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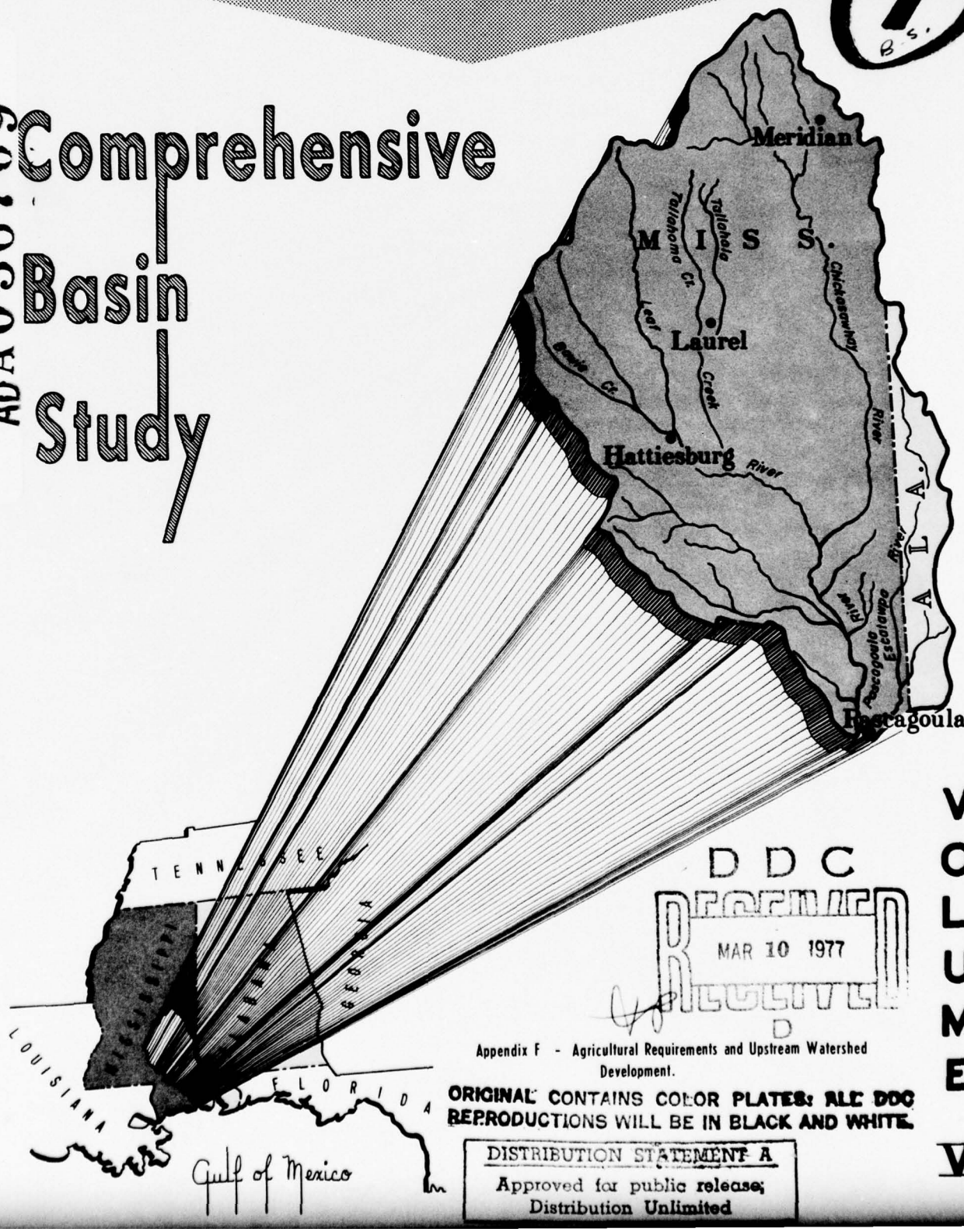
Comprehensive Basin Study



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Appendix F - Agricultural Requirements and Upstream Watershed Development.

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VOLUME II	Appendix A - Views of Federal and State Agencies on Comprehensive Plan Appendix B - Assurances of Local Cooperation Appendix C - Digest of Public Hearings
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VOLUME VIII	Appendix N - Role of the States of Mississippi and Alabama in the Planning and Development of the Water and Related Land Resources in the Pascagoula River Basin

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PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

Volume V.

APPENDIX F.

This volume, subtitled,

AGRICULTURAL REQUIREMENTS AND UPSTREAM WATERSHED DEVELOPMENT, includes the following topics: → (cont on p iii)

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Prepared by
UNITED STATES DEPARTMENT OF AGRICULTURE
Soil Conservation Service
Economic Research Service
Forest Service,

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AGRICULTURAL REQUIREMENTS AND UPSTREAM WATERSHED DEVELOPMENT

CHAPTER I

INTRODUCTION

This report by the U. S. Department of Agriculture is part of a comprehensive plan for the development of the water and related land resources in the Pascagoula River Basin located in the southeastern part of Mississippi and southwestern Alabama. Studies and reports by other Federal and State agencies are also expected to make their contribution to the comprehensive plan. The purpose is to guide the orderly development of all water and land resources of the Basin to keep abreast or slightly ahead of the needs.

Needs for the development of water and related land resources result from economic and resource losses as well as social losses of an intangible nature. Need arises from such occurrences as water shortages, water surpluses, deficiencies in water quality, land losses due to water action, and inefficiencies in the use of both water and related land. The adverse effects of these water related problems are identified in terms of damages, both direct and indirect, to land, to firms, households, communities, and the Basin and regional economy in the absence of correction or development of water and land related resources currently existing or of potential consequence.

The responsibility for determining Basin-wide water development needs for agricultural and non-agricultural uses was borne by several participating agencies and departments. The U. S. Department of Agriculture collaborated with and assisted other agencies as necessary to achieve a complete and consistent assessment of all water problems. This report, however, is concerned primarily with water and related land problems and ways of alleviating them in the headwater areas. A complete assessment of total Basin water and land related problems and proposed solutions will be presented in the U. S. Department of Agriculture report. 1/

1/ This document is an appendix report to the Pascagoula River Comprehensive Basin Study. The Department of Agriculture report will include the same material plus development plans of other agencies - local, State and Federal - encompassing total Basin problems and recommended solutions.

Authority

This study was made under the authority of Section 6 of the Watershed Protection and Flood Prevention Act of the 83rd Congress (Public Law 566, as amended) which authorized the Secretary of Agriculture to cooperate with other Federal, State and local agencies in their investigations of watersheds, of rivers, and of other waterways to develop coordinated programs. This study was carried out in cooperation with other Federal agencies and the States of Mississippi and Alabama.

Participants

The principal participants within the U. S. Department of Agriculture were the Soil Conservation Service, the Forest Service, and the Economic Research Service. Participation of the USDA agencies was carried out in accordance with assigned responsibilities and coordinated through a Washington Advisory Committee and a Field Advisory Committee. The functions of these committees are set forth in a Memorandum of Understanding between the Soil Conservation Service, the Forest Service, and the Economic Research Service which states in part:

> "The field committee members will maintain appropriate liaison with the administratively responsible officers of their respective Services and facilitate the coordination of activities by their respective Services in carrying out the investigations and surveys. The field committee will meet from time to time on the call of the chairman and shall meet often enough to accomplish effective coordination of the work and to keep a constant check on progress. The Committee will maintain sufficient liaison with field officers of other Department agencies and other Departments to provide assurance that the field work of the Department of Agriculture is adequately coordinated with that being done by other Departments."

The personnel assigned to the river basin survey by the three USDA agencies functioned as a planning team under the guidance of the Field Advisory Committee. Each agency had leadership responsibility for designated aspects of the survey as outlined in an adopted plan of work.

Other principal Federal Departments involved in the study were Army, Interior, and Health, Education, and Welfare. At the Washington level, cooperative relationships among the departments were maintained through the Water Resources Council of Representatives. At the river basin level, cooperative relationships were maintained through a coordinating committee. This committee, made up of representatives of

participating Federal and State agencies and chaired by the Corps of Engineers, served as a means of achieving coordination in conducting the studies and formulating the proposed plan.

The planning efforts were coordinated closely with the Pat Harrison Waterway District, the Mississippi Board of Water Commissioners, the State of Alabama and local agencies and organizations concerned with the development, utilization and management of water and land resources. Full consideration was given to the desires and objectives of the local interests. Viewpoints of project sponsors and other interests directly affected by the agricultural and rural community aspects of the surveys and results were solicited and considered.

Objectives

The primary objective of the U. S. Department of Agriculture study is to facilitate the coordinated and orderly conservation, development, utilization and management of water and related land resources of the Basin. To achieve this aim necessitated a general appraisal of the overall water and related land resource problems and development potentials of the Basin and included:

(1) An inventory of resources.
(2) Studies and projections of economic development.
(3) Translations of such projections into needs for water and related land resource uses.
(4) Appraisals of the availability of water supplies both as to quantity and quality.
(5) Appraisals of the availability of related land resources.
(6) A description of the characteristics of present and future problems and the general approaches that appear appropriate for their solution.
(7) Studies and identification of projects which need to be initiated during the next 10 to 15 years.
(8) Studies to determine the extent to which recreational, fish and wildlife habitat improvement, flood control, drainage, irrigation, rural, municipal and industrial water supplies and water quality control can be provided by water and related land resource development and programs in upstream areas to satisfy the demands.
(9) A compilation of economic, engineering, and related data to assist local groups and organizations in planning the development of resources.

Nature, Scope, and Intensity of Investigations

The Pascagoula River Study is defined as a Type II comprehensive detailed survey. A study of this type includes the major elements of a Type I study (objectives 1 through 6) plus intensive studies of specific projects, the installation of which will need to be initiated within the next 10 to 15 years.

The Department of Agriculture agencies analyzed historical information and developed projections of the following major indicators in addition to minor ones: (1) volume and value of agricultural and timber output; (2) income and employment in basic agricultural and forestry activities; (3) use of rural lands, including the acreage devoted to major crops, forest production, recreation, and fish and wildlife; and (4) employment income and other measures of economic activity directly and locationally related to the basic agricultural and forest industries. Analyses and projections of other sectors of the Basin's economy were obtained from results of an economic base study prepared under contract to the Corps of Engineers by Michael Baker, Jr., Inc., of Jackson, Mississippi.

The appraisal of agricultural and rural community water problems and development needs were based on the economic base studies and projections. The determination of resource development needs involved: (1) a physical inventory of the nature, distribution, and extent of agricultural and rural community water problems; (2) appraisals of economic losses sustained by farmers, households, and related trade and service centers which result from these problems under present and projected patterns of land use and development; (3) appraisals of the markets for products and services obtainable from the use of water and related land resources; (4) appraisals of potential for meeting needs for products or services through alternative means essentially unrelated to water resource development; and (5) estimates of the costs of obtaining the desired products or services from various types of more intensive uses or from development of available supplies of water and related land.

The Soil Conservation Service collaborated with other agencies in hydrologic studies to determine current water supplies and projections of future water availability. The Soil Conservation Service made reconnaissance studies on the amounts of sediment that would enter the stream system at selected points.

The current and future (1980 and 2015) land requirements for all uses were estimated by the Economic Research Service and Forest Service in collaboration with other agencies. The estimated land needs were compared with the availability of land of various types and capabilities. The cooperation of

other agencies with responsibilities for management of public lands was sought so as to include all land in the appraisal.

Potential solutions to water and land related problems include both structural and non-structural measures. Project and non-project type action was considered. Individual watershed projects identified for initiation of installation within the next 10 to 15 years meet the basic requirements for PL-566 projects. Their sizes, purposes, and cost-sharing arrangements are compatible with PL-566.

The agricultural plan for the development of water and related land resources of the Basin is proposed according to the method of authorization, PL-566 and Basin-wide authorization. The projects recommended for implementation through the going PL-566 program are presented in Chapter VI. The projects proposed for Basin-wide authorization are presented in Chapter VIII.

The basic reason that projects are proposed under different methods of authorization is that the interests of local organizations and the Pat Harrison Waterway District demanded immediate action in satisfactorily solving the water and land related problems. Thus, eight watersheds demanding immediate attention were identified and authorization proposed under PL-566. Nine additional watersheds determined as needing action in the next 10 to 15 years are proposed in Chapter VIII for Basin-wide authorization.

CHAPTER II

DESCRIPTION OF BASIN

Location and Size

The Pascagoula River Basin is located in the southeastern part of Mississippi and southwestern Alabama (Figure 1). The river is made up of two dominant tributary streams - the Leaf River and the Chickasawhay River. The Chickasawhay River rises in Neshoba and Kemper Counties while the Leaf River heads up in Scott County. These two streams flow in a southern direction with confluence in the northern part of George County. The Pascagoula River flows in a southern direction into the Gulf of Mexico. Minor tributary streams that flow into the Pascagoula are Bluff and Red Creeks. The drainage area is approximately 164 miles long and is about 84 miles in width at the widest place. The total drainage area is approximately 9,700 square miles. The valleys vary in width from one-half mile in the upper tributary stream to 5 miles in the lower portion of the Pascagoula River. Land subject to overflow comprises about 16 percent of the area.

A list of counties wholly or partially within the Basin is presented in Table 1. Throughout the report, reference to the Pascagoula Basin refers to these counties and the area within the hydrologic boundary.

An economic study of the delimitated River Basin entails an analysis of the economy of those smaller areas comprising the Study Area. Counties were used as the unit for forming sub-areas for several reasons: (1) they were the smallest political unit for which large quantities of statistical information were available on many different subjects; (2) county units are recognized as record keeping units; (3) county units are sufficiently small to provide a satisfactory reflection of leading local economic variations; (4) county boundaries are quite stable.

The boundaries of the sub-areas were delimitated by grouping together those counties that possessed similarities in water needs, geographical characteristics and economic activities. This homogeneity in socio-physio-economic characteristics permitted a meaningful analysis of the dominant forces influencing future economic changes in the Basin.

The three sub-areas have some watershed characteristics in common (Figure 1). The Chickasawhay River serves as a drainage system for five Mississippi counties - Clarke, Greene, Lauderdale, Newton and Wayne, which make up the Chickasawhay Sub-Area. The Leaf Sub-Area contains

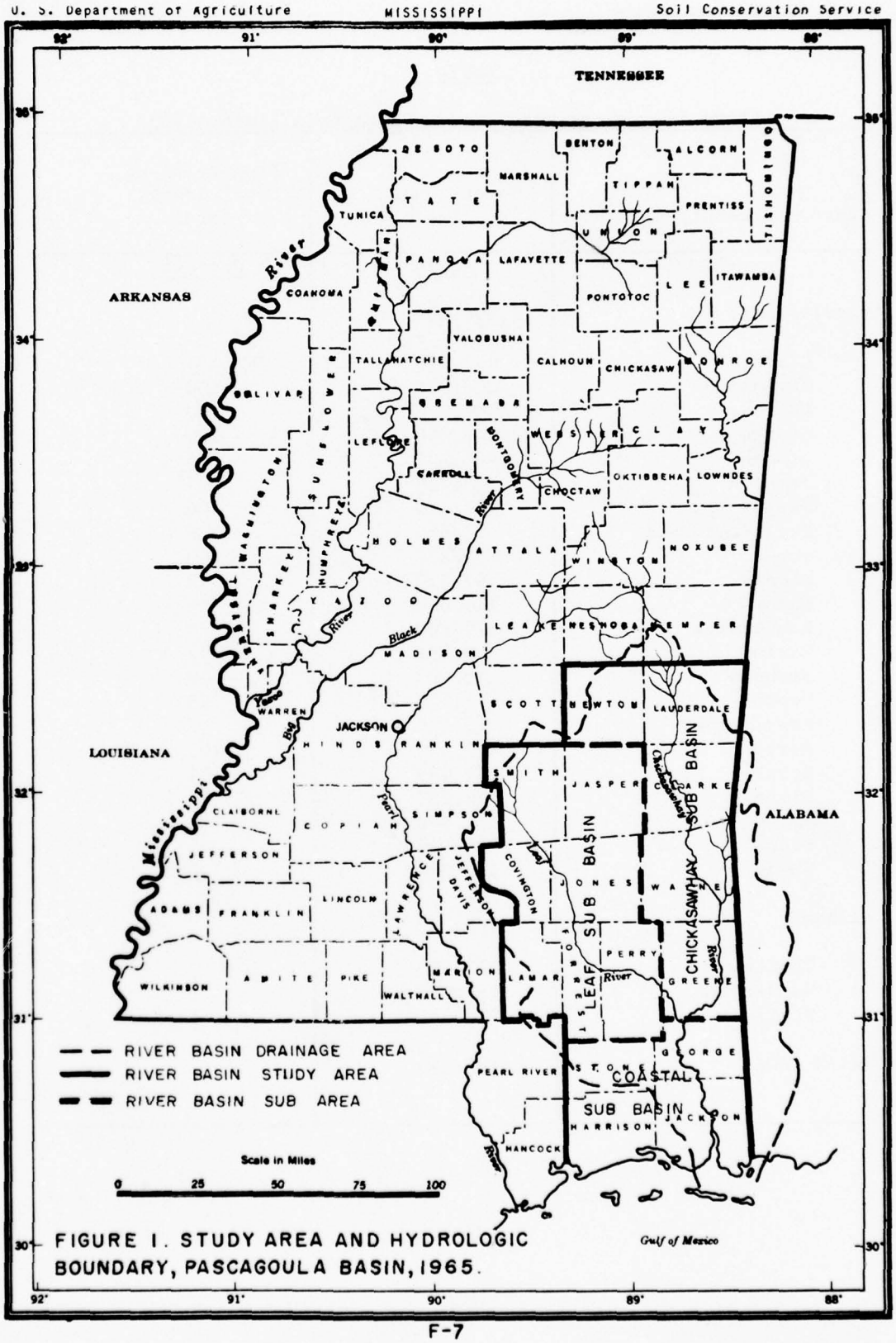

FIGURE 1. STUDY AREA AND HYDROLOGIC BOUNDARY, PASCAGOULA BASIN, 1965.

Table 1

State and county area in the Pascagoula Basin, 1958

State and county	County area in Basin	Proportion of total county area
	Acres	Percent
Mississippi:	5,650,605	
Clarke	431,280	97
Covington	266,240	100
Forrest	300,160	100
George	307,840	100
Greene	465,920	100
Jackson	365,230	77
Jasper	437,120	100
Jefferson Davis	78,640	30
Jones	451,840	100
Kemper	57,320	12
Lamar	210,660	66
Lauderdale	312,480	70
Marion	3,456	1
Neshoba	35,400	10
Newton	277,120	75
Pearl River	35,060	7
Perry	417,920	100
Scott	54,480	14
Simpson	74,279	20
Smith	352,900	86
Stone	185,980	65
Wayne	529,280	100
Alabama:	539,938	
Choctaw	17,935	3
Washington	195,582	29
Mobile	326,421	41
Basin total	6,190,543	

seven Mississippi counties draining into the Leaf River - Covington, Forrest, Jasper, Jones, Lamar, Perry and Smith. The remaining counties - George, Harrison, Jackson and Stone, comprise the Coastal Sub-Area. They are located south of the juncture of the Leaf and Chickasawhay Rivers and drain into the Pascagoula River and the Gulf of Mexico. In this report, these sixteen whole counties are called the Pascagoula Study Area (Table 2).

Table 2

Area of counties in the Pascagoula Study Area, 1958

Sub-area and county	Total area in county
	Acres
Chickasawhay	2,273,920
Clarke	446,080
Greene	465,920
Lauderdale	461,440
Newton	371,200
Wayne	529,280
Leaf	2,604,260
Covington	266,340
Forrest	300,160
Jasper	437,120
Jones	451,840
Lamar	320,000
Perry	417,920
Smith	410,880
Coastal	1,445,120
George	307,840
Harrison	374,400
Jackson	476,160
Stone	286,720
Study Area	6,323,300

Topography and Physiography

The Pascagoula Basin is roughly oval in shape with a maximum length of 164 miles and a maximum width of 84 miles. It lies within the Gulf Coastal Plain Physiographic Province. The Province is divided into four physiographic regions - North Central Hills, Jackson Prairie, Long Leaf Pine Hills and Coastal Pine Meadows.

The physiographic regions cross the Basin in a northwesterly direction. The northernmost region, the North Central Hills, is drained by Okahatta Creek, Tallahatta Creek and Chunky Creek which flow southeasterly, and Okatibbee Creek and the East and West Forks of Bucatunna Creek which flow generally south to the Chickasawhay River. The Jackson Prairie is a narrow belt of moderately high hills with numerous small prairies interspersed. Bucatunna Creek and Chickasawhay River cross this belt in a southerly direction. The Long Leaf Pine Hills region contains the Leaf River and its tributaries, the lower portion of the Chickasawhay River and the Escatawpa River. The confluence of the Leaf and Chickasawhay Rivers in the lower portion of this region forms the Pascagoula River. The Coastal Pine Meadows region is drained by the Escatawpa River which flows generally south-southwesterly in this area to the Pascagoula River and by the Pascagoula River, which flows southerly, to the Mississippi Sound at Pascagoula.

Elevations in the Basin range from sea level in the Coastal Pine Meadows to about 700 feet above mean sea level in the North Central Hills. Topography is rugged in the northeast corner of the Basin, but gently rolling to flat in the remainder.

Land Resource Areas and Soils

Corresponding roughly in location to the geological physiographic regions are land resource areas (Figure 2). These are physical groupings, based on soils and topography, made for purpose of agricultural interpretations. Within the Pascagoula Basin are three land resource areas - Southern Coastal Plain, Blacklands or Prairie, and Gulf Coastal Flatwoods.

The Coastal Plain comprises most of the Basin above the Coastal Flatwoods. Topography ranges from almost flat in the bottomlands to very steep in the uplands. Most of the land is wooded but where slopes are gentle and soil conditions favorable, a general type farming is practical. Most of the bottomlands are in woods except for limited areas of pasture and cropland where drainage work has been established.

The principal upland soils are Ruston, Ora, Savannah, Prentiss, Bowie, Shubuta, Boswell, and Lauderdale. Ruston is a deep friable well-drained soil. Ora, Savannah and Prentiss are friable, moderately well-drained soils with fragipans.

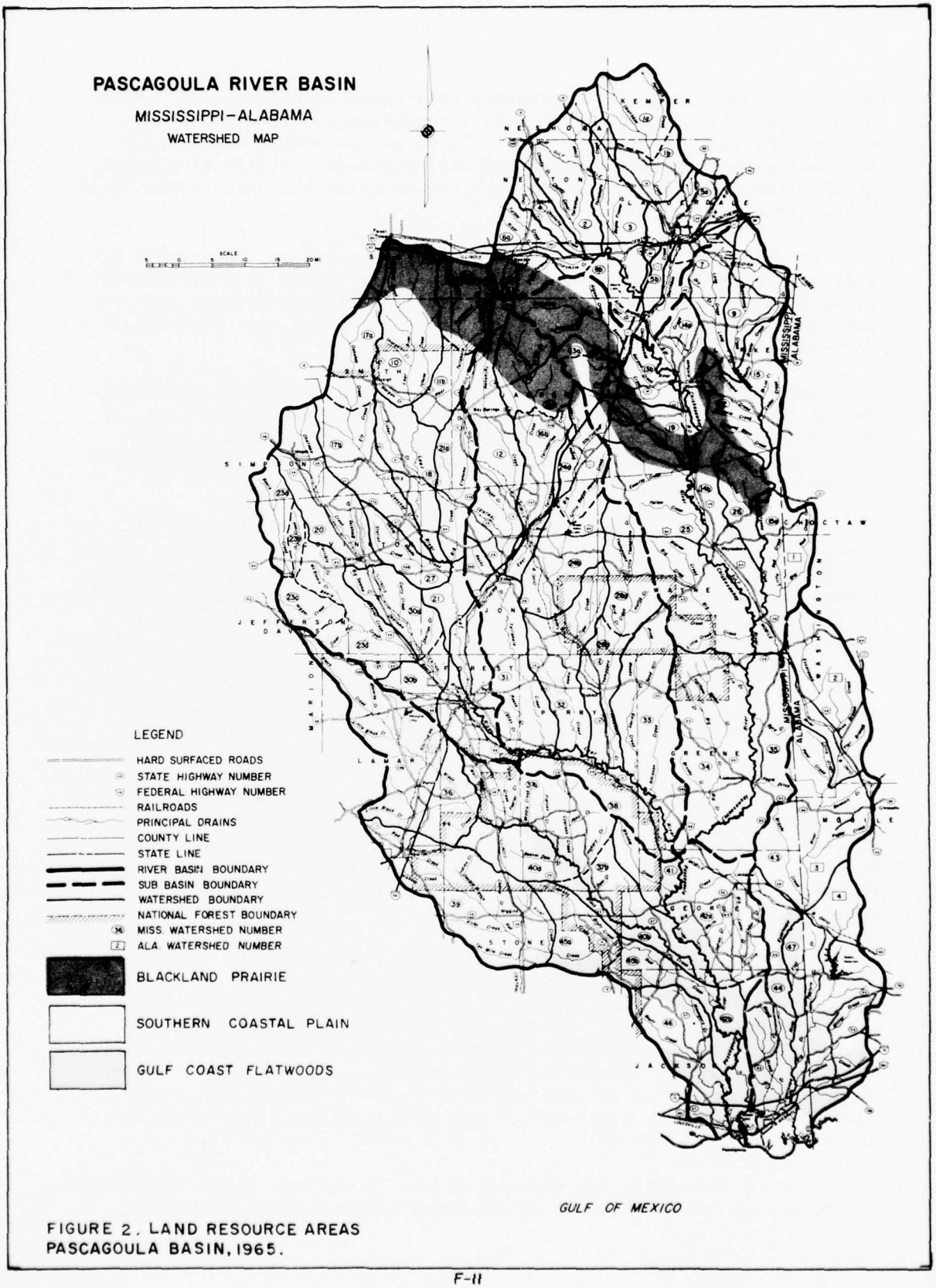

FIGURE 2. LAND RESOURCE AREAS
PASCAGOULA BASIN, 1965.

Bowie is a deep, friable, moderately well-drained soil over plinthite. Shubuta is well-drained and Boswell is moderately well-drained over clayey subsoils. Lauderdale is a well to excessively drained stony soil not generally used for agricultural purposes. Yields of commonly grown crops are moderate to high when these soils are used within their capabilities.

Principal bottomland soils are Mantachie and Bibb. Mantachie is a friable somewhat poorly drained soil. It is suited to most locally grown crops, grasses and legumes and yields well when drained and protected from overflow. Bibb is a low, poorly drained soil best suited to pasture or bottomland hardwoods.

The Blackland Resource Area is in form of a narrow belt crossing the Basin in a northwesterly direction. Uplands are rolling to steep and bottoms are flat and relatively wide. The dominant land use is forest and pasture. The soils are clayey except for areas that have an over-burden or coarser material.

Principal upland soils are Houston, Vaiden, Eutaw, Mayhew and Sumter. Houston is somewhat poorly to moderately well-drained. Eutaw and Mayhew are poorly drained and Sumter is a shallow soil over calcareous material. Surface textures are clayey causing management to be a problem when used for row crops. The soils are best suited to grasses, legumes and trees.

Dominant bottomland soils are Houlka and Una. Houlka is somewhat poorly drained and Una is poorly drained. Both soils are clayey and therefore are difficult to manage. They are well suited to grasses, legumes and bottomland hardwoods.

The Coastal Flatwoods is a relatively low flat plain paralleling the Gulf of Mexico and extending several miles inland. The native vegetation consists largely of slash pine, water grasses and gallberry bushes. Little of the land is used for agricultural purposes but in recent years there has been a great deal of urban and recreational development.

Principal soils are Eustis, Lakeland, Goldsboro, Klej, Lynchburg, Dunbar, Rains, Plummer, Coxville, and Bayboro. Eustis and Lakeland are excessively drained sandy soils. Goldsboro and Klej are moderately well-drained loamy soils. Lynchburg and Dunbar are somewhat poorly drained loamy soils. Rains and Plummer are poorly drained sandy soils. Coxville and Bayboro are poorly and very poorly drained clayey soils. Natural soil fertility is low. Goldsboro and Klej soils are the most desirable agriculturally, however, Eustis and Lakeland are suited to early season truck crops.

Bottoms are narrow and depression-like in nature. Soils are similar to the poorly drained members of the Lower Coastal Plain Resource Area.

Climate

The average annual rainfall varies from 54 inches in the northern part of the Basin to 62 inches in the southern part. The length of growing season will average 233 days between the last killing frost in March and the first killing frost in November in the upper part of the Basin. In the lower part near the coast line, the length of growing season will average 260 days. The mean average annual temperature varies from 65.0 degrees in the northern part to 67.0 degrees in the coastal areas. In the upper part the temperature averages 48.5 degrees in January and 81.5 degrees in July. For the lower coastal areas, the average is 52.0 degrees in January and 81.5 degrees in July.

Natural Resources

Land Use and Cover

The major land use is forests. This use covers almost 79 percent of the total land area with the majority of the forested land in the Upland. The Major forest types vary from longleaf-slash in the southern part to loblolly-shortleaf in the northern part. The oak-gum-cypress type is located throughout the Basin along the Leaf, Chickasawhay, Pascagoula Rivers and the other streams and tributaries (Figure 3). Softwoods cover 76 percent of the forest area and are comprised mostly of four southern pines - longleaf, slash, loblolly and shortleaf. The hardwood species are many with black, tupelo and sweet gum, bay, magnolia, red and white oak, yellow poplar, hickory and pecan being the principal species. The stand size is mostly pole timber, seedlings and saplings.

Cropland comprises about 10 percent of the total land. Corn, hay, cotton, oats and soybeans are the principal crops and account for most of the harvested cropland.

Pasture and other uses account for 5 and 6 percent, respectively, of the total land area. Grasses used for pasture include Bermuda, Dallis and Carpet. Idle, urban and built-up areas, water, Federal lands (except National Forests) are defined as other uses.

Water

The Pascagoula Basin is richly endowed with surface-water and ground-water sources capable of yielding large supplies of water that require a minimum of treatment for most uses. These resources are the result of an abundant rainfall which averages about 57 inches annually over the Basin and geologic conditions that are conducive to storage and transmission of large quantities of ground water.

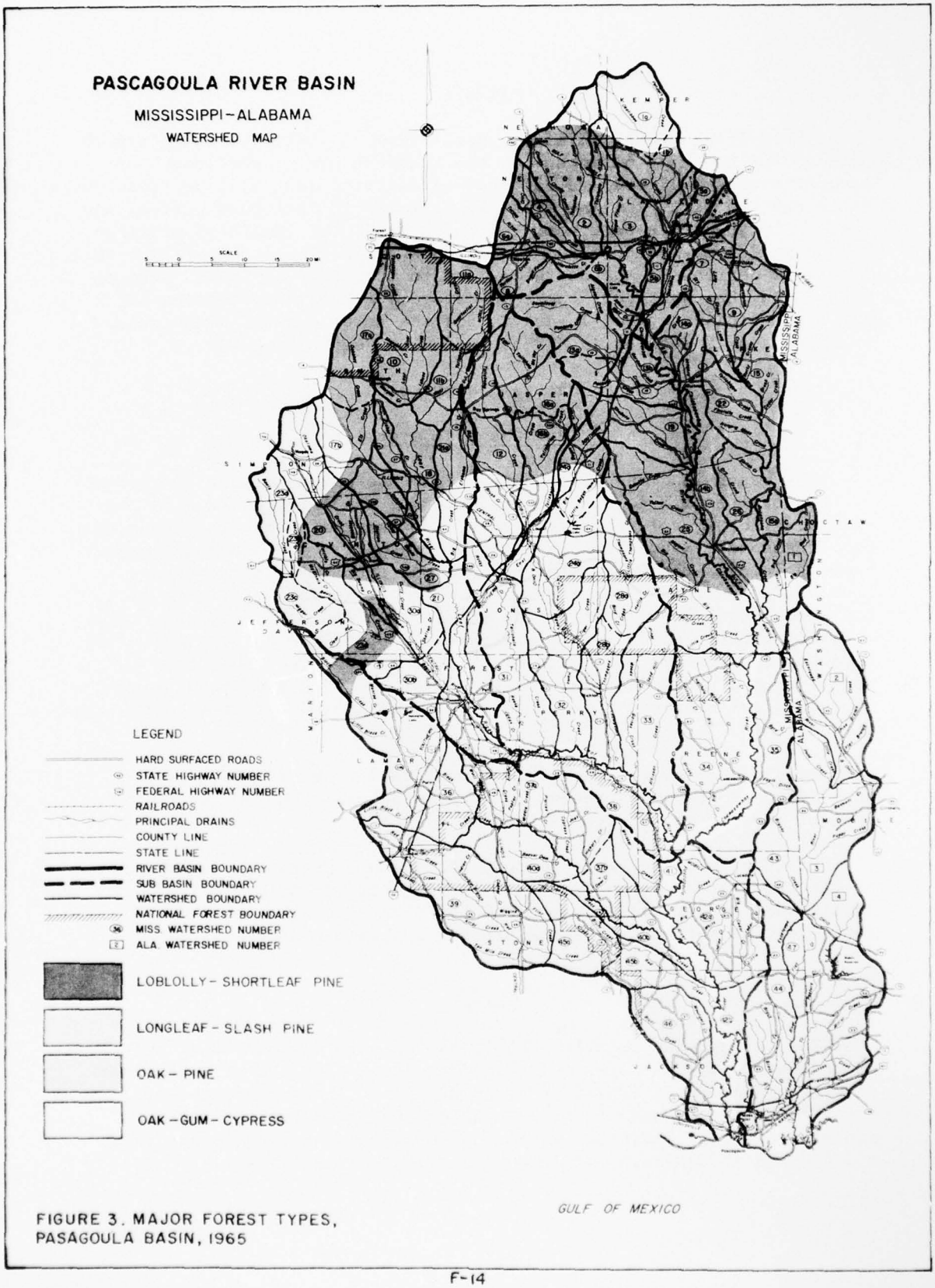

FIGURE 3. MAJOR FOREST TYPES, PASAGOULA BASIN, 1965

The major streams, other than the Pascagoula River, are the Leaf, Chickasawhay and Escatawpa Rivers. This river system during an average year discharges approximately 10,000 mgd (million gallons per day) of water into Mississippi Sound. Only a small fraction of the available surface water from this drainage basin is now being utilized.

During a 10-year drought, flow in the Leaf River increases downstream from 41 mgd at U. S. Highway 84 near Collins, Mississippi, to 400 mgd at the confluence with the Chickasawhay River, and flow in the Chickasawhay River increases from 45 mgd at U. S. Highway 45 at Shubuta, Mississippi, to 160 mgd at the mouth of the Chickasawhay River. On the main stem of Pascagoula River, a flow of nearly 700 mgd is expected during a 10-year drought just below the mouth of Big Cedar Creek and about 850 mgd is expected under the same conditions at Graham Ferry near Wade. Escatawpa River near Wilmer, Alabama, has a sustained flow of 35 mgd and Escatawpa River near Orange Grove, Mississippi, has a sustained flow of 139 mgd during a 10-year drought.

Natural quality of the stream water is good; even when subjected to brine pollution, mineral quality parameters seldom exceed limits for most uses. Pollution of the Leaf River at Hattiesburg and Tallahala Creek at Laurel by industrial and municipal waste, limits the usefulness of these streams. Effect of pollution is sometimes observed as much as 90 miles downstream.

In the tidal reaches of Pascagoula and Escatawpa Rivers, the downstream flow is interrupted periodically by flood tide, and, until the tide ebbs, saline water from the Mississippi Sound flows upstream. The saline water, which is more dense than fresh water, flows upstream as a wedge under the fresh river water. Except for brief periods during hurricane tides, it is unlikely that salt water will penetrate more than 20 miles up the Pascagoula River or 18 miles up the Escatawpa River.

Abundant ground-water resources underlie the Pascagoula River Basin. These resources have been developed intensively in only a few places, namely Hattiesburg, Laurel, Meridian, and Pascagoula. Seepage from the ground-water reservoirs sustains the base flows of the Leaf, Chickasawhay, Pascagoula and Escatawpa Rivers and their tributaries.

The fresh-water-bearing section is 300 to 3,500 feet thick and is composed chiefly of sand and clay of Eocene to Recent age. Major rock units represented are the Wilcox, Claiborne, Jackson, and Vicksburg Groups and formations of Miocene and Pliocene ages.

Aquifers in the Claiborne Group provide water for all purposes in the northern third of the Basin. The Claiborne is underlain by the potentially important but virtually untapped Wilcox Group. Miocene

aquifers are the main source of water supplies in the southern half of the Basin, but Pliocene aquifers furnish most supplies in the Jackson County area at the Basin's southern extremity.

Much of the fresh-water section has undergone no water-supply development because of the great depth of many aquifers and the availability, at shallow depths, of supplies adequate for present needs. However, it is probable that a large part of any substantial increase in ground water withdrawal will come from wells deeper than those commonly drilled in the region.

Ground-water levels are within 50 feet of the surface in most places, and flowing wells are common in the valleys and near the coast. Water-level declines due to pumping have become serious problems only in a few localities of heavy withdrawal. In most of these places redistribution of pumpage would alleviate the problem of excessive drawdown.

Although few wells in the Basin yield more than 500 gpm (gallons per minute), yields of 2,000 gpm or more could be reasonably expected from efficiently constructed wells almost anywhere in the region.

Total ground-water pumpage is estimated to be about 60 mgd. Potential pumpage is many times that figure. Well fields capable of yielding several million gallons of water per day would be feasible in most places.

The ground water is of good to excellent quality. Most of it is a sodium bicarbonate type of water. It usually is soft and has a low to moderate dissolved-solids content. Excessive iron is a problem in places, particularly where water supplies are obtained from shallow aquifers, but at least a part of the iron problem results from corrosion of well and distribution-line fittings by the slightly acidic water.

Salt-water encroachment is a potential problem in the coastal area, but little increase in saltiness has been observed in monitor wells in the period 1960-65. Saline-water resources are available for development at considerable depth in most of the region.

Fish and Wildlife

The Basin is outstanding in certain wildlife resources. Early restocking efforts of the Mississippi State Game and Fish Commission in replenishing deer and turkey were initiated in the late 1930's. Since then a cooperative effort by the U. S. Forest Service, the Mississippi Game and Fish Commission and private landowners has made possible a wildlife management program on more than a half-million acres of land. In addition to supplying an abundant harvest of game, the managed areas have served as reservoirs of deer and turkey for

restocking other parts of the State. The Basin deer harvest was estimated to be 4,745 during the 1965-66 season from a herd estimated to be in excess of 40,000 animals. The 1966 spring turkey season yielded 1,377 birds from an increasing flock.

Plant ecology and the resulting wildlife habitat conditions change within the Basin from north to south. Carrying capacities of game animals are generally higher within the loblolly-shortleaf and oak-pine types in the upper half of the Basin. Lower forage production for forest game is common to the longleaf-slash type of the southern portion but the extensiveness of this type and the associated bottomland hardwoods along the Pascagoula River make the entire Basin comparable in forest game production.

Bobwhite quail are native to the dominant longleaf-slash forest type in the lower half of the Basin. History, and more recent research, confirms the compatibility of prescribed burning within the longleaf type and the resulting bobwhite habitat and populations. However, more recently considered a farm game species, this bird finds suitable habitat on much of the 649-thousand acres of cropland within the Basin.

The cropland also supports most of the cottontail rabbit population while squirrel populations are associated with the numerous stream bottoms throughout the Basin. Waterfowl is generally associated with the larger streams; however, in some areas beaver ponds are important woodduck habitat. Within the lower coastal area various species of shorebirds find suitable nesting and feeding habitats. Preservation of these birds is becoming increasingly important as bird study and bird watching becomes a popular outdoor recreation activity.

Game fishery resources lie principally in the abundant production of bass and pan fish from several popular streams - Black, Thompson and Bluff Creeks. Float fishing with the associated aesthetic values, is a popular activity. Commercial fishery resources are important within the Pascagoula River and its associated estuaries. The more important commercial nongame gross fish include catfish and buffalo. Pollution is a problem in parts of the Leaf and Chickasawhay River systems and affects the fishery resource primarily at the point of loading.

Fishing camps and weekend-type cabins line the banks of some of the major streams. The Pascagoula River has become extremely important in this respect. The Mississippi Game and Fish Commission operates six lakes for public fishing while the lower part of the Basin supports a significant number of natural lakes along the Pascagoula River. An estimated 14,900 acres of water are found in areas less than five acres in size within the Basin with varying degrees of fishery management being carried out. Water areas over five acres in size number 895 and comprise 16,659 acres. Generally, however, the lake fishery resource may be considered low within the Basin as a whole.

Minerals

The Bureau of Mines of the U. S. Department of the Interior furnished basic inventory data of the mineral resources. Mineral commodities produced are clay, lime, magnesium compounds, sand and gravel, stone, petroleum, natural gas, and natural gas liquids. In 1965, total value of mineral production was $87.9 million and represented 38 percent of the total mineral production value in Mississippi.

Clay is produced in Forrest, Jasper, Jones, Lauderdale and Smith Counties. Output in 1965 was 126,000 tons or nine percent of total Mississippi production. The different types of clays are used for a variety of products such as building brick, sewer pipe, fertilizer filler, and as an absorbent.

Sand and gravel, produced mainly in Forrest and Perry Counties, totaled 1.3 million tons in 1965. About 65 percent of this material is used in the building trade and 35 percent for paving.

Crude petroleum is produced in several Basin counties. The output in 1965 was 28 million barrels or 42 percent of the total State output. Refineries are operated in Lamar, Jones and Jackson Counties. Natural gas output exceeded 49 billion cubic feet in 1965. Production was reported in several counties.

There are 26 known salt domes in the Basin. Salt is available in nearly inexhaustible quantities as a raw material to support an expanding chemical industry.

Other minerals include minor quantities of iron ore deposits in Kemper County. Dolomite and seawater are available outside the Basin for use in making magnesium compounds in Jackson County. Small quantities of limestone are quarried and crushed in Smith County and used as a soil conditioner.

Timber Resources

The timber resource available from the forest land consists of 2.1 billion cubic feet of growing stock. Sixty-two percent of this volume is softwood species. Sawtimber volumes are estimated at 7.4 billion board feet. Softwood species account for 72 percent of the total sawtimber volume and hardwood species, 28 percent. The average volume of standing timber per acre is 460 cubic feet for growing stock and 1,600 board feet for sawtimber.

The total net annual growth of growing stock is 187.4 million cubic feet; 68 percent from sawtimber class and 32 percent from pole timber class. The average net annual growth is 40 cubic feet per acre. The net annual growth for sawtimber is 698.6 million board feet, or a yield of 150 board feet per acre.

Eighty-four percent of the forest land, containing eighty percent of the growing stock and sawtimber, is privately owned. The volume of standing timber per acre is 440 cubic feet for growing stock and 1,500 board feet for sawtimber.

Sixteen percent of the forest land, containing twenty percent of the growing stock and sawtimber, is publicly owned. The volume of standing timber per acre is 500 cubic feet for growing stock and 2,120 board feet for sawtimber. The larger per acre volume on public land results primarily from better management practices.

During the calendar year 1965 the Study Area had a reported timber drain of 307.3 million board feet of board measure products. Board measure products include lumber, logs, poles, and cross ties. Other products harvested included 797,375 cords of pulpwood, 83,600 tons of distillate wood, and 24,775 barrels of turpentine.

CHAPTER III

ECONOMIC DEVELOPMENT-PRESENT AND PROJECTED 1980-2015

General

The principal factors determining the future water needs of the Study Area are its population and production. As these increase, the withdrawal and use of water and needs in fields related to water resources will increase. Thus, one of the basic needs is the extent and character of water resource activities that will be needed for all purposes between the present time, 1980, and 2015 as associated with population growth and industrial and agricultural production.

Longer-run economic policy and related commitments involve appraisals and assumptions regarding future expansion in the demand for goods and services and in general economic growth. Water and related land resource development often requires either systems of river basin or watershed works or large control structures which may endure for a period of 50 years or more and which affects many people, many square miles and many economic activities. The scale of these developments requires that consideration be given to the impacts of these projects on the people and the economy they are intended to serve.

Assumptions

The projections of economic growth in the Study Area were developed under the following major assumptions: (1) sufficient quantities of water of acceptable quality will be made available by timely development in such a manner as to avoid being a constraint to economic growth; (2) no major depressions and reasonably full employment for the Nation with a stable general price level; and (3) a continued trend toward relative stability of the international situation with no significant worsening of the "coid war" and no widespread outbreak of hostilities.

Limitations

To predict what will happen in the next half century is a feat beyond the power of social science. The projections should not be interpreted as being precise, specific figures for future years. Rather, they should be utilized as the relative magnitudes, directions and patterns that may be expected to prevail. For small Study Areas such as the Pascagoula, analysis and projections were complex because in many instances sharp fluctuations in the direction or rate of historical

economic change provided no satisfactory statistical long-run trend. It is expected that such fluctuations will continue to occur in these areas among the smaller economic components, thus emphasizing the necessity of evaluating such projections as general long-range trends past 1965, rather than specific projections for the specific years of 1980 and 2015.

Population

Approximately one-half million people resided in the Pascagoula Study Area in 1960 compared to 76,200 in 1870. Each sub-area experienced a period of economic leadership between 1870 and 1960. The Chickasawhay Sub-area held a majority of the total population from 1870 to 1900. In 1910, it was displaced by the rapidly growing Leaf Sub-area, which possessed the bulk of the total population until 1960, when the fast rising Coastal Sub-area surpassed the Leaf in population. During the decade of the '50's, the Leaf's agricultural and forestry-oriented economy yielded to technological progress and the consequent shrinkage in available employment and population growth.

At the same time, the Coastal Sub-area's broadening industrial and recreational complex supported large population gains. From 1940 to 1960, population in the Coastal Sub-area increased from 86,300 to 193,100. Its long range rate of growth has been equally amazing - averaging 20 percent per year over the 90-year period. Its share of the total population rose from 13 percent in 1870 to 39 percent in 1960. The Coastal Sub-area should continue its dynamic growth, reaching 733,200 by 2015. Its rate of growth will surpass all other sub-areas from 1960 to 1980, but from 1980 to 2015 some of this growth is forecast to overflow into Hancock County in the Pearl River Study Area. The Leaf and Chickasawhay Sub-areas should increase their population totals to 345,800 and 211,200, respectively, by 2015. The Hattiesburg, Laurel and Meridian areas are expected to set the pace for growth in these sub-areas. In spite of this, by 2015, more people are expected to be living in the Coastal Sub-area than in the other two sub-areas (Table 3).

Urban, Rural Nonfarm and Rural Farm Population

There are several characteristics of population other than total size that exert influences upon the shape and movement of the economy. One is the extent of urbanization. Urbanization has become almost synonymous with economic growth, for as an area becomes more urban its rate of economic growth tends to increase.

In 1960, one-half the urban population was concentrated in the four-county Coastal Sub-area. This Sub-area had a majority of urban population as early as 1940. From 1940 to 1960, population in the urban areas increased three times as fast as population in the rural

Table 3

Summary of historic and projected economic indicators, Pascagoula Study Area, 1930-1960 and projected 1965, 1980 and 2015

	Historical				Projections		
	1930	1940	1950	1960	1965	1980	2015
Population (Thousands)							
Leaf Sub-area	144.7	161.4	176.3	179.5	181.3	203.4	345.8
Chickasawhay Sub-area	121.3	129.5	131.4	127.8	128.8	138.5	211.2
Coastal Sub-area	73.3	86.3	131.8	193.1	226.6	332.2	733.2
Pascagoula Study Area	339.3	377.2	439.5	500.4	536.7	674.1	1,290.2
Number of Households (Thousands)							
Leaf Sub-area	31.8	38.0	45.0	48.0	49.8	59.1	104.8
Chickasawhay Sub-area	27.1	31.0	34.7	35.2	36.6	40.7	64.0
Coastal Sub-area	17.0	21.6	33.7	50.3	60.3	92.7	222.2
Pascagoula Study Area	75.9	90.6	113.4	133.5	146.7	192.5	391.0
Labor Force (Thousands)							
Leaf Sub-area	54.1	55.9	58.9	60.2	61.6	70.4	121.0
Chickasawhay Sub-area	48.0	46.8	46.8	44.1	44.4	48.5	70.2
Coastal Sub-area	26.0	33.0	52.3	72.8	85.5	123.0	280.4
Pascagoula Study Area	128.1	135.7	158.0	177.1	191.5	241.9	471.6
Employment (Thousands)							
Leaf Sub-area	51.2	46.7	56.7	55.5	56.7	65.6	114.5
Chickasawhay Sub-area	43.6	38.0	44.2	40.4	40.4	44.7	66.7
Coastal Sub-area	22.3	27.0	39.9	53.2	63.5	93.0	224.6
Pascagoula Study Area	117.1	111.7	140.8	149.1	160.6	203.3	405.8
Personal Income (Millions of 1962 Dollars)							
Leaf Sub-area	56.8	86.0	173.2	247.0	290.8	463.9	1,435.4
Chickasawhay Sub-area	53.6	67.8	128.4	164.6	185.7	281.0	784.1
Coastal Sub-area	41.3	60.5	140.3	269.0	372.3	767.7	3,152.9
Pascagoula Study Area	151.7	214.3	441.9	680.6	848.8	1,512.6	5,372.4
Per Capita Income (1962 Dollars)							
Leaf Sub-area	393	533	982	1,376	1,604	2,281	4,151
Chickasawhay Sub-area	442	524	977	1,288	1,442	2,029	3,713
Coastal Sub-area	563	701	1,064	1,393	1,643	2,311	4,300
Pascagoula Study Area	447	568	1,005	1,360	1,582	2,244	4,164

areas. Rural population increased 62 percent between 1940 and 1960. It is noteworthy that all of the rural population increase was concentrated in rural nonfarm. Rural nonfarm increased from 25,000 in 1940 to 60,300 in 1960 -- almost equaling the urban population rate of increase. Rural farm decreased from 16,200 to 6,300.

The Coastal Sub-area's rural farm population is projected to continue to decline from 1960 to 2015, but its rural nonfarm population will increase. Between 1960 and 1980, the Coastal Sub-area's urban population is projected to almost double, reaching 248,000 in 1980, then increasing 134 percent to 580,700 in 2015. With 79 percent of its total population urbanized by 2015, the Coastal Sub-area's accumulation of total urban population will have increased from 50 percent in 1960 to 62 percent by 2015.

The growth of urban population in the Chickasawhay Sub-area has been contingent upon the growth of Meridian, the Sub-area's major city. Population in the Sub-area's urban areas increased 76 percent from 1930 to 1960, but faster urban growth in the remainder of the Study Area reduced its share of the total urban population from 31 to 22 percent.

Even though the Chickasawhay Sub-area had a rural population decrease of 22,700 from 1940 to 1960, it still remained predominantly rural with 56 percent of its people living in rural areas. However, of its 71,400 rural inhabitants in 1960, only 19,100 or 27 percent actually lived on farms.

Farm population in the Chickasawhay is expected to continue to decline during the forecast period, falling to 9,800 in 1980 and to 7,200 in 2015. Nonfarm population should continue to assume a larger portion of the Sub-area's total rural population, reaching 92 percent in 2015.

Meridian's growth should continue to foster the expected increase in the Chickasawhay's urban population from 56,500 in 1960 to 123,400 in 2015. In spite of such growth, the Sub-area should contain only 13 percent of the total urban population in 2015.

From 1930 to 1960, rural population in the Leaf Sub-area decreased by 100. The 45,600 increase in rural nonfarm population over the three decades was completely neutralized by the decrease of 45,700 in the rural farm population. The Sub-area was completely dependent, growth wise, on the 34,900 increase in urban population during the period 1930 to 1960.

Urban population growth should continue to produce the Leaf Sub-area's future population growth. By 1980, urban population should surpass the 100,000 mark and rise to 231,000 by 2015. The expected

acceleration of growth in the Hattiesburg and Laurel areas after 1980 will result in the urban population more than doubling during the 35-year period.

Rural nonfarm population should also contribute to total population growth. However, the projected addition of 27,300 rural nonfarm inhabitants from 1960 to 2015 may be countered by the projected decrease of 20,500 rural farm inhabitants, leaving a net rural population growth of only 6,800 compared to an urban increase of 159,500.

Labor Force

The employment potentials of the Study Area are limited roughly by the size of its labor force, derived from its population. In turn, the productivity of the labor force is a major indicator of the income flow that the economy can generate.

The labor force includes all persons 14 years and over classified as employed or unemployed, as well as members of the Armed Forces. Employed persons are all civilians 14 years and over who were either at work (those who did any work for pay or profit or worked without pay for 15 hours or more on a family farm or in a family business), or those with a job but not at work, such as those who had a job or business from which they were temporarily absent because of bad weather, industrial disputes, vacations, illness or other personal reasons.

The labor force grew from 128,100 in 1930 to 177,100 in 1960. This represented a 38 percent gain over the 30-year interval. The growth momentum created by expanding job opportunities centered in the Coastal Sub-area was sufficient to cause the proportion of the Area's total labor force concentrated in this Sub-area to rise from 20 percent in 1930 to 41 percent in 1960.

Labor force expansion, though, lagged in both the Leaf and Chickasawhay Sub-areas. Rising at a slow but continuous rate, the labor force of the Leaf Sub-area increased only slightly between 1930 and 1960. The labor force in the Chickasawhay Sub-area, which failed to generate nonagricultural jobs, actually declined from 1930 to 1960 and no real increase is anticipated until the 1965-1980 period.

The Coastal Sub-area, in contrast, attained a phenomenal gain of 180 percent in its labor force in the 1930-1960 period. In the 1950-1960 decade this Sub-area displaced the Leaf as the center of labor force concentration.

The concentration of labor force expansion is expected to continue to be in the Coastal Sub-area in the forecast period with gains far above those projected for the United States. In the 1960-2015 period, 207,600 of the 294,500 labor force increase anticipated in the

Pascagoula Study Area should take place in the Coastal Sub-area. Strong expansion of industrial jobs should increase the Coastal Sub-area's labor force from about 40 percent of the total in 1960 to 60 percent in 2015. High labor force gains in the Coastal Sub-area between 1960 and 2015 will be reflected in the almost 170 percent growth of the Study Area.

Employment

Total employment rose 27 percent from 1930 to 1960. From 1950 to 1960 all employment growth was accounted for by gains in the fast growing Coastal Sub-area, as employment declined in both the Leaf and Chickasawhay Sub-areas. Employment gains are anticipated in the other two Sub-areas, but in 1965, the Coastal displaced the Leaf as the leading Sub-area in terms of total employment. The growth of technologically advanced industries in the Coastal Sub-area and the accompanying non-agricultural-non-manufacturing activity demanded by a mushrooming population is forecast to push employment up to a projected level of 225,000 in the year 2015, representing over one-half of the total employment in the Study Area.

With expanding port traffic and the extensive development of deep-water industrial sites, construction of a major oil refinery, the embryonic development of a petrochemical complex, and an expanding heavy industrial base, the Coastal Sub-area has significant assets for growth in industrial employment. The Leaf and Chickasawhay, on the other hand, will continue to depend heavily on labor-intensified, relatively low value added industries to stimulate gains in total employment. However, it is not unreasonable to foresee that these sub-areas may gain employment from future economic growth spillover in the Coastal Sub-area.

Employment in Major Water-Using Manufacturing Industries

Employment in major water-using industries increased from 3,800 workers in 1930 to 12,300 workers in 1960. The most noticeable employment increases occurred in the paper, food and chemical industries.

In coming periods, the Study Area will experience noticeably higher levels of employment in all major water-using industries, excepting primary metals. Between 1960 and 2015, food employment is scheduled to rise from 4,700 to 11,600, paper employment from 5,300 to 17,100, chemical employment from 1,700 to 10,100 and petroleum employment from 400 to 5,100 workers.

In 1960, the Leaf Sub-area accounted for about half of all employment in major water-using industries. However, by 2015, of a projected

45,000 workers of this type, 16,300 or 36 percent will be employed in the Sub-area.

The Coastal Sub-area, by all indications, should surpass the Leaf Sub-area in workers employed in major water-using industries by the year 2015 with 55 percent of the Study Area total. Employment in major water-using industries demonstrated good growth from 1,700 employees in 1930 to 4,800 employees in 1960 and is projected at a level of 24,600 employees by 2015.

The Chickasawhay Sub-area cannot be considered a significant employer in any major industrial water-using group. Actual employment in all major water-using groups numbered 1,600 in 1960 and is forecast at 4,100 in 2015.

Employment in Agriculture

Employment shifts in the economy of both the Pascagoula Study Area and the United States have tended to be influenced historically by decreasing demands for labor in agriculture. Massive adjustments in the agricultural sector have been precipitated by an expansion in the size of farms, mechanization of agricultural jobs, and dramatic gains in agricultural productivity. These adjustments, occasioned by the substitution of capital for human labor, have freed a large portion of the agricultural labor force for employment in other occupations.

Over the past three decades the national growth in output per man hour in agriculture has been very rapid - at a rate approaching 1.5 percent per year. This growth has been achieved with approximately the same crop acreage but with a large increase in the amount of farm machinery and equipment per man. Further, declining labor requirements have been accompanied by higher expenditures for variable capital inputs, viz., fertilizer, seed, insect and disease control and weed eradication.

Agricultural employment in the Study Area stood at 55,113 in 1930 and represented 47 percent of total employment. Since then, agricultural employment has declined and represented only seven percent of total employment in 1965. This trend is expected to continue in the future, however, the rate of decline beyond 1980 should be less drastic than the decline between 1965 and 1980 (Table 4).

Table 4

Employment in agriculture, by sub-area, Pascagoula Study Area
1930-1960 and projected 1965, 1980 and 2015

Sub-area	1930	1940	1950	1960	Projections		
					1965	1980	2015
	Number	Number	Number	Number	Number	Number	Number
Leaf	27,426	21,857	17,173	7,770	6,200	3,700	2,600
Chickasawhay	22,047	16,150	12,180	4,191	3,300	1,900	1,400
Coastal	5,640	3,761	3,643	1,977	1,700	1,200	900
Basin	55,113	41,768	32,996	13,938	11,200	6,800	4,900

Employment in Nonagricultural - Nonmanufacturing Industries

Nonagricultural - nonmanufacturing employment consists of employment in mining, contract construction, transportation and communications, utilities, wholesale and retail trade, finance, insurance and real estate, services, government and other industries.

A pronounced upswing in nonagricultural - nonmanufacturing employment has accompanied the economic expansion of the Pascagoula Study Area. Total employment of this type more than doubled between 1930 and 1960 and is projected to increase to 292,600 workers by 2015. Since 1950, the Coastal Sub-area has been the center of this type employment. This position of dominancy is expected to continue, with 160,300 workers in 2015 representing almost 55 percent of the total nonagricultural - nonmanufacturing employment.

An increase is expected in the Leaf Sub-area with employment of this type rising from 34,500 in 1960 to 83,500 in 2015. In the Chickasawhay, an increase from 26,500 in 1960 to 48,800 in 2015 is expected - a somewhat less spectacular rise than in the other two Sub-areas.

Income

Total personal income is the income received by residents of an area from all sources, inclusive of transfers from government and business but exclusive of transfers among persons. It is income received before taxes and includes allowances for nonmonetary income or

income received "in kind" rather than cash. It consists of six major components; wage and salary disbursements, other labor income, proprietors' income, property income, and transfer payments, less personal contributions for social insurance.

Growth in personal income in the Pascagoula Study Area rose approximately 350 percent from 1930 to 1960. Income projections reflect a continuation in income growth and the 2015 level should be almost eight times the 1960 level. Such a rate of growth should exceed that of the Nation during the projection period.

Personal income movements in the Leaf Sub-area are heavily influenced by Hattiesburg and Laurel, just as the Chickasawhay Sub-area is dominated by Meridian. Outside of and surrounding Hattiesburg and Laurel in the Leaf Sub-area and Meridian in the Chickasawhay Sub-area, there is still strong agricultural activity and rural influence which is reflected in a considerably less rapid rate of growth in personal income.

Between 1930 and 1960 the Leaf Sub-area generally maintained its relative position in personal income growth within the Study Area as compared with a significant decline in the position of the Chickasawhay. Both, however, are expected to incur erosion of their positions as the Coastal Sub-area assumes a larger portion of all income generated between 1960 and 2015.

Growth of personal income in the Coastal Sub-area from 1930 to 1960 has been dynamic, rising six and one-half times during this 30-year period. Projections of personal income, therefore, in this Sub-area reflect dynamic expectations of growth to the terminal forecast year. Total income in the Coastal Sub-area is expected to rise almost 12 times from 1960 to 2015. Hence, its rate of growth in personal income will exceed the rate of growth in income in any sub-area, as well as the Nation.

Whereas, in 1960, personal income in the Coastal Sub-area accounted for 40 percent of total income, it is forecast to constitute almost 60 percent in 2015. The growth should result from the Coastal Sub-area's rapidly broadening, diversified economic base. The Coastal Sub-area is expected to be the most dramatically developing Sub-area along the entire distance of the "booming" coastline area from Pensacola, Florida, to New Orleans, Louisiana. So rapid is the expected growth and development of this entire area that by the year 2015 this entire strip is forecast to constitute one of the South's major megalopolises.

Households

The household is the basic consuming unit of home construction and accessory items in our economy. By definition, the number of households and the number of occupied dwelling units are synonymous. The

actual number of households is related to marriage rates in the adult population and, especially since 1950, to the number of non-family units occupying separate housing units. Further, population age composition and sex distribution have strongly influenced the rate of household formations.

The number of households in the Pascagoula Study Area increased from 75,900 in 1930 to 133,500 in 1960. The greatest gain occurred in the 1940's when the addition of 22,800 new households represented a 25 percent increase.

The Study Area should continue to add households at an accelerated rate of gain. Between 1960 and 2015, the number of households is projected to almost triple. Since the 1930-1940 decade, the Leaf Sub-area has experienced a rate of growth well below that attained by the Study Area. Households in the Sub-area comprised 36 percent of the Area's total in 1960, down from 42 percent in 1940. Household growth in the Leaf Sub-area in the forecast period is not expected to be spectacular. A 118 percent gain is anticipated between 1960 and 2015, boosting total households to 104,800 in 2015.

Increases in the number of households in the Chickasawhay Sub-area have become relatively static, especially since 1950, and its 1960 total of 35,200 households was only 8,100 above the figure recorded in 1930. A decade growth rate of only 1.4 percent during the 1950's caused it to become the least significant Sub-area in the Study Area in terms of number of households. However, it will continue to add households during the forecast period but at an anticipated rate well under that of the Study Area. The addition of only 28,800 households between 1960 and 2015 should cause the concentration of households in the Chickasawhay to fall from 26 percent of the total in 1960 to 16 percent in 2015.

The number of households in the Coastal Sub-area increased at a better rate of gain than that attained by any other sub-area. Total households numbered 17,000 in 1930 and 50,300 in 1960, an almost threefold gain. The record economic acceleration of the Coastal Sub-area will boost total households to 222,200 by 2015 and its proportion of total households from 38 percent in 1960 to 57 percent in 2015.

The Land and Water Resource Base

The total land resource base is divided into two broad classes; land in farms, and land not in farms. Detailed use of land in farms was derived from Censuses of Agriculture. Land use of the area not in farms was derived from information presented in the 1958 Conservation Needs Inventory. 1/ Major land use data for the Study Area are presented in Table 5.

1/ Reference here and elsewhere in report refers specifically to 1958 Conservation Needs Inventory.

Table 5

Major land use, Pascagoula Study Area
1959 and projected 1980 and 2015

Land use	1959 [1]	Projected 1980	Projected 2015
	Acres	Acres	Acres
In farms	2,552,482	2,571,000	2,245,000
Other than in farms	3,770,818	3,752,300	4,078,300
Forest	3,461,918	3,310,900	3,291,500
DeSoto National Forest	482,200	482,200	482,200
Bienville National Forest	91,000	91,000	91,000
Other	2,888,718	2,737,700	2,718,300
Federal [2]	40,100	70,100	102,100
Urban	231,600	310,100	593,500
Water	37,200	[3] 61,200	[3] 91,200
Total approximate area [3]	6,323,300	6,323,300	6,323,300

1/ Data from 1958 CNI and 1959 Census.
2/ Does not include National Forest
3/ Area converted to new water not deducted from total approximate area.

A primary factor affecting future agricultural production is the availability and quality of land. A number of forces are working to reduce the land resource base available for agricultural use. Land is currently being withdrawn from agricultural use for urban and industrial uses and for related developments required to support the expanding economy and the related increase in population. Highway development, airport construction, and recreational demand on the land base are notable examples. Reservoirs and other types of water-resource developments also require additional land and result in impacts on related land.

The demand for non-agricultural land is not as great in the Study Area as the demand that exists in some other areas of the United States. The Coastal Sub-area probably will realize a greater demand for non-agricultural land due to the expected population growth. Although the agricultural resource base of the Study Area will not undergo

any great reduction by 1980, a relatively small decline will occur by 2015. The decline is not significant since within the farm land base there exists room for flexibility in uses.

Agricultural Economy

The agricultural portion of the total economy of the Pascagoula Study Area was developed to cover three time periods; (1) historical years (primarily up through 1959), (2) the year 1980, and (3) the year 2015. The present status for farm characteristics is indicated primarily in terms of 1959 data and for forestry, primarily in terms of 1957 data.

National Production Requirements

The food, feed and fiber (wood and cotton) requirements were developed to support a national population of 254 million in 1980 and 461 million in 2015. The projected national requirements for 1980 and 2015 represents the expected demand under the specified assumptions presented earlier. The national production requirements were adjusted to account for imports and exports. Consequently, the end result is the amount of agricultural products that will need to be produced to supply domestic requirements in the United States and to allow for projected exports.

Expanding national requirements for agricultural production results from three major economic forces, i.e., growth of population, rising per capita consumer income and the associated changes in taste which influence trends in per capita use and growth of foreign demand. The product requirements of the United States, in the aggregate, can be expected to increase largely as a function of an assumed population growth. At higher income levels, consumer response to further income gains is reflected mainly in shifts among individual products with little increase in total overall consumption of farm products per person. Nutritional and medical findings, food fads, and development of synthetic materials have influenced past trends in consumption, although their influence is difficult to measure quantitatively. These and other intangible factors will continue to affect growth in demand for farm products in the future.

The basis of projecting national product requirements was to project requirements per person for all major crop and livestock products. Estimates of total requirements were derived by multiplying the resulting per capita estimates for each commodity by projected population. The historical and projected per capita utilization rates of major farm products in the United States are shown in Table 6. Current and projected requirements for major crops, livestock products and industrial timber products are presented in Table 7.

Table 6

Per capita utilization of major farm products, United States, 1959-1961 and projected 1980 and 2015 1/

Item	1959-1961	1980	2015
	Number	Number	Number
Eggs	359.5	308.7	307.8
	Pounds	Pounds	Pounds
Cotton	---	41.0	41.0
Wheat	393.4	366.0	300.0
Rye	8.7	7.7	7.2
Rice	29.3	33.1	22.4
Flax	8.8	5.1	4.7
Soybeans	198.3	333.0	302.4
Peanuts	9.7	9.9	9.8
Sugar cane	85.3	146.0	190.0
Sugar beets	188.6	278.0	362.0
Dry beans	10.3	7.7	7.7
Dry peas	2.2	1.2	1.2
Potatoes	142.8	158.1	157.6
Sweet potatoes	9.3	6.8	6.8
Vegetables	230.4	236.6	236.0
Citrus fruit	85.4	96.0	92.0
Noncitrus fruit	89.6	96.0	106.0
Tree nuts	1.7	1.6	1.6
Beef and veal	156.0	193.1	197.4
Lamb and mutton	9.2	6.9	7.0
Pork	113.7	97.8	97.7
Chicken	41.9	46.4	50.0
Turkey	8.5	13.9	13.8
Milk	670.2	583.5	578.1

1/ Internal data, Economic Research Service, United States Department of Agriculture.

Table 7

Current and projected requirements for major crops, livestock products, and industrial timber products, United States, 1959-61, and projected 1980 and 2015

Commodity	Unit	1959-1961	1980	2015
		Thousands	Thousands	Thousands
Crops				
Cotton	Bales	---	20,582	37,302
Feed grains	Thou.F.U.	287,432,000	344,196,000	465,213,000
Wheat	Bushels	1,185,533	1,660,071	2,469,643
Rye	Bushels	28,143	34,925	59,271
Rice	Cwt.	52,960	84,070	1,032,640
Flax	Bushels	28,411	23,132	38,691
Soybeans	Bushels	597,600	1,409,700	2,324,400
Peanuts	Pounds	1,760,000	2,515,000	4,517,800
Sugar crops:				
Sugar cane	Tons	7,712	16,542	43,795
Sugar beets	Tons	17,047	35,306	83,441
Dry beans	Cwt.	18,710	19,558	35,497
Dry peas	Cwt.	4,010	3,048	5,532
Potatoes	Cwt.	258,230	401,320	728,380
Sweet potatoes	Cwt.	16,840	17,272	31,348
Vegetables	Cwt.	416,640	600,964	1,087,960
Fruits, citrus	Tons	7,723	12,192	21,206
Fruits, noncitrus	Tons	8,098	12,192	24,433
Tree nuts	Pounds	307,000	406,400	737,600
		Millions	Millions	Millions
Livestock				
Beef and veal 1/	Pounds	28,206	49,047	91,001
Lamb and mutton 1/	Pounds	1,658	1,752	3,227
Pork 1/	Pounds	20,564	24,841	45,040
Chicken 1/ (Ready to cook)	Pounds	7,571	11,786	23,050
Turkey 1/ (Ready to cook)	Pounds	1,540	3,531	6,362
Milk	Pounds	121,164	148,209	266,504
		Millions	Millions	Millions
Eggs	Number	64,993	78,410	141,896
		Thousands	Thousands	Thousands
Industrial timber products 2/				
Saw logs (lumber)	Cu.ft.	3/5,191,000	6,650,000	8,340,000
Veneer logs (veneer and plywood)	Cu.ft.	3/ 856,000	1,540,000	2,400,000
Other miscellaneous industrial timber products	Cu.ft.	3/ 464,000	460,000	460,000
Total	Cu.ft.	3/6,511,000	8,050,000	11,200,000
Pulpwood	Cords	3/ 41,700	77,000	138,500

1/ Liveweight

2/ All round timber products harvested from the forests except fuelwood. Estimates exclude Hawaii, Alaska, and the Tennessee Valley.

3/ Timber products data are for 1962.

Pascagoula Study Area Production Requirements

A share of the future national production requirements for agricultural products was assigned to the Pascagoula Study Area based upon the historic relationship of the Area's production to that of the State of Mississippi. 1/ The share assigned to Mississippi was based upon the historic relationship of its production to that of the Delta Area composed of Mississippi, Arkansas and Louisiana. The Delta Area's assigned share was based on its historic production relationship to that of the United States. The Study Area production requirements, therefore, were stepped down from the national level, to a regional level, to a state level, thence to those counties that compose the universe under investigation.

Information concerning agricultural production in the Pascagoula Study Area and Sub-areas was obtained from many sources. Previous publications were examined, college and experiment station personnel were contacted and direct consultation with production specialists was made in some instances. The primary source of data and the main basis of the analysis, however, was from USDA Crop Reporting Board information and United States Agricultural Censuses. The difference between present output in the Pascagoula Study Area and its assigned share of the projected requirements provides a guide to the needs for development of land and water resources to meet future needs for agricultural products. Selected current and projected agricultural and forestry statistics are presented in Table 8.

Farm Production

The increase in population expected in the United States for 1980 and 2015 will place some demands on the Pascagoula Study Area for an expanded agricultural production of certain products. Studies indicate there will be an increase demand for agricultural products such as cotton, soybeans, feed crops and livestock and poultry products that are produced in the Study Area. In order to meet national needs for food and fiber products, it is projected that the Pascagoula Study Area would need to produce 4,700 more bales of cotton in 2015 than were produced in 1959. In addition, the Study Area would need to produce 223,000 more bushels of soybeans in 2015 than were produced in 1959.

Due to expanded national demand for livestock and poultry products, production will increase. In the Study Area production of some items will decline and others will increase because of production efficiencies. Study Area production of beef and veal will need to expand by 103 million pounds in 2015 as compared to 1959. Likewise, the Study Area would need to produce about 50 million more pounds of lamb and mutton, 349 million more pounds of broilers and turkeys, 106 million more pounds of milk and

1/ Primarily for the period 1939-59.

Table 8

Agricultural and forestry resource statistics, Pascagoula Study Area 1954 and 1959 and projected 1980 and 2015

Item	1954	1959	Projected 1980	Projected 2015
General				
Number of farms	30,086	21,303	12,200	8,500
Average size of farm (acre)	100	121	210	260
Capital investment (million dollars)	192	264	305	382
Average investment per farm (dollars)	6,413	12,389	25,000	45,000
Agricultural production base				
Land in farms (thousand acres)				
Cropland	769	649	590	500
Woodland	1,787	1,511	1,600	1,390
Pasture	336	324	321	310
Other	73	68	60	45
Total	2,965	2,552	2,571	2,245
Use of cropland (thousand acres)				
Cotton	91	42	20	25
Corn	229	171	95	48
Oats	18	8	10	6
Soybeans	2	3	8	9
Hay	76	63	80	76
Miscellaneous and other	69	53	37	36
Total harvested	485	340	250	200
Total pastures	180	203	255	240
Total idle	104	106	85	60
Total cropland	769	649	590	500
Pasture for livestock (thousand acres)				
Cropland	180	203	255	240
Woodland	1,049	839	800	656
Other-permanent pasture	336	325	321	310
Total pastureland	1,565	1,367	1,376	1,206
Land in forests (thousand acres)				
Farm forests	1,787	1,511	1,600	1,390
Nonfarm forests	2,894	3,462	3,311	3,292
Total forest	4,681	4,973	4,911	4,682

Continued --

Table 8

Agricultural and forestry resource statistics, Pascagoula Study Area 1954 and 1959 and projected 1980 and 2015 (Continued)

Item	1954	1959	Projected 1980	Projected 2015
Other land and/or water use (thousand acres)				
Federal	---	40	70	102
Urban	---	232	310	593
Water	---	37	61	91
Total other	---	309	441	786
Agricultural production requirements				
Crop production				
Cotton (thousand bales)	61	29	20	34
Corn (thousand bushels)	4,597	5,129	4,750	3,000
Oats (thousand bushels)	522	244	420	300
Soybeans (thou. bu.)	15	58	200	281
Hay (thousand tons)	69	69	104	190
Livestock numbers (thou.)				
All cattle and calves	364	301	393	516
Milk cows	70	44	33	42
Sheep and lambs	20	16	8	12
Hogs and pigs	110	135	64	53
Horses and mules	28	17	7	5
Farm chickens	1,012	1,407	2,800	2,985
Broilers	10,160	30,217	69,617	123,840
Turkeys	5	16	22	35
Livestock production				
Beef & veal (thou. lb.)	---	75,239	125,800	178,000
Lamb & mutton (thou.lb.)	---	452	300	500
Pork (thou. lbs.)	---	35,032	17,400	16,000
Broilers (thou.lbs.)	---	93,673	243,700	433,400
Turkeys (thou.lbs.)	---	256	400	700
Milk (thou.lbs.)	---	124,118	158,400	229,900
Eggs (thousands)	---	233,640	509,600	814,800
Forestry production 1/				
Growing stock (million)				
Inventory Cu.ft.	---	2,136	5,836	3,720
Growth Cu.ft.	---	187	307	220
Cut Cu.ft.	---	125	145	381
Sawtimber (million)				
Inventory Bd.ft.	---	7,457	18,340	13,830
Growth Bd.ft.	---	699	1,041	810
Cut Bd.ft.	---	431	541	1,278

1/ Historical forestry production data for 1956.

48 million more dozens of eggs than were produced in 1959. Studies indicate that pork production in the Study Area will decline approximately 50 percent by 2015 when compared with 1959 production. An expanded output of agricultural products must be met with fewer farms and farm people on essentially the same land base as existed in 1959.

Farm marketings of agricultural products are projected to reach $194 million in the year 2015 in the Pascagoula Study Area as compared to $61 million in 1959. Broilers, eggs and cattle and calves will account for 86 percent of total farm marketings in 2015. In order to meet the production requirements, some adjustments in the agricultural industry will be required. Farm size will be about twice as large in 2015 as in 1959 and the capital investment will be considerably greater because of the shift in enterprise combinations. The total acreage of cropland harvested will decline, there will be an increase in cropland pastures and permanent pasture and farm woodland will remain essentially unchanged.

Commodity Requirements

Total agricultural output in the Pascagoula Study Area is projected to increase in the aggregate but for some individual commodities a decrease is projected. The projected amount is the requirements of the area to meet its share of local and national requirements including exports. Farm operators of the Study Area may find it to their advantage to produce more of some commodities and less of some others. However, the resources of the area are such that the requirements could be produced should it be profitable for farmers to do so. Increased production in the Study Area will occur from shifts in acreages of crops and in number of livestock and from increased yields per acre of crops and per head of livestock.

Cotton

The percentage of the national cotton production originating in the State of Mississippi has ranged mostly between 10 to 15 percent over the past 25 years. Production in the Pascagoula Study Area as a percentage of State has declined considerably due to an economic advantage of producers in the Delta Area, the prevalence of small farms not adapted to mechanization, small allotments, problems of insect control, growth of competitive enterprises, shifts to nonfarm employment and other factors. Study Area acreage is expected to decline to around 20 thousand acres by 1980 and increase slightly to 25 thousand acres in 2015. There is some evidence that the Study Area is improving cotton production methods, is increasing size of farms, is obtaining higher yields, and is therefore attempting to become more competitive. Present control programs that allow for shifting of allotted acres will help to stabilize cotton acreage in the better cotton producing counties or on farms adapted to specialization.

Corn

Corn is the most widely grown crop in the Study Area. Sixty-nine percent of total farms report some corn acreage. Of those farmers growing corn, 63 percent harvest less than 11 acres. Farmers have traditionally used corn production to round out their farm business. In many instances farmers have utilized for corn production land and labor left over from other cash crops.

There is a downward trend in both acreage and production of corn and this trend is projected to continue. As a result of increased yields per acre, corn production will not decline as much as acreage. The Study Area is now deficit in total corn and feed-grain needs and in future years the spread will be even greater.

Oats

Oats are a minor crop both in terms of acreage and production. No significant changes are expected in terms of acreage, yields or production. Study Area acreage and production represents about four percent of Mississippi acreage and production and its share likewise represents a very small percentage of national - about one percent.

Soybeans

Soybeans are currently a minor enterprise. Most farmers producing soybeans harvest less than 10 acres. However, there are isolated instances of a few farmers harvesting in excess of 100 acres. Acreage is expected to increase in future years but the total land devoted to this specific crop will remain relatively small. Some farmers within some counties may increase production greatly but others with limited productive resources will have limited acreage.

Hay

The principal hay crops grown are small grain, lespedeza, clover-timothy, alfalfa and miscellaneous hay. There will be an increased hay requirement needed for the projected increase in livestock output. Acreage devoted to the production of hay is not expected to change much from the current acreage but an increased output will be realized from increased yields and shifts to those hays better adapted to the land.

Miscellaneous and Other Crops

Most of the acreage of miscellaneous and other crops is used for products for home consumption or as livestock feed. A decline in acreage devoted to these crops will likely occur as the number of farms decline. Production, while of little commercial value, has meant a food supply for many marginal farmers.

Beef and Veal

The shift in emphasis from row crops to livestock production occurred in the early 1940's. Since that time, farm income derived from livestock production has steadily climbed in relation to that derived from crops. Acreage control of cotton necessitated a shift or the addition of other enterprises. Beef cattle production has represented an important substitute enterprise.

Beef and veal production is projected to increase from 75 million pounds in 1959 to 126 million pounds in 1980 with further increases through 2015. The production-demand relationship currently is roughly in equilibrium and will approximate equilibrium in 1980 but by 2015 the Study Area will not be producing sufficient beef to supply its own population needs.

Pork

Mississippi pork production peaked at 250 million pounds in 1943 and since that time the trend has been downward and is expected to range between 100 to 200 million pounds in the immediate future. Study Area pork production followed the same general trends. Current production is approximately 35 million pounds and is projected to decline to approximately 17 million in 1980 and 2015.

Consumption of pork has always been high, as in other areas of the South, and this trend is expected to continue. The Study Area is now a deficit producer of pork and will become more so with an increasing population and a decreasing level of output.

Lamb and Mutton

Sheep production is a minor enterprise with little or no change anticipated in future years. National future requirements indicate that the State of Mississippi and the Study Area will contribute only a meager portion. With other changes and adjustments being made in the Area's agriculture, it is likely that sheep production will do no more than hold its own in the future and continue to be a deficit producing area.

Broilers

The percentage of national broiler production originating in the State of Mississippi increased from one-half of one percent in 1946 to approximately seven percent in 1965. The Pascagoula Study Area has shared well in the expanded output of broilers. Current production is about 100 million pounds and it is anticipated that production will increase to about 250 million pounds in 1980 and 450 million pounds in 2015. The Study Area is currently in a good competitive position and is a surplus supplier of broilers to other

areas of the United States. With a continued strong demand for broilers and the adoption of new and emerging production and marketing techniques, the Study Area should experience a relatively prosperous future for this enterprise.

Eggs and Turkeys

The production of eggs is another important and profitable poultry enterprise. The Study Area is currently a surplus egg producing area and it is anticipated that egg production will increase still further by 1980 and 2015 and will help meet the future national requirements.

Turkeys are a relatively small poultry enterprise. Some increase in numbers and production is anticipated but the change will have little effect on national product requirements.

Milk

The Study Area is a deficit area in the production of milk and manufactured dairy products. It is anticipated that milk production will expand in future years but not enough to take care of the needs of the population. Some of the inability to meet local needs arises from the decline in numbers of milk cows, however, production per cow will greatly improve by 2015 and therefore reduce the impact caused by the decline in numbers of milk cows.

Production Versus Food Requirements of Local Population

A comparison of the projected production of major nonfeed crops and livestock products with the utilization requirements for the projected population is presented in Table 9. The data reveal the magnitude of the deficit and surplus situations for the years 1980 and 2015. As indicated in the above discussion of individual commodities, the Study Area in the future will be deficit in the production of beef and veal, lamb and mutton, pork, milk and cotton and soybeans. The Study Area will be surplus in the production of broilers and eggs.

Production of Feeds Versus Livestock Requirements

The main requirement for feed crops is livestock production, however, industrial uses, human consumption and net exports are realized to be a part of the total requirement. The requirement for feed crops is influenced by many factors. Two of the most important are the demand for livestock products and the efficiency of converting feed grains into livestock products.

Based on the projected acreage and production of the crops - corn, oats and hay - as well as the level of livestock output anticipated in

Table 9

A comparison of the projected production of major livestock products, nonfeed crops, and feed units with projected utilization, Pascagoula Study Area, 1980 and 2015

Commodity	Units	Basin	
		1980	2015
		Thou.	Thou.
Livestock products			
Beef and veal 1/			
Indicated production 2/----	Pounds	125,800	178,000
Projected utilizations 3/--	Pounds	130,169	254,686
Lamb and mutton 1/			
Indicated production 2/----	Pounds	300	500
Projected utilization 3/---	Pounds	4,651	9,031
Pork 1/			
Indicated production 2/----	Pounds	17,400	16,000
Projected utilization 3/---	Pounds	65,927	126,053
Milk			
Indicated production 2/----	Pounds	158,400	229,900
Projected utilization 3/---	Pounds	393,337	745,865
Poultry 1/			
Indicated production 2/----	Pounds	244,100	434,100
Projected utilization 3/---	Pounds	40,648	82,315
Eggs			
Indicated production 2/----	Pounds	66,200	105,900
Projected utilization 3/---	Pounds	27,053	51,626
Nonfeed crop production			
Cotton			
Indicated production 2/----	Bales	20	34
Projected utilization 3/---	Bales	55	106
Soybeans			
Indicated production 2/----	Bushels	200	281
Projected utilization 3/---	Bushels	3,741	6,503
Feed units			
Indicated production-------	Feed units	869,999	883,805
Projected utilization------	Feed units	2,199,440	2,961,910

1/ Liveweight.

2/ Indicated production based on an analysis of historical data and projected to 1980 through the use of least square regression techniques.

3/ Projected requirements calculated on the basis of projected population and per capita utilization rates.

1980 and 2015, the feed units necessary to sustain the projected level of livestock output will be far short of needs. By 1980, it will require 2.2 billion feed units to sustain the projected level of livestock output and 3.0 billion feed units in 2015 (Table 9).

The principal source of feed in 1980 will be from corn and oats (32 percent), hay (10 percent), and grazing (58 percent). The combined feed units supplied from these sources will satisfy only 40 percent of needs. The balance will have to be imported if production adjustments are not made. By 2015, the gap is anticipated to be even wider.

Farm Income

Income estimates presented in this report are the product of unit prices times the quantity of commodity. Actual prices were used to cover sales reported for historical years. Projected receipts from farm marketings were determined by combining projected production for 1980 and 2015 with anticipated long-run prices of agricultural commodities as presented in the 1957 U. S. Department of Agriculture publication entitled "Agricultural Prices and Cost Projections."

Farm income is that received in cash and non-monetary allowances. It consists of four major components - farm marketings, home consumption of farm produced products, rental value of farm dwellings, and government transfer payments.

The 1959 farm marketings totaled $60.7 million and are the principal component of farm income. Income from marketings is comprised of the quantity of production marketed times the price per unit received. Currently, livestock and livestock products account for 79 percent of marketing receipts and crops 21 percent. Broilers and eggs are the most important source of livestock receipts while cotton and farm forestry products are the most important source of crop receipts.

Income from sources other than product marketings contribute about 15 percent toward total gross income. In 1959, gross income minus production expenses yielded a farm proprietors income of approximately $30 million. Derived net income per farm amounted to $1,414 which was about $500 less than the average for the State of Mississippi. Derived per capita farm income amounted to $516 or less than half that for all segments of the population.

Projected farm income data are presented in Table 10. Most of the increased income in the future is due to the projected increase in production with only a small part due to price changes.

Table 10

Gross income, production expense and net income, Pascagoula Study Area 1959 and projected 1980 and 2015

Item	Unit	1959	Projected	
			1980	2015
		Dollars	Dollars	Dollars
Receipts				
Farm marketings	Thousands	60,682	124,078	194,042
Other 1/	Thousands	11,046	16,920	21,560
Total gross income 2/	Thousands	71,728	140,998	215,602
Total production expense	Thousands	41,602	77,549	118,581
Net income 2/	Thousands	30,126	63,449	97,021
Net income per farm 2/	Dollars	1,414	5,201	11,414
Per capita farm income	Dollars	516	2,073	4,218

1/ Includes value of home consumption of farm products, value of farm dwellings and Government transfer payments.
2/ Excludes changes in inventories.

Farmland

Land in farms changed but little during the period 1944-59. The projected land in farms indicates little change by 1980 and only a small reduction by the year 2015.

Land in farms is classified according to the way in which it is used. The four major categories of use are - cropland, woodland, pasture and other land.

Cropland harvested has been declining the past two decades and will decline more by 1980 and 2015. An increasing amount of cropland taken out of production is being pastured. Cropland used for this purpose will peak in the 1980's and remain relatively stable to the year 2015.

Farm woodland acreage has fluctuated within rather narrow limits. A slight increase is expected up through the 1980's with a gradual decline beyond then and continuing through 2015.

Permanent pasture land has increased gradually during the past 20 years but has stabilized and will change but little by 1980 and 2015. Better management in terms of grasses and legumes, fertilization, rotation grazing, mowing and the like, will result in increased carrying capacities to sustain the increase in livestock numbers and production.

Forestry Resources

The area occupied by forests is greater than the combined acreage devoted to all other land uses. Forest acreage accounts for almost 5 million acres out of a total of 6.3 million acres in the Study Area. Eighty-four percent of the commercial forest land is under private ownership - farm, forest industry and other. Thirty percent of the forest area is in the farm land sector and 70 percent is in other types of ownership. Large timber holdings are held by basic wood-using industries such as lumber and pulp companies.

The trend toward conversion of farm lands to forests has tended to offset the effects of localized land clearing. Area-wide, the net result of shifting land use is that the 1980 acreage will be only one percent lower than the present acreage and by 2015 the forest acreage will decline only six percent. The forest acres in the Chickasawhay and Leaf Sub-areas will remain fairly constant but the Coastal Sub-area will register a decrease of about 15 percent due to an increasing demand for urban and built-up areas during the projected period.

The softwood forest types, which include longleaf-slash pine, loblolly-shortleaf pine, and oak-pine, cover 76 percent of the commercial forest land. Most of the type is longleaf-slash pine and loblolly-shortleaf pine. Twenty-four percent of the commercial forest area is stocked with hardwood types which include oak-hickory, elm-ash-cottonwood, and oak-gum-cypress. The stand size for both hardwood and softwood types is mostly pole timber and seedlings and saplings.

There is light to moderate grazing damage on 26 percent of the upland forests. Improperly located trails and over-cutting, exposing the humus and litter to the weather, accounts for damage to 14 percent of the area. Thirteen percent of the present woodland formerly was cultivated and reverted to woods through natural regeneration. Good timber management was found on 32 percent of the upland forest consisting primarily of industry and National Forest land. A few of the large private landowners are realizing the advantages of proper forest management.

The Area's wood supply is derived from trees that are now standing on commercial forest land. In 1956, these trees contained 2.1 billion cubic feet of wood classified as forest growing stock. The volume does not include that of cull trees, salvable dead trees, and hardwood limbs.

The forest growing stock is the significant portion of the timber resource. Fifty-eight percent of it is in sawtimber trees; the other 42 percent is in poletimber trees - smaller trees that may become sawtimber trees in the future. The volume for growing stock was 460 cubic feet per acre.

Total net volume of sawtimber on commercial forest lands is 7.4 billion board feet, measured by the International one-fourth inch log rule. Softwood species account for 72 percent of the total sawtimber volume and hardwood species 28 percent. The inventory volume amounted to 1,600 board feet per acre.

Growing stock is projected at 5.8 billion cubic feet in 1980 and sawtimber 18.3 billion board feet. The growing stock and sawtimber inventory will decline by 2015 but will be 74 and 85 percent greater than the 1956 inventory respectively. Softwoods are the major species now and by 2015 their proportionate share will be larger. The increase is expected from pine plantings of open areas, inter and underplantings, stand conversion, release work and improved management of the forest land. Hardwood growing stock will register a slight increase by 1980 but by 2015 it is expected to be 11 percent less than in 1956.

The net annual growth for sawtimber in 1956 was 569.9 million board feet of softwood and 128.7 million board feet of hardwood. The combined growth per acre was 150 board feet. Net annual growth for growing stock in 1956 was 138.5 million cubic feet of softwood and 48.9 million cubic feet of hardwood. The growth for all species equals 40 cubic feet or 0.5 cords per acre per year. This is a growth rate of approximately nine percent on the 1956 inventory base. Annual growth of growing stock and sawtimber is expected to increase about 16 percent by 2015. This increase is due to the much larger volume of softwoods and offsets the decline in hardwood species.

The softwood species, in line with inventory and growth, accounts for the largest volume being cut. By 2015 softwoods will account for over 90 percent of the growing stock and sawtimber cut. The 1956 figures show the annual cut of growing stock to be 67 percent of growth and the cutting of sawtimber amounts to 62 percent of growth.

A comparison of annual timber cut and net annual timber growth of growing stock shows that growth exceeds the cut through 1980 but between 1980 and 2015 a deficiency of growth will amount to 161 million cubic feet. This deficiency occurs in the softwood species. This deficiency in growth may be offset if forest landowners will increase their inventory and growth through intensified timber management; such as, conversion, thinnings, stand improvement and full stocking.

On the basis of the stumpage prices, the annual timber harvest represented an annual gross income to the forest landowners of about

$3.00 per acre in 1956. By 2015, with a much larger cut, this gross income to the landowners increases to $7.60 per acre.

The value of the standing timber for 1956 was approximately 250 million dollars and increases to 350 million dollars by 2015.

Employment in timber-based manufacturing industries in the Study Area is presented for two Standard Industrial Classification Groups: (1) Lumber and Wood Products (SIC 24) and Furniture and Fixtures (SIC 25), and (2) Paper and Allied Products (SIC 26). Basin employment in the lumber, wood and furniture groups has remained fairly constant except for 1950. By 1980, a slight decrease in employment is indicated but by 2015 a small upturn is indicated. Paper and allied products employment steadily increased since 1930 and by 2015 will have more than tripled the 1960 employment figure.

Forestry employment also includes forest management and timber harvesting. Forest management includes all employment involved in protecting and managing forest lands for the production of timber and related products. Timber harvesting is employment involved in harvesting and transporting timber and related products from forests to local points of delivery. Employment in forest management will approximate 800-900 by 1980 and 2015. Employment in timber harvesting will approximate 4,000 in 1980 and increase to about 5,000 in 2015.

Outdoor Recreation and Related Economic Activity

Outdoor recreation studies and surveys on National, State, and Basin levels strongly suggest the phenomenal future demand to be expected in outdoor recreation activity. In considering present and future needs, one of the major factors is the population and its expected growth. Other considerations, related to the recreational demand, are the many and varied socio-economic factors as population structure, personal income, trends toward urbanization, and leisure time. A better concept of the intricacies encountered in outdoor recreation planning may evolve when one considers the proximity and accessibility of recreation facilities, two key factors that determine actual use. Growth, nevertheless, in outdoor recreation activity is evident and the various governmental agencies at all levels have become keenly aware of the potential economic impact.

Many agencies concerned with land and resource management have been delegated responsibilities in the field of outdoor recreation. In the Federal Government the Bureau of Outdoor Recreation develops guidelines and criteria for determining supply and demand and is further concerned with actual development of recreational facilities. The Corps of Engineers, National Park Service, Fish and Wildlife Service, Forest Service and Soil Conservation Service are among the Federal agencies with responsibilities in this area.

The Mississippi State Park System, Mississippi Game and Fish Commission, special districts and local municipalities and, within the Basin, the Pat Harrison Waterway District, all have functions in the recreational field. The private sector is becoming increasingly conscious of the opportunities in providing public outdoor recreation as an enterprise. This becomes more evident in the Coastal Area.

Appraisals of outdoor recreation have been primarily to point out recreational needs for present and future. Appendix H, "A Report on the Recreation Aspects of the Pascagoula River Basin-Mississippi and Alabama", BOR, Department of Interior, is a large part of this effort. Appendix I, "A Report on the Fish and Wildlife Aspects of the Pascagoula River Basin-Mississippi and Alabama", presents supply and demand for two important outdoor recreation activities within the Study Area.

Relationship of Economic Development and Land and Water Resource Development

In the early part of the nineteenth century, much of the Pascagoula Study Area was a virgin timber wilderness with sparse settlement. The early settlers cleared the land for agriculture, principally to raise cotton. With the land denuded of its arboreal cover, the heavy annual rainfall rapidly washed away the topsoil and deeply eroded the sub-soil choking streams with sediment.

By 2015, 1.3 million people are projected to live in the Pascagoula Study Area, supported by $5.4 billion in personal income earned by approximately one-half million workers and entrepreneurs. This means that between 1960 and 2015, population will rise 158 percent, employment 172 percent, and personal income 689 percent.

The projections of economic growth were guided by the assumption that sufficient quantities of water of an acceptable quality would be made available by timely development in such a manner as to avoid being a constraint to economic growth. If this is not accomplished, inadequate water resources may inhibit the Area's economic growth and adversely affect projected rates of economic progress.

Failure of growing cities to develop additional sources of clean, fresh drinking water will restrict their ability to serve the growing human and industrial population, thus causing the economic development of such cities to lag behind the projected growth. Failure to correct pollution problems in some sections will deter the location of major water-using industries in these sections, causing employment growth to falter and adversely affecting income that would have been created and population that would have been supported by this additional employment.

Demands in coming decades on the water supplies will arise basically from the increase in population and the expansion of industry. Water requirements, however, will be greater than indicated by projected levels of population and industrial employment because of several trends now evident in the Study Area. Extensive urbanization will raise water demands, as per capita consumption is higher in cities. More leisure time will amplify demands for water related recreational uses. The requirements for clean, fresh water from streams will increase demands to dilute organic wastes as the concentration of people and industry continues.

The Study Area is endowed with abundant supplies of useable industrial water which should sustain growth in industries requiring relatively large quantities of water in manufacturing processes. Unlike many water-short regions in the United States where extensive use of water in industry, together with costly pollution treatment facilities is required, the Area possesses the natural resource assets fundamental to employment gains in all groups of major water-using industries -- food, pulp and paper, chemicals, petroleum and primary metals.

The Study Area is endowed with large quantities of water, however, in comparison to the remainder of the United States, its water resources are relatively undeveloped. Therefore, municipal water problems are ones of variations in the quantity and quality of water. Because of problems of yearly, seasonal and irregular variations in rainfall, the quantity of water in a given place and time is never constant. Cities must construct storage facilities to offset such variations as well as plan for increased demands for water in the future. Rising per capita consumption, the trend toward industries favoring municipal water supply and the expansion of residential areas farther away from the cities' core are examples of the needs for adequate planning. Anticipation of these demands must be made, distribution systems must be expanded and improved, and adequate supplies for projected peak demands provided if the cities and other users are to experience optimum economic growth. What is required is not more water as such but more foresight as to future needs, the willingness to finance preparation of water development plans, and construction of additional water facilities needed.

CHAPTER IV

WATER AND RELATED LAND RESOURCES PROBLEMS AND NEEDS

General

Identifying land and water resource problems is the first important step in the development of these resources. This step, in conjunction with estimates of what the future portends, is necessary before the people can plan for the satisfaction of human needs associated with land and water resource development.

Continued population growth generates greater competition for land and water resources. Agricultural production will continue to increase and increased agricultural benefits and efficiencies in farm production will be related to the solution of land and water problems. The solution to many problems and the satisfying of needs can be achieved through local, State and Federal cooperation. Solving some problems will depend upon local initiative and resources.

The problems of the land are many and real. They began many years ago and were accelerated when the early settlers migrated into the Basin. Thousands of acres of the Basin's forest were cleared and the land planted to cotton, corn and other row crops. In the late 1800's and early 1900's timbermen logged the entire Basin. The many lumber companies that located in the Basin, using "cut out and get out" methods, removed billions of board feet of southern pine and hardwood timber. Problems as erosion, flooding, uncontrolled grazing, wildfires, insects and diseases, and other related problems were accelerated.

Over 30 years ago the Federal Government, at the invitation of the Mississippi State Legislature, purchased nearly 600,000 acres of land in the Study Area. The land became part of the National Forest system - 482,200 acres in DeSoto National Forest and 91,000 in the Bienville National Forest. These National Forests are managed under the principals of the multiple-use and sustained yield, and provide benefits from timber, water, recreation, range, wildlife and fish. This was a beginning in the solution of many of the problems through conservation. Some of the land has been treated and thousands of acres have been restored to the productivity of growing trees.

On forest land and open land, attempts have been made to solve the various problems and progress is being made. Still, old problems remain and new ones appear. Additional constructive work is needed before the water and land related problems of the Basin are solved.

Major Water and Related Land Problems

Erosion

Erosion is still a serious problem but less intense now than in the past. Changes in the agricultural economy in recent years have resulted in shifts of land from crops to pasture and forests.

There are 3,106,476 acres of inventory land that have an erosion problem or are susceptible to erosion (Table 11). Approximately 857,800 acres in land capability sub-classes IIe through VIIe are slightly to severely eroded. Of this amount, sheet erosion is moderately to severely active on 530,300 acres of cropland and slightly to moderately active on 327,500 acres of pasture and idle land.

Table 11

Nature of dominant conservation problems, 1/ by major land use categories, Pascagoula Study Area, 1958

Land use	Erosion	Excess water	Unfavorable soil	Land with no problems	Unclassified	Total
	Acres	Acres	Acres	Acres	Acres	Acres
Cropland	525,690	19,470	64,900	38,940	0	649,000
Pastureland	210,600	45,360	64,800	3,240	0	324,000
Forest - woodland	2,332,106	572,026	880,040	0	616,028	4,400,200
Other	38,080	17,000	10,880	1,360	680	68,000
Total 2/	3,106,476	653,856	1,020,620	43,540	616,708	5,441,200

1/ Land susceptible to a problem.
2/ These estimates exclude problems associated with non-inventory acreage.

The magnitude of erosion problems on open and forest land is listed in Table 12. There are approximately 28,424 acres of forest land and 61,151 acres of open land deemed critical (moderate to severe) and in need of treatment. Gully erosion is less active now than in the past. There are still, however, an estimated 8,000 acres of gullies, pits, and abandoned logging roads on the open land and another 32,865 acres of logging roads and trails on the forest land that are actively yielding sediment.

The Basin has thousands of miles of farm to market, county, secondary, State and other roads in its highway system. Erosion on 8,505 miles of roadbanks has caused moderate deposition in road ditches, culverts, and channels.

Some scour damage occurs on the floodplains. Damage is limited in scope and does not seem to appreciably affect the use or productivity of the land.

Table 12

The magnitude of erosion problems on open and forest land, by ownership category, Pascagoula Basin, 1965

Item	Unit	Private	National Forest	Total
Critical areas				
Open	Acres	61,151	---	61,151
Forest	Acres	28,250	174	28,424
Logging roads and trails				
Open	Acres	8,000	---	8,000
Forest	Acres	31,700	1,165	32,865
Roadbanks				
Open	Miles	1/ 8,037	---	8,037
Forest	Miles	---	468	468

1/ Public - County and State

Floodwater

There are 765,500 acres of land subject to overflow in upland watersheds. The total direct annual damages from flooding is $1,901,340. Of this amount $1,123,807 are damages to crops and pastures, and $777,533 are damages to fixed improvements such as fences, public roads, bridges and urban-industrial areas.

Investigations show that extensive damage occurs in those watersheds in the upper reaches of the stream system. All or parts of 17 watersheds have land and water problems that materially affect the use, management and production of crops and pastures. The remaining 46 watersheds (or parts) are affected to a lesser extent and the problems are not considered of such magnitude as to constitute a serious community or land area problem.

Within the 17 watersheds 219,144 acres of floodplain lands are inundated on an average of three to four times during the growing season. The floods cause an estimated damage of $700,824 annually

to crops and pastures and $390,797 damage to roads, bridges, other minor fixed improvements and urban damage.

Estimates of crop and pasture damages in the other 46 watersheds in the Basin are $422,983 annually and damages to roads, bridges and other fixed improvements are $386,736 annually.

The damages incurred from two recent floods are reviewed to stress the severity of flooding. One flood occurred February 17-25, 1961. The Soil Conservation Service was requested to investigate the effects of this flood on rural properties. Most of the damages were in the central and lower parts of the Basin and occurred after crops were harvested and before the new growing season started.

The storm produced total rainfall in the Pascagoula Basin varying from approximately 8.0 inches in the upper headwaters to approximately 17.0 inches in the Hattiesburg area (Forrest and Perry Counties). Over 50 percent of the total rainfall occurred on February 18. It is estimated that 750,000 acres were flooded, of which 6,000 acres were cropland and 25,000 acres pasture land.

Maximum agricultural damage to farmland occurred on the tributaries of the Leaf, Bowie and Pascagoula Rivers. The greatest damages were those to farm buildings, livestock, fences, and farm equipment. Estimated monetary damages were as follows:

Damage to cropland	$ 20,000
Damage to pasture land	50,000
Damage to farm buildings	500,000
Damage to livestock (poultry)	85,000
Other damage	76,000
Total	$731,000

There was less damage to cropland and pasture. Sediment deposits (sand) were found to be directly adjacent to the large channels. There was some silt deposition and light debris on pastures which caused slight damage to the lands.

The other flood occurring April 7, 1964, and while more local in nature, caused considerable damage to urban property in Laurel, Mississippi. The Corps of Engineers, Mobile District, estimated urban damages at $510,000 and rural damages at $172,000.

This storm, plus other water needs and problems in the vicinity of Laurel, resulted in public hearings and a request to the Corps of Engineers to make an economic study of the Tallahala Creek. From the study evolved a proposed project plan that will provide flood control, water supply for Laurel, water quality storage for pollution abatement and recreation.

Sediment

Damages from soil deposition are relatively minor. However, they contribute to the flooding problem by filling stream channels and causing added damages to crops, pastures, fixed improvements, and in some cases fishery resources. The monetary damages were evaluated and combined with flood damages.

Studies of annual gross erosion and sediment yields indicate an annual sediment yield ranging from 150 to 941 tons per square mile of drainage area. Greater amounts of sediment enter the streams in the upper Coastal Plain and Central Prairie Resource Areas than in the Lower Coastal Plain and Coastal Flatwood Resource Areas. Fifteen percent of the sediment that enters the streams comes from eroding road banks.

On site investigations made behind detention reservoirs indicate that annual soil movements for various land uses are as follows: 1/

Land use	Annual soil moved (Tons per acre)
Cultivated 2/	12.5 to 62.2
Idle	1.3 to 15.1
Pasture	2.7 to 14.9
Woodland	0.48 to 10.2

The amount of soil that is actually lost and deposited at any given point downstream from the various land uses is dependent on watershed characteristics and on distance traveled.

Impaired Drainage

Surface drainage is a problem in the Coastal Flatwoods Resource Area of the Pascagoula Study Area. Most of the channels in the upland watersheds have sufficient capacity to carry run-off from normal precipitation on the bottom lands. However, the channels are usually inadequate when run-off from upland areas is considered or when the precipitation is above normal. In many instances complete water disposal systems have not been constructed because of the frequency of flooding on bottom lands. Conservation Needs Inventory data prepared in 1958

1/ This is expressed as average annual soil movement in average tons per acre for each structure site and land use. These figures do not show actual soil loss but they are significant in that they do indicate the severity of the erosion problem.

2/ Excludes bottomland.

identified 463,000 acres of land with a drainage problem. Of this amount, 189,000 acres are open land in crops and pasture and 274,000 acres are in woodland.

An economic analysis of the drainage problem was made to determine the total average yearly reduction in net farm income due to inadequate drainage which occurs with present cropping patterns and farming conditions. The estimated average annual reduction in net farm income from inadequate drainage of open land is $1.2 million. No detailed analysis was made of drainage problems on forested land.

A drainage study of the Coastal Flatwoods Resource Area was made and it was found that 95 percent of the land (not including urban areas) is in forest that is considered undrained. In Jackson County, 56 percent of the nine major soil associations studied is classified as poorly drained and 19 percent is classified as somewhat poorly drained.

Surface and sub-surface water may constitute a problem on some forest lands (wet pineland) within the Study Area. These areas are located in the Coastal Flatwood Resource Area. The removal of water from forest lands is primarily for increased timber production. It is not implied that water removal is beneficial on all forest land, for in some cases it has detrimental effects. The benefits could consist of early restocking, better juvenile growth, and improved accessibility for logging by conventional methods.

Four soil associations - Rains and Plummer; Rains, Lynchburg, Goldsboro; Coxville, Bayboro, Dunbar; and Bayboro, Coxville, Dunbar - make up approximately 118,470 acres of forest land. Seventy-six percent of the acreage is poorly drained, 17 percent is somewhat poorly drained, and 7 percent is moderately well drained.

Major Land and Water Development and Management Needs

Flood Control and Prevention

The problems of flooding are more severe in 17 upland watersheds in the northern and northwestern parts of the Basin. Studies made in these watersheds indicate an immediate need for flood prevention measures. Structural measures needed in these watersheds to reduce flood damage include 133 floodwater retarding structures, 20 multiple purpose structures with recreational facilities and 852 miles of channel improvement. Also, there is an important need for land treatment measures in conjunction with structural measures for flood prevention that are discussed under conservation treatment. These strucutral and land treatment measures are needed in an early-action program (1980). Also, there is a need for additional floodwater retarding and multiple purpose structures along with channel improvement work in all or parts of 30 watersheds that are not presently economically feasible. However, the measures

in these watersheds are considered potentially feasible for project action by the year 2015. There are 16 watersheds (or parts) in which the flood problems are minor and project improvements are not expected to be economically feasible within the next 50 years.

Land Conservation Treatment and Management

Open Land - The problems of erosion, floodwater, sediment and drainage were described above in terms of their causes, extent and economic losses. The total open land treatment needs, as directly or indirectly associated with either one or more problems or a combination of problems, are presented in Table 13. The land treatment needs identified are those primarily associated with cropland, pastureland and other farmland in all or parts of 63 watersheds. Also included is the amount of each land treatment measure that is expected to be accomplished by project action in the 17 feasible watersheds along with the remaining needs. The major problems for open land are critical area treatment which consists of planting grasses and legumes on 14,951 acres of badly eroded land and 8,037 miles of caving road banks. Other measures needed to reduce the problems on open land include conservation cropping systems, pasture planting, pasture renovation, diversion and terrace construction, grassed waterways, drainage ditches, farm ponds and wildlife habitat development.

Forest Land - The magnitude of the erosion problems was identified in a preceding section. Open land that should be planted to trees totals 46,200 acres and 28,424 acres of forest land needs treatment to reduce erosion. Some is gullied land but the majority suffers from sheet erosion. The result is that tons of soil are silting the streams and rivers in the Basin. Treatment with trees, grasses, and wildlife food-cover plants is necessary to stop the loss of soil and reduce the flow of damaging sediment by giving protection, through litter, to the bare soil. In time, humus will develop to aid in absorbing storm rainfall and carry it into the soil profile. Pines furnish good protective cover for many erodible areas. Grass and wildlife food-cover plants will serve to stabilize many areas plus provide food and cover to game birds and animals. Abandoned logging roads and trails need to be stabilized by revegetation of bare soil. Roadbanks need sloping and planting with grass to reduce erosion.

To establish the needed cover on eroding land - critical areas, logging roads and trails, and roadbanks - approximately 66,781 acres of site preparation work is needed to prepare the land for trees and grasses and about 1,314 miles of fencing to protect these and other areas from grazing. Data pertaining to needs on private forest land and on National Forest land are presented in Table 14.

Besides treatment of the critical areas on openland, treatment for watershed protection is needed on many acres of forest land. Forest land measures such as tree planting (conversion, inter, and

Table 13

Land treatment needs of open land, Pascagoula Basin, 1965

Measures	Unit	Total Basin needs	To be applied - 17 watersheds		Remaining needs
			Eight under PL-566 authorization	Nine under Basin-wide authorization	
Conservation cropping system	Acres	590,000	100,833	55,665	433,502
Pasture planting	Acres	285,000	46,919	27,415	210,666
Pasture renovation	Acres	315,000	68,862	22,995	223,143
Diversion	Miles	780	133	50	597
Terracing, gradient	Miles	3,200	765	299	2,136
Grassed waterways	Acres	5,250	755	341	4,154
Drainage, main and lateral	Miles	700	131	56	513
Drainage field ditch	Miles	1,450	289	120	1,041
Farm ponds	Number	10,250	2,029	875	7,346
Wildlife habitat development	Acres	47,550	3,816	2,013	41,721
Critical area planting 1/					
Grasses and legumes	Acres	14,951	2,748	2/ 10,983	1,220
Roadside erosion control	Miles	8,037	953	2/ 6,730	354

1/ Tree planting on open land and related practices are presented under conservation treatment - forest land.

2/ Applies to entire Basin.

Table 14

Land treatment needs on private forest land and National Forest land, Pascagoula Basin, 1965

Measures	Unit	Total Basin needs	To be applied - 17 watersheds		Remaining needs
			Eight under PL-566 authorization	Nine under Basin-wide authorization	
Private forests:					
Critical area stabilization					
Tree planting	Acres	74,450	7,130	1/ 53,630	13,690
Logging roads and trails	Acres	31,700	0	1/ 23,140	8,560
Site preparation	Acres	31,570	5,320	1/ 22,395	3,855
Fencing	Miles	1,250	123	1/ 889	238
	Acres	25,030	2,450	1/ 17,760	4,820
Tree planting					
Open	Acres	234,617	7,310	3,570	223,737
Conversion	Acres	120,720	3,260	2,285	115,175
Inter and under	Acres	268,340	5,110	2,740	260,490
Fencing	Miles	851	36	13	802
	Acres	29,470	1,410	795	27,265
Hydrologic stand imp.					
Conversion release	Acres	120,720	3,260	2,285	115,175
Underplanting release	Acres	208,870	3,390	1,700	203,780
Pine	Acres	936,350	15,950	8,270	912,130
Hardwood (upland)	Acres	75,310	3,670	1,180	70,460
Fencing	Miles	2,392	54	35	2,303
	Acres	383,020	8,620	5,570	368,830
Improvement cut	Acres	451,900	64,530	30,170	357,200
Management plans	Acres	2,169,230	191,640	116,030	1,861,560

Continued

Table 14

Land treatment needs on private forest land and National Forest land, Pascagoula Basin, 1965 (Cont'd)

Measures	Unit	Total Basin needs	To be applied - 17 watersheds		Remaining needs
			Eight under PL-566 authorization	Nine under Basin-wide authorization	
National Forests:					
Critical area stabilization					
Roadbank	Acres	1,874	72	1/ 1,696	106
	Miles	468	18	1/ 424	26
Logging roads and trails	Acres	1,165	130	1/ 867	168
Tree planting	Acres	174	0	1/ 174	0
Erosion control - other 2/	Acres	472	7	1/ 462	3
Fencing	Miles	64	5	1/ 54	5
Tree planting, direct seeding and seedbed preparation	Acres	56,825	500	300	56,025
Fencing	Miles	106	5	7	94
Release - stand conversion and other	Acres	42,875	500	650	41,725
Fencing - range management	Miles	736	5	15	716

1/ Applies to entire Basin.
2/ Includes grasses and wildlife food-cover plants.

under), releasing and thinning are needed to put desirable tree species into the best productive condition. Treatment will help to develop a protective cover and an absorbent forest floor of spongy humus under a protective layer of litter. Treatment also will aid in retarding runoff and reducing soil losses and sediment to a minimum.

Conversion (planting and releasing) to more favorable tree species is needed on 120,720 acres of private forest land (Table 15). The removal of undesirable species is needed on 1,220,530 acres. Tree planting - open, inter and under - is needed on 502,957 acres of open and forest land. Approximately 451,900 acres of forest land should have merchantable timber removed and thereby provide growing room for the remaining timber.

Table 15

Problems and management needs on private forest land, Pascagoula Basin, 1965

Item	Unit	Amount
Critical area stabilization		
Open 1/	Acres	46,200
Forest 2/	Acres	28,250
Logging roads and trails	Acres	31,700
Site preparation	Acres	31,570
Fencing	Miles	1,250
Uncontrolled grazing	Acres	824,420
Insects and diseases	Acres	824,420
Management		
Planning	Acres	2,169,230
Tree planting		
Open	Acres	234,617
Conversion	Acres	120,720
Inter and underplanting	Acres	268,340
Releasing		
Conversion	Acres	120,720
Underplanting	Acres	208,870
Pine	Acres	936,350
Hardwood (Upland)	Acres	75,310
Improvement cut	Acres	451,900

1/ Trees.
2/ Trees, grasses, and wildlife food-cover plants.

Reforestation and stand improvement have been accomplished on many acres of National Forest land. Some 56,825 additional acres were determined as needing reforestation. These measures include seedbed preparation, direct seeding and planting. Approximately 42,875 acres of reforested areas need releasing from the overtopping scrub hardwoods (Table 16). These phases of forestry will enhance timber production and improve related soil, water and wildlife resources.

Table 16

Total land treatment needs, National Forest land, Pascagoula Basin, 1965

Land treatment	Unit	Amount
Critical area stabilization		
Roadbank	Miles	468
Logging road and skid trail	Acres	1,165
Tree planting	Acres	174
Erosion control - other 1/	Acres	472
Fencing	Miles	64
Direct seeding, planting, and seedbed preparation	Acres	56,825
Fencing	Miles	106
Release, stand conversion and other	Acres	42,875
Fencing - range management	Miles	736

1/ Includes grasses and wildlife food-cover plants.

Insects and Diseases - Insects and diseases are prevalent in the forests with resulting losses in timber production through a reduction in growth, lower quality, deformities, and death. Insects that affect the pine reproduction are the tip moth, pine sawflies, the pales weevil and the pine webworm. Bark beetles such as Ips, southern pine and black turpentine are a threat to the larger pine trees. Evidence of insects was found on two percent of the forest land but insects can infest an area and move on before the damage is discovered. It requires the combined effort of all landowners to locate these problem areas and contain them while they are small.

Scatterings of fusiform rust, Cronartium fusiforme, were found in 24 percent of the Basin, mostly in the northern part. As yet there is no economically feasible method to prevent fusiform rust infection. Some control can be expected through pruning infected branches on young

trees and the removal, through thinnings, of larger trees with trunk cankering. Through breeding, progress is being made in developing rust-resistant pine seedlings.

Grazing - Grazing of forest land is a practice that dates back to the coming of the settlers in the early 1800's. Thousands of cattle, sheep and swine roamed the open and forested areas. As the years passed, the native grasses and other feed gradually disappeared. The cattle trampled and destroyed hardwood and pine seedlings. The soil became compacted and the water absorptive rate declined. This, in turn, increased surface runoff and started soil erosion and sedimentation. Currently, approximately 824,420 acres of private upland forests are in need of protection and treatment. The damages range from light to severe.

On private lands measures are needed to control cattle grazing. Approximately 3,240 miles of fencing is needed to keep animals out of or to control the number of animals within a forested area. Education of landowners concerning the damage grazing does to forest land is needed. Greater emphasis should be placed on improving permanent pasture land with only carefully managed grazing of forested lands.

Uncontrolled grazing has been a problem on National Forest land, but efforts have been made in recent years to remedy this practice. In accordance with better land management, all grazing will be eliminated from the northern part of the Bienville National Forest. Managed grazing as a forest practice is largely confined to the DeSoto National Forest and the southern part of the Bienville National Forest. There are approximately 413,000 acres of National Forest land suitable and available for grazing. This area is divided into grazing allotments. One of the grazing problems is unfenced allotment boundaries. It is estimated that 736 miles of fencing is needed to control the number of animals during seasonal grazing periods.

Also, a plan has been developed in an attempt to provide solutions to other problems - public attitude and trespass, distribution of range use, winter use and intermingled private land. The plan calls for maintaining a working business relationship with all range users to aid in public acceptance of the plan; cooperation between parties to obtain proper use within each allotment; to eliminate late fall and winter grazing because of nutrient shortages in the native forage; to obtain agreements of common use on intermingled private land and National Forest land; and if agreements cannot be worked out, boundary fences will be necessary.

Forest fires - Wildfires are not as serious a problem today as they were in days gone by. Fire was an uncontrolled tool used by the farmers to get rid of underbrush and to dispose of crop residue, to "green up" the woods for grazing, and to kill off "varmints." Mississippi Forestry Commission information shows that over 12 percent

of the protected acreage in the State of Mississippi was destroyed by forest fires in 1927-28. Since that time the percentage of protected acres burned decreased to 0.43 percent in 1965-66. In the Pascagoula Study Area, a similar trend has taken place. Over the years county after county has come under fire protection of the Mississippi Forestry Commission and currently only the private land in the northwestern corner and the southern portion of Perry County is not under protection. For the past nine years, the annual burn of the protected acres ranged from 20,777 acres or 0.47 percent to 74,753 acres or 1.69 percent. The State fire loss index goal is 0.25 percent. To achieve this goal, the annual burn must be reduced in the Basin. It is estimated that damage to forest by fire is $14.20 per acre. This includes damage to timber, forage, watershed, wildlife, and recreation. During the period 1958-66, monetary losses amounted to over $5 million in the Basin.

Fire protection for State and private forest lands in the Pascagoula Basin is handled by the Mississippi Forestry Commission and the Division of Forestry, Alabama Department of Conservation, cooperating with the U. S. Forest Service.

The Mississippi Forestry Commission's present equipment of 51 three-man crews and 44 look-out towers can handle all fires under normal conditions. With a build-up of forest fire fuels, forest values, and to achieve the State's fire loss index goal of 0.25 percent, additional manpower and suppression equipment is needed. Thirty-five additional units and crews will be needed by 1980. The initial cost for the new suppression units is estimated at $472,500.

The Division of Forestry, Alabama Department of Conservation, has had Mobile and Washington Counties under full fire protection since 1951. Since 1962 the annual burn of the protected acres has ranged from 7,720 acres or 0.65 percent to 37,457 acres or 3.17 percent. The Division has 9 fire units and 10 towers in this area. It is anticipated that the future may call for one additional fire unit with an initial cost of $13,500.

Fire protection on the Bienville and DeSoto National Forests is provided by the U. S Forest Service. Their equipment of 16 units and 17 look-out towers aids in keeping the annual burn very low. The effectiveness of this fire protection is shown in the comparison between 1936 and the 1965 figures. In 1936, man-caused fires numbering 578 consumed 26,397 acres. In 1965 the 93 man-caused fires burned only 375 acres.

Forest industry firms have a number of fire fighting units. They are located in various counties within the Basin. All units - State, Federal and industry - combine into an effective fire fighting organization.

Cooperation needs to be strengthened between the land protection agencies and private landowners. An effective continuing education

program will keep the people informed of losses to resources caused by fires. The problem, wildfires, is the same regardless of forest ownership.

Irrigation

Lack of water or moisture for the production of crops and pastures is not considered a serious problem in the Pascagoula Basin. The Conservation Needs Inventory indicates there are 142,000 acres of irrigable land in the Basin. 1/ Of this amount 58,000 acres are open and 84,000 acres are woodland. Production of crops and pastures could be increased by the use of supplemental water. However, the Basin's share of food and fiber can be produced without employing supplemental irrigation.

Livestock and Rural Domestic Water

Water for rural and domestic needs is not a problem insofar as supply is concerned. Adequate ground water is available from wells, springs and streams in all parts of the Basin. Also farm ponds, mainly for livestock water, either have been or can be constructed on most of the farms in the Basin. Water for household use is mostly from wells located near the farm or rural residences. In some cases community water systems have been developed that use deep wells as a source of water supply. The quality of the water is usually good and presents no serious problem. Some of the industrial water systems use a filtering process to remove undesirable minerals from the water.

The supply of water is adequate. There is a need to develop the supply in some parts of the Basin, however.

Fish and Waterfowl Habitats and Capacities

The fresh-water habitat of the Study Area was inventoried by the Bureau of Sport Fisheries and Wildlife (Table 17). Since fishing habits of the residents are influenced by the available coastal fishing waters, any comparison of supply and demand must consider salt-water fishing. It was necessary to allocate existing and projected fishing demand between available fresh-water and salt-water resources. The distribution of present and future sport fishing demand within subareas was estimated as follows: Leaf and Chickasawhay, 5 percent salt water and 95 percent fresh water; Coastal, 60 percent salt water and 40 percent fresh water.

When the demand allocated to salt water is compared to supply, salt-water habitat is adequate to support the estimated demand -- now and in target years. In contrast, the demand for fresh-water fishing exceeds supply. A comparison of fresh-water demand and supply may be ascertained from the data in Table 18.

1/ Does not include irrigable land in Alabama portion of the Basin.

Table 17

Fresh water fishing areas and capacities, Pascagoula Basin, 1965 1/

Item	Amount	Fishing capacity
	Acres	Man-days
Reservoirs	4,400	77,200
Farm ponds	12,635	252,700
Natural lakes	7,620	228,600
Public fishing lakes		
State	2,151	107,550
Federal	187	3,740
Streams		
Main stem	13,489	344,470
Major tributaries	6,482	142,770
Intermediate tributaries	5,025	26,800
Small tributaries	680	495
Total	52,669	1,184,325

1/ A Report on the Fish and Wildlife Aspects of the Pascagoula River Basin-Mississippi and Alabama, Appendix I, BSF&W, United States Department of the Interior, December 1966.

In 1965, the unsatisfied demand (or need) for fishing amounted to 67.9 thousand man-days. Assuming no change in the 1965 supply and capacities, the estimated need in 1980 amounts to 248.6 thousand man-days as related to projected population and participation rates. Fishing capacities provided for in 20 early-action reservoirs planned by the Soil Conservation Service and the expansion of existing Forest Service projects will supply 32.9 thousand man-days of fishing. The unsatisfied demand (or need) is thereby reduced to 215.7 thousand man-days.

Wildlife Habitat

The Bureau of Sports Fisheries and Wildlife inventoried hunting areas and measured the hunting capacity (Table 19). Waterfowl were not included in calculations of hunting capacity, although waterfowl hunting occurs on small scattered areas of good natural habitat.

A comparison of hunting demand and estimated supply may be ascertained from the data in Table 18. Currently, an excess capacity of 1,768.8 thousand man-days of hunting are indicated. Projected demand for upland game hunting is expected to be satisfied by estimated supplies in all sub-areas through 1980. Demand will exceed capacity in the Coastal Sub-area by 2015 when human populations are expected to about double the 1980 levels. The supplies in other parts of the Basin could satisfy Coastal deficits.

Table 18

Existing and projected annual demand, supply and needs for specified recreational activities, Pascagoula Basin, 1965 and 1980

Activity	Unit	1965			1980			
		Demand 1/	Supply 1/	Demand-supply relationship	Demand 1/	Supply 1/ 2/	USDA projects 3/	Demand-supply relationship
		1,000	1,000	1,000	1,000	1,000	1,000	1,000
Swimming	Activity occasion	6,360.6	1,070.9	-5,289.7	11,320.3	1/1,558.4	1,223.7	-8,538.2
Boating	Activity occasion	2,838.0	104.2	-2,733.8	5,050.0	104.2	166.2	-4,779.2
Fishing	Man-days	1,252.2	1,184.3	- 67.9	1,432.9	1,184.3	32.9	- 215.7
Camping	Activity occasion	914.6	272.2	- 642.4	1,627.1	1/ 362.5	151.7	-1,112.9
Picnicking	Activity occasion	3,214.9	327.8	-2,887.1	5,723.4	1/ 530.4	252.4	-4,940.6
Hunting	Man-days	704.9	2,473.7	+1,768.8	806.9	2,449.6	----	+1,642.7

1/ Demand and supply estimates from: A Report on the Recreation Aspects of the Pascagoula River Basin-Mississippi and Alabama, Appendix H, BOR, United States Department of the Interior, December 1966 and A Report on the Fish and Wildlife Aspects of the Pascagoula River Basin - Mississippi and Alabama, Appendix I, BSFW, United States Department of the Interior, December 1966.

2/ Includes expansion of U. S. Forest Service facilities existing in 1965.

3/ Includes the recreational facilities to be developed in connection with the 17 feasible watershed projects and new recreational areas to be constructed by the U. S. Forest Service.

Table 19

Hunting areas and capacities, Pascagoula Study Area, 1965

Item	Amount	Hunting capacity
	Acres	Man-days
Cropland	648,800	207,616
Forests (Farm and nonfarm)		
Type 2 1/	1,687,393	624,335
Type 8 2/	2,682,521	1,099,834
Type 13 3/	603,245	452,434
Pasture	324,697	68,186
Federal-non forest 4/	40,100	8,421
Other 5/	67,744	12,871
Urban	231,600	0
Water 6/	37,200	0
Total	6,323,300	2,473,697

1/ Longleaf-slash
2/ Shortleaf-loblolly-hardwoods.
3/ Mixed bottomland hardwoods.
4/ Government lands not in National Forest.
5/ House lots, farm lots, lanes, roads, ditches, land area of ponds, and wastelands.
6/ Water impoundment areas 1 to 40 acres in size and streams less then 1/8 mile in width.

The man-days of hunting as determined from the existing supply of hunting habitat is reduced from 2,473.7 thousand man-days in 1965 to 2,449.6 thousand man-days in 1980. This results from shifts of forest and wildlife habitat acres to water areas included in action projects contemplated by 1980.

Recreational Water, Land and Facilities

Many outdoor recreation activities are enhanced or directly dependent upon water. An adequate supply of clean water is necessary before full development of recreational facilities can be realized. Generally, recreational water for dependent activities are lacking within the Study Area as a whole. Locally, State Parks, Game and Fish Commission lakes and natural streams support much activity but these developments and natural waters are far from adequate. A list of known recreational facilities is presented in Table 20.

A comparison of the demand and supply situation for swimming, boating, camping and picnicking may be ascertained from the data

Table 20

Existing recreational facilities, Pascagoula Study Area, 1965

Item	Unit	Type			Total
		Other public 1/	Private 2/	National Forest 3/	
Water with access	Acres	3,510	4,565	790	8,865
Beach	Acres	31.5	5.8	3	40.3
Swimming pools	Sq.Ft.	6,900	0	0	6,900
Picnic	Acres	149	N/A	58	207
Picnic tables	No.	208	207	90	505
Camping units	No.	230	71	23	324
Group camping	No.	0	1	2	3
Cabins	No.	120	133	0	253

1/ A Report on the Recreation Aspects of the Pascagoula River Basin - Mississippi and Alabama, Appendix H. BOR, United States Department of the Interior, December 1966. (Excludes National Forest).

2/ An Appraisal of Potentials For Outdoor Recreation Developments in Southeast Mississippi, Soil Conservation Service, United States Department of Agriculture, January 1967.

3/ National Forest Recreation Survey, Forest Service, United States Department of Agriculture. (These estimates are for the Basin boundary).

in Table 18. A complete assessment of the many facets of recreation may be ascertained from information presented in Appendix H. 1/

Water Quality

A report by the Federal Water Pollution Control Administration indicates that there is a need for water storage for low flow augmentation in several areas of the Basin. Studies of existing stream flows, municipal and industrial pollution in the streams for present and projected growth of municipalities show that adequate treatment to limit future waste discharges will maintain satisfactory dissolved oxygen levels in the Hattiesburg area. Low flow augmentation is required in Tallahala Creek in and below Laurel, Mississippi. Flow augmentation is needed in the Pascagoula River estuary and bay including the Escatawpa River near Pascagoula.

1/ A Report on the Recreation Aspects of the Pascagoula River Basin - Mississippi and Alabama, BOR, United States Department of the Interior, December, 1966.

The occurrence of heavy water using industries such as chemical, fertilizers or pulp-paper that were not accounted for in the Economic Base Study 1/ will necessitate a re-evaluation of the needs for low flow augmentation.

Sediment as a pollutant must bear consideration if water is taken from the streams for municipal or industrial use. Also the location of impoundments for outdoor recreation may be affected if care is not taken in their location. The Soil Conservation Service estimated that in an average year, 668 acre feet of sediment will flow past Hattiesburg in the Leaf River, 419 acre feet by Enterprise on the Chickasawhay River in Clarke County, 1,445 acre feet by McLain on the Leaf River and over 2,800 acre feet at Pascagoula.

A one year sampling of suspended sediments in the Pascagoula River near Benndale, Mississippi, by the U. S. Geological Survey shows that the concentration of suspended sediment is low. A mean daily discharge of 16,000 cubic feet per second has a sediment concentration of 165 parts per million. Approximately 10 percent of the material is organic and 90 percent inorganic.

Water pollution appears to be a problem of variable proportions. A complete assessment of the magnitude of pollution problems and recommended solutions may be ascertained from information presented in Appendix G. 2/

1/ Economic Base Study, Pascagoula, Pearl and Big Black River Basin, Michael Baker, Jr., Inc., Jackson, Mississippi, 1964.

2/ Municipal and Industrial Water Supply and Water Quality Control Study - Pascagoula River Basin, Mississippi and Alabama, FWPCA, United States Department of the Interior, 1967.

CHAPTER V

WATER AND LAND RESOURCE DEVELOPMENT POTENTIAL

Availability of Land for Development

The Pascagoula Study Area comprises 6,323,300 acres of land with a water surface area of 37,200 acres. The area devoted to Federal uses, urban uses and water comprises 882,100 acres. The remaining 5,441,200 acres are in farms and non-farm forests. Therefore, there currently exists a plentiful supply of land for a diversity of development purposes.

The 5.4 million acres in farms and non-farm forests (excluding Federal) is referred to as inventory acreage. In 1958, approximately 57 percent was suitable for cropland. The actual recorded use was 12 percent in cropland, 6 percent in pastureland, 81 percent in forest and one percent in other inventory uses. 1/

Potentially there are 3.1 million acres in the Study Area suitable for cultivation. Presently only about 649 thousand acres are cultivated. If an increased demand for cropland were manifest, the additional cropland would probably come from land presently in forest and in pasture; however, additional cropland requirements are not indicated. Land use shifts in terms of physical potential for development are assessed below.

Cropland Suitable for Regular Cultivation

The acreage devoted to each major land use by land capability classes is shown in Table 21. Land capability estimates show that 545,809 acres of the 1958 cropland are Classes I - III land, which is suitable for regular cultivation with proper farming practices under good management. Of the present cropland suitable for full-time cultivation, 36,344 acres are Class I, or very good land which requires no special erosion control or other practices; 325,798 acres are Class II, or good land which needs only simple erosion control practices and correction of fertility needs or other practices; and 183,667 acres are Class III land, which is sloping, moderately fertile, difficult to drain or irrigate, or which for some other reason needs extra good practices

1/ Land use distribution presented under Land Use and Cover included both inventory and non-inventory acreage.

Table 21

Use of inventory acreage by capability class, Pascagoula Study Area, 1958

Class	Cropland	Pastureland	Forest	Other	Total	Distribution
	Acres	Acres	Acres	Acres	Acres	Percent
I	36,344	4,212	17,201	1,156	58,913	1.1
II	325,798	111,456	683,732	17,612	1,138,598	20.9
III	183,667	109,836	799,837	16,932	1,110,272	20.4
IV	59,708	40,176	563,326	6,392	669,602	12.3
V	2,596	12,636	417,119	4,216	436,567	8.0
VI	38,940	42,120	937,444	5,984	1,024,488	18.9
VII	1,298	2,592	275,213	15,164	294,267	5.4
Unclassified	649	972	706,328	544	708,493	13.0
Total	649,000	324,000	4,400,200	68,000	1/5,441,200	100.0

1/ Excludes 882,100 acres classed as non-inventory.

for permanent use as cropland. Another 59,708 acres of cropland are Class IV land which is severely limited as to possibilities for cultivation. Most of it is suitable only for occasional cultivation in long-time rotations. In addition, 43,483 acres of Classes V - VII, and unclassified land, or about seven percent of the presently cultivated cropland, are not suitable for use as cropland. This land is too steep, too eroded, too stony or otherwise poorly adapted to cultivated crops. Thus, of the 649,000 acres of presently cultivated cropland, 84 percent is adapted to full time cultivation, and nine percent can be cultivated to a limited extent if suitable precautions are taken.

Potential Shift of Grassland Pasture to Cropland

Additional areas shown by the land capability estimates as the most susceptible and physically feasible land for development for long-time regular cultivation, through plowing and improvement of the soil, consists of 225,504 acres of grassland pasture. Much of this grassland could be put into cultivation by plowing up the sod. Limited areas would require drainage and some would respond to irrigation, erosion control, or other improvements. Of the 225,504 acres of grassland suitable for full-time cultivation, 4,212 acres are Class I; 111,456 acres are Class II; and 109,836 acres are Class III land.

Development of suitable grassland pasture as cropland and its incorporation into the rotation would take several years. Time would need to be allowed for demand for the products from it to materialize. Plowing of pasture and use of cultivated crops would reduce the acreage available for pasture. It would substitute one kind of production for another, and changes in the systems of farming followed would be required. Apparently such a shift from grassland pasture to cropland will be neither necessary nor desirable in the near future in the Pascagoula Study Area.

Potential Shift of Woodland to Cropland

If cleared and properly cultivated, 17,201 acres now in generally level and fertile woodland would make Class I cropland. Another 683,732 acres of woodland are suitable for regular cultivation as Class II cropland, if simple erosion control practices are followed, and if the moderate fertility is corrected by adding fertilizers or other soil amendments. An additional 799,837 acres of woodland can be converted into Class III cropland with permanent cultivation, but special erosion control and soil management practices will be needed. Here in the aggregate are 1,500,770 acres of woodland that could be converted to cropland.

The new areas of land suitable for farming that could be brought into cultivation primarily by clearing woodland and farm drainage are quite large. Much of the undeveloped wet land that is physically feasible to develop for farming requires both drainage and clearing.

The Pascagoula Study Area with its large acreage of suitable land is well adapted for production of additional food and feed crops. Alternative costs and returns of placing this land in cultivated crops and improved pasture over returns from production of timber products and grazing, however, needs to be studied before large scale clearing operations are undertaken. Desirable commercial timber species already on the forest land in the long run may give better returns than would clearing for cultivation.

Recommended Shift of Cropland to Grassland and Woodland

Partly offsetting the potential shift of grassland and woodland to cropland are 43,483 acres of cropland which the Soil Conservation Service has classified as best suited to grassland and woodland. This is mainly land which has so much slope that it should be kept in continuous sod or tree cover. Assuming that the present cropland acreage of 43,483 acres were placed in continuous sod or tree cover, the remaining acreage in Class I, II and III would more than meet the needs of the indicated acreage requirements for crops in the Basin in both 1980 and 2015.

Surface Water Availability and Development Potential

Runoff

Surface water runoff is that part of the precipitation that appears in surface streams. The total runoff may come from one or more of the following sources - surface runoff, storm seepage or ground-water runoff. There are, or have been, eleven stream gaging stations with satisfactory streamflow records in the Pascagoula River Basin that could be used in the runoff analysis.

Surface runoff analysis in this report is based on the period from the beginning of water year 1939 through water year 1963. The average runoff during this 25-year period appears to be typical of the average runoff that could be expected over a long period of years. The average annual runoff rate (in watershed inches and in acre-feet per square mile), the maximum runoff rate and the minimum runoff rate at each gaging station is shown in Table 22. The average annual runoff ranged from a low of 17.21 inches or 918 acre-feet per square mile above the Chunky Creek near Chunky stream gaging station to a high of 27.10 inches or 1,445 acre-feet per square mile above the Escatawpa River near Wilmer, Alabama, stream gaging station. A summary of annual runoff for each of the eleven gaging stations for the water years 1939 through 1963 is shown in Table 23.

Table 22

Maximum, minimum and average runoff rates, at selected gaging stations, Pascagoula Basin 1/

Gaging station	Drainage area	Watershed inches			Square mile		
		Average	Maximum	Minimum	Average	Maximum	Minimum
	Sq.Mi.	Inches	Inches	Inches	Ac.Ft.	Ac.Ft.	Ac.Ft.
Leaf River							
Near Collins	752	18.76	37.67	7.07	1,000	2,009	377
At Hattiesburg	1,760	20.13	38.85	9.17	1,073	2,072	489
Near McLain	3,510	20.58	42.75	7.81	1,098	2,280	417
Tallahala Creek							
At Laurel	233	18.83	40.98	5.57	1,004	2,185	297
Near Runnelstown	612	19.51	43.21	7.32	1,040	2,304	390
Bowie Creek							
Near Hattiesburg	304	20.09	38.57	9.53	1,071	2,057	508
Chickasawhay River							
At Enterprise	913	17.48	34.92	6.37	932	1,862	340
At Leakesville	2,680	18.81	39.05	7.09	1,003	2,083	378
Chunky Creek							
Near Chunky	368	17.21	32.58	6.31	918	1,737	337
Pascagoula River							
At Merrill	6,600	19.98	39.91	7.64	1,066	2,128	407
Escatawpa River							
Near Wilmer, Ala.	506	27.10	44.77	9.75	1,445	2,388	520

1/ Based on water years for period 1939 through 1963.

Table 23

Average annual runoff rates, eleven gaging stations, Pascagoula Basin, 1939-63

Water year	Gaging Stations										
	Leaf River			Tallahala Creek		Bowie River	Chickasawhay River		Chunky Creek	Pascagoula River	Escatawpa River
	Near Collins	At Hatties-burg	Near McLain	At Laurel	Near Runnels-town	Near Hatties-burg	At Enter-prise	At Leakes-ville	Near Chunky	At Merrill	Near Wilmer, Ala.
	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches	Inches
1939	13.94	15.36	15.14	13.23	15.21	15.18	15.79	16.37	14.13	16.76	21.79
1940	22.97	22.90	22.52	23.17	23.85	19.75	18.71	21.47	17.93	22.02	31.44
1941	13.20	14.28	13.95	12.91	13.48	14.83	13.70	13.23	14.13	14.04	20.42
1942	15.99	18.34	19.10	17.51	17.30	20.30	13.68	15.96	13.50	18.03	24.67
1943	16.21	21.04	22.11	18.01	11.99	25.87	12.48	16.87	11.99	19.56	28.27
1944	23.90	25.31	25.66	29.40	27.04	24.94	22.32	24.17	21.32	25.69	35.65
1945	19.32	19.41	19.72	21.74	20.55	20.06	21.32	20.14	21.16	20.27	29.29
1946	20.53	26.59	25.15	22.10	23.28	23.79	23.82	25.52	24.18	25.51	39.71
1947	25.29	29.48	29.63	31.39	29.88	31.55	24.08	26.78	23.39	27.91	31.59
1948	19.89	22.83	25.68	21.94	23.54	24.47	21.12	23.60	19.26	25.98	34.56
1949	37.67	38.85	42.75	40.98	43.21	38.75	34.92	39.05	32.58	39.91	44.77
1950	25.71	23.31	20.17	18.15	19.31	23.94	21.93	17.82	23.25	19.31	21.00
1951	15.51	15.73	16.17	15.13	14.71	16.51	18.45	17.65	18.65	16.82	20.77
1952	8.43	10.96	11.78	8.55	10.60	11.92	7.00	9.17	6.37	11.18	11.56
1953	21.65	21.37	20.97	20.07	19.97	19.52	15.99	16.92	16.69	18.56	20.98
1954	9.67	11.54	13.88	10.24	12.34	11.06	8.20	12.05	6.80	13.38	13.52
1955	9.90	11.68	10.96	7.76	9.16	12.38	8.39	8.46	8.75	10.40	20.87
1956	14.57	10.42	13.50	10.42	12.01	13.36	17.43	12.47	17.40	13.07	17.64
1957	10.45	11.64	10.53	6.36	8.51	11.44	7.82	7.44	8.14	9.55	26.99
1958	23.84	25.62	28.02	26.59	27.88	23.66	22.23	26.55	22.22	27.17	34.19
1959	13.85	15.54	16.50	10.70	14.17	13.42	12.11	14.56	13.25	16.58	31.98
1960	17.41	19.66	20.67	16.74	20.39	17.55	16.61	19.62	16.97	20.14	28.56
1961	29.06	30.71	32.34	32.75	32.29	31.56	25.04	30.43	24.12	31.35	40.87
1962	32.86	31.47	30.23	29.22	29.83	27.85	27.50	26.95	27.67	28.66	36.72
1963	7.07	9.17	7.81	5.57	7.32	9.53	6.37	7.09	6.31	7.64	9.75
Total	468.89	503.21	514.94	470.63	487.82	503.19	437.01	470.34	430.16	499.49	677.56
Average	18.76	20.13	20.60	18.83	19.51	20.09	17.48	18.81	17.21	19.98	27.10
Maximum	37.67	38.85	42.75	40.98	43.21	38.57	34.92	39.05	32.58	39.91	44.77
Minimum	7.07	9.17	7.81	5.57	7.32	9.53	6.37	7.09	6.31	7.64	9.75

The annual runoff can be expected to equal or exceed 11.9 watershed inches, 635 acre-feet per square mile or 20.7 million gallons per square mile in the Chickasawhay drainage basin in eight out of ten years. For the Leaf drainage basin runoff can be expected to equal or exceed 13.4 watershed inches, 715 acre-feet per square mile or 23.3 million gallons per square mile in eight out of ten years. For the Escatawpa drainage basin the runoff can be expected to equal or exceed 18.9 watershed inches, 1,008 acre-feet per square mile or 32.8 million gallons per square mile in eight out of ten years.

A portion of the annual runoff is allocated for beneficial use by the Mississippi Board of Water Commissioners. The amount allocated, as of July 1966, is shown in Table 24. The portion of annual runoff allocated is only a small percentage of the total annual runoff that could be allocated for beneficial uses.

Table 24

Water use allocation by the Mississippi Board of Water Commissioners through July 1966, Pascagoula Basin

Sub-basin	Domestic	Industrial	Irrigation	Municipal	Recreation	Fish Culture
	Ac.Ft.	Ac.Ft.	Ac.Ft.	Ac.Ft.	Ac.Ft.	Ac.Ft.
Leaf River	25	173,133	922	---	1,260	15
Chickasawhay	4	194	274	26,469	---	---
Escatawpa	---	59,224	---	---	---	---
Pascagoula	12	640	175	---	76	1
Total	41	233,191	1,441	26,469	1,336	16

Impoundments

The topography of the Basin is such that there are suitable physical sites in all portions of the Basin, with the exception of the Gulf Coast Flatwoods, that could be utilized to impound sufficient storage so that the entire average annual runoff, minus water losses, could be made available for beneficial uses. In the Southern Coastal Plain Resource Area the potential storage capacity is about 46 to 48 watershed inches from the drainage area above the impoundment. This potential storage capacity would vary with site selection and each site's individual storage characteristics. The sediment storage requirement would range from about 0.20 inch equivalent to about 1.50 inch equivalent. The floodwater detention capacity

requirement would range from about 5.50 inch equivalent to about 7.15 inch equivalent. 1/ This would leave sufficient capacity of storage available to store about two times the average annual runoff for beneficial uses. This is enough storage to provide enough carry over storage to make up for less than average runoff years for most beneficial uses.

In the Alabama and Mississippi Blackland Prairies Resource Area the potential storage capacity is about 42 to 44 watershed inches from the drainage area above the impoundment. This potential storage capacity would vary with site selection and each site's individual storage characteristics. The sediment storage requirement would be about 1.00 inch equivalent. The floodwater detention capacity requirement would range from about 5.00 inch equivalent to about 6.50 inch equivalent. This would leave a capacity that would almost store two times the average annual runoff. This is almost enough storage to make up for less than average annual runoff years for most beneficial uses. The selection of sites for multi-purpose storage in the Blackland Prairies Resource Area is of more importance because of the lesser number of good storage sites as contrasted to the number of sites in the Coastal Plain Resource Area. Suitable reservoir sites are not limited because of unfavorable soil or geologic conditions.

In the Gulf Coast Flatwoods, sites for storage of water for any purpose is very limited due to flat topography and the small difference in elevation from depression to ridge. There are, however, a few sites that could be utilized to store limited amounts of water for beneficial uses.

Ground Water Developments

Wells 2/

Practically all domestic and municipal water supplies and most of the industrial supplies are obtained by use of wells from the ground-water reservoir. Present pumpage is estimated at 60 mgd. Most pumpage is at four centers - Hattiesburg, Laurel, Meridian and Pascagoula.

Additional development can be undertaken at any point in the Basin. With proper areal distribution, proper screening, and with the tapping of the available aquifers well fields can be developed at several locations in the Basin to produce a yield of 25 mgd. Efficient use of the

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1/ 100 year project life.

2/ Geology and Ground-Water Resources of the Pascagoula River Basin, Appendix K, Geological Survey, United States Department of the Interior, 1965.

abundant ground-water resources that underlie the Pascagoula River Basin requires: (1) tapping of the thick deep aquifers, (2) construction of large capacity, efficient wells, and (3) spacing of wells to avoid excessive interference. The potential ground-water supply is less suitable for irrigation uses because of the natural predominance of sodium bicarbonate type water than it is for other uses. This type water is suitable for most domestic, municipal and industrial uses.

Recharge 1/

Artificial recharging of aquifers for the purposes of raising water levels, preventing salt-water encroachment, and disposing of waste water is feasible in the Pascagoula Basin. In addition, "water spreading" to flush saline water from coastal terrace aquifers and for storage purposes has received some consideration in recent years. The objectives of most artificial-recharge operations are to maintain or re-establish water levels and to maintain or improve water quality. Therefore, disposal of clean waste water into aquifers and storage of water in one season for use in another season are to be encouraged in most circumstances.

Channel Improvements and Levees

The potential for use of channel improvements and levees as structural measures for flood prevention in upstream watersheds and flood control in the mainstem and tributaries is directly associated with the natural characteristics of the landscape and cultural features imposed by society. Floodplain lands in all resource areas other than the Gulf Coast Flatwoods are relatively narrow. Existing channels in most instances are of such a nature as to permit enlargement without undue physical restrictions. However, the steady increase in agricultural lands being used for non-agricultural purposes is imposing problems in the location or depth of channels or levees in flood prevention. Numerous oil and gas transmission lines, new highways, urban and industrial developments present problems in site locations, relocations and extent of improvement in resource development.

As urban centers continue to enlarge and the need for flood protection increases the choice of structural measures for prevention of floods grows more complex. Flood control dams in combination with some channel enlargement will continue to provide an adequate degree of protection to agricultural lands. These measures with floodwalls or levees will be needed as an added measure to protect urban areas.

1/ Geology and Ground-Water Resources of the Pascagoula River Basin, Appendix K, Geological Survey, United States Department of the Interior, 1965.

Irrigation

There are about 142,000 acres of potentially irrigable land in the Pascagoula Basin. 1/ Of the amount, 58,000 acres are open land used for crops and pasture. The use of supplemental irrigation as a production practice is limited. In some years, irrigation of some crops would increase net returns a substantial amount. This situation existed during the dry years of 1952 to 1954. There are other years in which the application of supplemental water would not be profitable. Supplemental water has been applied to cotton in some years and extreme wet conditions later during the year caused a decrease in net returns compared to non-irrigated cotton.

The feasibility and potential of irrigation in the Basin no doubt needs to be further investigated under present conditions and the changes in the future structure of agriculture will have some influence on the need for supplemental water. However, the long-run profitability of irrigation is considered to be questionable.

Irrigation may prove to be very profitable for some specialty crops, such as fruits and vegetables, but these crops are of minor importance as judged by the acreage. Sufficient ground or surface water exists for irrigation of these specialty crops and project action does not appear to be justified in the next 10 to 15 years.

Because of the questionable nature of applying supplemental water to major crops presently grown, a detailed economic analysis was not made. An examination was made, however, which indicated that the total increase in income that might presently accrue from irrigating cotton, corn, and soybeans is only $136,052. 2/ The cost of supplying supplemental water is not included and would reduce the estimate substantially.

Studies of the upstream watersheds indicate that some have physical potential for development of irrigation water supplies. However, no storage projects for irrigation water supply appear to be justified in the foreseeable future. Development of the full irrigation potential will depend on future national, regional and local requirements and changing economic conditions.

1/ Excludes irrigable land in Alabama portion of Basin.

2/ Water Management Analysis of Pascagoula River Basin, Economic Research Service, USDA, July 1966.

Recreational Developments and Fish and Wildlife 1/

An appraisal of the potential of eleven types of private recreational facilities was conducted within the Study Area under the auspices of the NASCD Commissioners. 2/ The method was one where a local group, composed of representatives from the several local, State, Federal agencies, and other interested organizations or persons, discussed the various elements affecting different types of recreational activities and appraised the potential for each type development within a county as high, medium or low. 3/ The potential numbers of recreational facilities revealed by this study are presented in Table 25.

Some activities rated high almost Area-wide while other activities, particularly ones that are user-oriented, received good ratings near urbanized areas only. This would be expected. On the other hand the proximity of selected distant urban centers influenced user-oriented activities to some degree. For instance, once the clients are in the area for a particular activity, as vacation cabins, the potential for other activities would increase.

Vacation cabins, cottages and home sites have a high potential in Jones, Forrest, Smith and Newton Counties. Potential impoundment sites apparently played an important part in Smith and Newton Counties in rating this activity.

Camping grounds including vacation sites, float trips, and transient campers received good ratings generally. Lauderdale, Newton and Smith Counties lack streams for float trip development and received poor ratings.

Picnic and field sports areas received mostly medium ratings throughout the Study Area with the exception of picnic areas which received high ratings in the more populated counties.

Fishing waters received high ratings as to potential development. The need for an increase in fishery management in private waters and better access in public waters influenced this potential. Existing water is important but impoundment sites also play a large role in

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1/ The appraisal of potentials is a group judgement of opportunities for further development of resources for recreation use. This necessarily involves more than the natural resources alone as development potential depends upon a combination of factors - physical, social, economic - among others.

2/ National Association of Soil Conservation District Commissioners.

3/ The methodology and scoring system is outlined in the Guide to Making Appraisals of Potentials For Outdoor Recreational Developments, Soil Conservation Service, United States Department of Agriculture, Washington, D. C., July 1966.

Table 25

Potential development of private recreational facilities, by subarea, Pascagoula Study Area, 1980 1/

Item	Chickasawhay	Leaf	Coastal	Basin
	Number	Number	Number	Number
Vacation cabins	48	65	19	132
Camping ground sites	33	59	32	124
Picnic and field sports areas	101	95	62	258
Fishing water areas	232	490	70	792
Golf Courses	13	20	6	39
Hunting areas	58	128	49	235
Natural, scenic and historic sites	12	12	6	30
Riding stables	14	49	13	76
Shooting preserves	9	9	10	28
Vacation farms	6	7	1	14
Water sports areas	28	36	29	93
New water-areas (Recreation)	159	401	94	654
-acres	2,510	4,590	1,722	8,822

1/ An Appraisal of Potentials For Outdoor Recreation Developments In Southeast Mississippi, Soil Conservation Service, United States Department of Agriculture, January 1967.

determining the development possibilities of this activity. Potential impoundment sites are numerous throughout the Study Area.

Golf courses received a remarkably consistent score of medium potential with exception of Smith County, reflecting its rural condition. Land resources are available but the population is comparatively sparse.

Hunting areas were sub-divided into three categories - farm game, forest game, and waterfowl. Newton, Jones and Smith Counties received high ratings with much weight being placed on farm game habitat. Other counties were rated as having a medium potential for farm game development. Forest game has a high potential with every county receiving a high rating except the coastal counties of Harrison and Jackson. The potential here, however, remains good. Waterfowl development potential is low to medium with the greatest opportunity being along rivers and development of waterfowl foods in private lakes and ponds to attract birds.

The potential for natural, scenic, and historic areas received generally poor ratings. The aesthetic beauty of the entire area is not lacking but a number of specific areas in the above three categories does not exist.

Riding stable potential might well be considered medium. Forrest and Harrison Counties received high ratings reflecting existing population of people.

Shooting preserves rated medium near population centers but low in rural areas, while vacation farm potential can be considered medium to low. Land use and rural ownership pattern within the Basin is not conducive to this type development.

A medium rating was consistently received for the potential of water sports areas. Potential sites for large impoundment was an important element in rating this activity.

A medium to high potential exists within the Study Area for most of the activities appraised. This assessment of potentials, as might be expected, points out variation for specific activities within the Study Area.

The U. S. Forest Service provides outdoor recreational facilities in the National Forest. The facilities are designed to meet probable increased needs for a growing local population and heavier demands on forest facilities by transient recreationists. A list of planned and potential recreational facilities within the National Forest lands is presented in Table 26. Accomplishment of planned development is contingent upon the availability of regular Forest Service funds for this purpose.

Table 26

Inventory of planned and potential recreation development by activity in the Bienville and DeSoto National Forests, Pascagoula Basin, 1980 and 2015

Activity	Planned facilities 1/		Potential 2/
	1980	2015	
Organization camps	144 acres	259 acres	0 acres
Camping 3/	135 acres 405 F. U.	141 acres 423 F. U.	162 acres 486 F. U.
Picnicking 4/	26 acres 78 F. U.	118 acres 354 F. U.	165 acres 495 F. U.
Swimming	18 acres	2 acres	15 acres
Boating	23 acre launch 1,089 acres water	9 acre launch 3,506 acres water	4 acre launch 0 acres water
Fishing	1,089 acres	3,506 acres	0 acres
Hunting	476,507 acres	---	---

1/ Estimates are not cumulative.

2/ Potential - area is suitable and available as defined by existing plans of U. S. Forest Service.

3/ F. U. - Family unit is a table, fireplace, garbage can, parking spur, and tent space.

4/ F. U. - Family unit is a table, fireplace, and garbage can.

Forest industries own approximately 25 percent of the forest land in the Basin. Many of these acres are open to use by the public for hunting, stream fishing, camping and picnicking. This does not mean that a great number of campgrounds or picnic areas have been developed, or have the facilities desired by most campers and picnickers - drinking water, toilets, etc. For the most part, forest industry lands are intermingled with those of other owners and bear no distinguishing characteristics. Most industries simply do not post their properties and sportsmen are permitted to come and go at will. The companies themselves are engaged primarily in the business of growing the raw material for their plants. Some lands open today may be closed tomorrow because of logging operations or severe forest fire hazards. Forest industry and other large forest landowners are in a fine position to furnish future recreation areas. The recreational potential on these lands is considered good.

The identification of water and land resource development potential as expressed in this report does not take into consideration the assessment of development potential investigated by other Federal and State agencies.

CHAPTER VI

EXISTING PROGRAMS, PROJECTS AND OPPORTUNITIES FOR MEETING SOME OF THE BASIN NEEDS

PL-46, PL-566 and Pat Harrison Waterway District

Covington, Clarke, Lauderdale, Kemper and Wayne Counties were organized in 1939 as the first Soil Conservation Districts in Mississippi. Since then, the remaining counties in the Basin have been organized and all are actively engaged in carrying out soil and water conservation programs with individual farmers.

To date, detailed soil surveys have been completed on approximately 70 percent of the agricultural land. Farm plans have been prepared on 36 percent of the farms covering 34 percent of the agricultural land. Practices carried out to date include conservation cropping systems, pasture planting and improvements, farm ponds, drainage, terracing, contour farming, critical area land treatment, tree planting, forest management practices, etc. Land treatment measures applied on the land as of June 30, 1966, are shown in Table 27. An accelerated land treatment program will be carried out in conjunction with early-action project development of the 17 feasible watersheds. A part of the remaining land treatment needs for water resource development as shown in Table 13 and Table 14 will be met in the future by the regular program - PL-46; Clarke-McNary Act, Sections 2 and 4; Cooperative Forest Management Act; Agricultural Conservation Programs and others.

The Pat Harrison Waterway District was created by an act of the State Legislature in 1962. This is a Basin-wide organization with legal authority to work with local, State and Federal agencies in the planning and construction of water and land related projects within their area of jurisdiction.

Local water management districts have been organized throughout the Basin. Dry Creek Watershed, covering 13,954 acres in Covington County, was approved for operations in August 1966. The work plan on Big Creek Watershed, covering 80,012 acres in Jasper, Jones and Smith Counties, was completed in January 1967. The work plan on Chunky Watershed, covering 240,650 acres in Newton and Neshoba Counties, was completed in January 1967. Authorization to plan Upper Leaf Watershed was granted in September 1966. It is expected that both the latter work plans will be completed by December 1967. The work plan on Sowashee Watershed, covering 52,910 acres in Lauderdale County, is expected to be completed in early 1968. Souinlovey Creek,

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Table 27

Land treatment and structural measures on the land, Pascagoula Basin, as of June 30, 1966

Practice	Unit	Amount
Conservation cropping system	Acre	106,258
Grassed waterway	Acre	5,269
Pasture planting	Acre	314,061
Pasture renovation	Acre	84,932
Farm ponds	Number	14,642
Drainage main and lateral	Miles	182
Drainage field ditch	Miles	175
Diversion	Miles	4
Terraces	Miles	9,257
Wildlife habitat development	Acre	6,092
Brush control	Acre	114,636
Contour farming	Acre	186,063
Controlled burning	Acre	113,004
Cover and green manure	Acre	50,411
Critical area planting	Acre	14,923
Crop residue use	Acre	163,732
Fire breaks	Ft.	15,385,970
Fish pond stocking	Number	12,559
Fish pond management	Number	3,756
Irrigation storage reservoir	Number	25
Irrigation sprinkler	Number	17
Land smoothing	Acre	6,573
Pasture and hayland management	Acre	221,386
Range proper use	Acre	27,767
Row arrangement	Acre	16,493
Spoilbank spreading	Ft.	636,349
Spring development	Number	117
Tree planting	Acre	228,305
Wildlife habitat preserve	Acre	33,274
Wildlife watering facility	Number	94
Woodland harvest cutting	Acre	145,269
Woodland intermediate cutting	Acre	332,673
Woodland interplanting	Acre	36,662
Woodland natural seeding	Acre	190,444
Woodland proper grazing	Acre	189,231
Woodland weeding	Acre	315,152
Land adequately treated	Acre	590,841
Recreation access road	Ft.	33,437

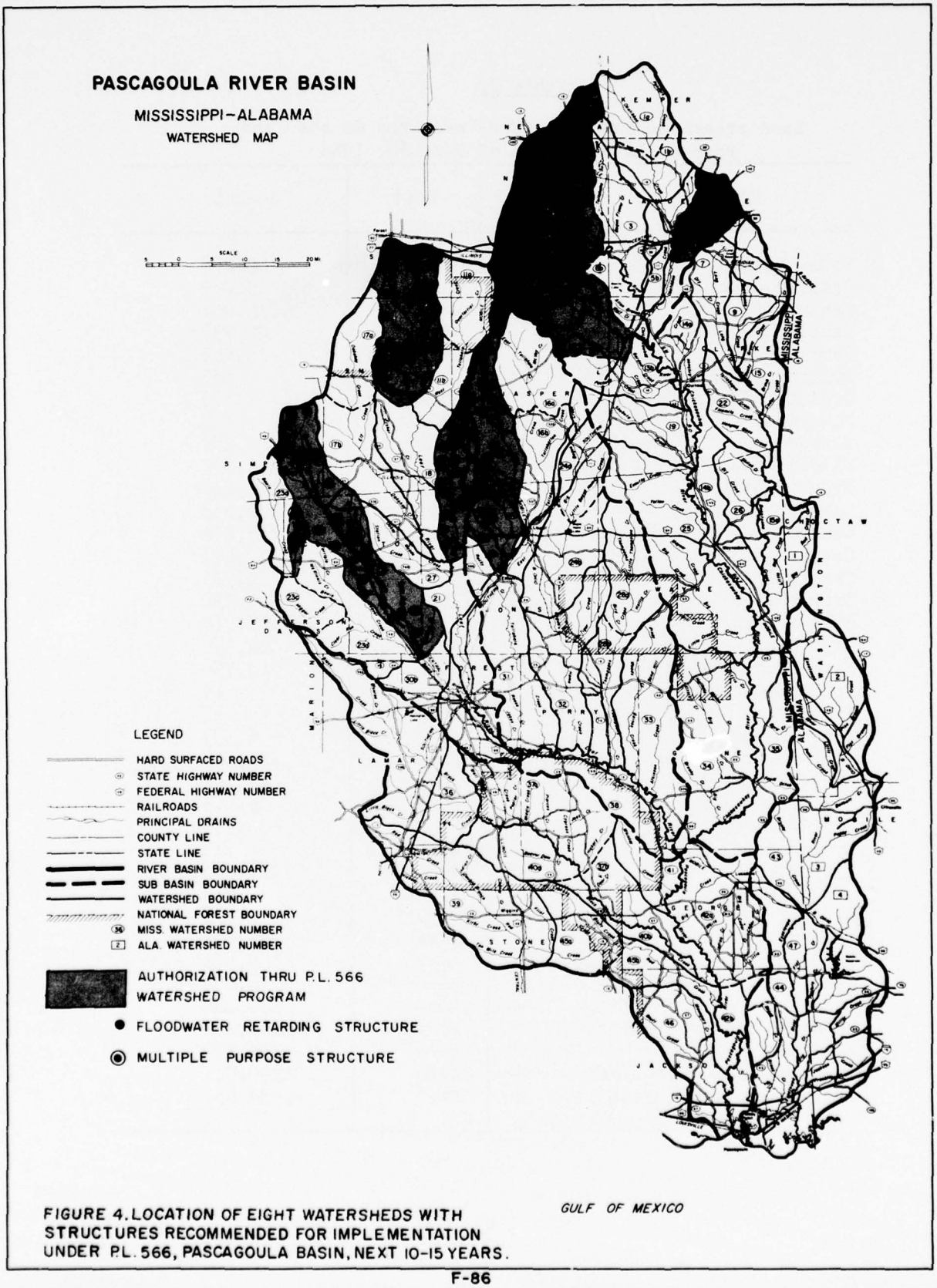

FIGURE 4. LOCATION OF EIGHT WATERSHEDS WITH STRUCTURES RECOMMENDED FOR IMPLEMENTATION UNDER P.L. 566, PASCAGOULA BASIN, NEXT 10-15 YEARS.

Okatoma Creek and Tallahala Creek Watersheds are in the process of organizing and are expected to submit application for planning authorization in the near future. Each project will have one or more planned multiple-purpose structures for recreation. In addition, each will be co-sponsored by the Pat Harrison Waterway District. The status of these eight PL-566 watersheds is depicted in Table 28 and their location with structure measures is depicted in Figure 4.

Table 28

Status of PL-566 watersheds, Pascagoula Basin[1/]

Watershed	Application pending	In planning stage	Approved for operation
Big Creek		X	
Okatoma Creek	X		
Upper Leaf River		X	
Dry Creek			X
Chunky		X	
Sowashee		X	
Tallahoma	X		
Souinlovey Creek	X		

1/ As of April 17, 1967.

Structural measures to be installed in the PL-566 watersheds include 96 floodwater retarding structures, 11 multiple-purpose structures with minimum basic facilities and 558 miles of channel improvement. During the planning stage discussions have been held with the U. S. Forest Service on structures that are on or near National Forest land. Additional discussions will be held during the operational stage. The estimated installation cost of these measures is $20,623,046. Land treatment measures include conservation cropping systems, pasture improvement, terracing, drainage, farm ponds, tree planting, hydrologic stand improvement and critical area treatment. The estimated cost of land treatment measures is $7,672,091. Critical area treatment consists of establishing a cover of grasses and legumes on 2,748 acres, vegetating 953 miles of eroded road banks and planting trees on 7,130 acres. Land treatment measures planned on National Forest land will be installed using regular program funds. Program accomplishment is contingent on the availability of Forest Service funds for this purpose. Physical and structural data along with costs and benefits by watershed are shown in Table 29.

Table 29

Physical data, costs and benefits, by PL-566 watersheds, Pascagoula Basin

Watershed	Total area	Drainage area controlled by structures	Structural measures to be installed				Estimated cost of land treatment measures	Total installation costs of structural measures	Annual benefits to structural measures	Annual cost of structural measures	Benefit cost ratio
			Floodwater retarding structures	Multi-purpose structures	Minimum basic recreational facilities	Channel improvement					
	Acres	Acres	Number	Number	Number	Miles	Dollars	Dollars	Dollars	Dollars	
Big Creek	80,012	24,851	11	2	2	59.7	860,703	2,336,595	218,160	112,107	1.9:1
Okatoma Creek	179,205	72,934	17	2	2	86.7	1,514,847	4,072,083	262,777	190,077	1.4:1
Upper Leaf River	138,120	37,741	7	1	1	71.1	1,085,410	2,129,075	173,610	107,173	1.6:1
Dry Creek	13,954	2,861	3	1	1	14.4	203,633	720,814	68,583	38,287	1.8:1
Chunky	240,650	66,138	25	2	2	148.5	1,873,152	4,778,641	387,608	230,508	1.7:1
Sowashee	52,910	11,706	9	1	1	30.7	397,284	1,397,051	128,795	69,570	1.9:1
Tallahoma Creek	137,264	39,245	13	1	1	85.7	977,972	2,903,235	208,486	149,147	1.4:1
Souinlovey Creek	109,851	25,338	11	1	1	61.1	759,090	2,285,552	149,111	110,588	1.3:1
Total	951,966	280,814	96	11	11	557.9	7,672,091	20,623,046	1,597,130	1,007,457	1.6:1

The total annual benefits for structural measures are $1,597,130. Of this amount, $573,029 is damage reduction benefits, $176,101 is from changed land use, $599,933 is from planned recreation in the 11 multi-purpose structures, $44,781 is incidental recreation in the floodwater retarding structures and $203,286 is secondary benefits. Benefits from planned recreation were based upon 474,645 visitor days. Incidental recreation was based upon 25 annual visitor days per surface acre of water in the sediment pool of the floodwater retarding structure. The benefits were discounted for decreasing water area because of sediment filling. Summary data for the eight PL-566 watersheds are shown in Tables 30 through 37.

Drainage, through group action, is practically non-existent in the Basin. Some drainage has been done in Newton County through three organized drainage districts. The Tuscolameta Drainage District, organized in 1922, had 20 miles of canal. Newton County Drainage Districts 1 and 3 were organized in 1925 and 1927, respectively. District 1 had 10 miles of canals and District 3 had 16 miles. These districts were reorganized into the Chunky River Master Water Management District in 1965 and expanded to include a part of Neshoba County.

The only completed Corps of Engineers flood control project in the Basin is located on Sowashee Creek at Meridian, Mississippi. This project was developed under the Flood Control Act of 1948, as amended by Section 212 of the Flood Control Act of 1950. The Corps has under construction in Lauderdale County the Okatibbee Reservoir project. The project is multiple-purpose and will provide protection to agricultural and industrial lands downstream, low flow augmentation, water for the town of Meridian, and recreation for people in the adjoining area. This project was authorized by the Flood Control Act of 1962.

The Naval Air Station in Lauderdale and Kemper Counties comprises about 8,000 acres of land. Land treatment and critical area stabilization measures have been completed on Station land through contractural agreements with the Soil Conservation Service.

Camp Shelby Military Reservation occupies about 77,000 acres in Forrest and Perry Counties. Most of the land is within the boundary of the DeSoto National Forest.

There are three State parks in the Basin. Paul B. Johnson Park near Hattiesburg has a 250 acre lake, Clarko State Park in Clarke County has a 60 acre lake and Magnolia State Park on the coast near Ocean Springs utilizes salt water bays for water sports and related activities. All parks have some facilities for camping and picnicking.

The University of Mississippi owns about 21,000 acres of timberlands in Stone, George and Jackson Counties. These lands are under forest and game management by agencies of the State.

Table 30

Estimated installation costs of land treatment and structural measures for eight watersheds recommended for authorization under PL-566 Pascagoula Basin

Item	Unit	Amount	Cost
			Dollars
LAND TREATMENT MEASURES			
Cropland and pastures			
Conservation cropping system	Acres	100,833	110,257
Pasture planting	Acres	46,919	1,582,406
Pasture renovation	Acres	68,862	1,270,305
Diversion	Miles	133	46,818
Terracing, gradient	Miles	765	92,220
Grassed waterways	Acres	755	44,257
Drainage main or lateral	Miles	627	219,630
Drainage field ditch	Miles	289	115,514
Farm ponds	Number	2,029	565,498
Wildlife habitat development	Acres	3,816	111,970
Critical area planting			
Grasses and legumes	Acres	2,748	271,214
Roadside erosion control	Miles	953	450,193
Technical assistance			1,289,759
Total - cropland and pastures			6,170,041
Forest Land 1/			
Tree planting	Acres	16,180	276,825
Hydrologic stand improvement 2/	Acres	91,300	278,760
Critical area - tree planting and Other 3/	Acres	7,130	598,105
Technical assistance			348,360
Total - Forest Land			1,502,050
Total land treatment			7,672,091
STRUCTURAL MEASURES			
Floodwater retarding structures	Number	96	5,879,339
Multiple purpose structures	Number	11	1,529,570
Minimum basic facilities	Number	11	1,607,065
Stream channel improvement	Miles	557.9	3,907,051
Sub-total-Construction			12,923,025
Installation services			4,168,095
Land easements and R.O.W.			3,308,146
Adm. of contracts and other			223,780
Total structural measures			20,623,046
TOTAL PROJECT			28,295,137

1/ Includes private forest and National Forest lands.

2/ Includes stand releasing, improvement cutting, and fencing.

3/ Includes roadbanks and logging roads stabilization and fencing.

Table 31

Estimated structural cost distribution,
eight watersheds recommended for authorization under PL-566
Pascagoula Basin

Item	Construction and installation services		Land easement and R.O.W.	Administration of contracts and other	Total installation cost
	Construction	Installation services			
	Dollars	Dollars	Dollars	Dollars	Dollars
Floodwater retarding structures	5,879,339	1,892,662	1,806,917	107,322	9,686,240
Multiple purpose structures	1,529,570	453,409	689,525	19,157	2,691,661
Minimum basic facilities	1,607,065	476,383	173,780	19,848	2,277,076
Channel improvement	3,907,051	1,345,641	637,924	77,453	5,968,069
Total	12,923,025	4,168,095	3,308,146	223,780	20,623,046

Table 32

Cost allocation summary, eight watersheds recommended for authorization under PL-566, Pascagoula Basin

Item	Purpose		Total
	Flood prevention	Recreation	
	Dollars	Dollars	Dollars
Floodwater retarding structures	9,686,240	---	9,686,240
Multiple-purpose structures	1,274,096	1,417,565	2,691,661
Minimum basic facilities	---	2,277,076	2,277,076
Channel improvement	5,968,069	---	5,968,069
Total	16,928,405	3,694,641	20,623,046

Table 33

Structure data, eight watersheds recommended for authorization under PL-566, Pascagoula Basin

Item	Unit	Total
Drainage area	Sq. Mi.	438.77
Storage capacity		
Sediment	Ac. Ft.	18,041
Floodwater	Ac. Ft.	144,713
Recreation	Ac. Ft.	1/ 16,599
Potential water storage	Ac. Ft.	984,097
Total	Ac. Ft.	1,163,450
Surface area		
Sediment pool	Acre	4,634
Floodwater pool	Acre	21,240
Recreation pool	Acre	2,510
Potential water storage pool	Acre	65,242

1/ Includes 3,033 acre feet of sediment storage.

Table 34

Annual cost, eight watersheds recommended for authorization under PL-566, Pascagoula Basin

Item	Amortization of installation cost 1/	Operation and maintenance cost	Other economic cost	Total
		Other funds		
	Dollars	Dollars	Dollars	Dollars
Floodwater retarding structures	307,881	32,966	0	340,847
Multiple purpose structures	85,872	7,413	0	93,285
Minimum basic facilities	72,623	176,221	0	248,844
Channel improvement	189,731	134,750	0	324,481
Total	656,107	351,350	0	1,007,457

1/ Structural measures were amortized for a period of 100 years at 3 percent interest for all watersheds except Dry Creek and Big Creek. Annual costs for these two were obtained from PL-566 plans in which installation costs were amortized for a period of 100 years at 3 1/8 percent.

Table 35

Estimated average annual flood damage reduction benefits, eight watersheds recommended for authorization under PL-566, Pascagoula Basin

Item	Estimated average annual damages		Damage reduction benefits
	Without project	With project	
	Dollars 1/	Dollars 1/	Dollars 1/
Floodwater			
Crop and pasture	501,085	162,688	338,397
Other agricultural	70,352	25,557	44,795
Non-agricultural			
Urban and industrial	16,800	3,669	13,131
Road and bridge	199,912	51,370	148,542
Sub-total	788,149	243,284	544,865
Erosion			
Reduced road maintenance	21,246	7,795	13,451
Indirect	78,528	24,801	53,727
Total	887,923	275,880	612,043

1/ Price base - Long term projected.

Table 36

Comparison of benefits and cost for structure measures,
eight watersheds recommended for authorization under PL-566, Pascagoula Basin

Evaluation unit	Average annual benefits 1/							Average annual cost	B/C ratio primary benefits	B/C ratio total benefits
	Flood prevention		Planned recreation	Incidental recreation Other	Total primary benefits	Secondary benefits	Total benefits			
	Damage reduction	Changed and more intensive land use								
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars		
Flood prevention	573,029	176,101		44,781	793,911	143,292	937,203	710,297	1.1:1	1.3:1
Recreation			599,933		599,933	59,994	659,927	297,160	2.0:1	2.2:1
Total	2/573,029	176,101	599,933	44,781	1,393,844	203,286	1,597,130	1,007,457	1.4:1	1.6:1

1/ Price base long term projected.

2/ In addition it is estimated that land treatment measures will provide flood damage reduction benefits of $22,017, erosion (reduced road maintenance benefits, $13,451, and indirect benefits, $3,546. Total benefits are $39,014 annually.

Table 37

Summary of physical and plan data,
eight watersheds recommended for authorization under PL-566,
Pascagoula Basin

Item	Unit	Quantity without project	Quantity with project
Watershed area	Sq.Mi.	1,487.45	1,487.45
	Acres	951,966	951,966
Area of cropland	Acres	141,015	118,728
Area of grassland	Acres	140,676	183,764
Area of woodland	Acres	560,779	550,454
Miscellaneous area	Acres	109,496	99,020
Floodplain area subject to inundation of maximum storm in evaluation series	Acres	137,727	
Area of floodplain benefited by proposed structural measures			
Directly	Acres		94,840
Indirectly	Acres		21,295
Total	Acres		116,135
Woodland conversions	Acres		14,679
Watershed area controlled by floodwater retarding structures	Acres		280,808
	Percent		29.4

There are two Federal fish hatcheries, one near Meridian and one near Lyman. The Meridian facility is comprised of 180 acres of land plus 27 acres of water. The Lyman facility is comprised of 140 acres of land plus 30 acres of water. The latter facility distributes approximately three million fingerlings annually.

Cooperative State-Federal Forestry and Related Programs

There are a number of different forestry programs available through the cooperation of the State-Federal governments. Some of these programs and their principal features are discussed briefly.

The Weeks Law of 1911 authorized and directed the Secretary of Agriculture to examine, locate and recommend for purchase such forested, cut-over, or denuded lands within the watersheds of navigable streams as in his judgement may be necessary to the regulation of the flow of navigable streams or for the production of timber.

The Clarke-McNary Act was passed June 7, 1924. This Act provides for forest fire control (CM-2), for sale of forest-tree planting stock at low cost (CM-4), and for farm forestry extension work. The assistance to private forest owners is handled through appropriate State agencies.

The McSweeny-McNary Act, passed in 1928, provides a broad charter for forest research programs in the United States. Under its provisions the U. S. Forest Service operates regional forest and range experiment stations to serve the principal forest regions of the Nation. The Basin is located within the boundary of the Southern Forest Experiment Station headquartered in New Orleans, Louisiana. Just north of Gulfport, Mississippi, in the DeSoto National Forest, is the Harrison Experimental Forest. Here research is done on forest insects, diseases, and genetics. At other experimental forests in the South, research is done on watershed management, forest fire, recreation, range and wildlife habitat, forest products utilization and engineering.

The Soil Conservation and Domestic Allotment Act, passed in 1935, authorized the Secretary of Agriculture through the Soil Conservation Service to furnish technical assistance (woodland planning) to farmers in soil conservation districts.

The Bankhead-Jones Farm Tenant Act of July 22, 1937, provided for a program of land conservation and land utilization to correct maladjustments in land use. The purpose of the Act was to assist in controlling soil erosion, reforestation, preserving natural resources, protecting fish and wildlife, and protecting the watersheds in navigable streams.

The Forest Pest Control Act of June 25, 1947, provides for Federal cooperation to protect and preserve forest resources from destructive forest insect pests and diseases. It empowered the Secretary of Agriculture to act on Federal lands, or through cooperative agreement with the State forester, or appropriate State officials on non-Federal lands.

The Granger-Thye Act of April 24, 1950, provided that funds could be expended for the erection of buildings, lookout towers, and other structures on land owned by States, counties, municipalities, and other political subdivisions, corporations or individuals.

The Cooperative Forest Management Act of August 25, 1950, authorized cooperation with State foresters or equivalent officials and provides funds, on a 50-50 basis, for technical services to private forest landowners and operators, and processors of primary forest products with respect to the management of forest lands and the harvesting, marketing, and processing of forest products.

The Watershed Protection and Flood Prevention Act (PL-566) provides authority to assist local watershed groups in solving water management and flood prevention problems. The Soil Conservation Service is the agency within the U. S. Department of Agriculture responsible for the administration of the Act. The U. S. Forest Service is responsible for making and carrying out the forestry plan for the forest lands. The Forest Service, in cooperation with State foresters, has responsibility for furnishing technical on-the-ground forest land management assistance including supervision of installation of the forestry measures recommended for the forest lands.

The Agricultural Conservation Program provides for assistance to the individual landowners for land treatment measures on forest land for the following practices: (1) establishment of a stand of trees on farm land for purposes other than the prevention of wind or water erosion; (2) establishment of a stand of trees on farm land to prevent wind or water erosion; (3) improvement of a stand of forest trees on farm land; (4) construction of firebreaks for forest land protection; and (5) the Naval Stores Conservation Program.

The Food and Agricultural Act of 1962 authorized a program to assist farmers in shifting their land to nonagricultural uses. The purpose is to promote the development of soil, water, forest, wildlife and recreational resources and to establish and protect open spaces and natural beauty.

The Land and Water Conservation Fund Act (P.L. 88-578) became effective on January 1, 1965. The purpose of this Act is to preserve, develop and assure accessibility to all citizens the quality and quantity of outdoor recreation resources as may be available and are necessary and desirable for individual active participation in such recreation. This will be done by: (1) providing funds for and authorizing Federal Assistance to the States in planning, acquisition, and development of needed land and water areas and facilities; and (2) providing funds for the Federal acquisition and development of certain lands and other areas.

The Mississippi Forestry Commission has programs that provide various services to the forest landowner. Some of these services are as follows: (1) utilization and marketing of timber products; (2) prevention and suppression of all wild forest fires; (3) forest land examination and advice to owners as to practices which should be applied if maximum timber production is desired. Assistance is given to Boards of Supervisors in managing and marketing timber on 16th Section school lands and to State and other public owned forest land; (4) timber marking up to 40 acres to each landowner; (5) tree seedlings are available for reforestation purposes; and (6) tree planting, control of undesirable trees, and fire lane construction is available on a fee basis.

National Forest Development and Multiple-Use Programs

The U. S. Forest Service manages two National Forests in the Pascagoula River Basin, comprising almost 500,000 acres of publicly-owned forest land. They are the Bienville and DeSoto National Forests, comprising all or portions of six ranger districts (Figure 5). The lands were purchased under the authority of the Weeks Law of 1911 and an enabling act by the Mississippi Legislature of 1926. The Federal Government was invited to purchase these cut-over lands and to manage them in the interest of conservation.

Since the Forest Service's beginning in 1905, the broad goal has been "the greatest good for the greatest number of people in the long run." The specific objective is multiple use. Multiple use is briefly defined as "the use of all the various resources of the forest - outdoor recreation, range, timber, watershed and wildlife and fish - in combination that best fits the needs of the American people." This is being done on the Bienville and DeSoto National Forests.

There are at present 75 acres of developed National forest camping and picnicking sites with many more acres inventoried for possible development to meet future demands. Water oriented development has been given a high priority. One of the new areas being developed is the float trip down the Black and Beaver Dam Creeks (Figure 6). The float trip is located in the Black Creek

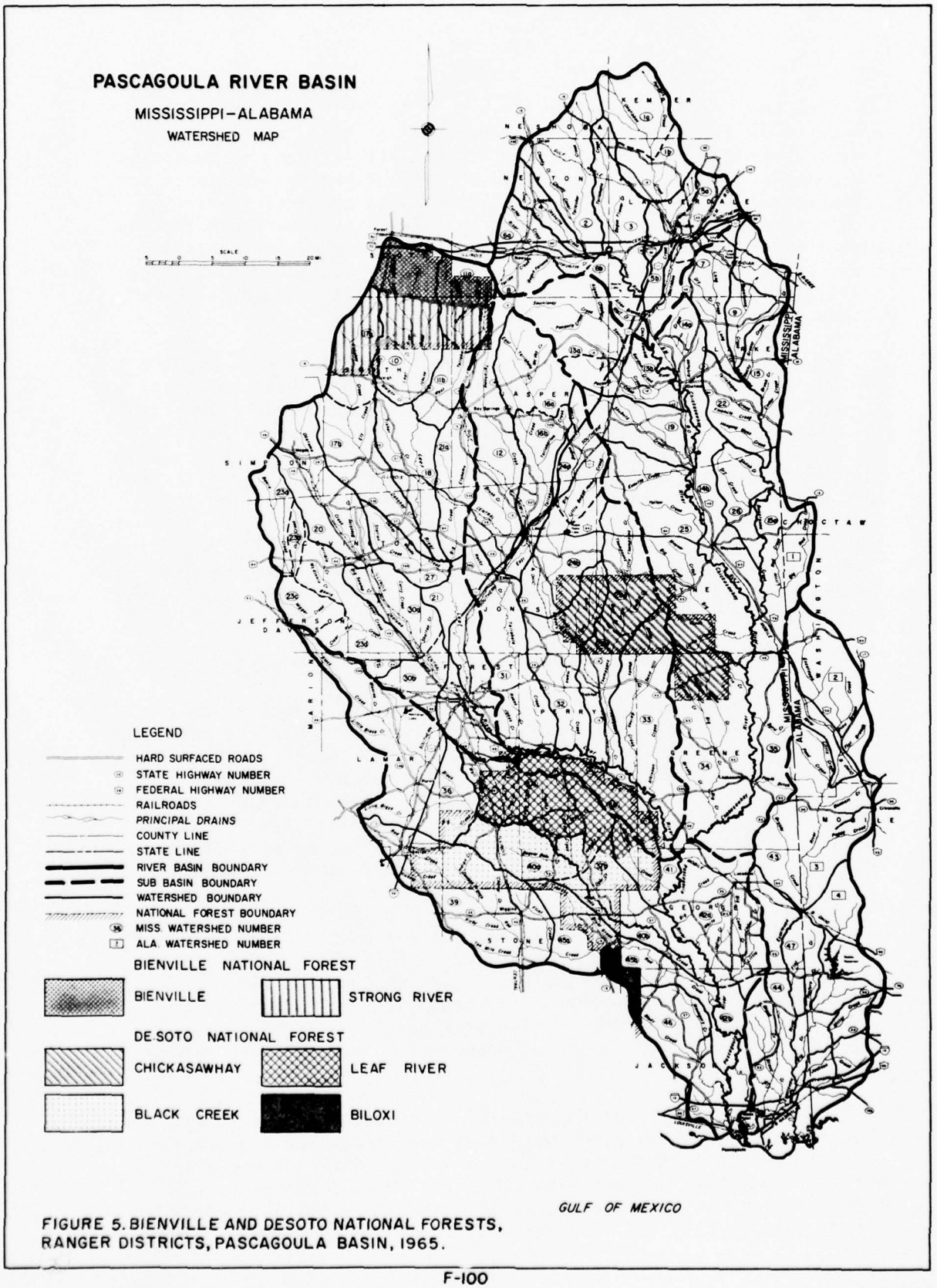

FIGURE 5. BIENVILLE AND DESOTO NATIONAL FORESTS, RANGER DISTRICTS, PASCAGOULA BASIN, 1965.

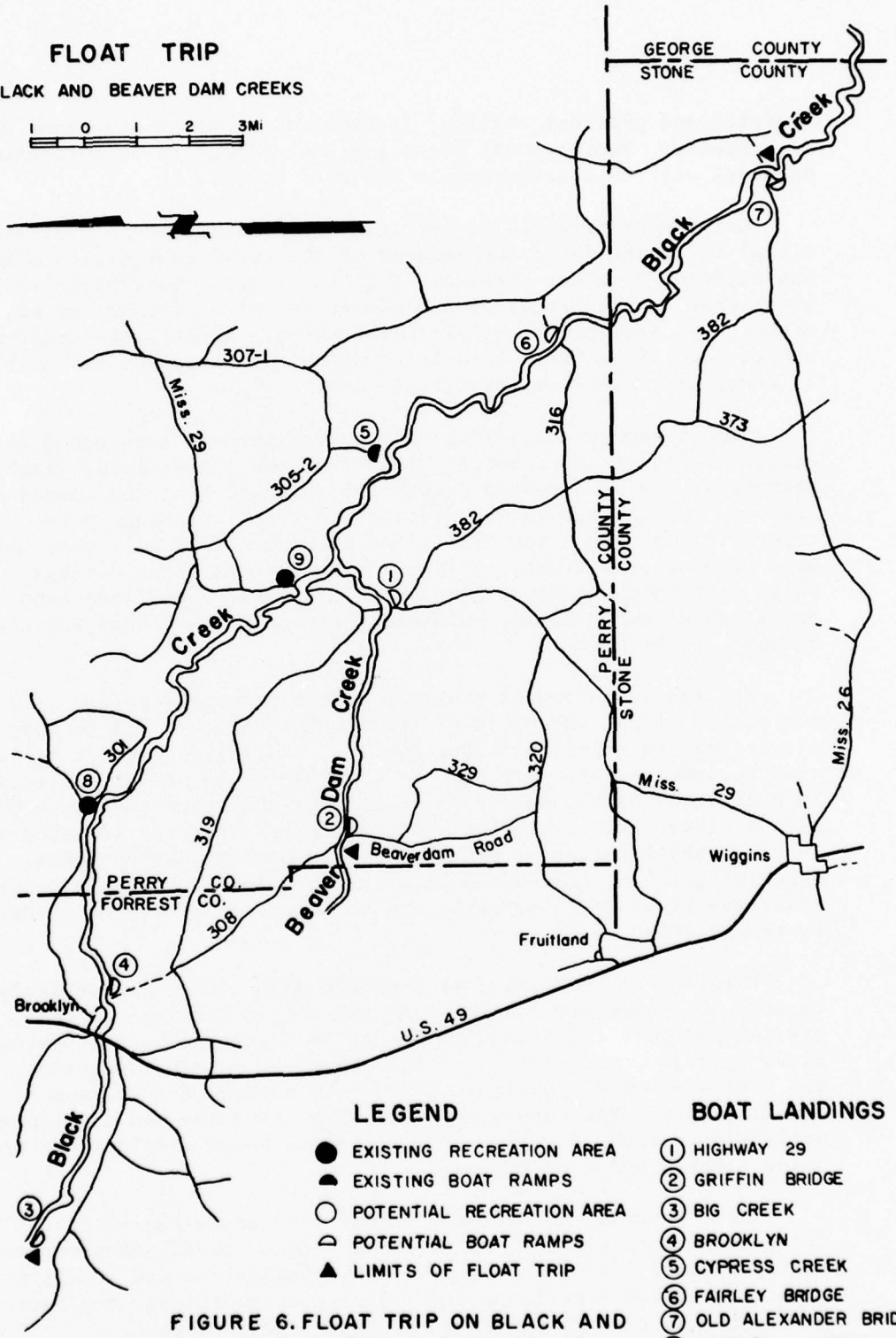

FIGURE 6. FLOAT TRIP ON BLACK AND BEAVER DAM CREEKS, PASCAGOULA BASIN, 1965

District and provides boating, fishing, and general enjoyment and sightseeing. Recreational areas and boat ramps are in existence and more will be constructed in the near future.

Grazing on National Forest lands (DeSoto and south half Bienville) is important to the economy of the rural communities within and adjacent to these forests. The objective is to manage livestock grazing consistent with good management of forage, water, timber, recreation, and wildlife resources. Efforts are underway now to regulate grazing through a program of education, distribution of range use, stocking rates, and fencing.

Timber management is making progress through even-age silviculture in achieving a better yield from the forest land. Each year areas are planted and seeded for full stocking and stands are improved through removal of undesirable trees, pruning, precommercial thinnings and prescribed burning. This will mean more wood products, sawtimber, pulpwood, veneer logs, post pilings, poles, firewood, handle bolts, shuttle blocks, distillate wood and naval stores which may be sold and the receipts absorbed into the economy of the area.

Watershed management consists of two principal parts: (1) protection of the watershed by stabilizing the soil and thereby preserving and improving water quality, and (2) management of the area to improve water yields. In this Basin the primary objective is protection of the watershed to improve the water quality and to give a better time control of water yields. Progress is being made in the rehabilitation of eroding and sediment-producing areas. Acres of gullied, galled and sheet eroded areas, abandoned forest roads and trails, and severely eroded roadbanks are being stabilized by revegetation.

Wildlife is becoming more abundant on National Forest lands through the cooperative efforts of the Forest Service and the Mississippi Game and Fish Commission. Wildlife habitat is being given special consideration in all phases of forest management. The Forest Service's ultimate goal is to produce the optimum annual crop of game consistent with other land use and development activities. Fishing is on the increase as water developments are being planned and constructed.

These programs on National Forest land bring the multiple-use concept into reality. It will take time, funds, manpower and public support. The job requires many professions and managers with diversified experience and training to coordinate the recreation, range, timber, watershed and wildlife resources.

CHAPTER VII

PLAN FORMULATION - USDA

General

The most important and complex problem encountered in comprehensive plan evolution is the problem of weaving together into one balanced plan the means of satisfying the water and related land needs that were identified. Selecting and fitting plan segments together and considering alternatives in the search for the proper programs, the proper number of projects, and the best size for each element of the plan required extensive analysis and coordinated effort. This is necessary because the ultimate aim of resource projects and programs, in common with all other productive activity, is to help satisfy human needs and desires.

Because of the widespread effects of land and water resource development, a responsibility falls on all levels of government and on the private sector to participate in resource planning and in the execution of resource programs. Through the Mississippi Legislature, the Pat Harrison Waterway District was created in 1962 to provide the means of coordinating and participating in river basin planning and implementing recommendations. The Legislature declared as a matter of legislative determination that the waterways and surface waters of the State are among its basic resources; that such waters have not been conserved to realize their full beneficial use; that the utilization, development, conservation and regulation of such waters are necessary to insure adequate flood control, sanitary water supply at all times, balanced economic development of State forests, irrigation of lands, and pollution abatement; and that the waters within the Pascagoula River are for the beneficial use and general welfare of the entire people of the State. The Pat Harrison Waterway District was created as necessary to comply with this "determination" ... and to work with all State, local and Federal agencies in planning and implementing such plans for the beneficial use of waters in the Basin. Its creation provided a necessary and opportune means of coordinating and formulating water resource development projects in upstream watersheds and on the mainstem and tributary streams in the Pascagoula Basin.

Coordination with Public and Private Agencies

A Basin Coordinating Committee was formed of representatives of participating Federal Agencies and States to serve as a means of achieving coordination in conducting the studies and formulating the proposed plan. The District Engineer of the Mobile District, U. S. Army Corps of Engineers, served as chairman. The State Conservationist of the SCS in Mississippi represented the USDA. The Executive Director of the Pat Harrison Waterway District represented the State of Mississippi.

A general plan of investigation was prepared by the Corps of Engineers and reviewed by the participating agencies to provide an orderly program for the Comprehensive Basin Study. The USDA prepared a detailed Plan of Work and Work Outline which governed the conduct of USDA activities. These documents provided for special investigations needed by the Corps of Engineers for use in their studies.

The Basin Coordinating Committee established Ad Hoc Working Committees on flood prevention, recreation, pollution, fish and wildlife development, and others as needed to facilitate investigations or studies in these fields. The State representative was a member of each and participated in called meetings.

Federal and State agencies made investigations to determine the needs or problems related to pollution, water supply other than rural domestic, ground water availability, recreation, fish and wildlife, minerals and power. Preliminary study results were used as a basis for determining needs and how the programs of the Corps of Engineers and USDA could best help in planning projects to share in the satisfaction of these needs.

Considerable local interest was manifested in the USDA PL-566 watershed program during the course of these investigations. The Pat Harrison Waterway District was largely responsible for this interest to the extent that four watersheds were authorized for planning under the PL-566 act. Information and need for water resource projects were incorporated in these plans as developed in the comprehensive Basin study. Structures were provided for flood prevention and recreation and fish and wildlife development. No provisions were made for additional storage for water supply or water quality control because no needs were evident in the four watersheds. Local interest viewpoints and needs were ascertained in other feasible watersheds while the study was in progress.

Conflicts of interest in overlapping projects proposed for early-action by the Corps of Engineers and USDA were resolved

through consultations with local watershed groups and the Pat Harrison Waterway District. Modifications in plans were made to the satisfaction of the Corps of Engineers, USDA and local interest groups involved without compromising Basin objectives.

The U. S. Forest Service is interested in the opportunities provided by all resource development projects of other agencies and is interested in cooperating from the initial time that a project may be considered. Where a proposed project falls within or adjacent to National Forest boundaries, the State Conservationist of the Soil Conservation Service notifies the Forest Supervisor of the U. S. Forest Service. The Forest Service District Ranger is notified and works with local sponsors and SCS personnel. Forest Service engineering design criteria is used for floodwater retarding and multiple-purpose dam structures whether they are to be built on or partly on National Forest land. If conflicts between proposed projects and National Forest interests should occur, they will be resolved in the process of project development. Installation of planned land treatment measures on National Forest lands will be carried out by the Forest Service and are contingent on the availability of Forest Service funds for this purpose.

USDA Policy and Local Interest Considerations

Detailed project appraisals were made for each potential watershed project identified for initiation of installation within the next 10 to 15 years. Project formulation, evaluation, and cost-sharing criteria were developed in conformity to PL-566 Watershed Protection and Flood Prevention Act, as amended. The policies of the Secretary of Agriculture in carrying out the provisions of the Act served as additional guides in formulating projects and plans in upstream watersheds.

Adherence to provisions in the Act and policies of the Secretary of Agriculture imposed limitations in planning for full resource development. The guides are as follows: (1) Plans were confined to watershed areas of less than 250,000 acres; (2) No structure providing more than 12,500 acre feet of floodwater detention capacity or more than 25,000 acre feet of total capacity was included in a plan; (3) No part of the installation costs was considered for cost allocation or cost sharing in any structure for purposes other than flood prevention, agriculture water management, recreation and fish and wildlife development; (4) The bringing of new land into production through irrigation and drainage measures and limited enhancement benefits from flood prevention measures limited full resource development. These limitations also tend to reduce the most efficient use and management of lands in the watersheds; (5) Increase in use of surplus

crops was not considered in watershed project formulation; (6) No provisions were made to include single purpose reservoirs for recreation or fish and wildlife development nor was consideration given to recommending watershed projects for just the accelerating of land treatment measures; and (7) The use of PL-566 funds for land acquisition as related to flood prevention measures and critical area measures was not considered in project formulation.

Watershed project formulation was designed to carry out the primary objectives of the Act and began with the formulation of plan objectives of the local people. Local objectives were not limited to flood prevention where recognizable needs for water storage for other purposes were obvious.

In carrying out the objectives of the local people for flood prevention, land treatment measures were considered the basic element for each watershed project and the initial increment for project justification. Floodwater detention structures were considered as the first choice in retarding the flow of floodwaters and in reducing damages to agricultural and urban areas. The second choice, in combination with detention reservoirs, is channel improvement.

The extent of structural measures for flood prevention are a combination of detention reservoirs and channel improvement needed to meet the overall objectives of the local people. Fulfilling this objective would, in effect, maximize the net benefits for flood prevention. Where recreation and fish and wildlife were project purposes, costs of constructing single-purpose flood prevention and single-purpose recreation reservoirs were compared with a multiple-purpose reservoir providing the same benefits. The combined costs of a multiple-purpose reservoir were less than two single-purpose structures.

The size of the recreation pool in multiple-purpose structures and the extent of basic facilities to satisfy the demand for recreation activities was based largely on the needs of and desires of the local people and their ability to share in the costs of facilities.

The Pat Harrison Waterway District has the legal authorities and financial capabilities to sponsor recommended projects of the Corps of Engineers or USDA and to assume the responsibilities of local cooperation, including the share of local costs allocated to the projects. They may also plan for and construct water resource projects that do not meet the statutory requirements of the Corps of Engineers and USDA.

Investigations and Analysis - Upstream Feasible Watersheds

Full use was made of existing information including studies made by other agencies. On-site field surveys and schedules were made so that tentative agreement could be reached on the nature and scope of the project and on levels of flood protection or project development and estimates of project costs and feasibility. Engineering field surveys included alternative sites so that the best possible combination of structural measures could be considered for potential development within the watershed.

Estimates of the present and projected land use of uplands and floodplain lands were made for each watershed in the Basin. Land capability data and soil association surveys were used to determine the need for land treatment measures for watershed protection, adjustments in land use between uplands and floodplain lands, and the potential for agricultural production in floodplain lands if protected from flooding. On-site investigations, land capability data and detail soil survey information were used to determine the scope, extent and need for critical area treatment on open lands and woodlands. This information also provided a base for estimating annual gross erosion and sediment yields for impoundments proposed by the USDA and Corps of Engineers.

On-site field investigations were made to determine the frequency, amount, and extent of floodwater damages to agricultural lands and fixed improvements in the rural and urban areas. Benefits from land enhancement were limited to the degree of protection expected and the dominant type of agriculture projected in the floodplains in specified future years. The value of enhancement benefits were not to exceed those benefits from flood damage reduction. In most instances, the enhancement benefits were derived from clearing not over 20 percent of the woods in the benefited floodplain.

The extent of enhancement benefits was also guided by the effects of existing fishery and wildlife habitat. Field biologists made on-site investigations in each feasible watershed to determine the damages, if any, to habitats from proposed project structural measures. Where damage to wildlife habitat would occur, provisions were made to mitigate damages.

Physically and economically feasible watersheds were identified as those where benefits from flood prevention were at least equal to costs. Primary flood prevention benefits include flood damage reduction, restoration and enhancement, and other (incidental recreation); additional benefits are secondary. The sum of these constitute the total benefits from flood prevention measures.

Benefits also were determined from planned recreation facilities. The appraisal of benefits is outlined in a succeeding section. The sum of the benefits from flood prevention and planned recreation provide the total benefits for all project purposes.

When in the evaluation of individual watersheds it was concluded that the total benefits from flood prevention were less than the cost of flood prevention measures, these watersheds were classified as not being economically feasible for the 1980 period.

All or parts of 17 watersheds were determined as being economically feasible watershed projects (Figure 7). All or parts of 30 watersheds are potentially feasible watershed projects and 16 watersheds are not considered as feasible because of the character of the soils in the floodplain or other undesirable features of the floodplain. The location of the watersheds, in relation to projects proposed by the Corps of Engineers Early-Action Program, was a factor in this determination.

Upstream Watersheds for Flood Prevention

A primary objective was to make physical appraisals of agricultural and rural water problems, determine the development potential in upstream areas, and evaluate the physical and economic effects of upstream projects and coordinate them with proposals of other agencies. Secondary sources of information, reconnaissance investigations and knowledge of the agricultural and rural water problems within the Basin provided a basis for determining the scope and intensity of investigations in fulfilling the objective. It was determined that most of the physically and economically feasible watersheds are located in the upper stream reaches of the Basin.

Evaluation of Land Treatment Measures as Related to Erosion and Sediment

Basin-wide accelerated land treatment is needed to reduce the total sediment load entering the streams in the Basin. Rectification of the critical sediment problems cannot be achieved through action of the 17 feasible watersheds. Reducing the sediment pollution problem can only be achieved in the immediate action period with an accelerated program having 100 percent Federal participation throughout the Basin.

One of the primary purposes of the USDA investigation was to determine the extent, need and cost of land treatment and land stabilization measures for watershed protection and flood prevention. The extent and costs of these measures were made for the entire

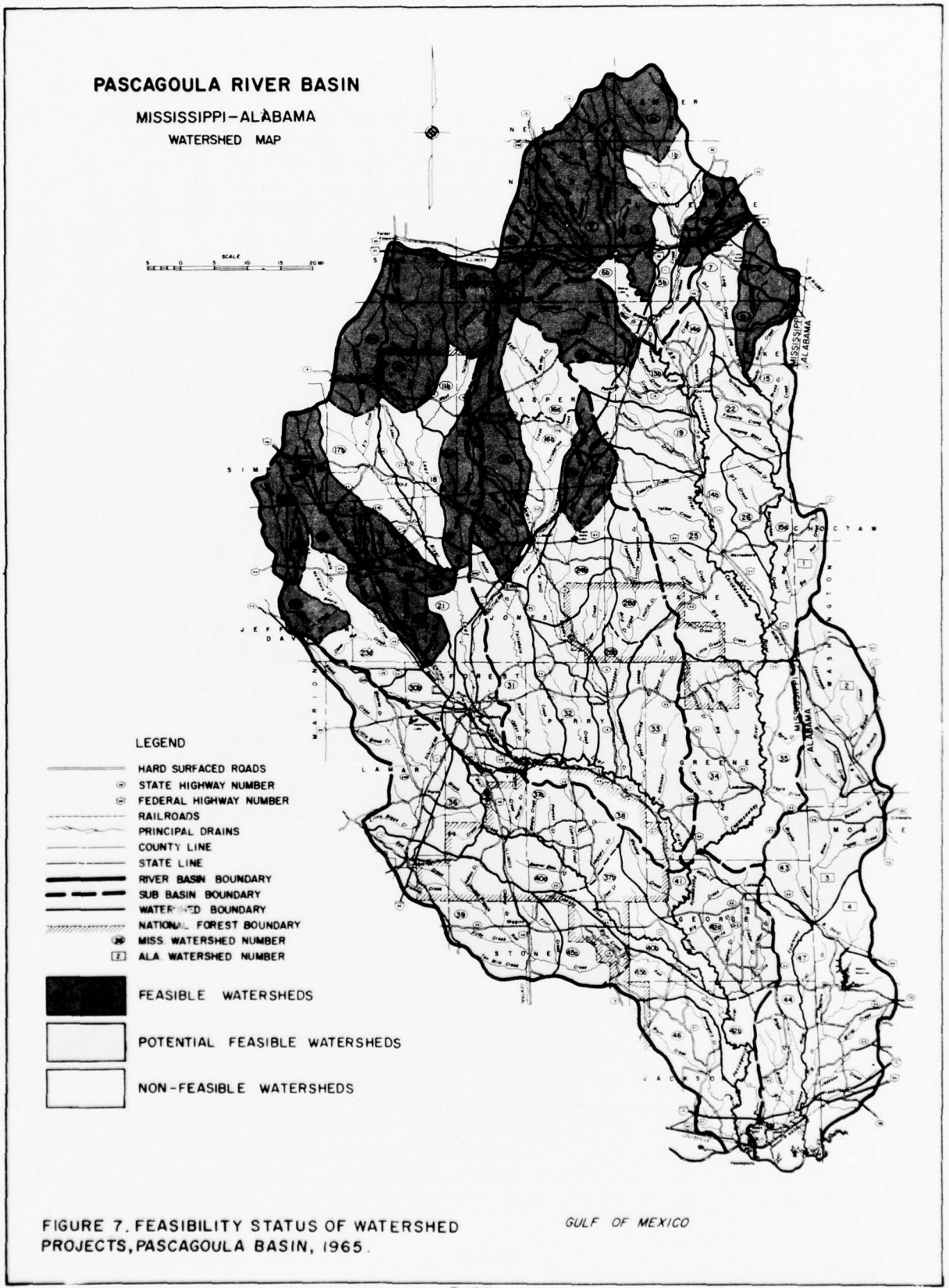

FIGURE 7. FEASIBILITY STATUS OF WATERSHED PROJECTS, PASCAGOULA BASIN, 1965.

Basin and were not limited to those feasible watershed projects within the next 10 to 15 years. The benefits that would accrue from land treatment and land stabilization measures have proven in the past to be equal to or greater than the costs, consequently no benefit cost ratio was established for these measures for the feasible watersheds or for the Basin as a whole.

In developing basic sedimentation data, criteria and procedures are in keeping with those used by the Department of Agriculture in the Small Watershed Program. A detailed field study was made on land above 50 proposed floodwater retarding structures located in sample watersheds throughout the Basin. Land use, cover and slope conditions were recorded. Gullies, pits and caved roadbanks contributing sediments were delineated. Existing soil surveys were used where available.

Annual sheet erosion in tons per acre was determined for each land use, under present and projected future conditions, using the Musgrave Soil Decline equation. The delivery ratio of sheet erosion was from the curve, "Sediment Delivery Rates vs. Size of Drainage Area."

Gullies, caved roadbanks and pits were assigned an annual soil loss of 300 tons per acre under present conditions and 150 tons per acre under future conditions. A delivery ratio of 60 percent was used in both instances.

Sediment storage requirements were calculated using Technical Release 12, "Procedures for Computing Sediment Requirements for Retarding Reservoirs." A volume weight of 1,300 tons per acre-foot was used for submerged sediments and 1,800 tons per acre for those aerated.

Floodplain scour and detrimental deposits on cropland and pasture were mapped where found. These seem to be of a minor nature.

Recreation in Upstream Watersheds

Multiple-purpose structures for recreation and fish and wildlife were considered for each of the economically feasible watersheds. The number and location of multiple-purpose structures in each watershed was not finalized until purpose needs were coordinated with studies of the Bureau of Outdoor Recreation, U. S. Fish and Wildlife Service and known projects of the Corps of Engineers. An analysis was made of the demand, supply and need for outdoor recreation in the Basin by the Bureau of Outdoor Recreation (Appendix H). The preliminary report of the BOR, which contains the methodology and planning criteria for determining the demand,

supply and needs, was agreed to by all participating agencies before any allocation of demand was made to any recreation project in the Basin.

The preliminary location and size of all multiple-purpose projects (reservoirs) proposed by USDA, Corps of Engineers, and the State were studied to see if too many reservoirs were being considered in any given area of the Basin to satisfy 1980 needs. When it was determined that an imbalance would not be created, individual site studies were made for each proposed multiple-purpose reservoir. An allocation of demand for water-dependent activities (boating, fishing and swimming) and water enhanced activities (picnicking, camping) were made for each site. The annual activity occasions were calculated and divided by 1.5 to arrive at a recreation user day.1/ The value of a recreation user day was used to determine the annual benefits for each site.

Costs for providing the recreation facilities, including the estimated added cost of the multiple-purpose dam, and the land necessary to achieve full recreation benefits were made and allocated to each purpose. Costs were amortized to an annual equivalent and benefits from recreation compared to the costs.

The number of multiple-purpose sites proposed in each feasible watershed did not exceed the criteria established by the Soil Conservation Service in planning PL-566 watersheds. The governing factors were the desires of the local people in the watershed and the Pat Harrison Waterway District, their financial capability to share the local costs, and the physical characteristics of the sites. Organic and inorganic pollutants were not problems in site selection. In all instances the topography, cover, soils and land use were conducive to good outdoor recreation features. The relationship of the drainage area to the recreation pool was adequate to maintain a satisfactory "permanent pool level" during the summer months or period of maximum use.

An appraisal of private outdoor recreation potential was made in the Pascagoula Basin in July 1966. One of the objectives of the appraisal was to determine the extent of water-based recreation development that would be provided by 1980. It was determined that the water resource recreation projects proposed for

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1/ The annual activity occasions for the major multiple-purpose reservoirs were calculated and divided by 2.3 to arrive at a recreation user day.

development by the public (Federal and State) and private sectors will not satisfy the estimated demand in 1980.

It is recognized at this time that pollution is a problem in many of the streams in the Pascagoula Basin. The extent and degree of the pollution problem will vary at different sites along these streams.

Bacterial standards for swimming and other body contact sports are being proposed by State and Federal agencies. Water quality criteria for interstate streams for the State of Mississippi is being promulgated by the State Air and Water Pollution Control Commission.

The USDA will work with local sponsoring organizations in the preparation of detailed watershed work plans in which multiple-purpose reservoirs will be included for recreation. If basic facilities are proposed to satisfy the needs for swimming, boating, camping, picnicking and water-oriented activities, assurances from the appropriate State and/or Federal agencies will be obtained to satisfy the requirements of meeting all health standards before inclusion in the plan.

Irrigation

The use of supplemental water for increasing the production of cotton, corn, soybeans or pasture to satisfy national or regional requirements is not needed in the Basin. No detail studies were made to determine specific benefits from increased production of row crops or pastures from irrigation. Consequently, no provisions were made to provide irrigation water storage in any proposed reservoirs as a project purpose.

Irrigation as a cultural practice can be of importance in specialized areas or to individual farmers who grow high value crops. Studies were made on the physical need for water for optimum production of truck crops, cotton, corn and pasture or hay crops. In most years, eight out of ten, the use of supplemental water is required for optimum plant growth.

Except in the Coastal Flatwood Resource Area the physical characteristics of the landscape are satisfactory for storing water for irrigation. The average annual runoff ranges from 18 to 30 inches. The storage-runoff relationship creates a favorable condition for using surface water for irrigation.

The initial construction cost of impounding an acre-foot of water varies with the amount of storage and the storage characteristics of the valley above the dam. On an average, the cost range

varies from $300 per acre-foot for storing 25 acre-feet, to $25 per acre-foot for storing 10,000 acre-feet. The number of acres irrigated from an impoundment will vary because of difference in the gross irrigation water needs of crops, the water losses at the impoundment site (seepage, evaporation, etc.), the recovery rate for the impoundment (inflow), and with the transportation losses from the impoundment to the farm. The cost of storing water per irrigated acre usually decreases as the size of impoundment is increased provided the inflow, water use, and water loss relationship remains constant.

The initial construction cost of wells will vary with the well capacity and with aquifer depths. For example, on an average, the initial construction cost for a 500 gallon per minute well will range from a low of $20,000 to a high of $35,000 and for a 1,000 gallon per minute well will range from $25,000 to $37,500. The number of acres that can be irrigated from a well will depend on the well capacity, the peak daily irrigation water need of the crop, the daily hours of pumpage, and any water losses from the well to the farm.

The comparison of costs in providing water for irrigation from surface impoundments and from wells will need to be made for each individual case. Generally, surface impoundments will provide the cheaper source of water for group-type irrigation enterprises for most crops. However, wells could provide the cheaper source of water for small acreages.

The feasibility of on-farm irrigation is dependent upon several criteria other than the availability and costs of water. The method of irrigation - furrow, flooding or sprinkler - affects unit costs, but the most important is the nature and topography of the soil. Most of the floodplain soils in the feasible watersheds are suitable for irrigation and land leveling.

The alternatives in recommending the use of supplemental water for on-farm irrigation, all other factors being equal, is where sufficient quality water is available from: (a) large streams or lakes, (b) impoundments, or (c) wells.

Drainage

At this time no plan to drain the wet pine forest land has been formulated. Some industrial forest owners may remove surface water through small ditches put in with fire plows in specific locations. Further studies are needed to determine the actual acres of forest land with a water problem and to what extent timber growth increases could be expected from drainage of these wet pinelands.

The need for group drainage to increase the production of row crops, grasses and legumes to satisfy regional or local requirements is not warranted. On the basis of field examinations and preliminary investigations in the Coastal Flatwood Resource Area no provisions were made to include multiple-purpose channels as a project purpose in the USDA plan. Improvements in farm efficiencies could be realized on individual farms with drainage systems designed for the specific crops involved.

Studies were made to locate and inventory acreages by land use and to determine the drainage problems of the agricultural land in the resource area. Included were determinations of acreages that are adequately drained, acres still needing drainage, the adequacy of outlets, and an estimate of works of improvement to provide adequate drainage where feasible.

The special drainage Study Area ranges inland 5 to 25 miles from the Mississippi Gulf Coast. The topography generally ranges from nearly level to gently sloping ridges. There are, however, some moderately sloping ridges and a few short, steep escarpments in the area. Elevations range from sea level to about 50 feet with most of the area being below an elevation of 25 feet.

The average annual rainfall for the Pascagoula Study Area is 58.58 inches, with annual extremes varying from 84.57 inches to 38.10 inches. The wettest and driest months of the year are July and October with average rainfalls of 7.14 inches and 2.49 inches, respectively.

Information on soils is necessary in order that the extent and severity of the drainage problem can be determined in any drainage survey. The Study Area was grouped into 13 soil associations to accomplish this. The following criteria were used to set one group apart from the other:

1. Patterns and percent soil composition.
2. Similarity in topography.
3. Similarity in drainage problems.
4. Use potential.
5. Associations of soils developed from one kind of parent material.

Each soil association is named for the three or four dominant soils that compose it and is described by stating the topographic and soil features. All but two, Coastal Beach and Made Land, have a definite drainage problem. Two others, Tidal Marsh and Swamp-Alluvial Land, were determined as not being feasible for drainage.

The remaining nine soil associations contained poorly drained soils that ranged from 24 percent to 87 percent of the total area in the association. If somewhat poorly drained soils are included along with the poorly drained soils these same percentages are 42 to 100. Where the drainage problem is the greatest the drainage pattern is not well defined.

A soil association map was prepared. The groups were delineated on photo mosaics at contact print scale. These groupings were also delineated on county highway maps. U. S. Geological Survey topographic maps cover the entire area and were used in studying the area.

Watershed boundaries were delineated on quadrangle sheets. These were studied and needed major ditches were determined. A field study confirmed or changed the location of the needed ditches. After the field study the final determination of the needed ditches was made. During the field study dimensions of major ditches, bridges and culverts at the key locations were obtained. Drainage area at key points for the major ditches were determined. The entire area was not investigated.

A sample in each of the nine soil associations was selected and engineering surveys were made to help determine the topography of these areas and the need for drainage. These areas were of small drainage areas, less than two square miles in size.

Profiles of the major ditches were obtained from the quadrangle maps of the area. The required capacities of the ditches were determined using the Cypress Creek formula. The formula is $Q = CM^{5/8}$ and for forest drainage the coefficient "C" is 10. The yardage of excavation and other items of work were determined for the major ditches sampled. Cost estimates were prepared.

Typical layouts for the minor ditches were established based on the field surveys for the various soil associations. Yardage of excavation and other items of work were determined and cost estimates were prepared. Capacities of the minor ditches were such that one-half inch runoff will be removed in 24 hours.

Data was expanded to entire area using the sample areas as a base.

CHAPTER VIII

USDA WATER AND RELATED LAND RESOURCE PROJECTS AND MEASURES RECOMMENDED FOR EARLY ACTION

Plan Presentation

The United States Department of Agriculture Plan for the headwater areas of the Basin is the culmination of Departmental studies and contributing studies by other Federal, State and local agencies. The Agriculture Plan for the Basin includes land and water resource developments in the headwater areas that contribute to meeting the needs projected to the years 1980 and 2015. Resource developments existing, under construction and expected to develop under going programs are a necessary part of the plan to meet the needs. However, only proposals for new developments to be initiated in the next 10 to 15 years are presented and their costs and benefits evaluated.

Watershed Projects

Nine upstream watersheds were identified and determined to be physically and economically feasible and are recommended for early action implementation under special Basin-wide authority (Table 38 and Figure 8). These are in addition to the eight watersheds physically and economically feasible and recommended for implementation through going programs (PL-566).

Table 38

Nine watersheds recommended for authorization under special Basin-wide legislation, Pascagoula Basin, next 10-15 years

Watershed	Watershed number	Acres	Counties
West Bowie River	23C	29,601	Jefferson Davis
Upper Bowie River	23A	46,603	Simpson, Jefferson Davis, Covington
Oakohay Creek	17A	60,444	Scott, Smith
West Tallahala Creek	11A	64,905	Scott, Smith, Newton, Jasper
Station Creek	27	35,980	Covington, Jones
Tallahatta Creek	3	83,880	Neshoba, Kemper, Newton, Lauderdale
Upper Okatibbee Creek	1A	67,641	Neshoba, Kemper, Lauderdale
Upper Bogue Homo Creek	24A	67,940	Jasper, Jones
Upper Bucatunna Creek	9	77,960	Lauderdale, Clarke
Total		534,954	

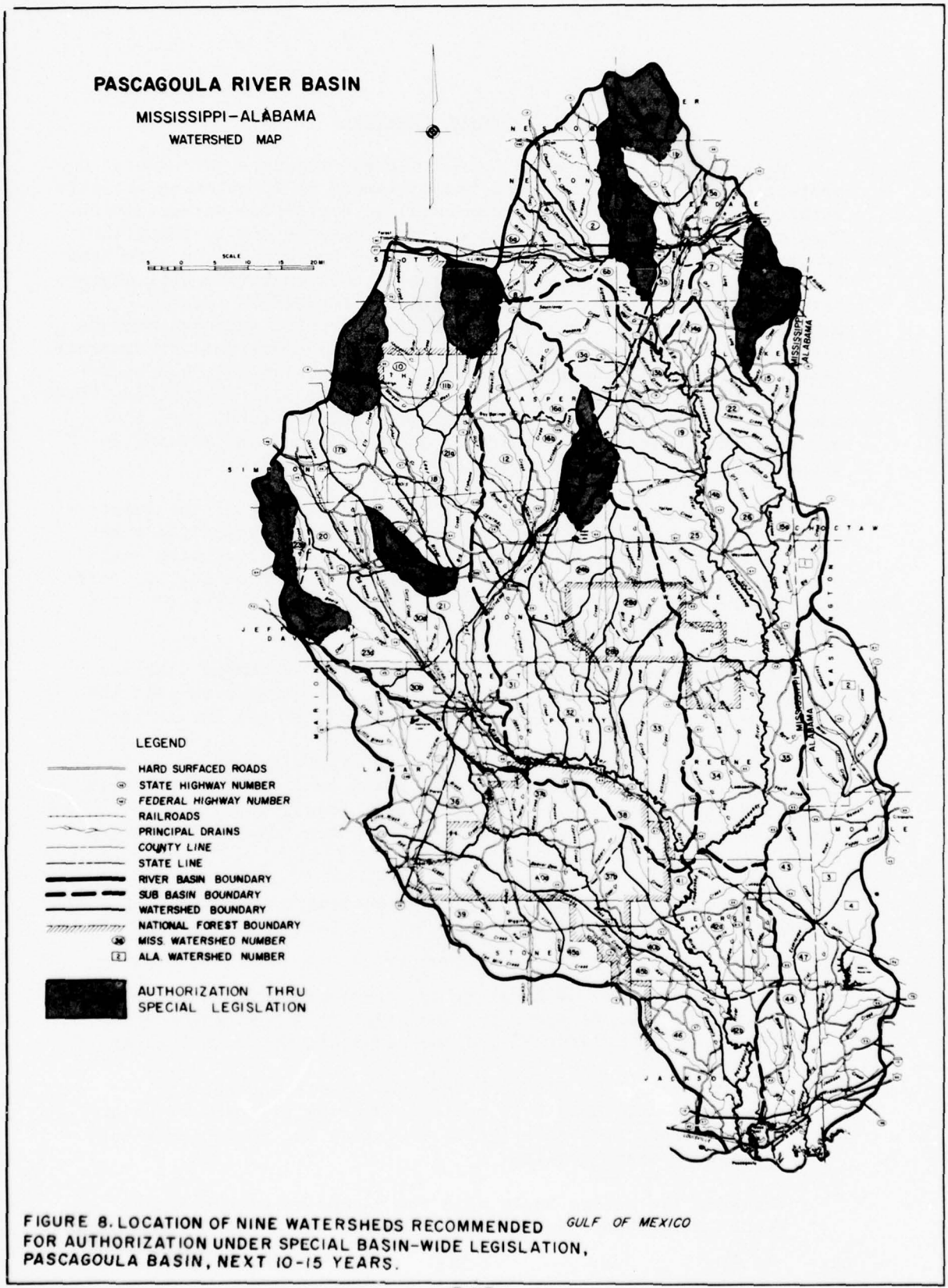

FIGURE 8. LOCATION OF NINE WATERSHEDS RECOMMENDED FOR AUTHORIZATION UNDER SPECIAL BASIN-WIDE LEGISLATION, PASCAGOULA BASIN, NEXT 10-15 YEARS.

Land Treatment Measures

Watershed Protection[1/] - Land treatment measures for watershed protection were considered as a basic element in formulating projects within the nine watersheds recommended for Basin-wide authorization. They are essential if planned structural measures are to function properly. These measures are to be planned and applied on farm land by individual farmers in cooperation with the respective Soil Conservation Districts in which the individual watershed is located. Measures to be applied are - conservation cropping systems, pasture planting and renovation, diversion and terrace construction, drainage, farm ponds, wildlife habitat development, tree planting, and hydrologic stand improvement of forest lands.[2/] The cost of applying these measures will be local but including some Federal funds from the Agricultural Conservation Program. There will be cost sharing on technical assistance between Federal, local and State.

Private forest land measures will be applied under the supervision of the Mississippi Forestry Commission in cooperation with the U. S. Forest Service. Cooperation is in accordance with such programs as the Clarke-McNary Act, Forest Pest Control Act, Cooperative Forest Management Act, and the Agricultural Conservation Program as presented in Chapter VI.

Treatment on National Forest land and the estimated cost are included in the overall totals. The U. S. Forest Service will install the land treatment measures planned on National Forest land.

The land to be treated for watershed protection is shown in Table 39. The total estimated installation cost of these measures is $2,999,576 (Table 44). Of this amount, $515,895 is to be financed by Federal funds and $2,483,681 by other funds. The Federal funds are for technical assistance.

Critical Area Treatment[3/] - Land treatment measures for land stabilization are important features of the Basin-wide program.

1/ Includes just the nine watersheds recommended for Basin-wide authorization. Measures for the eight PL-566 watersheds are identified in Chapter VI and the remaining Basin in Chapter IV.

2/ The improvement of forest hydrologic conditions through the release of desirable soil building species, release of underplanted trees from undesirable overstory and improvement cuts to improve stand quality.

3/ Includes the entire Basin with the exception of the eight PL-566 watersheds identified in Chapter VI.

Critical area treatment will consist of establishing grasses and legumes, tree planting, site preparation, sloping and revegetating roadbanks, fencing to control grazing, etc. These measures will provide protective cover for the critical areas and reduce the rate of erosion, the production of sediment and the amount of runoff. The amount of land to be treated for critical area stabilization is shown in Table 39.

Critical area treatment measures on non-Federal land will be installed by local water management districts or Soil Conservation Districts on a contract basis. The Mississippi Forestry Commission in cooperation with the U. S. Forest Service will supervise the installation of forestry measures on private forest land. On National Forest land the U. S. Forest Service will install the needed critical area treatment.

The total installation cost of critical area treatment measures needed in the next 10-15 years is $11,691,799 (Table 40 and Table 44). Included in this amount is the $482,465 cost of installing needed measures on National Forest lands. The Forest Service anticipates receiving $313,470 of this through its regular funding.

Structural Measures

Floodwater Retarding Structures - These structures were the first choice of structural measures in formulating a plan to reduce flooding in upstream watersheds. The structures are compacted homogeneous earth fill dams having a fixed drawdown tube and an emergency spillway.

There are 37 floodwater retarding structures planned for the nine watersheds. The approximate location in each watershed is shown in Figure 9. The estimated installation cost is $4,162,132.

Flood Prevention Channels - Improvement of stream channels was the second combination of structural measures planned for further reduction in floods and damages to floodplain land in upstream watersheds. Channel improvement consists of snagging and shaping, clearing and snagging, and channel enlargement or excavation. Cutoffs and realignment of channels were practically non-existent.

Approximately 294 miles of channel improvement are planned for the nine watersheds. The total installation cost is $2,814,467. The number of floodwater retarding structures, miles of channel improvement, and estimated costs are shown in Table 41.

Table 39

Estimated land to be treated, by watershed, and for the remaining area, Pascagoula Basin, next 10-15 years

Item	Land treatment						
	Watershed protection				Critical area		
	Crop-land	Grass-land	Wild-life	Forest	Grass & legumes	Roadside erosion	Trees
	Acres	Acres	Acres	Acres	Acres	Miles	Acres
West Bowie River	4,321	3,013	493	3,120	375	38	490
Upper Bowie River	3,669	4,744	776	4,920	380	60	770
Oakohay Creek	3,775	4,276	3,256	2,305	990	154	300
West Tallahala Creek	2,123	4,447	1,945	1,895	450	70	480
Station Creek	2,307	3,562	1,942	2,370	405	71	250
Tallahatta Creek	3,090	4,225	3,593	10,570	1,140	105	3,170
Upper Okatibbee Creek	2,921	4,930	2,782	9,370	995	85	1,960
Upper Bogue Homo Creek	5,737	4,632	2,768	5,930	690	39	130
Upper Bucatunna Creek	2,807	5,507	853	12,670	690	122	1,160
Above Reservoirs of Corps of Engineers					6,838	570	3,030
Pat Harrison Water-way District					3,024	363	2,360
Other 1/					19,475	5,477	39,704
Total	30,750	39,336	18,408 2/	53,150	35,452	7,154	53,804

1/ Includes all critical areas in the Basin except in the eight PL-566 watersheds and nine watersheds for Basin-wide authorization.

2/ Includes idle and miscellaneous.

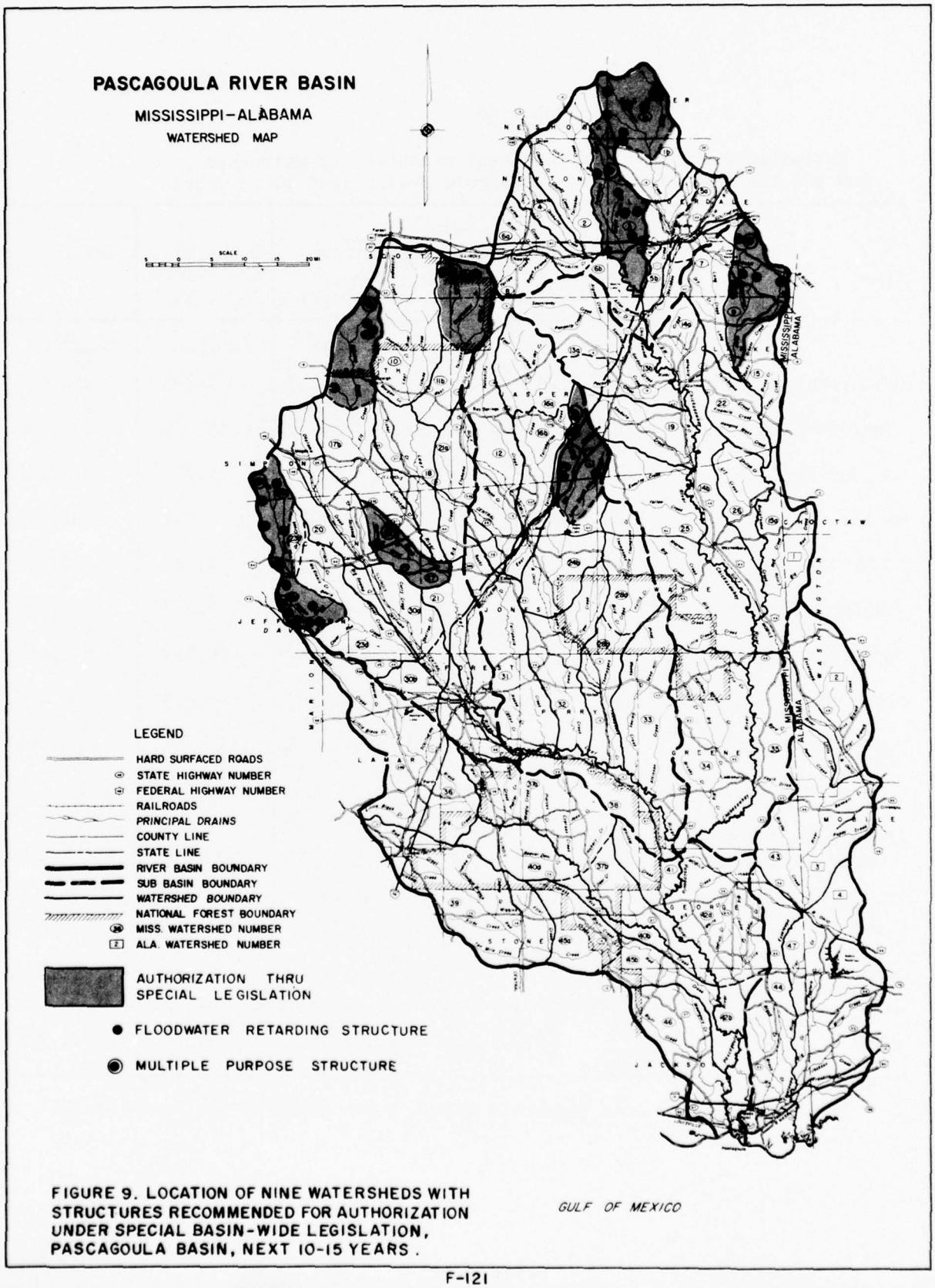

FIGURE 9. LOCATION OF NINE WATERSHEDS WITH STRUCTURES RECOMMENDED FOR AUTHORIZATION UNDER SPECIAL BASIN-WIDE LEGISLATION, PASCAGOULA BASIN, NEXT 10-15 YEARS.

Table 40

Estimated costs for land treatment measures, by watershed , and for the remaining area, Pascagoula Basin, next 10-15 years

Item	Watershed number	Land treatment for watershed protection	Critical area treatment	Technical assistance SCS & FS	Total
		Dollars	Dollars	Dollars	Dollars
West Bowie River	23C	143,081	92,444	59,353	294,878
Upper Bowie River	23A	225,207	123,795	85,050	434,052
Oakohay Creek	17A	319,496	188,916	95,272	603,684
West Tallahala Creek	11A	309,759	111,625	70,803	492,187
Station Creek	27	197,970	90,841	67,510	356,321
Tallahatta Creek	3	247,908	400,704	180,467	829,079
Upper Okatibbee Creek	1A	210,502	279,410	148,353	638,265
Upper Bogue Homo Creek	24A	241,395	87,587	105,493	434,475
Upper Bucatunna Creek	9	335,487	197,174	153,985	686,646
Sub-total Watersheds		2,230,805	1,572,496	966,286	4,769,587
Above Reservoirs of Corps of Engineers		0	1,120,536	110,980	1,231,516
Pat Harrison Waterway District		0	661,277	56,620	717,897
Other 1/		0	7,277,760	694,615	7,972,375
Total		2,230,805	10,632,069	1,828,501	14,691,375

1/ Includes critical area treatment in all other areas of the Basin except PL-566 watersheds.

Table 41

Number of floodwater retarding structures, miles of channel improvements and estimated costs, by watershed, Pascagoula Basin, next 10-15 years

Watershed	Floodwater retarding structure	Total installation cost	Channel improvement	Total installation cost	Total structure measures cost
	Number	Dollars	Miles	Dollars	Dollars
West Bowie River (23C)	6	436,322	20.3	192,613	628,935
Upper Bowie River (23A)	5	475,500	30.2	430,711	906,211
Oakohay Creek (17A)	3	313,500	29.1	205,370	518,870
West Tallahala Creek (11A)	2	236,000	22.5	221,920	457,920
Station Creek (27)	1	193,000	22.8	209,660	402,660
Tallahatta Creek (3)	5	549,500	43.6	426,270	975,770
Upper Okatibbee Creek (1A)	6	774,000	37.3	305,850	1,079,850
Upper Bogue Homo Creek (24A)	3	374,000	42.8	405,858	779,858
Upper Bucatunna Creek (9)	6	810,310	45.3	416,215	1,226,525
Total	37	4,162,132	293.9	2,814,467	6,976,599

Multiple-Purpose Structures for Flood Prevention and Planned Recreation - Recreation as a project purpose was planned for each watershed.[1/] In addition to the water storage, basic facilities are to be installed for each structure. Basic facilities include, but are not necessarily limited to, solid waste disposal, toilet facilities, access roads, electric power, domestic water, boat ramps, swimming beaches, camping and picnic grounds and the necessary associated features to provide a well developed, highly attractive outdoor recreation facility. Nine multiple purpose structures for flood prevention and recreation are planned for installation in the nine watersheds. The estimated installation cost, including basic facilities, is $3,367,238 (Table 42).

Table 42

Costs of multiple-purpose structures and basic recreational facilities, by watershed, Pascagoula Basin, next 10-15 years

Watershed	Multiple-purpose structures	Surface pool	Cost of structures	Basic facilities	Total cost
	Number	Acres	Dollars	Dollars	Dollars
West Bowie River (23C)	1	100	120,954	149,842	270,796
Upper Bowie River (23A)	1	100	177,080	149,842	326,922
Oakohay Creek (17A)	1	150	146,210	217,105	363,315
West Tallahala Creek (11A)	1	150	167,080	173,526	340,606
Station Creek (27)	1	150	194,624	145,105	339,729
Tallahatta Creek (3)	1	100	116,992	156,947	273,939
Upper Okatibbee Creek (1A)	1	250	325,246	235,856	561,102
Upper Bogue Homo Creek (24A)	1	200	203,162	210,637	413,799
Upper Bucatunna Creek (9)	1	250	241,174	235,856	477,030
Total	9	1,450	1,692,522	1,674,716	3,367,238

[1/] Facilities will be available for public use.

Installation Costs [1/]

Installation cost of land treatment measures is $14,691,375. Approximately $9,189,963 of this will be financed by Federal funds and $5,501,412 by other funds (Tables 40 and 44).

Federal funds are for additional technical assistance to accelerate the land treatment for watershed protection program, for financing of the installation of critical area plantings and roadside erosion control. Other funds are for installing the land treatment measures for watershed protection and come from local, State and going Federal programs.

Installation cost of the 37 floodwater retarding structures is $4,162,132, of which $3,347,678 will be financed by Federal funds and $814,454 financed by other funds.

Federal costs include construction, engineering services, and general administrative costs. Other costs include easements and rights-of-way, administration of contracts and general miscellaneous costs. The estimated structural cost distribution identifies these costs for all structural measures in the nine watersheds.

The 294 miles of flood prevention channels will be installed at an estimated total cost of $2,814,467. Of this amount, $2,421,661 will be financed by Federal funds and $392,806 by other funds.

Federal funds include costs for construction, engineering services and general administrative costs. Other funds will be used for easements and rights-of-way, administration of contracts and administrative costs.

Installation costs of multiple-purpose structures is $1,692,522. Of this amount, $1,331,531 will be financed by Federal funds and $360,991 will be financed by other funds. The specific costs of the multiple-purpose structures were allocated directly to the purpose they serve. The joint costs of these structures were allocated between flood prevention and recreation by the "Use of Facilities" method.

1/ 1964 costs.
1.0357 = factor for converting from 1964 to 1965 prices.
1.0777 = factor for converting from 1964 to 1966 prices.

Special costs for flood prevention include costs for flowage easements and relocation. Specific costs for recreation include land purchases and relocations. Primary joint costs are associated with the construction of the structure.

The cost of basic facilities for the nine planned recreation sites is $1,674,716. Of this amount, $829,759 will be financed by Federal funds and $844,957 by other funds.

The estimated cost of preparing work plans for the nine watersheds recommended for Basin-wide authorization is $418,786. These watershed work plans will contain about the same information as those presently prepared for PL-566 watersheds. This cost will be financed with Federal funds.

The total estimated cost of installing the recommended project is $25,453,998. This includes land treatment and structural measures along with the cost of preparing the watershed work plan. Of this amount, $17,539,378 is to be financed with Federal funds and $7,914,620 with other funds. (See Table 44).

Comparison of Monetary Benefits and Costs

The estimated total average annual benefits accruing to planned works of improvement are $863,213. Damage reduction benefits are estimated at $210,616; changed and more intensive land use, $87,864; planned recreation, $438,087; incidental recreation, $20,031; and secondary benefits, $106,615. Annual benefits in the amount of $5,806 will accrue to three upstream watersheds above proposed Corps of Engineers projects for 1980. The benefits are from increased storage of beneficial water resulting in less sediment entering the Corps reservoirs from proposed upstream watersheds. However, the benefits were not used in project justification.

The estimated annual costs, including operation and maintenance of all structural measures installed in the nine watersheds is $546,486. These measures include floodwater retarding structures, channel improvements, multiple-purpose structures and basic facilities for recreation.

A comparison of total annual benefits to total annual costs for all structural measures in the nine watersheds is 1.6:1. A comparison of annual benefits to annual costs for each watershed is shown in Table 43. Specific summary data not previously referred to are presented in Tables 44 through 51.

Table 43

Comparison of total annual benefits to total annual costs for each watershed, Pascagoula Basin, next 10-15 years

Watershed	Total annual benefits	Total annual costs	Benefit to cost ratio
	Dollars	Dollars	
West Bowie River	71,588	46,836	1.5:1
Upper Bowie River	86,872	61,050	1.4:1
Oakohay Creek	105,238	53,920	2.0:1
West Tallahala Creek	75,666	44,173	1.7:1
Station Creek	60,068	39,793	1.5:1
Tallahatta Creek	88,709	62,630	1.4:1
Upper Okatibbee	131,164	84,466	1.6:1
Upper Bogue Homo	110,706	70,209	1.6:1
Upper Bucatunna	133,202	83,409	1.6:1
Total	863,213	546,486	1.6:1

Table 44

Estimated installation costs of land treatment and structural measures proposed for authorization under special Basin-wide legislation, Pascagoula Basin, next 10-15 years

Item	Unit	Amount	Estimated cost		
			Federal	Other[1]	Total
			Dollars	Dollars	Dollars
LAND TREATMENT MEASURES					
Watershed protection [2]					
Cropland and pastures					
Cropland	Acres	30,750	---	234,556	234,556
Grassland	Acres	39,336	---	1,636,102	1,636,102
Wildlife land	Acres	18,408	---	60,372	60,372
Technical assistance			399,235	187,876	587,111
Total-cropland and pasture			399,235	2,118,906	2,518,141
Forest land					
Private Forest land	Acres	52,200	---	270,070	270,070
Technical assistance			116,660	65,000	181,660
National Forest land	Acres	950	---	29,705	29,705
Total-Forest land			116,660	364,775	481,435
Total Watershed			515,895	2,483,681	2,999,576
Critical area treatment within the 9 feasible watersheds					
Cropland and pasture					
Grasses and legumes	Acres	2,845	184,925	99,575	284,500
Roads and bridges	Miles	682	223,778	120,496	344,274
Technical assistance			142,515	---	142,515
Total-cropland and pasture			551,218	220,071	771,289
Forest land					
Private Forest	Acres	11,400	693,800	173,500	867,300
Technical assistance			55,000	---	55,000
National Forest	Acres	826	35,610	42,410	78,020
Total-Forest land			784,410	215,910	1,000,320
Total-9 feasible watersheds			1,335,628	435,981	1,771,609
Critical area treatment - Remaining area [3]					
Cropland and pasture					
Grasses and legumes	Acres	8,138	528,970	284,830	813,800
Roads and bridges	Miles	6,048	1,984,470	1,068,560	3,053,030
Technical assistance			573,215	---	573,215
Total-cropland and pasture			3,086,655	1,353,390	4,440,045
Forest land					
Private Forest	Acres	65,370	3,829,400	957,300	4,786,700
Technical assistance			289,000	---	289,000
National Forest	Acres	2,373	133,385	271,060	404,445
Total-Forest land			4,251,785	1,228,360	5,480,145
Total-Remaining area			7,338,440	2,581,750	9,920,190
Total critical area treatment			8,674,068	3,017,731	11,691,799
Total land treatment			9,189,963	5,501,412	14,691,375
STRUCTURAL MEASURES					
Floodwater retarding structures	Number	37	2,528,787	---	2,528,787
Multiple-purpose structures	Number	9	839,039	147,681	986,720
Minimum basic facilities	Number	9	598,960	598,961	1,197,921
Stream channel improvement	Miles	293.9	1,801,691	---	1,801,691
Sub-total - Construction			5,768,477	746,642	6,515,199
Installation services			1,908,902	177,550	2,086,452
Land easements & rights-of-way			253,250	1,382,690	1,635,940
Adm. of contracts and other			---	106,326	106,326
Total Structural Measures			7,930,629	2,413,208	10,343,837
Work plan preparation			418,786	---	418,786
TOTAL PROJECT			17,539,378	7,914,620	25,453,998

1/ Includes private and public program funds.

2/ Includes only the measures to be applied in the nine watersheds recommended for authorization through special legislation.

3/ Includes all critical areas to be treated outside of sub-watershed projects.

Table 45

Estimated structural cost distribution, nine watersheds proposed for authorization under special Basin-wide legislation, Pascagoula Basin, next 10-15 years

Item	Construction and installation services		Land easement and R. O. W.	Administration of contracts and other	Total installation cost
	Construction	Installation services			
	Dollars	Dollars	Dollars	Dollars	Dollars
Floodwater retarding structures	2,528,787	818,891	770,839	43,615	4,162,132
Multiple purpose structures	986,720	292,492	400,000	13,310	1,692,522
Minimum basic facilities	1,197,921	355,099	106,500	15,196	1,674,716
Channel improvement	1,801,691	619,970	358,601	34,205	2,814,467
Total	6,515,119	2,086,452	1,635,940	106,326	10,343,837

Table 46

Cost allocation summary, nine watersheds proposed for authorization under special Basin-wide legislation, Pascagoula Basin, next 10-15 years

Item	Purpose		Total
	Flood prevention	Recreation	
	Dollars	Dollars	Dollars
Floodwater retarding structures	4,162,132		4,162,132
Multiple purpose structures	918,463	774,059	1,692,522
Minimum basic facilities		1,674,716	1,674,716
Channel improvement	2,814,467		2,814,467
Total	7,895,062	2,448,775	10,343,837

Table 47

Structure data, nine watersheds proposed for authorization under special Basin-wide legislation, Pascagoula Basin, next 10-15 years

Item	Unit	Total
Drainage area	Sq. Mi.	210.76
Storage capacity		
Sediment	Ac. ft.	7,645
Floodwater	Ac. ft.	68,294
Recreation	Ac. ft.	1/ 8,330
Potential water storage	Ac. ft.	2/404,481
Total	Ac. ft.	488,750
Surface area		
Sediment pool	Acre	1,905
Floodwater pool	Acre	9,767
Recreation	Acre	1,450
Potential water storage pool	Acre	2/ 28,453

1/ Includes 1,921 acre feet for sediment storage.
2/ Additional storage physically possible at the proposed dam sites included in the watersheds. Watershed yields may limit this storage.

Table 48

Annual costs, nine watersheds proposed for authorization under special Basin-wide legislation, Pascagoula Basin, next 10-15 years

Item	Amortization of installation cost 1/	Operation and maintenance cost	Other economic	Total
		Other funds		
	Dollars	Dollars		Dollars
Floodwater retarding structures	131,730	13,170		144,900
Multiple purpose structures	53,568	5,614		59,182
Minimum basic facilities	53,003	133,975		186,978
Channel improvements	89,077	66,349		155,426
Total	327,378	219,108		546,486

1/ Structural measures were amortized for 100 year period at 3 percent interest.

Table 49

Estimated average annual flood damage reduction benefits, nine watersheds proposed for authorization under special Basin-wide legislation, Pascagoula Basin, next 10-15 years

Item	Estimated average annual damages		Damage reduction benefits
	Without project	With project	
	Dollars 1/	Dollars 1/	Dollars 1/
Floodwater			
Crop and pasture	199,739	68,246	131,493
Other agricultural	28,309	10,395	17,914
Non-agricultural			
Urban and industrial			
Road and bridge	75,424	20,484	54,940
Sub-total	303,472	99,125	204,347
Erosion			
Reduced road maintenance	14,151	5,677	8,474
Indirect	30,909	10,481	20,428
Total	348,532	115,283	233,249

1/ Price Base - Long term projected.

Table 50

Comparison of benefits and cost for structure measures, nine watersheds proposed for authorization under special Basin-wide legislation, Pascagoula Basin, next 10-15 years

Evaluation unit	Average annual benefits 1/							Average annual cost	B/C ratio primary benefits	B/C ratio total benefits
	Flood prevention		Planned recreation	Incidental recreation	Total primary benefits	Secondary benefits	Total benefits			
	Damage reduction	Changed and more intensive land use								
	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars	Dollars		
Flood prevention	210,616	87,864		20,031	318,511	62,806	381,317	332,827	1.0:1	1.1:1
Recreation			438,087		438,087	43,809	481,896	213,659	2.1:1	2.3:1
Total	2/210,616	87,864	438,087	20,031	756,598	106,615	863,213	546,486	1.4:1	1.6:1

1/ Price base long term projected.

2/ In addition it is estimated that land treatment measures will provide flood damage reduction benefits of $12,101, erosion (reduced road maintenance) benefits, $8,474, and indirect benefits, $2,058. Total benefits of $22,633 annually.

Table 51

Summary of physical and plan data, nine watersheds proposed for authorization under special Basin-wide legislation, Pascagoula Basin, next 10 - 15 years

Item	Unit	Quantity without project	Quantity with project
Watershed area	Sq.mi.	835.86	835.86
	Acres	534,954	534,954
Area of cropland	Acres	84,967	70,467
Area of grassland	Acres	56,732	79,689
Area of woodland	Acres	304,461	297,902
Miscellaneous area	Acres	88,794	86,896
Floodplain area subject to inundation of maximum storm in evaluation series	Acres	81,417	
Area of floodplain benefited by proposed structural measures			
Directly	Acres		47,129
Indirectly	Acres		13,275
Total	Acres		60,404
Woodland conversions	Acres		7,501
Watershed area controlled by floodwater retarding structures	Acres		134,888
	Percent		25.2

Financing Project Installation

Special legislation is needed for the concurrent implementation of works of improvement in these nine watersheds. The USDA Field Advisory Committee determined that simultaneous concurrent authorization of these watershed projects is the best means of solving watershed problems and at the same time serving downstream needs. The nine watersheds that are proposed for special authorization are those shown in Table 38.

Watersheds 23A and 23C are immediately above the proposed Corps of Engineers structure on Bowie River; Watershed 17A is above the proposed Corps of Engineers structure on Oakohay Creek; Watershed 11A is above the proposed Corps of Engineers structure on Leaf River; Watershed 1A is immediately above the Corps of Engineers project on Okatibbee Creek, which is under construction; Watersheds 3 and 9 are above proposed Corps of Engineers structures that will be considered for implementation after 1980; Watersheds 24A and 27 will satisfy local problems relating to needs for flood prevention and recreation.

Adequate sponsorship exists to satisfy the requirements of local interest to participate in carrying out, operating and maintaining works of improvement in the watersheds. Federal assistance for carrying out the works of improvement on non-Federal lands, as described in this plan, will be requested under special legislative authority granted by the Congress of these United States. The requirements of local water management districts in the construction, operation and maintenance of installed flood prevention and multiple purpose works of improvement will be the same as those required under existing PL-566 authorities at the time of project implementation.

The total estimated cost of establishing land treatment measures is $14,691,375. Land treatment measures to be installed on non-critical lands (watershed protection measures) will be approximately $2,999,576. Of this amount, $515,895 is to be financed by Federal funds and $2,483,681 by other funds. Federal funds are to be used for technical assistance only (Table 44).

The estimated cost of critical area treatment is $11,691,799, of which $8,674,068 is to be financed from Federal funds and $3,017,731 from other funds. The costs that are to be financed from other funds are for those measures that are planned to be established on National Forest land (next 10-15 years) and will be financed by the Forest Service through regular funding means. Program accomplishment is contingent upon the availability of funds for critical area treatment. Of the Federal watershed funds, $168,995 is needed by the Forest Service to complete installation of needed critical area treatment measures on National Forest land. The measure to be established

on private land and the technical assistance required will be financed with Federal funds (Table 44).

Structural measures will be installed at a cost of $10,343,837, of which $7,930,629 will be financed from Federal funds and $2,413,208 will be financed from other funds (local water management districts) (Table 44).

Provisions for Operation and Maintenance

Land treatment measures for watershed protection will be operated and maintained by landowners and operators under cooperative agreements with the respective Soil Conservation Districts. The operation and maintenance will be the financial responsibility of the landowners and operators. Operation and maintenance of critical area measures will be financed by the local sponsoring water management districts or by other non-Federal interests.

Each of the legal water management districts will assume the responsibility to operate and maintain the floodwater retarding structures and flood prevention channels in their respective districts. They will also operate and maintain the flood prevention aspects on multiple purpose reservoirs in their districts.

The Pat Harrison Waterway District will operate and maintain the recreation features on all multiple-purpose structures and basic facilities except those on National Forest land. This may be done through a lease arrangement with other legally responsible groups such as municipalities, County Boards of Supervisors or Commissioners of Water Management Districts.

The estimated annual costs for operating and maintaining floodwater retarding structures, channel improvements, structures, and basic facilities for recreation are shown in Table 52.

Table 52

Estimated annual operation and maintenance costs of structural measures and basic facilities, nine watersheds, Pascagoula Basin, next 10-15 years

Item	Floodwater retarding structures	Channels	Multiple purpose structures	Basic facilities	Total
	Dollars	Dollars	Dollars	Dollars	Dollars
Special legislation nine watersheds	144,900	155,426	59,182	186,978	546,486

Institutional Arrangements for Carrying Out the Plan

Legislative History

The first drainage law was enacted in Mississippi in 1886. Since that time numerous drainage laws and amendatory acts have been passed by the State Legislature.

In a 20 year period, 1886-1906, 48 Swamp Land Districts were organized; from 1906-1930, 256 Drainage Districts were organized, most of which were in the Mississippi Delta and the Blackland Resource Area in northeast Mississippi. The peak period of organization was in the early 1920's.

The powers and authorities of drainage districts during the period 1886-1930 remained fairly constant. Amendments to these laws were usually confined to the manner governing procedures of administration or how benefited lands would be assessed by the District.

An Act known as the Soil Conservation District Law was passed by the Legislature in 1938. This act defines a District as being a governmental sub-division of the State, a public body corporate and political. Soil Conservation Districts have the power to conduct surveys and investigations relating to the character of soil erosion and the preventive measures needed - to carry out preventive and control measures - to cooperate and enter into agreements with any agency, owner or operator of lands within the District in carrying out erosion control measures --. They do not have the power to assess or levy taxes in carrying out the functions of the District.

The Watershed Protection and Flood Prevention Act of 1954, as amended, established a new national policy for Federal assistance to State and local agencies in projects for flood prevention and the conservation, development, utilization and disposal of water.

Chapter 92, Laws of Mississippi, Extraordinary Session, 1955, (Senate No. 1220), as amended, confers on existing drainage districts the additional authority to cooperate with the United States under the provisions of PL-566 in constructing, operating and maintaining works of improvement -- and provides the procedure which must be followed before such additional authorities may be exercised.

House Bill 670, Mississippi Legislature, 1960, provides for the creation of master water management districts, and the inclusion of existing drainage districts, -- and provides that this authority be limited to projects developed and carried out under PL-566 or other laws of the United States.

Chapter 222, General Laws of Mississippi, 1962, (Senate Bill 2082) as amended by Chapter 31, Second Extraordinary Session, 1962, (Senate Bill 1545), created the Pat Harrison Waterway District. This District comprises 15 counties in southeast Mississippi which drain into the Pascagoula River and its tributaries.

Chapter 186, Laws of Mississippi, 1956 (House Bill 429) authorized the Boards of Supervisors in each county to make contributions to any Soil Conservation District. As such, each Soil Conservation District will encourage financial or other assistance from the respective Boards of Supervisors to implement and accelerate known control measures on roadbanks needing such treatment in each Soil Conservation District.

Sponsoring Organizations

Drainage districts, water management districts and river basin districts (Pat Harrison Waterway District) have the power to: develop with agencies of the U. S. Government, State and local, plans for works of improvement, enter into agreements with these agencies and to meet the local requirements of cost sharing; acquire by condemnation lands or other property for rights-of-way; construct, operate and maintain any kind of facility in the Basin necessary to the project. In addition to the above, the Pat Harrison Waterway District has power to: acquire lands for recreation facilities and issue rules and regulations for use of these facilities; issue bonds, fix and collect charges for services, lease, sell and dispose of property.

Local - Owners and operators of land within each watershed (less than 250,000 acres) will be the primary motivating force in requesting technical and financial assistance in the planning, construction, operation and maintaining of works of improvement in each of the nine watersheds recommended for Basin-wide authorization. Each will petition and organize under appropriate laws of the State which provides for the participation of the Federal government in planning and construction of works of improvement within organized drainage or water management districts.

Each local sponsoring organization will be responsible for working with appropriate Federal agencies in the development of the watershed work plan, which will not only identify the problems and needs in the watershed but reflect the decisions and agreements reached in work plan development. The work plan will identify those measures required to solve these problems or provide the needs in the watershed, make estimates of the costs and benefits from proposed works of improvement, allocate costs to purposes, determine cost sharing between the Federal government and local people, and provide for the operation and maintenance of works of improvement or facilities identified in the watershed work plan.

Soil Conservation Districts - Soil Conservation Districts will act as a co-sponsor for each watershed project and will be responsible for carrying out all the accelerated land treatment measures as identified in the work plan.

In addition, Soil Conservation Districts will be the primary sponsoring organization in planning for and in carrying out accelerated land treatment measures on critical areas in the Basin not otherwise identified with a watershed project.

Pat Harrison Waterway District - The Pat Harrison Waterway District will act as co-sponsor to the local sponsoring organizations in each watershed project. They have agreed to share with each local sponsoring organization in the development of the watershed work plan and to encourage the maximum development and use of multiple-purpose structures commensurate with the needs of the people in each watershed.

To encourage maximum development and use of the water resource in each watershed, the Pat Harrison Waterway District has agreed to support the local sponsoring organizations by assuming the costs for legal services, rights-of-way and easements for floodwater retarding structures and multiple purpose structures and basic facilities for recreation.

In addition, they will work with Soil Conservation Districts in the planning and carrying out of land treatment measures on critical areas above structures proposed by the Corps of Engineers and the Pat Harrison Waterway District as well as other areas in the Basin not identified with a watershed project.

Conclusions

The plan is considered the most practical and economically feasible to meet the present and future needs in upstream watersheds for flood prevention and planned outdoor recreation. The benefit to cost ratio is greater than one to one for each watershed. Watershed projects were coordinated with other agencies and no conflict of interest in projects exists. Works of improvement proposed are needed and constitute harmonious elements in the comprehensive development of the Basin. Local interests will provide the necessary cooperation in implementing and constructing the works of improvement.

Implementation of watershed projects will be carried out in accordance with the Watershed Protection and Flood Prevention Act. Plans will be developed by the local sponsoring organizations, Soil Conservation Districts, water management districts, and the Pat Harrison Waterway District, with technical assistance being provided by the United States Department of Agriculture.

Watershed projects will be planned and works of improvement installed in a progressive manner. Projects will be planned one or two a year to satisfy the needs and requirements of the Basin in the next 10-15 years. Local sponsoring organizations will assure the Secretary of Agriculture that they can make arrangements for local participation.

Other purposes for water resource development may be included in amended legislation in the next 10-15 years. Where such amendments may prove beneficial to proposed watershed projects or potentially feasible watershed projects as identified in the USDA Plan, the nine watershed projects may be re-evaluated to include these in the next 10-15 year period for authorizations if economically feasible and supported by local interests.

Recommendations

The USDA Field Advisory Committee recommends that:

1. The nine watersheds identified in Table 38 be authorized for construction through special legislation essentially in accordance with the Plan and to include:

    a. Those items of land treatment measures for watershed protection and technical assistance costs as identified in Table 44.

    b. Those items of critical area treatment and technical assistance costs for accelerating treatment of critical areas in the nine watersheds and other parts of the Basin and as identified in Table 44.

    c. And costs of structural measures including installation services and work plan preparation as identified in Table 44.

2. Prior to construction, that a legally constituted water management district be organized in each watershed to assure the Secretary of Agriculture that it will meet the requirements of local interests in their share of the installation costs, obtain necessary easements and rights-of-way, and guarantee the operation and maintenance of works of improvement, as outlined in a detailed watershed work plan and work plan agreement.

3. In areas of the Basin outside of the nine watersheds identified in Table 38, where critical area treatment measures are to be installed, assurance be given to the Secretary of Agriculture by local sponsoring organizations or other legally constituted agencies that such measures will be operated and maintained in a satisfactory manner.