1962

(6)

REVIEW OF REPORTS

YADKIN-PEE DEE RIVER NORTH CAROLINA AND SOUTH CAROLINA

U. S. ARMY ENGINEER DISTRICT, CHARLESTON
CORPS OF ENGINEERS

CHARLESTON, SOUTH CAROLINA

SERIAL NO. 74

B

SYLLABUS

The District Engineer investigated the water resource development needs of the basin. In accordance with the resolutions authorizing this report a plan of reservoirs for hydroelectric power generation recommended in House Document No. 652, 78th Congress, has been reviewed. None of the projects in that plan or any other possibilities investigated for hydroelectric power generation are justified for Federal participation at this time. Hydroelectric power was once important in meeting growing power needs in the basin but steam electric power has for many years been the principal source of supply.

The District Engineer finds that navigation improvements are not needed or requested at this time. Commerce on the lower Pee Dee River has almost ceased; there are no significant upstream commerce potentials which would justify improvements.

Floods inundate over 900,000 acres along the rivers of the basin, mostly in the Coastal Plain. The damage is not sufficient to warrant large flood-control improvements. The existing W. Kerr Scott Reservoir project and the authorized Reddies River project include flood-control storage for the benefit of the upper Yadkin, as does the Roaring River project recommended in a report to the Appalachian Regional Commission. The Corps of Engineers, under special-continuing-authority programs, is authorized to construct small flood-control projects. Significant work is being accomplished through those programs to solve local flood problems in the basin. The Flood Plain Management program of the Corps of Engineers is of much value in reducing the flood damage potential. The Soil Conservation Service has a small watershed program for flood control and land treatment which reduces flood damage in agricultural areas.

Water supply and water quality control in the upper Yadkin basin are provided for in the reservoir projects mentioned. No other projects for those purposes are found needed at this time.

The District Engineer finds that Federal participation in improvements other than those currently authorized or recommended is not warranted at this time.

The District Engineer recommends that no plan of improvement be authorized at this time.

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DEPARTMENT OF THE ARMY
CHARLESTON DISTRICT, CORPS OF ENGINEERS
P. O. BOX 919
CHARLESTON, S.C. 29402

SANGP-I

SUBJECT: Review of Reports on Yadkin-Pee Dee River, North Carolina and South Carolina

Division Engineer, South Atlantic
Atlanta, Georgia

INTRODUCTION

1. Authority. This report is submitted in response to the following resolution adopted 28 June 1962:

> Resolved by the Committee on Public Works of the United States Senate, that the Board of Engineers for Rivers and Harbors created under Section 3 of the River and Act, approved June 13, 1902, be, and is hereby, requested to review the reports of the Chief of Engineers on the Yadkin-Pee Dee River, North Carolina and South Carolina, published as House Document Numbered 652, Seventy-eighth Congress, Second Session, and other reports, with a view to determining the advisability of modifying the existing project at the present time, with particular reference to the development and maximum utilization of the water resources of the main stem and tributaries downstream from the Wilkesboro Reservoir, North Carolina.

2. Other resolutions outstanding on streams in the Yadkin-Pee Dee River Basin were later combined with the 1962 resolution and are responded to in this report:

a. A resolution on Lynches River adopted 16 March 1954:

> Whereas the Chief of Engineers has completed a preliminary examination pursuant to a resolution adopted by the Committee on Public Works, House

of Representatives, U. S., on July 6, 1949, requesting a review of reports on Lynches River, South Carolina, submitted in House Document Numbered 1225, Sixty-fifth Congress, Second Session, and the reports submitted March 12, 1938, with a view to determining whether it is advisable at this time to clear the channel below Welches Bridge of obstructions to admit of a more rapid-run-off of flood waters; and

Whereas, the Chief of Engineers, after a favorable finding of the Board of Engineers for Rivers and Harbors, has recommended by letter, dated July 3, 1952, directed to the Chairman of the Committee on Public Works, that a survey be made:

Now, Therefore, Be it resolved by the Committee on Public Works, House of Representatives, U.S., that the Board of Engineers for Rivers and Harbors be and is hereby authorized to proceed with the preparation of a survey report thereon.

b. A resolution on Lynches River adopted 26 February 1958:

Resolved by the Committee on Public Works of the United States Senate, that the Board of Engineers for Rivers and Harbors created under Section 3 of the River and Harbor Act, approved June 13, 1902, be, and is hereby, requested to review the reports of the Chief of Engineers on the Yadkin-Pee Dee River and its tributaries, North Carolina and South Carolina, published as House Document Numbered 68, Seventy-third Congress, First Session, and other reports, with a view to determining the advisability of modifying the recommendations contained therein at the present time, with particular reference to providing flood control and major drainage improvements on Lynches River at and in the vicinity of Lynches Swamp and Lake City, South Carolina.

c. A resolution on Willow Creek adopted 6 August 1948:

Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports on Great

Pee Dee River, and tributaries, transmitted to Congress December 28, 1936, and other reports, with a view to determining what measures are necessary and justified at this time to provide for flood control, drainage and allied purposes in the Great Pee Dee River Basin with particular reference to improvements of Willow Creek, South Carolina.

3. Purpose. This report of general but abbreviated scope presents findings of investigations of the need for improvements for flood control, navigation, hydroelectric power, general recreation, fish and wildlife conservation, water supply, and water quality control, in the Yadkin-Pee Dee River Basin.

4. Extent of investigation. Information used in this study includes data developed for House Document No. 68, 73rd Congress, 1st Session, 9 June 1933, and House Document No. 652, 78th Congress, 5 June 1944; and subsequent review of those documents; studies of the Yadkin River made for the General Design Memorandum on the Wilkesboro (now W. Kerr Scott) Reservoir; a recent Economic Restudy of Reddies River Project, N. C., July 1969; studies for the Roaring River Project made for a report on "Development of Water Resources in Appalachia" prepared for the Appalachian Regional Commission; meteorological and hydrological data; and topographic maps published by the U. S. Geological Survey and the Corps of Engineers. Hydrologic studies include unit hydrograph analysis, flood routings, flood hydrographs, and peak stage-frequency studies. Hydraulic studies include backwater computations to establish water surface profiles under existing and improved conditions. Field investigations, published data, and office studies provided information to evaluate average annual flood damages and estimates of costs.

5. Coordination in planning. Many Federal and State agencies were consulted and supplied information during the studies. The Federal Power Commission and the Southeastern Power Administration, Department of the Interior, were consulted on potential hydroelectric power development. The Federal Water Pollution Control Administration (FWPCA), Department of the Interior, now Water Programs Branch of the Environmental Protection Agency furnished data on water supply and water quality needs. The Bureau of Sport Fisheries and Wildlife, Fish and Wildlife Service, Department of the Interior, in Cooperation with the North Carolina Wildlife Resources Commission and the South Carolina Wildlife Resources Department, furnished evaluations of the effects of proposed projects on fish and wildlife. The Bureau of Outdoor Recreation, Department of the Interior, furnished data and studies of outdoor recreation. The Department of Agriculture furnished data on agriculture, including crop acreage and yields. The South Carolina Water Resources commission and the North Crolina Office of Water and Air Resources were the coordinating agencies of their respective states in the conduct of the study. General assurances of cooperation of North Crolina, where appropriate, were furnished by the latter agency.

6. Prior reports.

a. Several minor reports not listed here were submitted many years ago

were the basis for for five obsolete navigation projects, later described, on the Lynches, Lumber, Little Pee Dee, Pee Dee, and Yadkin Rivers.

b. A compreshensive report on the basin, "Yadkin-Pee Dee River, N. C. and S. C.," made under the provisions of House Document No. 308, 69th Congress (referred to as the "308 Report") was published as House Document 68, 73rd Congress, 1st Session (1933). It investigated flood control, navigation, hydroelectric power, and other water resources needs of the basin. The report was unfavorable to Federal participation in any improvement at that time.

c. The report under review, "Yadkin-Pee Dee River and its tributaries, North Carolina and South Carolina, "House Document 652, 78th Congress, 2nd Session, 5 June 1944, recommended improvement of the Yadkin-Pee Dee Rivers and tributaries for power development, flood control, navigation, and other purposes by a general plan for construction of reservoir projects, discussed later. The Wilkesboro reservoir project of the general plan was recommended for initial construction.

d. Congress rejected the recommendations of the Chief of Engineers as contained in House Document No. 652 mainly because of opposition to extensive land inundation required for the Wilkesboro Reservoir. A review study was authorized to determine the practicability of a plan for flood control only in the Upper Yadkin River in lieu of the Wilkesboro power and flood control project. The review report was submitted by the Chief of Engineers on 19 June 1946. The report was later transmitted for publication by the Secretary of Army on 9 March 1949. The report, titled "Yadkin-Pee Dee River and Tributaries, North Carolina and South Carolina" was printed as Senate Document No. 31, 81st Congress, 1st Session, and was the authorizing document for four small detention reservoirs for flood control in the upper Yadkin basin at the Wilkesboro, Upper Wilkesboro, Reddies Numbered 1, and Reddies Numbered 3 sites. This plan was authorized by Section 10 of the Flood Control Act of 1946 (Public Law 526, 79th Congress, 2nd Session). A definite project report on Reddies River Dam and Reservoir, 15 March 1950, recommended that only one earthfill dam for the Reddies River be constructed at Reddies No. 1 site; this modification was approved by the Chief of Engineers on 28 August 1950.

e. A review report of preliminary examination scope, 14 August 1953, recommended a single earth dam for the Yadkin River at the Wilkesboro site, instead at the two authorized. The Chief of Engineers in a letter, dated 4 April 1955, to the Secretary of the Army approved this modification and the project was subsequently built and is now known as the W. Kerr Scott Dam and Reservoir, later described.

f. A report on "Development of Water Resources in Appalachia," prepared for the Appalachian Regional Commission for submission to

Congress contains studies of the upper basin which is in the area designated as Appalachia by the legislation which created the commission. This report recommends construction of the Roaring River project as described later.

DESCRIPTION OF BASIN

7. General. The Yadkin-Pee Dee River basin, the largest basin draining to the South Atlantic coast, extends northwest from the coast at Georgetown, South Carolina, across the North Carolina state line into western North Carolina; a small portion extends into Virginia. The greatest length and width of the basin are about 250 and 105 miles, respectively. The basin drainage area is about 16,340 square miles of which about 42 percent or 6,880 square miles are in South Carolina; about 57 percent or 9,280 square miles are in North Carolina; and about one percent or 180 square miles are in Virginia.

8 The basin lies in three distinct physiographic provinces: The Blue Ridge Mountains, the Piedmont Plateau and the Coastal Plain. The mountain portion is a region of high rainfall, steeply sloping streams and little economic development. The streams in the Piedmont Plateau have steep slopes and narrow flood plains. They are developed to a degree for hydroelectric power generation. Most of the basin population and economic activity is in the Piedmont section. The Coastal Plain, separated from the Piedmont Plateau by the "fall line", has streams with flat slopes and wide flood plains. The Coastal Plain rivers are extensively navigable, most at shallow depth. Pertinent river data are shown in Table 1 and a map of the basin is shown on Plate 1. Profiles of the Yadkin-Pee Dee River and their principal tributaries are shown on Plate 2.

9. The Yadkin-Pee Dee River is a single stream about 436 miles long, called the Yadkin River in its upper 203 miles above its junction with the Uwharrie River near Badin, N. C., and the Pee Dee, or Great Pee Dee River, in its lower 233 miles. The Yadkin River portion rises where it is in excess of 3,700 feet above mean sea level, on the eastern slope of the Blue Ridge Mountains in North Carolina. In its upper 15 miles the river descends to the Corps of Engineers W. Kerr Scott Reservoir which has a normal conservation pool of 1,030 feet. The 1,475 acre pool extends downstream to W. Kerr Scott Dam at mile 404, about 6 miles above Wilkesboro and North Wilkesboro, N. C. On emerging from W. Kerr Scott Dam at elevation 953 the Yadkin River flows eastward about 70 miles, dropping to about elevation 700. The Reddies, Roaring, Fisher, Mitchell, and Ararat Rivers are tributaries in that reach flowing into the Yadkin from the mountains to the north. The towns of Elkin and Jonesville, N. C. in the vicinity of mile 372 are on the river in this reach.

10. Several miles below the Ararat River, Yadkin River turns south and flows about 100 miles to its junction with the Uwharrie River where its name changes to the Pee Dee River. South Yadkin River, the largest tributary of

TABLE 1

YADKIN-PEE DEE RIVER AND TRIBUTARIES
PERTINENT DATA

Stream and Station	River Miles Above Mouth: Main Stem	River Miles Above Mouth: Tributaries	Drainage Area In Square Miles: Main Stem	Drainage Area In Square Miles: Tributary Only	Elevation of Low Water (feet msl)
YADKIN RIVER, N.C.					
W. Kerr Scott Dam	404		348		953
Reddies River	398	0		97	945
Reddies River Damsite		2		96	987
USGS gage at Wilkesboro	398		493		944
Roaring River	388	0		140	915
Roaring River Damsite		3		129	963
USGS gage at Elkin	372		854		867
Mitchell River	367	0		112	850
Mitchell River Damsite		9		77	930
Fisher River	359	0		195	866
Fisher River Damsite		6		135	884
Ararat River	347			309	770
Upper Donnaha Damsite	337		1,540		750
USGS gage at Enon	330		1,680		703
Styers Ferry Damsite	316		1,870		680
Idols Reservoir	309		1,876		662
USGS gage at Yadkin College	295		2,280		640
South Yadkin River	275	0	3,370	908	624
Cooleemee Damsite		11		534	640
USGS gage at Mocksville		17		313	665
High Rock Dam	253		3,930		557
Tuckertown Dam	244		4,080		510
Narrows Dam	236		4,180		324
Falls Dam	234		4,190		275
Uwharrie River	233			378	275
PEE DEE RIVER, N.C. [1]					
Lake Tillery, Norwood Dam	224		4,688		205
Rocky River	219	0	6,125	1,413	184
USGS gage at Norwood		6		1,372	213
Blewett Falls Dam	195		6,847		125
PEE DEE RIVER, S.C. [2]					
USWB gate at Cheraw	161		7,320		60
USGS gage at Pee Dee	100		8,830		25
Lynches River	62	0		1,450	10
USGS gage at Effingham		44		1,030	59
USGS gage at Bishopville		90		675	157
Little Pee Dee River	33	0		3,110	6
USGS gage at Galivants Ferry		42		2,790	26
USGS gage at Dillon		88		524	78
Lumber River		0 [3]		1,760	35
U. S. Highway 74 at Lumberton, N.C.		70 [4]		720	102
Black River	3	0		2,030	0
USGS gage at Kingstree		87		1,260	26
U.S. Highway 378 at Gable		123		401	95
Pee Dee River at mouth, Winyah Bay	0		16,340		-1.6

1/ Yadkin River changes name to Pee Dee River below mouth of Uwharrie River.
2/ All locations S.C. unless noted N.C.
3/ Mile 58 of Little Pee Dee River.
4/ Miles above mouth of Lumber River.

the Yadkin, enters from the west bank at mile 275. It originates at an elevation of approximately 1,750 feet above mean sea level in the Brushy Mountains of Wilkes County, N. C., descends to elevation 830 within 14 miles, then flows easterly 20 miles and southeasterly 21 miles with an average fall of 6.5 feet per mile to its confluence with the Yadkin River. One small retired water-power installation is located at Cooleemee, N. C., mile 11 of the South Yadkin River.

11. The Pee Dee River crosses the fall line near the North Carolina-South Carolina border, about seven miles north of Cheraw, S. C. The river takes an easy winding course below the fall line and enters the Atlantic Ocean through Winyah Bay near Georgetown, S. C. Between Bull Creek and Winyah Bay, there are three deep creeks connecting the Pee Dee River to the neighboring Waccamaw River which act as multiple outlets of the Pee Dee River and carry a major share of its discharge. The Waccamaw River, although connected to the Pee Dee River by Bull Creek, also empties into Winyah Bay but is not a tributary of the Pee Dee River. The Pee Dee River is navigable to the fall line at varying depths as described later.

12. The Yadkin and the Pee Dee Rivers from below the Ararat River to the fall line, drop over 600 feet in some 150 miles. Most of this fall is developed for hydroelectric power by five dams on the Yadkin River and two on the Pee Dee River, to be discussed later. The Pee Dee River prior to the construction of the Falls and Narrows hydroelectric projects, had a fall of nearly 100 feet in one four-mile reach known as the Narrows.

13. Major tributaries. Major tributaries of the Pee Dee are as follows:

a. Rocky River rises in Iredell County, N. C., at about elevation 800 feet mean sea level. It flows southeasterly through hilly country for 24 miles with an average fall of 11.1 feet per mile, then easterly for 22 miles with a fall of 4.1 feet per mile. It then continues easterly for 28 miles through a deep narrow valley over many rapids with a fall of about 8.7 feet per mile, and then flows easterly for nine miles through an alluvial valley with a fall of 1.8 feet per mile to its confluence with the Pee Dee River at mile 219. The total drainage area of the Rocky River is 1,430 square miles.

b. Lynches River with a drainage area of 1,450 square miles, rises in Union County, near the North Carolina-South Carolina boundary at about elevation 300 feet mean sea level and flows southeasterly for 166 miles through rolling country, with slopes averaging between 0.95 feet and 2.40 feet per mile to its mouth at Pee Dee River, through Clark Creek at mile 56.4. Lynches River, for the greater part of its length, winds through a wooden swamp choked with debris. Stream depths range from one foot to seven feet, and widths between 30 and 100 feet.

d. Lumber River, drainage area 1,760 square miles, rises in Moore County, N. C., at an elevation of approximately 250 feet above mean sea level. It flows in a southeasterly direction 90 miles with an average slope of 1.5 feet per mile to the vicinity of Lumberton, N. C., then continues southerly 70 miles with an average slope of 0.9 foot per mile to its mouth at Little Pee Dee River, mile 58.03. This stream is choked with debris.

e. Black River, drainage area 2,030 square miles, originates near Bishopville, S. C., at an elevation of approximately 175 feet above mean sea level and flows southeasterly 175 miles with an average slope of approximately one foot per mile to its junction with the Pee Dee River, 20.4 miles above its mouth at Winyah Bay.

14. Willow Creek, subject of the congressional resolution of 6 August 1948, is a small creek near Florence, S. C., drains 52 square miles of flat to rolling crop and forest land into Jeffries Creek, a tributary of the Pee Dee River.

15. Major cities. None of the major cities of the basin are situated on the main streams. High Point, the second largest city of the basin area, is on the divide between the Yadkin and Cape Fear River Plains, being predominately in the Cape Fear River Basin. A tabulation of the major cities in the basin with their populations is given in paragraph 18.

16. Topography The Yadkin-Pee Dee River Basin lies in three well-defined physiographic provinces: the Coastal Plain which contains about 50 percent of the basin drainage area or 8,110 square miles; the Piedmont Plateau comprises about 46 percent of the basin drainage area or 7,500 square miles; the Blue Ridge Mountains contain about 4 percent of the basin drainage area or 730 square miles. The Coastal Plain extends inland slightly over 100 miles to the fall line which separates the Coastal Plain from the Piedmont Plateau. The topography varies from flat marshy coastland to rolling terrain with red hills and sand hills up to elevations of about 500 feet mean sea level. The fall line passes through the basin in the vicinity of McBee and Chesterfield, S. C., and Rockingham and Southern Pines, N. C. The Piedmont Plateau extends from the fall line to the Blue Ridge Mountains, with elevations ranging from about 700 feet in the eastern portion to 1,200 feet in the western portion. The Blue Ridge Mountain Region, as its name implies, consists of rugged foothills and mountainous reaches. Elevations along the upper watershed boundary vary generally between 3,000 and 4,000 feet.

17. Geology. The characteristic rock formations apparent in the upper portions of the Yadkin River basin, including South Yadkin River and extending downstream to the vicinity of Badin, N. C. are of igneous origin consisting of granite, granite gneiss, schist, and quartzite that have been subjected to igneous intrusions of traprock or diabase. In general, the overlying material

is composed of a deep blanket of silt and clay resulting from the oxidation in place of the granite rocks. The diabase intrusions are evident as narrow dikes or hard durable rocks that have resisted erosion and oxidation. From the vicinity of Badin to the fall line, including the Rocky River Basin, the rock formations are metamorphics of sedimentary and volcanic derivations with igneous intrusions of diabase rock. The overburden is predominantly a silty clay soil. The area between the fall line and the coast is of comparatively recent geologic age and is composed of sedimentary deposits of silt, sand, clay, and shell, probably underlain at great depths by limestone and sandstone. In general, the rock formations above the fall line are satisfactory for foundations of dams and other structures if provision is made for the removal of the overlying oxidized and weathered portion. The native subsoils are generally satisfactory material for the construction of earth dams.

18. Economic development. The dependence of the economy of the Yadkin-Pee Dee Basin on agriculture is declining. Manufacturing and nonagricultural, non-manufacturing activity are growing rapidly. Population is shifting from rural areas to urban centers as a result. The urban population in 1970 was about 43 percent of the basin population of about 1,600,000. This trend is expected to continue over the next 50 years when about 66 percent of the total basin population would live in urban areas. Of the projected 34 percent future rural population, only two percent are expected to live on farms and about one percent would be employed in agriculture. The 1970 population is concentrated in the upper portion of the Coastal Plain and the Piedmont Plateau portions of the basin. None of the large cities are located on the main rivers. The population of the largest cities in 1970 and 1960 are tabulated below:

	1970	1960
Winston-Salem, N. C.	132,913	111,135
High Point, N. C. (1)	63,259	62,063
Florence, S. C.	25,997	24,722
Salisbury, N. C.	22,515	21,297
Statesville, N. C.	19,996	19,844

(1) High Point, on the basin divide, is mostly in the Cape Fear River Basin.

19. The employment mix in the basin has undergone considerable change since 1940 when employment was about equally divided among agriculture, manufacturing, and the nonagriculture, non-manufacturing sectors. By 1960 agriculture accounted for only about 14 percent of total employment. In the same period, manufacturing employment increased steadily from about 31 percent to 36 percent of total employment, representing a net addition of over 87,000 jobs. Manufacturing employment is

expected to continue to grow, but its relative share of total employment is projected to decline to about 31 percent by 2020.

20. Total personal income of the basin has more than tripled since 1940, but the per capita income of the area is still only about 80 percent of the national level. The per capita income gap between the basin and the nation is expected to close due to the continued shift to urbanization and the consequent higher paying jobs.

HYDROLOGY

21. Climate. The Yadkin-Pee Dee River Basin has a temperate climate, with warm summers and usually mild winters. Severe cold weather seldom occurs except in the extreme upper watershed and sub-freezing temperatures are usually of short duration. The mean annual temperature is approximately 61 degrees Fahrenheit.

22. Precipitation. Precipitation occurs chiefly as rainfall. The amount varies with the season and distance from the mountains and the coast. Precipitation is normally well distributed throughout the year but the greatest quantity of rainfall generally occurs in July, August, and September. The average annual rainfall for the basin is about 47 inches. The maximum and minimum recorded annual precipitation is 76.37 and 22.56 inches, respectively. Snowfall is generally light except in the mountain areas where the average annual amount is about 10 inches.

23. Storms of record. Of the several types of storms that occur in the basin, hurricanes and tropical storms are generally the most severe and cause the heaviest, most widespread precipitation. Late afternoon thunderstorms, usually of short duration but with high intensities, may produce large amounts of highly localized precipitation. The more significant storms of record are discussed below:

a. The storm of 23-26 August 1908, resulting from a series of local disturbances, produced intense rainfall over large portions of Georgia, North Carolina, South Carolina, and Virginia. One rainfall center occurred at Monroe, N. C., where 7.3 inches fell in one day and a total of 15.7 inches was recorded during the four-day storm. Another rainfall center was at Vade Mecum, N. C., where 8.0 inches fell in one day and 18.0 inches was recorded over the four-day storm period. The heaviest rainfall over the Yadkin-Pee Dee Basin occurred in the central portion, especially in the Rocky River Basin where precipitation totaled 11 inches. Rainfall averaged between three and four inches in the upper Yadkin Basin and between one and two inches in the Coastal Plain area near Florence, S. C. Two-day precipitation totals for the stations in the heaviest rainfall area were Cheraw, S. C., 6.54 inches; Rockingham, N. C., 7.35 inches; Statesville, N. C., 7.35 inches; and Winston-Salem, N. C., 5.34 inches.

b. The hurricane-produced storm of 14-16 July 1916 was accompanied by intense rainfall through North and South Carolina. The storm had two rainfall centers, one at Kingstree, S. C. with 16.8 inches occurring on 14-15 July and the other at Altapass, N. C., with 23.7 inches occurring on 15-16 July. Two-day precipitation totals for selected stations within the basin were 16.35 inches at Blowing Rock, N. C.; 15.75 inches at Effingham, S. C.; 11.46 inches at Wilkesboro, N. C.; and 9.80 inches at Cheraw, S. C. Precipitation totals in the lower and middle Piedmont areas of the basin varied between three and five inches.

c. The hurricane-produced storm of 16-19 September 1928 was accompanied by heavy volumes of precipitation all along the Atlantic Coast from Florida to Virginia. There were several storm centers; one at Darlington, S. C., produced 12.53 inches in 42 hours during the period 17-19 September. Precipitation averaged between eight and twelve inches in the Coastal Plain area of the basin and decreased to about four inches in the upper Yadkin Basin. Two-day precipitation totals at selected stations were Florence, S. C., 12.17 inches; Effingham, S. C., 11.30 inches; Kingstree, S. C., 11.10 inches; and Marion, S. C., 10.60 inches.

d. The storm of September-October 1929 caused by a tropical disturbance produced heavy rainfall throughout the Piedmont Plateau of the southeastern states. A storm center at Moncure, N. C., produced 11.6 inches. Two-day precipitation totals for selected stations in the basin were 9.31 inches at Statesville, N. C.; 9.20 inches at Southern Pines, N. C.; 9.02 inches at Mount Airy, N. C.; and 9.00 inches at Salisbury, N. C.

e. The hurricane produced storm of 11-17 August 1940 is without parallel in the South Atlantic states for the great depth of rainfall over a large area. An area of 120,000 square miles experienced rainfall in excess of four inches. The heaviest rainfall occurred in the western South Carolina and North Carolina mountains; however, the most intense rainfall occurred at Beaufort, S. C., where 7.2 inches fell in six hours. The storm had four rainfall centers ranging in magnitude from 12.6 inches at Beaufort, S. C., to 19.6 inches at Swansboro, N. C. Precipitation over the basin varied from three to six inches except over the upper Yadkin Basin between the ridge line and Mount Airy to Statesville, N. C., where up to 14 inches fell and an area around Florence, S. C., where over 10 inches fell. Total precipitation for selected stations in the basin were Buffalo Cove, N. C., 13.2 inches; Kilbys Gap, N. C., 11.9 inches; Florence, S. C., 11.9 inches; Mars Bluff Bridge, S. C., 9.9 inches; and North Wilkesboro, N. C., 9.5 inches.

f. The hurricane produced storm of 13-18 September 1945 centered at Rockingham, N. C., where 14.8 inches of rain fell. Total precipitation for a few basin stations are 13.3 inches at Laurinburg, N. C.; 12.8 inches at Mocksville, N. C.; 12.5 inches at Kingstree, S. C.; and

12.1 inches at Albemarle, N. C.

24. Runoff and streamflow data. Annual runoff from the basin averages about 16 inches, equivalent to about one-third of the average annual rainfall. Average annual runoff varies throughout the basin from 9.52 to 22.88 inches. The maximum annual runoff of record is 40.48 inches on the Yadkin River at Wilkesboro, N. C.; the minimum of record is 1.97 inches on Black River at Kingstree, S. C. Runoff varies seasonally; it is highest in the winter and early spring and lowest in the summer. The United States Geological Survey operates 41 stream gaging stations throughout the basin. The collected data is published annually in Water Supply Papers. The survey also collects and publishes stream water quality data, which includes temperature, chemical analysis, and sedimentation data. The National Weather Service (formerly Weather Bureau) records and publishes river stages at locations throughout the basin.

25. Floods of record. No single flood produced the maximum stages in all portions of the basin; however, the August 1940 flood was the most widespread and generally the most severe. The 1940 flood was the maximum along the upper Yadkin River, while in the lower portion of that river, the July 1916 flood was the maximum. The August 1908 flood was a maximum at one station on the Pee Dee River and the September 1945 flood was the maximum at all other stations. Other large floods occurred in August and September 1928, October 1929, and September 1944. The three largest known floods at 17 long-term representative basin gaging stations are shown in Table 2. Figures 1 and 2 depict flood scenes at selected points in the basin.

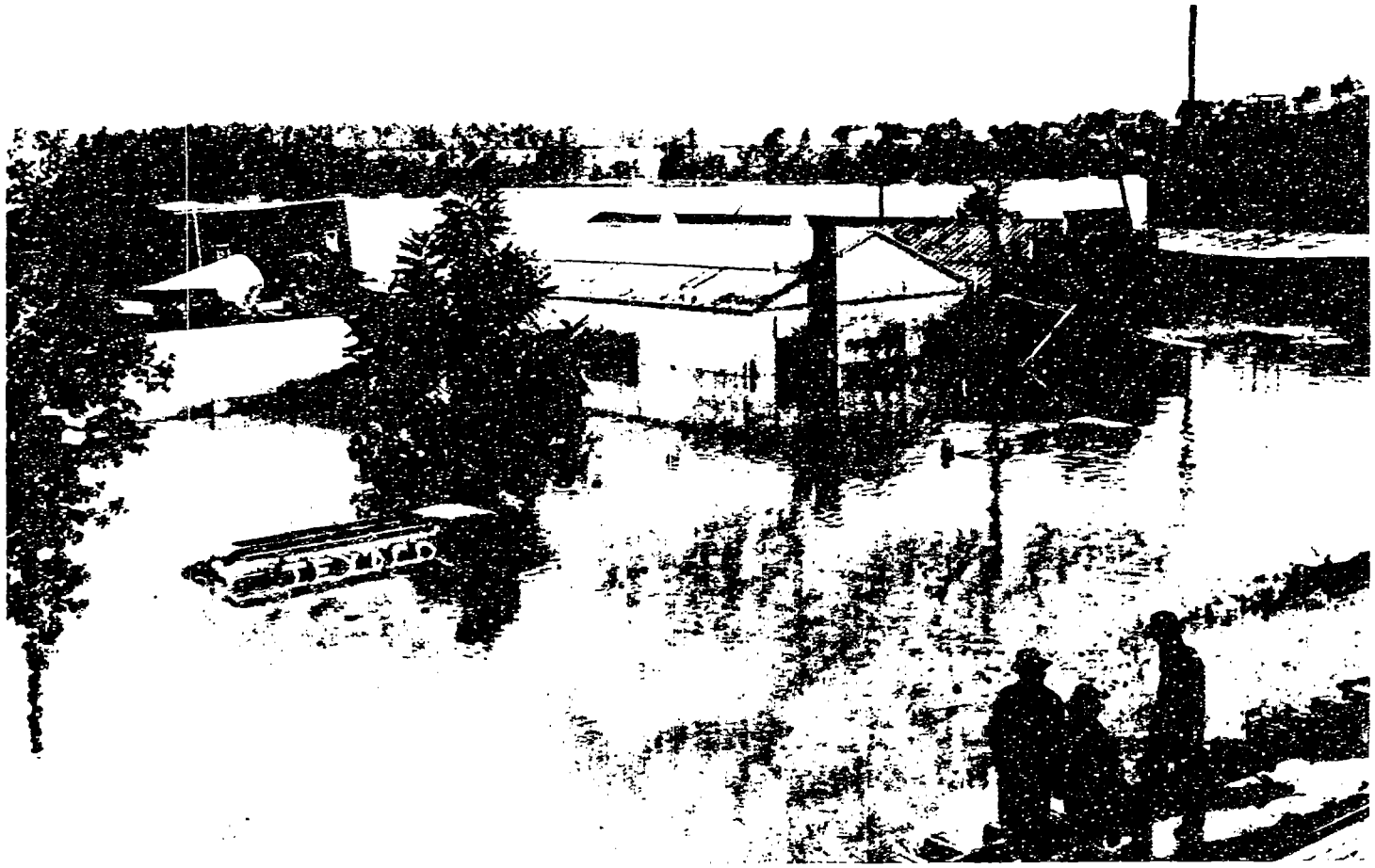
EXISTING CORPS OF ENGINEERS IMPROVEMENTS

26. Navigation projects. Navigation was the earliest type of river improvement by the Corps of Engineers in the basin, but it is now of minor importance. One adequate, but little used, and five obsolete shallow-draft navigation projects described below were authorized many years ago. Five of the projects are too shallow throughout for modern barge traffic.

a. Great Pee Dee River, S. C. The Pee Dee River near its mouth in Winyah Bay is shallow. The adjoining Waccamaw River which also empties into Winyah Bay, is deep in its lower reaches and is connected with the Pee Dee River at mile 31.8 by Bull Creek which is also deep, thus affording a better access for navigation to the upper Pee Dee than the natural river mouth. Accordingly, the lower 21 miles of the Waccamaw River and Bull Creek are part of the route of the Great Pee Dee River navigation project. The project provides for a cleared 9-foot channel from Waccamaw River via Bull Creek to Smiths Mills and thence a 3.5 foot-channel to Cheraw at all stages of water. The existing project was authorized by the following River and Harbor Acts: June 14, 1880 - S. Ex. Doc. 117, 46th Congress, 2nd Session, and Annual Report, 1880, p. 844 (for map see Annual Report for 1889, p. 1180); June 13, 1902 - H. Doc. 124, 56th Congress, 2nd Session. The project was completed in 1909, with project dimensions obtained from the head of

August 1940 flood, maximum of record

Figure 1 YADKIN RIVER AT ELKIN, NORTH CAROLINA



August 14, 1940, 6.5 feet below peak stage

Figure 2 YADKIN RIVER AT NORTH WILKESBORO, NORTH CAROLINA

TABLE 2

MAXIMUM KNOWN FLOODS

Stream and Station	Period of Record	Drainage Area (sq. miles)	Maximum Known			Second Largest Known			Third Largest Known		
			Date	Stage (ft.)	Discharge (cfs)	Date	Stage (ft.)	Discharge (cfs)	Date	Stage (ft.)	Discharge (cfs)
YADKIN RIVER											
Yadkin River at Patterson, NC	1939-68	29.0	13 Aug 40	12.70	16,200	11 Mar 52	7.70	4,930	13 Feb 66	6.54	3,300
Yadkin River at Wilkesboro, NC	1920-68	439.0	14 Aug 40	37.6	160,000	Jul 16	34.5	116,000	2 Oct 29	24.0	29,000
Forbush Creek near Yadkinville, NC	1940-68	21.7	30 Sep 44	11.02	2,450	3 Aug 58	11.08	2,060	22 Jun 57	10.38	2,060
Yadkin River at Yadkin College, NC	1928-68	2280.0	Jul 16	36.3	94,300	15 Aug 40	33.75	80,200	3 Oct 29	29.8	67,800
Yadkin River at High Rock, NC	1941-62	4000.0	21 Jul 16	22.1	-	21 Jul 19	-	85,000	18 Mar 23	-	76,900 1/
SOUTH YADKIN RIVER											
South Yadkin River near Mocksville, NC	1938-68	313.0	3 Oct 29	22.6	22,000	17 Oct 64	18.23	11,800	23 Jan 54	16.73	9,240
ROCKY RIVER											
Rocky River near Norwood, NC	1929-68	1370.0	18 Sep 45	46.37	105,000	Aug 08	35.00	67,600	31 Aug 52	34.0	63,400
PEE DEE RIVER											
Pee Dee River near Rockingham, NC	1927-68	6870.0	27 Aug 08	31.28	276,000	18 Sep 45	30.80	270,000	19 Sep 28	25.38	212,000 2/
Juniper Creek near Cheraw, SC	1940-58	64.0	18 Sep 45	5.71	3,910	9 Jun 53	2.30	880	1 Sep 52	2.05	778
Pee Dee River at Peedee, SC	1938-68	8830.0	22 Sep 45	33.30	220,000	23 Sep 28	29.6	-	7 Oct 29	27.3	- 2/
LYNCHES RIVER											
Lynches River near Bishopville, SC	1942-68	675.0	19 Sep 45	22.35	29,400	3 Sep 52	18.06	15,000	22 Mar 44	17.43	12,400
Lynches River at Effingham, SC	1929-68	1030.0	22 Sep 45	21.21	25,000	30 Aug 08	20.0	18,000	24 Sep 28	19.5	16,100
LITTLE PEE DEE RIVER											
Little Pee Dee near Dillon, SC	1939-68	524.0	20 Sep 45	14.64	9,810	12 Jun 66	12.07	5,220	17 Oct 59	11.42	4,650
Drowning Creek near Hoffman, NC	1939-68	178.0	18 Sep 45	10.29	10,900	15 Jul 44	9.63	8,000	21 Jul 56	9.65	8,000
Lumber River near Boardman, NC	1929-68	1220.0	Aug 28	11.8	25,000	22 Jul 01	10.8	14,800	24 Sep 45	10.64	13,400
Little Pee Dee River near Galivants Ferry	1941-68	2790.0	Sep 28	16.0	-	9 Oct 64	13.01	27,600	23 Sep 45	13.23	26,800
BLACK RIVER											
Black River at Kingstree, SC	1929-68	1260.0	21 Sep 28	18.0	41,600	20 Sep 45	16.07	29,100	7 Oct 64	14.73	17,900

1/ Except for major floods, flow completely regulated by High Rock Lake since 1927.

2/ Flow largely regulated since 1928 by six reservoirs.

Bull Creek at Great Pee Dee River (mile 32.5) to Smiths Mills (mile 55). The cost of new work was $183,700 and maintenance cost has totaled $269,700. There has been substantially no commerce and there has been no maintenance cost during the last five years. The waterway has been used principally for the movement of logs.

b. Little Pee Dee River, S. C. This project provides for clearing a channel for 4-foot depth steam navigation from the mouth to the Lumber River, then 4-foot pole boat navigation to Little Rock, S. C. Abandonment was recommended in 1926 (H. Doc. No. 467, 69th Congress, 1st Session). The cost of new work was $19,500 and maintenance cost has totaled $25,600.

c. Lumber River, N. C. and S. C. This project provides for improving the river for steamboats from its mouth to Lumberton, North Carolina, by snagging and clearing the banks. It was authorized by the River and Harbor Act of 1896. No work has been done since 1897. The total cost was $19,000.

d. Lynches River and Clark Creek, South Carolina. This project provides for clearing a channel in Clark Creek to affort a navigable outlet for Lynches River. Abandonment of the project was recommended in 1926 (H. Doc. No. 467, 69th Congress, 1st Session). The cost was $9,500.

e. Mingo Creek, South Carolina. This provides for a navigation channel 60 feet wide and 8 feet deep at mean low water from the mouth to Hemingway bridge, 11 miles, authorized by the River and Harbor Act of July 25, 1912 - H. Doc. 782, 61st Congress, 2nd Session. The existing project was completed in 1913. The creek was last cleared of obstructions between its mouth at Black River and the Hemingway bridge (mile 11), the head of commerical navigation, during January 1945. The cost for new work was $29,000 and maintenance cost has totaled $7,100.

f. Yadkin River, North Carolina. This project provides for a channel 2.5 feet deep for a distance of 33.5 miles above the railroad bridge at Salisbury, N. C. Abandonment was recommended in 1926 (H. Doc. No. 467, 69th Congress, 1st Session). The cost was $102,800.

27. The Atlantic Intracoastal Waterway project of the Corps of Engineers follows Winyah Bay below the Pee Dee River for a part of its route along the coast. The 12 feet deep waterway carries an active commerce. Georgetown Harbor on Winyah Bay is the seaport outlet for such river navigation as may use the Pee Dee. The channel from the ocean to Georgetown Harbor is 27 feet deep.

28. Flood control projects. The major Corps of Engineers project in the basin is the "Yadkin River, N. C." project which includes the

existing W. Kerr Scott Dam and Reservoir and the authorized Reddies River Reservoir. These reservoirs were authorized by the Flood Control Act of 1946, with modifications approved later, as discussed before under "Prior Reports".

29. The W. Kerr Scott Dam and Reservoir was constructed in 1960-1962 at a site at mile 404 on the Yadkin River above the cities of Wilkesboro and North Wilkesboro, N. C. Flood control for the Wilkesboro-North Wilkesboro area and the upper Yadkin River is the major purpose. Water supply storage is provided for the use of Wilkes County and the city of Winston-Salem, N. C. Recreation is an important use of the project; there were over 643,000 visitors in 1971. The dam is an earthfill structure about 148 feet high. The reservoir capacity is 153,000 acre feet at maximum flood pool elevation 1075. The capacity of 112,000 acre feet from elevation 1075 down to conservation pool elevation 1030 is for flood control. From elevation 1030 to elevation 1000 the capacity of 33,000 acre feet is for water supply and 8,000 acre feet below elevation 1,000 is for sediment storage. The normal full conservation pool at elevation 1,030 has an area of 1,475 acres, with facilities for recreational use. The construction cost to date is $8,656,893.

30. Reddies River Lake is authorized to be constructed on Reddies River at mile 1.72, a short distance above North Wilkesboro. The drainage area above the site is 94.5 square miles. A definite project report submitted in March 1950 was unfavorable to construction of the project at that time and resulted in the project being classified as inactive. In recent years, the project was reclassified as "deferred for restudy". A report, "Reddies River Project, North Carolina, Economic Restudy", dated July 1969, resulted in the project being reclassified to "active status". Funds have been appropriated for reconstruction planning.

31. The Reddies River dam would be rolled earthfill, 165 feet high, with an uncontrolled spillway in the right abutment and a conduit with a multiple-level intake located near the river channel. The total reservoir storage at the top of the flood control pool, elevation 1,110.0, would be 58,350 acre feet. The reservoir area at elevation 1,110.0 would be 1,334 acres. Between elevation 1,110.0 and the top of the conservation pool, elevation 1,074.2 a storage of 35,030 acre feet would be available for flood control, equivalent to 6.95 inches of runoff, sufficient to control all floods of record and the Standard Project Flood to non-damaging releases immediately below the dam. The reservoir area at elevation 1,074.2 would be 680 acres. Below the top of conservation pool would be 23,320 acre feet for water supply, water quality control, and sediment storage. The storage allocated to water supply would provide a dependable yield of 30 million gallons per day, which will assist in providing for the long-range water supply needs of the upper Yadkin River Basin. The North Carolina Department of Water and Air Resources furnished satisfactory assurances of repayment of the allocated costs of providing the reservoir storage for water supply in accordance with the Water Supply Act of 1958 (Title III of Public Law 85-500).

32. Four local flood control projects have been constructed and others, discussed later, are being investigated under speical continuing authorities which authorize the Chief of Engineers to build projects without specific authority from Congress. Section 205 of the Flood Control Act of 1948 as amended authorizes the construction of small flood control projects with the Federal cost limited to $1,000,000. Section 208 of the Flood Control Act of 1954 authorizes snagging and clearing of channels for flood control at a limit of Federal cost of $100,000. Project maintenance is the responsibility of local interests. The four projects constructed are:

a. Gapway Swamp. The Gapway Swamp project, located in Columbus County, N. C. and Horry County, S. C. was completed in April 1968, under Section 205 authority at a construction cost of $373,900. The work consisted of channel enlargement of 14 miles of Gapway Swamp, a tributary of the Lumber River. The project has alleviated the local flood problem.

b. Old Field Swamp. The Old Field Swamp project, located at Fairmont, N. C. was completed in August 1968 under Section 208 authority at a construction cost of $86,600. The work consisted of 3.2 miles of channel improvement on Old Field Swamp and Mill Branch, a tributary of Old Field Swamp which flows through Fairmont. Old Field Swamp outlets into Hog Swamp, a tributary of the Lumber River.

c. Shot Pouch Creek. The Shot Pouch Creek project was completed in 1971 under the authority of Section 208 at a construction cost of $72,400. The work consisted of 2.15 miles of channel enlargement of Shot Pouch Creek, which flows through Sumter, S. C. and is ultimately tributary to the Black River. The project has alleviated flooding in Sumter from Shot Pouch Creek.

d. Turkey Creek. Construction began on the Turkey Creek flood control project in June 1971, and the estimated completion date is the spring of 1973. The project was authorized and funded under Section 205. The work consists of 4.5 miles of channel enlargement. It will protect a major portion of the east side of the city of Sumter, S. C. from flood damages. Turkey Creek originates northeast of Sumter and flows through the east side of the city, discharging into the Pocotaligo River, a tributary of the Black River.

33. Furnishing flood plain information is an important activity of the Corps of Engineers relating to flood control. This program is described later.

IMPROVEMENTS BY OTHER FEDERAL AGENCIES

34. Soil Conservation Service program. The Soil Conservation Service,

U. S. Department of Agriculture, has an active land and water resource development program underway in the Yadkin-Pee Dee River Basin. The overall program involves land treatment measures, establishing conservation practices on agricultural land, and structural improvements to provide for more efficient water control and management in agricultural areas. Under the small watershed flood control program authorized by Public Law 566, 83rd Congress, erosion control and flood prevention are the basic purposes; but needs for irrigation, drainage, water supply, recreation, and fish and wildlife conservation are also considered in the projects.

35. The Soil Conservation Service has completed construction on four upstream watershed projects and partially completed construction on one watershed project under Public Law 566 authority. Completed projects service about 111,000 acres of land. An additional 72,000 acres of land will be serviced when the partially completed project is finished. These completed improvements consist of land treatment programs where needed, 16 small flood detention reservoirs, and about 60 miles of stream channel improvement. Also under Public Law 566 authority, construction has been authorized on 12 additional upstream watershed areas covering about 235,000 acres. These projects, when completed, will provide needed treatment measures in the upstream watershed areas, about 40 small detention reservoirs, and over 170 miles of stream channel improvement. This program is scheduled for completion around 1980. When completed, these small detention reservoirs will provide partial control of flood producing runoff from about 500 square miles or about 3 percent of the basin area.

NON-FEDERAL IMPROVEMENTS

36. Hydroelectric power development. The major water resource activity of the basin by non-Federal interests is development of hydroelectric power. Of 15 hydroelectric plants constructed within the basin, there are eight operating plants with a total installed hydroelectric capacity of 311,821 kilowatts. These existing projects have a storage capacity usable for power of about 500,000 acre-feet and provide about 29,000 acres of water surface area that may be utilized for recreation activities. Data on the operating hydroelectric plants are shown in Table 3.

37. Hydroelectric power, once the principal source of electrical power in the basin, is now secondary to steam-electric generation. The total installed steam-electric capacity in the basin is now over 1,700,000 kilowatts, or over 5 times that of water power.

38. Water supply projects. Several reservoirs in the basin have water supply as the primary purpose. These reservoirs provide water supply storage for Concord, Lexington, Marshville, Monroe, Rockingham, and Winston-Salem, N. C. Pertinent data for these reservoirs are shown in Table 4. Other towns in the basin use run-of-the-river flows, as modified by existing reservoirs, or use water without charge from reservoirs constructed primarily for hydroelectric power generation. Winston-Salem, N. C. in

TABLE 3

HYDROELECTRIC POWER PLANTS

		Installed Capacity KW 1 January 1970
Idols	Yadkin River, mile 309. Drainage area, 1,876 sq. mi. Duke Power Co. FPC No. 2585. Built 1897. 1,411 kw in 6 units. Head, 10 ft.	1,411
High Rock	Yadkin River, mile 253. Drainage area, 3,980 sq. mi. Yadkin, Inc. (formerly Carolina Aluminum Co.) FPC No. 2197. Built 1927. 33,000 kw in 3 units. Head, 59 ft. Lake area, 15,180 ac. at el. 624. Power drawdown storage el. 624.1 to 594.1, 234,866 ac. ft.	33,000
Tuckertown	Yadkin River, mile 244. Drainage area, 4,080 sq. mi. Yadkin, Inc. FPC No. 2197. Built 1962. 42,000 kw in 3 units. Head, 55 ft. Lake area 2,560 ac. at el. 565.1. Power drawdown storage 6,744 ac. ft. in 3 ft. drawdown.	42,000
Narrows	Yadkin River, mile 236. Drainage area, 4,180 sq. mi. Yadkin Inc. FPC No. 2197. Built 1917, improved since. 96,500 kw in 4 units. (25,000 kw, 22,000 kw and 2 at 24,750; Lake area (bad in Lake) 5,355 acres, at el. 510.2. Drawdown storage, 128,937 ac. ft. in 31.1 ft. drawdown.	96,500
Falls	Yadkin River, mile 234. Drainage area 4,190 sq. mi. Yadkin, Inc. FPC No. 2197. Built 1919, improved since 29,500 kw (7,000 kw, 2 at 11,250 kw installed in 1962). Head, 55 feet. Lake area, 204 acres at el. 330. Drawdown storage about 1,824 ac. ft. in 10 ft. drawdown.	29,500
Tillery	Pee Dee River, mile 224. Drainage area, 4,600 sq. mi. Carolina Power and Light Co. FPC No. 2206. Built 1928. 84,450 kw in 5 units (3 at 22,000, 1 at 18,000, 1 auxiliary at 450). Gross head, 73 ft. Lake area 5,260 ac. at el 278. Drawdown storage, 88,000 ac. ft.	84,450
Blewett Falls	Pee Dee River, mile 195. Drainage area, 6,830 sq. mi. Carolina Power & Light Co. Built 1911; 24,600 kw in 6 units. Gross head, 50 feet.	24,600
Hartsville	Black Creek, mile 32. Sonoco Prod. Co. Built 1941. 360 kw.	360
	TOTAL	311,821

addition to the storage listed below is using water from the Yadkin River which will be supplemented from storage in W. Kerr Scott Reservoir when needed. High Point, N. C., on the divide between the Yadkin and Cape Fear River Basins, gets its water from the Cape Fear Basin.

TABLE 4

WATER SUPPLY RESERVOIRS

City	Stream	Storage (Acre-Feet)	Surface Area Acres	Dependable Yield (mgd)
Concord, N.C.	Cold Water, Lumby, & Chambers Creeks	4,578	378	11.5
Lexington, N.C.	Abbotts Creek & Leonards Creek	6,522	786	10.0
Marshville, N.C.	Lanes Creek	46	1/	1/
Monroe, N.C.	Little & Big Richardson Creeks	1,228	140	1/
Rockingham, N.C.	Falling Creek	1/	1/	8.0
Winston-Salem, N.C.	Salem Creek	1/	400	9.0

1/ Data not available.

WATER RESOURCE PROBLEMS AND NEEDS

39. Public hearings.

a. Three public hearings were held early in this study of the Yadkin-Pee Dee River Basin for the purpose of determining the needs and desires of the local people. A hearing was held in Wadesboro, N. C., on 20 January 1965, with 206 people in attendance; in Winston-Salem, N. C., on 21 January 1965, with 327 people in attendance; and in Florence, S. C., on 19 June 1965, with 137 people in attendance. Discussion of navigation projects was limited primarily to the main stem of the Pee Dee River below the Blewett Falls Dam. Flood control studies were requested for the Pee Dee, Little Pee Dee, Lumber, and Lynches Rivers and several of their smaller

tributaries. The most controversial subject was water resource conservation developments for the upper Yadkin River. There was considerable interest and divergence of opinion over the alternatives of a large main stem reservoir or a system of tributary stream reservoirs such as the authorized Reddies River project.

b. Another hearing was held in Winston-Salem, N. C., on 4 January 1968, with 109 people in attendance. A plan for the upper Yadkin River Basin was presented which included immediate construction of the Roaring River project, recommended in the report for "Development of Water Resources in Appalachia," and the future construction of the Mitchell and Fisher River reservoirs. The majority of those presenting views favored this plan. The electric membership associations expressed preference for a large main stem reservoir.

c. A public meeting was held on 5 October 1972 at Wilkesboro, N. C., on the Reddies River Lake project. A large majority of the 112 people in attendance expressed support of the project with there being substantially no opposition.

d. Copies of the transcripts of these public hearings are on file in the Charleston District Office and the Board of Engineers for Rivers and Harbors, Washington, D. C.

40. Navigation needs. As described before, there are five obsolete and inadequate navigation projects in the basin and one project in the Great Pee Dee River, S. C., project, which has useable depth in its lower part but has had no commerce of significance for many years. There are no large centers of possible waterway commerce on the Pee Dee River or other navigable or potentially navigable rivers of the Coastal Plain. There is no demonstrated need for navigation improvements at this time.

41. Flood control needs. The flood plains of the Yadkin-Pee Dee River Basin range from small, narrow, steeply sloping areas in the mountain and Piedmont Plateau to wide, flat, swampy, and marshy areas in the Coastal Plain. Flood plain areas by stream and class of development are presented in Table 5. About 80 percent of the total 899,750 flood plain acres are in the wooded swamps of the Coastal Plain.

42. Urban flooding along the main stem and major tributaries of the Yadkin-Pee Dee River is of significance in several cities. Wilkesboro, North Wilkesboro, Elkin, and Jonesville, N. C. are subject to flooding from the Yadkin River. Lumberton, N. C. is subject to flooding from the Lumber River. Urban damages from small tributary streams occur in numerous cities and towns. In North Carolian, urban damages from these tributary streams occurs in Lexington, Winston-Salem, Concord, Kannapolis, Salisbury, and Laurinburg. In South Carolina, damages by tributary streams occur in Florence, Kingstree, Sumter, Sellers, and Mullins. Main stem stream areas for which estimates of average annual damages have been made are discussed briefly below:

TABLE 5

LAND AREA IN THE FLOOD PLAIN
(Acres)

Stream	Agricultural	Wooded	Miscellaneous	Total
Pee Dee River	18,525	359,948	7,900	386,373
Yadkin River	11,780	12,780	600	25,160
Black River	9,110	93,206	2,100	104,416
Little Pee Dee River	12,099	137,459	3,100	152,658
Lumber River	9,582	110,963	2,500	123,045
Lynches River	16,775	68,364	1,800	86,939
Rocky River	4,670	8,129	300	13,099
South Yadkin River	1,600	6,260	200	8,060
TOTALS	84,141	797,109	18,500	899,750

a. Wilkesboro and North Wilkesboro, N. C. These two towns are separated only by the Yadkin River which causes some flooding in both of them. The W. Kerr Scott reservoir project now affords a high degree of flood reduction but there is some flood potential remaining. The authorized Reddies River project, when constructed, would reduce average annual flood damages from $121,000 to $6,000.

b. Elkin and Jonesville, N. C. Flood damages in Elkin and Jonesville, N. C., from the Yadkin River currently estimated at $64,000 annually would be reduced to $38,000 if the authorized Reddies River project were in operation.

c. Lumberton, N. C. The Lumber River causes flooding in the city of Lumberton but estimates of average annual damages have not been made at this time. Over $220,000 in urban damages were caused in Lumberton by the March 1971 flood on the Lumber River. Similar damages were experienced again in February 1973. A separate survey study of the Lumber River is authorized and is scheduled to begin soon.

43. The rural flood plains of the main stem and tributaries in the upper portion of the basin are well developed for agricultural purposes, with approximately 40 percent of the area used for farming. In the lower part of the basin, water damage from both flooding and drainage problems severely limits its use for agricultural purposes. This is evidenced by the fact that less than 13 percent of flood plains here are used for farming. Most of the land not developed as cropland is heavily wooded. Primary crops in the basin are corn, soybeans, hay, truck crops, small grains, and pastures.

44. Damage from flooding in the Yadkin-Pee Dee River Basin is approximately evenly divided between agriculture and nonagriculture. Damages to transportation facilities are generally minor and distributed throughout the basin, though major floods have caused extensive damages to bridges, highways, and railroads. Flood damages along the Yadkin River between the W. Kerr Scott Dam and the head of High Rock Lake were evaluated during studies for the report, "Development of Water Resources in Appalachia," prepared for the Appalachian Regional Commission. This is the only basin area which would be affected significantly by the flood control storage in the reservoirs considered in that report and discussed later. Flood damage estimates for this area were based on field inspections, interviews with property owners, and various officials and statistical data. Estimates for other areas were based on more approximate methods.

45. In estimating rural flood damages, crop flood losses are based on the percent chance of flooding each month, since the value of a crop in the field varies seasonally. Agricultural lands in the flood plains are usually small isolated acreages. Cropland is used primarily for the production of corn, soybeans, hay, truck crops, and pasture. Losses to other than crops do not vary seasonally. Rural industrial property is included in the rural nonagricultural classification, but most of the damage in this category occurs to transportation facilities.

46. Urban flood damages include all tangible physical and business losses to urban properties such as industrial, commercial, residential, utilities, transportation, and government properties. Urban damages on the major streams and tributaries occur primarily at the localities mentioned before.

47. A summary of the flood damage evaluation study is shown in Table 6 for the major streams and tributaries in the basin. These values reflect the flood damages at the present stage of development, assuming the authorized Reddies River project in operation; flood damages for the stage of development expected to be reached 50 years hence; and flood damages over a 100-year period, discounted to an average annual equivalent value, assuming that development remains constant after 50 years. In addition to damages on the major streams and tributaries, local flood damage occurs on small tributary streams as shown in Table 7.

TABLE 6

AVERAGE ANNUAL FLOOD DAMAGES
ON MAJOR STREAMS AND TRIBUTARIES

Stream	Annual Damages		
	Current Flood Plain Development	50-Year Future Flood Plain Development	Discounted Average Annual Flood Damages 1/
Yadkin River	$ 463,000	$ 755,000	$ 568,000
Pee Dee River	229,000	281,000	248,000
Black River	130,000	169,000	144,000
Little Pee Dee River	155,000	197,000	170,000
Lumber River	185,000	259,000	212,000
Lynches River	227,000	318,000	260,000
Rocky River	102,000	163,000	124,000
South Yadkin River	61,000	97,000	74,000
TOTAL	$1,552,000	$2,239,000	$1,800,000

1/ 5-1/2 percent discount interest rate, 100-year amortization period.

TABLE 7

LOCAL FLOOD DAMAGES
(WITH EXISTING CONDITIONS)

Location		Average Annual Damages		
Stream	City	Urban	Rural	Total
Kingstree Branch	Kingstree, S.C.	$34,000	-	$34,000
Turkey Creek	Sumter, S.C.	38,000	-	38,000
Jeffries Creek	Florence, S.C.	1,000	-	1,000
Lowery Swamp	(none)	-	$25,000	25,000
Willow Creek	(none)	-	70,000	70,000

48. The need for flood control in the Yadkin-Pee Dee River Basin by structural improvements such as reservoirs, levees, and channel improvements is not relatively great. The larger areas subject to flooding are along the Coastal Plain streams where there is little development. There is also little urban development on the main rivers above the Coastal Plain. Much of the urban damage could have been avoided had better regulation of the uses of the flood plains been effected. This matter will be discussed in greater detail later.

49. Water supply needs. There is usually an abundance of water supply throughout the Yadkin-Pee Dee River Basin for present needs; however, during dry periods, some severe water shortages do occur along the basin's streams. The growth of population, the increasing rate of per capita consumption, and the requirements of industrial expansion have increased the use of water in the basin. Water supply needs are presently obtained from both surface and ground water sources. Current needs are normally met by existing systems, but future shortages are foreseen in the upper part of the basin. The greatest future demand for additional water supply will be in the upper Yadkin River Basin which at present has an ample supply from stream flows and the water supply storage in the W. Kerr Scott project. Eventually, additional water supply is expected to be needed by the city of Winston-Salem and Forsyth County, North Carolina. Their projected water supply needs as estimated by the Corps in the report on "Development of Water Resources in Appalachia" and based on assumed intensive regional economic development indicates a possible demand of about 411 mgd by 2020. These needs could be met from the existing W. Kerr Scott project, the authorized Reddies River project, the recommended Roaring River project, and other possible projects to be justified in the future as the growth of needs warrant their construction. Other projected basin area needs may be met by non-Federal interests expanding their present facilities.

50. Agricultural water needs for irrigation. Agriculture is an important segment of the overall economy of the Yadkin-Pee Dee River Basin, and there is an increasing trend toward using surface water for irrigation. However, small surface water reservoirs distributed throughout the basin have been and are expected to continue to be developed by local interests to provide agricultural-irrigation water supply needs.

51. Water quality control needs. The Federal Water Pollution Control Administration in its investigations for the Appalachian Report, evaluated the needs for water quality control in the Yadkin River Basin. Detailed studies were conducted only in areas downstream from projects under detailed study for the Appalachian Report. The water quality problems of the remaining portions of the Yadkin-Pee Dee River Basin have not been studied in detail for this report.

52. The greatest need for water quality control is the reach of the Yadkin River below Winston-Salem, North Carolina, extending from Muddy Creek downstream to the confluence with the South Yadkin River. Flow

objectives were established by the Federal Water Quality Control Administration which would maintain acceptable levels of dissolved oxygen in the year 2020 for streams in the Yadkin River Basin which receive treated municipal and industrial effluent. The Reddies River and the Roaring River projects would help to meet these objectives on the Yadkin River.

53. Minimum flows during the summer month of July, ranging from 205 cubic feet per second in 1980 to 1,180 cubic feet per second in 2020, would be required to satisfy the water quality criteria for dissolved oxygen in the Yadkin River. Water quality control problems in other parts of the basin have not been sufficiently evaluated to ascertain needs, but during the course of this investigation, no additional major problems were brought to the Corps' attention.

54. Outdoor recreation needs. There is a present need for additional outdoor recreation opportunities in the basin and the need is expected to increase in the future. In the studies for this report, emphasis has been placed on determining the need for outdoor recreation activities which are generally classified as water oriented or enhanced. It is recognized that activities such as boating, swimming, and fishing require a definite water surface area, while others are less directly related to water surface. The basin needs for water based recreation opportunities are expected to total nearly 50,000,000 annual recreation days by the year 2020.

55. Fish and wildlife needs. Increases in pollution could harm fish and wildlife, especially in the critical reach of the Yadkin River from Muddy Creek to the South Yadkin River if water quality control storage is not provided. Construction of reservoirs would destroy some wildlife habitat and some of the stream fishery resources. Most losses of stream fisheries would be replaced by reservoir fisheries, which would have much greater productivity and utilization. Losses of wildlife habitat, due to reservoir construction, could be mitigated by intensive management of reservoir lands and by more extensive development and management of wildlife habitat in other areas of the basin.

56. Hydroelectric power needs. Most of the electrical generating capacity and energy in the basin is now produced by steam-electric plants. The basin needs for electrical power are doubling in less than 10 years. Studies by the Federal Power Commission show that all of the potential remaining hydroelectric power (less than 400,000 kilowatts) could supply only a small part of the future power needs if developed. Therefore, steam-electric power is expected to be the main source of future power. However, hydroelectric power, where it can be economically justified, could supply a part of the future needs. The possibilities for additional hydroelectric power are discussed later.

CRITERIA GOVERNING ECONOMIC EVALUATIONS

57. Introduction. The following sections of the report present the criteria used in evaluating viable engineering alternatives which would serve the water resource needs previously discussed.

58. Conditions governing Federal participation. In order to be eligible for recommendation of Federal participation projects must meet conditions of economic justification. The estimated project cost and the cost of each separable unit or project purpose must not exceed the respective benefits. The benefits are primarily those established under Federal policy as contributing to the general welfare, such as reduction of flood damages, savings in transportation costs from waterways, development of hydroelectric power resources and water supply, development of water-related recreation, etc.

59. Price levels and discount rates. Present prices were used in estimating construction costs. An investment rate of 5-1/2 percent was used for estimating the annual charges on the Federal portion of the project as prescribed by the Water Resource Council. A rate of 6 percent or more was used on the non-Federal investment. The project cost of large multiple-purpose reservoir projects was amortized over a 100-year project life. The economic life of other projects was generally estimated at 50 years.

60. Hydroelectric power benefits. The Atlanta Regional Office of the Federal Power Commission furnished unit power values based on the cost of alternative non-Federal steam-electric generation for estimating hydroelectric power benefits. Estimates of power revenues were prepared with the cooperation of the Southeastern Power Administration.

61. Criteria for apportioning costs. Benefits for recreation and fish and wildlife development at projects may be claimed in estimates of project benefits and may be used in allocating costs to those purposes under authority of the Federal Water Project Recreation Act of 1965. The Act provides that the cost allocable to recreation and fish and wildlife may not exceed the cost allocated to irrigation, power, water supply, navigation and flood control. The Act also requires that as a condition of crediting the recreation benefits fully to a project, non-Federal public bodies must agree to pay one-half of the separable cost of the recreation facilities and to operate and maintain the recreation facilities.

62. Navigation waterways for general commerce are usually provided at Federal expense except that local interests are required to furnish public terminals and usually must furnish lands and alter utilities. Flood control storage in reservoirs is provided at Federal cost, but for local flood protection works, local interests are required to furnish lands and operate the projects after completion. A cash contribution

toward the cost of local flood protection works may be required where the benefits include significant enhancement of land values accruing to a few individuals. Water supply is considered to be primarily the responsibility of non-Federal interests, but may be included in a Federal project if justified, and if non-Federal interests will repay allocated costs.

FLOOD CONTROL PLANS

63. General. In the section on flood control needs, it was shown that nearly 900,000 acres are subject to flooding by the rivers of the basin. Nearly 80 percent of that area is in the Coastal Plain. The overall flood damage is, not of great magnitude because there is little urban and industrial or other intensive development affected by floods. It is found that providing a high degree of flood protection throughout the basin by provision of reservoir storage, by leveeing of extensive areas or by channel improvement is not economically justified. Some reservoir storage for flood control on the upper Yadkin River is provided by the W. Kerr Scott project and more is authorized in the Reddies River project as described before. The Appalachia study recommends additional flood control storage in the Roaring River Reservoir described later. The Soil Conservation Service program provides flood control storage for the benefit of agricultural areas, as previously mentioned.

64. A principal flood control activity of the Corps of Engineers is the small project program under the special continuing authorities delegated to the Chief of Engineers. In addition to the four completed projects previously described, the following work is being done under those authorities:

a. Plans and specifications are being prepared and local interest is acquiring lands, easements and rights-of-way for a channelization project affecting a 9,650 foot reach of Kingstree Branch at Kingstree, South Carolina. Work will be accomplished under Section 205 of the Flood Control Act of 1948, as amended.

b. Section 205 studies are being made of Richardson Creek, Monroe and Union County, North Carolina; Leiths Creek, Scotland County, North Carolina; and Caraway Creek, Randolph County, North Carolina.

c. A study of snagging and channel clearing for flood control is being made under Section 208 of the 1954 Flood Control Act for Sellers Branch, Marion County, South Carolina.

65. Lumber River. A survey report to investigate flood control for the Lumber River was authorized 15 October 1968 by the Senate Committee on Public Works. The study is expected to be initiated soon.

66. Lynches River. The authorizing resolution of 16 March 1954 cited in paragraph 2 requested a study of channel clearing of Lynches River, South Carolina, below Welches Bridge for flood control Subsequent investigation of this problem shows that the Lynches River flood plain below Welches Bridge (U. S. Highway 301, river mile 73) and the mouth of Lynches River contains about 64,500 acres, of which about 8,000 acres are cropland; 2,500 acres are pasture lands; and 54,000 acres are forest lands. The only flood control improvements in the Lynches River Basin are 25 miles of channel improvement by the Soil Conservation Service in the upper Lake Swamp watershed tributary to Lynches River. Between 1888 and 1910, the river channel at its mouth was cleared under authority of an old navigation project. This work was discontinued in 1910. Average annual flood damages are presently estimated at $200,000. Solutions considered included clearing and snagging and channel improvement. Clearing and snagging, with an estimated first cost of $800,000, would yield annual benefits of about $40,000 at an average annual cost of about $65,000 with a benefit-cost ratio of 0.6. Channel improvement, with an estimated first cost of about $5,000,000 would yield annual benefits of about $150,000 at an average annual cost of about $330,000 with a benefit-cost ratio of 0.5. Therefore, no improvements in the interest of flood control would be economically feasible for Lynches River at this time.

67. Lynches Swamp (Lake Swamp). The authorizing resolution of 26 February 1958 calls for a study of flood control on Lynches River at and in the vicinity of Lynches Swamp and Lake City, South Carolina. The Lynches Swamp referred to is actually Lake Swamp, primarily a swampy, heavily-wooded area with numerous intermingling channels draining from the southwest into Lynches River at mile 13. Lake Swamp has a valley length of about 30 miles, an average width of 3,000 feet, and an elevation about 18 feet below the adjoining cultivated croplands. Its headwaters are located about ten miles northwest of Lake City in Florence County.

68. The Soil Conservation Service has completed 25 of 30 planned miles of channel improvement on the Camp Branch and Cypress Creek watersheds, tributaries to Lake Swamp above Lake City, South Carolina. Flood damage below Lake City, South Carolina, from inundation is minor, but channel improvement in this reach could provide for a more efficient outlet for farm drainage systems. However, preliminary economic analysis indicated that such an improvement for Lake Swamp is economically infeasible at this time.

69. Willow Creek. The authorizing resolution of 6 August 1948 requested a study of flood control and drainage for Willow Creek, South Carolina. The Willow Creek drainage area comprises 52 square miles of flat to rolling crop and forest land in Florence County. The creek heads up about five miles southeast of Florence, South Carolina, and extends southeasterly for about ten miles, where it flows into Jeffries Creek, a tributary of the Pee Dee River at river mile 89. About 7,200 acres, generally classified as swampland, border Willow Creek and its tributaries. About 2,500 acres of cropland are estimated to be subject to flood damage, the average annual value of which is estimated at $70,000. Average annual benefits, estimated at about $50,000, would be derived from a plan of improvement consisting of channel improvement of Willow Creek and its tributaries at an estimated first cost of about

$1,000,000, with average annual costs of about $76,000 and a benefit-cost ratio of 0.7. Therefore, no improvements for flood control would be economically justified at this time.

70. Flood plain management program. A program for reducing the future flood potential and improving uses of the flood plains was authorized by Section 206 of the Flood Control Act of 1960, Public Law 85-645, as amended. Under this program, the Corps of Engineers is authorized to prepare flood plain information reports on critical flood areas at the request of state and local governmental agencies. These reports define flood plain areas and provide guidance for establishing flood plain regulations for better uses of the flood plains. An amendment in 1966 provided for expanded flood plain management services to assist Federal and non-Federal agencies on flood hazard problems. Since the establishment of this program, six flood plain information reports have been made for the Yadkin River at Elkin and Jonesville, North Carolina; the Yadkin and Reddies Rivers at Wilkesboro and North Wilkesboro, North Carolina; and tributary streams at Lexington, North Carolina, Winston-Salem, North Carolina, Florence, South Carolina, and Mecklenburg County, North Carolina. Flood plain information reports are being prepared for Sumter, South Carolina, Salisbury, North Carolina and Monroe, North Carolina.

71. Flood insurance. A related activity established by the Housing and Urban Development Act of 1968 authorizes a national flood insurance program to be administered by the Department of Housing and Urban Development (HUD) in cooperation with insurance companies and other insurers. Under this program, flood insurance is to be made available, under certain conditions, at rates less than the estimated full risk rates to assist owners of existing property to meet flood losses, in lieu of disaster assistance (new developments would be insured only at full risk rates). The Corps has been authorized to assist HUD in identifying areas of flood hazard. A flood insurance study of Winston-Salem, North Carolina, has been made by the Corps of Engineers for HUD. The Soil Conservation Service has made such a study of Forsythe County, North Carolina.

MULTIPLE-PURPOSE PLANS

72. House Document 652 recommended plans. As stated before, House Document NO. 652, submitted to Congress in 1944, presented a plan recommended by the Chief of Engineers for reservoir development. The plan consisted of the Wilkesboro reservoir development for flood control and hydroelectric power as the initial step to be followed by the Tuckertown, Junction, Morven, Greater Blewett and Crump's Fork hydroelectric developments. Congress did not act on the Chief of Engineers' plan except to request a review study of House Document No. 652 with respect to flood control for the upper Yadkin River. The review, printed as Senate Document No. 31, 81st Congress as mentioned

previously, resulted in the authorization and construction of the Wilkesboro project without power (now the W. Kerr Scott Dam and Reservoir). The Tuckertown project of the 1944 plan has since been built by the Carolina Aluminum Co. (now Yadkin, Inc.) under Federal Power Commission license, essentially as in House Document No. 652. Therefore, of the Chief of Engineers' recommended plan in House Document No. 652, the Wilkesboro and Tuckertown sites are built on and only the Junction, Morven, Greater Blewett and Crumps Ford sites remain as potential reservoir sites for power and other purposes. A discussion of these sites and of other reservoir possibilities with power, in downstream order follows.

73. The Elkin. A site on the upper Yadkin River at mile 373, 1 mile upstream from Elkin, North Carolina was studied in House Document No. 652 as the site for a power project with pool elevation 950, 77-foot gross head and 17,400 kilowatts installed capacity. The project was found unjustified in House Document No. 652. It would inundate much of the valley between Elkin and Wilkesboro, which is benefited by the flood control provided by the W. Kerr Scott project. The Elkin project is clearly unjustified at this time.

74. Next below the Elkin site on the Yadkin River are the upper and lower Donnaha sites at mile 340 and 336 respectively. Reservoirs at either of these sites with a pool at elevation 877 would extend upstream to the vicinity of Elkin. Both of the Donnaha sites were marginal economically in the District Engineer's studies for House Document no. 652. The upper donnaha site was slected by the District Engineer in preference to the lower Donnaha site, as the upper site would permit development of the Styers site next downstream at mile 316. The Styers project at pool elevation 750 would back water up to the upper Donnaha site.

75. Next downstream on the Yadkin River from the Styers site is the Junction site at mile 276 at the head of High Rock Lake and about 1 mile above the junction with the South Yadkin River. Developments at the Junction site to pool elevation 685 and 720 were studied in detail for House Document No. 652. The Junction reservoir at the lower elevation would just extend upstream to the Styers site but the higher pool would submerge the Styes site deeply. The District Engineer's selected plan included the Junction project to the lower elevation which was compatible with the Styers plan. In the final plan of the Chief of Engineers for House Document No. 652 the higher elevation at Junction was selected, eliminating the Styers project. The upper Donnaha site was also eliminated by the Chief of Engineers as of marginal value.

76. A project on the South Yadkin River at the Coolemee site, mile 11, was studied by the District Engineer for House Document No. 652. A project at pool elevation 740 could develop a head of 86 feet. It was definitely uneconomical and was not included in the recommended plan.

77. The next opportunity for development downstream on the Yadkin was at the Tuckertown site between the existing Narrows and High Rock power projects. The Tuckertown project was recommended in House Document No. 652 and has since been built by Yadkin, Inc., as mentioned.

78. Below the Tuckertown site are the existing Narrows, Falls, and Tillery projects in series. The Yadkin River becomes the Pee Dee River within the Uwharrie River arm of the Tillery project. Downstream from the Tillery project, Rocky River enters the Pee Dee River at mile 219. Three sites were studied on the Rock River in House Document No. 652, at Love's Fork, Nance's Ford and Crump's Ford in downstream order. The Love's Ford and Nance's Ford projects were eliminated by the District Engineer as minor uneconomical possibilities. The Crump's Ford project was recommended by the District Engineer as one of the later stages in his plan and was included by the Chief of Engineers in his recommended plan.

79. Downstream on the Pee Dee River at mile 195 is the Blewett Falls Dam of the Carolina Power and Light Co. The possibility exists of raising the dam from pool elevation 174 to pool elevation 205 to utilize all of the available head to the existing Tillery project upstream. This proposal was recommended in House Document No. 652 as the Greater Blewett Falls development.

80. The last downstream power site is the Morven site on the Pee Dee River at mile 181, at the fall line. A project with pool elevation 125 would back water to the Blewett Falls Dam and have a head of 34 feet.

81. All of the above power possibilities are now economically unjustified. There are no alternative sites of consequence or significant changes in plan since House Document No. 652 which would materially improve the prospects of the sites recommended in that document. There has been considerable increase in the cost of this type of project since 1944. Construction costs and the cost of land and reservoir relocations have more than doubled. The interest rate on the investment cost has nearly doubled and the cost of operation and maintenance has increased greatly. As a result the annual charges of multiple-purpose projects have increased in the order of five times since 1944. Power benefits on the other hand have not risen correspondingly since House Document No. 653 as the cost of alternative steam-electric power has not increased much since then. Benefits for outdoor recreation and for fish and wildlife enhancement may now be claimed toward project justification as appropriate under the Federal Water Project Recreation Act of 1965 (with the cost of providing recreational facilities added to the project cost). Overall, the result of the economic changes since 1944 have been adverse to the economic justification of the reservoir projects described above and none are justified for Federal participation at this time. Plate 3 shows potential reservoir sites and Table 8 shows data on the principal sites and estimates of their approximate cost and economic justification. The benefits include full recreational benefits assuming for purpose of the estimates that the states or other governmental agencies would share in the cost of providing recreational facilities after completion. It is uncertain whether such cooperation would be provided if the reservoirs were

TABLE 8

PRINCIPAL MULTIPLE-PURPOSE SITES WITH POWER

	Upper Donnaha	Lower Donnaha	Styers	Junction (High)	Crump's Ford	Greater Blewett	Morven
River	Yadkin	Yadkin	Yadkin	Yadkin	Rocky	Pee Dee	Pee Dee
River mile	340	336	316	276	8	195	181
Drainage area, sq. mi.	1,540	1,620	1,870	2,430	1,375	6,860	7,240
Full pool elevation, feet	877	877	750	720	340	205	125
Reservoir area at full pool level, acres	11,300	19,700	13,700	53,000	14,300	21,100	2,900
Tailwater elevation, ft.	753	729	680	614	205	125	91
Gross head, feet	124	148	70	106	135	80	34
Installed capacity, kilowatts	58,800	82,100	54,000	100,000	42,800	120,000	44,900
Average annual energy, kilowatt-hours	125,000,000	150,000,000	76,000,000	150,000,000	85,000,000	364,000,000	138,000,000
Construction cost	$53,000,000	$79,000,000	$48,000,000	$106,000,000	$46000,000	$96,000,000	$38,000,000
Annual charges	$ 4,200,000	$ 5,700,000	$ 3,600,000	$ 7,700,000	$3,700,000	$ 7,400,000	$ 2,700,000
Annual benefits	$ 3,200,000	$ 4,400,000	$ 3,100,000	$ 6,000,000	$3,100,000	$ 5,600,000	$ 2,000,000
Benefit-cost ratio	0.76	0.77	0.86	0.78	0.84	0.76	0.74

economically justified and requests for cooperation were made.

82. Appalachian report plans. As stated previously, the Appalachian report submitted to the Appalachian Regional Commission recommends construction of the Roaring River project as a multiple-purpose reservoir project which would aid in economic development of the Appalachian Region. The site of the Roaring River Dam is at mile 2.9 on Roaring River, drainage area 129 square miles. An earthfill dam 159 feet high would impound a reservoir of 77,300 acre feet capacity at the top of flood control pool elevation 1092.0, reservoir area, 1,740 acres. Flood control storage of 48,200 acre-feet would be contained between elevation 1,092.0 and elevation 1,053.0, top of conservation pool. The reservoir area at elevation 1,053.0 would be 821 acres. Below elevation 1053.0 would be 29,100 acre feet for water supply, water quality flow and sediment storage. The estimated total cost as of December 1967 was $10,758,000. The benefits would be for flood control, water supply, water quality control, recreation and expansion benefits for economic development of Appalachia.

83. Two other reservoir projects similar to the Roaring River project were studies in the Appalachian report, with sites on the Fisher and Mitchell Rivers. These were not recommended for construction at present.

OTHER PLANS

84. Navigation. In the absence of needs for navigation improvements, no plans were formulated for that purpose. Improvement of the Pee Dee River for modern barge navigation above the litte used tidal reaches would require the construction of locks and dams at great cost as compared with the possible transportation benefits at this time.

85. Water supply. The greatest potential need for future water supply is in the upper Yadkin River Basin. The existing and authorized reservoirs and the recommended Roaring River Reservoir in the Appalachian report are expected to meet the future needs of that area.

86. Water quality control. Oother than the water quality control storage incorporated in the reservoirs discussed, no plans are proposed for water quality control in this report. Water quality control programs on the Pee Dee River are probably ameliorated to a large extent by reservoir releases for hydroelectric power generation.

COORDINATION WITH OTHER AGENCIES

87. Federal, State, and municipal agencies were consulted during the preparation of this report. Principal coordination with these agencies was accomplished for the Appalachia studies. However, coordination was also accomplished with appropriate agencies during all phases of the investigation. Federal agencies whose views are documented and reflected in the report, "Development of Water

Resources in Appalachia," presented by the Office of Appalachian Studies, are as follows:

a. U. S. Department of Agriculture;
b. U. S. Department of the Interior;

(1) Federal Water Pollution Control Authority, FWPCA (now the Water Quality Office of the Environmental Protection Agency, WQO of EPA);
(2) U. S. Fish and Wildlife Service;
(3) Bureau of Outdoor Recreation;

c. Federal Power Commission.

In addition coordination was effected with appropriate non-Fedeeral interests, including state and other local agencies.

DISCUSSION

88. This report is submitted primarily in response to the Seante Resolution of 28 June 1962 calling for a review of plans in House Document No. 652, 78th Congress, and other reports. Other possibilities of water resource development were also studied for this report.

89. House Document No. 652, submitted in 1944, contained a general plan of reservoirs at the Wilkesboro, Tuckertown, Junction, Morven, Greater Blewett and Crumps' Ford sites for hydrelectric power, with flood control storage also included at Wilkesboro. The Wilkesboro recommendation was strongly opposed by residents in the valley to be inundated by the project. A review of House Document No. 652 was then authorized leading to a plan of four small reservoirs for flood control, without power, in the upper Yadkin Basin above Wilkesboro. The plan was recommended in 1946 and is presented in Senate Document No. 31, 81st Congress. The plan was later revised to the present project plan which includes the completed W. Kerr Scott Reservoir project and the authorized Reddies River project as described before.

90. Of the sites besides Wilkesboro proposed for development in House Document No. 652, the Tuckertown site has since been developed for hydroelectric power by the Carolina Aluminum Company, now Yadkin, Inc. The remaining undeveloped sites of House Document No. 652 and all other reservoir possibilities for hydroelectric power have been considered for this report. Recreation was added as a purpose which may be claimed in project justification, as was not possible in 1944, under provisions of the Federal Water Project Recreation Act of 1965. The construction cost of this type of project has increased greatly since 1944 and the rate of interest on investment has nearly doubled. The power benefits, on the other hand, have not increased greatly since 1944, because of economies in the cost of alternative steam-electric

generation, the measure of hydroelectric power benefits. It is found that none of the multiple-purpose possibilities with hydroelectric power are justified for Federal participation at this time. Hydroelectric power, although the principal activity in water resource development in the past, now supplies only a small part of the basin's power needs. Steam-electric power is expected to furnish most of the future supply.

91. A multiple-purpose reservoir project without power is recommended for a site on Roaring River in the report, "Development of Water Resources in Appalachia" prepared by the Corps of Engineers' Office of Appalachian Studies for the Appalachian Regional Commission. The Roaring River Reservoir would include flood control, water supply, water quality control, recreation, and economic expansion benefits for Appalachia.

92. Navigation improvement is found to be not needed or requested at this time. There is no commerce of significance on the lower Pee Dee River and no potential commerce on the river upstream which would justify improvement.

93. Floods inundate about 900,000 acres along the rivers of the basin, mostly in the Coastal Plain region. There are no large cities along the main rivers or centers of concentrated damage which would justify large-scale programs for flood control. Flood-control storage included in the existing, authorized, and recommended reservoirs in the upper Yadkin River Basin would reduce floods in the upper Yadkin River as described. Local flood damage by tributaries has been investigated under special continuing authorities which authorize construction of small flood control projects by the Corps of Engineers. Several projects have been accomplished or are being investigated under these authorities. The small project program is expected to solve many future flood problems as they arise.

94. The Flood Plain Management Program of the Corps of Engineers authorizes the Corps to provide flood plain information and guidance to the States and local governments to help in planning for better uses of the flood plains. This program is of much benefit in reducing the future potential for flood damage. A related program under the Department of Housing and Urban Development provides for flood insurance under certain conditions to assist owners of existing developments where flood control improvements are not justified. The Corps of Engineers assists HUD in identifying areas of flood hazard.

95. Congressional resolutions responded to in this report authorized the study of flood control for Lynches River, Lynches Swamp (Lake Swamp), and Willow Creek near Florence, South Carolina. Channel improvements were studied for these locations and were found not justified for Federal participation.

96. The needs for water supply, water quality control, and recreation in addition to that provided in the authorized and potential projects described were considered. No additional projects for those programs were found justified at this time.

97. Additional information on this report, called for in Senate Resolution 148, 85th Congress, adopted January 28, 1958, is contained in a supplement to this report.

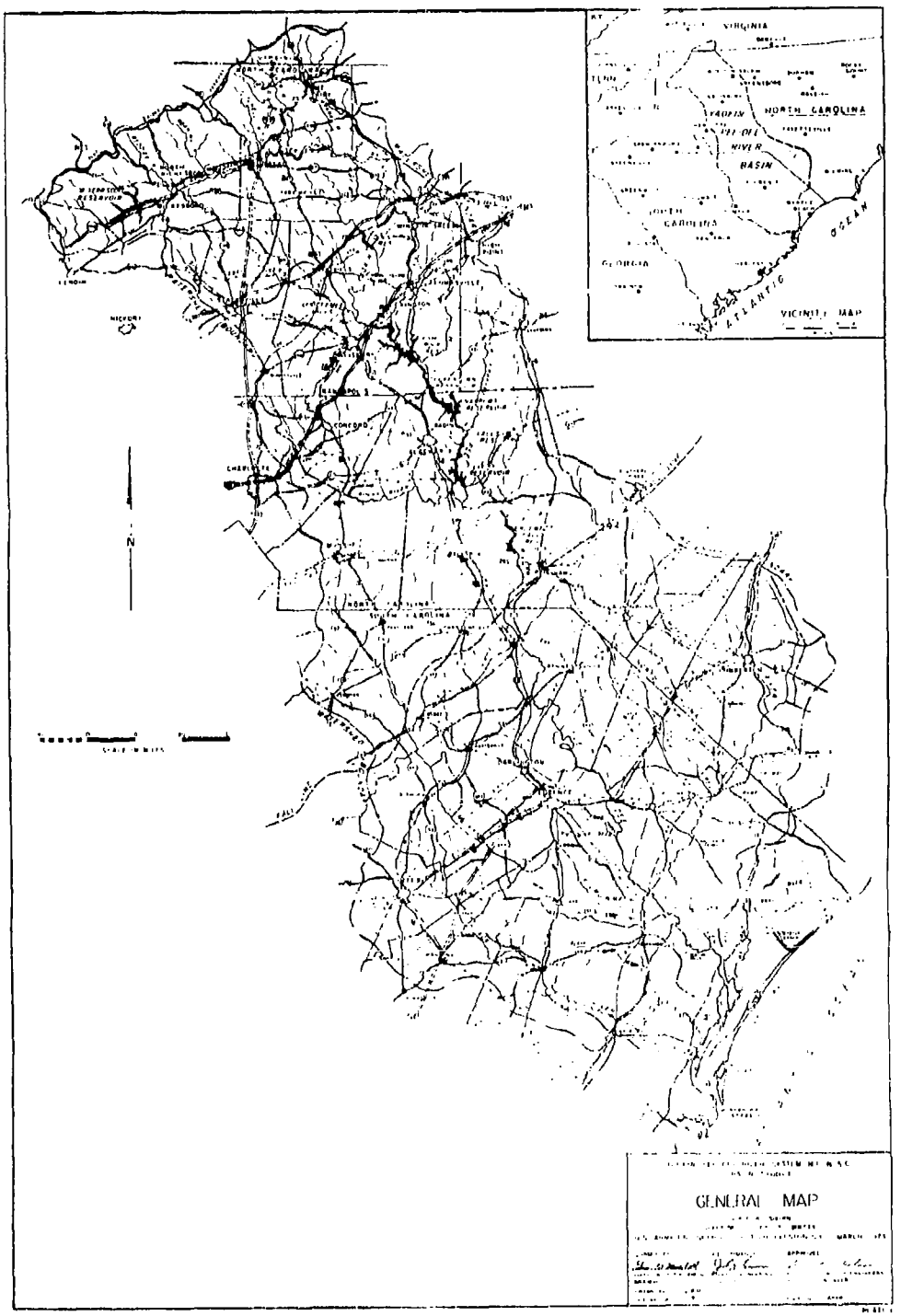
CONCLUSIONS

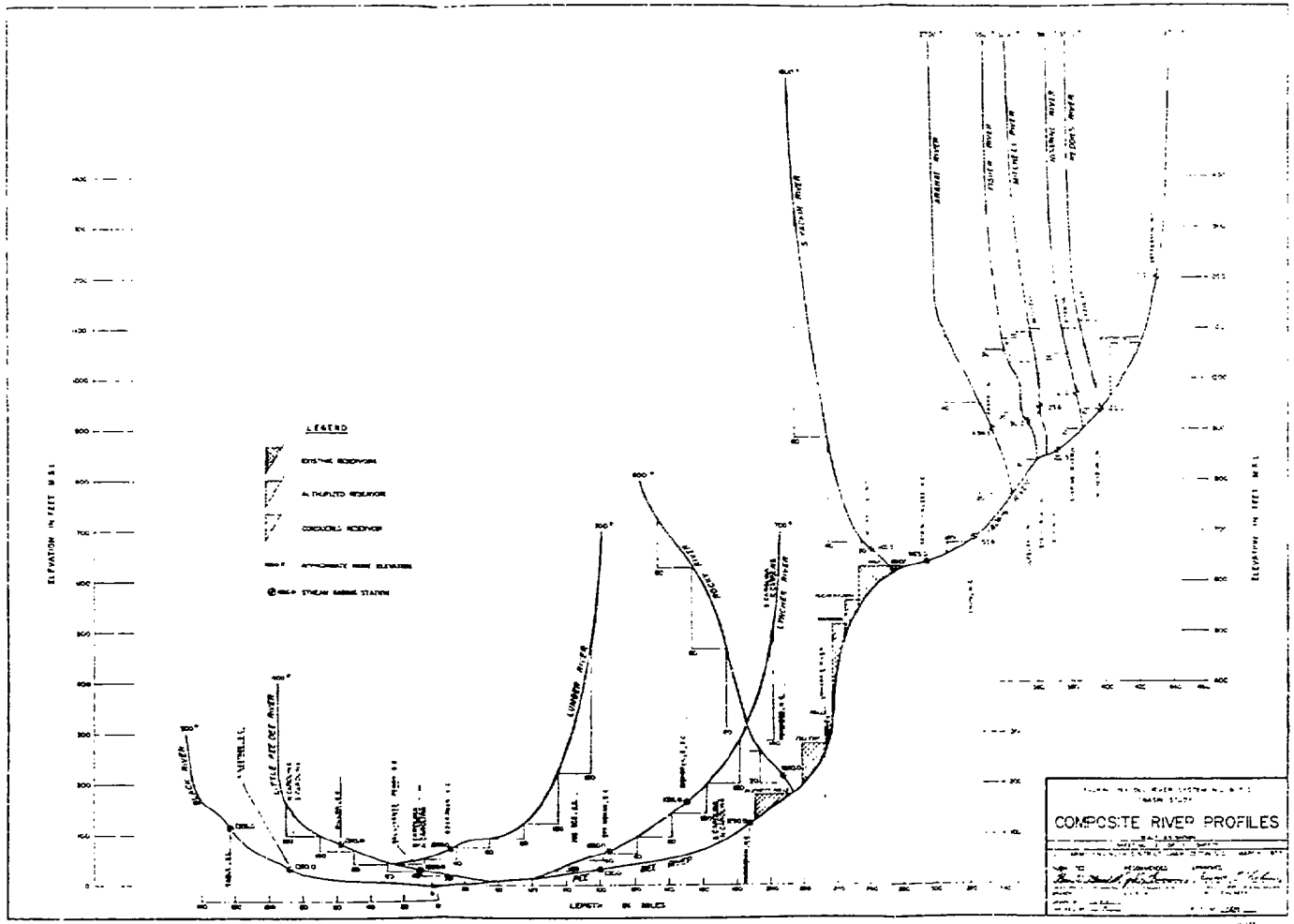
98. The District Engineer concludes that no improvements in addition to those already a reality or those authorized for construction or separate study or recommended for authorization in the Appalachian Studies Report, are justified for Federal participation at this time.

RECOMMENDATIONS

99. The District Engineer recommends that no additional improvements of the water resources of the basin be authorized for Federal participation at this time.

ROBERT C. NELSON
Colonel, Corps of Engineers
District Engineer

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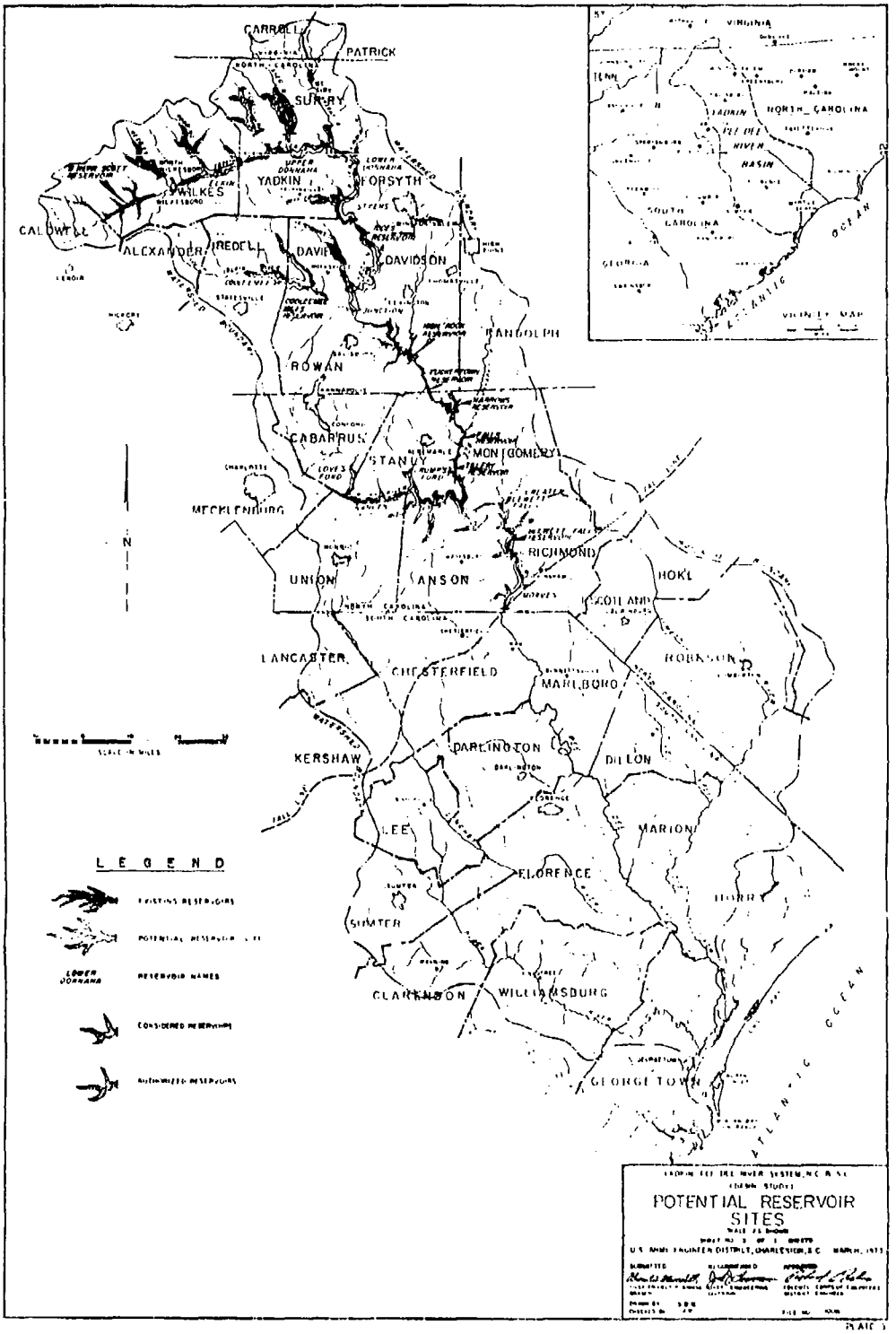
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CLARENDON
WILLIAMSBURG
GEORGETOWN
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RESERVOIR NAMES
CONSIDERED RESERVOIRS
AUTHORIZED RESERVOIRS
POTENTIAL RESERVOIR SITES
U.S. ARMY ENGINEER DISTRICT, CHARLESTON, S.C.
MARCH, 1973

PLATE 1

SUPPLEMENT

INFORMATION CALLED FOR
BY SENATE RESOLUTION 148,
85TH CONGRESS, 1ST SESSION,
ADOPTED 28 JANUARY 1958

SUPPLEMENT

INFORMATION CALLED FOR BY SENATE RESOLUTION 148

1. General. The information in this supplement is furnished in response to resolutions adopted by the Committee on Public Works of the United States Senate on 26 February 1958, which requested a review of the report on the Yadkin-Pee Dee River, North Carolina and South Carolina, printed as House Document No. 68, 73rd Congress, 1st Session, with a view to determining whether any modification of the recommendations contained therein at the present time, with particular reference to providing flood control and major drainage improvements on Lynches River at and in the vicinity of Lynches Swamp and Lake City, South Carolina; and on 28 June 1962, which requested a review of the report on the Yadkin-Pee Dee River, North Carolina and South Carolina, printed as House Document No. 652, 78th Congress, 2nd Session, with a view to determining the advisability of modifying the existing project at the present time, with particular reference to the development and maximum utilization of the water resources of the main stem and tributaries downstream from the Wilkesboro Reservoir, North Carolina. Also a resolution adopted by the Committee on Public Works of the House of Representatives, United States, on 6 August 1948, which requested a review of the reports on Great Pee Dee River and tributaries, transmitted to Congress on December 28, 1938, and other reports with a view to determining what measures are necessary and justified at this time to provide for flood control and drainage in the Great Pee Dee River Basin with particular reference to Willow Creek, South Carolina. Also a resolution adopted by the Committee on Public Works, House of Representatives, United States, on 16 March 1954, that a survey report be prepared on Lynches River with a view to determining whether it is advisable at this time to clear the channel below Welches Bridge of obstructions to admit a more rapid runoff of flood waters.

2. Report findings and recommendations. The present report recommends that no plan of improvement be authorized as a result of the current evaluation. However, the Reddies River project is authorized and the Roaring River project is recommended for construction in the report, of "Development of Water Resources in Appalachia," prepared for the Appalachian Regional Commission. Both projects have flood control, water supply, water quality control, general recreation, and fish and wildlife conservation as project purposes. The present report further recommends that local water resource problems be solved as they arise, either under the special continuing authorities of the Corps of Engineers, or a separate Congressionally authorized survey report, or the watershed program of the Soil Conservation Service, U. S. Department of Agriculture.

3. Project description.

a. General. The Yadkin-Pee Dee River basin extends northwest from the coast of South Carolina at Georgetown, S.C., into central North Carolina and a small portion of the basin extends into Virginia. The total basin drainage area is 16,340 square miles of which 6,880 square miles are in South Carolina; 9,280 square miles are in North Carolina; and 180 square miles are in Virginia. The basin lies within the Coastal Plain, Piedmont Plateau, and the Blue Ridge Mountain Provinces with elevations varying from about 4,000 feet above mean sea level at the headwaters to about mean sea level at the mouth where the river flows into Winyah Bay. The principal tributaries of the Yadkin-Pee Dee River are the Black, Lynches, Little Pee Dee, Rocky, South Yadkin, Uwharrie, Arrarat, Fisher, Mitchell, Roaring, and Reddies Rivers. There are nine existing privately owned reservoirs in operation for the generation of hydroelectric power within the basin.

b. Plan of improvement. The plans of improvement considered in the present report were designed to provide the basin's remaining water resource needs for flood control, water supply, water quality control, general recreation, fish and wildlife conservation, and hydroelectric power. Several reservoir sites in the basin were investigated for all water resource development needs. Economic analysis indicated that these projects, except for the Reddies River and Roaring River projects discussed in paragraph 2, would not be economically feasible at this time.

4. Project costs and benefits. No projects recommended in the present report.

5. Intangible benefits. No projects recommended in the present report.

6. Future needs. The authorized Reddies River and recommended Roaring River projects would, if constructed, provide most of the near term basin water resource needs. Benefits that could be derived from the provision of other basin-wide water resource conservation needs would be insufficient to economically justify any other Federal improvements at this time. The future growth of the basin needs could require the construction of the Mitchell River and Fisher River projects which are economically infeasible at this time.

7. Allocation of costs. No projects recommended in the present report.