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Environmental Evaluation Report onn Various Completed Channel Improvement Projects in Eastern Arkansas

Edward E. Dale Jr.
University of Arkansas, Fayetteville

Thomas M. Buchanan
University of Arkansas, Fayetteville

Richard L. Meyer
University of Arkansas, Fayetteville

Robert T. Huffman
University of Arkansas, Fayetteville

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Edward E. Dale, Jr.
Project Director

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By

Edward E. Dale, Jr.
Project Director
Department of Botany and Bacteriology
University of Arkansas
Fayetteville

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PREFACE

The environmental evaluation report which follows is based on information supplied by the Corps of Engineers, Little Rock District, available literature, and field observations made during May and June, 1974.

A considerable amount of information has been published on effects of channel improvement projects of hydrology, economics, and agricultural activities, but comparatively few investigations have been made on the effects of channel improvement and maintenance on native plant and animal life, esthetics, and on water quality. This is particularly true in Arkansas where detailed studies both before and after channel improvement projects have not been made. Furthermore, the available literature concerning channelized streams in Arkansas is widely scattered; but enough information is available to provide at least some reasonably sound predictions as to the effects of channel improvement projects and maintenance on biological elements, water quality, and esthetics in the existing environment of Village Creek Basin in Randolph, Lawrence, and Jackson Counties, Arkansas.

Investigators on this project were Edward E. Dale, Jr. (Project Director, Botany and Esthetics), Thomas M. Buchanan (Ichthyology), Richard L. Meyer (Water Quality) and Robert T. Huffman (Botany).

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ENVIRONMENTAL EVALUATION REPORT ON VARIOUS COMPLETED CHANNEL IMPROVEMENT PROJECTS IN EASTERN ARKANSAS

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1. Objective. The objective of this report is to evaluate the beneficial and adverse effects that certain channel improvement projects have had on the natural or man-made environments of selected areas in eastern Arkansas. This evaluation will be used as a baseline for determining the immediate and long-term effects that a project may have on the existing environment of the Village Creek Basin.

2. Location and description of study area. The study area is located in northeastern and east central Arkansas. Ten of the sites selected for study were in the St. Francis River Basin, ten in the Cache River Basin including three on Bayou DeView, three on Village Creek, and two in the Arkansas River Basin on Plum Bayou north of Pine Bluff, Arkansas (Plates 1, 2, and 3, and Table I).

All of the area is considered to be a part of the Arkansas Delta Region (Holder, 1970) and is characterized by flat or slightly rolling topography with poor drainage typical of regions with mature rivers and streams except for Crowleys' Ridge and similar areas. Most of the areas at lower elevations are subject to flooding at least part of each year.

3. Elements evaluated.

a. Biological. The presence of rare or endangered plant or animal species and the kinds of plant communities present were noted. Emphasis was placed on fish life present in the channels, and on plant successions at channel improvement projects of different areas.

b. Water quality. Information was obtained on water quality conditions in channel improvement projects of different ages from available literature and from analysis of selected water quality factors made from samples taken during field observations.

c. Esthetics. Observations were made and color and black and white photographs were taken to identify esthetic values at each project. Also, the appearance of the water was noted.

d. Channel clearing. A comparison of vegetation communities, animal life and water quality was made between unchannelized streams, streams that had been completely channelized, and those on which clearing was done on one side only. Also, vegetation regrowth on spoil areas was observed and possible beneficial effects of planned vegetation on spoil areas was considered.

e. Maintenance. The effects of maintenance on biological elements, water quality and esthetics along channels was investigated. Also, a library study was made of the effects of various maintenance practices on improving habitat conditions for fish.

DESCRIPTION OF AREAS STUDIED

The name, nature of the channel improvement, age, and general description of projects investigated are described below and their locations are shown on the accompanying maps.

Biological elements, water quality, esthetics, the effects of channel clearing on the environment and the effects of maintenance are discussed for all projects to the extent that information is available.

Many of the channel improvement projects in the same general areas that have undergone similar treatment at about the same time show essentially the same kinds of vegetation present and similar environmental conditions. These projects in the discussion that follows are considered together in the interest of brevity and the avoidance of unnecessary repetition.

1. Lower Cache River near Clarendon, Monroe County.

The channel was cleared out and the banks were cleared on both sides or one side only for a distance of 3.8 miles in 1972. Parts of the old channel that formed meanders were left intact in some instances and water was flowing between some of these meander loops and the channelized portion of the river in August, 1973 and June, 1974 (Plate 3, No. 18).

a. Biological Elements.

The spoil banks near Dobbs Landing were dominated by both woody and herbaceous vegetation in August, 1973 and in June, 1974. Natural woody vegetation was confined almost entirely to the lower part of the spoil near the edge of the water. Principal tree seedlings present were black willow (*Salix nigra*), sandbar willow (*Salix interior*), and cottonwood (*Populus deltoides*). A few seedlings of tupelo (*Nyssa aquatica*), cypress (*Taxodium distichum*), persimmon (*Diospyros virginiana*), bitter pecan (*Carya cordiformis*) and elderberry (*Sambucus canadensis*) were present also. The only woody vine noted was trumpet creeper (*Campsis radicans*).

The drier areas on top of the spoil supported a population of various herbaceous species. The most common species present in approximate decreasing order of importance included horseweed (*Erigeron canadensis*), bermuda grass (*Cynodon dactylon*), fog fruit (*Lippia cuneata*), goldenrod (*Solidago rugosa*), groundnut (*Apios americana*), begger-ticks (*Bidens* sp.), Queen Anne's lace (*Daucus carota*), tea weed (*Acalypha virginica*), evening primrose (*Oenothera serrulata*) and climbing hempweed (*Mikania scandens*).

Several introduced species had been planted on parts of the spoil banks in 1972 and many of them appeared to be growing well in June, 1974. Some of these were Russian sunflower (*Helianthus* sp.), pecan (*Carya illinoensis*) and crab apple (*Malus* sp.).

Vegetation of areas adjacent to the river that were undisturbed by channelization was typical of streamside and bottomland hardwood forests of the delta area. Principal species present along a decreasing moisture gradient from the river to drier areas on the banks include bald cypress (Taxodium distichum), black willow (Salix nigra), water hickory (Carya aquatica), swamp privit (Forestiera acuminata), overcup oak (Quercus lyrata), nuttall oak (Quercus nuttallii), hackberry (Celtis laevigata), ash (Fraxinus pennsylvanica and F. americana), sweetgum (Liquidambar styraciflua), willow oak (Quercus phellos), water oak (Quercus nigra), American elm (Ulmus americana), persimmon (Diospyros virginiana), and southern red oak (Quercus falcata).

It was reported by local fishermen that fishing success was better in the old meander loops after channelization than before channelization, and better in the loops than in the channelized part of the river. An informal creel census in June, 1974 showed that principal fish species being caught were catfish, crappie, and largemouth bass.

b. Water Quality.

Measurements indicative of water quality taken in the channelized part of the river on June 12, 1974, showed a turbidity value of 133 Formazin Turbidity Units (FTU's), a dissolved oxygen content of 5.6 ppm, carbon dioxide 7.3 ppm, and a pH of 7.0 (Table II).

c. Esthetics.

The appearance of vegetation of the undisturbed part of the stream was that of a typical lowland forest in the area. This would be considered as a pleasing natural scene to most people. The spoil banks were unattractive by usual standards showing a growth of weeds growing on bare and eroding soil (Figures 1 and 2).

The water in the channel has a murky, brown appearance resembling the color of the loessal-derived soils found upstream.

d. Channel Clearing.

The obvious effects of channel clearing on one or both sides of the channel is the sparseness of vegetation on the spoil banks in cleared areas and presence of forest on undisturbed parts of the river banks. The effects of the exotic plant species planted on the spoil banks in 1972 is not evident at present since not enough time has elapsed to predict the degree of their establishment and survival.

Water appearance was similar in channelized and unchannelized parts of the river, but it was noted on June 13, 1974 that near the west bank of the river the dissolved oxygen content was 5.6 ppm, carbon dioxide 7.3, and turbidity was 190 FTU's. Dissolved oxygen was 4.1, carbon dioxide 5.0 and turbidity 130 FTU's near the uncleared east bank.

e. Maintenance.

The area has received no maintenance since channelization.

2. Cache River near Grubbs, Jackson County.

(Plate 2, No. 22). The section of the river near Grubbs and south of Arkansas Highway 18 was channeled by local interests in

1964-1965, and has had little or no maintenance. The presence of some large trees on the banks and lack of trees near the edge of the channel suggest that trees were snagged from the channel area only, and that in most cases little work was done on the banks.

Biological elements and physical environmental factors near Grubbs very closely resemble those of the Cache River at Amagon, Jackson County, and Augusta in Woodruff County where additional observations were made and water samples collected for analysis.

a. Biological Elements.

The most common vegetation on the banks of the river were black willow (Salix nigra), cottonwood (Populus deltoides), and sycamore (Platanus occidentalis). Both bald cypress (Taxodium distichum) and tupelo (Nyssa aquatica) trees occurred singly or in small scattered groups near or in the water at the edge of the channel. American elm (Ulmus americana), sweetgum (Liquidambar styraciflua), persimmon (Diospyros virginiana), silverleaf maple (Acer saccharinum), red maple (Acer rubrum), and honey locust (Gleditsia triacanthos) occurred as scattered trees on higher ground near the stream. Other typical bottomland hardwood forest species occurred on first terrace parts of the floodplains in areas not cleared for agriculture.

Cleared, uncultivated areas were dominated mostly by Johnson grass (Sorghum halepense), bermuda (Cynodon dactylon), meadow fescue (Festuca sp.), trumpet vine (Campsis radicans), tall ragweed (Ambrosia trifida) and annual ragweed (Ambrosia artemisiifolia).

An informal creel census on June 6 showed that catfish was the most common fish being caught on that day. Common species reported in June and July, 1973 as present on the Cache River downstream from Grubbs and east of Augusta included longnose gar, silvery minnow, gizzard shad, mosquito fish, quillback, catfish, white crappie, largemouth bass and freshwater drum (U.S. Army Corps of Engineers, 1973).

b. Water Quality.

Turbidity at Grubbs on June 6 was 1100 FTU's, which was much higher than at Amagon (410 FTU's) on that same day. Turbidity was 570 FTU's at Grubbs on June 12, 545 at Amagon, and 260 at Augusta. Dissolved oxygen at Grubbs was 6.1 and 5.1 ppm on June 6 and June 12, respectfully, carbon dioxide was 10.0 ppm and pH 6.7 on June 12. These values were not significantly different at Augusta or Amagon (Table II).

c. Esthetics.

The unkept buildings, piles of dirt and gravel, and general occurrence of weeds and debris near the birdge at this site would be considered unattractive to most people. The more natural forest setting away from the birdge at Grubbs, near the river east of Augusta and at Amagon were more pleasing (Figure 3).

The water had a murky brown appearance resembling the color of the loess-derived soil found upstream. This was true at all sites examined during this study except at Hurricane Ditch, where the water was nearly clear.

d. Channel Clearing.

The lack of large trees such as cypress and tupelo trees near the channel and the presence of pioneer species such as black willow near the water's edge are the main indicators of channel clearing or other disturbance as indicated by vegetation. It was noted that small meanders were beginning to form in the bank at several points along the stream.

e. Maintenance.

No evidence of channel maintenance was noted at this site.

3. Village Creek Northeast of Tuckerman at Highway 226, Jackson County. (Plate 2, No. 2).

This area, another site on Village Creek near Newport and the Cache River near Sedwick on the Greene-Lawrence County line have similar characteristics and are the least disturbed areas observed in this study. The Village Creek sites appeared to be unchannelized. The Cache River near Sedwick had some channel modification about 50 years ago, but the appearance of the area except near the bridge closely resemble the Village Creek sites.

a. Biological Elements.

One of the most common aquatic vascular plants present was spatter dock (Numphar advena) at the Newport and Tuckerman sites. Other aquatic or semi-aquatic species noted as present in the shallow areas were smartweed (Polygonum sp.), lizard tail (Saururus cernuus) and swamp mallow (Hibiscus lasiocarpus).

Large cypress or tupelo trees or both were present at all sites near the edges of the channel. Cottonwood, sycamore, black willow, and black river birch (Betula nigra) occurred as single trees or in small scattered groups in the edge of the water, particularly in small cleared areas near bridges or other construction. Button bush (Cephalanthus occidentalis) and swamp privit (Forestiera acuminata), and blue beech (Carpinus caroliniana) were common woody understory species near the edges of the streams. Bands of bottom-land hardwood forest occurred on higher ground on both sides of the streams. Principal species present include water oak (Quercus nigra), willow oak (Quercus phellos), overcup oak (Quercus lyrata), bitter-nut hickory (Carya cordiformis), green ash (Fraxinus pennsylvanica) and American elm (Ulmus americana).

b. Water Quality.

Turbidity at this site on June 6 was 170 FTU's and 350 on June 12. Dissolved oxygen was 4.4 ppm and 5.2 at these same dates, respectfully. Carbon dioxide content was 7.5 ppm, and pH of the surface water was 6.7 on June 12. These values were similar at the Newport site and at the Cache River near Sedwick, except that oxygen content and turbidity tended to be higher at Sedwick (Table II).

c. Esthetic.

These sites are pleasing esthetically to most people since they are the least disturbed of all sites examined. The forest vegetation is in a late stage of succession, and except for the absence of very large trees, resembles an essentially undisturbed forest. Such ecosystems are rare in this part of Arkansas (Figure 4).

d. Channel Clearing.

No channel clearing has occurred in these areas for many years, if ever.

e. Maintenance.

No evidence of maintenance in any of these areas was noted.

4. Bayou DeView near Weiner, Poinsett County. (Plate 2, No. 20).

Bayou DeView north of U.S. Highway 64 was channelized by local interests in the 1920's and 30's.

The site located 2½ miles west of Weiner in the Bayou DeView Game Management Area is representative of 2 other sites investigated on Bayou DeView during this study. One of these other sites is west of Fisher in Poinsett County and the other is at the Highway 64 bridge near Morton in Woodruff County. The site near Weiner is surrounded by a wooded area and the other sites are surrounded mostly by agricultural lands except for narrow bands of trees along the river.

a. Biological Elements.

The most common tree near the water was black willow. Others growing singly or in small groups on the banks included cottonwood, silver leaf maple, green ash, persimmon, cedar elm (Ulmus crassifolia) and overcup oak. Woody shrubs and vines present included buttonbush, climbing hempweed (Mikania scandens) and poison ivy (Rhus toxicodendron). Common herbaceous species in disturbed, open places included goldenrod (Solidago rugosa), tall ragweed (Ambrosia trifida), annual ragweed (Ambrosia artemisiifolia), annual sunflower (Helianthus annuus), stiff sunflower (Helianthus divaricatus), Johnson grass (Sorghum halepense), foxtail grass (Setaria sp.) and bermuda grass.

A census of fish taken near this area in 1973 showed that the most common species present included gizzard shad, carp, channel catfish, tadpole madtom, flathead catfish, mosquito fish, smallmouth buffalo, green sunfish, white crappie, and freshwater drum (U.S. Army Corps of Engineers, 1973).

b. Water Quality.

Turbidity at the Weiner site was 305 FTU's on June 6 and 145 on June 12. Turbidity at Fisher was 390 and 235, during the same sampling periods. Water samples taken on June 6 or June 12 at all 3 sites showed dissolved oxygen present as between 4.5 and 5.3 ppm, carbon dioxide 8.7, and a pH range between 6.5 and 6.7.

Selected physiochemical characteristics taken at the Weiner site between June 22-30, 1973, showed dissolved oxygen to be 11 ppm, carbon dioxide 20, pH 8.3, and turbidity 48 Jackson Turbidity Units (U.S. Army Corps of Engineers, 1973).

c. Esthetics.

Bayou DeView has the general appearance of a straight, deep ditch filled with rapidly flowing muddy water following heavy rains. During periods of low flow, much of the steep, muddy, clay banks devoid of vegetaion are evident. Most people would not consider this esthetically desirable. It should be pointed out, however, that much of Bayou DeView has a heavy growth of timber along its banks which at least during periods when the water is not too low, give it an appearance acceptable to most people (Figure 5).

d. Channel Clearing.

No evidence was observed of recent clearing on either bank, or of any meandering tendencies at any of the sites examined during this study.

e. Maintenance.

No effects of recent maintenance were observed on the banks, but the scarcity of aquatic vegetation and absence of trees in or near the channel suggest some channel clearing maintenance during the last few years.

5. Big Ditch Slough 4 miles east of Marmaduke at Highway 34, Greene County. (Plate 1, No. 5).

Big Ditch Slough is similar to Mayo Ditch, located about 3 miles southeast near Mounds, Tulot ditch near Tulot, Poinsett County, and the Right Hand Chute of Little River at the bridge near Floodway in Mississippi County. These projects are among the largest ditches investigated; they were carrying large volumes of water when they were observed. All support the same general type of vegetation, and have been intensively maintained. Also, all projects were completed 10-13 years ago with the possible exception of Little River, where completion time is unknown.

a. Biological Elements.

No large trees or woody plants were present on the banks. A few scattered tree seedlings such as black willow, persimmon, cottonwood and river locust (Amorpha fruiticosa) were present. Few aquatic or semi-aquatic vascular plants were growing in or near the water. The sides and tops of the banks had been cleared. Bermuda grass, meadow fescue, and various weeds were the most common species present. Cultivated fields or cow pastures were present near Big Ditch Slough and at the other sites.

b. Water Quality.

Turbidity on June 4 was 45 FTU's and 100 on June 12 in Big Ditch Slough. Turbidity values were similar at Mayo Ditch, but were 380 FTU's at Tulot Ditch on June 5 and 135 at Little River. Turbidity was 800 FTU's at Little River on June 12 after heavy rains had occurred upstream a few days previously. Oxygen content was 7.0 ppm at Big Ditch Slough on June 4 and 6.0 on June 12. Carbon dioxide was 7.5 and pH 8. Oxygen, carbon dioxide and pH values varied somewhat at the other sites but were not significantly different from those at Big Ditch.

c. Esthetics.

The vegetation along the edges of the ditches is well established and generally well maintained. Also, the fact that the channel is relatively free of logs, tree limbs and other debris adds to its generally well-kept appearance. It is likely that most people would not consider these projects as ugly, but they are not likely to be thought of as things of beauty (Figure 6).

d. Channel Clearing.

The channels and both banks have been cleared on all of these projects at the sites examined. No tendency toward the development of meandering qualities was noted.

e. Maintenance.

The regrowth of native vegetation has been largely prevented on top of the banks because of farming or maintenance activities, but some growth of both native and introduced species are present on the sides. The maintenance of the grassy cover on the top and sides of the banks has prevented soil erosion and soil slump which may partially block the channel. If slumps occurred it could cause accumulation of debris at the slump area, and initiate meandering tendencies by the stream.

6. East Floodway Ditch near Floodway, Mississippi County. (Plate 2, No. 13).

This project on Little River had 3 miles of channel cleanout in 1955. Vegetation here is similar to that at Hurricane Slough northeast of Paragould, Greene County, which had a channel cleanout completed in 1953 and to Willow Ditch at Highway 37 east of Tuckerman, Jackson County. All are about the same size at points where they were observed, and all support a heavy growth of young trees on their banks which cast a heavy shade on the channels at many places.

a. Biological Elements.

The most common tree along the banks was black willow. Other common trees present included silver leaf maple, black river birch, American elm, (*Ulmus americana*), sycamore (*Platanus occidentalis*) and honey locust. Woody shrubs and vines present were wild grape (*Vitis* sp.) smooth sumac (*Rhus glabra*), and honeysuckle (*Lonicera japonica*). Herbaceous species present included tall ragweed, Bosc panic grass (*Panicum boscii*), bermuda grass and Johnson grass. Fewer herbaceous species were present at Hurricane Slough than at the other sites probably because the channel at the point of observation was heavily shaded.

b. Water Quality.

Turbidity in East Floodway Ditch was 675 FTU's on June 5 and 800 on June 12. Oxygen content was 4.7 and 5.3 ppm during these same times. Carbon dioxide was 6.3 ppm and pH 7.5 on June 12.

Turbidity values in Willow Ditch were 1100 FTU's on June 6 and 310 on June 12, and dissolved oxygen was 6.5 ppm on both of these dates. Carbon dioxide and pH were essentially the same as in East Floodway Ditch.

The turbidity in Hurricane Slough was the lowest of all projects examined (20 and 35 FTU's) and the water was clear. Oxygen and pH values were not significantly different than those in Willow Ditch, but carbon dioxide was lower (3.7 ppm).

c. Esthetics.

The appearance of these projects as a row of young trees along a channel helps break the monotony of a flat cultivated landscape, but a muddy or debris-filled bottom of the channel does not present a pleasing appearance (Figures 7 and 8).

d. Channel Clearing.

The fact that channel clearing has minimized tendencies for the stream to meander is well illustrated at these sites.

e. Maintenance.

Keeping the channel clear but permitting some tree growth on the banks of these shallow ditches has provided a heavy shade important in reducing the growth of aquatic and semi-aquatic vegetation in the channels at these sites.

7. Float Road Slough east of Walnut Ridge, Lawrence County. Plate 1, No. 10).

This project consisted of clearing, snagging, and channel clean-out that was completed in 1954. Eight Mile Ditch near Paragould in Greene County is a similar project completed in 1957.

Float Road Slough has cultivated fields on both sides and the tops of the banks have been cleared of trees. Eight Mile Ditch is surrounded by open areas and parts of the city of Paragould at the site observed. Both have scattered tree seedlings and weeds growing on the sides of the banks.

a. Biological Elements.

The most common trees on the banks include black willow, green ash, sweetgum and American elm. Other woody species include button-bush, trumpet vine, and poison ivy. Common herbaceous species present are meadow fescue, Johnson grass, bermuda grass, and various weeds such as tall ragweed, annual ragwee, lambs quarters (*Chenopodium album*), and cane (*Arundinaria gigantea*). Float Road Slough had some aquatic weeds growing in the shallow water in the center of the channel.

b. Water Quality.

Turbidity values at Float Road Slough on June 5 were 1050 FTU's and 220 on June 12, and dissolved oxygen was 5.7 ppm and 6.2 on those same dates. Carbon dioxide was 6.3 ppm and the pH was 7.5 on June 12.

The turbidity was much lower at both sampling periods at Eight Mile Ditch (44 and 80 FTU's, respectively), and oxygen content was 9.3 and 7.6 ppm on those same dates. Carbon dioxide was 3.8 and pH 7.7 on June 12.

e. Esthetics.

The short, but somewhat ragged appearance of the predominently weedy vegetation on the sides of the banks and the lack of trees on the top would not be considered very attractive to most people. Also, the weedy growth in the channel would not be esthetically pleasing (Figure 9).

d. Channel Clearing.

Channel clearing on these projects has reduced the tendency for meandering, but some bends in the channel at Eight Mile Ditch were evident, possibly caused by debris in the ditch introduced since channelization.

e. Maintenance.

The effects of maintenance has been to reduce tree growth on the sides of ditch and permit growth of grasses which make a better ground cover and reduce soil erosion. However, this lack of trees on the spoil banks may not make the ditch esthetically pleasing.

8. Johnson Creek near Highway 1 north of Paragould, Greene County. (Plate 1, No. 2).

Johnson Creek had a channel cleanout in 1960. Locust Creek, located about 3 miles northeast of Johnson Creek near Halliday had a channel cleanout in 1960 also. Conditions at both of these projects are essentially identical and both are small straight ditches through farmlands, but with a growth of small trees or brush on their banks or on the tops of the spoil.

a. Biological Elements.

Principal tree species growing along the banks include box elder (*Acer negundo*), American elm (*Ulmus americana*), ash (*Fraxinus pennsylvanica* or *F. americana*), and sweetgum. Black willow was present in some of the more open places, but not in the densely shaded areas near the channel. Common shrubs or vines which usually occurred in more open areas were sumac (*Rhus glabra*), elderberry (*Sambucus canadensis*), and poison ivy (*Rhus toxicodendron*). Herbaceous species which dominated in open areas included bermuda grass, meadow fescue, and various weeds.

A seine sample of fish taken at Locust Creek on May 22, 1974, showed that the emerald shiner, striped shiner, blacktail shiner. blackspotted minnow, flier, and green sunfish were present.

b. Water Quality.

Turbidity of water in Johnson Creek was 40 FTU's on June 4 and 28 on June 12. Dissolved oxygen content was 7.8 and 7.3 ppm during these same sampling periods. Carbon dioxide was 5 ppm and pH was 7.7 on June 12.

Water quality characteristics measured for Locust Creek did not vary significantly from the values found at Johnson Creek.

c. Esthetics.

The small trees along the edges of the ditch help break the monotony of the flat cultivated fields that occur on both sides of the ditches, but the scrubby appearance of these trees does not add greatly to the beauty of the landscape (Figures 10 and 11).

d. Channel Clearing.

A small amount of meandering was noted in the channel at Locust Creek since channelization, but this was not evident in Johnson Creek.

e. Maintenance.

The effects of maintenance are indicated by the absence of large trees on the banks and growth of grasses and other ground cover. This ground cover has helped prevent soil erosion at this site.

9. Little Slough, west of Monette, Craighead County. (Plate 2, No. 2).

Little Slough had a channel cleanout for a distance of 6 miles in 1958 and was sprayed with herbicide probably during 1972 or 1973.

Little Village Creek Ditch located two and one-half miles northeast of Walnut Ridge in Lawrence County near Highway 34 has been subject to herbicide also, and closely resembles Little Slough in other ways.

Both of these small ditches have dead black willow and other trees in or on the edges of their channels, support a narrow band of small trees on the spoil banks, and drain cultivated lands on both sides.

a. Biological Elements.

The most common tree along the banks was black willow. Other woody plants present include silver leaf maple, river locust, button bush, sumac, poison ivy, and greenbrier (*Smilax bona-nox*). Common herbaceous species were tall ragweed, Johnson grass, and goldenrod (*Solidago* sp.).

b. Water Quality.

Turbidity at Little Slough on June 5 and June 12 was 30 FTU's and dissolved oxygen was 4.8 and 6.8 ppm on these same dates. Carbon dioxide was 11.3 ppm, and the pH was 8.0 on June 12. Turbidity at Village Creek was higher and dissolved oxygen was lower on these same days. Turbidity values were 250 and 65 FTU's, and oxygen 4.2 and 4.9 ppm. Carbon dioxide content was 10.0 ppm and pH was 6.5 on June 12.

c. Esthetics.

A strip of trees on the edge of a ditch extending through cultivated areas breaks the monotony of the landscape, but the dead snags of black willow in or near the channel would be considered as very unattractive by most people (Figure 12).

d. Channel Clearing.

Killing trees in the channel by the use of herbicide is likely to be an ineffective method of controlling vegetation growth in the channel if this was the purpose of the herbicide applications. The dead trunks will slow down the velocity of the water and accelerate silt deposition and meandering tendencies as was evident at both Little Slough and Village Creek.

e. Maintenance.

The effects of maintenance through the use of herbicides is likely to have an adverse effect on aquatic life in the channel and increase soil erosion. Also, the dead trees will eventually be washed into the channel and prevent free flow of the water causing meandering tendencies, and increasing local flooding conditions.

10. Plum Bayou north of Pine Bluff, Jefferson County. (Plate 3, No. 24).

Some parts of Plum Bayou have been cleared on both sides and other parts on one side only. Also, some of the channels are of different ages, and trees have been snagged from the channel.

This project was observed where Highway 79 crosses it about 4 miles west of Altheimer and at the Highway 15 bridge 3 miles south of Sherrill. Observations were made here primarily to supplement vegetation and water quality information obtained from studies of other sites.

a. Biological Elements.

The area near Altheimer appeared to have been cleared on one side only many years ago. Common tree species present include black willow, cottonwood, American elm, green ash, and bitternut hickory. Some of the more common weeds in open places are Johnson grass, tall ragweed, annual ragweed, goldenrod, tickseed (*Bidens* sp.) and bermuda grass.

The banks of the bayou near Sherrill had been cleared on both sides and supported a good growth of pasture grasses such as bermuda and fescue. A few small scattered black willow and pecan trees were growing near the stream and in the surrounding pasture.

b. Water Quality.

Water quality measurements were taken on June 13 only. Turbidity was 360 FTU's near Altheimer and 275 near Sherrill. Dissolved oxygen was 3.4 ppm, carbon dioxide 8.8, and pH 6.7 at both sites. The water was higher than usual when the samples were taken.

c. Esthetics.

Both sites are esthetically acceptable, depending on whether a person prefers to view a stream bordered by woods or a well-kept pasture in a rural setting (Figures 13 and 14).

d. Channel Clearing.

The effects of channel clearing on meandering tendencies were not evident at either of these sites because of high water at the time when they were observed.

e. Maintenance.

The effects of maintenance of the channel were not evident at either of these sites because of high water at the time when they were observed.

THE EFFECTS OF CHANNEL IMPROVEMENT PROJECTS

GENERAL

The effects of channel improvements and maintenance on the environment at any particular location depend on many factors. Some of these are biological elements present, physical characteristics of the area such as geology, soils, climate, and topography, the kind of channel improvements made, the magnitude of the improvements, man's activities in the surrounding area, and the nature and degree of maintenance. Also, many characteristics of channel improvement projects owe their existence to conditions upstream in the same drainage basin and to successional interactions between biological elements and physical factors of the environment over a period of time.

Biological elements, water quality and esthetics will be affected differently by complete channel clearing than by channel clearing on one side only. However, this difference is primarily one of the degree of the effects rather than any change in the nature of the effects.

1. The Effects of Channelization.

a. Biological Elements.

(1) Vegetation.

No previous study has been published on plant succession in the Arkansas Delta, and only two investigations have been made in nearby lowland areas. Turner (1931) made a study of plant succession on levees one to fifty years old in the lowlands of Illinois, and Dale (1972) reported on successional trends on the lower part of Big Mulberry Creek near the Arkansas River in Franklin County, Arkansas.

The results of the present investigation show that general correlation exists between the kinds of plant communities present and the age of some of the channelization projects investigated in the Arkansas Delta. Exceptions occur on areas that have undergone maintenance.

Studies in August, 1973 and June, 1974 on 2 miles of spoil banks established in 1972 on the lower Cache River near Clarendon, Monroe County, indicated that the kinds and numbers of plant species present and successional relationships during the first two years is highly variable. This is attributed primarily to variability in soil and aerial environmental conditions, the kinds of plants nearby that might serve as seed sources, and the time of year when the spoil area was established. Woody species such as black willow, sandbar willow (*Salix interior*) and cottonwood become established the first year on the edge of the spoil bank near the water. New seedlings of these plants were noted during the second year, and in addition, cypress, tupelo, elderberry, bitter pecan (*Carya cordiformis*), oak, and persimmon seedlings. A very few individuals of American elm and a silver leaf maple (Acer saccharinum) were noted, also. Drier areas on the top and sides of the bank supported horseweed (Erigeron canadensis), bermuda grass, crabgrass (Digitaria sp.), fog fruit (Lippia cuneata), Queen Anne's lace (Daucus carota), tea weed (Acalypha virginica), trumpet vine (Campsis radicans), lambs quarters (Chenopodium album), and tall ragweed (Ambrosia trifida) during both the first and second years. Other species of weeds were noted also, but they were fewer in number and more widely distributed.

These results are in general agreement with results reported by Turner (1931) on levees in lowland areas of Illinois one to three years old. Many of the same species are present and they occur in comparable places in the habitat.

The next youngest projects available that had not undergone maintenance were three areas ten years old on the Cache River near Grubbs, Amagon, and Augusta.

A comparison of vegetation present at the two year old site at Clarendon, the ten year old areas on the Cache River, and on levees in Illinois (Turner, 1931) gave good indications of successional trends between two and ten years in the study area.

The most significant change that occurred during the next three to ten years following channelization was an increase in size of woody species and introduction and establishment of others. Black willow grew rapidly and became the most important dominant near the edge of the water after 8 to 10 years.

Young cypress and tupelo increased in size near the edge of the water, and floodplain species such as black river birch, silver leaf maple, American elm, hackberry (Celtis laevigata), sweetgum, persimmon and other floodplain species became established on the banks. Also, more shade tolerant vines such as virginia creeper (Parthenocissus quinquefolia) and wild grape (Vitis sp.) and various herbaceous species invaded the forest floors. Shade intolerant pioneer species including horseweed, tea weed, ragweed, and lambs quarters disappeared. Herbaceous species such as smartweed and others that grow at or near the water line tended to remain because annual inundation destroys most herbaceous growth, and a one year succession beginning every year often occurs in such places.

An examination of vegetation in small patches of woods on Johnson and Locust Creeks and a slough near Tulot Ditch that had apparently been omitted in maintenance operations for about ten to fifteen years indicated successional trends for that period of time. Black willow and cottonwood trees became larger but fewer in number, and cypress or tupelo became more prominent near and in the water. Cane (Arundinaria gigantea) became established in sandy areas, and such species as river locust, buttonbush, and southern wild rice (Zizaniopsis miliacea) became prominent near the edge of the water. American elm, silver leaf maple, green ash, sweetgum, sycamore (Platanus occidentalis) willow oak (Quercus phellos), water oak (Q. nigra), and honey locust (Gleditsia tricanthos) were common trees on banks behind the willows and cottonwood.

Woody shrubs and vines present included sumac (*Rhus glabra* and *R. copallina*), poison ivy, virginia creeper (*Parthenocissus* sp.), trumpet vine, wild grape (*Vitis* sp.), and elderberry (*Sambucus canadensis*). Herbaceous species on forest floors were replaced by more shade tolerant species typical of floodplains, and cover on the forest floor was greatly reduced primarily because of the increased shade.

Plant species present at projects sixteen to twenty-five years old such as sections on Willow Ditch and Hurricane Slough were about the same as at the 10 to 15 year old projects. However, it was noted that the trees were larger and streamside species that are shade intolerant such as black willow and cottonwood tended to decline in numbers.

Studies on channels twenty-five to fifty years old on parts of the upper Cache River with no maintenance showed further changes in vegetation along the banks. Except for a few large and scattered individual trees, cottonwood and black willow were almost absent and cypress or tupelo were the most common trees in or near the water. This can be attributed to the fact that while cottonwood and willow can tolerate flooding for several days, they cannot survive high water for long periods of time. The channel became more shallow and meanders formed during this fifty year period causing water to stay in the area longer. This, together with shading effects by large hardwood trees on the banks were important contributing factors to the replacement of black willow and cottonwood by the more water-tolerant cypress and tupelo.

Vegetation on the banks supported typical bottomland forest species as were present at the sixteen to twenty-five year period, but American elm, green ash, water oak and willow oak increased in size and numbers, but black river birch and silver leaf maple decreased. Understory and ground cover were reduced further because of the dense shade and the trees of the overstory became larger.

Vegetation on the apparently unchannelized part of Village Creek near Newport and Tuckerman and on the old channel (over fifty years) on the Cache at Sedwick represents the oldest and most stable plant communities investigated. They represent at least for practical purpose, a near terminal stage of plant succession of streamside plant communities except for the smaller size of the trees and presence of some species of the herbaceous understory.

Several aquatic and semiaquatic herbaceous species were present in the water at the bases of the cypress and tulepo trees. Some of these were spatter dock (*Numphar advena*), lizard tail (*Saururus cernuus*), and smartweed (*Polygonum* sp.). Black willow, cottonwood, black river birch, and sycamore occurred as small groups or individual trees on the banks behind the cypress and tupelo. The ground was almost bare of vegetation on the banks near the water, and cypress knees were evident in many places.

The upper part of the banks behind the streamside species was dominated by a typical bottomland hardwood forest of the same species as described in the sixteen to twenty-five, and the twenty-five to fifty year old forests, but the trees were larger and the ground cover was more sparce.

(2) Fish.

Several studies have been conducted in various parts of the United States on the effects of stream channelization on fish populations within the last few years. The investigations that best summarize the known effects of channelization are those of Barstow (1971), Congdon (1971), Funk and Ruhr (1971), Hansen (1971), Mills et al. (1966), Smith (1971), and Tarplee et al. (1971). Other publications which include pertinent information are those of Henegar and Harmon (1971), Larimore and Smith (1963), Laser et al. (1969), and Sanderson and Bellrose (1969).

There has been very little information published on the effects of channelization on fishes in Arkansas. Alexander (1973) discussed the general environmental effects of a plan by federal agencies to develop the basin of the upper White River, Buchanan (1973) cited stream channelization as a major factor in altering fish distributional patterns in Arkansas, Madson (1972) and Purvis (1973) evaluated the effects of the proposed Cache River channelization project, and Holder (1970) documented the extent and effects of the disappearing wetlands of eastern Arkansas.

Because of the limited amount of information available, the following evaluation of the effects of stream channelization on fishes in eastern Arkansas is based on results of studies by other workers on comparable streams in other states, the investigator's experience in working on fish in eastern Arkansas streams, and a limited on-site inspection trip on May 19-24, 1974 to selected streams of different ages since channelization (Table III).

Most channelized streams in eastern Arkansas are little more than straight, shallow ditches, having few or no deep pools. The streams observed during the present study had little instream fish habitat such as natural obstructions or other cover essential for a good fish population. The removal of the natural forest canopy from the stream banks has raised the temperature of the water and caused greater siltation, which is further intensified by increased agricultural activity right up to the spoil banks of the channel. All of these major physical aspects of stream channelization have combined to produce the following effects on the fishes:

(a) Reduced abundance: There are fewer numbers and pounds of fishes in channelized streams. This is due not only to habitat destruction, but also to reduction of the food supply since often one or more trophic levels of food chains are completely eliminated. Also, the average size of fishes in channelized streams is smaller.

(b) Shifts in relative species abundance: Channelization completely changes the community structure of a stream. In general, sport fish populations are more severely affected than rough fish or forage fish populations, the latter two categories becoming relatively more abundant. Fishes such as carp (Cyprinus carpio), river carpsucker (Carpiodes carpio), smallmouth buffalo (Ictiobus bubalus), and the silvery minnow (Hybognathus nuchalis) tend to increase in relative abundance, especially in the larger channelized streams such as the St. Francis River. The shift towards forage species appears to be greater in the smaller channelized streams which often become intermittent or dry in the summer.

(c) Reduced species diversity: Fewer species occur in channelized streams as well as fewer numbers. Tarplee et al. (1971) found in a study of North Carolina streams that the difference between the mean species diversity in natural and channelized streams indicated that the overall quality of streams was reduced by 27.5% following channelization. This is to be expected because the habitat diversity is greatly reduced by the channelization process.

There is a group of fishes that is very useful in determining whether a substantial amount of habitat destruction has taken place in an Arkansas lowland stream. Several lowland species of the Family Percidae, commonly known as "darters", may be used as "indicator organisms" to judge the degree of cover removal and other channel disturbances. In the few lowland streams of eastern Arkansas which have not been significantly altered by man's activities such as certain streams on the White River National Wildlife Refuge, there are always three or more species of darters present, depending upon stream size and habitat. For example, at a single locality on Indian Bayou in Monroe County, nine different species of darters have been collected during a single sampling period of one hour. Some of the lowland darters which are frequently found in natural streams are the mud darter (Etheostoma asprigene), the bluntnose darter (E. chlorosomum), the slough darter (E. gracile), the harlequin darter (E. histrio), and the cypress darter (E. proeliare). Other lowland species which are less frequently found are the swamp darter (E. fusiforme), the logperch (Percina caprodes, found more abundantly in the uplands), the dusky darter (P. sciera), and the river darter (P. shumardi). Different amount of habitat alteration eliminate the more susceptible species, and channelization eliminates all darters.

(d) Elimination or reduction of rare or threatened species: Any strictly lowland species of fish has had its numbers and distributional area greatly reduced in Arkansas because of the widespread channelization that has occurred, especially in the Coastal Plain Lowlands. Fishes of commercial or sport value which have declined drastically in numbers because of channelization (as well as other factors) are the paddlefish (Polyodon spathula), the shovelnose sturgeon (Scaphirhynchus platorynchus), and the alligator gar (Lepisosteus spatula). No species, as far as is known, has yet been completely eliminated from the state by channelization activities, but there is a real danger of this happening to the cypress minnow (Hybognathus hayi), the ironcolor shiner (Notropis maculatus), the swamp darter (*Etheostoma fusiforme*), the goldstripe darter (*E. parvipinne*), and probably several other species if channelization is carried out in a few drainages where these threatened species still occur.

(3) Wildlife.

No detailed studies have been made in eastern Arkansas on the relation of wildlife populations to channelization projects of direct ages, but it has been known for many years that destruction or alteration of the habitat is one of the important factors that affects wildlife populations in any given area. Thus it follows that in general, most natural wildlife populations are affected the most during construction at new projects and progressively less at older ones as plant succession and habitat conditions revert toward original conditions.

The degree of initial disruption is important also. If all vegetation is removed from the banks of the channel area and spoil is deposited on both sides, the effects will be more severe than if vegetation is removed wholly or partially from one side and the channel is less altered. If regrowth of vegetation is permitted along the stream, the area may form an "edge" that will favor some species.

A discussion of the probable effects of the Cache River Basin Project on wildlife is presented in the Draft Environmental Impact Statement (U.S. Army Corps of Engineers, 1973). Since results of this study give good indications as to the impact of channelization on animal populations, much of the pertinent information from this source is used as a basis for the discussion that follows.

(a) Amphibians and reptiles. Most amphibians are dependent on standing water for successful reproduction, and increased drainage of the area could cause adverse effects. Destruction of damp or heavily shaded habitats would adversely affect snakes and lizards. Thus, if the channel is cleared on both sides and many trees removed, many reptiles and amphibians would be eliminated. If only partial clearing is done, they would not be so severely affected, and the return of many segments of the original populations could be expected as original habitat conditions developed on older channels. Some species such as bullfrogs, leopard frogs, chorus frogs, toads, some salamanders, water snakes and turtles may benefit locally in bendway lakes and channel cut-offs since water quality may improve in such areas.

(b) Birds. Some species that inhabit bottomland hardwood and streamside areas would be adversely affected by complete channel clearing and removal of vegetation on both sides, primarily because of destruction of the habitat and food supplies in the stream or forest.

Species such as quail and dove may benefit since they thrive best in areas of early plant succession, such as on spoil banks a few years old, or in edges of woods. As the original habitat conditions return on older channels, numbers of these species can be expected to decrease. Flyway populations of waterfowl species such as mallard ducks are not likely to be significantly affected. Wood ducks will be adversely affected by habitat destruction in young channelization project areas.

(c) Mammals. Mammal populations will be affected largely by loss of woodlands and in the case of many fur bearers, by drainage of wet areas in previously unchannelized areas or near old channel projects. Construction activities will disrupt faunal populations in new areas, but populations in channel cleanout areas of previously channelized parts of the stream will be affected relatively less.

Deer and squirrels will be affected to the extent that woodlands are removed along the new channels, and the presence of such species as swamp rabbit, mink, muskrat and beaver will be influenced by the manipulation of channels and stream banks. Effects on populations of these animals will be greatest initially, but less so in older channel areas.

Cottontail rabbits may benefit a few years after channelization by increased amount of thickets and brush piles along ditches and brushy or herbaceous growth on spoil banks, but populations would be expected to decline along older channel areas as weedy and brushy habitats are eliminated.

Species such as coyote, skunk and fox will be less affected by channelization activities since their habitat includes more upland areas.

b. Water Quality.

There is very little published information on water quality in the Arkansas Delta Region. Some information is available from water quality records published by the United States Department of the Interior (1965, 1967, 1971) or from Arkansas State agencies such as the Department of Pollution Control and Ecology. Other sources include Jenkins and Harp (1971) who briefly describe selected water quality elements in the Big Creek Watershed in Craighead and Green Counties, and the Draft Environmental Impact Statement on the Cache River Basin Project (U.S. Army Corps of Engineers, 1973) where water quality on the Cache River and Bayou DeView are discussed. Also, references are made to water quality at some sites in the Arkansas Delta by Wilkerson (1973, 1973a).

Although the data from these sources are useful for some purposes, they are of little value to this study primarily because most of the water samples were taken at sites other than those utilized in this investigation and at too many different times. Accordingly, selected water quality measurements made in June, 1974 are the basis for most of the discussion that follows.

It is well known that water quality at or below a channel improvement project may change radically from original conditions during and immediately following the completion of the project, particularly during the first year. Increased run off caused by removal of vegetation and soil disruption may cause higher turbidity values and affect other water elements also. In addition, foreign materials may be washed into the stream as a result of the construction. As vegetation cover returns to the bare areas, run off from the site is reduced, which will in turn reduce local influence on water quality in the channel.

An examination of data from water quality samples collected in June from channelization projects varying between two and fifty years old showed no correlation between the age of the project and turbidity, dissolved oxygen, carbon dioxide, and pH (Table II). This is not surprising in the case of oxygen, carbon dioxide and pH because these factors fluctuate with water temperature, biological activity, and chemical changes in the water. Also, no correlation was apparent between oxygen and turbidity values taken between the first and second weeks in June (which represent times before and after flooding conditions) or between any water quality element and different kinds of channelization projects or the kind or frequency of maintenance.

These disparities are probably related to the location of the flood flow in the area, such factors as erosion, transport and dilution in upstream areas, and input from feeder streams, but accurate identification of the causative factor or factors is not possible with the limited data available.

There is a good correlation between turbidity values and the river basin or part of the basin in which the projects are located. Also, there is some correlation between turbidity and oxygen values, and between tubidity and size of the ditch in the same basin in some instances (Figures 15 and 16).

These correlations between turbidity and basin location can be explained by the fact that the water and its contents in the lower part of a river or stream comes from areas above it in the same basin, and the water quality at any given point, with some exceptions, reflects water quality conditions upstream rather than at the sampling site. Since the environmental conditions and activities of man vary in each basin, these results can be expected.

c. Esthetics.

The esthetic value of something is a highly subjective matter depending on a person's point of view. A well-tilled field may be beautiful to some people, but others may prefer an undisturbed forest.

Grizzell and Vogan (1973) suggest that landscape management is related to esthetics and to beauty. It seems logical therefore, to consider a man-made structure as being esthetically acceptable if it exhibits evident harmonious relationship of all parts being observed (Grizzell and Vogan, 1973). This implies that a channelization project should be in harmony with the surrounding landscape if it is to be esthetically acceptable.

Some people would probably agree that a new channelization project with the accompanying disruption of the landscape would not be esthetically pleasing. It may become so when regrowth of vegetation covers bare soil and the area becomes more natural.

Channels of intermediate age may be considered as esthetically pleasing if, for example, the growth of trees on the banks of a channel through cultivated fields would help break the monotony of the landscape.

Most people would consider an old channel project at which vegetation appeared as in a natural area as esthetically acceptable.

2. The Effects of Maintenance.

a. Biological Elements.

(1) Vegetation.

Stream maintenance involves the removal of bankside vegetation by herbicides or drag lines and the removal of sediments and debris from the stream channel (Wilkinson, 1973). This may involve removal of aquatic vegetation and trees or masses of roots from the stream banks and the water, also.

If a new channel project is not maintained, plant succession will begin immediately, and progress from a weedy area through various intermediate stages of plant succession to a mature vegetation type in about 60 to 75 years. Vegetation of initial stages of succession will resemble those previously described on the lower Cache near Clarendon. Developmental stages will be similar to vegetation at unmaintained sites of intermediate ages, and the mature, near-terminal community will resemble those found at Tuckerman or Newport on Village Creek. Also, the stream characteristics, water, soil and aerial environmental factors and fish and wildlife populations will tend to develop toward their original conditions as before channelization concurrently with changes in the vegetation.

If the channel area is cleared of debris and snagged but the banks are left intact, the consequent overall drying of the area caused by better drainage could cause trees and other vegetation that usually grows away from the river to become established nearer the channel. If the ditch is small, the heavy shade such as found in areas like Hurricane Slough or Johnson Creek may inhibit the growth of aquatic plants in the water or on the banks.

In areas where the banks are kept clean of brush and trees by frequent mowing, the banks will tend to support grasses such as Johnson grass, fescue or bermuda and various weeds. These plants will retard soil erosion, but lack of shade will cause higher water temperatures and make the stream a poor habitat for fish and many other kinds of aquatic life.

If herbicides are used to control vegetation on the banks or in the water, they can have very deleterious effects on aquatic life in the channels. Also, woody vegetation killed by herbicides may take several years to decay.

It will continue to clog the channels while standing and after it falls into the channel following decay, it will in turn hasten siltation and meandering.

(2) Fish.

Maintenance activities such as dredging and snagging to remove obstructions to flow are as harmful to fish populations as the original channel construction. Therefore, regardless of the date of channel construction, maintenance effectively prevents normal ecological succession and subsequent reestablishment of a balanced fish community.

One maintenance technique that was observed in certain areas of eastern Arkansas, especially in eastern Craighead and western Mississippi Counties, was the use of chemical herbicides to kill vegetation along stream banks. This method appeared to be employed mainly along channelized streams that had not been maintained for several years. Herbicides are highly toxic to fish life and tend to further compound the harmful effects of channelization on fish populations.

Most of the basic effects of channelization on fishes are reversible if maintenance operations are discontinued. Tarplee et al. (1971) found that fish populations, as represented by species diversity in channelized streams in North Carolina, may recover to natural levels in approximately 15 years provided no further alterations of the stream bed, bank, forest canopy, or aquatic vegetation occur. Similar information about Arkansas streams is not available, and the North Carolina streams studied are different from most of the eastern Arkansas drainages. Succession would probably require a longer amount of time in Arkansas to completely reestablish a natural fish community; however, management programs could be initiated to accelerate the process. The reestablishment of rare or threatened species in previously channelized streams would probably not occur naturally because of the isolation of their few remaining populations.

Several maintenance practices have been suggested by Grizzell and Vogan (1973) to improve fish habitats in channelized streams. One of these is to plug each end of channel loops with a water control structure and allowing overflow water to maintain desirable water levels. Such loops can provide a pondlike habitat suitable for fish. Also, sediment and pollutants carried by the flowing stream may bypass the loop. Another is to clear a channel from one side only leaving the other side essentially undisturbed, and to plant vegetation on the disturbed side as soon as possible.

Weirs have been used successfully in many areas to establish permanent pools for fish and to control excess aquatic weeds. The depth and water quality determine the value of such pools for fish.

Other structures recommended are bank deflectors made of rocks or logs to form pools and help create riffles, which are primary food producing areas in streams.

(3) Wildlife.

The effects of channel maintenance on wildlife will depend on the extend that the habitat is altered.

If maintenance permits the growth of grasses and weeds only along the channels, few if any of the original wildlife population would be expected to occur there. If partial recovery is permitted, then the area may be occupied by those species characteristic of the new habitat.

If no maintenance is done on a new channel area, wildlife will return as suitable plant communities and other habitat conditions develop. For example, quail populations would probably increase as weedy vegetation became dominant on spoil areas, and cottontail rabbits would become more numerous as brushy areas developed after a few more years. As trees became dominant, quail and rabbit populations would decline and populations of forest species such as deer and squirrels would increase. Many other examples could be cited, also. According to Grizzell and Vogan (1973), vegetation spoil areas are one of the best wildlife habitats in eastern Arkansas and in other intensively farmed flatland areas. Rabbits, squirrels, foxes, raccoons, quail, doves, hawks, owls and songbirds are often seen on spoil areas. These areas may be the only place where terrestrial wildlife can escape floodwaters during periods of excessive rains.

b. Water Quality.

The effects of maintenance activities on water quality will depend on the extent and nature of the maintenance. Unless extensive maintenance is accomplished such as channel dredging or removal of vegetation from the banks for a comparatively long distance along a channel, the effects (probably an increase in turbidity is the most important) will be local, as vegetation covers bare areas, the effects of the maintenance activities will diminish.

c. Esthetics.

Proper use of existing vegetation in maintenance of a channel area can greatly improve its appearance. Groups of trees left at selected places along a construction site can add variety to a project surrounded by a flat, cultivated area.

In some instances, particularly near urban areas, a vegetation planting plan can be a valuable maintenance procedure for making an area more esthetically acceptable. Trees, shrubs and ground covers should be used in addition to grasses and legumes. The species selected should be native to the area, require little maintenance, and provide food or cover for wildlife (Grizzell and Vogan, 1973). Plants not native to the area should be able to survive competition with native plants.

3. Summary.

a. The Effects of Channelization.

(1) Vegetation.

General correlations occur between the kind of plant communities present at channel projects of different ages. Results of this investigation show that during the pioneer stage of plant succession which lasts from one to three years, principal species on spoil banks in wetter areas near the water included black willow (*Salix nigra*), sandbar willow (*Salix interior*), and cottonwood (*Populus deltoides*). These plants grow larger the second year, and seedlings of tupelo (*Nyssa sylvatica*), cypress (*Taxodium distichum*) and other woody species became established. Drier areas on top of the spoil supported a population of weeds and grass during both the first and second years, with horseweed (*Erigeron canadensis*), bermuda grass

(Cynodon dactylon), crabgrass (Digitaria sp.) and Queen Anne's lace (Daucus carota) occurring as the most common species.

The Second Stage, which lasts three to five years is characterized by an increase in size of the woody vegetation of the lower banks and establishment of woody species such as black river birch (Betula nigra), hackberry (Celtis laevigata), American elm (Ulmus americana), buttonbush (Cephalanthus occidentalis), and trumpet vine (Campsis radicans).

One of the most significant changes during the Third Stage, which lasts from six to ten years is that black willow became dominant along the banks and twenty feet or more in height in ten years. Cypress and tupelo increased in size near the water and other woody species such as black river birch (Betula nigra) silver leaf maple (Acer saccharinum), hackberry (Celtis laevigata), sweetgum (Liquidambar stryaciflua), water oak (Quercus nigra) and willow oak (Quercus phellos) became established on drier parts of the bank. Also, shade tolerant vines such as Virginia creeper (Parthenocissus quinquefolia), wild grape (Vitis sp.) and various shade tolerant herbaceous species invaded the forest floors. Pioneer species intolerant of shade such as horseweed and tea weed tended to disappear.

The Fourth Stage, which occurs between ten and fifteen years was characterized by an increase in size but a decrease in numbers of cottonwood and black willow trees and the increasing prominence of cypress and tupelo in and near the water. Cane (Arundinaria gigantea), southern wild rice (Zizaniopsis miliacea), river locust (Amorpha fruticosa) and buttonbush became more prominent near the edge of the water. Bottomland hardwood type forest species as described in Stage Three became larger on the drier areas of the banks.

Common species present during the Fifth Stage which occurs between fifteen and twenty five years are about the same as the previous stage.

During the Sixth Stage between twenty-six and fifty years, cottonwood and willow declined further, cypress and tupelo increased in size and number and American elm, water oak, willow oak, and ash increased but silver leaf maple and black river birch decreased.

Vegetation of unchannelized streams over fifty years old represents the oldest and most stable plant communities investigated. Aquatic and semi-aquatic herbaceous species such as spatter dock (Numphar advena), lizard tail (Saururus cernuus) and smartweed (Polygonum sp.) were at the bases of cypress and tupelo trees in the edge of the water. The upper part of the bank was dominated by a bottomland hardwood type forest with large trees and sparce ground cover.

(2) Fish.

The physical aspects of stream channelization have combined to produce several effects on fishes.

One of these is reduced abundance and size of fishes because of habitat destruction and reduction in food supply. Also, shifts in relative species abundance occurs. Rough fish such as carp tend to increase in numbers in larger channelized streams and forage fish increase in the smaller streams.

Fewer species occur in channelized streams as compared to natural streams, and various species of darters are almost entirely eliminated in streams that have been channelized. Also, populations of various game fishes are reduced by channelization. No species has been known to have been completely eliminated from the state by channelization, but there is a danger of this happening to the cypress minnow (*Hybognathus hayi*), the ironclad shiner (*Notropis maculatur*), the swamp darter (*Etheostoma fusiforme*) and probably several other species if channelization is carried out in places where these threatened species occur.

(3) Wildlife.

Most wildlife populations are affected most during construction at new projects and progressively less as plant succession and habitat conditions revert toward original conditions.

Most amphibians and reptiles are eliminated with increased drainage of their habitats, but some species such as some frogs, salamanders, water snakes and turtles may benefit in channel cut-offs if water quality improves.

Birds that inhabit bottomland hardwood areas are severely affected by channelization and removal of trees, but such species as quail and dove may benefit since they thrive best in areas of early plant succession such as on spoil banks a few years old or in edges of woods. Flyway populations of waterfowl species are not likely to be significantly affected.

Mammal populations, particularly many fur bearer species such as muskrat, beaver and mink will be adversely affected by channelization of streams, and squirrels and other forest dwellers will be eliminated if forests are removed. However, such species as cottontail rabbits and deer may benefit a few years after channelization by increased amounts of brush on older spoil banks. Trees and brushy areas on spoil banks of channelized streams may be the only suitable wildlife habitats available in some intensively cultivated areas.

b. Water Quality.

Water quality at or below channel improvement projects may change radically from original conditions during and immediately following the completion of the project, but changes will be less as vegetation returns to bare areas.

Results of this investigation showed no correlation between water quality elements and channelization projects varying in age from two to over fifty years old. However, a good correlation was present between turbidity values and the river basin or part of the basin in which the projects were located. Some correlations were present between turbidity and oxygen values, and turbidity and size of the ditch in the same basin in some instances.

c. Esthetics.

The esthetic value of something is a highly subjective matter, but man-made structures are often considered as esthetically acceptable if they exhibit harmonious relationships with the surrounding landscape. Some people would not consider a new channelization project as esthetically pleasing, but an older project at which vegetation appeared as in a natural area would be esthetically acceptable.

b. The Effects of Maintenance.

(1) Biological Elements.

(a) Vegetation.

If a new channel is not maintained, plant succession will begin immediately and progress from a weedy area through intermediate stages to a mature vegetation type in about 60 to 75 years. If the channel is cleared but the banks are left intact, better drainage is likely to cause bottomland forest species to grow near the river. If the ditch is small, heavy shade may inhibit the growth of aquatic plants.

In areas where banks are kept clean of trees or brush by mowing, the banks will support such grasses as Johnson grass, bermuda or fescue, or various weeds.

If herbicides are used to control vegetation, very deleterious effects will likely occur on aquatic life in the channels.

(b) Fish.

Maintenance activities such as dredging and snagging are as harmful to fish as the original construction. Herbicide applications are highly toxic to fish life also, and tend to compound the harmful effects of channelization on fish life.

Most of the basic effects of channelization on fishes are reversible if maintenance operations are discontinued. It takes approximately 15 years after channelization for fish populations to recover to natural levels in North Carolina in the absence of maintenance, but it will probably take longer than this in eastern Arkansas.

Fish habitats can be improved in channelized streams by maintenance practices such as controlling water in channel loops and by the construction of weirs and bank deflectors in the stream.

(c) Wildlife.

The effects of maintenance on wildlife will depend on the extent that the habitat is altered. If no maintenance is done on a new channel area, wildlife will return as soon as a suitable habitat develops. If maintenance permits the growth of grasses and weeds only, few if any of the original wildlife population would be expected to occur there.

(2) Water Quality.

The effects of maintenance will depend on the extent and nature of the maintenance for the first few years. At first the effects will be local, but as vegetation covers bare areas, the local effects will dimenish.

(3) Esthetics.

Proper use of existing native plants or vegetation planting can add greatly to the appearance of a channel project. If possible, species selected for planting should be native to the area, require little maintenance, and provide food or cover for wildlife.

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Fig 1. View of lower Cache River north of Clarendon.

Fig 2. Weeds and eroding soil on spoil bank on west side of Cache River near Clarendon.

Fig 3. Cache River as seen upstream from Highway 18 bridge at Grubbs.

Fig 4. View of Village Creek near Tuckerman.

Fig 5. Bayou DeView near Weiner.

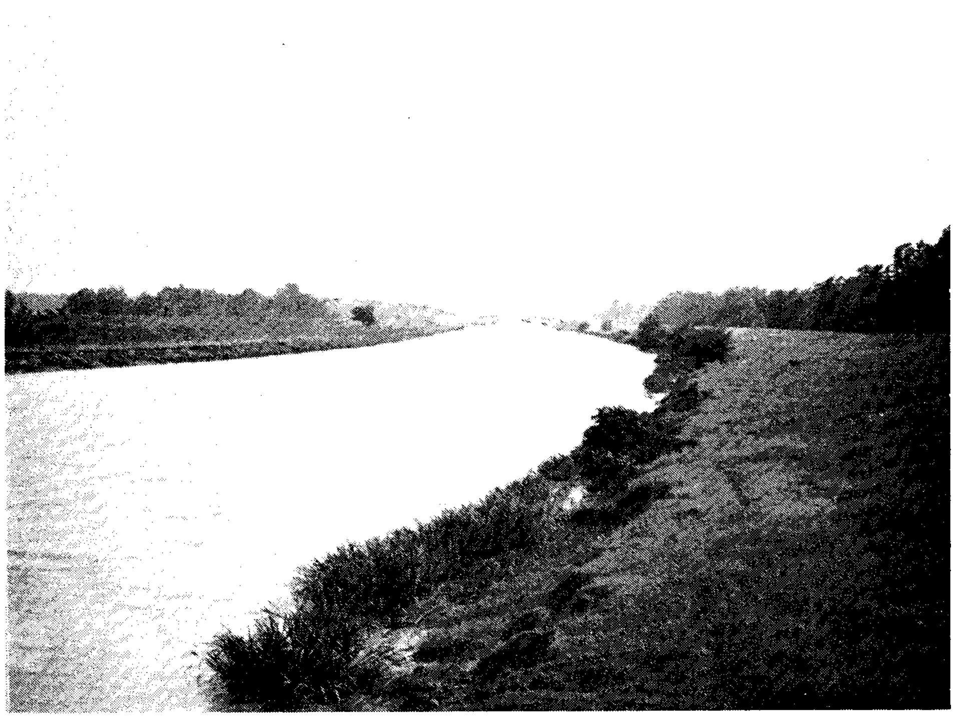


Fig 6. View of Big Ditch Slough near Marmaduke.

Fig 7. Channel of Hurricane Slough near Highway 37 east of Tuckerman.

Fig 8. East Floodway Ditch at Highway 77 near Floodway.

Fig 9. Float Road Slough as seen from bridge on Highway 25 east of Walnut Ridge.

Fig 10. Johnson Creek near Highway 1 north of Paragould.

Fig 11. View of Locust Creek near Halliday.

Fig 12. Little Slough west of Monette.

Fig 13. Plum Bayou west of Altheimer as seen from Highway 79 bridge.

Fig 14. View of Plum Bayou from Highway 15 south of Sherrill.

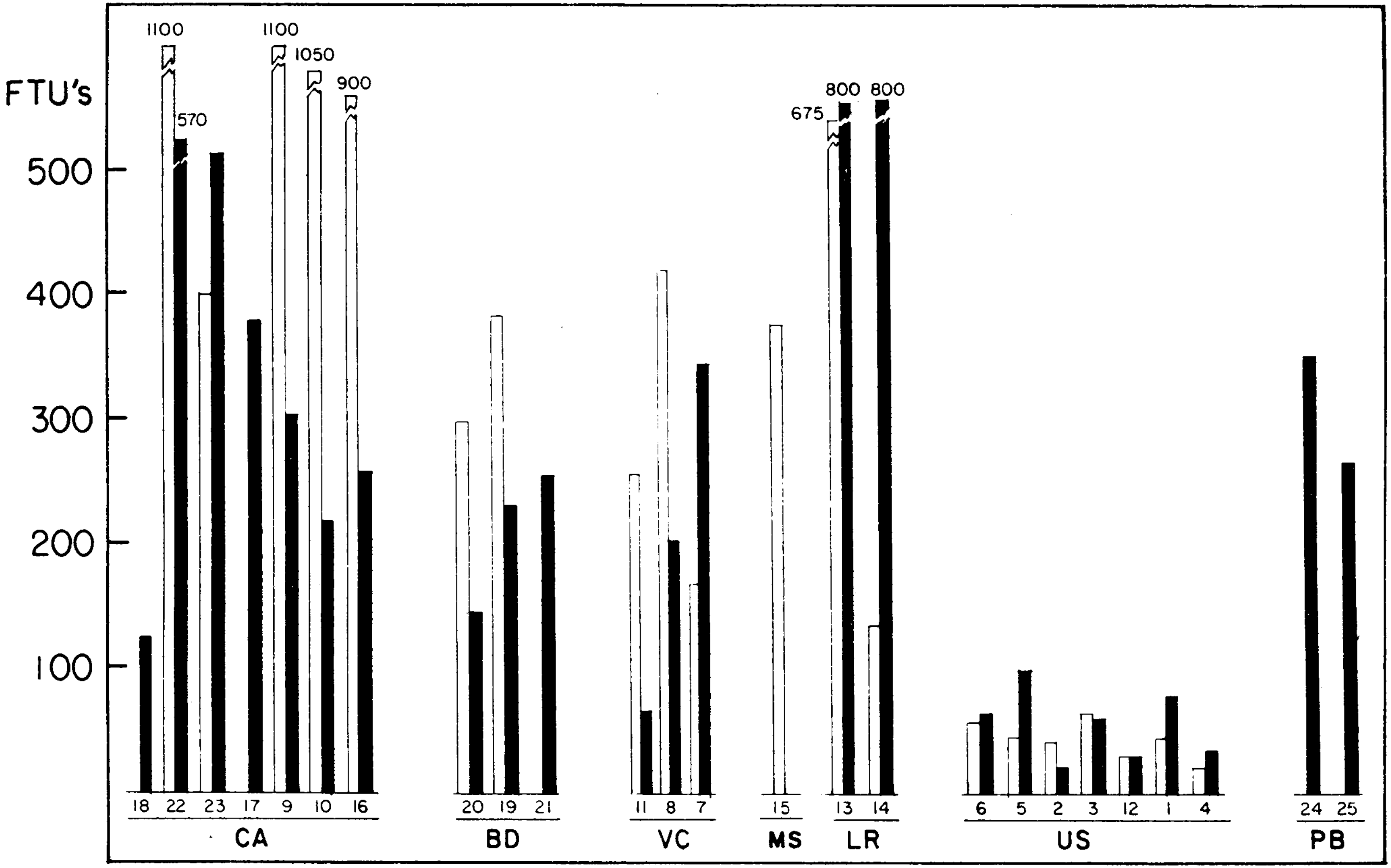


Figure 15. Turbidity in Formazin Turbidity Units (FTU's) of water samples collected at different sites. Turbidity of samples collected during the first week in June, 1974, are indicated by the white bar on the left, and those for the second week by the black bar on the right. A blank space indicates that data were not collected. Sites on the same river or in the same river basin are listed together in approximate order of increasing age from left to right. The names of the site numbers are indicated in Table I and their locations are shown on Plates 1, 2, and 3. River basins in which the sites are located are indicated as follows: CA = Cache, BD = Bayou DeView, VC = Village Creek, MS = Middle St. Francis, LR = Little River, US = Upper St. Francis, PB = Plum Bayou.

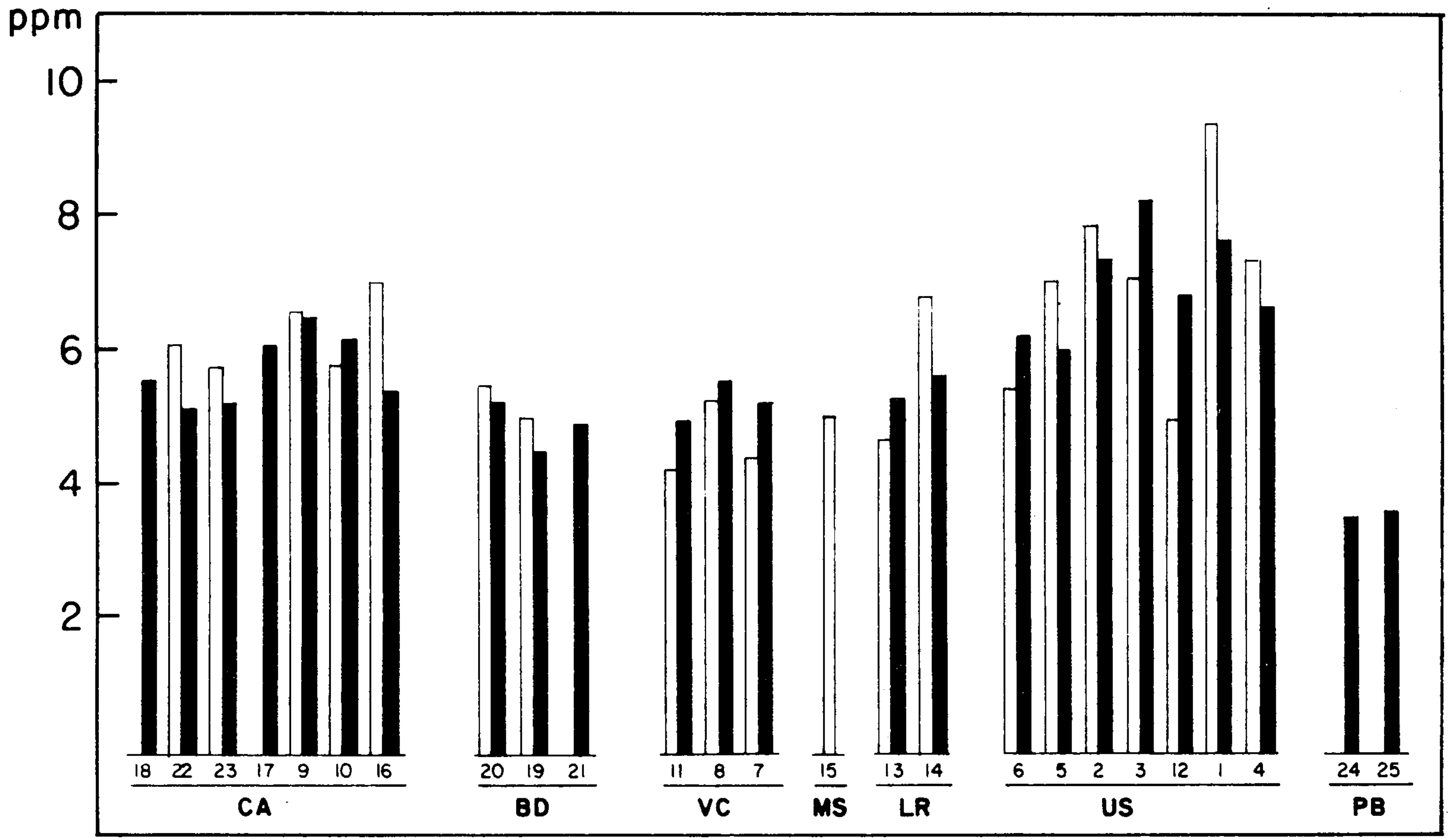


Figure 16. Dissolved oxygen in parts per million (ppm) of water samples collected at different sites. Dissolved oxygen content of samples collected during the first week of June, 1974 are indicated by the white bar at the left and those for the second week by the black bar on the right. A blank space indicates that data were not collected. Sites on the same river or in the same river basin are listed together in approximate order of increasing age from left to right. The names of the site numbers are indicated in Table I and their locations are shown on Plates 1, 2, and 3. River basins in which the sites are located are indicated as follows: CA = Cache, BD Bayou DeView, VC = Village Creek, MS = Middle St. Francis, LR = Little River, US = Upper St. Francis, PB = Plum Bayou.

TABLE I

Names and numbers of channel projects investigated. The numbers on Plates 1, 2, and 3, and on Figures 15 and 16 refer to the channel projects listed below.

1. Eight Mile Ditch
2. Johnson Creek
3. Locust Creek
4. Hurricane Slough
5. Big Ditch Slough
6. Mayo Ditch
7. Village Creek near Tuckerman
8. Village Creek near Newport
9. Willow Ditch
10. Float Road Slough
11. Little Village Creek Ditch near Walnut Ridge
12. Little Slough
13. East Floodway Ditch
14. Right-Hand Chute of Little River
15. Tulot Ditch
16. Cache River at Sedwick
17. Cache River east of Augusta
18. Cache River near Clarendon
19. Bayou DeView near Fisher
20. Bayou DeView near Weiner
21. Bayou DeView east of Augusta
22. Cache River near Grubbs
23. Cache River near Amagon
24. Plum Bayou west of Altheimer
25. Plum Bayou near Sherrill

TABLE II

Selected water quality values at different sites. Samples were taken on June 3, 4, or 5 during the first week; on June 11, 12, or 13, 1974 the second week. Turbidity values are in Formazin Turbidity Units and dissolved oxygen and carbon dioxide in parts per million. Sites on the same river or in the same river basins are listed together in approximate order of increasing age. CA = Cache, BD = Bayou DeView, VC = Village Creek, MS = Middle St. Francis, LR = Little River, US = Upper St. Francis, PB = Plum Bayou, Dash (-) = data not collected.

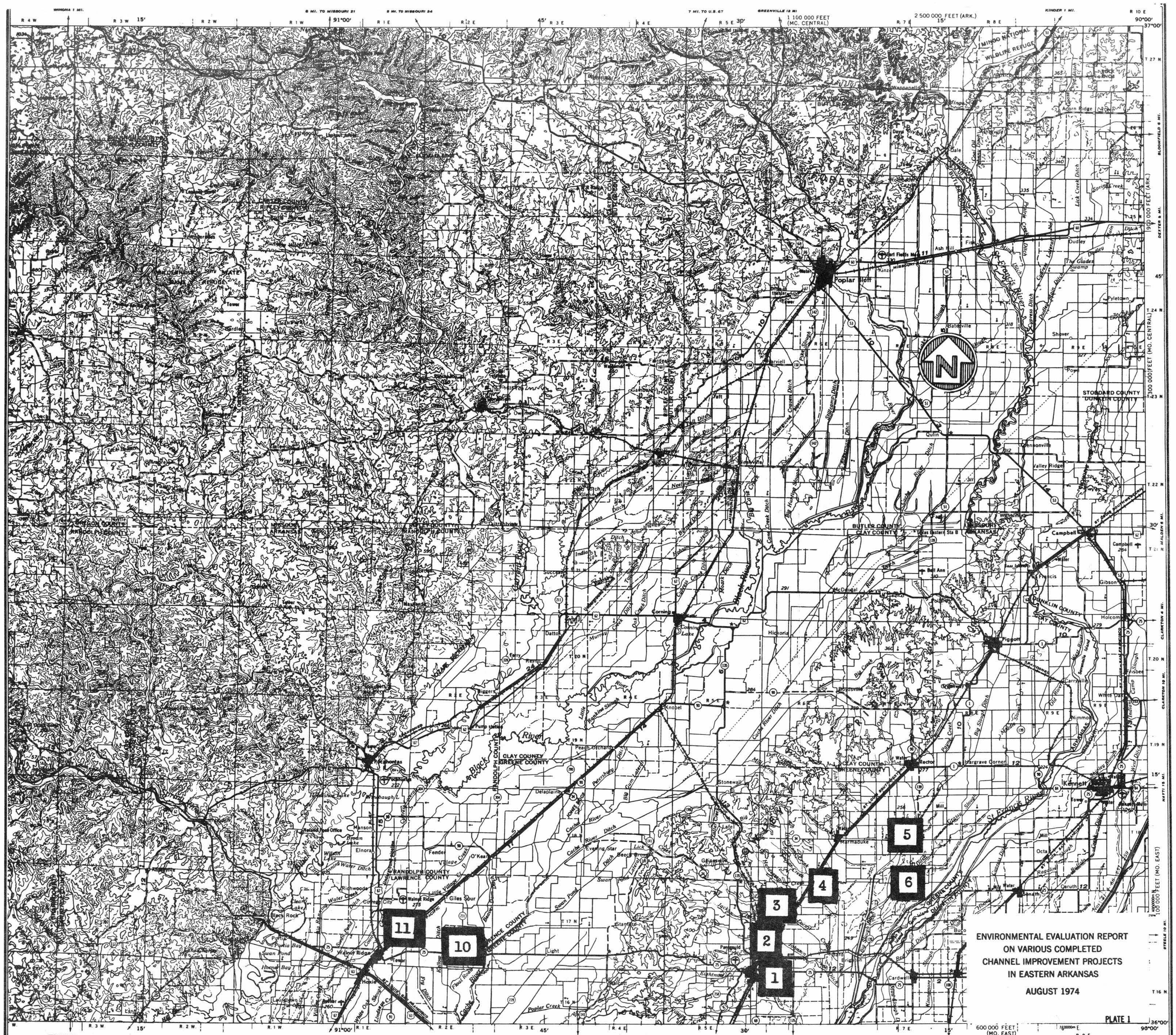
Site	Site No.	Turb. 1st wk	Turb. 2nd wk	O_2 1st wk	O_2 2nd wk	CO_2 2nd wk	pH 2nd wk
CA-Clarendon	18	-	133	-	5.6	7.3	7.0
CA-Grubbs	22	1100	570	6.1	5.1	10.0	6.7
CA-Amagon	23	410	545	5.8	5.2	6.3	6.7
CA-Augusta	17	-	385	-	6.1	5.0	7.0
CA Willow Ditch	9	1100	310	6.6	6.5	6.3	7.2
CA Float Rd. Slough	10	1050	220	5.8	6.2	6.3	7.5
CA-Sedwick	16	900	260	7.0	5.4	7.5	7.0
BD-Weiner	20	305	145	5.5	5.3	8.8	6.7
BD-Fisher	19	390	235	5.0	4.5	8.8	6.7
BD-Augusta	21	-	260	-	4.9	8.8	6.5
VC-Walnut Ridge	11	260	65	4.2	4.9	10.0	6.5
VC-Newport	8	428	205	5.2	5.5	6.3	6.7
VC-Tuckerman	7	170	350	4.4	5.2	7.5	6.7
MS-Tulot Ditch	15	380	-	5.0	-	-	-
LR-E. Floodway	13	675	800	4.7	5.3	6.3	7.5
LR-Little River	14	135	800	6.8	5.6	8.8	7.0
US-Mayo Ditch	6	55	63	5.4	6.2	10.0	7.7
US-Big Ditch	5	45	100	7.0	6.0	7.5	8.0
US-Johnson Creek	2	40	28	7.8	7.3	5.0	7.7
US-Locust Creek	3	63	60	7.0	8.2	3.8	7.5
US-Little Slough	12	30	30	4.9	6.8	11.3	8.0
US-Eight Mile	1	44	80	9.3	7.6	3.8	7.7
US-Hurricane	4	20	35	7.3	6.6	3.4	7.0
PB-Altheimer	24	-	360	-	3.4	8.8	6.7
PB-Sherrill	25	-	275	-	3.5	8.8	6.7

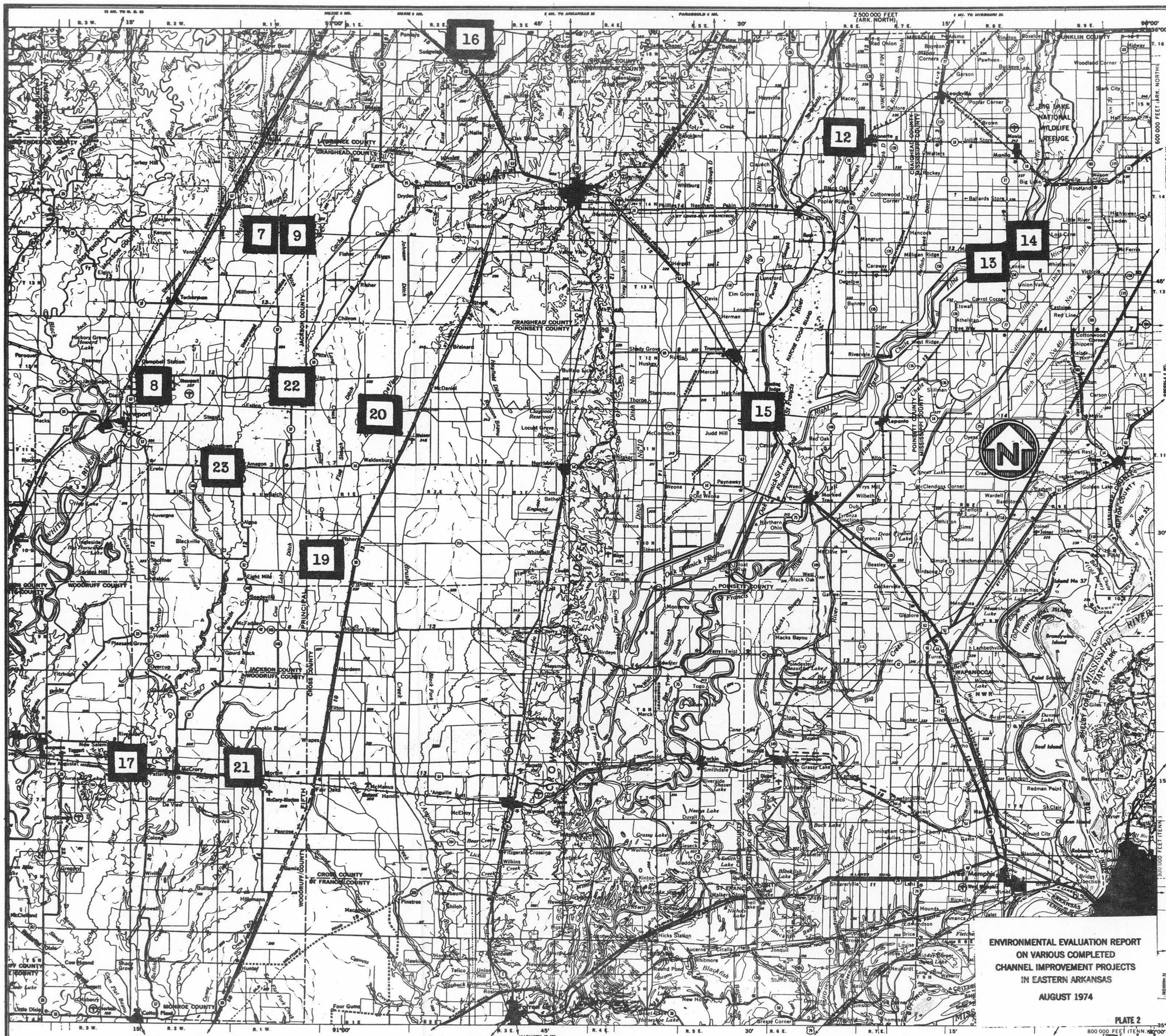
TABLE III

Streams examined, for amount and kinds of fish present, their dates of channelization, and their apparent maintenance.

Stream & Locality	Channelization Date	Maintenance
Float Road Slough, E. of Walnut Ridge	1954	Recent*
Eight Mile Ditch, SE of Paragould	1957	Recent*
Hurricane Slough, NE of Paragould	1953	Recent*
Little Slough, SE of Paragould	1958	Recent*
Locust and Johnson Creeks, E. of Paragould	1960	Recent*
East Floodway Ditch, Little River, N. of Westridge	1955	Recent
Cache River upstream from Hwy 18, E. of Grubbs	1920's	Recent in places
Tulot Ditch NE of Cherry Valley	1961	Recent
Big Slough and Mayo Ditch N & E of Paragould	1961-65	Recent

* - Some sort of channel maintenance within last 4 years.


ENVIRONMENTAL EVALUATION REPORT
ON VARIOUS COMPLETED
CHANNEL IMPROVEMENT PROJECTS
IN EASTERN ARKANSAS
AUGUST 1974
PLATE 1
1
2
3
4
5
6
10
11
Poplar Bluff
Corning
Kennett
Rector
Piggott
BUTLER COUNTY
CLAY COUNTY
RANDOLPH COUNTY
LAWRENCE COUNTY
GREENE COUNTY
DUNKLIN COUNTY
STODDARD COUNTY



ENVIRONMENTAL EVALUATION REPORT
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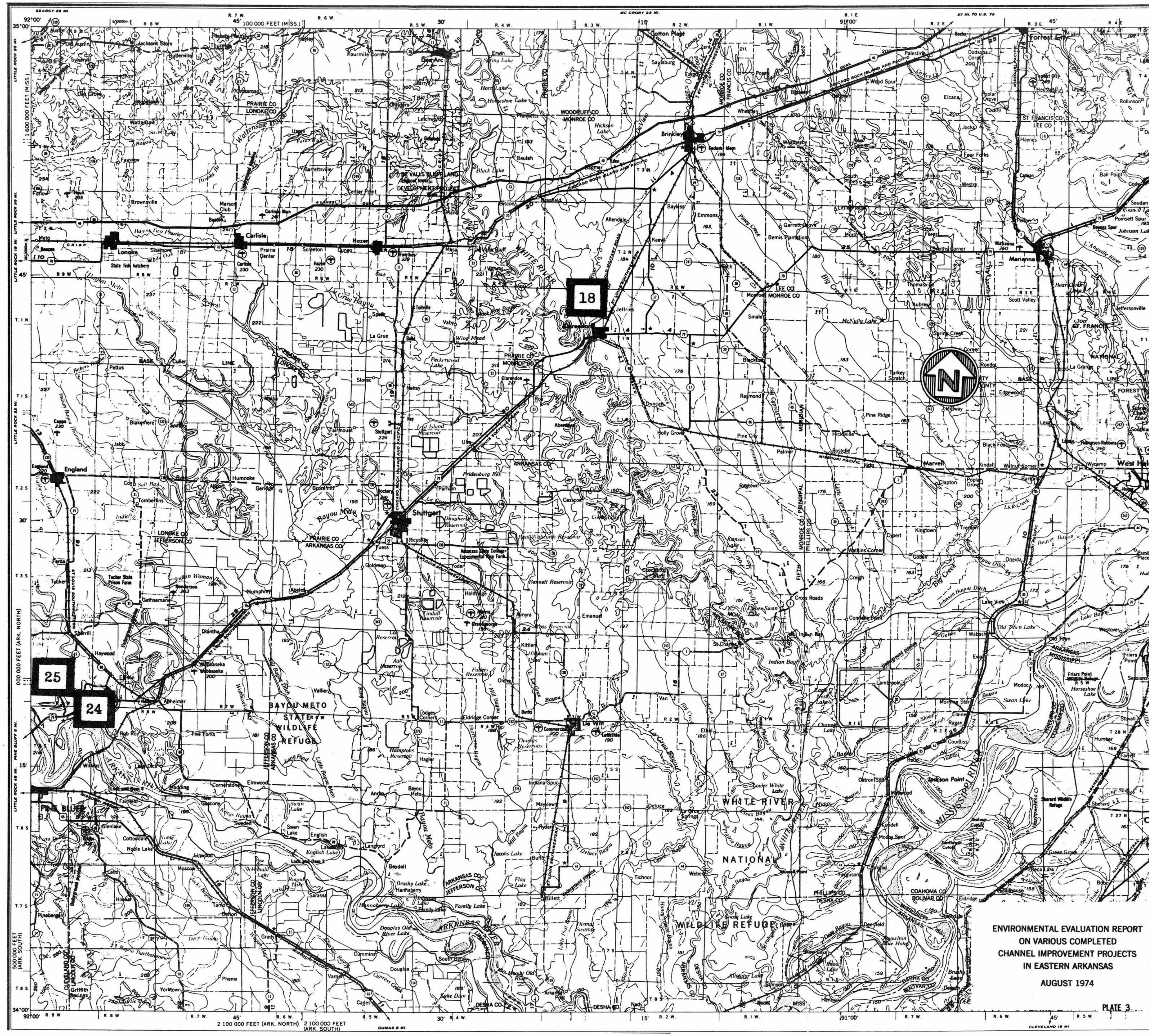
AUGUST 1974

PLATE 2



ENVIRONMENTAL EVALUATION REPORT
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AUGUST 1974

PLATE 3