate the annual flooding in this fine fertile valley.

We believe the construction work enumerated in House Document No. 339, 90th Congress 2d Session should be carried out to completion in Drainage District No. 17 of Mississippi County, Arkansas, substantially as contained in that document.

The opportunity to present our comments in reply to your letter of 2 January 1973 is appreciated.

Yours truly,

J. W. Meyer
Consulting Engineer

JWM/ljg

National Wildlife Federation
12 SIXTEENTH STREET, N.W.
INGTON, D.C. 20036
Phone: 202-483-1550

37th ANNUAL MEETING
March 16-18, 1973
Washington Hilton Hotel
Washington, D.C.

January 15, 1973

Colonel John V. Parrish, Jr.
Chief
Memphis District
Army Corps of Engineers
668 Clifford Davis Building
Memphis, Tennessee 38103

Dear Colonel Parrish:

The National Wildlife Federation submits the following comments on the draft environmental impact statement, December 1972, concerning St. Francis Basin, Missouri and Arkansas. We note that on page four the statement is made that the original mitigation plan for this project has been rendered moot by the destruction of the designated mitigation areas. We further note that although a substitute plan is being prepared, there is no such plan presently in existence. I am sure that you are aware that federal courts in both Arkansas and Tennessee has declared as a matter of law that mitigation plans must accompany NEPA statements, and further that appropriations for the mitigation under these plans must accompany requests for appropriations for construction features. We find ourselves unable to comment on the NEPA draft because we have no idea what mitigation plan is proposed or whether, given the recognized serious environmental impact of the project, this plan will be adequate. The National Wildlife Federation therefore is withholding its comments on the draft environmental statement until the statement is supplemented by the proposed mitigation plan.

Sincerely,

O. A. Houck

Oliver A. Houck
Counsel

cc: Andrew H. Hulsey, Director
Arkansas Game and Fish Commission
David M. Goodrich, Director
Tennessee Game and Fish Commission
Donald Pfitzer, Director
Southeastern Region
Bureau of Sport Fisheries and Wildlife
F. H. Farrar, Regional Executive Director
National Wildlife Federation
Robert E. Apple, Regional Executive
National Wildlife Federation
Ralph Gillham, President
Arkansas Wildlife Federation, Inc.
Anthony J. Campbell, Executive Director
Tennessee Conservation League

UNIVERSITY OF MISSOURI
GAYLORD MEMORIAL LABORATORY
PUXICO, MISSOURI 63960

DIVISION OF BIOLOGICAL SCIENCES
AND
MISSOURI CONSERVATION COMMISSION
COOPERATING

RESEARCH IN WILDLIFE ECOLOGY
PHYSIOLOGY AND BEHAVIOR

March 9, 1973

Mr. Gene A. Dodson
Chief, Engineering Division
Memphis District, Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

Re: Comments on the Draft Environmental Statement for the St. Francis

Dear Mr. Dodson:

During America's development, the clearing of timber and the drainage of swamps were part of the accepted steps toward becoming a modern industrial nation. The present condition of the St. Francis Basin is a prime example that the wilderness has been tamed. This once viable system has become in comparison a biological desert. The contents of this Environmental Statement reflect this old attitude. With the information available in the fields of ecology, sociology, economics, and engineering in 1973, Federal Agencies dealing with natural resources have the responsibility of examining systems rather than isolated aspects of a problem. Man must realize that he is an integral part of this system and must act accordingly. This environmental statement is deficient in the following areas.

1. Effects on Fish and Wildlife
   A. Wappapello Reservoir
   B. Castor River
   C. St. Francis River
   D. State and National Wildlife Refuges
2. Mitigation
3. Hydrology
4. Agriculture
5. Cost Benefit Ratios
6. Lack of Systems Approach
7. Quality of Life

1. Effects on Fish and Wildlife.--Completion of the project in the lowland areas will be the final demise of the remaining forested habitat either by direct loss due to the project or due to actions by private citizens following completion of the project. The Table on Land Use is extremely misleading. The watershed should be

divided on the basis of uplands and lowlands. Then the forested lowland areas in state and federal ownership should be subtracted from the total lowland areas to give a clear picture of the impact of this project on the lowland forest. To assign any wildlife benefits to this project is misleading. The losses far outweigh any benefits in the Big Lake Area. In addition the statement should provide comments on both consumptive and non-consumptive uses.

A. Wappapello Reservoir.--The statement gives a false impression of the benefits at Wappapello. The Corps relates number of people using the site to a quality program when in fact the Memphis District has been mismanaging the reservoir for wildlife. The Missouri Department of Conservation has extremely effective programs on other Missouri reservoirs in cooperation with other Corps Districts. Specifically:

1) Water is held too high in summer for production of waterfowl food on moist soil sites.

2) Water is held so high during the fall migration that aquatic vegetation is unavailable as food to waterfowl.

3) Upland areas are mismanaged for wildlife

If these practices continue the value of Wappapello Reservoir for outdoor experiences will continue to decline. This should be indicated in the impact statement.

B. Castor River.--Castor River is mentioned only once in the report, yet the area along this stream is extremely important for wildlife and the enjoyment of wildlife by area residents for hunting, fishing, and nature study. The impact on this area should be described specifically in the report.

C. St. Francis River.--The St. Francis River below Wappapello Dam provides untold hours of outdoor recreation by hunters, fishermen, and others. The total impact on this resource is not given anywhere in the report. The lowland habitat along the St. Francis River also provides the remaining habitat in private ownership for such unusual species as otter, amphiuma, and siren.

D. State and National Wildlife Refuges.--Wildlife areas will indeed be affected by this project. True, channelization will not occur within Mingo or Wappanoca National Wildlife Refuges, but they will be the victims of indirect effects. Citizens seeking outdoor recreation opportunities will be

forced (if they have the money) to other areas. These refuges will feel the increased pressure for hunting, fishing, and nature study as will the state wildlife areas in Arkansas and Missouri. These effects must be considered in the impact statement.

2. Mitigation.--Mitigation in the lower St. Francis Basin will be extremely difficult because so little habitat remains. For example, if flooded sites are lost, there are not sufficient sites remaining in the basin that have equal quality for wildlife. There is the possibility that mitigation might be satisfactory for some species. For instance, flooded timber used by wintering waterfowl might be mitigated by providing croplands specifically to replace the loss of flooded timber. The cost of land purchase and the operation of such areas is expensive. On the other end of the scale mitigation for the habitat needed by the otter, some fishes, herps, and birds will be extremely difficult. Mitigation is a necessity to protect the few remaining wetlands along the lower St. Francis Basin. Because animal species cannot be moved successfully, habitat lost equals animals killed. Knowing the Corps of Engineers' poor record on mitigation, this impact statement barely touches on this important area.

3. Hydrology.--The statement admits that the hydrology of the area is not understood. The project should not be started until the proper studies have been completed.

Examination of rainfall data from the U. S. Weather Bureau Climatological Data indicates that winter rainfall is uniform over the entire basin. No system of ditches can accommodate heavy rainfall over the entire basin. However, periods of heavy rainfall over widespread areas generally do not occur during the growing season; hence, crops are less likely to be flooded during the growing season anyway. The report also suggests that runoff is less from agricultural lands than from forested lands. Such information is suspect.

4. Agriculture.--Soybeans may be the major crop in the area, but this report suggests that pesticide treatment on other crops is then nil. In actual practice, cotton is usually treated excessively with persistent pesticides. Treatment of crops other than soybeans should be discussed.

The report suggests that erosion should be controlled on the farm with good agricultural practices. Because good soil conservation practices are of primary value to reduce the cost of maintaining the project, what effort is the Corps making to assure that such practices do occur?

The remaining forested areas contain a reservoir of parasitic insects so necessary to control crop pests. Such values are not discussed in the report.

The Corps' contention that Wappapello Reservoir controls runoff is open to question. Farms below the dam are often flooded when water is released from the reservoir.

5. Cost Benefit Ratios.--One has to dig deep to find any mention of this ratio in the statement. Such information should be provided in tabular form with a description of the methods used to determine the stated values.

6. Lack of Systems Approach.--This impact statement treats the St. Francis Basin as a group of disarticulated entities. The impact statement should examine the Basin as an ecosystem. Only when this is done can a true evaluation of the environmental impact of such a project be determined. This requires integration of engineering, biological, sociological, and economic aspects of this project.

7. Quality of Life.--Monetary values seem to be equated with quality of life throughout this report. Large water projects in this country have traditionally not added to the quality of human life of the local inhabitants. Quality means much more than money. Such values are not discussed in this impact statement.

The Corps could provide a better quality of life by switching its expertise from channelization to sewage treatment and to the development of sound land practices to increase water quality.

I am pleased to see that the Corps of Engineers admits that there will be environmental damage in this project. However, these adverse impacts are not examined with the expertise that is now available.

Sincerely,

Leigh H. Fredrickson
Director

LHF:ssc

THE UNIVERSITY OF TEXAS AT AUSTIN
AUSTIN, TEXAS 78712

Department of Zoology

January 8, 1973

Gene A. Dodson
Department of the Army
Memphis District, Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103
Attn: LMMED-PR

Dear Mr. Dodson:

I have your letter of January 2, 1973 requesting comments on the Draft Environmental statement for the Saint Francis River Basin, Missouri and Arkansas Project. Because I have not had the opportunity of an on site examination of the project, my comments (although somewhat extensive) are limited by that circumstance.

I note a number of areas where the report should have been amplified, notably, there is no comparison anywhere in the project of data obtained with from channelized regions in the Saint Francis Basin ~~in~~ those which have had minimal alteration. I would think that such an analysis would be a prerequisite to a real understanding of this project. This comparison of local conditions is uniquely available for an understanding of regional conditions. For example, there is a statement on page 21 "The overall benthic community and streamside vegetation are virtually the same for both artificial and natural channels", yet there is no documentation for that allegation. A proper report should have included this documentation. This type of statement is repeated on the bottom of the same paragraph "is that usually the "oxbow" or cut off portions of the old channel furnish a much better fishery than is presently the case in the region involved". Again, no documentation and one would assume that it would be a rather simple procecure to make an analysis of these sections and demonstrate the validity of the allegation.

With regard to stream biota, a standard procedure is to contrast environmental diversity. There are a host of diversity indices available one could use to determine "environmental health" and use of one of these might provide much more insight as to the environmental impact of this statement. Although my information is probably no better than that of the writer of the paragraph on page 21, I would tend to feel that his estimate as reflected on plate 2 of minor environmental impact on Blackfish Bayou, Castor River, Tyronza River, Fifteen Mile Bayou and

Big Creek are miscalculations. It is difficult to analyze the estimates of changes in Pemisco Bayou and Ditch Number 6 as these apparently semi-natural streams are not listed on page 21, yet they are considered to have major environmental benefit from the project. Where is the evidence?

I note an apparent contradiction on page 10 in which it says that there is a problem on eutrophication in the water shed, first paragraph, and a statement that an eutrophic compound, ammonium sulfomate, page 5, will not harm fish or wildlife. If there is a eutrophication problem the addition of nitrogen compounds will exacerbate that matter.

I note what appears to be a curious type of circular logic. The project will result in an increase in flood plain construction based on a 10 year flooding safety factor which in turn could cause major flood damage if a greater flood were to occur. The potentiality of an increase in flood damage from the flood control project seems almost counter productive.

Environmental impacts may be direct or indirect. For example, turbidity changes are discussed and the implied impact is direct lethalities to economically valuable organisms. I did not note a discussion of the indirect impact of reduced primary productivity and lowered food availability. I also failed to note ~~my~~ any discussion of the impact of turbidity on the feeding efficiency of predators with a primary visual sensory modality in contrast with these with chemical sensors as a major element.

The listing of fishes is notably imcomplete. The major citation, page 11, includes "Minnows of various species were also common to all ditches but no classification by species was attempted." In addition to the complexities of cyprinid interactions overlooked, that statement implies the absence of darters, cyprinodonts, mad toms, etc. that should be important in the food web. This second group is especially significant in that they are a major component in biological control of vectors (page 14).

I failed to note any discussion of the rather complex thermal impacts of channelization and removal of streamside vegetation (the quote on page 15 does not even allude to Q10 impacts). Obviously, the thermal effects of this project will be very significant to the aquatic biota and yet I do not see a mention of that. For the convenience of your staff, I enclose a reprint of a paper of thermal consequences of environmental manipulations of water I wrote last year.

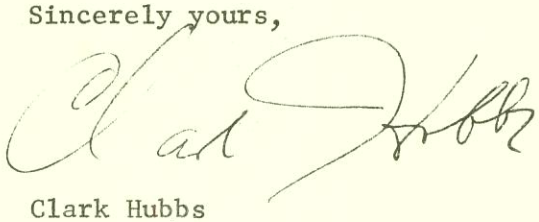
I also fail to note reference to a paper by Professor Emerson in Science, entitled "Channelization, A Case Study". This clearly shows that the impact of channelization is not restricted to the immediate segment, but rather has an indirect impact up and downstream. The problems mentioned in this report obviously pertain to the project, ~~pe and~~.

The listing of endangered species omits discussion of the possible occurrence of Acipenser fluvescens in the area. This species is listed in the United States Department of Interior Redbook. Similarly, two other species might well be in the area: Scaphirhynchus albus and Percina nasuta, both of which are listed as "status undertermined" species in the U. S. Department of Interior Book. I also call your attention to a paper in Transactions of the American Fisheries Society, 1972, entitled "Endangered Fresh Water Fishes in the United States", by Professor Miller, pages 239-252, in which a large series of rare fishes are mentioned from Missouri including two you mentioned in your account on page 11. I strongly suspect that this project will have an adverse effect on one-third to one-half of that list. An evaluation of each should have occurred.

As you may gather from the above, I find the report omits discussion of several items I would consider to have been appropriate. It is regretable that in many instances the indirect environmental impact of a developmental project is not discovered until after the project is completed and the damage is irretrievable. A more thorough analysis might make an evaluation of these probabilities an element of the evaluation of the merits of the project.

In summary the statement omits discussion of so many significant environmental factors that it is not only not possible to ascertain the environmental impact but also it is not possible to determine what other factors may apply.

Sincerely yours,



Clark Hubbs

GH/am

RECOMMENDATION OF THE DUNKLIN COUNTY SPORTSMAN ASSOCIATION
In re: The Environmental Impact Statement

As a result of the public hearing concerning the St. Francis River Basin Project, the Dunklin County Sportsman Association would like to endorse the Environmental Impact Statement with the following suggestions:

1. Due to the increased flood and seep water in Dunklin County, the existing river channel south of the present dredging operations be cleared, deepened, and widened to accommodate more water.

2. More impoundments should be built north of present Wappapello Reservior to retain and slow the flood waters and these impoundments be used for recreational facilities -- hunting, fishing and family parks.

3. The Corps of Engineers should give serious consideration to the construction of future wildlife impoundments along the St. Francis River such as improving Wappapello Reservoir, developing Ben Cash Wildlife Area and the possible acquisition and development of the Wilhelmina Cut-Off, and other areas in Stoddard County outside of the St. Francis River flowage.

Thanks
Fred Ford.
Ch-Board directors.

PERTINENT CORRESPONDENCE
DRAFT DATED APRIL 1971

ENVIRONMENTAL STATEMENT

ST. FRANCIS BASIN PROJECT
ARKANSAS AND MISSOURI

The following letters are in response to coordination of the draft environmental impact statement dated April 1971, and are arranged chronologically. These comments were used in preparing the revised draft.

Date	Agency
21 April 1971	Arkansas Industrial Development
4 May 1971	U.S. Department of the Interior, Geological Survey
5 May 1971	U.S. Department of Agriculture Forest Service
7 May 1971	Arkansas Department of Parks and Tourism
7 May 1971	Arkansas State Highway Commission
10 May 1971	Arkansas Public Service Commission
10 May 1971	The State of Missouri Water Resources Board
11 May 1971	Arkansas Game and Fish Commission
11 May 1971	Arkansas Soil and Water Conservation Commission
11 May 1971	U.S. Department of Agriculture, Soil Conservation Service
12 May 1971	Missouri State Park Board
21 May 1971	U.S. Department of the Interior, National Park Service
26 May 1971	Environmental Protection Agency, Water Quality Office
8 June 1971	Missouri Department of Conservation
20 August 1971	U.S. Department of the Interior, Fish and Wildlife Service
13 September 1971	St. Francis Levee District, West Memphis, Arkansas
23 September 1971	St. Francis Levee District of Missouri
12 October 1971	The Little River Drainage District, Cape Girardeau, Missouri
6 December 1971	Arkansas Historic Preservation Program

ARKANSAS INDUSTRIAL DEVELOPMENT COMMISSION

April 21, 1971

COMMISSIONERS

DEPARTMENTS

Mr. S. Keith Jackson
Arkansas Soil and Water Conservation Commission
State Capitol
Little Rock, Arkansas 72201

Dear Mr. Jackson:

We have no comments regarding the environmental statement, development plan for the St. Francis River Basin, Arkansas and Missouri, by the Corps of Engineers, which was attached to your memorandum of April 19.

Yours very truly,

R. W. Strauss, Director
Finance and Research

RWS:mtg

United States Department of the Interior

GEOLOGICAL SURVEY

Water Resources Division
Arkansas District
Room 2301 Federal Office Building
Little Rock, Arkansas 72201

May 4, 1971

Your reference:
LMMED-PR

District Engineer
Department of the Army
Memphis District, Corps of Engineers
668 Federal Building
Memphis, Tennessee 38103

Dear Sir:

Your letter of April 15, addressed to the Regional Hydrologist, St. Louis, was forwarded to this office for reply. The enclosure incorporates observations from both the Missouri and Arkansas Districts, Water Resources Division.

We suggest that the appraisal of the project's effect on water resources as prompted by the enclosed comments should be included in the environmental statement.

The enclosed informal statements are intended for technical assistance in your appraisal of the project's effect on the environment and does not reflect policy of the Department of the Interior.

Sincerely yours,

R. T. Sniegocki
District Chief

Enclosure

cc: (w/cy of encl)
Regional Hydrologist, MCR, WRD
Assistant Chief Hydrologist for Research
Washington, D.C. (Code 4300-0016)
Attention: Mr. George H. Davis
District Chief, Missouri District, WRD

U.S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
ARKANSAS DISTRICT

Comments on the environmental impact of the Corps of Engineers' St. Francis Basin Project, Missouri and Arkansas.

Effects on ground water: Alluvial aquifers contribute water to the low flow of streams in the St. Francis River basin. In some areas the St. Francis River is a source of recharge to the alluvium, whereas the Little River ditches function as a regional drain. The alluvium is a source of recharge to underlying aquifers which in turn are utilized for municipal water supplies. The alluvial aquifer is used extensively for irrigation.

Water levels along the St. Francis River and floodway in Quaternary deposits range from as little as 6 feet below land surface to more than 30 feet below land surface. The St. Francis Basin Project will probably lower water levels in the vicinity of dredged channels. Improved drainage, lowering of water levels, and clearing will increase recharge to the Quaternary deposits. Base-flow yield to drainage channels will increase. Dredged channels will change the Quaternary ground-water divides, resulting in changes in direction of ground-water flow. Effects on deeper aquifers are difficult to predict. Effects on regional ground-water movement should be evaluated.

Effects on surface water: Improved drainage and dredging of new channels will change the drainage pattern. There may be a decrease in time of concentration of floodflow and an increase in peak flow. Flood peaks will be of shorter duration. Velocity of flow will increase. Base flow in most channels east of St. Francis River will increase.

Effects on water quality: Changes in water levels and rate of recharge will result in a change in dissolved-minerals content in ground water. At present there seems to be some correlation between quality of ground water and surface water, especially east of St. Francis River and floodway. This condition may change if water levels are lowered.

Sediment load in streamflow will be increased during and for a short time after construction. A faster rate of runoff and a reduction in flow duration will probably alter the quality of surface water. Herbicides used for brush control will contaminate surface water. There may be a buildup of agricultural pollutants in the alluvium if overbank flooding is eliminated.

Summary: Probably the most noticeable effects of the project will be increased recharge and lowering of the Quaternary water table. Changes in the surface-water regimen will be, for the most part, beneficial. Changes in quality of water will be only slight and of little consequence except for herbicides introduced into streams and buildup of agricultural contaminants.

R. T. Sniegocki
District Chief
May 4, 1971

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Southeastern Area, State and Private Forestry
Atlanta, Georgia 30309

May 5, 1971

1920 (3520)

Colonel John V. Parish, Jr.
District Engineer, Memphis District
U.S.Army, Corps of Engineers
668 Federal Building
Memphis, Tennessee 38103

Dear Colonel Parish:

The environmental statement on the St. Francis River Basin sent us with your letter of April 15 has been reviewed. Our comments on the Draft are -

In general, the statement is quite comprehensive, taking into account most of the environmental impacts. A few points, however, have either been omitted or not stressed sufficiently.

- - Paragraph 4, page 5 describes the intention to use herbicides to control vegetation in and adjacent to channels, but no subsequent mention is made of the possibility of pollution as a result of this practice.

- - While it is true, as shown on page 9, that forested acres in the bottomland portion of the basin comprise a small percentage of the total area, the very scarcity increases the importance of the stands remaining. Item 4, on page 14, is the only reference to project connected clearing, indicating only that concerned with rights-of-way. No indication is made of the further loss induced by protection afforded to lands not now safe for agricultural uses.

- - A further detrimental effect not mentioned is that of loss of natural wind-breaks now afforded by even the narrow strips of timber and brush found along stream banks and un-maintained ditches. A combination of virtual total clearing from Crowleys Ridge to the Mississippi River, prevailing westerly and southwesterly winds, lack of topography, and the generally north-south direction of drainage roughly perpendicular to the prevailing winds, makes wind-breaks doubly important to this area. Loss of all or most of these strips can only mean increased wind erosion, air pollution, and deposition.

- - One additional item involves an apparent contradiction. Item 2, page 6, indicates no habitation prior to 1803, while paragraph 5, page 11, mentions at least 45 archeological sites, most of which are ancient Indian villages.

Carter P. Qualls
Assistant Area Director

Dale Bumpers, *Governor*
William E. Henderson, *Executive Director*
Lou Oberste, *Director, Travel*
Lloyd E. Surles, *Director, Parks*

Arkansas
EXCITINGLY DIFFERENT!

Department of Parks & Tourism

STATE CAPITOL BUILDING • LITTLE ROCK, ARKANSAS 72201

May 7, 1971

Re: Environmental Statement
St. Francis River Basin,
Arkansas and Missouri

Mr. Keith Jackson
Arkansas Soil and Water Conservation Comm.
State Capitol Building
Little Rock, Arkansas 72201

Dear Mr. Jackson:

Your notification pertaining to the St. Francis River Basin development plan has been received and reviewed.

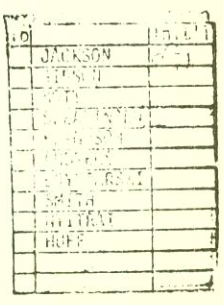
I wish to state that the Arkansas Department of Parks and Tourism is totally concerned with the quality of the environment and of human life.

We wish to note that in the interest of preserving the environmental quality of the St. Francis River Basin project, we are concerned with the protection of the streams and stream channels and would consider any plans for extensive channeling adverse to the best interest of fish, wildlife and recreational potentials.

With respect to the detention resevoir our attitude toward these structures would be based on the features of these resevoirs. They might tend to retard normal stream flow and cause changes in water temperature and/or the chemistry of the waters which are affected.

We feel that because of the extent of this area and the effect this project will have, every effort should be directed toward disturbing as little of the area as possible.

We realize the need for flood control and stabliza-tion, we also realize the dire need for the ecology to be considered. Any alteration of this scope will cause irreversible changes to the landscape.



Dale Bumpers, *Governor*
William E. Henderson, *Executive Director*
Lou Oberste, *Director, Travel*
Lloyd E. Surles, *Director, Parks*

Arkansas
EXCITINGLY DIFFERENT!

Department of Parks & Tourism

STATE CAPITOL BUILDING • LITTLE ROCK, ARKANSAS 72201

We will be more than happy to work with you on any plans or projects relating to the St. Francis River Basin River Project.

Sincerely,

Steven H. Gillum

Steven H. Gillum
State Parks Planner

SG:lt

ARKANSAS
STATE HIGHWAY COMMISSION

WARD GOODMAN, DIRECTOR
P. O. BOX 226
LITTLE ROCK, ARKANSAS
72203

May 7, 1971

Mr. S. Keith Jackson, Executive Director
Arkansas Soil & Water Conservation Commission
State Capitol
Little Rock, Arkansas, 72201

Dear Mr. Jackson:

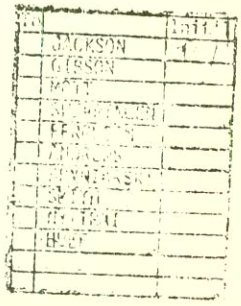
This is to acknowledge receipt of the Environmental Statement, St. Francis Basin, Missouri and Arkansas, as prepared by the U. S. Army Engineer District, Memphis, Tennessee.

The Department has reviewed the Statement and has no comments to make regarding the effects of the proposed works.

Sincerely yours,

B. K. Cooper

B. K. Cooper
Chief Engineer



ARKANSAS
PUBLIC SERVICE COMMISSION
JUSTICE BUILDING
STATE CAPITOL
LITTLE ROCK
72201

PAT MORAN
CHAIRMAN
ROBERT C. DOWNIE
COMMISSIONER
DON S. SMITH
COMMISSIONER

May 10, 1971

Mr. S. Keith Jackson
Arkansas Soil & Water Conservation Commission
State Capitol Building
Little Rock, Arkansas 72201

Re: Environmental Statement, development plan for the St. Francis River Basin, Arkansas and Missouri, by the Corps of Engineers

Dear Mr. Jackson:

Reference is made to your letter of April 19, 1971. To my knowledge, the Arkansas Public Service Commission has no objections to the above captioned development plan.

Very truly yours,

Ben McMinn, Chief Counsel

BM:aa

To	Init'l
JACKSON	
GIBSON	
MOTT	
SWEARENGEN	
FERGUSON	
ANDERSON	
BRYNELSON	
SMITH	
NYTTEN	
HUFF	

THE STATE OF MISSOURI

Water Resources Board

Department of Business and Administration
JEFFERSON CITY, MISSOURI 65101

CLIFFORD L. SUMMERS
Executive Director

P. O. Box 271
Area Code 314
Telephone 635-9251

May 10, 1971

Colonel John V. Parish, Jr.
Memphis District, Corps of Engineers
668 Federal Building
Memphis, Tennessee 38103

Dear Colonel Parish:

Your draft environmental statement on the St. Francis Basin, Missouri and Arkansas, has been distributed to those Missouri state agencies having responsibilities in the environmental areas. Each of the agencies has indicated that they cannot, within the allocated time, respond in detail to the anticipated impacts that might result from completion of the project. It is noted that no mention was made of drainage design and reservoir operation in the interest of reducing mosquito populations in the basin.

Your statement appears adequate to cover generally those changes that have resulted and to establish trends that will continue. Perhaps the greatest deterrent to reducing environmental impacts are the restrictions placed on mitigation action as contained in the authorization documents. At this stage of development, it appears appropriate to review the provisions for mitigating fish and wildlife losses in light of the current situation and to acquire and restore new areas selected for mitigation of fish and wildlife losses. In light of the loss of natural environment to local development and the project, and the continuing trend in this direction as the project is completed, it would appear desirable to give highest priority to compliance with the provisions of the Fish and Wildlife Coordination Act. The state of Missouri is calling this problem to the attention of our congressional delegation in the event authorization is required for the Corps of Engineers to resubmit mitigation proposals.

The state of Missouri will look forward to an opportunity for review of environmental impacts as the remaining individual project features are funded.

Sincerely,

Clifford L. Summers
Executive Director

CLS/dd

Arkansas
Game and Fish Commission

LITTLE ROCK, ARKANSAS 72201

May 11, 1971

Mr. S. Keith Jackson, Executive Director
Arkansas Soil & Water Conservation Commission
State Capitol, Room 151
Little Rock, Arkansas 72201

Dear Mr. Jackson:

These comments are responsive to your letter of April 19, 1971 and the attached Environmental Statement for the St. Francis River Basin Development Plan as prepared by the Memphis District, U.S. Corps of Engineers, in accordance with Section 102(2)(C) of the National Environmental Policy Act.

The intent of the National Environmental Policy Act, as we understand it, is to provide a means of anticipating the consequences of resource utilization and to project as accurately as possible the potential that such utilization may have for altering conditions within a given ecosystem. While man is ultimately dependent on his natural environment, his abilities to manipulate the ecosystem have often induced dangerous levels of ecological instability. The National Environmental Policy Act should provide a safeguard against various forms of unregulated resource exploitation. Unfortunately, however, the word "environment" has been rather ambiguously defined. A comprehensive environmental statement should include the projected impact of the project in question of the entire complex of climatic, edaphic and biotic factors that act upon the ecological community and ultimately determine form and survival. Adapted forms of animal life probably provide the best criterion for determining and measuring the more insidious environmental effects of resource manipulation.

Exclusive of these basic constituents of an environmental impact statement, the human environment may also include social and cultural factors.

While fish, wildlife and natural environmental values have been severely damaged by land and water management activities throughout the St. Francis Basin, these resources are still quite significant in the overall consideration of human interest. The interests of the Arkansas Game & Fish Commission in the St. Francis Basin Project are centered on obtaining just mitigation for fish and wildlife losses that have occurred as a result of drainage and land conversion activities. Outstanding project measures in this respect include control structures for 210'msl water level maintenance in St. Francis Lake and acquisition of some 13,500 acres of timbered mitigation lands in the Johnson Lake - Mud Lake area.

Due to a delay in the acquisition processes, lands in the Johnson Lake - Mud Lake area have been cleared for conversion to intensive agricultural uses and an alternate mitigation site has been considered in Lee and Phillips Counties. Any further delay in mitigation land purchased may well result in similar conversion of land use patterns in the alternate site. Expedient acquisition of fish and wildlife mitigation lands is of fundamental importance to the overall environmental impact of the St. Francis Basin Project.

In the interest of maintaining ecological balance and diversity and retaining suitable habitat for native fauna, the Arkansas Game & Fish Commission has acquired some 17,000 acres in the St. Francis Sunk Lands in Poinsett, Craighead and Greene Counties. The lower portion of these lands are in the St. Francis Lake Area. Perpetuity of natural environmental conditions over these lands is largely dependent on maintenance of water levels in the St. Francis Lake and, conversely, water levels are dependent on the structures to be installed at the lower end of the Lake. We understand that this project phase is deadlocked for want of non-federal sponsorship. In our estimation, sponsorship of this project by the Arkansas Game & Fish Commission would be highly inconsistent with the principles set forth in

fish and wildlife mitigation guidelines. (Testimony presented by the Commission before the Water Resources Council in 1969 specified that mitigation of state fish and wildlife losses be at federal expense). As an emergency measure, the Arkansas Game and Fish Commission may consider sponsorship of this project to maintain water levels in St. Francis Lake; however, we wish to point out that the state would, in effect, be mitigating its own losses by such action. Retention of specified water levels in St. Francis Lake is most relevant to the maintenance of ecological balance in the entire St. Francis Sunk Lands System.

The opportunity to comment on this Draft Environmental Statement is appreciated.

Yours very truly,

Andrew H. Hulsey

Andrew H. Hulsey,
Director

AHH:RWB:ac

forced (if they have the money) to other areas. These refuges will feel the increased pressure for hunting, fishing, and nature study as will the state wildlife areas in Arkansas and Missouri. These effects must be considered in the impact statement.

2. Mitigation.--Mitigation in the lower St. Francis Basin will be extremely difficult because so little habitat remains. For example, if flooded sites are lost, there are not sufficient sites remaining in the basin that have equal quality for wildlife. There is the possibility that mitigation might be satisfactory for some species. For instance, flooded timber used by wintering waterfowl might be mitigated by providing croplands specifically to replace the loss of flooded timber. The cost of land purchase and the operation of such areas is expensive. On the other end of the scale mitigation for the habitat needed by the otter, some fishes, herps, and birds will be extremely difficult. Mitigation is a necessity to protect the few remaining wetlands along the lower St. Francis Basin. Because animal species cannot be moved successfully, habitat lost equals animals killed. Knowing the Corps of Engineers' poor record on mitigation, this impact statement barely touches on this important area.

3. Hydrology.--The statement admits that the hydrology of the area is not understood. The project should not be started until the proper studies have been completed.

Examination of rainfall data from the U. S. Weather Bureau Climatological Data indicates that winter rainfall is uniform over the entire basin. No system of ditches can accommodate heavy rainfall over the entire basin. However, periods of heavy rainfall over widespread areas generally do not occur during the growing season; hence, crops are less likely to be flooded during the growing season anyway. The report also suggests that runoff is less from agricultural lands than from forested lands. Such information is suspect.

4. Agriculture.--Soybeans may be the major crop in the area, but this report suggests that pesticide treatment on other crops is then nil. In actual practice, cotton is usually treated excessively with persistent pesticides. Treatment of crops other than soybeans should be discussed.

The report suggests that erosion should be controlled on the farm with good agricultural practices. Because good soil conservation practices are of primary value to reduce the cost of maintaining the project, what effort is the Corps making to assure that such practices do occur?

The remaining forested areas contain a reservoir of parasitic insects so necessary to control crop pests. Such values are not discussed in the report.

The Corps' contention that Wappapello Reservoir controls runoff is open to question. Farms below the dam are often flooded when water is released from the reservoir.

5. Cost Benefit Ratios.--One has to dig deep to find any mention of this ratio in the statement. Such information should be provided in tabular form with a description of the methods used to determine the stated values.

6. Lack of Systems Approach.--This impact statement treats the St. Francis Basin as a group of disarticulated entities. The impact statement should examine the Basin as an ecosystem. Only when this is done can a true evaluation of the environmental impact of such a project be determined. This requires integration of engineering, biological, sociological, and economic aspects of this project.

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The Corps could provide a better quality of life by switching its expertise from channelization to sewage treatment and to the development of sound land practices to increase water quality.

I am pleased to see that the Corps of Engineers admits that there will be environmental damage in this project. However, these adverse impacts are not examined with the expertise that is now available.

Sincerely,

Leigh H. Fredrickson
Director

LHF:ssc

THE UNIVERSITY OF TEXAS AT AUSTIN
AUSTIN, TEXAS 78712

Department of Zoology

January 8, 1973

Gene A. Dodson
Department of the Army
Memphis District, Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103
Attn: LMMED-PR

Dear Mr. Dodson:

I have your letter of January 2, 1973 requesting comments on the Draft Environmental statement for the Saint Francis River Basin, Missouri and Arkansas Project. Because I have not had the opportunity of an on site examination of the project, my comments (although somewhat extensive) are limited by that circumstance.

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I note what appears to be a curious type of circular logic. The project will result in an increase in flood plain construction based on a 10 year flooding safety factor which in turn could cause major flood damage if a greater flood were to occur. The potentiality of an increase in flood damage from the flood control project seems almost counter productive.

Environmental impacts may be direct or indirect. For example, turbidity changes are discussed and the implied impact is direct lethalities to economically valuable organisms. I did not note a discussion of the indirect impact of reduced primary productivity and lowered food availability. I also failed to note ~~my~~ any discussion of the impact of turbidity on the feeding efficiency of predators with a primary visual sensory modality in contrast with these with chemical sensors as a major element.

The listing of fishes is notably imcomplete. The major citation, page 11, includes "Minnows of various species were also common to all ditches but no classification by species was attempted." In addition to the complexities of cyprinid interactions overlooked, that statement implies the absence of darters, cyprinodonts, mad toms, etc. that should be important in the food web. This second group is especially significant in that they are a major component in biological control of vectors (page 14).

I failed to note any discussion of the rather complex thermal impacts of channelization and removal of streamside vegetation (the quote on page 15 does not even allude to Q10 impacts). Obviously, the thermal effects of this project will be very significant to the aquatic biota and yet I do not see a mention of that. For the convenience of your staff, I enclose a reprint of a paper of thermal consequences of environmental manipulations of water I wrote last year.

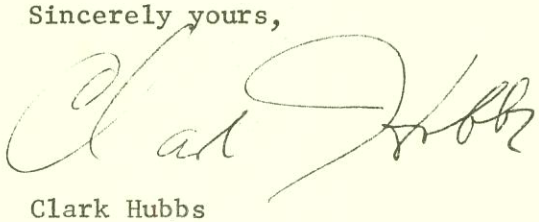
I also fail to note reference to a paper by Professor Emerson in Science, entitled "Channelization, A Case Study". This clearly shows that the impact of channelization is not restricted to the immediate segment, but rather has an indirect impact up and downstream. The problems mentioned in this report obviously pertain to the project, ~~pe and~~.

The listing of endangered species omits discussion of the possible occurrence of Acipenser fluvescens in the area. This species is listed in the United States Department of Interior Redbook. Similarly, two other species might well be in the area: Scaphirhynchus albus and Percina nasuta, both of which are listed as "status undertermined" species in the U. S. Department of Interior Book. I also call your attention to a paper in Transactions of the American Fisheries Society, 1972, entitled "Endangered Fresh Water Fishes in the United States", by Professor Miller, pages 239-252, in which a large series of rare fishes are mentioned from Missouri including two you mentioned in your account on page 11. I strongly suspect that this project will have an adverse effect on one-third to one-half of that list. An evaluation of each should have occurred.

As you may gather from the above, I find the report omits discussion of several items I would consider to have been appropriate. It is regretable that in many instances the indirect environmental impact of a developmental project is not discovered until after the project is completed and the damage is irretrievable. A more thorough analysis might make an evaluation of these probabilities an element of the evaluation of the merits of the project.

In summary the statement omits discussion of so many significant environmental factors that it is not only not possible to ascertain the environmental impact but also it is not possible to determine what other factors may apply.

Sincerely yours,



Clark Hubbs

GH/am

RECOMMENDATION OF THE DUNKLIN COUNTY SPORTSMAN ASSOCIATION
In re: The Environmental Impact Statement

As a result of the public hearing concerning the St. Francis River Basin Project, the Dunklin County Sportsman Association would like to endorse the Environmental Impact Statement with the following suggestions:

1. Due to the increased flood and seep water in Dunklin County, the existing river channel south of the present dredging operations be cleared, deepened, and widened to accommodate more water.

2. More impoundments should be built north of present Wappapello Reservior to retain and slow the flood waters and these impoundments be used for recreational facilities -- hunting, fishing and family parks.

3. The Corps of Engineers should give serious consideration to the construction of future wildlife impoundments along the St. Francis River such as improving Wappapello Reservoir, developing Ben Cash Wildlife Area and the possible acquisition and development of the Wilhelmina Cut-Off, and other areas in Stoddard County outside of the St. Francis River flowage.

Thanks
Fred Ford.
Ch-Board directors.

PERTINENT CORRESPONDENCE
DRAFT DATED APRIL 1971

ENVIRONMENTAL STATEMENT

ST. FRANCIS BASIN PROJECT
ARKANSAS AND MISSOURI

The following letters are in response to coordination of the draft environmental impact statement dated April 1971, and are arranged chronologically. These comments were used in preparing the revised draft.

Date	Agency
21 April 1971	Arkansas Industrial Development
4 May 1971	U.S. Department of the Interior, Geological Survey
5 May 1971	U.S. Department of Agriculture Forest Service
7 May 1971	Arkansas Department of Parks and Tourism
7 May 1971	Arkansas State Highway Commission
10 May 1971	Arkansas Public Service Commission
10 May 1971	The State of Missouri Water Resources Board
11 May 1971	Arkansas Game and Fish Commission
11 May 1971	Arkansas Soil and Water Conservation Commission
11 May 1971	U.S. Department of Agriculture, Soil Conservation Service
12 May 1971	Missouri State Park Board
21 May 1971	U.S. Department of the Interior, National Park Service
26 May 1971	Environmental Protection Agency, Water Quality Office
8 June 1971	Missouri Department of Conservation
20 August 1971	U.S. Department of the Interior, Fish and Wildlife Service
13 September 1971	St. Francis Levee District, West Memphis, Arkansas
23 September 1971	St. Francis Levee District of Missouri
12 October 1971	The Little River Drainage District, Cape Girardeau, Missouri
6 December 1971	Arkansas Historic Preservation Program

ARKANSAS INDUSTRIAL DEVELOPMENT COMMISSION

April 21, 1971

COMMISSIONERS

DEPARTMENTS

Mr. S. Keith Jackson
Arkansas Soil and Water Conservation Commission
State Capitol
Little Rock, Arkansas 72201

Dear Mr. Jackson:

We have no comments regarding the environmental statement, development plan for the St. Francis River Basin, Arkansas and Missouri, by the Corps of Engineers, which was attached to your memorandum of April 19.

Yours very truly,

R. W. Strauss, Director
Finance and Research

RWS:mtg

United States Department of the Interior

GEOLOGICAL SURVEY

Water Resources Division
Arkansas District
Room 2301 Federal Office Building
Little Rock, Arkansas 72201

May 4, 1971

Your reference:
LMMED-PR

District Engineer
Department of the Army
Memphis District, Corps of Engineers
668 Federal Building
Memphis, Tennessee 38103

Dear Sir:

Your letter of April 15, addressed to the Regional Hydrologist, St. Louis, was forwarded to this office for reply. The enclosure incorporates observations from both the Missouri and Arkansas Districts, Water Resources Division.

We suggest that the appraisal of the project's effect on water resources as prompted by the enclosed comments should be included in the environmental statement.

The enclosed informal statements are intended for technical assistance in your appraisal of the project's effect on the environment and does not reflect policy of the Department of the Interior.

Sincerely yours,

R. T. Sniegocki
District Chief

Enclosure

cc: (w/cy of encl)
Regional Hydrologist, MCR, WRD
Assistant Chief Hydrologist for Research
Washington, D.C. (Code 4300-0016)
Attention: Mr. George H. Davis
District Chief, Missouri District, WRD

U.S. GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
ARKANSAS DISTRICT

Comments on the environmental impact of the Corps of Engineers' St. Francis Basin Project, Missouri and Arkansas.

Effects on ground water: Alluvial aquifers contribute water to the low flow of streams in the St. Francis River basin. In some areas the St. Francis River is a source of recharge to the alluvium, whereas the Little River ditches function as a regional drain. The alluvium is a source of recharge to underlying aquifers which in turn are utilized for municipal water supplies. The alluvial aquifer is used extensively for irrigation.

Water levels along the St. Francis River and floodway in Quaternary deposits range from as little as 6 feet below land surface to more than 30 feet below land surface. The St. Francis Basin Project will probably lower water levels in the vicinity of dredged channels. Improved drainage, lowering of water levels, and clearing will increase recharge to the Quaternary deposits. Base-flow yield to drainage channels will increase. Dredged channels will change the Quaternary ground-water divides, resulting in changes in direction of ground-water flow. Effects on deeper aquifers are difficult to predict. Effects on regional ground-water movement should be evaluated.

Effects on surface water: Improved drainage and dredging of new channels will change the drainage pattern. There may be a decrease in time of concentration of floodflow and an increase in peak flow. Flood peaks will be of shorter duration. Velocity of flow will increase. Base flow in most channels east of St. Francis River will increase.

Effects on water quality: Changes in water levels and rate of recharge will result in a change in dissolved-minerals content in ground water. At present there seems to be some correlation between quality of ground water and surface water, especially east of St. Francis River and floodway. This condition may change if water levels are lowered.

Sediment load in streamflow will be increased during and for a short time after construction. A faster rate of runoff and a reduction in flow duration will probably alter the quality of surface water. Herbicides used for brush control will contaminate surface water. There may be a buildup of agricultural pollutants in the alluvium if overbank flooding is eliminated.

Summary: Probably the most noticeable effects of the project will be increased recharge and lowering of the Quaternary water table. Changes in the surface-water regimen will be, for the most part, beneficial. Changes in quality of water will be only slight and of little consequence except for herbicides introduced into streams and buildup of agricultural contaminants.

R. T. Sniegocki
District Chief
May 4, 1971

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE
Southeastern Area, State and Private Forestry
Atlanta, Georgia 30309

May 5, 1971

1920 (3520)

Colonel John V. Parish, Jr.
District Engineer, Memphis District
U.S.Army, Corps of Engineers
668 Federal Building
Memphis, Tennessee 38103

Dear Colonel Parish:

The environmental statement on the St. Francis River Basin sent us with your letter of April 15 has been reviewed. Our comments on the Draft are -

In general, the statement is quite comprehensive, taking into account most of the environmental impacts. A few points, however, have either been omitted or not stressed sufficiently.

- - Paragraph 4, page 5 describes the intention to use herbicides to control vegetation in and adjacent to channels, but no subsequent mention is made of the possibility of pollution as a result of this practice.

- - While it is true, as shown on page 9, that forested acres in the bottomland portion of the basin comprise a small percentage of the total area, the very scarcity increases the importance of the stands remaining. Item 4, on page 14, is the only reference to project connected clearing, indicating only that concerned with rights-of-way. No indication is made of the further loss induced by protection afforded to lands not now safe for agricultural uses.

- - A further detrimental effect not mentioned is that of loss of natural wind-breaks now afforded by even the narrow strips of timber and brush found along stream banks and un-maintained ditches. A combination of virtual total clearing from Crowleys Ridge to the Mississippi River, prevailing westerly and southwesterly winds, lack of topography, and the generally north-south direction of drainage roughly perpendicular to the prevailing winds, makes wind-breaks doubly important to this area. Loss of all or most of these strips can only mean increased wind erosion, air pollution, and deposition.

- - One additional item involves an apparent contradiction. Item 2, page 6, indicates no habitation prior to 1803, while paragraph 5, page 11, mentions at least 45 archeological sites, most of which are ancient Indian villages.

Carter P. Qualls
Assistant Area Director

Dale Bumpers, *Governor*
William E. Henderson, *Executive Director*
Lou Oberste, *Director, Travel*
Lloyd E. Surles, *Director, Parks*

Arkansas
EXCITINGLY DIFFERENT!

Department of Parks & Tourism

STATE CAPITOL BUILDING • LITTLE ROCK, ARKANSAS 72201

May 7, 1971

Re: Environmental Statement
St. Francis River Basin,
Arkansas and Missouri

Mr. Keith Jackson
Arkansas Soil and Water Conservation Comm.
State Capitol Building
Little Rock, Arkansas 72201

Dear Mr. Jackson:

Your notification pertaining to the St. Francis River Basin development plan has been received and reviewed.

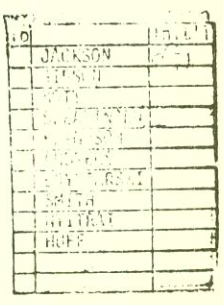
I wish to state that the Arkansas Department of Parks and Tourism is totally concerned with the quality of the environment and of human life.

We wish to note that in the interest of preserving the environmental quality of the St. Francis River Basin project, we are concerned with the protection of the streams and stream channels and would consider any plans for extensive channeling adverse to the best interest of fish, wildlife and recreational potentials.

With respect to the detention resevoir our attitude toward these structures would be based on the features of these resevoirs. They might tend to retard normal stream flow and cause changes in water temperature and/or the chemistry of the waters which are affected.

We feel that because of the extent of this area and the effect this project will have, every effort should be directed toward disturbing as little of the area as possible.

We realize the need for flood control and stabliza-tion, we also realize the dire need for the ecology to be considered. Any alteration of this scope will cause irreversible changes to the landscape.



Dale Bumpers, *Governor*
William E. Henderson, *Executive Director*
Lou Oberste, *Director, Travel*
Lloyd E. Surles, *Director, Parks*

Arkansas
EXCITINGLY DIFFERENT!

Department of Parks & Tourism

STATE CAPITOL BUILDING • LITTLE ROCK, ARKANSAS 72201

We will be more than happy to work with you on any plans or projects relating to the St. Francis River Basin River Project.

Sincerely,

Steven H. Gillum

Steven H. Gillum
State Parks Planner

SG:lt

ARKANSAS
STATE HIGHWAY COMMISSION

WARD GOODMAN, DIRECTOR
P. O. BOX 226
LITTLE ROCK, ARKANSAS
72203

May 7, 1971

Mr. S. Keith Jackson, Executive Director
Arkansas Soil & Water Conservation Commission
State Capitol
Little Rock, Arkansas, 72201

Dear Mr. Jackson:

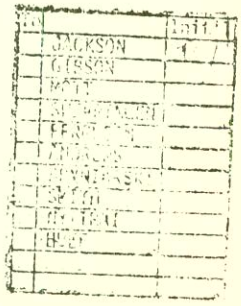
This is to acknowledge receipt of the Environmental Statement, St. Francis Basin, Missouri and Arkansas, as prepared by the U. S. Army Engineer District, Memphis, Tennessee.

The Department has reviewed the Statement and has no comments to make regarding the effects of the proposed works.

Sincerely yours,

B. K. Cooper

B. K. Cooper
Chief Engineer



ARKANSAS
PUBLIC SERVICE COMMISSION
JUSTICE BUILDING
STATE CAPITOL
LITTLE ROCK
72201

PAT MORAN
CHAIRMAN
ROBERT C. DOWNIE
COMMISSIONER
DON S. SMITH
COMMISSIONER

May 10, 1971

Mr. S. Keith Jackson
Arkansas Soil & Water Conservation Commission
State Capitol Building
Little Rock, Arkansas 72201

Re: Environmental Statement, development plan for the St. Francis River Basin, Arkansas and Missouri, by the Corps of Engineers

Dear Mr. Jackson:

Reference is made to your letter of April 19, 1971. To my knowledge, the Arkansas Public Service Commission has no objections to the above captioned development plan.

Very truly yours,

Ben McMinn, Chief Counsel

BM:aa

To	Init'l
JACKSON	
GIBSON	
MOTT	
SWEARENGEN	
FERGUSON	
ANDERSON	
BRYNELSON	
SMITH	
NYTTEN	
HUFF	

THE STATE OF MISSOURI

Water Resources Board

Department of Business and Administration
JEFFERSON CITY, MISSOURI 65101

CLIFFORD L. SUMMERS
Executive Director

P. O. Box 271
Area Code 314
Telephone 635-9251

May 10, 1971

Colonel John V. Parish, Jr.
Memphis District, Corps of Engineers
668 Federal Building
Memphis, Tennessee 38103

Dear Colonel Parish:

Your draft environmental statement on the St. Francis Basin, Missouri and Arkansas, has been distributed to those Missouri state agencies having responsibilities in the environmental areas. Each of the agencies has indicated that they cannot, within the allocated time, respond in detail to the anticipated impacts that might result from completion of the project. It is noted that no mention was made of drainage design and reservoir operation in the interest of reducing mosquito populations in the basin.

Your statement appears adequate to cover generally those changes that have resulted and to establish trends that will continue. Perhaps the greatest deterrent to reducing environmental impacts are the restrictions placed on mitigation action as contained in the authorization documents. At this stage of development, it appears appropriate to review the provisions for mitigating fish and wildlife losses in light of the current situation and to acquire and restore new areas selected for mitigation of fish and wildlife losses. In light of the loss of natural environment to local development and the project, and the continuing trend in this direction as the project is completed, it would appear desirable to give highest priority to compliance with the provisions of the Fish and Wildlife Coordination Act. The state of Missouri is calling this problem to the attention of our congressional delegation in the event authorization is required for the Corps of Engineers to resubmit mitigation proposals.

The state of Missouri will look forward to an opportunity for review of environmental impacts as the remaining individual project features are funded.

Sincerely,

Clifford L. Summers
Executive Director

CLS/dd

Arkansas
Game and Fish Commission

LITTLE ROCK, ARKANSAS 72201

May 11, 1971

Mr. S. Keith Jackson, Executive Director
Arkansas Soil & Water Conservation Commission
State Capitol, Room 151
Little Rock, Arkansas 72201

Dear Mr. Jackson:

These comments are responsive to your letter of April 19, 1971 and the attached Environmental Statement for the St. Francis River Basin Development Plan as prepared by the Memphis District, U.S. Corps of Engineers, in accordance with Section 102(2)(C) of the National Environmental Policy Act.

The intent of the National Environmental Policy Act, as we understand it, is to provide a means of anticipating the consequences of resource utilization and to project as accurately as possible the potential that such utilization may have for altering conditions within a given ecosystem. While man is ultimately dependent on his natural environment, his abilities to manipulate the ecosystem have often induced dangerous levels of ecological instability. The National Environmental Policy Act should provide a safeguard against various forms of unregulated resource exploitation. Unfortunately, however, the word "environment" has been rather ambiguously defined. A comprehensive environmental statement should include the projected impact of the project in question of the entire complex of climatic, edaphic and biotic factors that act upon the ecological community and ultimately determine form and survival. Adapted forms of animal life probably provide the best criterion for determining and measuring the more insidious environmental effects of resource manipulation.

Exclusive of these basic constituents of an environmental impact statement, the human environment may also include social and cultural factors.

While fish, wildlife and natural environmental values have been severely damaged by land and water management activities throughout the St. Francis Basin, these resources are still quite significant in the overall consideration of human interest. The interests of the Arkansas Game & Fish Commission in the St. Francis Basin Project are centered on obtaining just mitigation for fish and wildlife losses that have occurred as a result of drainage and land conversion activities. Outstanding project measures in this respect include control structures for 210'msl water level maintenance in St. Francis Lake and acquisition of some 13,500 acres of timbered mitigation lands in the Johnson Lake - Mud Lake area.

Due to a delay in the acquisition processes, lands in the Johnson Lake - Mud Lake area have been cleared for conversion to intensive agricultural uses and an alternate mitigation site has been considered in Lee and Phillips Counties. Any further delay in mitigation land purchased may well result in similar conversion of land use patterns in the alternate site. Expedient acquisition of fish and wildlife mitigation lands is of fundamental importance to the overall environmental impact of the St. Francis Basin Project.

In the interest of maintaining ecological balance and diversity and retaining suitable habitat for native fauna, the Arkansas Game & Fish Commission has acquired some 17,000 acres in the St. Francis Sunk Lands in Poinsett, Craighead and Greene Counties. The lower portion of these lands are in the St. Francis Lake Area. Perpetuity of natural environmental conditions over these lands is largely dependent on maintenance of water levels in the St. Francis Lake and, conversely, water levels are dependent on the structures to be installed at the lower end of the Lake. We understand that this project phase is deadlocked for want of non-federal sponsorship. In our estimation, sponsorship of this project by the Arkansas Game & Fish Commission would be highly inconsistent with the principles set forth in

fish and wildlife mitigation guidelines. (Testimony presented by the Commission before the Water Resources Council in 1969 specified that mitigation of state fish and wildlife losses be at federal expense). As an emergency measure, the Arkansas Game and Fish Commission may consider sponsorship of this project to maintain water levels in St. Francis Lake; however, we wish to point out that the state would, in effect, be mitigating its own losses by such action. Retention of specified water levels in St. Francis Lake is most relevant to the maintenance of ecological balance in the entire St. Francis Sunk Lands System.

The opportunity to comment on this Draft Environmental Statement is appreciated.

Yours very truly,

Andrew H. Hulsey

Andrew H. Hulsey,
Director

AHH:RWB:ac

The loss of habitat for small game due to clearing along ditches, or channels, which are to be redredged or enlarged is very small in our District as in most instances the area is kept cleared by the landowners. In some instances where the spoil banks are not farmed the area is soon covered with weeds and sprouts and will furnish cover and food for wildlife.

I appreciate the opportunity to make the above comments.

Yours very truly,

Ernest Schultz

ERS:ls

Chief Engineer

ARKANSAS HISTORIC PRESERVATION PROGRAM
1023 WEST THIRD STREET LITTLE ROCK, ARKANSAS 72201 501 374-0375

December 6, 1971

Mr. J. W. Dement, Chief
Engineering Division
Memphis District Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 72203

Dear Mr. Dement:

On the basis of your letter, Environmental Statement and attached map, relating to the St. Francis Basin Project, there is only one National Register Property which may be affected. This is the Parkin Indian Mound at the north edge of the City of Parkin, and on the St. Francis River.

However, there are other sites which, while not presently on the National Register, may be nominated at a later date; these are: Chalk's Bluff Battle Site (Clay County), St. Francis (Cross County), Black Oak (Craighead County), Marked Tree (Poinsett County), and Wittsburg (Cross County). We have not, as yet, been able to conduct the "in depth" historical survey which we feel is important in any evaluation of this area.

This office would appreciate being kept abreast of any actual construction planned for the near future as we do not feel that we are in a position, at the present time, to adequately comment on your proposal.

Sincerely,

William E. Henderson
State Liaison Officer

By: Jack E. Porter
Jack E. Porter
Administrator

JEP:mfw

1696 So. Downing St.
Denver, Colo. 80210
December 20, 1971

J. W. Dement
Chief, Engineering Division
Department of the Army
Memphis District, Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

Dear Mr. Dement:

Thank you for sending me the draft environmental statement of the St. Francis Basin Project, Missouri and Arkansas. I would appreciate being kept up to date on the project and any additional information you obtain.

My comments on the draft statement are for the record as follows.

General comments on the draft

The most glaring inconsistency is the repeated statement that earlier developments in the basin have already substantially destroyed the natural features and that this destruction precludes protective measures now and necessitates this latest project.

The impacts on wildlife, recreation, habitat and other environmental considerations are sketchily described. For example, the status and impacts on plant communities such as the cypress-tupelo gum are not considered.

Economic disbenefits are not mentioned and described.

The economic benefits of more agriculture and lessening of flooding are often repeated but are not documented. Indeed, documentation of such benefits should be arrived at endependently and not be Corps-initiated or rest on testimonials from landowners.

Specific comments

p. 5--States that maintenance of 860 miles of channels and ditches will be accomplished by herbicide treatment of undesirable brush, snagging and/or clearing, maintenance excavation and drift removal. The impact of these procedures is not described in the draft. In particular the impact of herbicide use on water quality, wildlife and general aesthetic appearance should be spelled. out. It would help the reader to know which plant species the Corps considers to be desirable and undesirable along channels and ditches.

p. 6--"Today, the only major resource value in the alluvial valley is agricultural." Economically, the valley relies on agriculture and small manufacturing. The other resource values should be described and these values should include those that make life in the valley more amenable, not necessarily those that are exploitative and have a cash return.

p. 13--"In the alluvial valley, where practically all the land is in agriculturall production, the reduction in frequency and duration of overbank flows, especially during the crop season, should in the long run, contribute to an improvement in the quality of the water through a reduction in sediment and agricultural pollutants reaching the streams and will also reduce mosquito problems." Elaboration on the improvement of water quality through reduction in sediment and pollutant loads is needed. Any contribution of sediment by construction and brush removal should be stated.

p. 14--"Continued development of the recreation facilities at Lake Wappapello will improve the quality of the recreation experience of the people who now take advantage of the opportunities afforded by the lake and for generations to come." It is not clear whether recreation development is part of the purpose of the overall project. On pp. 5-6 the developemnt of additional facilities at Lake Wappapello and W. G. Huxtable pumping station is described as a cost of operation and maintenance, yet it is stated on p. 6 that the Huxtable facilities are to be only constructed by the Corps but operated and maintained by the State of Arkansas. The separate costs for recreation are not delineated. What are they and precisely how much does recreation contribute to the cost/benefit ration of the total project?

In addition, increased use of Lake Wappapello for recreation may be of doubtful value because many activities cannot coexist in the same area. For example, water skiing and fishing cannot be satisfactorily or safely pursued in the same stretch of water simultaneously.

The improvements of quality recreational experiences should be explicitly detailed. Many people prefer unimproved recreational experiences and any improvements should be considered in the disbenefit column.

p. 14--Paragraph headed "Adverse environmental effects which cannot be avoided should the proposal be implemented." Recreational disbenefits are not considered, although the destruction of wildlife and fish habitat will certainly decrease greatly the opportunities for fishing, hunting and other outdoor activities. In addition the "monotonous terrain" now screened or broken up with trees will be matched by a less diverse, perhaps monotonous, ecosystem. p. 9--"Bottomland hardwoods, at the present time, comprise about seven percent of the total basin, or approximately 376,000 acres, limited to public lands, narrow strips along ditches and channels, areas within floodways, and scattered low-lying pockets and the backwater areas still too wet to facilitate clearing.... It is estimated that completion of currently authorized works in the St. Francis basin will induce the clearing of approximately one-half of existing bottomland woods."

The edge habitats, including the bottomland hardwoods, also provide an opportunity for people "to relax from the tensions of normal daily life" (lst paragraph, p. 14) and should be given equal consideration with the developed recreational facilities.

p. 14--Section headed "Alternatives to proposed action." The Corps has presented no provisions for lessening visual and habitat impacts such as tree replanting on the bare spoil banks or careful placement of spoil banks such that the humus layer is not buried in the barren or near-barren earth. An environmental impact statement is supposed to containe the provisions to lessen the impact.

p. 15--"All or portions of the unconstructed features of the project could be abandoned or simply not constructed. These remaining features are needed and desired by the people of the basin. Their adverse impacts on man's environment are relatively minor and tend to be localized in scope. Therefore, in view of the national concern for the well-being of all our people, this is not considered to be a reasonable or desirable alternative." It should also be stated that any benfits from the project are also local and not of national concern. The environment, in general, is of national concern.

This parapgrah contradicts other statements in the draft: p. 17, "Whenever it is determined by the Corps, or brought to our attention by other interests that adverse impacts may result, all feasible alternatives to the proposed action will be explored, and appropriate environmental consideration given." and "With implementation of an action program, the Corps of Engineers would make any feasible modifications to its plans which might be required to accommodate or assist in the balanced development or preservation of all of the basin's natural resources." By law, alternatives to a proposed project are to be described in the environmental statement; they have not been in this draft. The responsibility of bringing adverse impacts to the attention of the Corps is here (p. 17) implied to rest with the public. The Corps itself has the responsibility of bringing these impacts to the attention of the public.

p. 17--"Many items are scheduled for development so far in the future that the nature or extent of impacts they may have on the environment are highly conjectural." If the future work is known and its cost/benefit ratios calculated as part of the overall project, then certainly the probable impacts of this work can be estimated and included in the environmental impact statement, with a certain degree of reliability.

p. 17--"...all feasible alternatives to the proposed action will be explored, and appropriate environmental consideration given,"and other statements quoted previously. Throughout the report the Corps has implied that no alternatives are available because previous developments in the basin has ruled any of them out.

The contradictions throughout the report should be resolved. In addition, the Corps should state and make reference to the input of any federal, state or local governmental agencies which have been concerned directly or indirectly with the environmental impact of this project. If none have had imput, that should also be stated.

APPENDIX A

Report on Mitigation Lands
Prepared by

U. S. Department of Interior Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife
with
Concurrence Letter From the Arkansas Game and Fish Commission

ENVIRONMENTAL STATEMENT

ST. FRANCIS BASIN PROJECT
ARKANSAS AND MISSOURI

United States Department of the Interior
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
PEACHTREE-SEVENTH BUILDING
ATLANTA, GEORGIA 30323

January 24, 1973

District Engineer
U.S. Army Corps of Engineers
Memphis, Tennessee

Dear Sir:

This is in response to your letter, LMMED-P, of August 18, 1972, requesting an expanded report on acquisition of lands for fish and wildlife mitigation for the St. Francis Basin feature of the Mississippi River and Tributaries project. Our comments are submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The Bureau of Sport Fisheries and Wildlife's report of November 9, 1958, identified fish and wildlife losses that would occur with the installation of the St. Francis Basin project. Two tracts of land were recommended for acquisition to partially mitigate these losses. These lands included about 10,000 acres known as Johnson Lake Area, and 3,500 acres known as Frenchman's Bayou-Mud Lake Area. This mitigation measure was recommended by the Secretary of the Army in House Document 308, 88th Congress, 2d Session, and authorized by the Flood Control Act of October 27, 1965.

We have been advised by your staff that acquisition of the closure levee right-of-way is essentially complete and construction contracts are being let. Pumps for the Huxtable Pumping Plant have been acquired and construction has been initiated.

Unfortunately, during the interval of time since authorization, most of the mitigation lands have been converted to croplands. Reforestation of these lands to bring about anticipated wildlife mitigation is possible but would require many years to accomplish the desired benefits. In addition, the cost of acquisition and reforestation of croplands would be very expensive.

Personnel of this Bureau and the Arkansas Game and Fish Commission have investigated a number of alternative mitigation sites. The most desirable site at this time is an area of approximately 13,900 acres south of the proposed W. G. Huxtable Pumping Plant (area 1 on attached map). This area is unprotected by the St. Francis and Mississippi River levees. Except for

a mile-wide isthmus, this area is bounded on the east by the Mississippi River, on the south and west by the St. Francis and L'Anguille Rivers, and on the north by the St. Francis River and the proposed project levee. At the present time, these lands are mostly wooded and range from moderate to high quality as bottom-land hardwood wildlife habitat.

The second most desirable alternative would be an area in Lee County known as Hardin Point (Area 2 on attached map). This wooded area, located on the east side of the present Mississippi River channel between miles 670 and 680, provides moderate to high quality wildlife habitat.

A third alternative would be the acquisition of scattered tracts of woodland located within the Oak Donnick-St. Francis Bay and the Steep Gut Floodways. Although there are wooded first bottoms and first bottom ridges in this area which provide quality wildlife habitat, the total acreage necessary to mitigate project losses probably could not be acquired by this method.

All other acceptable alternatives for mitigation lands are considerably removed from the St. Francis Basin. Acquisition of woodlands in the White River flood plain above the White River National Wildlife Refuge would be acceptable. Woodlands adjacent to the Trusten Holder Wildlife Management Area, located south of the White River National Wildlife Refuge, provide high quality wildlife habitat and also would be acceptable. However, areas this far removed from the project area are not generally considered for mitigation. If forthright action is not taken concerning the above referenced alternatives, areas outside the basin will be the only forested bottom lands left to consider for mitigation purposes.

Alternative area number 1 is capable of providing 14,000 man-days of hunting annually with only public access and basic management. With development and more intensive management, the wildlife-oriented use could be doubled. This use potential compares favorably to that of the originally authorized area. The potential for wildlife-oriented use on alternative area number 2 would be similar to that of area 1. However, since area 2 is located on the east side of the Mississippi River, it would not be readily accessible for residents of the St. Francis Basin.

Land clearing has far exceeded that anticipated during project development. Considerable land clearing in the project area has been accomplished as a result of flood protection provided by completed segments of the project, or in anticipation of planned project works. While we recognize that changes in the agricultural market and plant varieties have contributed to the trend to clear additional forested land, we are of the opinion that completion of the project will directly encourage the clearing of bottom-land forest in excess of the 42,000 acres anticipated during project design.

It should be recognized that the most desirable alternative site (area 1) has experienced some clearing and is subject to additional clearing even though this may not be the best long-term use of these lands. This is also true of other forest lands in this portion of Arkansas. It is therefore imperative that funding for land acquisition be accomplished as

expeditiously as possible. Authorization should be broad enough to allow the selection of mitigation lands from among the alternatives presented in this report without the need to seek additional authorization should the presently more desirable alternative sites become unsuitable as a result of land use changes.

Such authority would bring about the possibility of early initiation of the acquisition program, and thus insure the congressional intent to mitigate losses of fish and wildlife resources as a result of the St. Francis Basin project.

We recognize that since 1968 you have advocated selection of an alternate site and subsequent approval by Congress to acquire the selected site in lieu of the Johnson Lake-Mud Lake area. It is regrettable that existing authority does not provide for an administrative decision to substitute areas to be acquired for mitigation. We assure you of our full support toward our common objective of seeking and securing authority to purchase an alternate area at the earliest possible time.

This Bureau therefore recommends that the Corps of Engineers pursue a course of action relative to mitigating project-induced losses that will facilitate authorization to acquire in fee title the lands herein suggested.

The following is our assessment of the environmental impact of acquiring lands for mitigation of fish and wildlife losses.

1. Environmental impact of the proposed action. The acquisition of wildlife habitat lands to be preserved and managed for public use would be beneficial. The extent of wooded bottom-land habitat has been greatly diminished in the recent past. If this trend continues, only those areas which have been specifically set aside for preservation will remain. Already, use of this habitat type by the general public is greatly restricted. Acquisition of the suggested mitigation lands would provide an additional area for public wildlife-oriented use while preserving a segment of wooded bottom-land habitat.

2. Adverse environmental effects which cannot be avoided. We know of no adverse effects to fish and wildlife resources which would result from acquisition of mitigation lands.

3. Alternatives to the proposed action. An obvious alternative to the acquisition of mitigation lands would be no acquisition. However, this alternative would not provide mitigation for project-induced losses to fish and wildlife. Another alternative to fee-title acquisition would be that of acquiring easements. However, in all probability the requested easements would be as costly as fee-title acquisition, and at the same time would not provide for optimum management and use capability.

4. Relationship between local short-term use of man's environment and enhancement of long-term productivity. The subject lands, if not acquired for mitigation will probably be cleared for cropland use, thus adding to an existing surplus of cropland in the United States. Acquisition would insure that the land will continue to provide wildlife-oriented recreation and timber products, both of which are in short supply.

5. Irreversible and irretrievable commitment of resources. The acquisition of mitigation lands and their preservation for fish and wildlife management would be neither irreversible nor irretrievable.

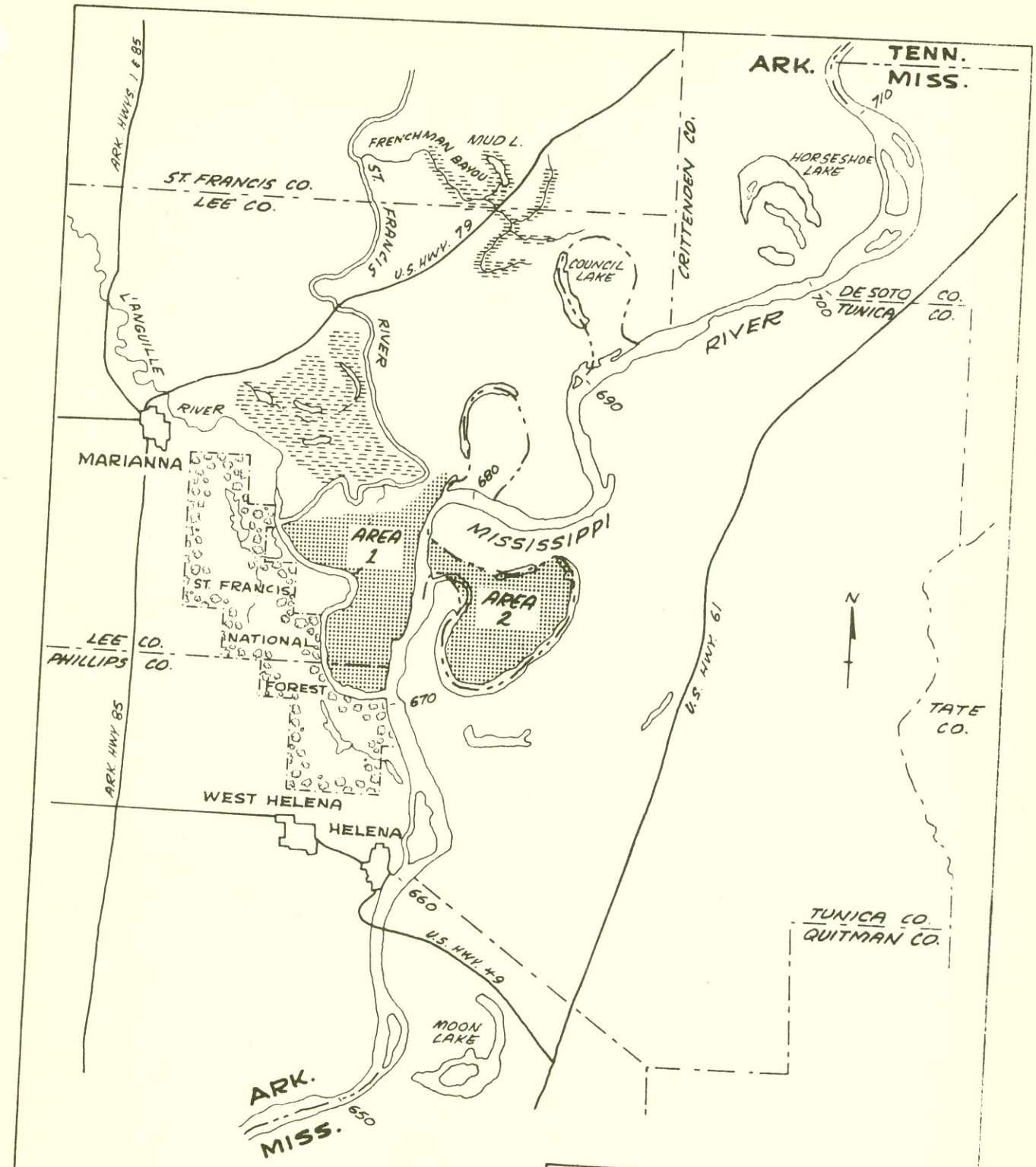
This report has been reviewed and concurred in by the Arkansas Game and Fish Commission. A copy of Director Hulsey's January 3, 1973, letter is attached.

Sincerely yours,

Jack E. Hemphill

Deputy Regional Director

Attachment


ARK.
TENN.
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FRENCHMAN BAYOU
MUD L.
ST. FRANCIS CO.
LEE CO.
ST. FRANCIS
U.S. HWY. 79
CRITTENDEN CO.
HORSESHOE LAKE
COUNCIL LAKE
DE SOTO CO.
TUNICA CO.
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RIVER
LANGUILLE
RIVER
RIVER
690
MARIANNA
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MISSISSIPPI
AREA 2
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LEE CO.
PHILLIPS CO.
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ARK. HWY 85
WEST HELENA
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QUITMAN CO.
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LANDS PRESENTLY PROPOSED FOR ACQUISITION
LANDS ORIGINALLY AUTHORIZED FOR ACQUISITION
PROPOSED MITIGATION LANDS
ST. FRANCIS BASIN PROJECT
ARKANSAS
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UNITED STATES DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

PLATE 1

ANDREW H. HULSEY, Director

Arkansas
Game and Fish Commission

LITTLE ROCK, ARKANSAS 72201

January 3, 1973

Mr. John D. Green
Acting Regional Supervisor
Division of River Basin Studies
Bureau of Sport Fisheries and Wildlife
Peachtree Seventh Building
Atlanta, Georgia 30323

Dear Mr. Green:

Receipt is acknowledged of your correspondence of December 29, 1972 and the attached report on the St. Francis Basin feature of the Mississippi River and Tributaries Project as concerns acquisition of lands for fish and wildlife mitigation.

We concur in this report and have no comments at this time.

Yours very truly,

Andrew H. Hulsey,
Director

AHH:RWB:ac

APPENDIX B

REFERENCES

ENVIRONMENTAL STATEMENT

ST. FRANCIS BASIN PROJECT
ARKANSAS AND MISSOURI

REFERENCES CITED

1. Heagler, Arthur E., Report on the Flood and Drainage Problem in the Lower Alluvial Valley of the St. Francis River, Arkansas. Report to the East Arkansas Drainage and Flood Control Association, Little Rock, Ark. by the Author, 1947

2. U. S. Army Corps of Engineers, St. Francis Basin, Arkansas and Missouri; Local Cooperation Requirements, Senate Document 11, 90th Congress, 1st Session, Committee on Public Works, United States Senate 1967.

3 Department of the Army, Corps of Engineers, Review Report, St. Francis River Basin from Wappapello Reservoir to Mouth, Memphis, Tennessee: Memphis District, ND.

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5. Design Memorandum No. 9 - State Line Ditches Outlet Channel - Item 3, Nos 1 and 2, Design Memo 102, Memphis, Tennessee: Memphis District, 1961.

6. Little River Drainage, General Design Memorandum, Design Memo 103. Memphis, Tennessee: Memphis District, 1962.

7. Upper St. Francis River, General Design Memorandum, Design Memo 104, Memphis, Tennessee: Memphis District, 1964.

8. Supplement to General Design Memorandum No. 104. Memphis, Tennessee: Memphis District, 1966.

9. Lower St. Francis River, East of Floodways, General Design Memorandum No. 2, Design Memo 105. Memphis, Tennessee: Memphis District, 1964.

10. Right Bank Tributaries, Arkansas, General Design Memorandum No. 106. Memphis, Tennessee: Memphis District, 1969.

11. Oak Donnick Floodway, General Design Memorandum No. 108. Memphis, Tennessee: Memphis District, 1969.

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16. Tarplee, William H., Jr.; Darrell E. Louder; and Andrew J. Weber, Evaluation of the Effects of Channelization on Fish Populations in North Carolina's Coastal Plain Streams. Raleigh, North Carolina: North Carolina Wildlife Resources Commission, 1971: 20 p.

17. Hansen, D. R. and R. J. Muncy, 1971. Effects of Stream River, Iowa. Iowa State Water Resources Research Institute 38: 119 p.

18. U. S. Congress, House, Committee on Public Works, Watershed Field Inspection, 1971. Hearings before the Subcommittee on Conservation and Watershed Development, House of Representatives, 92d Congress, 1st Session, 1971.

19. U. S. Congress, House, Committee on Government Operations, Stream Channelization, Parts 1 through 4. Hearings before a Subcommittee of the Committee on Government Operations, House of Representatives, 92d Congress, 1st Session, 1971.

20. Wharton, Charles H., Southern River Swamp: A Multiple Use Environment. Atlanta, Georgia: Georgia State University, 1970.

21. Holder, Trusten H., Disappearing Wetlands in Eastern Arkansas. Little Rock, Arkansas: Arkansas Planning Commission, 1970.

22. Holder, Trusten H., Progress in the Preservation of Delta Wetlands. Little Rock, Arkansas: Arkansas Department of Planning.

23. The Effects of Pesticides on Water Resource Development. Papers and Presentations by a Panel at Joint Meeting of the Arkansas-White-River Basin Inter-Agency Committee and the Southeast Basins Inter-Agency Committee. New Orleans, Louisiana: NP, 1970.

24. U. S. Water Resources Council, Regulation of Flood Hazard Areas to Reduce Flood Losses. Washington, D. C.; Government Printing Office, ND.

25. U. S. Department of the Interior, Fish and Wildlife Service. Wetlands of the United States: Circular 39. Washington, D. C.: Government Printing Office, 1971.

The loss of habitat for small game due to clearing along ditches, or channels, which are to be redredged or enlarged is very small in our District as in most instances the area is kept cleared by the landowners. In some instances where the spoil banks are not farmed the area is soon covered with weeds and sprouts and will furnish cover and food for wildlife.

I appreciate the opportunity to make the above comments.

Yours very truly,

Ernest Schultz

ERS:ls

Chief Engineer

ARKANSAS HISTORIC PRESERVATION PROGRAM
1023 WEST THIRD STREET LITTLE ROCK, ARKANSAS 72201 501 374-0375

December 6, 1971

Mr. J. W. Dement, Chief
Engineering Division
Memphis District Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 72203

Dear Mr. Dement:

On the basis of your letter, Environmental Statement and attached map, relating to the St. Francis Basin Project, there is only one National Register Property which may be affected. This is the Parkin Indian Mound at the north edge of the City of Parkin, and on the St. Francis River.

However, there are other sites which, while not presently on the National Register, may be nominated at a later date; these are: Chalk's Bluff Battle Site (Clay County), St. Francis (Cross County), Black Oak (Craighead County), Marked Tree (Poinsett County), and Wittsburg (Cross County). We have not, as yet, been able to conduct the "in depth" historical survey which we feel is important in any evaluation of this area.

This office would appreciate being kept abreast of any actual construction planned for the near future as we do not feel that we are in a position, at the present time, to adequately comment on your proposal.

Sincerely,

William E. Henderson
State Liaison Officer

By: Jack E. Porter
Jack E. Porter
Administrator

JEP:mfw

1696 So. Downing St.
Denver, Colo. 80210
December 20, 1971

J. W. Dement
Chief, Engineering Division
Department of the Army
Memphis District, Corps of Engineers
668 Clifford Davis Federal Building
Memphis, Tennessee 38103

Dear Mr. Dement:

Thank you for sending me the draft environmental statement of the St. Francis Basin Project, Missouri and Arkansas. I would appreciate being kept up to date on the project and any additional information you obtain.

My comments on the draft statement are for the record as follows.

General comments on the draft

The most glaring inconsistency is the repeated statement that earlier developments in the basin have already substantially destroyed the natural features and that this destruction precludes protective measures now and necessitates this latest project.

The impacts on wildlife, recreation, habitat and other environmental considerations are sketchily described. For example, the status and impacts on plant communities such as the cypress-tupelo gum are not considered.

Economic disbenefits are not mentioned and described.

The economic benefits of more agriculture and lessening of flooding are often repeated but are not documented. Indeed, documentation of such benefits should be arrived at endependently and not be Corps-initiated or rest on testimonials from landowners.

Specific comments

p. 5--States that maintenance of 860 miles of channels and ditches will be accomplished by herbicide treatment of undesirable brush, snagging and/or clearing, maintenance excavation and drift removal. The impact of these procedures is not described in the draft. In particular the impact of herbicide use on water quality, wildlife and general aesthetic appearance should be spelled. out. It would help the reader to know which plant species the Corps considers to be desirable and undesirable along channels and ditches.

p. 6--"Today, the only major resource value in the alluvial valley is agricultural." Economically, the valley relies on agriculture and small manufacturing. The other resource values should be described and these values should include those that make life in the valley more amenable, not necessarily those that are exploitative and have a cash return.

p. 13--"In the alluvial valley, where practically all the land is in agriculturall production, the reduction in frequency and duration of overbank flows, especially during the crop season, should in the long run, contribute to an improvement in the quality of the water through a reduction in sediment and agricultural pollutants reaching the streams and will also reduce mosquito problems." Elaboration on the improvement of water quality through reduction in sediment and pollutant loads is needed. Any contribution of sediment by construction and brush removal should be stated.

p. 14--"Continued development of the recreation facilities at Lake Wappapello will improve the quality of the recreation experience of the people who now take advantage of the opportunities afforded by the lake and for generations to come." It is not clear whether recreation development is part of the purpose of the overall project. On pp. 5-6 the developemnt of additional facilities at Lake Wappapello and W. G. Huxtable pumping station is described as a cost of operation and maintenance, yet it is stated on p. 6 that the Huxtable facilities are to be only constructed by the Corps but operated and maintained by the State of Arkansas. The separate costs for recreation are not delineated. What are they and precisely how much does recreation contribute to the cost/benefit ration of the total project?

In addition, increased use of Lake Wappapello for recreation may be of doubtful value because many activities cannot coexist in the same area. For example, water skiing and fishing cannot be satisfactorily or safely pursued in the same stretch of water simultaneously.

The improvements of quality recreational experiences should be explicitly detailed. Many people prefer unimproved recreational experiences and any improvements should be considered in the disbenefit column.

p. 14--Paragraph headed "Adverse environmental effects which cannot be avoided should the proposal be implemented." Recreational disbenefits are not considered, although the destruction of wildlife and fish habitat will certainly decrease greatly the opportunities for fishing, hunting and other outdoor activities. In addition the "monotonous terrain" now screened or broken up with trees will be matched by a less diverse, perhaps monotonous, ecosystem. p. 9--"Bottomland hardwoods, at the present time, comprise about seven percent of the total basin, or approximately 376,000 acres, limited to public lands, narrow strips along ditches and channels, areas within floodways, and scattered low-lying pockets and the backwater areas still too wet to facilitate clearing.... It is estimated that completion of currently authorized works in the St. Francis basin will induce the clearing of approximately one-half of existing bottomland woods."

The edge habitats, including the bottomland hardwoods, also provide an opportunity for people "to relax from the tensions of normal daily life" (lst paragraph, p. 14) and should be given equal consideration with the developed recreational facilities.

p. 14--Section headed "Alternatives to proposed action." The Corps has presented no provisions for lessening visual and habitat impacts such as tree replanting on the bare spoil banks or careful placement of spoil banks such that the humus layer is not buried in the barren or near-barren earth. An environmental impact statement is supposed to containe the provisions to lessen the impact.

p. 15--"All or portions of the unconstructed features of the project could be abandoned or simply not constructed. These remaining features are needed and desired by the people of the basin. Their adverse impacts on man's environment are relatively minor and tend to be localized in scope. Therefore, in view of the national concern for the well-being of all our people, this is not considered to be a reasonable or desirable alternative." It should also be stated that any benfits from the project are also local and not of national concern. The environment, in general, is of national concern.

This parapgrah contradicts other statements in the draft: p. 17, "Whenever it is determined by the Corps, or brought to our attention by other interests that adverse impacts may result, all feasible alternatives to the proposed action will be explored, and appropriate environmental consideration given." and "With implementation of an action program, the Corps of Engineers would make any feasible modifications to its plans which might be required to accommodate or assist in the balanced development or preservation of all of the basin's natural resources." By law, alternatives to a proposed project are to be described in the environmental statement; they have not been in this draft. The responsibility of bringing adverse impacts to the attention of the Corps is here (p. 17) implied to rest with the public. The Corps itself has the responsibility of bringing these impacts to the attention of the public.

p. 17--"Many items are scheduled for development so far in the future that the nature or extent of impacts they may have on the environment are highly conjectural." If the future work is known and its cost/benefit ratios calculated as part of the overall project, then certainly the probable impacts of this work can be estimated and included in the environmental impact statement, with a certain degree of reliability.

p. 17--"...all feasible alternatives to the proposed action will be explored, and appropriate environmental consideration given,"and other statements quoted previously. Throughout the report the Corps has implied that no alternatives are available because previous developments in the basin has ruled any of them out.

The contradictions throughout the report should be resolved. In addition, the Corps should state and make reference to the input of any federal, state or local governmental agencies which have been concerned directly or indirectly with the environmental impact of this project. If none have had imput, that should also be stated.

APPENDIX A

Report on Mitigation Lands
Prepared by

U. S. Department of Interior Fish and Wildlife Service
Bureau of Sport Fisheries and Wildlife
with
Concurrence Letter From the Arkansas Game and Fish Commission

ENVIRONMENTAL STATEMENT

ST. FRANCIS BASIN PROJECT
ARKANSAS AND MISSOURI

United States Department of the Interior
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE
PEACHTREE-SEVENTH BUILDING
ATLANTA, GEORGIA 30323

January 24, 1973

District Engineer
U.S. Army Corps of Engineers
Memphis, Tennessee

Dear Sir:

This is in response to your letter, LMMED-P, of August 18, 1972, requesting an expanded report on acquisition of lands for fish and wildlife mitigation for the St. Francis Basin feature of the Mississippi River and Tributaries project. Our comments are submitted in accordance with provisions of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; 16 U.S.C. 661 et seq.).

The Bureau of Sport Fisheries and Wildlife's report of November 9, 1958, identified fish and wildlife losses that would occur with the installation of the St. Francis Basin project. Two tracts of land were recommended for acquisition to partially mitigate these losses. These lands included about 10,000 acres known as Johnson Lake Area, and 3,500 acres known as Frenchman's Bayou-Mud Lake Area. This mitigation measure was recommended by the Secretary of the Army in House Document 308, 88th Congress, 2d Session, and authorized by the Flood Control Act of October 27, 1965.

We have been advised by your staff that acquisition of the closure levee right-of-way is essentially complete and construction contracts are being let. Pumps for the Huxtable Pumping Plant have been acquired and construction has been initiated.

Unfortunately, during the interval of time since authorization, most of the mitigation lands have been converted to croplands. Reforestation of these lands to bring about anticipated wildlife mitigation is possible but would require many years to accomplish the desired benefits. In addition, the cost of acquisition and reforestation of croplands would be very expensive.

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a mile-wide isthmus, this area is bounded on the east by the Mississippi River, on the south and west by the St. Francis and L'Anguille Rivers, and on the north by the St. Francis River and the proposed project levee. At the present time, these lands are mostly wooded and range from moderate to high quality as bottom-land hardwood wildlife habitat.

The second most desirable alternative would be an area in Lee County known as Hardin Point (Area 2 on attached map). This wooded area, located on the east side of the present Mississippi River channel between miles 670 and 680, provides moderate to high quality wildlife habitat.

A third alternative would be the acquisition of scattered tracts of woodland located within the Oak Donnick-St. Francis Bay and the Steep Gut Floodways. Although there are wooded first bottoms and first bottom ridges in this area which provide quality wildlife habitat, the total acreage necessary to mitigate project losses probably could not be acquired by this method.

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It should be recognized that the most desirable alternative site (area 1) has experienced some clearing and is subject to additional clearing even though this may not be the best long-term use of these lands. This is also true of other forest lands in this portion of Arkansas. It is therefore imperative that funding for land acquisition be accomplished as

expeditiously as possible. Authorization should be broad enough to allow the selection of mitigation lands from among the alternatives presented in this report without the need to seek additional authorization should the presently more desirable alternative sites become unsuitable as a result of land use changes.

Such authority would bring about the possibility of early initiation of the acquisition program, and thus insure the congressional intent to mitigate losses of fish and wildlife resources as a result of the St. Francis Basin project.

We recognize that since 1968 you have advocated selection of an alternate site and subsequent approval by Congress to acquire the selected site in lieu of the Johnson Lake-Mud Lake area. It is regrettable that existing authority does not provide for an administrative decision to substitute areas to be acquired for mitigation. We assure you of our full support toward our common objective of seeking and securing authority to purchase an alternate area at the earliest possible time.

This Bureau therefore recommends that the Corps of Engineers pursue a course of action relative to mitigating project-induced losses that will facilitate authorization to acquire in fee title the lands herein suggested.

The following is our assessment of the environmental impact of acquiring lands for mitigation of fish and wildlife losses.

1. Environmental impact of the proposed action. The acquisition of wildlife habitat lands to be preserved and managed for public use would be beneficial. The extent of wooded bottom-land habitat has been greatly diminished in the recent past. If this trend continues, only those areas which have been specifically set aside for preservation will remain. Already, use of this habitat type by the general public is greatly restricted. Acquisition of the suggested mitigation lands would provide an additional area for public wildlife-oriented use while preserving a segment of wooded bottom-land habitat.

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3. Alternatives to the proposed action. An obvious alternative to the acquisition of mitigation lands would be no acquisition. However, this alternative would not provide mitigation for project-induced losses to fish and wildlife. Another alternative to fee-title acquisition would be that of acquiring easements. However, in all probability the requested easements would be as costly as fee-title acquisition, and at the same time would not provide for optimum management and use capability.

4. Relationship between local short-term use of man's environment and enhancement of long-term productivity. The subject lands, if not acquired for mitigation will probably be cleared for cropland use, thus adding to an existing surplus of cropland in the United States. Acquisition would insure that the land will continue to provide wildlife-oriented recreation and timber products, both of which are in short supply.

5. Irreversible and irretrievable commitment of resources. The acquisition of mitigation lands and their preservation for fish and wildlife management would be neither irreversible nor irretrievable.

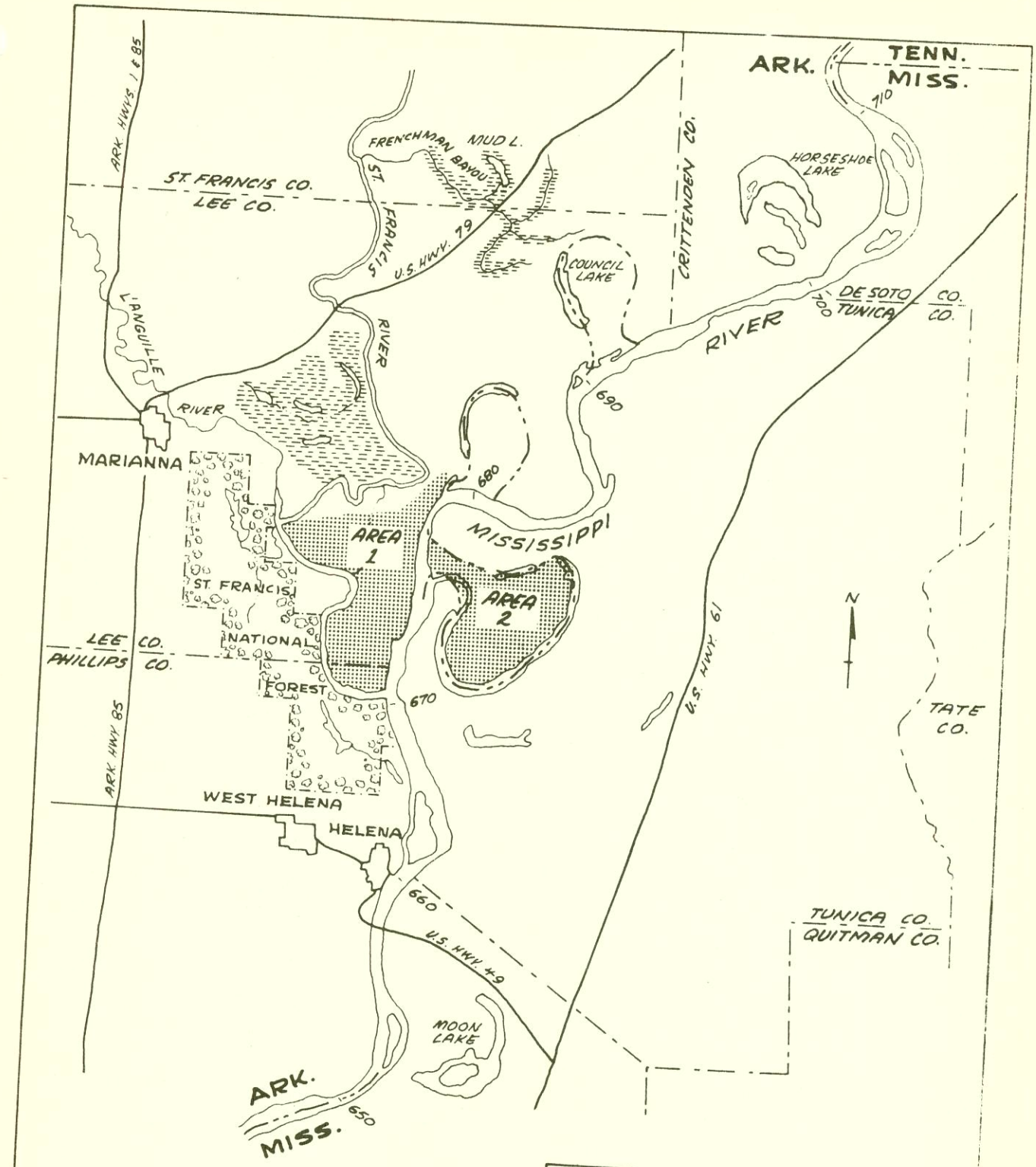
This report has been reviewed and concurred in by the Arkansas Game and Fish Commission. A copy of Director Hulsey's January 3, 1973, letter is attached.

Sincerely yours,

Jack E. Hemphill

Deputy Regional Director

Attachment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FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

PLATE 1

ANDREW H. HULSEY, Director

Arkansas
Game and Fish Commission

LITTLE ROCK, ARKANSAS 72201

January 3, 1973

Mr. John D. Green
Acting Regional Supervisor
Division of River Basin Studies
Bureau of Sport Fisheries and Wildlife
Peachtree Seventh Building
Atlanta, Georgia 30323

Dear Mr. Green:

Receipt is acknowledged of your correspondence of December 29, 1972 and the attached report on the St. Francis Basin feature of the Mississippi River and Tributaries Project as concerns acquisition of lands for fish and wildlife mitigation.

We concur in this report and have no comments at this time.

Yours very truly,

Andrew H. Hulsey,
Director

AHH:RWB:ac

APPENDIX B

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ENVIRONMENTAL STATEMENT

ST. FRANCIS BASIN PROJECT
ARKANSAS AND MISSOURI

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7. Upper St. Francis River, General Design Memorandum, Design Memo 104, Memphis, Tennessee: Memphis District, 1964.

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LEGEND

60 RIVER MILE

LEVEE

CAPE GIRARDEAU

HEADWATER DIVERSION SYSTEM

COMMERCE HILLS

OHIO RIVER

CAIRO

GREENBRIER

WAPPAPELLO

BLOOMFIELD

DEXTER

POPLAR BLUFF

SIKESTON

SIKESTON RIDGE

SCOTT CO.

MISS. CO.

NEW MADRID CO.

OTTER SLOUGH DITCH

DRAINAGE SYSTEM

FLOODWAY

EAST

STODDARD CO.

DUNKLIN CO.

MALDEN

NEW MADRID

MISSOURI

ARKANSAS

RIDGE

ST FRANCIS

PORTAGEVILLE

KENTUCKY

TENNESSEE

OHIO RIVER

PIGGOTT

CLAY CO.

Vancel Cr.

CARUTHERSVILLE

Pemiscot Bayou

PARAGOULD

LITTLE

Elk Chute D D

HORNERSVILLE

DUNKLIN CO. MO.

MISS. CO. ARK.

PEMISCOT CO. MO.

GREENE CO.

CRAIGHEAD CO.

RIVER

Big Lake

BLYTHEVILLE

JONESBORO

Big Lake Ditch

Little River

CRAIGHEAD CO.

POINSETT CO.

ST FRANCIS

St Francis Lake

Left Hand Chute of Little River

MISSISSIPPI

MARKED TREE

POINSETT CO.

CROSS CO.

Steep Gut Ditch

MISS. CO.

CRITTENDEN CO.

L'Anguille River

St Francis Bay

Tyronza

Big Cr.

WYNNE

St Francis River

Bayou

CROSS CO.

ST FRANCIS CO.

Black Fish Bayou

Fifteenmile Bayou

MEMPHIS

FORREST CITY

MADISON

Frenchmans Bayou

ST FRANCIS CO.

LEE CO.

MARIANNA

WHITEHALL

HELENA

N

5 0 5 10 15 20

SCALE OF MILES

VICINITY

SCALE OF MILES

10 0 50 100 150 200

MISSOURI ILL. KAN. KY. TENN. OKLA. TEXAS. MISSISSIPPI LOUISIANA ARKANSAS

Cape Girardeau

Fort Smith

MEMPHIS

LITTLE ROCK

Helena

Arkansas River

White River

ST FRANCIS R.

LITTLE RIVER

MISSISSIPPI RIVER AND TRIBUTARIES

ST. FRANCIS BASIN, MISSOURI, AND ARKANSAS
LEVEE AND DRAINAGE WORKS BY LOCAL INTERESTS PRIOR TO 1930

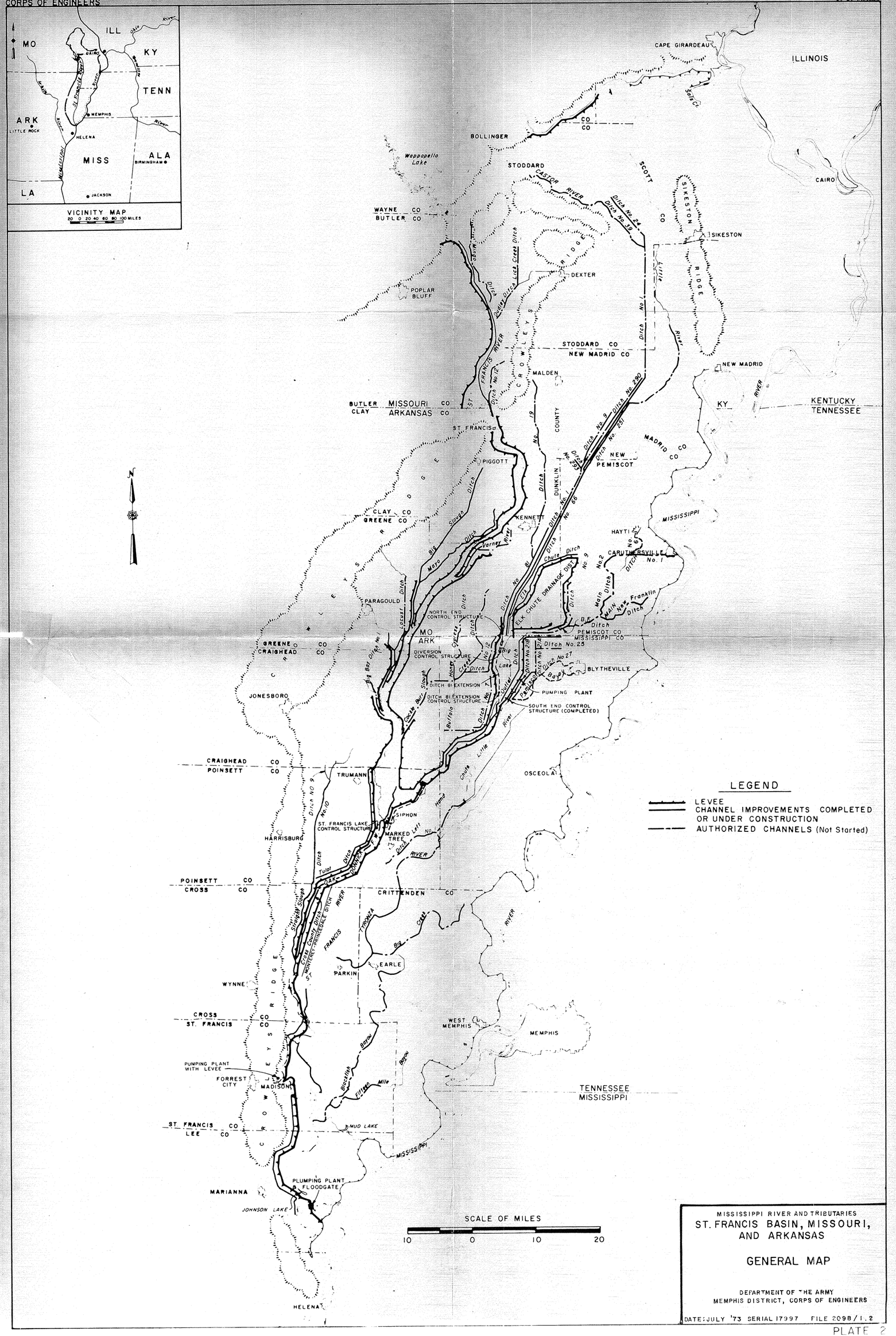
DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS

DATE: JULY '73 SERIAL 20028 FILE 41H/436

PLATE 1

CORPS OF ENGINEERS

U. S. ARMY



LEGEND

- LEVEE
- CHANNEL IMPROVEMENTS COMPLETED OR UNDER CONSTRUCTION
- AUTHORIZED CHANNELS (Not Started)

MISSISSIPPI RIVER AND TRIBUTARIES

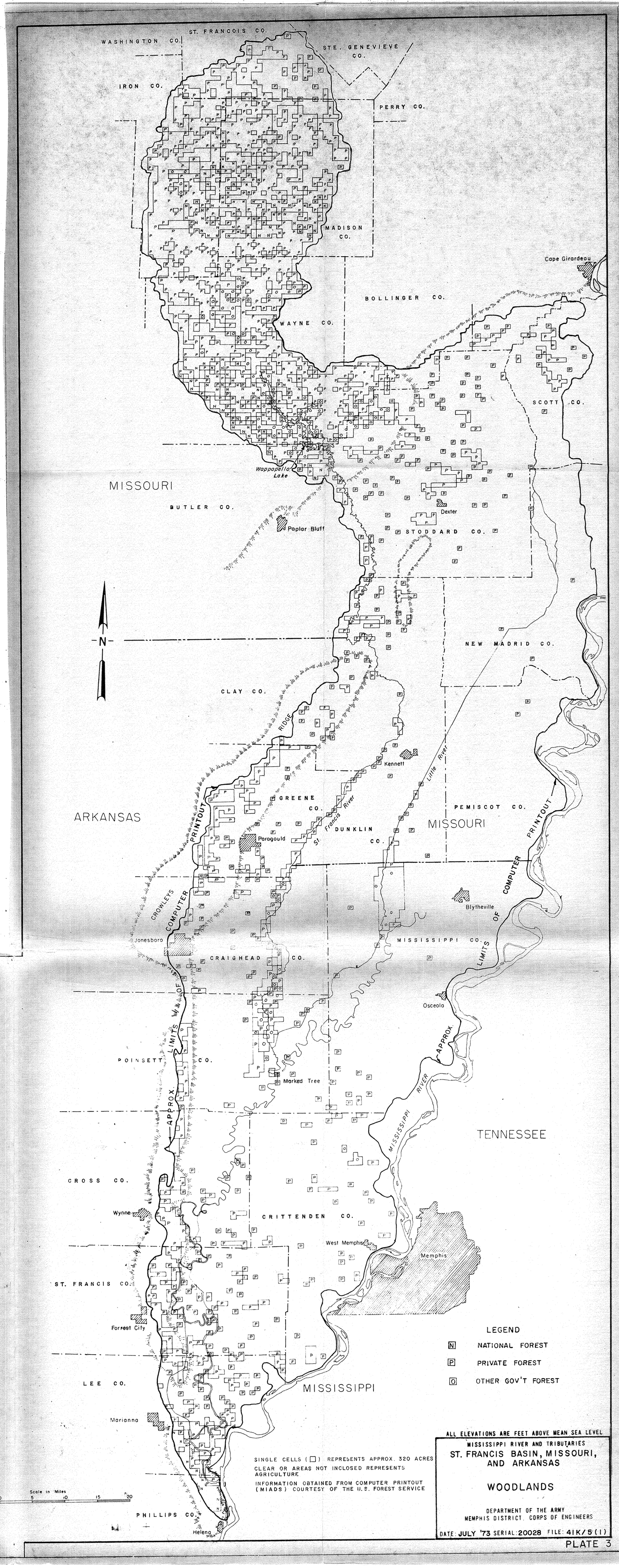
ST. FRANCIS BASIN, MISSOURI, AND ARKANSAS

GENERAL MAP

DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS

DATE: JULY '73 SERIAL 17997 FILE 209B/1.2

PLATE 2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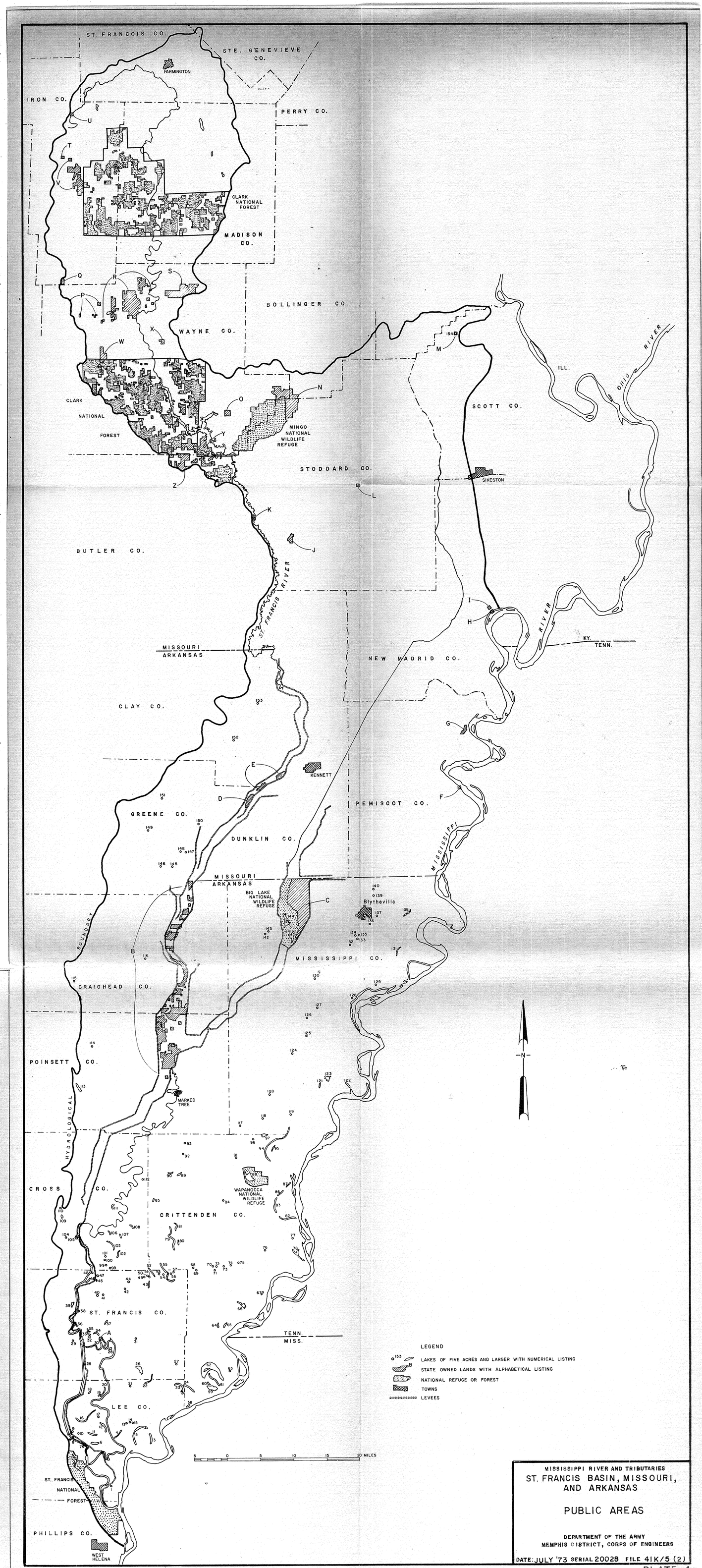
STE. GENEVIEVE CO.
IRON CO.
PERRY CO.
MADISON CO.
WAYNE CO.
Cape Girardeau
BOLLINGER CO.
SCOTT CO.
Wappapello Lake
MISSOURI
BUTLER CO.
Poplar Bluff
Dexter
STODDARD CO.
NEW MADRID CO.
CLAY CO.
RIDGE
PRINTOUT
Kennett
Little River
GREENE CO.
St. Francis River
PEMISCOT CO.
ARKANSAS
Paragould
DUNKLIN CO.
MISSOURI
CROWLEYS RIDGE
COMPUTER LIMITS OF
Blytheville
Jonesboro
CRAIGHEAD CO.
MISSISSIPPI CO.
Osceola
APPROX.
POINSETT CO.
Marked Tree
MISSISSIPPI RIVER
TENNESSEE
CROSS CO.
Wynne
CRITTENDEN CO.
West Memphis
Memphis
ST. FRANCIS CO.
Forrest City
LEE CO.
MISSISSIPPI
Marianna
PHILLIPS CO.
Helena
N
Scale in Miles
5 0 5 10 15 20
LEGEND
N NATIONAL FOREST
P PRIVATE FOREST
O OTHER GOV'T FOREST
SINGLE CELLS ( ) REPRESENTS APPROX. 320 ACRES
CLEAR OR AREAS NOT INCLOSED REPRESENTS AGRICULTURE
INFORMATION OBTAINED FROM COMPUTER PRINTOUT (MIADS) COURTESY OF THE U.S. FOREST SERVICE
ALL ELEVATIONS ARE FEET ABOVE MEAN SEA LEVEL
MISSISSIPPI RIVER AND TRIBUTARIES
ST. FRANCIS BASIN, MISSOURI, AND ARKANSAS
WOODLANDS
DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
DATE: JULY '73 SERIAL: 20028 FILE: 41K/5(1)

PLATE 3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STE. GENEVIEVE CO.
FARMINGTON
IRON CO.
PERRY CO.
CLARK NATIONAL FOREST
MADISON CO.
BOLLINGER CO.
WAYNE CO.
CLARK NATIONAL FOREST
MINGO NATIONAL WILDLIFE REFUGE
STODDARD CO.
SCOTT CO.
ILL.
OHIO RIVER
SIKESTON
BUTLER CO.
ST. FRANCIS RIVER
MISSOURI
ARKANSAS
NEW MADRID CO.
KY.
TENN.
CLAY CO.
KENNETT
GREENE CO.
PEMISCOT CO.
DUNKLIN CO.
MISSISSIPPI RIVER
BIG LAKE NATIONAL WILDLIFE REFUGE
Blytheville
BOUNDARY
MISSISSIPPI CO.
CRAIGHEAD CO.
POINSETT CO.
HYDROLOGICAL
MARKED TREE
CROSS CO.
WAPANOCCA NATIONAL WILDLIFE REFUGE
CRITTENDEN CO.
ST. FRANCIS CO.
TENN.
MISS.
LEE CO.
ST. FRANCIS NATIONAL FOREST
PHILLIPS CO.
WEST HELENA
N
5 0 5 10 15 20 MILES
LEGEND
LAKES OF FIVE ACRES AND LARGER WITH NUMERICAL LISTING
STATE OWNED LANDS WITH ALPHABETICAL LISTING
NATIONAL REFUGE OR FOREST
TOWNS
LEVEES
MISSISSIPPI RIVER AND TRIBUTARIES
ST. FRANCIS BASIN, MISSOURI, AND ARKANSAS
PUBLIC AREAS
DEPARTMENT OF THE ARMY
MEMPHIS DISTRICT, CORPS OF ENGINEERS
DATE: JULY '73 SERIAL 20028 FILE 41K/5 (2)

PLATE 4