WATERSHED WORK PLAN

SWEETWATER CREEK WATERSHED

MONROE, LOUDON, AND McMINN COUNTIES, TENNESSEE

Photo courtesy Hiwassee College

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
AND
FOREST SERVICE

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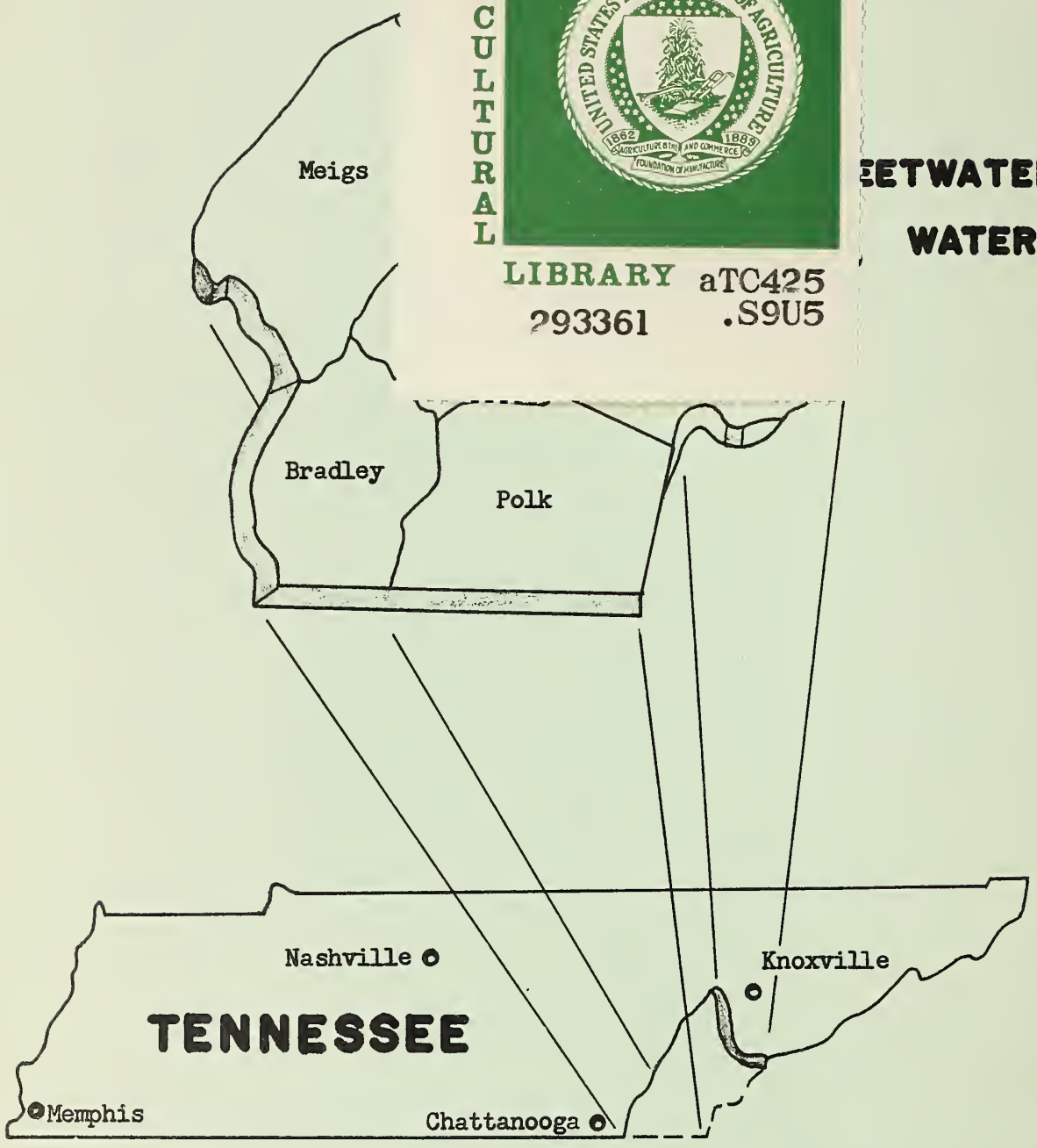

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SWEETWATER CREEK WATERSHED

Monroe, Loudon, and McMinn Counties, Tennessee

Prepared under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended.

Prepared by: Sweetwater Creek Watershed District

Monroe County Soil Conservation District

Loudon County Soil Conservation District

McMinn County Soil Conservation District

With assistance by:

U. S. Department of Agriculture, Soil Conservation Service

U. S. Department of Agriculture, Forest Service

June 1969

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Monroe, Loudon, and McMinn Counties, Tennessee

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SUMMARY OF PLAN

This document is a plan for watershed protection and flood prevention in the 37,640-acre Sweetwater Creek Watershed LOCATED within Monroe, Loudon, and McMinn Counties in the southeastern section of Tennessee. The plan was developed by the sponsors with assistance from the United States Department of Agriculture, Soil Conservation Service and Forest Service. The SPONSORS are:

Sweetwater Creek Watershed District
Monroe County Soil Conservation District
Loudon County Soil Conservation District
McMinn County Soil Conservation District

Sweetwater Creek headwaters originate in McMinn County, flowing northeasterly through Monroe and Loudon Counties to its confluence with the Tennessee River (Watts Bar Reservoir) about 2 miles west of Loudon. This area is in the Appalachian Region of the United States.

The primary PROBLEM along Sweetwater Creek is an estimated $198,900 annual flood damage from overbank flow. This damage occurs to:

(1) industrial, commercial, and residential properties in the cities of Sweetwater and Philadelphia;

(2) crop and pasture values on 2,750 acres of bottom land; and

(3) other fixed improvements such as roads, bridges, barns, fences, etc.

The WORKS OF IMPROVEMENT designed to give relief to the flood problem along Sweetwater Creek will be installed during a 4-year period. The project measures to be installed are:

(1) the application of conservation measures on 14,915 acres;

(2) the stabilization of 200 acres of critically eroding uplands by land treatment;

(3) the construction of nine floodwater retarding structures; and

(4) the improvement of about 223,600 feet of stream channels.

The land treatment measures, except critical area planting, will be voluntarily planned and applied by the landowners in cooperation with the

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going and accelerated program of the soil conservation district. Such cost-sharing assistance as will be available under the Agricultural Conservation Program or other going programs will be utilized in applying them. Technical assistance for applying and maintaining the forestry measures will be furnished by the U. S. Forest Service, by and through the Tennessee Division of Forestry. The Soil Conservation Service will furnish, from P. L. 566 funds, the technical assistance needed for application of the other planned measures.

The Sweetwater Creek Watershed District will be responsible for the installation, operation, and maintenance of the critical area planting.

The estimated INSTALLATION COSTS of project measures are:

Project Measure	Installation Cost (Dollars)		
	P. L. 566 Funds	Other Funds	Total Cost
(1) Conservation Land Treatment	57,600	705,500	763,100
(2) Critical Area Stabilization	20,400	4,500	24,900
(3) Nine Floodwater Retarding Structures	1,403,300	156,000	1,559,300
(4) Improvement of About 223,600 Feet of Stream Channel	297,000	124,100	421,100
(5) Project Administration	199,600	20,000	219,600
TOTAL PROJECT COST	1,977,900	1,010,100	2,988,000

Average annual BENEFITS to be derived from installation of structural measures are:

Flood Damage Reduction	
Crops and Pasture	$ 20,800
Other Agricultural	1,100
Non-Agricultural	
Roads and Bridges	9,800
Urban Property	
Sweetwater	90,000
Philadelphia	18,200
Rural Property	7,000
Indirect	33,000
Redevelopment	22,100
Local Secondary	14,700
TOTAL	$216,700

The average annual COST of the structural measures is $114,775 and yields a benefit-cost ratio of 1.9 to 1. Estimates also indicate that about 14,000 people utilizing industrial and farm lands in the watershed will be directly benefited. About 2,500 acres will be directly benefited.

The Sweetwater Creek Watershed District will use its authority to plan and install the proposed project measures and will be responsible for adequately PROTECTING, OPERATING, AND MAINTAINING the structural measures at an estimated annual cost of $6,600.

FEDERAL financial and technical ASSISTANCE will be furnished by the U. S. Department of Agriculture's Soil Conservation Service and Forest Service under authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress, 68 Stat. 666), as amended.

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DESCRIPTION OF THE WATERSHED

Sweetwater Creek Watershed is located in southeastern Tennessee and includes 37,640 acres or about 58.8 square miles, with stream headwaters in the edge of McMinn County, flowing in a northeasterly direction through Monroe and Loudon Counties to its confluence with the Tennessee River.

Historical Data

According to historical records, the earliest inhabitants of the valley were the mound-builders. They were believed not to be American Indians, but kin to the Aztecs of Mexico, since they were more civilized than the American Indian. For many years, the valley is said to have been without inhabitants, nameless, and without roads or trails. To the Indian, it was only a breeding place for game until the white men took possession of the area in the early 1800's.

The Rev. James Axley, one of the first settlers, built his home near a large spring that is located about one-half mile southeast of the Southern Railway Depot in the city of Sweetwater. It is believed that he settled there in the early twenties (1820) or soon after the Hiwassee Purchase from the Indians.

The name, "Sweetwater", came about in an unusual way. The Cherokee Indians, who formerly occupied this section, called the creek and valley, "Soitee Woitee", which means in Cherokee language, "happy home". When the early settlers came, they heard the Indians pronouncing the name, but getting the pronunciation only half correct, they referred to the name as "Sweetwater", which is merely how "Soitee Woitee" sounded to them.

Issac Thomas Lenoir in 1851 purchased from his father, W. B. Lenoir, 1,240 acres of land in the Sweetwater Valley. The city of Sweetwater is now located on a portion of the Lenoir land. When the East Tennessee and Georgia Railroad was completed to Sweetwater in 1852, the only towns of any size in this section of the country were Philadelphia, Madisonville, and Athens.

In planning the town of Sweetwater, Mr. I. T. Lenoir divided the land into 65 lots. These lots were to be sold to local people interested in establishing business houses. The first recorded sales were to N. W. Haun and William Stokely on May 14, 1852. In 1854, J. C. Vaughn purchased the property now occupied by the Hyatt Hotel. A majority of the lots laid out by Mr. I. T. Lenoir were sold prior to 1860. He took great pains to sell lots only to those persons whom he knew to be responsible businessmen and good citizens.

Goodspeed's History of East Tennessee, published in 1887, states that "During the Civil War, the town of Sweetwater and surrounding country suffered severely. The depot burned and much of the other property was either destroyed or carried away by both armies. However, at the close of hostilities, the unexcelled resources soon restored the area to its former prosperity; and at the present time, Sweetwater is the largest shipping point between Knoxville and Chattanooga."

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Lenoir's History of Tennessee says that the first newspaper published in Sweetwater was "The Sweetwater Forerunner", dated September 1, 1867. Sweetwater was incorporated as a city on December 7, 1875. Other historical records show that the first settlers and pioneers of Monroe County came down the broad valleys of Virginia, over the mountains, through the passes from the Carolinas in wide wagons covered with stout white cloth. Guiding these convoys were armed men on horseback. In Eastern and Middle Tennessee, they found choice land in plenty--the Little Tennessee River Valley being particularly rich. The determined people staked their land, felled the trees, hewed logs for homes, and planted crops. Then all gave spare land for schools and churches which became the heart of each settlement. One of these settlements was in the vicinity of what is now known as Monroe County. According to a Portuguese narrative of DeSoto's explorations, Monroe County had its humble beginning in about the year 1540. While DeSoto was in the upper regions of the Savannah River looking for gold, he met with Indians, thought to be a tribe of the Uchees, wearing ornaments made of copper and gold. These metals came from a race of people called "Chalaque", who lived in villages beyond the mountains and beside rivers "which ran westward into the great river". These villages were in the Monroe County and Sweetwater Creek Watershed area.

The fertile valleys and lands of Sweetwater Creek were known to traders, trappers, hunters, and scouts in early Colonial times. Old records show that as early as 1690, traders drove packhorse trains loaded with trade goods, destined to the Indians, over what is now called the Wauchesi Trail.

In 1756, Captain Raymond Demere came over the Northwest Passage and down the Wauchesi Trail, commanding a column of about 300 troops and artisans from South Carolina to begin construction of Fort Loudon, which is located some 20 miles east of Sweetwater Creek. While living in the fort, many of the men brought their wives and children from England and South Carolina to live with them. Thus, the first English settlement west of the mountains was established.

Monroe County, the core of the Cherokee Nation, was named for President James Monroe, fifth president of the United States. It was sliced from the Hiwassee District in 1819 when the United States Government persuaded the Cherokee to an outright sale of the land. The Cherokees moved across the mountain into settlements below the North Georgia Plateau.

According to Tennessee State Historian, Dr. Robert White, the date of the establishment of Monroe County was November 13, 1819. The county has an area of some 665 square miles which includes about 47 percent of the Sweetwater Creek Watershed. The county also lies partially in the Tennessee River Valley and partially on the Unaka or Unicoi Mountain which is a part of the Great Smoky Mountain Range.

Physical Data

The Sweetwater Creek Watershed lies about 40 miles southwest of Knoxville and some 40 miles west of the world famous Great Smoky Mountains National Park.

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Sweetwater, a town rich in East Tennessee tradition, lies in the flood plain of Sweetwater Creek in a precarious position where about 12,000 acres can release its floodwater with devastating results. The recently incorporated city of Philadelphia lies further downstream in the flood plain.

The topography of the watershed is flat to rolling with low ridges on either side. Elevations around the rim of the watershed area range from about 900 to 1,200 feet above sea level. Sweetwater Creek enters the Tennessee River at elevation 741 (MSL).

The climate is excellent all year with an average annual temperature of 61 degrees. Temperatures range from an average low of 42 in January to an average high of 77 in July. Normal annual precipitation is about 50 inches. Rains occur heaviest in the late winter or early spring and the driest season is mid-fall. There are about 130 days throughout the year with measurable precipitation. Clear skies prevail on about 135 days during the year. The relative humidity averages about 72 percent. However, the nights are cool during the hot summer season.

Sweetwater Creek Watershed is in the Appalachian Valley and Ridge Physiographic Province of East Tennessee. The valley trends in a northeast-southwest direction parallel to the bounding ridges on either side. Geologic formations in the watershed are sedimentary in origin and range in age from Cambrian to Ordovician. These formations consist principally of shales, limestones, and dolomites.

The geologic column for formations in the watershed is as follows:

Age		Name of Unit
Middle Ordovician		Ottosee Shale Holston Formation Lenoir Limestone
Lower Ordovician	Knox Group	Mascot Dolomite Kingsport Formation Longview Dolomite Chepultepec Dolomite
Upper Cambrian	Knox Group	Copper Ridge Dolomite
Upper & Middle Cambrian	Conasauga Shale	Maynardsville Limestone Member Main Part of Conasauga Shale Formation

Thrust faulting has been intense in the area. The major fault systems trend in a northeast-southwest direction. Rock formations, though locally distorted, dip at relatively high angles to the southeast. The Knoxville fault system traverses the southeast side of the watershed. Here, the older Cambrian rocks have been thrust up onto the younger Ordovician formations as is the case along the Saltville fault in the adjacent valley to the northeast. The more resistant Copper Ridge dolomite forms the ridges on either side of the watershed. The bedrock is highly fractured

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and development of solution channels in the limestones and dolomites is evidenced by the numerous "sink holes", caves, and springs in the area.

Soils of this watershed include six major soil associations. These associations are:

Huntington-Lindside Association - These soils are found in the broader areas of the bottom lands and dominate the area. They consist of recent alluvium and differ from each other by drainage. Huntington is well-drained--Lindside is moderately well- to somewhat poorly-drained. These soils have a high natural fertility and they are generally acid in reaction. They produce high yields of the adapted crops but flooding, periodic high water table, and poor drainage limit the range of crops which can be grown.

Dewey-Decatur Association - This association includes an estimated 30 percent of the watershed area. These soils are some of the most productive upland soils of the watershed. The relief is predominantly rolling to hilly but ranges from undulating to hilly. Practically all of these soils are well-drained and deep over bedrock. Natural fertility is moderately high and the fertility is easy to maintain. These soils are well-suited to the production of grasses and legumes and most row crops.

Fullerton-Dewey Association - This area is predominantly hilly but the slopes range from undulating to very steep. The lay of the land is highly irregular and is modified in many places by depressions and sinks. The soils are predominantly upland or residual soils that have developed over dolomitic limestone. They are deep and well-drained. The natural fertility of the soils range from very low on the light colored cherty soils to moderately high on the red soils. Adequate fertilization is an important management factor in the production of crops and pastures in this association.

Fullerton-Clarksville Association - These soils include an estimated 30 percent of the watershed. The area consists of a great mass of irregularly shaped hills that have narrow tops and long, moderately steep to steep side slopes. There are some small level areas in draws, along streams, and in depressed areas. Upland or residual soils dominate the area. Practically all of the soils of this area are low or very low in natural fertility and strongly to very strongly acid, but they give good response to adequate fertilization. About one-fourth of this area is still hardwood forest. The remainder is used for a wide variety of crops and pasture but yields are generally low. A large acreage is in unimproved pasture. High yielding cropland is scarce in the area due to chertiness, strong slopes, and low fertility. However, most of the acreage is potentially suitable pasture land.

Tellico-Alcoa Association - This association is a hilly area which consists mainly of upland soils developed over sandy limestone and sandy shales.

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The soils are mostly dark red to red, well-drained, and range from moderately deep to deep over bedrock. Many of the steeper slopes are severely eroded and shallow gullies are in some areas. These soils are medium in fertility and medium to strongly acid. Many of the steeper slopes are in unimproved pasture, idle, or in pine forest.

Sequoia-Litz Association - These soils are located in the extreme western part of the watershed and include about 2 percent of the total area. Most of these soils have developed over shales and are soft and leached in the upper few feet. They are well-drained but range from a few inches to about 30 inches to bedrock. They are low in fertility and strongly acid. Most of these soils are suitable for crops in rotation. The natural fertility is low and adequate fertilization is an important management problem.

Economic Data

The Sweetwater Creek Watershed has a relatively well-diversified economy. In the early history of Tennessee, Sweetwater Valley was recognized more as a rich farming center than as an industrial center, although several large industries were organized by Sweetwater citizens in the late 1800's. Some of these were the American Textile and the Sweetwater Hosiery Mills. Also, the mining of barite ore was a lucrative industry for over 50 years. These and other industrial developments in the valley have contributed greatly to the overall economy of the watershed and surrounding area.

The boundary of the watershed lies within three southeast Tennessee counties. About 47 percent of the watershed lies in Monroe County, 38 percent in Loudon County, and 15 percent in McMinn County. All land in the watershed is under private ownerships.

Present land use distribution is:

Land Use	Acres	Percent
Cropland	8,874	23.6
Grassland	15,814	42.0
Idle	3,228	8.6
Critical Area	200	0.5
Woodland	7,543	20.0
Miscellaneous	1,981	5.3
TOTAL	37,640	100.0

The agricultural economy is tied primarily to the production of cultivated crops, livestock and livestock products. The major crops produced in the watershed are corn, tobacco, small grain, silage, hay, and pasture. Tobacco is the main cash crop. The major source of farm income is livestock and livestock products. It is estimated that about 71 percent of the agricultural income is from livestock and livestock products and about 29 percent from crops. Income from forestry products is estimated to be less than 1 percent. It is estimated that about 40 percent of the family type farms are in the low income or economically depressed category. Data taken from the U. S. Census of Agriculture showing trends in the

agricultural economy in Monroe, Loudon, and McMinn Counties (combined) are shown in the following table:

Items	Unit	Year		
		1954	1959	1964
Number of Farms	Number	5956	4867	4242
Average Size of Farm	Acre	95	100	107
Average Per Acre Value of Land and Buildings	Dollars	93	135	208
Full Farmowners	Number	4339	3496	3232
Part Farmowners	Number	790	758	653
Average Age of Farm Operators	Years	51	52	53
Operators Working Off Farm 100 or More Days Per Year	Number	2311	1967	1828
Commercial Farms	Number	2767	1804	1887
Class I	Number	15	25	40
Class II	Number	132	66	104
Class III	Number	202	250	163
Class IV	Number	301	253	219
Class V	Number	960	499	443
Class VI	Number	1265	784	835

Markets for livestock and other farm products within the area are considered to be adequate; although, shipping by truck and railroad to outside markets in Chattanooga, Athens, and Knoxville is common practice.

The Sweetwater Creek Watershed lies within the Appalachian Region. In the past 20 years, the social and economic opportunities of the nation have bypassed the once relatively prosperous Sweetwater valley; however, areas immediately outside the watershed, such as Knoxville, Oak Ridge, Alcoa, Cleveland, and Chattanooga have shown a steady economic growth.

Monroe County has been designated as eligible for assistance under the Public Works and Economic Development Act of 1965 (formerly the Area Redevelopment Act of 1961), although it is not designated at present. As shown in the Overall Economic Development Program for Monroe County, Tennessee, dated 1962, the following factors contribute to a lack of economic development:

1. Partial depletion and termination of the mining of barite, iron ore, and gold.

2. The agricultural economy can no longer support as large a number of people.

3. Lack of venture capital.

4. Competition with other areas such as Alcoa, Oak Ridge, Chattanooga, Cleveland, and Knoxville.

5. Limited skills of labor force.

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6. Lack of creation of an industrial atmosphere.

7. Lack of development of the many human and natural resources.

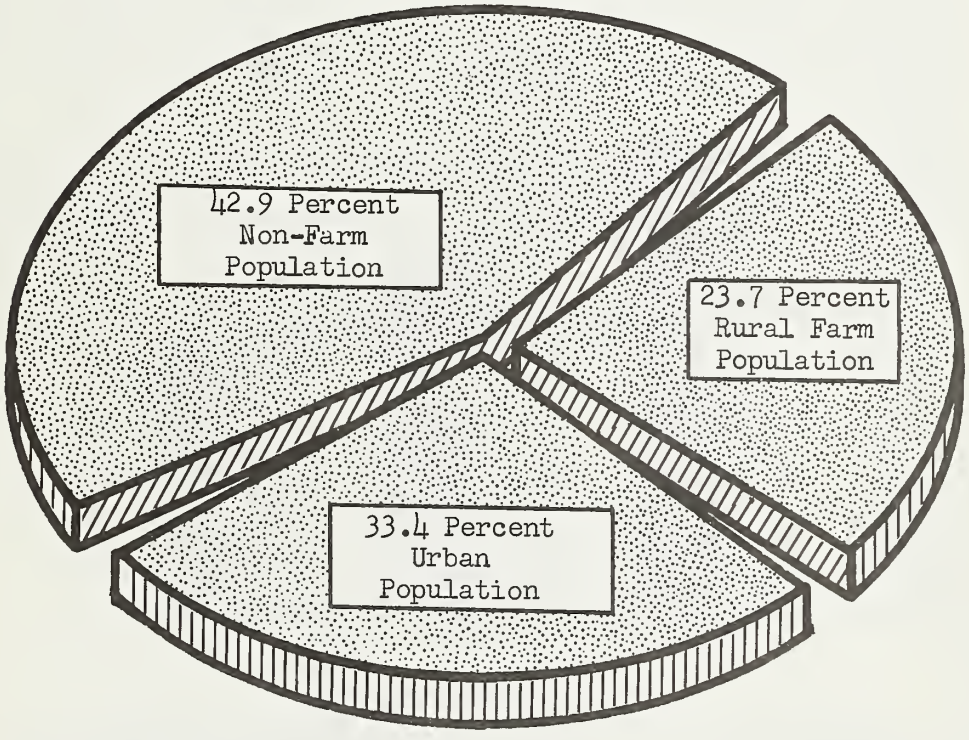
8. Partial depletion of the good woodlands.

9. Lack of a coordinated effort to bring about economic development.

The tri-county population has varied tremendously since 1930. Census data indicate a population of 68,200 in 1930, 74,900 in 1940, 65,600 in 1950, 80,000 in 1960, and 84,100 in 1966. Statistics indicate that the population is not yet stable. Outmigration of the younger people, as they graduate from high school, still plagues the area. They leave the area in search of better employment.

The general characteristics of the 14,000 population in the Sweetwater Creek Watershed are shown in the following graph:

GENERAL POPULATION CHARACTERISTICS
Sweetwater Creek Watershed
1968



The population of Sweetwater Creek Watershed is estimated to be 14,000 residents, or about 3,500 families. There are 3,400 parcels of property, of which 500 are classified as farms. Farms are decreasing in number but increasing in size. The average size farm is about 115 acres and the size varies from about 10 to 2,500 acres. The average value including fixed improvements is $35,000. The average value of flood plain land is about $400 per acre.

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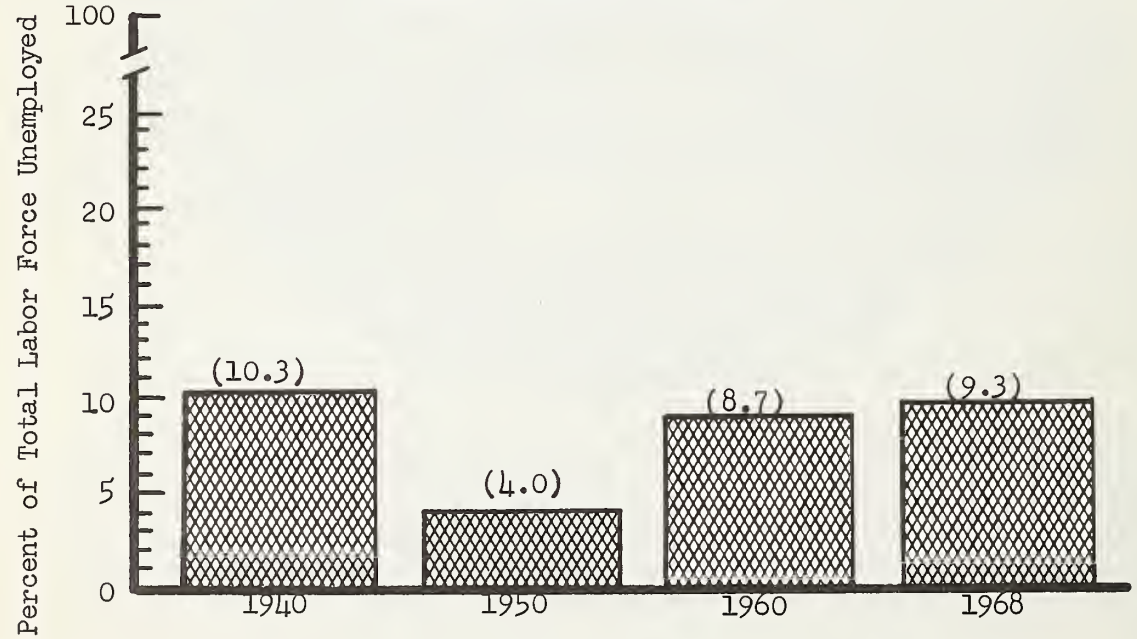
The city of Sweetwater's population is about 5,000. Statistical records show that there has been a slight increase in population since 1940. The city of Philadelphia's population was about 200 in 1966. Trends indicate a decrease in population since 1940.

The potential for development of the many assets of the watershed and surrounding area is high. In reviewing the assets for possible development, the people appear to have the greatest potential. The labor force is about 90 percent native born with an average junior high school education and readily trainable. Workers are exceptionally eager to learn and have the ability to absorb training rapidly. Certain innate skills, particularly manual dexterity, appear to be inherited from pioneering ancestors trained in handcraft.

Educational facilities in the watershed include grade schools, junior and senior high schools, and a military institute. The Tennessee Military Institute is an honor military high school located near the city limits of Sweetwater, with an enrollment of over 200 boys from more than 30 states. The school was founded in 1874 and has a campus of 145 acres. The institute is a member of the Southern Association of Colleges and the Association of Military Colleges of the United States. Other educational facilities include four colleges within a 50-mile radius of the watershed. These are the University of Tennessee--Chattanooga Branch, Wesleyan College at Athens, Maryville College at Maryville, Hiwassee College at Madisonville, and the University of Tennessee at Knoxville.

Employment characteristics of the Sweetwater valley show 32 percent of the population in the labor force. The labor force is estimated to be about 4,500 residents. Many of the employed are underemployed. The following graphs show the unemployment and per capita personal income trends.

ESTIMATE - EMPLOYMENT CHARACTERISTICS
Sweetwater Creek Watershed



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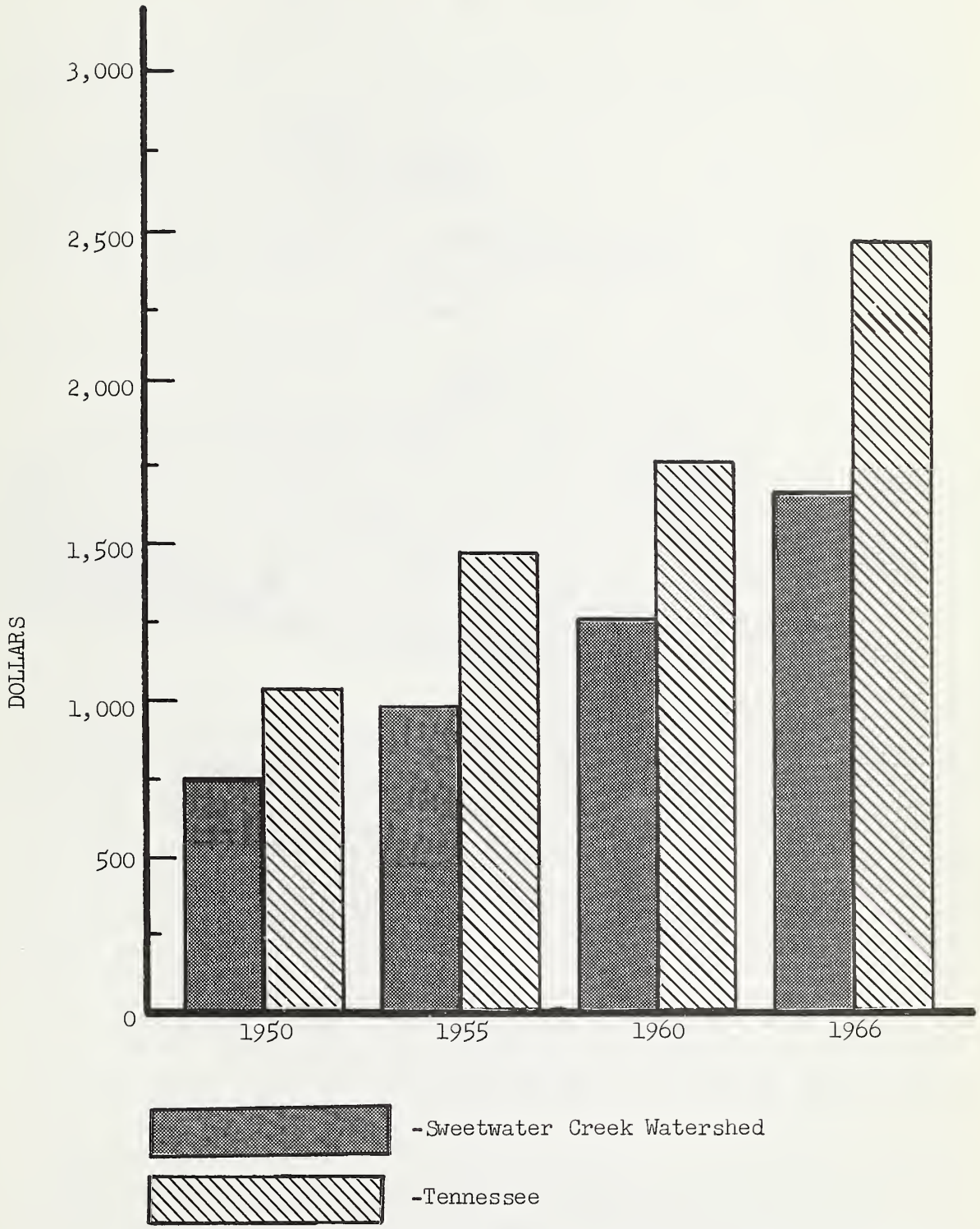
ESTIMATE - PER CAPITA PERSONAL INCOME

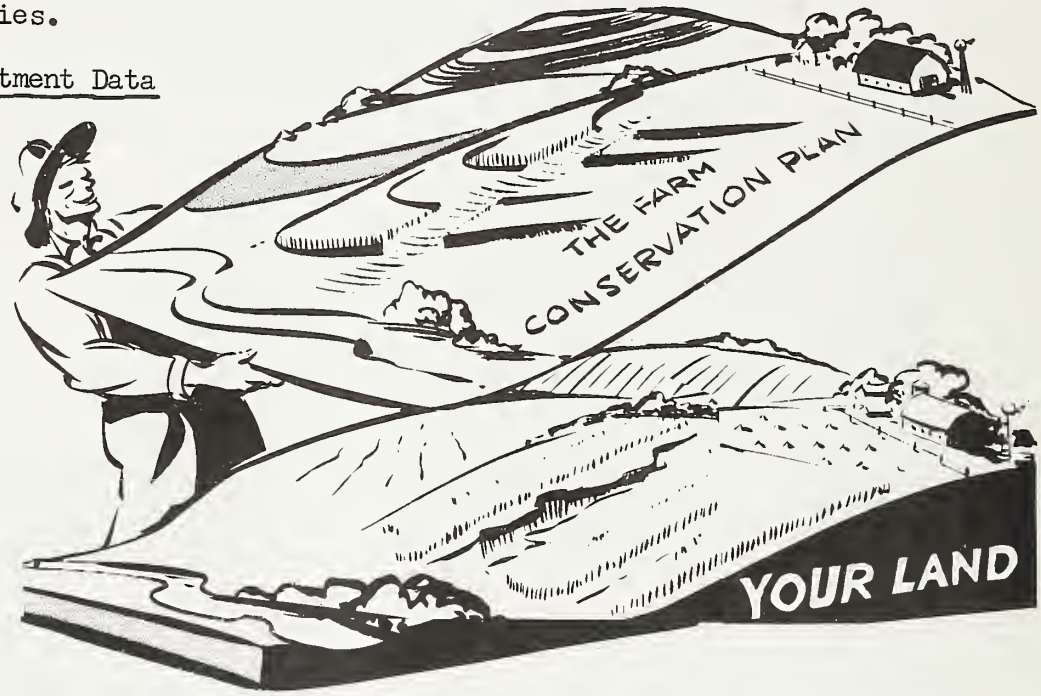


Source: Tennessee Department of Employment Security Research and Statistics.

Transportation facilities in the watershed are excellent, with one major railroad, one municipal airport within commuting distance, two U. S. highways and a good system of state and county roads.

Supporting services are also available, including electricity, gas, telephone service, and others. Long-term capital for industrial development is not available at the local level and must come from outside lending agencies.

Land Treatment Data



The entire watershed (37,640 acres) is serviced by the soil and water conservation districts of Monroe, Loudon, and McMinn Counties. About 13,688 acres in the watershed are now under a soil and water conservation plan, with an additional 20,273 acres receiving technical assistance under going district programs. A total of 137 landowners are active cooperators in the district programs. Eighty-nine farms in the watershed have basic soil and water conservation plans. It is estimated that about 50 percent of the conservation treatment measures have been applied on the land in the past 10 years with district and other agency assistance. The cost of applying these measures is estimated to be about $670,000. (See table 1A, page 51).

The U. S. Forest Service, by and through the Tennessee Division of Forestry, is providing forest management assistance, forest fire prevention and suppression, distribution of planting stock and forest pest control assistance to private landowners in the watershed.

The forest types are pine, 16 percent; hardwood-pine, 16 percent; and hardwood, 68 percent. The principal species are Virginia and shortleaf pine, red and white oak, hickory, cherry, cedar, yellow poplar, and dogwood. Minor species include black gum, maple, post oak, sassafras, and sourwood. There are no lands in the watershed administered by the U. S. Forest Service.

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Fish and Wildlife Resource Data

A major portion of the watershed is open land which is about evenly divided between cropland and pasture. Less than 20 percent of the land is wooded and this is located mostly in the steep areas at the upper and surrounding edges of the watershed with a small amount along the main channel in the flood plain. Several large springs are located in the watershed, and as a result, the main stream channel and several tributaries have a year-round flow. Physically, the stream appears to be supporting a fishery. The abundance of small game in the watershed is low. The hunting pressure of quail and waterfowl is confined to jumpshooting along the channel and adjacent flood plain. Wildlife resource areas in the watershed are used moderately by local sportsmen.

Bank fishermen fish the stream from the junction with the Tennessee River upstream to the vicinity of Robertson, which is a distance of about 2 miles.

WATERSHED PROBLEMS

The primary problem along Sweetwater Creek is severe flood damage to urban and farm areas from overbank flow. The total average annual flood damage without project conditions is estimated to be $198,900, table 5. The average annual flood damage to crops and pasture values is $26,900; roads and bridges, $10,800; other agricultural, $1,500; urban property, $123,700; and indirect, $36,000.

Floodwater Damage

Floods large enough to be mentioned in newspaper accounts have occurred 20 times since 1875. The largest known floods on Sweetwater Creek occurred on February 23, 1875, January 10, 1946, and March 12, 1963. These three floods are remembered by the people in the valley as being the most devastating. The flood that occurred on March 12, 1963 as a result of 5.2 inches of rainfall in 20 hours was evaluated as a 70-year frequency storm.

High water marks and other information handed down from "oldtimers" indicate that flood crests are getting higher. The flood crest of the January 10, 1946 storm was 4 to 6 inches higher than the February 23, 1875 flood and the March 12, 1963 flood was 6 to 14 inches higher than the January 10, 1946 flood. People in the valley are now living in constant fear of the possible recurrence of a much larger flood.

A Knoxville paper, "The Press and Messenger", gave the following account of the February 23, 1875 flood:

> February 24
>
> "No trains arrived at or left the city yesterday, as was feared by the authorities of the East Tennessee, Virginia, and Georgia Railroad. The portion of the bridge over the Hiwassee at Charleston went into the river, one span going at one o'clock yesterday morning

and another at three o'clock. Besides this, two small bridges on Sweetwater Creek are gone. There is a fill 250 feet long washed out near Sweetwater. There are a number of slides and washes on the road both east and west of Knoxville, 25 breaks on the road being ascertained up to midnight.

February 25

The most destructive flood ever known here came upon us last night. Half of Sweetwater is inundated. Houses, fences, etc., are washed away. The railroad is seriously damaged above and below Sweetwater. Three bridges are washed away and the track is gone in several places. Near Reagans Station, about 150 yards of track is washed away.

February 27

The railroads all through this section have been badly damaged by the FRESHET. The passenger train on the East Tennessee, Virginia, and Georgia Railroad which left Knoxville on Wednesday morning for Chattanooga has been lying ever since at Athens, 56 miles from this city with 40 through passengers. The passenger train on the same road which left Chattanooga for Knoxville on Wednesday morning has been lying at Charleston, 41 miles from Chattanooga, since that day. West of Knoxville, the damage was more extensive and until the waters in Sweetwater Valley go down, it will not be possible to repair the breaks. In some of the cuts in the valley, the tracks are 15 and 20 feet under water...."

"The Sweetwater Valley News" gave the following account of the January 10, 1946 flood:

HEAVIEST RAIN IN 69 YEARS PARALYZES EAST TENNESSEE

"The worst rainstorm since 1875, according to oldtimers, hit Sweetwater and East Tennessee Monday and Tuesday of this week. Six inches of rain fell in 24 hours, according to an announcement from the Weather Bureau Office at Knoxville.

The rain started Monday morning and came down in a steady downpour. Practically every basement in Sweetwater was flooded. The highways were all under water and many tourists were stranded for the night, with the hotel and the hotel lobby full, and several homes being opened to the stranded visitors.

The Presbyterian basement was opened and accommodated about 65 residents who had to be moved from the lower end of town. Some of these were removed by trucks and at the end, a boat had to be placed in service to pull out a few last-minute victims that had been overlooked.

The Woolen Mill closed down at ten o'clock when the boilers were surrounded by water, and the employees had to be evacuated.

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Sweetwater was cut off from the outside as a result of stoppage of train service for 24 hours. A small bridge north of town was washed out and traffic was stopped until crews could repair the damage. The locomotive of a stranded freight train stood on a small bridge across Sweetwater Creek all night to keep the bridge from floating away.

The storm covered all of East Tennessee. Many places being hit as hard or worse than Sweetwater. Dayton was completely surrounded by water and dozens of families had to be taken to high ground. Thirty-six families living on lower ground had to be moved in Philadelphia.

Some farmers were hard hit; their planted crops being completely washed away together with valuable topsoil. The storm spared no one.

Luckily, Sweetwater has already been prepared for a catastrophe of this nature by the Red Cross. The town had already been organized and patriotic citizens assigned to certain duties in case of a need of this type. The citizens "fell to" like veterans and everything was handled in splendid shape. The State Guard was called out and assisted the police and the rescuers. Everything was done that could be done, and well done.

Tuesday, a representative of the Atlanta headquarters of the American Red Cross will send a caseworker into town and give assistance where assistance is vitally needed.

Wednesday morning Ol' Sol came out and has begun to do his duty. Now, if the rain stays away for a few days, we will eventually get out of the mud and back to normalcy."

Sweetwater Creek meanders through a comparatively broad, level flood plain in the cities of Sweetwater and Philadelphia. During the growth of the Sweetwater valley, the flat terrain between the creek and Southern Railroad has been extremely attractive to industrial, commercial, and residential development. It is evident that the present development in the flood plain has impaired the flood-carrying capacity of the natural valley. The encroachment on the natural waterway by adding fill material for commercial or industrial sites, roads, bridges, etc., is ever raising the height of flooding.

The highest monetary flood loss in the Sweetwater valley occurred March 12, 1963. About 165 individual parcels of industrial, commercial, and residential property and 2,500 acres of farmland were damaged. This flood caused an estimated 1.6 million dollars in damage. Many parcels of property flooded from a depth of a few inches to about four-and-one-half feet.

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"The Sweetwater Valley News" gave the following account of the March 12, 1963 flood in the March 14, 1963 issue:

FLOODWATER VICTIMS CLEAN UP AS WATER RECEDES

"Torrential Rain Floods Highways and Railroad, Damaging Homes and Stores.

Approximately 20 Sweetwater business firms and a large number of families started the tremendous task Wednesday of cleaning up after floodwaters from Sweetwater Creek reeked havoc with merchandise, buildings, and personal property Monday night.

Torrential rains throughout Monday night brought the creek rushing from its banks flooding a vast section of the city, and for all practical purposes, isolated the city from the rest of the world.

Business houses located on Highway 11 both north and south of Main Street as well as those on Highway 68 toward Madisonville felt the fury of the floodwaters. Approximately 40 families living in the creek section in the area near Madisonville and Vonore roads were forced to leave their homes during the night, leaving their furniture and clothing to the mercy of the rampaging waters.

First indication that flooding conditions were on their way came when the large drainage ditch which dumps tons of water into Sweetwater Creek near the intersection of Highway 11 and Oakland Road overran its banks, spilling water across the highway.

While a majority of the Sweetwater residents slept, the Monroe County Rescue Squad and the National Guard started the arduous task of awakening families in the lower section of the city and moving them to City Hall, the Armory, and the Methodist Church.

Estimates of damage run as high as $200,000 with Sweetwater Rug Company, a subsidiary of Carolyn Chenilles, recording the highest losses. According to one spokesman of the mill, damage to materials such as dyed yarn, rubberized rug matting, and other material used in manufacture of chenille rugs will run better than $50,000 besides the loss involved in the 3 or 4 days necessary to put the plant back into operation. Other places suffering considerable damage were Rose Feed Company, O. K. Jones, Inc., Loomis Packing Company, and Hicks Furniture Company. All businesses near these firms suffered water damage to some extent as the creek roared into buildings from all directions.

Tremendous as these losses were, those who felt the fury of the flood the most were the families living in that section on Vonore Road and Highway 68 near Carolyn Chenille. Most of these families

WATERSHED PROBLEMS
Sweetwater Creek Watershed, Tennessee

View of U. S. Highway 11 showing approach to the main business district, city of Sweetwater, from the south. About 30 inches of floodwater inundated road, Richesion Farm and Home Center, Sweetwater Auto Supply Company, and other commercial and residential property on March 12, 1963.

Photo courtesy Sweetwater Valley News.

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WATERSHED PROBLEMS
Sweetwater Creek Watershed, Tennessee

Flooding of Walnut Street in city of Sweetwater on March 12, 1963. About 2 feet of floodwater inundated the O. K. Jones Wholesale Company on the right, and Rose Feed Company and Gaston House on left. Main channel of Sweetwater Creek is to the right of Esso sign in background.

Photo courtesy McCrary Photographers.

WATERSHED PROBLEMS
Sweetwater Creek Watershed, Tennessee

Flooding March 12, 1963, of commercial property along Morris Street in the city of Sweetwater. Carolyn Chenille Industrial Plant is in background.

Photo courtesy Monroe County Agricultural Extention Agent.

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View of U. S. Highway 11 showing approach to main business district, city of Sweetwater, from north. About 30 inches of floodwater inundated road, Hicks Furniture Store, and other commercial and residential property on March 12, 1963.

Photo courtesy McCrary Photographers.

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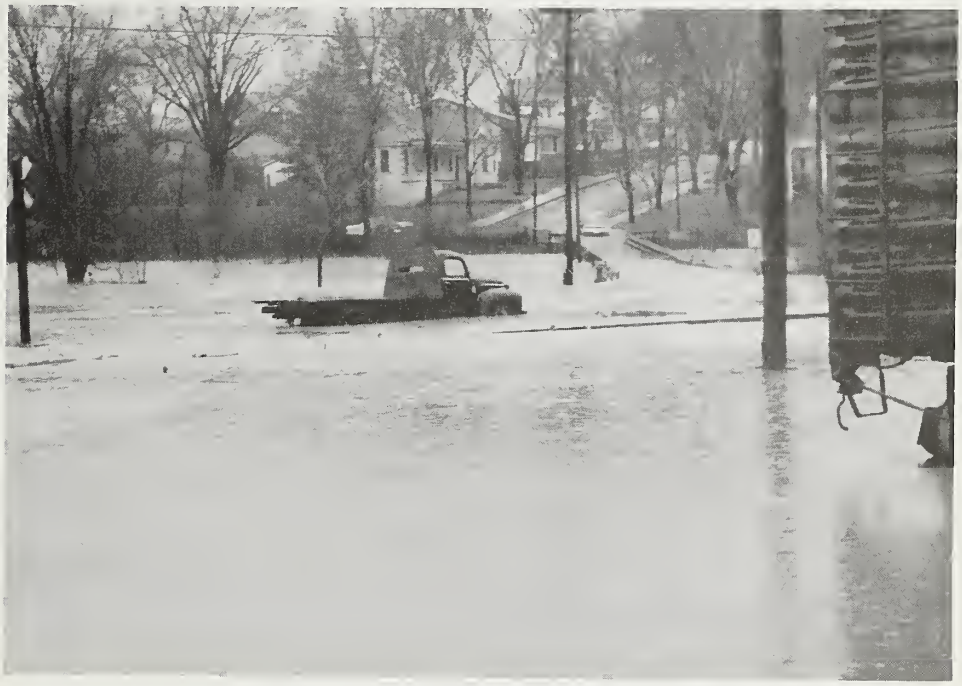
Flooding of commercial and residential property in Sweetwater along Vonore-Sweetwater County road in February 1961.

Photo courtesy Monroe County Agricultural Extention Agent.



Flood scene in Sweetwater March 12, 1963 as viewed from Tennessee Highway 68 showing the main north-south line of Southern Railroad covered as well as the highway.

Photo courtesy McCrary Photographers.

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Flood sale, clean-up, and repairs of Hicks Furniture Store in city of Sweetwater after overflow of Sweetwater Creek on March 12, 1963.

Commercial property damaged March 12, 1963 in Sweetwater as 24 inches of rampaging floodwaters inundated these buildings.

Photo courtesy Monroe County Agricultural Extention Agent.

WATERSHED PROBLEMS
Sweetwater Creek Watershed, Tennessee

Flooding in Philadelphia on March 12, 1963. Hosiery Mill and Warehouse is on the right, and Edd Knox home is on the left. Sweetwater Creek is in background and Bacon Creek is left of photograph.

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Flooding of homes and urban property in city of Philadelphia March 12, 1963. Homes from left to right are: Mrs. Lillie Johnson, Mrs. Harrison, Mrs. Bill Nelms, and Mrs. George Hickey.

Flooding March 12, 1963 of the homes of Mrs. Joe Clark and Rev. Tine Ratlige in the city of Philadelphia.

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Damage to Mrs. Bill Nelms' home and furniture in city of Philadelphia. Floodwater depth inside house on March 12, 1963 was about 18 inches.

Mr. Roy Bledsoe looking at damage to Mrs. Joe Clark's home and furnishings in the city of Philadelphia. Floodwater depth inside house on March 12, 1963 was about 30 inches.

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left all their clothing and furnishings in their homes as they were awakened in the middle of the night. The muddy water completely destroyed a vast majority of their belongings.

There was not much argument on the part of oldtimers concerning the "size of this flood". Most are in agreement that the city of Sweetwater has never had water this high before."

It is estimated that 2,750 acres of bottom land is subject to flooding by water originating from Sweetwater Creek and its tributaries. Land subject to flooding by small or medium storms is inundated on an average of three to four times a year.

In spite of the fact that the flood hazards depress land values, the average value of flood plain land is $400 per acre. Other land in the watershed averages about $500 per acre.

Crop damage realized by flooding is relatively minor due to the fact that the frequency of flooding has forced farmers to move most of their row crops to upland areas. Indicated land use under flood-free conditions is 30 acres tobacco, 483 acres corn, 350 acres silage, 1,030 acres pasture, 140 acres small grain, 85 acres woodland, and 382 acres miscellaneous. Estimates of yields indicate a per acre range as follows: tobacco, 1800-2300 pounds; corn, 80-90 bushels; silage, 14-16 tons; pasture, 6-7 AUM's; and small grain, 24-28 bushels.

Pasture and hay crops formerly grown on the uplands have, of necessity, been shifted to the flood plain. Deposition of silt on the foliage causes a delay in the use of pasture and lowers the quality of hay. Floods during the months of April and May delay land preparation and planting on flood plain lands. Floods that occur after normal planting time make it necessary to prepare a new seedbed before replanting. As a result, broken and uneven stands are obtained. Increased costs of production are incurred and crop yields are reduced.

Land use shifts necessitated by the flood hazards have depressed farm income. The elimination of crop and pasture losses are the primary objectives of the farmers.

Other agricultural damage within the flooded area consist of livestock losses; damage to fences, watergates, farm bridges, and damage to drainage systems by the accumulation of debris. The cost of repairing this damage is often higher than the complete replacement cost.

Damage to roads within the flood plain consists of shoulder scouring, silting of road drainage ditches, washed out segments of earth fill, loss of surface gravel, the breaking up of asphalt pavement, and roadbed erosion. Paved asphalt areas around stores and other commercial buildings are also damaged by the scouring action of the floodwaters.

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WATERSHED PROBLEMS
Sweetwater Creek Watershed, Tennessee

A typical scene of floodwater damage to on-farm bridges along Sweetwater Creek.

Typical health hazard and source of stream pollution after receding floods along Sweetwater Creek.

Southern Railroad and farm land covered by floodwater from Sweetwater Creek as viewed from U. S. Hwy. 11 looking south toward VS-56 and Sweetwater.

Photo courtesy Monroe County Agricultural Extention Agent.

Agricultural land flooded on March 12, 1963, as viewed from U. S. Hwy. 11 near Loudon and Monroe County line.

This isolated farm home is a common occurrence from flooding on Sweetwater Creek. This incident occurred in February 1961.

Photo courtesy Monroe County Agricultural Extention Agent.

Rampaging floodwater along Sweetwater Creek damages agricultural land. This scene frequents the valley as it did in February 1961.

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Photo courtesy Monroe County Agricultural Extention Agent.

Sediment Damage

The cultivation of rolling and steep uplands, the lack of adequate cover on some of the grassland, and poor hydrologic condition of woodland have contributed to sediment production in the watershed. Due to the karst topography in the area, some of this sediment is not delivered to the main stream but is deposited in topographic depressions in the upland areas. Much of the sediment delivered to the channel system is fine-textured and is carried as a suspended load out of the watershed. This suspended sediment load increases the turbidity of the stream and adds to the pollution problem.

Sediment deposition on the flood plain land is not a major problem. Only slight damage has occurred in the upper reaches of the flood plain area. Textural differences in the deposited sediment and underlying soils are insignificant and the only damage is caused by a slight reduction in fertility.

Erosion Damage

The continued cultivation of rolling and steep uplands, the lack of adequate cover on some of the grassland, and poor hydrologic condition of woodland have contributed to the loss of top soil in the watershed. Discounting the use of fertilizers, this loss of top soil has had the effect of reducing per acre crop and pasture yields. Upland sheet erosion ranges from slight to moderate. There are 200 acres of critical runoff and sediment producing areas in the watershed that are primarily raw and eroding gullies on open land.

Damage in the flood plain is caused by scouring or erosion during periods of overbank flow. The width and depth of the scour channels and the severity of the damage is related to the depth, velocity, duration, and type as well as the amount of ground cover at the time of flood flow. Soil materials have been completely removed in some places exposing the underlying bedrock. The effect of these scour channels has reduced the productive capacity of 102 acres of flood plain land. Due to this small area, the values were not considered to be significant in the overall evaluation. Also, some values were inseparable from floodwater.

Indirect Damage

Indirect damages are associated with the direct flood damages. The losses are less obvious but are just as real and their effects are felt long after the flood has subsided. Indirect damages that occur are a result of disruption of employment, loss of production during flood periods, interruption of the management, sales, etc., of products already manufactured, the disruption of traffic, mail delivery, and school bus service, delay and inconvenience to the traveling public, and the interruption of the management, feeding, disease control program, and marketing of livestock and livestock products.

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WATERSHED PROBLEMS
Sweetwater Creek Watershed, Tennessee

Erosion damage in main business district of Sweetwater to U. S. Highway 11.

Sediment and erosion damage to main business district of Sweetwater and Southern Railroad from flooding of Sweetwater Creek on March 12, 1963.

Problems Related to Water Management

Farm Drainage: Farm drainage is not a major problem; however, the deposition of silt and other debris along the banks of the main stream and some tributaries impedes the return of surface water into the main channel. The main stem and most tributary channels have more than adequate capacities and depths for present drainage requirements but lack sufficient capacities for flood prevention.

Irrigation: Normal rainfall provides moisture for good production of the present crops throughout the watershed. At the present time, under normal weather conditions, no project action is needed to provide additional sources of water for use in crop irrigation. There is a need for additional farm ponds to facilitate an increase in the level of livestock and pasture management.

Municipal and Industrial Water: The sources of municipal and industrial water in the past have been adequate. However, at the present time, the source of water for municipal and industrial use appears to have reached a peak capacity. Under present trends of industrial development in and around the towns of Sweetwater, Philadelphia, and Loudon, a new source of water will be needed. Plans are now underway to tap Watts Bar and Tellico reservoirs as a new source of water for industrial use. The new source of water (Watts Bar and Tellico reservoirs) being planned by the three towns is not a part of the Sweetwater Creek Watershed Work Plan.

Fish and Wildlife: Water pollution appears to be detrimental to the fish habitat in Sweetwater Creek. Municipal and industrial development in and around the towns of Sweetwater and Philadelphia are considered to be the main sources of pollution in the downstream areas of the watershed.

Recreation: Farm ponds and a few private lakes are the only sources of water-based recreation within the watershed; however, excellent fishing and hunting is available within a 20-mile distance from the watershed area. These facilities include, but are not limited to, Chickamauga and Watts Bar Lakes on the Tennessee River, Tellico Plains Hunting Preserve, and other wildlife areas in and near the Great Smoky Mountains.

There are 111 miles of trout streams in the Tellico Wildlife Management Area. These streams are intensively managed through the efforts of a trout biologist. A full-time rearing station, located at Pheasant Field, is operated by the State Game and Fish Commission for the sole purpose of stocking these streams. Long-range fish management plans for the Tellico Wildlife Management Area call for additional raceways and pools, plus more intensive stocking of adult trout. The warm water streams of this area also receive considerable attention from the biologists in the management of warm water species, such as smallmouth bass, rock bass, and bream.

Monroe County, which includes 47 percent of the Sweetwater Creek Watershed, is one of the few counties in the nation where the famous Russian wild boar is hunted.

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The game and fish management program on the Tellico Wildlife Management Area is a cooperative effort between the Tennessee Game and Fish Commission and the U. S. Forest Service. Deer, bear, and boar are also available to hunters during the open season in the mountainous areas outside of the Tellico Wildlife Management Area. Small game such as rabbit, quail, and squirrel are hunted on the farms and in the woodlots throughout the area.

Forestry: About 20 percent or 7,543 acres of the watershed is forest land. Based on five hydrologic classes, the hydrologic condition is good, 5 percent; fair, 24 percent; poor, 42 percent; and very poor, 29 percent. Over-grazing, burning, over-cutting, and past cultivation of lands which are now forested have contributed to poor hydrologic conditions.

PROJECTS OF OTHER AGENCIES

The Sweetwater Creek Watershed is located in the Tennessee River Basin and comes under the purview of the Corps of Engineers, Nashville District, and the Tennessee Valley Authority. This watershed work plan has been coordinated with these agencies.

There are no other water resource development works of improvement (County, State, or Federal) now under construction or planned for future construction that will affect or be affected by the works of improvement included in this plan.

The Tennessee Valley Authority, at the request of the City of Sweetwater, has developed a plan for the 3.2 miles of channel improvement to provide flood relief for the city. The TVA project is being held in abeyance at the request of the sponsors.

The City Council of Sweetwater has done some stream channel improvement work within the city limits on at least three different occasions in the past 20 years. Following the 1946 and 1947 floods, the creek through the city was cleared of debris in order to improve the carrying capacity of the stream. All tree growth, vegetation, and other debris was destroyed or removed from the channel. After the 1951 flood, another attempt was made to improve the channel by dredging and other improvement work. After the March 12, 1963 flood, more channel improvement work was done including the construction of a new channel extending from the Southern Railroad to the Vonore Highway. These channel improvements have been beneficial, but this work is more effective on small floods. The improvements are not sufficient to materially affect the height of larger floods such as that of January 10, 1946 and March 12, 1963.

PROJECT FORMULATION

An intensive investigation was made to determine the location, frequency, and causes of damages in the watershed before any attempt was made to propose works of improvement that would reduce or eliminate the damage. The Soil Conservation Service discussed the nature of these damages with

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the local sponsoring organization so there would be a common understanding of the type and degree of protection that might be expected from any proposed flood control program.

Project formulation was based on the objectives agreed upon which are: (1) to accelerate the rate of establishing soil and water conservation measures, to improve the ground cover conditions, to stabilize all critically eroding areas, and to reduce runoff; (2) to reduce annual crop and pasture damage about 75 percent on the flood plain so that the farmers may enhance their income; and (3) to reduce or give protection to the highly damaged area from the 100-year frequency flood in the cities of Sweetwater and Philadelphia.

Land treatment measures were considered and agreed upon in project formulation on the basis that they will: (1) be effective in reducing erosion damage on existing cropland; (2) reduce runoff and sediment production that would adversely affect the operation and maintenance of the proposed works of improvement; (3) assure the realization of benefits used in justification of structural measures; and (4) increase the efficiency of land use.

In project formulation, a forest management program was developed from a field survey of the watershed and aimed at fulfilling watershed needs and objectives including: (1) forest lands be managed to fulfill timber, wildlife, and recreation needs; (2) to maintain hardwood on hardwood sites, and to encourage pine-hardwood mixtures on pine lands, and (3) maintain a balance between food-bearing, den, and potential timber trees.

The selection of structural works of improvement were guided by the objectives of the sponsoring local organizations, physical characteristics of the watershed, and appropriate engineering criteria. The size and location of the floodwater retarding structures were influenced by the level of protection needed to meet project goals; flood plain areas needing protection; and obstructions such as highways, county roads, farmsteads, and other developments.

Twenty-one floodwater retarding structure sites were selected for evaluation and included sites on Bacon Creek, Pleasant Run Branch, Dry Valley Creek, and all other major tributaries. Six combinations ranging from four to twenty-one floodwater retarding structures with channel improvement were studied. All sites below Philadelphia were dropped due to the lack of economic justification. The site on Bacon Creek was dropped due to a telephone coaxial cable and other fixed improvements. An alternate site on Rausin Creek was dropped since it did not significantly affect flood reduction in Philadelphia.

In the final analysis of project formulation, the local sponsors were in agreement that nine floodwater retarding structures with channel improvement would meet their objectives. The sponsors and the Soil Conservation Service are in agreement that the structural program consisting of nine floodwater retarding structures and stream channel improvement is economically sound and feasible and is the best combination of those studied. In determining the overall structural program, consideration

was given to incremental benefits, costs, and degrees of protection.

In the cities of Sweetwater and Philadelphia, the channel has been designed to be compatible with structural control, economical flood reduction, location of the sewage disposal pipeline, size and location of bridges, and cost of excavation. Generally, the depth of this channel will be confined to the rock elevation of the present channel bottom.

As a part of the preliminary plan, structure sites were investigated to determine their feasible adaptability as a new source of municipal and industrial water for use by the cities of Sweetwater and Philadelphia. After the investigations were made, the sponsors decided that the cities of Sweetwater and Philadelphia would tap Tellico and Watts Bar reservoirs as demands for municipal and industrial water develop.

WORKS OF IMPROVEMENT TO BE INSTALLED

The planned works of improvement to be installed are: (1) the application of needed conservation measures on 14,915 acres of land; (2) the stabilization of about 200 acres of critically eroding uplands by land treatment; (3) the installation of nine floodwater retarding structures, and the improvement of about 223,600 feet of stream channel for flood prevention.

The kinds of measures, quantities, and distribution of installation costs (P. L. 566 funds and Other funds) for the total project are shown on table 1, page 50.

Land Treatment Measures

The land treatment measures to be installed on 15,115 acres of land will have a measurable physical effect on the watershed. These measures will improve the hydrologic condition, decrease runoff, erosion and sediment production, and assure the realization of benefits used in project justification. These planned land treatment measures will be installed at an estimated cost of $788,000. (table 1, page 50).

Conservation planning is a prerequisite to successful application of a soil and water conservation program. Technical assistance will be provided to landowners for planning and applying land use adjustments.

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The adjustments, together with conservation and management practices, will be worked out with the individual farmers and landowners in harmony with the overall land use and water management plan for the watershed. The resulting Conservation Plans will be in accordance with needs for sustained productive use of the land.

Soil surveys in the McMinn and Loudon County portions of the Sweetwater Creek Watershed are complete. The remaining portion in Monroe County will be mapped in an accelerated program.

Alternative measures and land uses will be in keeping with standards used in obtaining effective soil and water conservation as outlined in the SCS Work Unit Technical Guide. Alternative land use and conservation measures that are necessary and justifiable for the conservation, development, protection, and improvement of the individual farms may be installed.

The conservation measures planned on 4,570 acres of cropland will consist of suitable combinations of conservation cropping systems, contour farming, strip-cropping, grassed waterways, and diversions on the upland or surface field ditches, diversions, row arrangements, and drainage mains and laterals on the flood plain.

The treatment of 7,000 acres of grassland will consist of land use conversions and establishment on 2,440 acres of idle or cropland to permanent type pasture or hayland; and renovation of 4,560 acres of pasture and hayland. Other alternative combinations of measures to achieve adequate treatment such as grassed waterways, pasture and hayland management, drainage or diversions will be used. About 82 farm ponds will be constructed to complement pasture management.

Forest land treatment measures will consist of tree planting on 455 acres of idle or open-land to improve watershed conditions by land use conversions; reforestation of 1,400 acres of understocked forest land to adjust land use within capabilities; and stand improvement measures on 1,400 acres of forest land to improve hydrologic conditions by manipulation of stand composition and density.

A forest management program aimed at fulfilling watershed needs and objectives will be followed. The forest lands will be managed to fulfill timber, wildlife, and recreation needs to the extent that such management is compatible with sound watershed management. The aim will be to maintain hardwood on hardwood sites and to encourage pine-hardwood mixtures on pine lands. A balance will be maintained between food-bearing and den trees, and potential timber trees.

Accelerated technical assistance will be provided for consultive services to assist the landowners of the Sweetwater and Philadelphia communities in planning needed forestry measures for special problems generated by urban development in the forested areas. This service to landowners could include information on how to select trees to leave during urban development, as

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well as how to protect these trees during and after urban expansion.

The stabilization of critically eroding upland will consist of about 150 acres of vegetative planting of perennial grasses and legumes and about 50 acres of tree planting. The vegetative plantings will consist of the establishment of fescue, sericea, or any other suitable vegetation by seeding, mulching, liming, and proper management. The seeding will be done in conjunction with shaping and preparation of an adequate seedbed with regular farm machinery and/or heavy equipment.

The tree planting will be loblolly pine or other soil stabilizing species. Protection from fire and limited or controlled grazing will insure success on this area needing heavy vegetative treatment.

The wildlife needs of food, cover, and water will be provided as a part of the adjustments in land use and land treatment program in the watershed. Individual landowners will be provided technical assistance in planning and carrying out practices that will enhance the supply of wildlife food and cover on the farms. A timber management program which favors woodland wildlife habitat will be encouraged and recommended. Wildlife habitat improvement will include the establishment of plantings for food and cover along field borders, stream banks, drainage ditches, fences, and other open areas.

The land treatment measures to be installed will meet the needs, desires, and objectives of the individuals and will vary with the land use, economic conditions, acreage controls, customs, trends, conservation needs, and flood reduction.

Structural Measures

The planned structural works of improvement are nine single-purpose floodwater retarding structures and approximately 223,600 feet of stream channel improvement.

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The nine floodwater retarding structures will detain 3.68" (2904 ac.ft.) of runoff from 25 percent of the watershed area. All structures are designed to provide storage for the 100-year sediment accumulation. Each earth structure includes a reinforced concrete riser and pipe conduit. The riser will be built initially to the elevation of the 50-year submerged sediment pool at all sites except sites 1, 3, and 4. The two-stage risers planned at sites 3 and 4 will be built to planned height with orifices set at the 50-year submerged sediment storage elevation. The impoundment created at site 1 by the 50-year sediment storage was unsatisfactory due to shallow depths at the shoreline; therefore, the elevation of the sediment pool was raised above the 50-year sediment level to elevation 952.5 (MSL) which is more compatible with reservoir storage characteristics and to create a more desirable impoundment. This change was approved by the State Conservationist.

Each dam will have an emergency spillway excavated in earth. A section of a typical floodwater retarding structure is shown on the inside of the back cover, and design data is shown on table 3, page 53.

The floodwater retarding structures will be constructed primarily from low plastic clay materials. Sufficient quantity of fill material is available within reasonable haul distances from the structures. Foundations for the structures are limestone and/or dolomite. Limited investigations revealed that extensive foundation treatment may be required to insure safe structures. A grouting program as well as blanket or rock toe drains may be required as portions of the overall foundation treatment program.

Fescue or other suitable vegetation will be established on the dams, borrow areas, emergency spillways, and other areas disturbed during construction. Plantings will be made on adequately prepared and fertilized seedbeds and will be protected from overgrazing.

Embankments and emergency spillway areas will be fenced, as needed, to provide protection from overgrazing. Costs of the fence installation will be borne by P. L. 566 funds.

The watershed district will make all the provisions and provide the funds to raise, relocate, or abandon all roads located within the easement areas of the floodwater retarding structures. These funds have been included in the land rights cost (table 2). Costs are included for the relocation, modification, or alteration of a barn, 3,200 feet of utility line, and 6,600 feet of gravel road involved in structure sites No. 3, 4, and 15.

Channel improvement will be installed on approximately 223,600 feet of stream channels within the Sweetwater Creek Watershed. This improvement will consist of approximately 96,600 feet of channel excavation or enlargement and about 127,000 feet of clearing and snagging. The excavation is confined almost entirely to the main stream and is composed of all reaches from VS-25 to VS-79 as shown on the project map.

Excavation will be performed on Lateral "B" and a short segment of Bacon Creek. The segment of Bacon Creek will extend from its confluence with Sweetwater Creek to the first road above Highway 11 at Philadelphia. Clearing and snagging will be performed on the remaining portion of the

Bacon Creek and on all other tributaries as shown on the project map. Very minor tree and drift removal will be performed from VS-79 to the Sweetwater Creek outlet.

The presence of limestone bedrock, sewer crossings, and bridge openings limits the amount of stream channel improvement that can be economically installed beyond that included in this plan. Isolated segments where rock ledges exist will need to be removed to maintain uniform channel flow characteristics.

The following procedure was used to determine the design discharge as shown in table 3A between valley cross-sections shown on the project map. The main channel from VS-25 to Lateral D was designed to carry approximately the peak flow from the 1-year, 24-hour storm with the structures in place. From Lateral D to approximately 500 feet below VS-75, a uniform 28-foot bottom width channel was designed with depths conforming approximately to the existing channel bottom grade. This reduced the amount of rock excavation required and eliminated the need for major bridge alterations. The actual design discharges were then determined from computed water surface profiles assuming the improved channel to be in place.

Some backwater may be experienced during large flood flows and the effects were evaluated. They were determined to be minor in comparison to the cost for bridge alterations necessary to eliminate this effect. This emphasizes the need for proper channel maintenance, especially through the urban area of Sweetwater.

The channels from approximately 500 feet below VS-75 to about VS-79 on the main stream and from the confluence of Sweetwater and Bacon Creeks to the first road above Highway 11 on Bacon Creek were designed to carry the expected peak flows for the 100-year frequency storm with both the structures and improved channels in place. The hydraulic grade lines of the water surface elevation in Philadelphia as shown in table 3A are above the low ground elevations. It was assumed that the valley in Philadelphia could be utilized for future development if it is filled to the elevation given in table 3A. Improvement on the remaining portion of the main stream to the outlet will consist of only minor tree and drift removal.

Design peaks for all tributaries, including the remaining portion of Bacon Creek, were determined from water surface profile computations using "aged n" values of 0.045 to 0.055 depending on the estimated future channel conditions.

Public Law 566 funds are included in the construction costs for lowering and underpinning the railroad culvert on Bacon Creek at Philadelphia as a result of deepening the channel.

Fescue or other suitable vegetation will be established on all improved stream channels requiring excavation. Spoil material from excavation will be shaped or spread adjacent to the channel and fescue or suitable vegetation will be established as needed. Planting will be made on adequately prepared and fertilized seedbeds and will be protected from overgrazing.

Where practical, existing cover will be retained on the channel to protect the stream fishery habitat below Philadelphia.

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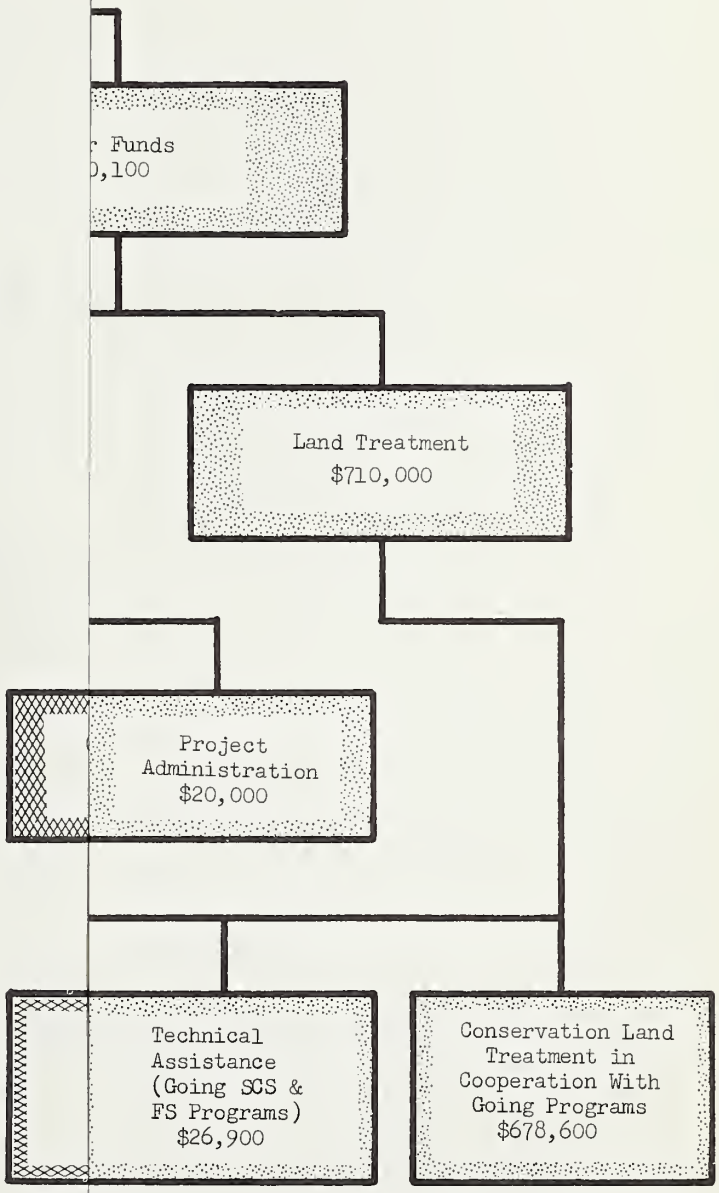
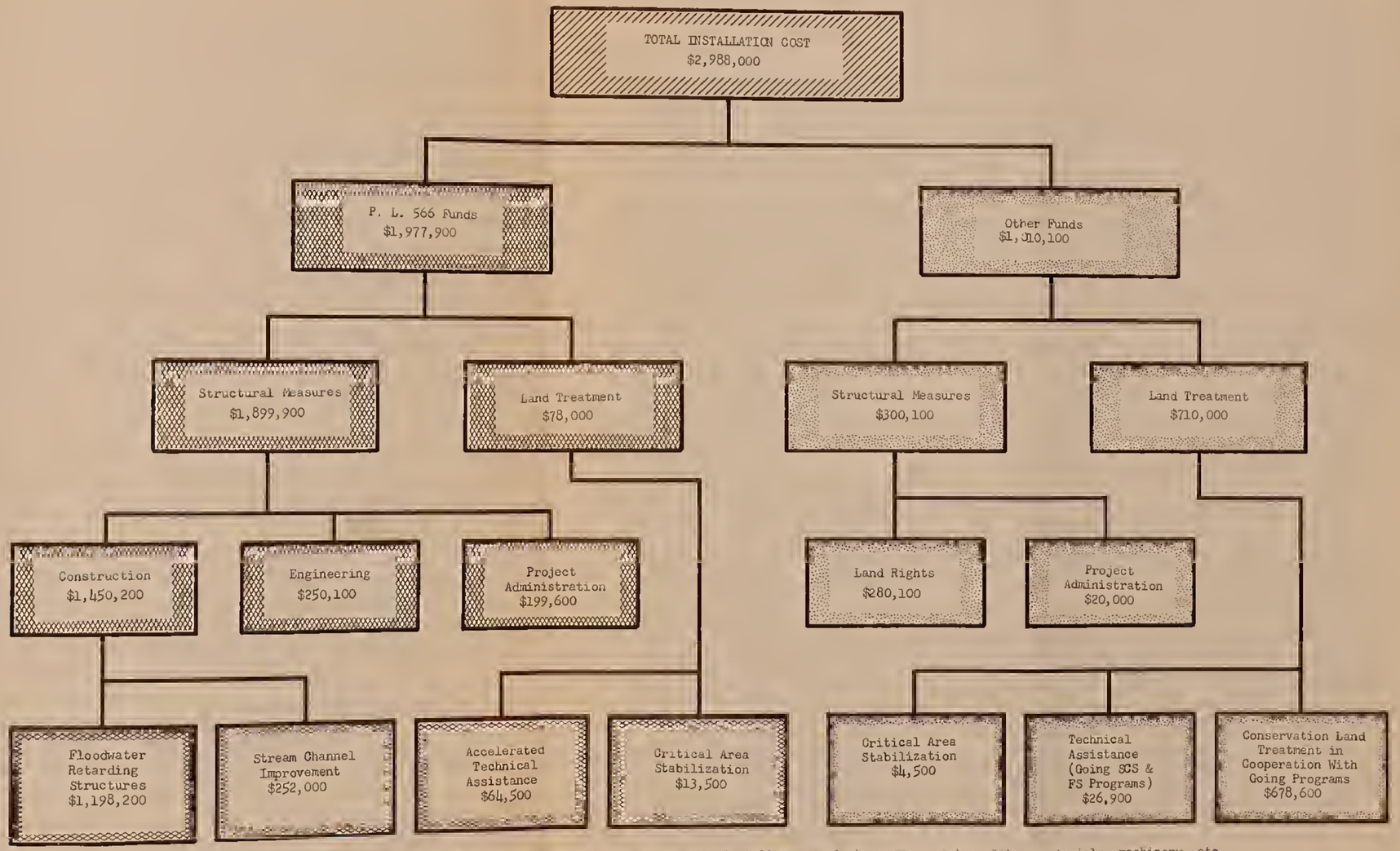
vill be P. L. 566 funds,
st as outlined in table 1.



materials, machinery, etc.

EXPLANATION OF INSTALLATION COSTS

The total estimated installation cost of the project is $2,888,000, of which $1,977,900, or about 68 percent, will be P. L. 566 funds, and $910,100, or about 32 percent, will be Other funds. The following chart illustrates the distribution of cost as outlined in table 1.



These estimates represent all of the direct and indirect cost items to install the project measures such as labor, materials, machinery, etc.

SWEETWATER CREEK WATERSHED

URBAN FLOOD PLAIN

CITY OF SWEETWATER

MONROE COUNTY, TENNESSEE

500 0 500 1000 1500

Scale in Feet

Land Treatment Measures

The land treatment measures have an estimated installation cost of $788,800--Public Law 566 funds will furnish $78,000 and Other funds will furnish $710,000.

The distribution of the critical area land treatment costs follow:

ITEM	ESTIMATED COST	
	P. L. 566 Funds	Other Funds
Critical Area		
Vegetative	$17,900	$4,000
Tree Planting	2,500	500

The critical areas to be treated by vegetative measures will be installed by a division of work. The costs for P. L. 566 funds include $5,900 for technical assistance to be furnished by the Soil Conservation Service to install the vegetative measures and $1,000 provided by the Forest Service for planning and applying the critical area tree planting.

The forest land treatment program, except critical area tree planting, has an estimated installation cost of $68,900. The cost of technical assistance is estimated to be $7,900. Of this, $6,300 will be provided under P. L. 566; the U. S. Forest Service, by and through the Tennessee Division of Forestry, will provide $1,400; and the going Cooperative Forest Management Program will provide services valued at $200. The landowners and operators will furnish about $61,000 for installation of the measures.

All other land treatment has an estimated cost of $694,200; $642,900 will be Other funds and $51,300 will be P. L. 566 funds for accelerated technical assistance which includes about $6,500 for soil surveys and about $44,800 for the preparation and application of basic farm conservation plans.

It is expected that financial assistance will be used as available through the Agricultural Conservation Program or other going programs.

The goals for land treatment measures were based on field surveys and were adjusted to meet expected landowner participation. Installation costs were based on prices paid by landowners.

The Tennessee Division of Forestry in cooperation with the U. S. Forest Service developed the installation cost to be used in the private land phase of the forestry programs. Technical assistance costs were based on the present cost of the going Cooperative Forest Management Program.

Structural Measures

The installation cost for the nine floodwater retarding structures is estimated to be $1,559,300. The cost of construction and engineering is

estimated to be $1,403,300 in P. L. 566 funds. The total construction cost is estimated to be $1,198,200, which includes $129,700 for contingencies. Land rights cost is estimated to be $156,000.

The total installation cost of 223,600 feet of stream channel improvement is estimated to be $421,100. This cost will include about $297,000 in P. L. 566 funds for construction and engineering. The construction cost is estimated to be $252,000, which includes about $27,000 for contingencies. It also includes $25,000 for lowering and reinforcing a railroad culvert at Philadelphia on Bacon Creek. Land rights cost is estimated to be $124,100.

Total project administration cost is estimated to be $219,600. This cost includes $199,600 in P. L. 566 funds and $20,000 in Other funds.

The following table is an estimated schedule of funds for the 4-year project installation period and covers land treatment and structural measures. This schedule may be adjusted from year to year on the basis of any significant change in the plans of the cooperating parties or in view of appropriations.

SCHEDULE OF ESTIMATED INSTALLATION COSTS
Sweetwater Creek Watershed

Project Year	Estimated Cost (Dollars)		
	Non-Federal Land P. L. 566	Non-Federal Land Other Funds	Total
(1)	(2)	(3)	(4)
Land Treatment			
First	26,300	145,500	171,800
Second	19,400	211,700	231,100
Third	19,400	211,700	231,100
Fourth	12,900	141,100	154,000
Subtotal - Land Treatment	78,000	710,000	788,000
Structural Measures			
First	959,000	116,000	1,075,000
Second	405,000	60,000	465,000
Third	238,300	122,100	360,400
Fourth	297,600	2,000	299,600
Subtotal - Structural Measures	1,899,900	300,100	2,200,000
TOTAL PROJECT COST	1,977,900	1,010,100	2,988,000

EFFECTS OF WORKS OF IMPROVEMENT

The proposed works of improvement in the Sweetwater Creek Watershed constitute a needed and harmonious element in the overall economic development program for Monroe, Loudon, and McMinn Counties and the Appalachian Region. Installation of the project measures will directly benefit about 17,215 acres of land consisting of 2,500 acres of flood plain and 14,715 acres of upland. Economic benefits used in project

justification as well as the financial and technical assistance provided as a result of project installation will have a socio-economic impact on the community and surrounding Appalachian area by improving, conserving, and utilizing the available natural and human resources.

It is conceivable that the installation and development of this project will directly benefit thousands of people. Some of the people that will receive direct benefits from the project's development and installation are those who live, seek employment, or trade within the watershed. Others are tourists and the traveling public that use U. S. Highway 11 and the people who depend on the Southern Railroad as a means of transportation, or as a common carrier, of supplies and products. It is estimated that 14,000 tax-paying citizens now occupying or utilizing some 300 farms and about 165 parcels of industrial property will be directly benefited.

It is estimated that crop and pasture damage will be reduced about 80 percent on the 2,500 acres of flood plain directly benefited; other agricultural damage, 80 percent; road and bridge damage, 94 percent; indirect damage, 95 percent; urban property damage in Sweetwater, 96 percent; and urban property damage in Philadelphia, 99.9 percent.

After the project is installed, damage sustained by homes, commercial and public properties in the flood plain of Sweetwater Creek at Sweetwater will essentially be eliminated from a flood of March 12, 1963 magnitude. The sewage treatment plant located in the low-lying area downstream from the main business district of Sweetwater could receive some degree of damage should another flood of the March 12, 1963 magnitude occur. The area of flood plain below the elevation of the sewage manholes will be inundated by a 100-year frequency flood as indicated by the Sweetwater Urban Damage Map, page 68.

Since a higher degree of protection cannot be economically justified due to railroad bridges and a sewerline, plus rock excavation, the sponsors plan to prevent to the extent possible, development (both reconstruction and new) in the area subject to flooding by the 100-year event. This can be accomplished by flood plain zoning and to publicize the area subject to flooding by the 100-year event at least once annually.

Damage sustained by homes, commercial, industrial, and public properties in the flood plain of Sweetwater Creek at Philadelphia will be essentially eliminated from the 100-year frequency flood. The low-lying area of flood plain along the creek will still flood as indicated on the Philadelphia Urban Damage Map, page 69. Proper flood plain zoning should be recognized and enforced. Development or enhancement of this flood plain will be dependent upon filling the low-lying area.

The application of proposed conservation measures and improvement of natural resources on about 15,115 acres is in the public and private interest. All lands within the watershed are eligible for assistance under the going and accelerated conservation program. The objective of individual farmers, especially those of low income, is to improve their socio-economic position by developing a long range plan that will result in the highest net family income. The plan would be based on production

alternatives that will provide the most productive use of land, labor, capital, and management.

The application of conservation measures will provide more adequate cover, improve infiltration and physical conditions of the soil, contribute to the control of excessive runoff, reduce erosion and sediment production, increase income potential, and aid in maintaining the effectiveness of group facilities.

Benefits will accrue to the stabilization of about 200 acres of critically eroding uplands for which treatment is beyond the economic capabilities of the individual farmers. These benefits will accrue to the national interest perpetually as the preservation and beautification of natural resources and to the public interest as a reduction in net loss to farm returns that cannot be recovered by alternative means, and to the individual farmer as an increase in net income.

The protection afforded by the project will permit land use adjustments of the flood plain and upland. Estimates indicate that there will be no increase in the total acreages of allotted crops within the watershed. Future land use is estimated to be:

Land Use	Acres	Percent
Cropland	10,635	28
Grassland	15,725	42
Woodland	8,171	22
Miscellaneous Use	3,109	8
TOTAL	37,640	100

Increased urbanization will cause urban and suburban fringes to encroach upon areas in this watershed that are now in agricultural production. Improved technology and the pressure from an increasing population will encourage increased agricultural production. Cost-price relationships will encourage shifts in land use as values of existing development increase because of new products and a higher standard of living.

Local secondary benefits will accrue in the watershed and surrounding area due to the installation of project measures. Goods and services produced by the project will tend to stimulate local activity on a permanent basis. Products produced will require additional services from within the area.

Profits will be realized from the sale of agricultural products by dealers and processors not directly benefited. Expenditures of management inputs such as fertilizer, seeds, machinery, and other needed materials will provide added profits to those who supply these additional materials and services.

Reduction in the flood hazard will permit farmers to use improved management technology. The protection afforded will stimulate the farmers to increase their management inputs, such as, to fertilize more efficiently, establish more effective on-farm drainage systems, use

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improved varieties of seed, and use a more effective insect control program. Farm income will be enhanced due to decreased unit cost of production, increased mechanization and efficiency when acreages of row crops are moved from the uplands to the fertile flood plain.

A complete soil and water conservation program can supply the food, cover, and water necessary to support many species of wildlife, and in return, the overall conservation program could benefit from the presence of wildlife. Land primarily used for cropland, pasture land, and woodland can produce wildlife as a by-product. Planned areas for wildlife habitat development on single farms will help make the farms efficient units for the production of both crops and wildlife. The construction of floodwater retarding structures and farm ponds, stream bank vegetation, and the stabilization of critically eroding areas can contribute to the increase in the amount of wildlife habitat.

Benefits will accrue due to the financial and technical assistance made available by the installation of the watershed project. The project will bring outside resources into the community and will provide an opportunity to use goods, services, and labor available in the local area.

PROJECT BENEFITS

The average annual benefits used in justification of the project are estimated to be $216,700, table 6.

The average annual flood damage without the project is estimated to be $198,900 and the estimated benefits from flood damage reduction are $187,100, table 5. These benefits consist of reduction in damages as follows: crop and pasture, $21,700; other agricultural, $1,200; urban property in Sweetwater, $93,800; urban property in Philadelphia, $18,700; rural property, $7,300; road and bridge, $10,100; and indirect, $34,300. The benefits from more intensive land use were not estimated but will accrue to agricultural land as a result of flood prevention.

The value of local secondary benefits that will accrue in the watershed and surrounding area due to project installation amounts to $14,700. The value of secondary benefits from a national viewpoint was not considered pertinent in the economic evaluation or justification of this project.

Redevelopment benefits were evaluated and amount to $22,100 annually. These benefits will accrue to the local economy from the values of local labor, services, materials used during project installation, and operation and maintenance throughout project life. Annual operation and maintenance costs on a descending scale for the first 20 years after project installation were used in project justification.

Research and experience have demonstrated that the combined private and public benefits derived from land treatment measures will exceed their cost of installation. Physical effects of land treatment measures included in this plan were estimated but no specific determinations of monetary benefits from the installation were made for their economic justification. Annual benefits accruing as a result of the installation

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of land treatment measures for watershed protection or flood prevention were not used in the economic justification of floodwater retarding structures or stream channel improvement.

COMPARISON OF BENEFITS AND COSTS

The proposed nine single-purpose floodwater retarding structures and 233,600 feet of stream channel improvement will be installed, operated and maintained at a total average annual estimated cost of $114,775. The average annual benefits used in project justification are estimated to be $216,700, which include local secondary benefits of $14,700, accruing within the zone of influence of the project. The benefit-cost ratio accruing as a result of total project benefits is 1.9 to 1.0, and the benefit-cost ratio without secondary benefits is 1.8 to 1.0.

PROJECT INSTALLATION

The sponsors of the Sweetwater Creek Watershed project plan to install the land treatment and structural measures during a 4-year period. Land treatment measures will be voluntarily planned and applied by the landowners in cooperation with the going and accelerated program of the Monroe, Loudon, and McMinn County Soil Conservation Districts. The Soil Conservation Service will provide technical assistance for the preparation and application of basic conservation farm plans and will accelerate the technical assistance to the going district programs from P. L. 566 funds.

The Monroe, Loudon, and McMinn County Soil Conservation Districts will obtain agreements from farmowners and operators to carry out conservation farm plans on not less than 50 percent of the land in the drainage area above the floodwater retarding structures. These agreements will be obtained prior to P. L. 566 funds being provided for construction of the works of improvement.

The U. S. Forest Service, by and through the Tennessee Division of Forestry, will provide the landowners assistance in applying and maintaining the forestry measures for good watershed management. Improved protection from fire will be necessary on many areas to insure the success of watershed forestry measures. A forester with training in watershed management will be assigned to advise and assist the sponsors in forestry management measures. During the installation of the watershed project, the going Cooperative Forest Management Program will be continued at its present level. An estimate of the State-Federal matched funds to be used for this going program is included in the Other cost of forestry technical assistance shown on table 1.

The Sweetwater Creek Watershed District will be responsible for installing the critical area plantings. The critical area treatment will consist of measures to stabilize or control high runoff and sediment producing areas. Emphasis will be placed on installing these measures during the first two project years. Technical assistance needed to apply

these measures will be provided by the Soil Conservation Service and the U. S. Forest Service. P. L. 566 funds will be used to pay for this assistance.

About 150 acres of critically eroding uplands will be vegetated with grass and/or legumes. The plantings will include fescue, sericea, or any other suitable vegetation. The seeding will be on a well-prepared, adequately treated seedbed to insure good stands. Fertilizers, lime, mulching, and other management practices will be used as needed to revegetate eroded areas.

The funds from P. L. 566 for the installation of the critical area vegetative planting will be used to furnish heavy equipment hire, as needed, such as bulldozers for shaping and to furnish planting materials to include seed, fertilizer, lime (to include spreading), mulch, and other similar materials, including delivery to a central location within the watershed. The local sponsors will furnish all other items required to prepare an adequate seedbed and to establish vegetation which includes, but is not limited to, labor, farm tractors, machinery, and transportation of materials within the watershed.

Trees will be planted on about 50 acres of critically eroded soils. These plantings will be established by the local sponsoring organizations and the U. S. Forest Service. Site preparation and fencing are included in the reforestation measures when required to assure success of tree planting.

The critical area tree planting may be installed by any method agreeable to the sponsoring local organization and the U. S. Forest Service. The sponsoring local organization will enter into a two-way agreement with the U. S. Forest Service to install the critical area tree planting measures on private land. This agreement will designate responsibility for accomplishing the plantings.

Prior to providing financial assistance from P. L. 566 funds for the construction of any planned structural measure, at least 75 percent of the effective land treatment measures must be installed or their installation started on critical sediment source areas, which, if left uncontrolled would require a material increase in the cost of construction, operation, and maintenance of the structural works of improvement.

The Sweetwater Creek Watershed District has legal authority to raise funds through assessments levied by the County Court and the power of eminent domain to acquire all land rights needed for the project measures in flood prevention. This authority will be used as needed for the orderly progress in installing the planned works of improvement. The Sweetwater Creek Watershed District will obtain all land rights, contract for the construction of the structural measures, and be responsible for all costs in acquiring the needed land rights, administering contracts, and other project administration costs such as additional organizational, assessor, legal, court hearings, and other administrative costs.

The Soil Conservation Service will provide technical assistance for design, preparation of specifications, construction inspection, final inspection,

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execution of certificates of completion and related tasks for the establishment of all planned works of improvement.

The roads within the pool area of the floodwater retarding structures will be raised or changed as agreed upon by the sponsoring local organization, the local branch of government responsible for the roads, and the Soil Conservation Service. The sponsoring local organization will be responsible for the disposition of these roads.

FINANCING PROJECT INSTALLATION

The Sweetwater Creek Watershed District was authorized by referendum on June 20, 1959, and was formed in accordance with the provisions of the Tennessee Watershed District Act of 1955, as amended. The District has completed its formal organization and has actively participated in the development of this watershed work plan. The major costs of organization have already been incurred and were locally financed. The watershed district will bear all costs of court hearings, assessor fees, and other project administration costs. This will permit operation under the Tennessee Watershed District Act of 1955, as amended.

The land treatment measures will be voluntarily installed by the landowners and operators at their own expense. Cost-sharing assistance available under the Agricultural Conservation Program or other going programs will be utilized in applying these measures.

All critical area treatment except critical area tree planting will be installed using P. L. 566 funds and Other funds by division of work. The ratio will not exceed that for similar measures under the current Agricultural Conservation Program in Tennessee.

The critical area tree planting will be cost-shared--75 percent P. L. 566 funds and 25 percent Other funds. This is the maximum cost-sharing ratio for similar measures under the current Agricultural Conservation Program in Tennessee.

The Sweetwater Creek Watershed District has initiated negotiations with the Farmers Home Administration by filing a letter of intent to finance their share of the project installation costs by utilizing the loan provisions of Section 8, P. L. 566, as amended, and is estimated to be $300,100. The district will repay their loan through an annual assessment levied by the County Court. The assessment will be determined so as to meet the loan repayment needs and the annual operating expense of the district. In addition, a maintenance assessment will provide the funds needed to adequately maintain the works of improvement.

Federal assistance for carrying out the works of improvement on non-Federal land, as described in this work plan, will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended. This assistance is contingent on the appropriation of funds for this purpose and the sponsoring local organizations meeting their necessary prior obligations.

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PROVISIONS FOR OPERATION AND MAINTENANCE

Landowners will be responsible for the maintenance of land treatment measures installed on their farms under agreement with either the Monroe County Soil Conservation District, Loudon County Soil Conservation District, or the McMinn County Soil Conservation District. The U. S. Forest Service, by and through the Tennessee Division of Forestry, will furnish the technical assistance needed to operate and maintain the watershed forestry measures under the going Cooperative Forest Management Program. Forest fire protection will be continued by the going Cooperative Forest Fire Control Program.

The Sweetwater Creek Watershed District, in cooperation with the three soil conservation districts, will be jointly responsible for the operation and maintenance of all critical area treatment. Most of the operation and maintenance will be carried out by the individual landowners in accordance with the provisions of their agreement with the soil conservation districts.

The watershed district will be responsible for adequately protecting, operating, and maintaining the floodwater retarding structures and stream channel improvement at a total estimated cost of $6,600 annually. The annual operation and maintenance cost is estimated to be $3,100 for the nine floodwater retarding structures and $3,500 for the stream channel improvement. The district will arrange with the landowners and operators for minor maintenance jobs to be done as a part of their regular farm operations, estimated to be $4,100 annually. The major maintenance jobs, estimated to cost $2,500 annually, will be accomplished by the district. The watershed district will provide, by annual assessment under the authority of the Tennessee Watershed District Act of 1955, as amended, whatever amount is needed for adequate maintenance.

Maintenance of the floodwater retarding structures includes performance of work and the application of measures to prevent deterioration as well as repairing damages after they occur. The cost can usually be minimized by performing maintenance when it is first needed. Maintenance of the structures will include, but may not necessarily be limited to, removal of debris from principal spillways, repair of fencing, keeping adequate vegetation on the dam and emergency spillway, restoring concrete that has deteriorated, restoring protective coatings to gates, valves, and metal, and other repair of damage that has resulted from flood events or vandalism.

The floodwater retarding structures will be maintained in accordance with regulations of the Tennessee State Department of Public Health.

The operation and maintenance of the improved stream channel will include, but may not necessarily be limited to, the removal of drifts and sediment bars from the channel and bridge openings and the controlling of obnoxious vegetative growth. Maintenance of improved channels is extremely important from the time of construction until adequate vegetation has been established. Although channel bottoms will be stable due to rock ledges,

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channel sides may experience some erosion. The sponsors plan to solicit the support of all landowners along the channel to report to them any unusual conditions that develop in the channel so that timely repairs and maintenance can be performed. The sponsors stand ready to provide assistance to state and county highway departments for protecting bridge abutments and piling that could influence the proper functioning of the channel.

A plan of operation and maintenance for the channel will be prepared and made a part of the basic operation and maintenance agreement as soon as detailed needs can be determined from the design. This plan will include regular inspections, reseeding significant areas of vegetation destroyed by erosion, cutting or spraying undesirable trees and shrubs, removing and disposing of silt or gravel bars, removing and disposing of debris, adding riprap, if needed, keeping access roads for maintenance in good condition, rehabilitating damaged pipe inlets from fields or side channels, and other items as needed to insure a stable channel that will function successfully.

The Service and the sponsors will make a joint inspection annually, or after unusually severe floods, for 3 years following installation of each structural measure. Inspection after the third year will be made annually by the sponsors and a report prepared by them with a copy to the Service representative.

The Sweetwater Creek Watershed District and the Service will execute specific operation and maintenance agreements prior to the issuance of invitations to bid on construction of any structural measure for flood prevention.

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TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Sweetwater Creek Watershed, Tennessee

Installation Cost Item	Unit	Number	Estimated Cost (Dollars) 1/		
		Non-Fed Land	P. L. 566 Funds	Other Funds	Total
			Non-Fed Land	Non-Fed Land	
(1)	(2)	(3)	(4)	(5)	(6)
LAND TREATMENT					
Soil Conservation Service					
Cropland	Acre	4,570	0	267,000	267,000
Grassland	Acre	7,000	0	301,000	301,000
Miscellaneous Land	Acre	90	0	49,600	49,600
Critical Area Vegetative Planting	Acre	150	12,000	4,000	16,000
Technical Assistance	xxxx		57,200	25,300	82,500
SCS - Subtotal		11,810	69,200	646,900	716,100
Forest Service					
Woodland	Acre	3,255	0	61,000	61,000
Critical Area Tree Planting	Acre	50	1,500	500	2,000
Technical Assistance	xxxx		7,300	1,600	8,900
FS - Subtotal		3,305	8,800	63,100	71,900
TOTAL - LAND TREATMENT		15,115	78,000	710,000	788,000
STRUCTURAL MEASURES					
Construction					
Soil Conservation Service					
Floodwater Retarding Strs.	No.	9	1,198,200	0	1,198,200
Stream Channel Improvement	Feet	223,600	252,000	0	252,000
Subtotal - Construction			1,450,200	0	1,450,200
Engineering Services					
Soil Conservation Service	xxxx		250,100	0	250,100
Subtotal - Engineering			250,100	0	250,100
Project Administration					
Soil Conservation Service					
Construction Inspection	xxxx		62,500	0	62,500
Other	xxxx		137,100	20,000	157,100
Subtotal - Administration			199,600	20,000	219,600
Other Costs					
Land Rights	xxxx		0	280,100	280,100
Subtotal - Other			0	280,100	280,100
TOTAL - STRUCTURAL MEASURES			1,899,900	300,100	2,200,000
TOTAL PROJECT			1,977,900	1,010,100	2,988,000
SUMMARY					
Total - SCS			1,969,100	947,000	2,916,100
Total - FS			8,800	63,100	71,900
TOTAL PROJECT			1,977,900	1,010,100	2,988,000

1/ Price base - 1968.

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT
Sweetwater Creek Watershed, Tennessee

Measures (1)	Unit (2)	Units Applied To Date (3)	Total Estimated Cost (Dollars) 1/ (4)
LAND TREATMENT			
Conservation Cropping Systems	Acres	2,960	35,500
Contour Farming	Acres	925	5,600
Cover & Green Manure Crops	Acres	820	20,500
Crop Residue Use	Acres	915	1,800
Diversion	Feet	7,200	600
Grass & Legumes in Rotation	Acres	2,550	30,900
Grassed Waterways or Outlet	Acres	149	14,900
Drainage Mains or Laterals	Feet	14,000	6,000
Mulch Planting	Acres	6	300
Plow Planting	Acres	10	500
Contour Stripcropping	Acres	240	4,800
Field Stripcropping	Acres	80	800
Drainage Field Ditch	Feet	7,550	500
Gradient Terraces	Feet	1,600	100
Tile Drain	Feet	1,150	1,000
Brush Control	Acres	2,210	8,800
Farm Ponds	Number	85	49,000
Pasture & Hayland Management	Acres	5,750	23,000
Pasture & Hayland Renovation	Acres	4,600	205,000
Pasture & Hayland Planting	Acres	5,300	222,000
Firebreak	Feet	6,500	100
Livestock Exclusion	Acres	4,760	23,800
Tree Planting	Acres	375	6,800
Improvement Cutting	Acres	865	4,300
Fishpond Stocking	Number	60	400
Fishpond Management	Number	25	300
Critical Area Planting	Acres	7	300
Hedgerow Planting	Feet	6,600	500
Stream Channel Improvement	Feet	7,400	1,900
TOTAL - LAND TREATMENT	xxxx	xxxx	670,000

1/ Price base - 1968.

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TABLE 2 - ESTIMATED STRUCTURAL COST DISTRIBUTION
Sweetwater Creek Watershed, Tennessee
(Dollars) 1/

Item	Installation Cost P. L. 566 Funds			Installation Cost Other Funds		Total Installation Cost
	Construction	Engineering	Total P. L. 566 Funds	Land Rights	Total Other	
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Floodwater Retarding Structures:						
1	379,100	67,700	446,800	64,800	64,800	511,600
3	116,900	19,600	136,500	9,600	9,600	146,100
4	148,200	23,800	172,000	21,600	21,600	193,600
11	130,800	20,400	151,200	8,100	8,100	159,300
14	95,400	17,000	112,400	12,300	12,300	124,700
15	103,300	18,100	121,400	13,200	13,200	134,600
16	69,400	12,400	81,800	6,600	6,600	88,400
17	75,800	13,500	89,300	9,000	9,000	98,300
18	79,300	12,600	91,900	10,800	10,800	102,700
Subtotal - Floodwater Retarding Structures	1,198,200	205,100	1,403,300	156,000 2/	156,000	1,559,300
Channel Improvement	252,000	45,000	297,000	124,100	124,100	421,100
Subtotal	1,450,200	250,100	1,700,300	280,100	280,100	1,980,400
Project Administration	::::::::::::::::::::::		199,600	:::::::	20,000	219,600
GRAND TOTAL	1,450,200	250,100	1,899,900	280,100	300,100	2,200,000

1/ Price base - 1968.
2/ Includes $25,000 for relocation, modification, or alteration of a barn, 3,200 feet of electric utility line, and 6,600 feet of gravel road involved in Sites No. 3, 4, and 15.

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TABLE 3 - STRUCTURAL DATA
STRUCTURES WITH PLANNED STORAGE CAPACITY
Sweetwater Creek Watershed, Tennessee

ITEM (1)	UNIT (2)	Structure Numbers 1 (3)	3 (4)	4 (5)	11 (6)
Class of Structure 1/		c	b	b	c
Drainage Area	Sq.Mi.	5.68	1.01	2.21	0.72
Curve No. (1-day) (AMC II)		75	71	72	72
Tc	Hrs.	1.81	0.80	1.08	0.56
Elevation Top of Dam	Ft.	972.6	932.3	907.2	928.4
Elevation Crest Emergency Spwy.	Ft.	966.5	924.5	897.0	918.0
Elevation Crest High Stage Inlet	Ft.	952.5	919.5	891.5	905.0
Elevation Crest Low Stage Inlet	Ft.		908.0	881.5	
Maximum Height of Dam	Ft.	35	33	38	42
Volume of Fill	Cu.Yds.	263,400	92,000	123,100	117,400
Total Capacity	Ac.Ft.	1,750	232	577	147
Sediment Submerged 1st 50 Years	Ac.Ft.	135	26	48	30
Sediment Submerged 2nd 50 Years	Ac.Ft.	159	30	55	35
Sediment Aerated	Ac.Ft.	24	5	8	5
Retarding	Ac.Ft.	1,432	171	466	77
Between High & Low Stages	Ac.Ft.		88	203	
Surface Area					
Sediment Pool	Acres	45	6	15	5
Retarding Pool	Acres	184	17	54	13
Principal Spillway					
Rainfall Volume (areal) (1-day)	In.	6.80	6.50	6.50	6.80
Rainfall Volume (areal) (10-day)	In.	13.00	11.50	11.80	13.00
Runoff Volume (10-day)	In.	7.10	5.10	5.48	6.44
Capacity of Low Stage (Max.)	cfs		14	26	
Capacity of High Stage (Max.)	cfs	103	99	104	61
Frequency Operation - Emergency Spillway	% Chance	1	2	2	1
Size of Conduit	Dim.	30	30	30	24
Emergency Spillway					
Rainfall Volume (ESH) (areal)	In.	11.50	8.00	8.00	7.80
Runoff Volume (ESH)	In.	7.87	4.58	4.69	4.52
Type		Veg	Veg	Veg	Veg
Bottom Width	Ft.	600	50	50	50
Velocity of Flow (V_e)	Ft./Sec.	7.68	7.32	7.80	7.38
Slope of Exit Channel	Ft./Ft.	0.022	0.022	0.021	0.022
Maximum Water Surface Elevation	Ft.	968.7	926.2	899.0	920.0
Freeboard					
Rainfall Volume (FH) (areal)	In.	28.80	28.90	28.90	28.90
Runoff Volume (FH)	In.	24.40	24.52	24.70	24.70
Maximum Water Surface Elevation	Ft.	972.6	932.3	907.2	928.4
Capacity Equivalents					
Sediment Volume	In.	1.06	1.54	0.95	1.82
Retarding Volume	In.	4.73	3.19	3.95	2.01

(Continued)

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TABLE 3 - STRUCTURAL DATA (Cont.)
STRUCTURES WITH PLANNED STORAGE CAPACITY
Sweetwater Creek Watershed, Tennessee

ITEM	UNIT	Structure Numbers 14 (7)	15 (8)	16 (9)
Class of Structure		c	b	b
Drainage Area	Sq.Mi.	1.13	1.57	0.73
Curve No. (1-day) (AMC II)		70	72	73
Tc	Hrs.	0.67	0.79	0.66
Elevation Top of Dam	Ft.	956.7	986.5	1009.1
Elevation Crest Emergency Spwy.	Ft.	950.5	980.5	1004.0
Elevation Crest High Stage Inlet	Ft.	936.0	958.5	986.5
Elevation Crest Low Stage Inlet	Ft.			
Maximum Height of Dam	Ft.	35	46	47
Volume of Fill	Cu.Yds.	75,500	96,100	47,000
Total Capacity	Ac.Ft.	230	353	144
Sediment Submerged 1st 50 Years	Ac.Ft.	30	46	23
Sediment Submerged 2nd 50 Years	Ac.Ft.	35	54	27
Sediment Aerated	Ac.Ft.	5	8	4
Retarding	Ac.Ft.	160	245	90
Between High & Low Stages	Ac.Ft.			
Surface Area				
Sediment Pool	Acres	6	7	4
Retarding Pool	Acres	26	19	10
Principal Spillway				
Rainfall Volume (areal) (1-day)	In.	6.80	6.50	6.50
Rainfall Volume (areal) (10-day)	In.	13.00	11.50	11.80
Runoff Volume (10-day)	In.	6.10	5.20	5.78
Capacity of Low Stage (Max.)	cfs			
Capacity of High Stage (Max.)	cfs	62	66	68
Frequency Operation - Emergency Spillway	% Chance	1	1	1
Size of Conduit	Dim.	24	24	24
Emergency Spillway				
Rainfall Volume (ESH) (areal)	In.	11.50	8.00	8.00
Runoff Volume (ESH)	In.	7.58	4.69	4.81
Type		Veg	Veg	Veg
Bottom Width	Ft.	200	100	60
Velocity of Flow (V_e)	Ft./Sec.	7.32	6.84	6.96
Slope of Exit Channel	Ft./Ft.	0.022	0.023	0.024
Maximum Water Surface Elevation	Ft.	952.6	982.3	1005.8
Freeboard				
Rainfall Volume (FH) (areal)	In.	28.90	28.90	28.90
Runoff Volume (FH)	In.	24.32	24.70	24.89
Maximum Water Surface Elevation	Ft.	956.7	986.5	1009.1
Capacity Equivalents				
Sediment Volume	In.	1.16	1.30	1.38
Retarding Volume	In.	2.66	2.93	2.30

(Continued)

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TABLE 3 - STRUCTURAL DATA (Cont.)
STRUCTURES WITH PLANNED STORAGE CAPACITY
Sweetwater Creek Watershed, Tennessee

ITEM	UNIT	Structure Numbers 17 (10)	18 (11)	Total (12)
Class of Structure 1/		b	b	
Drainage Area	Sq.Mi.	0.94	0.81	14.80
Curve No. (1-day) (AMC II)		74	72	
Tc	Hrs.	0.77	0.63	
Elevation Top of Dam	Ft.	1038.1	1019.9	
Elevation Crest Emergency Spwy.	Ft.	1032.5	1014.0	
Elevation Crest High Stage Inlet	Ft.	1020.0	1001.5	
Elevation Crest Low Stage Inlet	Ft.			
Maximum Height of Dam	Ft.	32	33	
Volume of Fill	Cu.Yds.	55,900	73,500	943,900
Total Capacity	Ac.Ft.	191	198	3,822
Sediment Submerged 1st 50 Years	Ac.Ft.	25	29	392
Sediment Submerged 2nd 50 Years	Ac.Ft.	30	33	458
Sediment Aerated	Ac.Ft.	4	5	68
Retarding	Ac.Ft.	132	131	2,904
Between High & Low Stages	Ac.Ft.			291
Surface Area				
Sediment Pool	Acres	6	7	101
Retarding Pool	Acres	18	17	358
Principal Spillway				
Rainfall Volume (areal) (1-day)	In.	6.50	6.50	
Rainfall Volume (areal) (10-day)	In.	11.50	11.50	
Runoff Volume (10-day)	In.	5.69	5.20	
Capacity of Low Stage (Max.)	cfs			
Capacity of High Stage (Max.)	cfs	56	61	
Frequency Operation - Emergency Spillway	% Chance	1	1	
Size of Conduit	Dim.	24	24	
Emergency Spillway				
Rainfall Volume (ESH) (areal)	In.	8.00	8.00	
Runoff Volume (ESH)	In.	4.93	4.69	
Type		Veg	Veg	
Bottom Width	Ft.	50	100	
Velocity of Flow (V_e)	Ft./Sec.	7.32	5.28	
Slope of Exit Channel	Ft./Ft.	0.023	0.026	
Maximum Water Surface Elevation	Ft.	1034.4	1015.1	
Freeboard				
Rainfall Volume (FH) (areal)	In.	28.90	28.90	
Runoff Volume (FH)	In.	25.08	24.70	
Maximum Water Surface Elevation	Ft.	1038.1	1019.9	
Capacity Equivalents				
Sediment Volume	In.	1.18	1.35	
Retarding Volume	In.	2.64	3.05	

1/ The class "c" freeboard hydrograph was routed through all emergency spillways.

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TABLE 3A - STRUCTURAL DATA - CHANNELS
Sweetwater Creek Watershed, Tennessee

Channel (No. or Name) (1)	Station (2)	Drainage Area (Sq.Mi.) (3)	Capacity (cfs) Req'd (4)	Capacity (cfs) Design 1/ (5)	Water Surface Elev. 2/ (6)	Hydr. Gradient (Ft/Ft) (7)	Channel Dimensions 3/ Bottom (Ft) (8)	Channel Dimensions 3/ Depth (Ft) (9)	"n" Value Aged (10)	"n" Value As Built (11)	Velocities Aged (12)	Velocities As Built (13)	Excav. (Cu.Yds) (14)	Type of Improve. 3/ (15)
Main Creek														
VS-26	137+50	2.61	227	220		0.0030	5	5.0	0.035	0.025	4.40	6.19	4700	CE
VS-28	286+50	5.44	295	267		0.0018	9	5.0	0.035	0.025	3.81	5.27	10,840	CE
VS-32	353+00	8.21	625	700	912.3	0.0016	28	5.0	0.035	0.025	4.24	5.90	17,350	CE
VS-41	384+50	9.47	625	700	908.3	0.0016	28	5.0	0.035	0.025	4.24	5.90	7,230	CE
VS-49	443+50	12.04	625	700	901.7	0.0016	28	5.0	0.035	0.025	4.24	5.90	22,950	CE
VS-60	531+00	15.93	600	720		0.0017	28	5.0	0.035	0.025	4.36	6.07	34,960	CE
VS-67	703+50	18.52	523	650		0.0014	28	5.0	0.035	0.025	3.94	5.51	19,030	CE
VS-75	840+00	23.33	668	1,000		0.0029	28	5.2	0.035	0.025	5.79	8.12	59,220	CE
VS-76	872+00	29.61	4,527	5,000	844.6	0.0013	60	10.0	0.030	0.025	7.14	8.50	40,860	CE
VS-79	879+00	30.77	5,000	5,800	842.0	0.0017	60	10.0	0.030	0.025	8.29	9.72	28,160	CE
Bacon Creek														
VS-16	835+00	5.64	1,100	1,134	854.6	0.0025	20	7.0	0.035	0.025	6.00	8.41	8,900	CE
Dry Valley Branch														
VS-23	1,117+00	3.01		72		0.0072	22	13.0 3/	0.055 4/	0.055	3.27	3.27		C&S
VS-24	1,243+00	5.47		200		0.0061	52	21.0 3/	0.055 4/	0.055	3.85	3.85		C&S
Lateral B														
VS-11	783+00	1.33	138	209		0.0027	5	5.0	0.035	0.025	4.18	5.87	11,500	CE

1/ Designed discharges as developed from water surface profiles.
2/ Water surface elevations for maximum storm of record (March 11-12, 1963) with planned project measures installed.
3/ Side slopes on excavated channels are 1:1. For channels requiring clearing and snagging, the cross-sectional area and wetted perimeter are shown in the "Bottom" and "Depth" columns. CE = channel excavation; C&S = clearing and snagging.
4/ Present "n" values are 0.075.

NOTE: Channel improvement (C&S) is planned on approximately 70,000 ft. of tributaries as shown on the project map.

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TABLE 4 - ANNUAL COST
Sweetwater Creek Watershed, Tennessee
(Dollars) 1/

Evaluation Unit (1)	Amortization of Installation Cost 2/ (2)	Operation and Maintenance Cost (3)	Total (4)
Floodwater Retarding Structures and Stream Channel Improvement	97,375	6,600	103,975
Project Administration	10,800	::::::: :::::::	10,800
GRAND TOTAL	108,175	6,600	114,775

1/ Price base: Installation 1968; O&M adjusted normalized.
2/ 100 years @ 4-7/8 percent interest rate.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS
Sweetwater Creek Watershed, Tennessee
(Dollars) 1/

Item	ESTIMATED AVERAGE ANNUAL DAMAGE		Damage Reduction Benefits
	Without Project	With Project	
(1)	(2)	(3)	(4)
FLOODWATER			
Crops and Pasture	26,900	5,200	21,700
Other Agricultural	1,500	300	1,200
Non-Agricultural			
Road and Bridge	10,800	700	10,100
Urban Property			
Sweetwater	97,200	3,400	93,800
Philadelphia	18,900	200	18,700
Rural Property	7,600	300	7,300
Subtotal	162,900	10,100	152,800
INDIRECT	36,000	1,700	34,300
TOTAL	198,900 2/	11,800	187,100

1/ Price base - Adjusted normalized.
2/ Additional damages may occur from floods greater than the 100-year frequency but were not evaluated.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES
Sweetwater Creek Watershed, Tennessee
(Dollars)

Evaluation Unit	Average Annual Benefits 1/				Average Annual Cost 3/	Benefit-Cost Ratio
	Damage Reduction	Re-development	Secondary	Total		
(1)	(2)	(3)	(4)	(5)	(6)	(7)
Floodwater retarding structures & stream channel improvement	179,900	22,100	14,700	216,700	103,975	2.1:1.0
Project Administration					10,800	
GRAND TOTAL	179,900 2/	22,100	14,700	216,700	114,775	1.9:1.0

1/ Price base - adjusted normalized.
2/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $7,200 annually.
3/ From table 4.

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INVESTIGATION AND ANALYSIS

Land Treatment

The conservation needs inventory for Monroe, Loudon, and McMinn Counties recently completed by the United States Department of Agriculture, under the leadership of the Soil Conservation Service, provided information on soil capability units by land use. Information was also obtained from the work units concerning soils, capability units, and land use in the watershed. The conservation needs for the watershed were developed using this information and the work unit technical guides.

The conservation practices established to date, both quantity and value, were determined from field inspections and interviews with farm operators and from work unit records. This information was utilized in preparing table 1A.

A systematic field survey showed ground cover, forest and hydrologic conditions, and treatment needs. This survey, supporting data, and information from other agencies and forestry officials, determined the amount of remedial measures. The measures recommended contribute to flood reduction and soil stabilization.

Conservation measures to be applied during the installation period were determined after considering the following factors: (1) future land use; (2) the availability of personnel for providing technical assistance and planning at the work unit office; (3) funds available from the Agricultural Stabilization and Conservation Service office for cost-sharing; (4) interviews with operators in the watershed regarding the resources available for installing the needed land treatment measures; and (5) experience gained from the installation of similar projects.

Engineering Surveys

The engineering field surveys on Sweetwater Creek Watershed consisted of establishing about 35 miles of vertical control, surveying 21 valley cross-sections, 27 channel sections, 30 bridge openings, and preparing topographic maps on 13 structure reservoir areas. Vertical control was established in feet with an elevation tolerance of 0.10 times the square root of the distance in miles. Control datum was mean sea level.

The valley and channel cross-sections and bridge opening sections were surveyed to determine shape, width, and other hydraulic characteristics for flood-routing and design. Topographic maps of the floodwater retarding structure areas were prepared using the plane table and telescopic alidade with an enlarged aerial photograph used as a base map. Contours

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were run on 5-foot intervals. Fixed improvements were located and elevations recorded to the nearest 0.1 foot. The topographic maps were used to develop stage-storage and stage-area curves for design as well as serving as base maps for preparation of land rights maps for the structure areas.

Design

Preliminary designs for the nine floodwater retarding structures were made in accordance with criteria and procedures contained in Engineering Memo SCS-27 (Revised), dated March 19, 1965. Structure classifications were determined from a field review of the proposed structure locations.

Provisions were made for storing the expected 100-year sediment accumulation in each of the structure reservoirs. Sediment distribution was determined using the procedure outlined in TR-12 (Revised), dated January 1968.

The principal spillway and the emergency spillway design and freeboard hydrographs were flood-routed by computer. Detention volume minimum requirements as determined from the routings were exceeded for sites 1, 14, 15, 16, 17, and 18 in order that structure routings and channel routings would be compatible, i.e., based on the same volume of storm runoff. Structure 1, 11, 14, 15, 16, 17, and 18 have single-stage risers and are designed to accommodate the runoff from the 100-year storm. Sites 3 and 4 were designed with 2-stage risers.

Additional safety has been incorporated into the design of the dams by routing the class "c" freeboard hydrograph through all the structures. Rainfall in excess of 28.90 inches in 6 hours would be required to overtop the dams. This design meets the requirements of Section 26a of the Tennessee Valley Authority Act of 1933, as amended.

The required peak discharges for channel design were determined from computer routings and from water surface profiles. Design discharges were calculated using Manning's formula with "n" values or roughness coefficients being estimated by procedures given in Supplement "B", Section 5, National Engineering Handbook. Average design velocities ranged from 4.40 to 9.72 feet/second for "as built" channels. The higher velocities are in rock areas. These velocities were comparable with those calculated using the "allowable velocity method" as outlined in the Soil Conservation Service Technical Release No. 25.

Hydrologic

Valley cross-sections were either surveyed or developed from quadrangle sheets at 83 valley locations. These cross-sections were used to develop water surface profiles using the computer program as outlined in EWP Technical Guide No. 22 for flood plains and constrictions. Stage-discharge, stage-area, and stage-end area curves as required for flood-routing purposes were generated as output from this program.

In determining the maximum flood plain inundated, rainfall distributions for the historical storms of January 7-8, 1946 and March 11-12, 1963 were developed from U. S. Weather Bureau Publications, "Climatological Data", and "Hourly Precipitation Data", and from the Tennessee Valley Authority publication, "Precipitation in Tennessee River Basin". These storm distributions

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were then used to develop incremental hydrographs which were routed and combined to ascertain flood peaks and elevations at selected locations for each of the respective storms. These elevations were compared and were in reasonable agreement with surveyed flood mark elevations.

The January 1946 storm began at approximately 11:00 p.m. on January 7, continued until about 3:00 p.m. on January 8, 1946, and produced a rainfall of approximately 4.87 inches.

Although the 1946 storm caused extensive flooding throughout the entire length of Sweetwater Creek, the March 1963 storm was even more severe. The 1963 storm generated a rainfall of approximately 5.21 inches in a 20-hour period with over 76 percent or 4.00 inches falling in less than 7 hours, and resulted in the maximum flood of record. This storm began around 5:00 p.m. on March 11 and ended about 1:00 p.m. on March 12, 1963.

Several synthetic storms were also developed and routed since the "Frequency Method of Analysis" was used for the economic evaluation of this project. Rainfalls for selected frequencies of 1, 2, 5, 10, 25, and 100-year, 24-hour storms were taken from the U. S. Weather Bureau Technical Paper No. 40 and were routed using both Type I and Type II "Cumulative Rainfall Tables for One-Day Watershed Evaluation Storms". The result of peak flow frequency analysis for these two rainfall distributions indicated that the Type I distribution gave peaks which were in close agreement with those of selected stream gages. The stream gages analyzed for this comparison were those lying in the same hydrologic area as the Sweetwater Creek Watershed and in close proximity to it. All flood-routings, both for the historical and synthetic storms, were accomplished using the IBM 360 or 1130 Computer Program as outlined in Technical Release No. 20. These routings were based on average antecedent moisture conditions for each of the synthetic storms, but due to a high prior 30-day rainfall, an antecedent moisture condition III was assigned to each of the historical storms. Routed peaks for the March 1963 storm and for selected frequencies from the synthetic series (using Type I rainfall table) were used as input data for the IBM 1130 Economic Computer Program.

Investigations revealed that although the 100-year frequency storm could still flood to a depth of approximately 2 feet in the city of Sweetwater after the project is installed, approximately 97 percent of all urban flood damage will be eliminated. It is not economically feasible to install project measures that will completely eliminate all flooding. An increase in channel size or capacities, above those planned, would result in the disruption of the main or trunk line of the sewer system in the city of Sweetwater. This sewerline crosses the planned channel improvement at seven locations. There are also seven lateral or feeder lines which cross the main stream of the planned channel improvement, and several of these would have to be removed and relocated or modified in some manner if an increase in channel size above planned capacities was attempted. Under present conditions, three of the sewer crossings are exposed.

Additional floodwater retarding structures above the city of Sweetwater were also studied, but none were found to be feasible.

Geologic

All available geologic maps and reports were reviewed to gain information on the location, extent, and composition of formations in the area and structural data such as location of faults, folds, and strike and dip of bedrock. The watershed is in an area of intense thrust faulting. The Knoxville fault traverses the length of the watershed and the Saltville fault lies just outside the watershed boundary to the northeast. The bedrock has been highly fractured and extensive weathering, solution channel and cavern development have taken place as a result of this faulting and fracturing. There are numerous areas of karst topography in the area and spring development is very common.

Preliminary geologic investigations were made at the proposed dam sites in an attempt to determine geologic feasibility and to note any unusual conditions which may require special considerations. These investigations consisted of shallow hand auger borings at selected locations and inspection of surface conditions and outcrops. Fairly extensive core drilling operations were carried out along the centerline of Site No. 1. A very limited amount of auger drilling was accomplished in the flood plain area of Site No. 4 during a 1960 investigation of a possible location for a dam under the Public Law 46 program.

At Site No. 1, the Knoxville fault crosses the reservoir area about one-fourth mile upstream from the centerline of the dam. A branch of this same fault crosses the centerline of the dam. Core drilling operations at this site revealed uneven weathering of the limestone and dolomite bedrock. This bedrock was found to be highly fractured and solution channel and cavern development is extensive. This condition is especially prevalent near the fault zone. The bedrock dips steeply to the southeast.

Auger drilling at Site No. 4 was confined to the flood plain area and consisted of one hole 48 feet deep. The entire hole was drilled in soft, silty materials. Bedrock was not encountered even though rock outcrops are present in both abutments at the site. This indicates deep weathering of the foundation rock. A large spring is located a short distance upstream from the centerline of the dam.

The preliminary investigations at most of the dam sites were not of sufficient intensity to adequately determine the foundation conditions present. Therefore, preliminary design recommendations are based primarily on the results of the Site No. 1 investigation and surface indications at the remaining sites. Extensive foundation treatment will be necessary on some, if not all, of the sites. The foundation rock profiles are expected to be irregular with varying amounts of highly weathered zones. Rock spleens rising near the surface and gorges in the bedrock as indicated at Site No. 4 are also expected. Excavation of foundation rock to positive slopes may be necessary to prevent differential settlement. Shallow, highly compressible foundation materials should be removed and replaced with compacted fill. Where removal of these materials is not feasible as in the case of Site No. 4, the highly

compressible materials will have to be pre-consolidated to prevent differential settlement.

The presence of solution channels and caverns have been confirmed by drilling operations at Site No. 1. Cavernous conditions probably exist at most of the other sites. Much of the solution development in the watershed has occurred along faults, fractures, and bedding planes in the limestone and dolomite bedrock. Residual clay materials and/or secondary deposits of silt, sand, and rock fragments are present in many of these solution channels and caverns. Subsurface as well as dental grouting will be required to provide stable foundation conditions. Blanket type foundation drains or rock toe drains may also be needed. Embankment materials should not be taken from the reservoir areas and disturbance of these areas should be kept to a minimum. Removal of materials from these areas would increase the possibility of excessive seepage losses and encourage the creation of sinks which might impair the proper functioning of the structures. Adequate quantities of borrow materials appear to be available outside the reservoir areas for construction of the dams. Extensive geologic investigations will be needed at all sites prior to final design and construction in order to include the design features needed to compensate for site deficiencies. Core drilling equipment will be required in the detailed investigation to determine depth of overburden and condition of foundation bedrock. In-place and laboratory testing of unconsolidated foundation materials will also be needed. Borrow areas will be delineated during the detailed site investigations.

The main Sweetwater Creek and Bacon Creek were investigated to determine materials present and depths to bedrock. Depths to rock were erratic but generally shallow. This information was needed for design consideration in planning the stream channel improvement features. This data was obtained by probing the channel bottoms at selected locations.

Fish and Wildlife

Studies and analyses were made by the biologists of the Tennessee Game and Fish Commission, U. S. Fish and Wildlife Service, and Soil Conservation Service working together and individually. The analyses included physical characteristics of the stream and watershed as related to the fish and wildlife resources, relative extent of fish and wildlife species, and population and relative hunting and fishing pressure and success. The extent and composition of the fish and wildlife resources in the Sweetwater Creek Watershed were determined by the Biology Work Group through interviews with local Tennessee Game and Fish Commission Conservation Officers and through observations and comparisons of this watershed with similar watersheds in Tennessee where intensive studies have been made.

The stream channel improvement proposed for flood prevention was evaluated by the Work Group for the effect on the fish and wildlife resources and will not significantly reduce the already low value habitat.

Sedimentation

The calculation of sheet erosion was made by use of Musgrave's Equation. Land use and cover conditions, percent slope, length of slope, maximum 2-year, 30-minute rainfall and basic erosion rates of the soils involved are factors used in these calculations to determine gross sheet erosion under present conditions and future conditions with the project installed. Due consideration was given to anticipated changes in land use and treatment in the future. Erosion from other sources was estimated by approved methods.

Detailed land use measurements were made of the area above each proposed floodwater retarding structure. This data, along with calculated average annual rates of sheet erosion and estimated rates of gully erosion, was used in the procedure outlined in Technical Release No. 12 (Rev.), Soil Conservation Service, Engineering Division, January 1968, to determine the required sediment storage capacities. Factors considered in these determinations include the percent of eroded material which will be delivered to the site from its source area, the trap efficiency of the reservoir, the volume weight of the deposited sediment, and the distribution of this sediment within the reservoir area. The area of the flood plain lands affected by sediment and scour damage was determined by mapping of the flood plain. Data gathered was processed and expanded for the reaches involved and summaries were prepared showing the location and extent of these damages.

Sediment deposition is related to the gross erosion from upstream sources; thus the future rates of sediment deposition was based on the decrease in gross erosion due to anticipated changes in land use, treatment, and cover conditions and the installation of the structural elements of the project. Reduction in scour damage was based on the reduction in frequency, depth, and duration of overbank flow with the project installed.

Forestry

A systematic field survey showed ground cover, forest, and hydrologic conditions, and treatment needs. This survey, supporting data, and information from other agencies and forestry officials determined the amount of remedial measures. The measures recommended contribute to flood reduction and soil stabilization. The forest land treatment measures planned on private land are limited by the expected participation and the length of the installation period.

Economics

The methods used in making economic investigations and analyses followed those approved by the Soil Conservation Service in benefit-cost evaluations on land and water resource projects. The methods followed are in accordance with instructions in the National Economic Guide. Basic data were obtained from local farmers, agricultural workers, State and County Highway officials, experiment stations, and agricultural publications. Basic information was obtained by interview with landowners and operators having flood plain land and consisted of the following: present land use and

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yields; normal flood-free land use and yields; anticipated land use and yields with various degrees of flood protection; information concerning the normal sequence of the various farming operations; estimates of the percent damage to the various crops and pasture by depths of inundation by months or specific flood events; and damage to urban and rural property and other fixed improvements by depths of inundation or by specific storm events.

Adjusted normalized prices were used as a basis for benefit computations, cost of production and cost of operation and maintenance. These adjusted normalized prices were developed from standards and criteria developed by the Interdepartmental Staff Committee of the Water Resources Council, dated April 1966.

The IBM 1130 computer was used to evaluate probable damages and benefits by use of the frequency method. A comparison of evaluated damages without and with project installed were used to determine flood damage reduction benefits from input physical and economic flood characteristics and their frequency of occurrence. Output data provided benefits from alternative programs for use in project formulation and justification.

Local secondary benefits were evaluated and used in project justification. Secondary benefits from a national viewpoint were not used in the evaluation or justification of this proposed work plan.

Although Monroe County is no longer eligible under the Public Works and Economic Development Act of 1965, the watershed is in the Appalachia portion of the state and this enables the use of benefits for increased employment as a result of the installation of project measures. The value of local labor used in project installation is estimated to be: (1) 30 percent of the construction cost, and (2) 50 percent of the annual operation and maintenance cost.

A 1968 price base was used as the basis for installation costs. The costs of land rights were developed in meetings with the watershed district sponsors. The unit costs of roads and bridges were developed in meetings with State and County Highway officials.

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- OF THE PEOPLE
- BY THE PEOPLE
- FOR THE PEOPLE

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SWEETWATER CREEK WATERSHED

URBAN FLOOD PLAIN

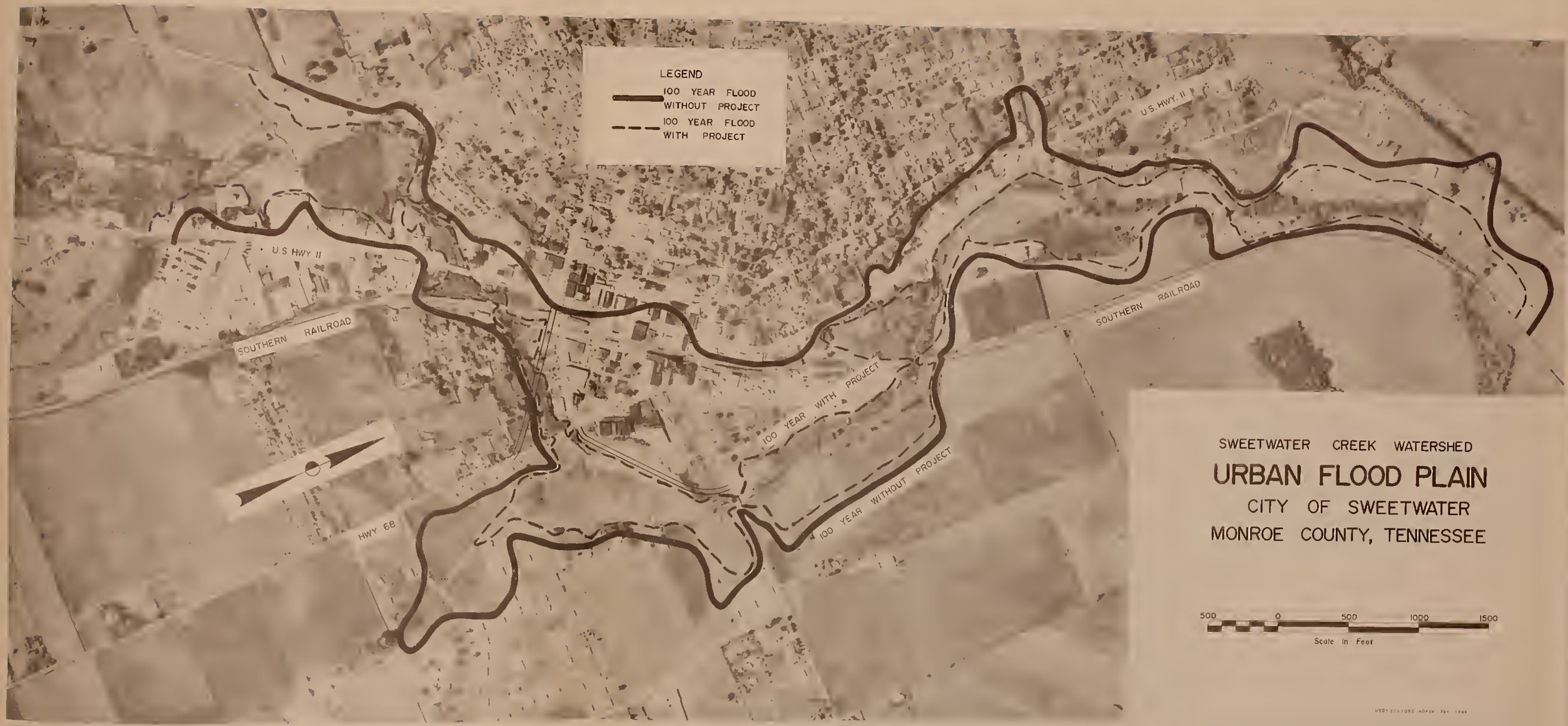
CITY OF SWEETWATER

MONROE COUNTY, TENNESSEE

500 0 500 1000 1500

Scale in Feet

USDA-SCS-FORT WORTH, TEX. 1968



SWEETWATER CREEK WATERSHED

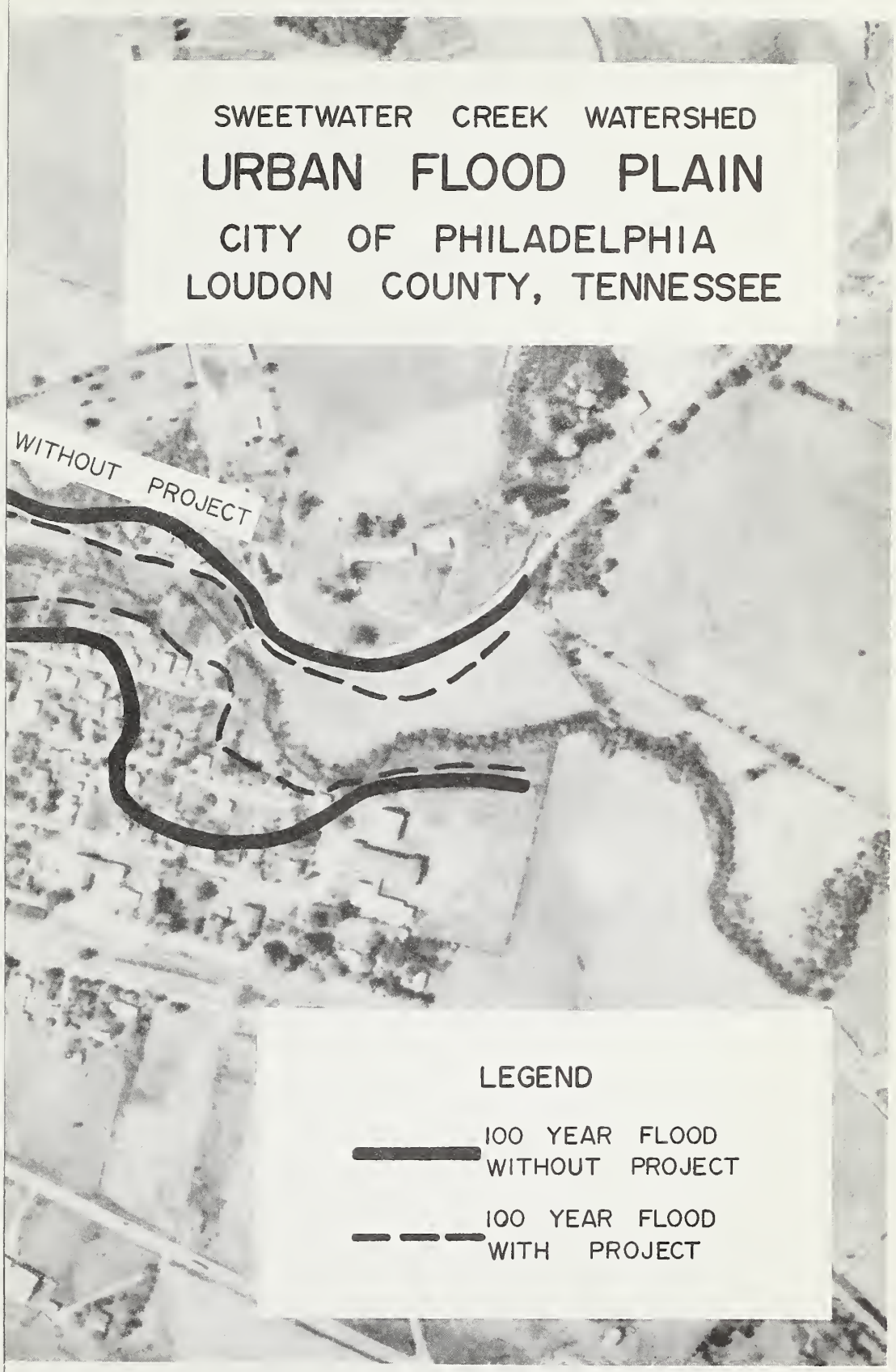
URBAN FLOOD PLAIN

CITY OF SWEETWATER

MONROE COUNTY, TENNESSEE

500 0 500 1000 1500

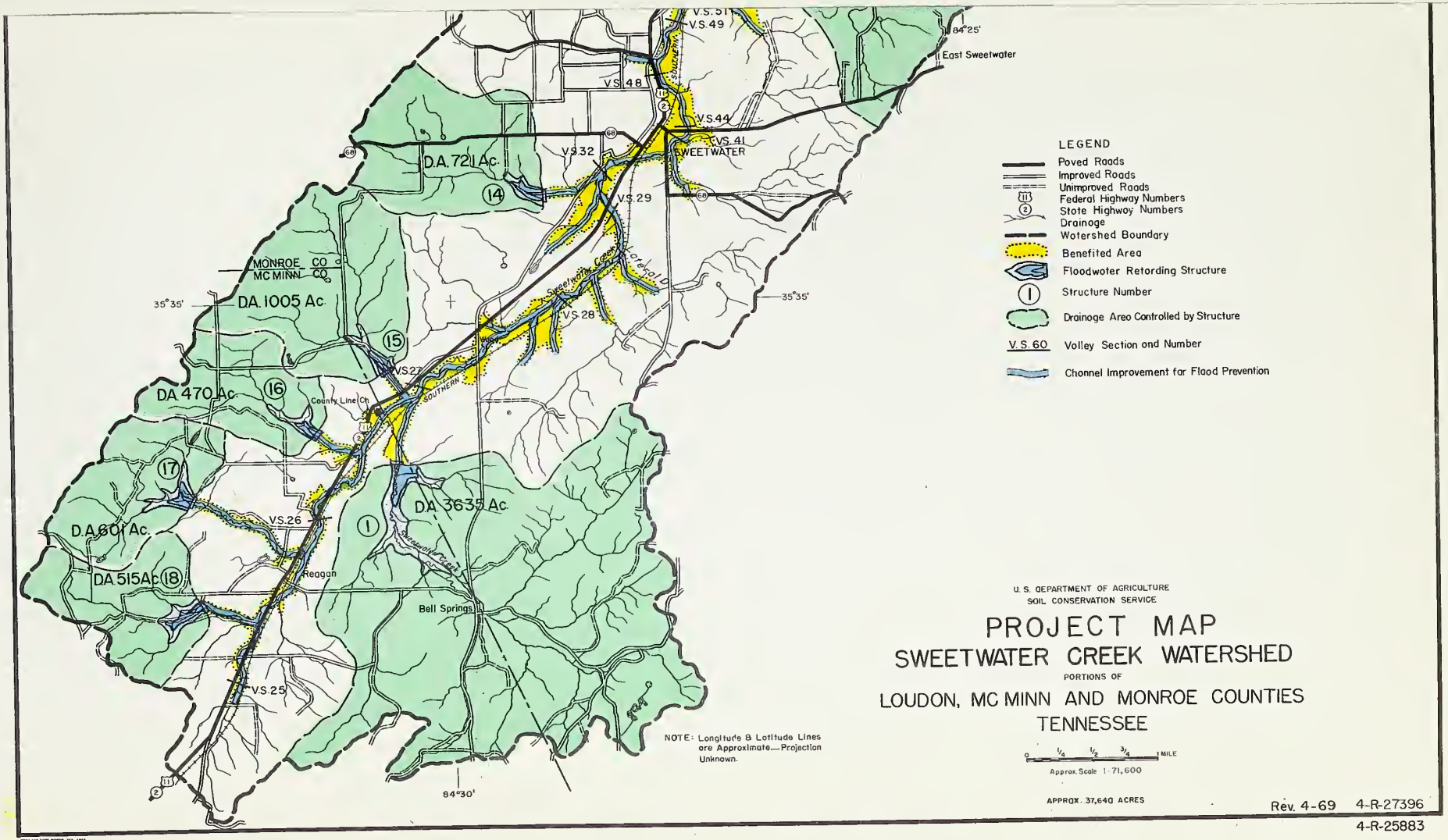
Scale in Feet


SWEETWATER CREEK WATERSHED
URBAN FLOOD PLAIN
CITY OF PHILADELPHIA
LOUDON COUNTY, TENNESSEE
WITHOUT PROJECT
LEGEND
100 YEAR FLOOD WITHOUT PROJECT
100 YEAR FLOOD WITH PROJECT

SWEETWATER CREEK WATERSHED

URBAN FLOOD PLAIN

CITY OF PHILADELPHIA
LOUDON COUNTY, TENNESSEE



U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PROJECT MAP
SWEETWATER CREEK WATERSHED
PORTIONS OF
LOUDON, MC MINN AND MONROE COUNTIES
TENNESSEE

0 1/4 1/2 3/4 1 MILE
Approx. Scale 1:71,600

APPROX. 37,640 ACRES

Rev. 4-69 4-R-27396
4-R-25883

TENNESSEE RIVER

VS 83
VS 82
VS 24
Robertson
VS 81
VS 23
VS 80
VS 79
VS 76
Philadelphia
VS 75
VS 16
LOUDON CO
MONROE CO
VS 68
VS 11
DA 461 Ac
VS 67
Old Sweetwater
Sunnyside School
Reed Spring Ch
VS 64
DA 1415 Ac
VS 60
VS 55
DA 644 Ac
VS 53
VS 51
VS 49
East Sweetwater
VS 48
VS 44
VS 41
SWEETWATER
DA 721 Ac
VS 32
VS 29
MONROE CO
MC MINN CO
DA 1005 Ac
VS 28
DA 470 Ac
VS 27
DA 3635 Ac
DA 601 Ac
VS 26
DA 515 Ac
Ducktown
Ball Spring
VS 25

LEGEND
- Paved Roads
- Improved Roads
- Unimproved Roads
- Federal Highway Numbers
- State Highway Numbers
- Drainage
- Watershed Boundary
- Benefited Area
- Floodwater Retarding Structure
- (1) Structure Number
- Drainage Area Controlled by Structure
- V S 60 Valley Section and Number
- Channel Improvement for Flood Prevention

NOTE: Longitude & Latitude Lines are Approximate — Projection Unknown

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PROJECT MAP
SWEETWATER CREEK WATERSHED
PORTIONS OF
LOUDON, MC MINN AND MONROE COUNTIES
TENNESSEE

Approx Scale 1" = 1 Mile

APPROX 37,440 ACRES

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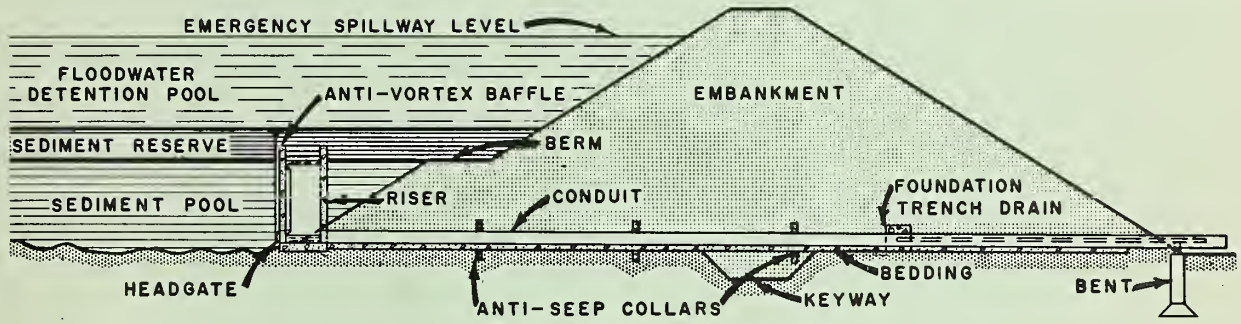
4-R-25883

UNITED STATES
DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE
COLUMBIA, SOUTH CAROLINA



SECTION OF A TYPICAL
FLOODWATER RETARDING STRUCTURE

(WITH SINGLE STAGE RISER)

USDA-SCS-FORT WORTH, TEX 1967

1-67 4-L-23364