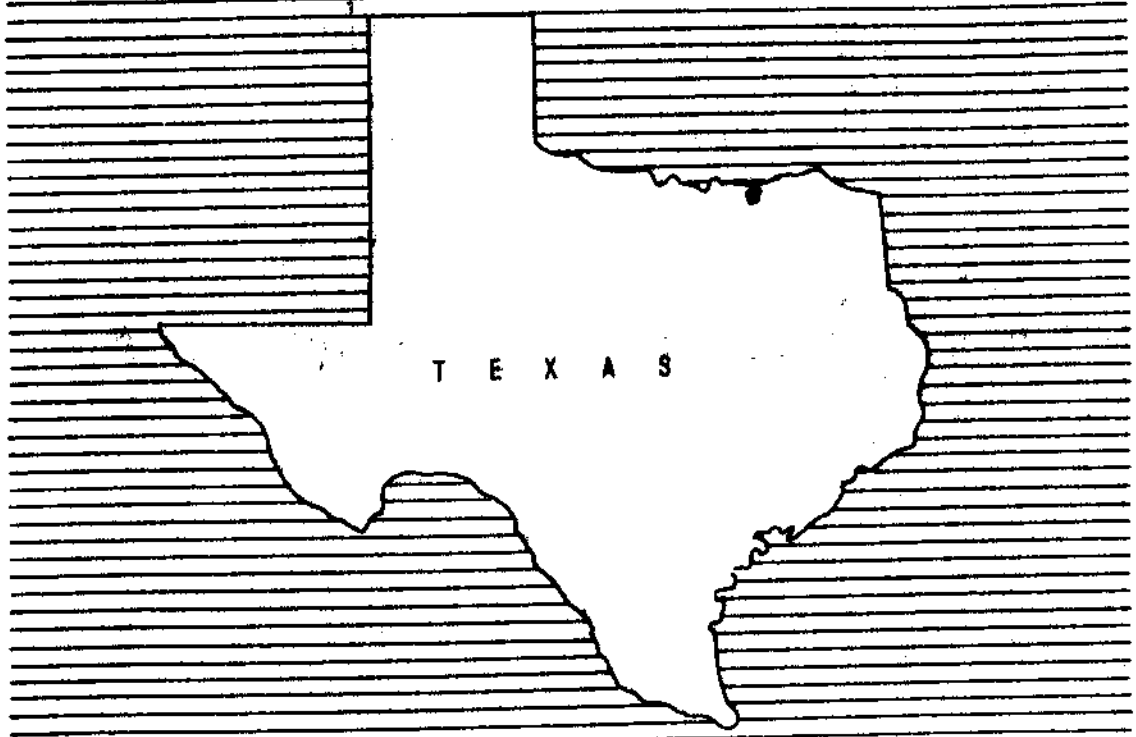
WORK PLAN

FOR
WATERSHED PROTECTION, FLOOD PREVENTION, RECREATION AND
AGRICULTURAL AND NON-AGRICULTURAL WATER MANAGEMENT

CHOCTAW CREEK WATERSHED

GRAYSON COUNTY, TEXAS



November 1965

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WATERSHED WORK PLAN AGREEMENT

between the

Choctaw Watershed Water Improvement District
Local Organization

Upper Elm-Red Soil and Water Conservation District
Local Organization

Grayson County Commissioners Court
Local Organization

City of Sherman
Local Organization

City of Denison
Local Organization

City of Bells
Local Organization

City of Howe
Local Organization

State of Texas
(hereinafter referred to as the Sponsoring Local Organization)

and the

Soil Conservation Service
United States Department of Agriculture
(hereinafter referred to as the Service)

Whereas, application haa heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Choctaw Creek Watershed, State of Texas, under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666), as amended; and

Whereas, the responsibility for administration of the Watershed Protection and Flood Prevention Act, as amended, has been assigned by the Secretary of Agriculture to the Service; and

Whereas, there has been developed through the cooperative efforts of the Sponsoring Local Organization and the Service a mutually satisfactory plan for works of improvement for the Choctaw Creek Watershed, State of Texas, hereinafter referred to as the watershed work plan, which plan is annexed to and made a part of this agreement;

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan can be installed in about 7 years.

It is mutually agreed that in installing and operating and maintaining the works of improvement substantially in accordance with the terms, conditions, and stipulations provided for in the watershed work plan:

1. The Sponsoring Local Organization will acquire such land, easements or rights-of-way as will be needed in connection with the works of improvement. (Estimated Cost $2,197,041). The percentages of this cost to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Land, Easements, and Rights-of-Way Cost (dollars)
ıltiple-Purpose Structure No. 35			
ıd Basic Recreation Facilities (Sherman)			
Payments to landowners for 1,070 acres and cost of relocation or modification of improvements	64.62	35.38	608,000
Legal fees, survey costs, flowage easements, and other costs	100.00	-	18,750
ıltiple-Purpose Structure No. 38			
ıd Basic Recreation Facilities (Denison)			
Payments to landowners for 22 acres and cost of relocation or modification of improvements	50.00	50.00	17,800
Legal fees, survey costs, flowage easements, and other costs	100.00	-	6,100
1 Other Structural Measures	100.00	-	1,546,391

2. The Sponsoring Local Organization will acquire or provide assurance that landowners or water users have acquired such water rights pursuant to State law as may be needed in the installation and operation of the works of improvement. (Estimated cost $7,200).

3. The percentages of construction costs of structural measures to be paid by the Sponsoring Local Organization and by the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
ultiple-Purpose Structure No. 1 (Sherman)	53.20	46.80	718,300
ultiple-Purpose Structure No. 4 (Sherman)	64.00	36.00	462,000
ultiple-Purpose Structure No. 13 (Howe)	63.33	36.67	210,100
Diversion Works	100.00	-	75,000
ultiple-Purpose Structure No. 30 (Bells)	43.02	56.98	129,800
Diversion Works	100.00	-	75,000
ultiple-Purpose Structure No. 34 (Choctaw WWID)	20.87	79.13	42,900
ultiple-Purpose Structure No. 35 (Sherman)	59.13	40.87	597,300
Basic Recreation Facilities	50.00	50.00	281,600
ultiple-Purpose Structure No. 38 (Denison)	14.845	85.155	103,400
Basic Recreation Facilities	50.00	50.00	144,210
10,180 feet of Stream Channel Improvement	-	100.00	391,600
1,600 feet of Drainage Main and Laterals (Choctaw WWID)	25.00	75.00	7,700
4 Single-Purpose Floodwater Retarding Structures	-	100.00	2,081,200
Grade Stabilization Structures	-	100.00	15,950

4. The percentages of the cost for installation services to be borne by the Sponsoring Local Organization and the Service are as follows:

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Installation Service Cost (dollars)
ltiple-Purpose Structure No. 1 (Sherman)	53.20	46.80	132,077
ltiple-Purpose Structure No. 4 (Sherman)	64.00	36.00	84,950
ltiple-Purpose Structure No. 13 (Howe)	63.33	36.67	38,632
Diversion Works	100.00	-	9,000
ltiple-Purpose Structure No. 30 (Bells)	43.02	56.98	28,072
Diversion Works	100.00	-	9,000
ltiple-Purpose Structure No. 34 (Choctaw WWID)	20.87	79.13	11,582
ltiple-Purpose Structure No. 35 (Sherman)	50.62	49.38	109,829
Basic Recreation Facilities	50.00	50.00	51,778
ltiple-Purpose Structure No. 38 (Denison)	-	100.00	24,576
Basic Recreation Facilities	50.00	50.00	26,518

4. Continued.

Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Installation Service Cost (dollars)
10,180 feet of Stream Channel Improvement	-	100.00	79,059
1,600 feet of Drainage Main and Laterals	-	100.00	3,239
4 Single-Purpose Floodwater Retarding Structures	-	100.00	524,633
Grade Stabilization Structures	-	100.00	4,651

5. The Sponsoring Local Organization will bear the costs of administering contracts. (Estimated cost $39,500.)

6. The Sponsoring Local Organization will obtain agreements from owners of not less than 50 percent of the land above each reservoir and floodwater retarding structure that they will carry out conservation farm or ranch plans on their land.

7. The Sponsoring Local Organization will provide assistance to landowners and operators to assure the installation of the land treatment measures shown in the watershed work plan.

8. The Sponsoring Local Organization will encourage landowners and operators to operate and maintain the land treatment measures for the protection and improvement of the watershed.

9. The Sponsoring Local Organization will be responsible for the operation and maintenance of the structural works of improvement by actually performing the work or arranging for such work in accordance with agreements to be entered into prior to issuing invitations to bid for construction work or concurrently with land rights, facilities or project agreements.

10. The costs shown in this agreement represent preliminary estimates. In finally determining the costs to be borne by the parties hereto, the actual costs incurred in the installation of works of improvement will be used.

11. This agreement does not constitute a financial document to serve as a basis for the obligation of Federal funds, and financial and other assistance to be furnished by the Service in carrying out the watershed work plan is contingent on the appropriation of funds for this purpose.

Where there is a Federal contribution to the project costs, separate agreements in connection with each phase will be entered into between the Service and the Sponsoring Local Organization prior to the incurrence of any financial obligations. Such agreements will set forth in detail the financial and working arrangements and other conditions that are applicable.

The Sponsoring Local Organization will deposit with the Service sufficient funds to cover its share of the estimated cost of installation services to be furnished by the Service. These funds will be deposited in advance of the services being rendered and will be placed in a special account from which the Service will disburse to pay the Sponsoring Local Organization's cost share of such services.

12. The watershed work plan may be amended or revised, and this agreement may be modified or terminated, only by mutual agreement of the parties hereto.

13. The program conducted will be in compliance with all requirements respecting non-discrimination as contained in the Civil Rights Act of 1964 and the regulations of the Secretary of Agriculture (7C.F.R. Sec. 15.1 - 15.13), which provide that no person in the United States shall, on the ground of race, color, or national origin, be excluded from participation in, be denied the benefits of, or be subjected to discrimination under any activity receiving Federal financial assistance.

14. The Sponsoring Local Organizations agree that all land on which cost-sharing has been provided will not be sold or otherwise disposed of for the evaluated life of the project except to a public agency which will continue to maintain and operate the recreational development in accordance with the Operation and Maintenance Agreement.

15. No member of Congress, or resident commissioner, shall be admitted to any share or part of this agreement, or to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

Choctaw Watershed Water Improvement District
Local Organization

By T. G. McGraw
T. G. McGraw

Title President

Date June 8 1966

signing of this agreement was authorized by a resolution of the governing
ly of the Choctaw Watershed Water Improvement District
Local Organization

pted at a meeting held on June 8 - 1966

(~~Secretary, Local Organization~~)

Date June 8 - 1966

Upper Elm-Red Soil and Water Conservation District
Local Organization

By Harold Skaggs
Harold Skaggs

Title Chairman

Date 6-7-1966

The signing of this agreement was authorized by a resolution of the governing body of the Upper Elm-Red Soil and Water Conservation District
Local Organization

adopted at a meeting held on April 16, 1966

Keith Templin
(Secretary, Local Organization)

Date June 8, 1966

Grayson County Commissioners Court
Local Organization

By Les Tribble
Les Tribble

Title County Judge

Date 6-7-66

The signing of this agreement was authorized by a resolution of the governing body of the Grayson County Commissioners Court
Local Organization

adopted at a meeting held on 6-7-66

Paul E. Lee
~~(Secretary, Local Organization)~~
County Clerk

Date 6-7-66

City of Sherman
Local Organization

By _____
G. R. Stephens
Title Mayor

Date June 1 - 1966

The signing of this agreement was authorized by a resolution of the governing body of the City of Sherman
Local Organization

adopted at a meeting held on 5-16-66

_____
~~(Secretary, Local Organization)~~
City Clerk

Date 6-1-66

City of Denison
Local Organization

By _____
Joe W. Gay
Title Mayor

Date 6-9-66

The signing of this agreement was authorized by a resolution of the governing body of the City of Denison
Local Organization

adopted at a meeting held on June 9 1966

_____
~~(Secretary, Local Organization)~~
Ass't Clerk

Date 6-9-66

City of Bells
Local Organization

By W. H. Atkinson
W. H. Atkinson

Title Mayor

Date 7 June 66

The signing of this agreement was authorized by a resolution of the governing body of the City of Bells
Local Organization

adopted at a meeting held on June 7, 1966

N. C. Young
(Secretary, Local Organization)

Date June 7, 1966

City of Howe
Local Organization

By C. C. Jones
C. C. Jones

Title Mayor

Date June 7, 1966

The signing of this agreement was authorized by a resolution of the governing body of the City of Howe
Local Organization

adopted at a meeting held on June 7, 1966

Fred W. Holcomb
(Secretary, Local Organization)

Date June 7, 1966

Soil Conservation Service
United States Department of Agriculture

By _____

Date _____

WATERSHED WORK PLAN

CHOCTAW CREEK WATERSHED
Grayson County, Texas
November 1965

PREFACE

The work plan for watershed protection and flood prevention, recreation, and agricultural and non-agricultural water development in the Choctaw Creek watershed, Texas, was prepared by the Choctaw Watershed Water Improvement District, the Upper Elm-Red Soil and Water Conservation District, the cities of Sherman, Denison, Howe, and Bells, Texas, and the Grayson County Commissioners Court, the local sponsoring organizations. Technical assistance was provided by the Soil Conservation Service of the U. S. Department of Agriculture. The Bureau of Sport Fisheries and Wildlife of the U. S. Department of Interior collaborated with the Texas Parks and Wildlife Department in the preparation of a reconnaissance report of the fish and wildlife aspects of the watershed. The Texas Water Development Board assisted the city of Bells to determine its needs for municipal water. Financial assistance in developing the work plan was provided by the Soil Conservation Service of the U. S. Department of Agriculture and the Texas State Soil Conservation Board. Housing for the planning staff was provided by the Grayson County Commissioners Court.

THE SPONSORS

Seated, left to right: Harold Skaggs, Chairman, Upper Elm-Red Soil and Water Conservation District; Les Tribble, County Judge, Grayson County; T. G. McGraw, President Choctaw Watershed Water Improvement District.

Standing: G. R. Stephens (left), Mayor, City of Sherman; Arthur Boatright, Mayor, City of Bells.

Insert, left to right: Mayor C. C. Jones, Howe, and Mayor Worth Campbell, Denison.

WATERSHED WORK PLAN

FOR

WATERSHED PROTECTION, FLOOD PREVENTION, RECREATION,

AND

AGRICULTURAL AND NON-AGRICULTURAL WATER MANAGEMENT

CHOCTAW CREEK WATERSHED
Grayson County, Texas

Prepared Under the Authority of the Watershed Protection and Flood Prevention Act, (Public Law 566, 83rd Congress, 68 Stat. 666), as amended.

Prepared By:

Choctaw Watershed Water Improvement District

Upper Elm-Red Soil and Water Conservation District

Grayson County Commissioners Court

City of Sherman

City of Denison

City of Bells

City of Howe

With Assistance By:

U. S. Department of Agriculture
Soil Conservation Service
November 1965

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USDA-SCA-FORT WORTH, TEX. 1A66

WATERSHED WORK PLAN

CHOCTAW CREEK WATERSHED
Grayson County, Texas
November 1965

SUMMARY OF PLAN

Choctaw Creek watershed comprises an area of 262.5 square miles and is located in the northeastern part of Grayson County, Texas. The cities of Sherman, Bells, and Howe, and half of the city of Denison are within the watershed.

About 31 percent of the project area is cropland, 55 percent is grassland, and 14 percent is miscellaneous, such as cities, farmsteads, industrial property, and roads. All of the agricultural land is privately owned.

The principal problem in the watershed is frequent flooding of 11,527 acres of bottomland along Choctaw Creek and its tributaries. Sand and Post Oak Creeks, tributaries of Choctaw Creek, offer a grave threat to encroaching building developments upon their flood plains in the city of Sherman. The total floodwater, sediment, and erosion damages are estimated to be $254,939 annually.

The work plan proposes the application of land treatment measures at an accelerated rate during a 7-year installation period for the protection of the watershed. Measures needed are those which will improve the hydrologic condition of the crop and grassland. The installation cost of these measures is $2,258,955. Of this amount, $25,267 will be borne by Public Law 566 funds to accelerate application of needed land treatment measures. Thirty-four floodwater retarding structures, 7 multiple-purpose structures, 7 grade stabilization structures, 20.87 miles of stream channel improvement, and 4.09 miles of drainage main and laterals will be installed. The multiple-purpose structures which create Iron Ore Lake, Site 35, and Waterloo Lake, Site 38, will have basic recreation facilities for water-based recreation. Iron Ore Lake will have storage for municipal water supply in addition to flood prevention and recreation storage. Four multiple-purpose sites, 1, 4, 13, and 30, will have municipal water storage as well as flood prevention storage.

The estimated cost of the structural measures is $8,717,397. The Public Law 566 share of the cost is $4,812,279. The local share of the cost is $3,905,118. All of the structural measures will be installed during a 7-year installation period.

The project will benefit directly about 100 owners and operators of 10,100 acres of agricultural flood plain, the landowners and residents of urban

property within the city of Sherman and the owners and operators of 260 acres of wet land in the Carpenters Bluff area.

Damages will be reduced to $49,053. Total benefits from the project will be $473,269 annually. The ratio of the average annual benefits accruing to structural measures ($464,422) to the average annual cost of these measures ($314,164) is 1.5 to 1.0.

The land treatment measures will be operated and maintained by the owners and operators of the land upon which the measures will be applied under agreements with the Upper Elm-Red Soil and Water Conservation District. The structural measures will be operated and maintained by the Choctaw Watershed Water Improvement District, the cities of Sherman, Denison, Howe, and Bells, Texas, and the Grayson County Commissioners Court. The value of the cost for operation, maintenance, and replacement is estimated to be $28,582 annually.

DESCRIPTION OF THE WATERSHED

> "I must say as to what I have seen of Texas it is the garden spot of the world, the best land and the best prospects for health I ever saw is here . . . I expect in all probability to settle on Bodark or Choctaw Bayou of Red River, that I have no doubt is the richest country in the world, good land and plenty of timber, and the best springs and good mill streams, good range, clear water and every appearance of health. Game aplenty. It is in the pass where the buffalo passes from north to south and back twice a year; and bees and honey plenty."

So wrote David Crockett to his children in Tennessee, in early January of 1836.

Physical Data

Choctaw Creek watershed lies in the northeastern part of Grayson County in North Texas. It drains an area of approximately 168,000 acres or 262.5 square miles. Choctaw Creek heads 7 miles southwest of the city of Sherman and flows in a northeasterly direction into the Red River about 16 miles downstream from Lake Texoma. Post Oak and Iron Ore Creeks flow into the mainstem from the northwest. Mill and Cedar Creeks enter from the south.

Sherman, located in the central part of the watershed on Post Oak Creek, and Denison, located on the northern divide, are the largest cities in the watershed. Other incorporated towns include Howe and Tom Bean, located on the southern divide, and Bells, located in the eastern part of the watershed.

All of the watershed is underlain by Cretaceous rocks of the Comanche and Gulf series. The Austin chalk, Eagle Ford shale, and Woodbine sand formations of the Gulf series make up over 75 percent of this coverage. Heavy clay soils of the Blackland Prairies have developed on the chalks and shales under a tall-grass prairie. The topography is gently to moderately rolling. An area with steep slopes is located south of Choctaw Creek. Sandy soils of the East Cross Timbers have developed on the Woodbine sands. This area has a gently rolling to hilly topography. It is covered by a savannah type vegetation under natural conditions.

Elevations above mean sea level range from 900 feet in the headwaters to 480 feet in the channel near the Red River.

Mineral resources include petroleum production near Sherman, local road base materials from the Austin chalk, and aome sand and gravel production from the Quaternary terrace deposits. Shallow wells in the Woodbine sands supply the greater portion of the groundwater. Deep wells in the Trinity sands are of secondary importance. The Pawpaw sands, Eagle Ford shale, and Austin chalk furnish water in small amounts.

The alluvial materials of the valleys are derived mainly from the Blackland Prairies. Highly productive flood plain soils of the Frio and Trinity series predominate. Some Miller and Yahola soils occur in the lower reaches near the Red River.

The over-all land use in the watershed is as follows:

Land Use	Acres	Percent
Cultivated	52,248	31
Grassland	93,072	55
Miscellaneous 1/	22,680	14
Total	168,000	100

1/ Area in roads, railroads, towns, farmsteads, and lakes.

The mean annual rainfall of 39.05 inches is well distributed, with larger average monthly amounts occurring in April and May. Mean temperatures range from 84.2 degrees Fahrenheit in July to 42.5 degrees in January. The average date of the last killing frost is March 20 and that of the first killing frost is November 14, providing a normal frost-free period of 239 days.

Economic Data

Choctaw Creek watershed is located in Grayson County, which has an agricultural-industrial economy. Approximately one person in eighteen is employed in manufacturing. Sherman and Denison have been, and still are,

Cultivated land is being converted to grassland at a rapid rate. This field of coastal bermudagrass has been out of crop production for only 10 months.

the home of most industry in the county. Industries in Sherman include cottonseed products, grain processing, food processing and distribution, surgical bandages, business machines, cotton gin machinery, petroleum, construction machinery, oil well servicing, aluminum products, asphalt, pipe, truck bodies, boats, and others. Denison has long been a leading railroad center in north central Texas. The railroad and its shops were the backbone of the economy for many years. In recent years, however, many new industries have joined the old. Denison's industries include refrigerated foods, canning plants, textiles, food processing, peanut mill, clothing, wood preserving, pipes, and furniture. Manufacturing accounts for almost 50 percent of the total county income.

In 1963 the county produced 7,133,321 barrels of oil.

Agricultural income in 1963 in Grayson County was $9,616,483 (approximately 18 percent of county income). Although Grayson County is not totally dependent on its agricultural income, it remains a significant factor in the over-all economy. Cash crops account for an income of $4,929,394 per year. Principal crops grown are small grains, alfalfa, grain sorghums, cotton and corn. However, there is a gradual shifting of acreage from cropland to grazing land. Agricultural land is being lost to the industrial and urban areas of Sherman, Denison, and Howe at a rapid rate. This expansion, plus the proximity of Perrin Air Force Base and Lake Texoma, has caused a steady increase in the price of land. Much of the land is being bought by residents of the Dallas-Fort Worth area and by military and civilian personnel stationed at Perrin AFB for retirement purposes.

In Grayson County as a whole, the average farm of 208 acres is valued in excess of $24,000 for land and buildings. However, in the watershed farms are smaller and are valued considerably higher. About 75 percent of the flood plain area is included in family-type farms.

According to the 1960 U. S. census, the distribution of population in Grayson County by place of residence is as follows: rural farm, 8.6 percent; rural non-farm, 26.1 percent; and urban, 65.3 percent. A higher percentage of the residents of the watershed are urban and rural non-farm.

Present crop distribution on the flood plain is as follows: wheat, 40 percent; alfalfa, 20 percent; pasture, 20 percent; hay, 10 percent; oats, 5 percent; wooded pasture, 4 percent; and miscellaneous areas, 1 percent. Future trends appear to be toward increased alfalfa and hay production, with an increase in livestock programs. There is no indication that acreages of crops in surplus supply will be increased.

Five railroads and 18 truck lines provide excellent facilities for transportation.

Land Treatment Data

The watershed is served by the Soil Conservation Service Work Unit at Sherman, which assists the Upper Elm-Red Soil and Water Conservation District. This district was organized in 1941 with the Grayson County portion, now Zone 5, being annexed in 1942.

A Civilian Conservation Corps Camp was located in Sherman for a period of 3 years, 1936-1939. Leading farmers at that time cooperated with the camp and started waterway and terrace construction as well as pasture development.

County agents, vocational agriculture instructors and their students, and Production and Marketing Administration field men, as well as Soil Conservation Service personnel, ran many miles of terraces in the next few years. Many of these terraces are still in existence even though much of the land has been retired from cultivation.

Most of the upland area was intensively cultivated in the past. Rapid deterioration of the natural fertility of the East Cross Timbers soils resulted in reversion to woods and low quality grasses. Large areas of soils in the Blackland Prairies have been converted to pastures. Most cultivated areas are now confined to land capability classes II and III.

There are 975 operating units in the watershed. Basic conservation plans have been developed for 605, or 62 percent.

Cooperators with the Soil and Water Conservation District have applied approximately 60 percent of the planned practices. About 50 percent of the cropland and 40 percent of the grassland have been adequately treated. Table 1A lists the practices which have been applied. The total cost of applying these practices is estimated at $2,777,889.

Application of land treatment has been lagging in the area of steep Blackland soils located on the south side of Choctaw Creek. These soils have lost most or all of the original topsoil. Active gullies are eroding into the underlying soft marl bedrock materials. The low inherent fertility of this material prevents natural revegetation. Low economic returns from this land have discouraged or hindered treatment by many landowners. In the flood plain a high percent of the cultivated crops are being grown on land that is frequently flooded.

WATERSHED PROBLEMS

Floodwater Damages

The principal problem in the watershed is frequent flood damage occurring on approximately 11,527 acres of valuable land. The area subject to damages as described herein is the flood plain that would be inundated by the 50-year

Flood of February 9, 1965 on Choctaw Creek. Eight similar floods occur in the fall of 1964.

Road and bridge damage on Choctaw Creek caused by flood of September 12, 1962.

Choctaw Creek overflow after five-inch rainfall in 24-hour period - September 22, 1965.

Scour damage caused by six-inch rain - September 12, 1962.

I-21466 3-66

frequency storm in the agricultural reaches, 10,582 acres; the 100-year frequency flood in the urban reach, 685 acres; and 260 acres of wet land near the Red River. Figure 8 shows the agricultural land that is subject to flood damage. The urban area that will be damaged by the 100-year frequency flood is shown in figure 9.

Choctaw Creek and its tributaries overflowed their banks 8 times in the fall of 1964. Each of these floods was caused by rains of from 3 to 5 inches falling only on parts of the watershed. Damages to small grain and alfalfa were extensive and flood plain scour damage was severe. During the 33-year evaluation period, 1930-1962, there were 327 floods. Of these, 51 were of major proportions, inundating more than half of the flood plain. The majority of the floods occur in the spring and fall months; however, floods can occur at any time of the year. The largest flood of record occurred in 1908. Recent major floods occurred in 1946, 1957, and 1962. The storm of September 7 and 8, 1962, with an estimated 4.16 inches of runoff, produced a peak discharge of 28,350 c.f.s. at valley section No. 1 (figure 8). This flood inundated approximately 9,800 acres in the agricultural reaches. Loss of small grain was high and flood plain scour was severe. A flood of this size can be expected to occur on an average of once in 15 years.

Flooding is most severe in the upper reaches of Mill and Cedar Creeks and in the central reaches of Choctaw Creek. Channel capacities have been greatly decreased in these areas by deposition of sediment. Land use throughout the flood plain has deteriorated because of frequent flooding with the resultant loss of investment to landowners. The value of flood plain land varies from $150 to $500 per acre, depending on location within the watershed. The value of production varies from $3.50 to $136.50 per acre, depending upon use.

Flooding in the urban area of Sherman on Post Oak and Sand Creeks has not posed a serious problem in the past because there were very few improvements in the area subject to flooding. Damages were limited to roads and bridges and a few isolated homes. In 1928 water got into 10 homes and one life was lost. In recent years commercial buildings and private homes have encroached upon the flood plains of Post Oak and Sand Creeks, thus creating a serious flood threat. In addition, construction in this area has reduced the carrying capacity of the stream channels and increased the rate of runoff, thereby creating a threat to areas that were previously safe from flooding. Residential and commercial property valued at approximately $1,000,000 is subject to flooding. Minor flooding to one commercial building was reported on September 21 and 22, 1965. Rainfall during this storm varied from 3.8 inches to 4.94 inches over the watershed of Post Oak Creek. A storm of this magnitude can be expected every year or two. It is estimated that damages of approximately $249,000 to property now constructed would occur in the event of a 100-year flood.

At the 1965 rate of encroachment upon the flood plains of Sand and Post Oak Creeks, it is expected that an additional $4,000,000 worth of residential and commercial improvements will be constructed in the near future. Damages from the 100-year frequency flood with this future construction in place are expected to reach $736,000.

Local efforts to reduce flood damages have consisted mainly of small reaches of channel improvement and levee construction. However, these efforts have met with little success due to the magnitude and complexity of the problem.

Under non-project conditions the average annual direct monetary flood damage is $231,763. Of this amount, $96,369 is crop and pasture; $35,747, other agricultural; $21,340, road and bridge; $4,068, sediment deposition; $19,589, flood plain erosion and valley trenching; and $54,650, urban damage in the city of Sherman. Indirect damage, such as interruption of travel, re-routing of school buses and mail routes, interruption to livestock feeding and management regimens, losses sustained by businessmen of the area, and similar losses, is estimated to average $23,176 annually.

Erosion Damage

Erosion rates in the uplands range from low in the East Cross Timbers and parts of the Blackland Prairies to high in steep-sloped and poorly vegetated, formerly cultivated lands of the Blackland Prairies (figure 8). Conversion of cultivated land to grassland and hayland has occurred in areas with low to moderate erosion rates. The predominance of close growing crops, such as small grains and alfalfa, has reduced erosion rates on cropland. Terracing has also reduced erosion. Severe erosion is still occurring on steep, formerly cultivated lands which have lost most or all of the original topsoil. This area, comprising 8,000 acres or less than 7 percent of the watershed, produces approximately 61,000 tons of sediment annually as a result of gully and sheet erosion. This is 81 percent of all soil being lost throughout the entire watershed. Active gullies on these areas hsve eroded into the underlying soft marl bedrock. The low inherent fertility of this material prevents natural revegetation. Of the total upland erosion, 90 percent occurs as sheet erosion, 8 percent as gully erosion, and 2 percent as streambank erosion.

Flood plain scour has damaged 933 acres to depths ranging from 5 inches to over 3 feet. This damage is most severe in the central reaches of Choctaw Creek where accelerated channel filling has reduced channel capacities. The estimated annual damage in terms of reduced productivity is as follows: 490 acres damaged, 10 percent; 286 acres damaged, 20 percent; 132 acres damaged, 40 percent; and 25 acres damaged, 80 percent.

Valley trenching has destroyed 20 acres of bottomland in the lower reaches of Choctaw Creek and is expected to destroy an additional 30 acres of land within the next 25 years.

Critical sediment source areas like these produce 61,000 tons of sedimer annually.

The average annual monetary value of flood plain scour erosion, including valley trenching, without the project is $19,589 (table 5).

Sediment Damage

Sediment damages are decreasing due to changed land use and conservation treatment. The largest volume of sediment is being produced by sheet erosion on cultivated land. However, the most highly damaging material consists of infertile, partially weathered marls and chalks derived from formerly cultivated, severely gullied lands. Sediment deposition has occurred in all channels and has severely affected flooding in local reaches. It has also impaired normal surface drainage and necessitated channel cleaning by landowners, which has been largely ineffective. This damage has been most severe in the upper reaches of Mill and Cedar Creeks and in the central reaches of Choctaw Creek.

The average annual monetary value of sediment damage to flood plain lands without the project is $4,068 (table 5).

Problems Relating to Water Management

Sherman and the small towns within the watershed obtain their water supply from underground sources. Denison obtains its water from Randell Lake and Lake Texoma. Sherman's 14 wells have a maximum daily production of 9,273,600 gallons. On August 5, 1965 the city used 7,015,500 gallons. City officials pointed out that one major breakdown would result in an acute water shortage.

Although the underground water supply is adequate to meet the needs of the area, its development will be limited because of increasing pumping head and well spacing and other economic factors.

The cities of Howe and Bells face similar situations in utilizing underground water as a source for municipal and industrial use.

The city of Sherman has been investigating possible sources of surface water supplies for several years. One of the stated objectives of the Grayson County Program Building Committee was that of making further studies of the possibilities of harnessing surface water to insure an economically adequate supply of good quality water for increased industry and population.

Shallow wells and farm ponds furnish water for rural domestic and livestock uses.

Inadequate surface drainage is a problem on 260 acres of land near the Red River (figure 8). The wet conditions of the soil seriously hamper farming operations and reduce pasture and orchard yields. Local efforts to improve the laterals and group mains have been unsuccessful because of inadequate outlets.

Very little land is being irrigated in the watershed. The Texas Water Commission has issued permits for diversion of 299.4 acre-feet of water from Choctaw and Mill Creeks to irrigate 199.7 acres of land. The soils and surface water are generally suited for irrigation. One of the principal problems connected with the development of irrigation in the flood plain of Choctaw Creek is the threat of frequent overflows.

The Bureau of Reclamation of the U. S. Department of Interior, in its Reconnaissance Report on Liberty Bottoms Project, Oklahoma - Texas (1958), includes a plan for irrigating 1,352 acres in the Lower Carpenters Bluff area. Nearly all of this is in the Choctaw Creek watershed. Development of a suitable outlet for drainage will be one of the problems to overcome.

Opportunities for water-based recreation are available at nearby Lake Texoma and Lake Loy. Lake Texoma provides recreation facilities for an estimated 6 million visitors annually. Existing facilities are overcrowded during the peak season. Since Lake Texoma is such a large body of water, many fishermen, boaters, and water skiiers would rather not risk their boats and lives on possibilities of becoming involved in bad weather.

There is a definite need for additional facilities in this fast-growing area.

Population estimates indicate that within a 25-mile radius of Sherman there are 100,000 people; within a 50-mile radius, 200,000; and within a 75-mile radius, 1,000,000 people.

Sherman and Howe discharge sewage effluent into Choctaw Creek. Denison discharges its effluent into Iron Ore Creek. If the area continues to grow and attract new industry at the rate anticipated, stream pollution may become a serious problem.

PROJECTS OF OTHER AGENCIES

Denison Dam, which forms Lake Texoma, on the Red River, was completed by the Corps of Engineers in 1943. Lake Texoma was primarily constructed for flood control, hydroelectric power, municipal and industrial water supply, and other allied benefits. This reservoir provides flood protection to the common bottomland from floods which originate on the Red and Washita Rivers.

Lake Loy, southwest of Denison on a tributary of Iron Ore Creek, was completed by the Civilian Conservation Corps in 1935. It is county-owned and is open to the public for recreation purposes.

Lake Waterloo, also on a tributary of Iron Ore Creek, is owned by the city of Denison. The dam was breached once and investigations indicate that the existing structure is not sound.

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The Corps of Engineers has conducted investigations of reconnaissance scope in the Choctaw Creek watershed. This study indicated the feasibility of enlarging the mainstem channel from mile 0 to mile 22.7 as an effective flood control measure.

The Bureau of Reclamation of the U. S. Department of Interior has made a reconnaissance report on the potentially irrigable land along the Red River below Lake Texoma. The Bureau has indicated that the Lower Carpenters Bluff area, most of which is in the watershed, has a net irrigable area of 1,352 acres.

BASIS FOR PROJECT FORMULATION

A reconnaissance and preliminary investigation of the watershed was made by representatives of the Soil Conservation Service and the Choctaw Watershed Water Improvement District to determine the location and extent of areas being damaged by floodwater, erosion, sediment, and inadequate drainage. A map was prepared to show the location of the areas being damaged (figure 8). Meetings were held with the sponsoring local organizations to discuss the seriousness of the problems and possible solutions, water resource development needs and to formulate project objectives. Initially the sponsors listed the following specific steps to be taken to reach the objectives:

1. Establish land treatment and structural measures which contribute directly to watershed protection as rapidly as possible.

2. Control runoff from as much of the hill land as is feasible with floodwater retarding structures.

3. Improve channels to carry release flows from floodwater retarding structures plus the runoff from the uncontrolled area to protect cultivated land from floods up to and including the 2-year event on Choctaw and Mill Creeks. The sponsors also requested that average annual floodwater damages in these areas be reduced by approximately 85 percent.

4. Provide protection from the annual storm event and reduce the average annual damages by 70 to 75 percent on Iron Ore Creek.

5. Determine the feasibility of providing additional capacity for municipal, industrial, and recreation use in a site located in the headwaters of Iron Ore Creek.

6. Provide the city of Sherman with a map showing the area that would be flooded in the urban area by the 100-year frequency storm for without and with project conditions.

In selecting floodwater retarding structure sites for detailed surveys and analysis, priority was given to those locations which had the greatest potential for providing the desired level of protection. The locations of structures which had good possibilities for development as multiple-purpose reservoirs were referred to the sponsors. Preliminary layouts of the surveyed structure sites were reviewed in the field with the sponsors to determine the extent of easement and rights-of-way problems. Alternate locations were investigated as the need arose and comparisons made to determine the most feasible systems of retarding structures. The location, number, design, and cost of the retarding structures were influenced by the physical, topographic, and geologic conditions in the watershed, improvements such as railroads, highways, and utility lines, the proximity of the structures to the damage areas and their effect on the extent of channel improvement which would be required to attain the project objectives.

The governing bodies of the cities of Sherman, Denison, Bells, Howe, and Tom Bean were informed of the possibilities which existed for developing floodwater retarding structure sites near the cities as multiple-purpose structures to include capacity for municipal water supply and/or recreation and fish and wildlife development.

The city of Denison requested that Waterloo Lake, Site 38, be developed to include additional capacity and basic facilities for recreation.

The city of Sherman requested that capacity for municipal and industrial use be incorporated in Sites 1 and 4. The development of these sites is in addition to the multiple-purpose development of the Iron Ore Creek Site 35 for municipal water and recreation that was made in the initial request.

The cities of Howe and Bells requested that additional capacity be included in Sites 13 and 30, respectively, to supplement present water supplies. The Choctaw Watershed Water Improvement District requested that capacity to store water for irrigation be included in Site 34.

Area-capacity curves, cost-capacity curves, results of operation studies and/or the financial ability of the local interests formed the basis for determining the degree of development to include in each multiple-purpose site.

Although the recommended works of improvement do not meet all of the desired project objectives listed in the initial request, it was agreed that the level of flood protection being provided is adequate and consistent with the use being made of the land. Additional structural measures considered in an attempt to further reduce damages were found to produce benefits less than the estimated annual equivalent cost for such measures. Consequently, in an attempt to maximize net project benefits, additional works of improvement for flood prevention were not included in the plan.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures

Landowners and operators cooperating with the Upper Elm-Red Soil and Water Conservation District have applied many of the needed conservation practices on their land. An effective conservation program, based upon the use of each acre of land within its capabilities and upon its treatment in accordance with its needs for protection and improvement, is necessary for a sound watershed protection and flood prevention program on the watershed. Basic to reaching this objective is the establishment and maintenance of all applicable soil and water conservation and plant management practices essential to proper land use.

The treatment of the watershed area which lies above planned floodwater retarding structures is necessary to reduce the rate of deterioration in the uplands and to prevent excessive sediment accumulation in the pools of these structures. The land treatment measures on crop and pasture land will reduce soil erosion, sediment production, and storm runoff by improving the soil-water relationship. Land treatment measures are the only planned treatment on the uplands which will not drain through planned floodwater retarding structures. This land treatment will serve to reduce floodwater and sediment damage to the flood plain lands below.

Table 1 shows the acreages of agricultural land which will receive land treatment during the project installation period. These measures will be applied and maintained by the landowners and operators in cooperation with the district program. Trends are toward a reduction in cultivated land and an increase in grassland and urban development. Approximately 40,138 acres will receive soil improving measures such as conservation cropping system, cover crops, legumes in rotation, and crop residue management. Mechanical treatment measures which will help in reducing runoff and soil loss include grassed waterways, gradient and parallel terraces, diversion terraces, grade stabilization structures, and contour farming. These measures, plus grass establishment, are needed to reduce the erosion rates to an acceptable level.

Drainage field ditches and drainage land grading will be installed on the 260 acres to be served by 4.07 miles of project main and lateral ditches to derive full benefits.

Pasture and hayland management and pasture and hayland renovation will be applied for the maintenance and improvement of cover on 92,902 acres of grassland. Pasture and hayland planting and critical area treatment are needed for the establishment of grasses on bare, highly erosive areas.

In accordance with Section 1110.6 of the Watershed Protection Handbook, not less than 75 percent of the effective land treatment measures must be

A parallel terrace system emptying into a bermudagrass waterway.

Severely gullied area that was shaped and seeded to common bermudagrass.

installed, or their installation provided for, in the drainage areas of Sites 20, 21, and 23. Critical area planting on 134 acres of severely gullied land is needed to reduce sediment delivered to these structures to an acceptable level. Basic conservation plans must be prepared prior to the execution of a project agreement for construction of these structures. These plans must schedule the installation of the required land treatment measures either before or concurrently with the installation of the structural measures covered by each project agreement.

Structural Measures

Thirty-four floodwater retarding structures, 7 multiple-purpose structures, 20.87 miles of stream channel improvement, and 7 grade stabilization structures will be installed to provide protection to the flood plain lands of Choctaw Creek and its tributaries. In addition, 4.09 miles of drainage mains and laterals will be installed to provide flood protection and adequate drainage for 260 acres of wet land. The locations of the planned structural measures are shown on the project map (figure 10). The storage capacity of the 34 floodwater retarding structures and 7 multiple-purpose structures will be 82,023 acre-feet. Of this, 11,699 acre-feet is sediment storage (includes 86 acre-feet in existing Loy Lake), 2,990 acre-feet is for water-based recreation (includes 314 acre-feet in existing Loy Lake), 24,127 acre-feet is for municipal and industrial use, 101 acre-feet is for irrigation, and 43,106 acre-feet is for floodwater detention. Runoff from 43 percent of the watershed will be retarded. This is an average of 7.20 inches of runoff from the area upstream from the 34 floodwater retarding structures and 7 multiple-purpose structures. The sediment storage provided is for the sediment accumulation for a 100-year period. The capacity equivalents for each structure are shown on table 3.

Of the 7 multiple-purpose structures, 2 are for recreation. Site 37, Loy Lake, an existing recreation facility, will be modified to include 874 acre-feet of floodwater detention capacity by raising the dam and installing a principal spillway. Site 35 will have 2,136 acre-feet of recreation storage and a surface area of 250 acres at the recreation pool elevation. This site will be known as Iron Ore Lake and will be sponsored by the city of Sherman. Site 38, Waterloo Lake, will have 540 acre-feet of recreation storage and a surface area of 52 acres at the recreation pool elevation. This site, which is located within the city limits of Denison, will be sponsored by that city.

Five of the multiple-purpose sites will have storage for municipal water. These are Sites 1, 4, and 35, which will have 20,335 acre-feet of storage for Sherman; Site 30, which will have 860 acre-feet of storage for Bells; and Site 13, which will have 2,932 acre-feet of storage for Howe. Diversion works or pumping stations will be installed upstream from Sites 13 and 30 to furnish municipal water for Howe and Bells.

Storage of 101 acre-feet of irrigation water will be included in multiple-purpose Site 34 for an individual landowner.

The improved stream channels will have trapezoidal cross sections with 1.5:1 side slopes.

The improved channels on Choctaw and Mill Creeks will be designed to carry the peak flow associated with the runoff produced by the 1-year frequency storm. The improved channel in the urban area of Sherman will be designed to carry the peak discharge associated with the runoff produced by the 100-year frequency storm. Pertinent design data are presented in table 3A.

Grade stabilization structures will be installed as appurtenances to the improved stream channels as needed to prevent erosion or head cutting where shallow ditches enter the larger and deeper channel. It is estimated that an average of 4 of these structures will be needed per mile of improved stream channel. The structures will be designed and installed in accordance with standards and specifications contained in the Work Unit Technical Guide. The spoil will be placed within the right-of-way area in accordance with Service criteria outlined in Texas State Manual Supplement 2441.8.

Drainage main I and laterals IA, IB, and IC will have a trapezoidal cross section with 3:1 side slopes. The capacity will be sufficient to remove the rainfall excess from the 2-year frequency, 24-hour storm within a period of one day in accordance with Engineering-Drainage Memorandum TX-2 criteria. The system will consist of a main ditch and 3 laterals. Spoil will be placed within the right-of-way and graded and smoothed sufficiently to permit safe mowing. Grade stabilization structures 101 and 102 will be installed in the drainage area of Site 15 to control existing overfalls. Structure 105 will be installed at the outlet end of drainage main I to drop the water into Red Slough without creating an overfall. Grade stabilization structures 103, 104, 106, and 107 will be installed to stabilize existing overfalls of small tributaries in the lower reach of Choctaw Creek. These structures will be designed and installed in accordance with standards and specifications contained in the Work Unit Technical Guides. Pertinent data concerning these structures are shown on table 3B.

Basic facilities for recreation will be provided at Sites 35 (Iron Ore Lake) and Site 38 (Waterloo Lake). They will include access roads, parking areas, boat docks and launching ramps, beach areas, sanitary facilities, picnic areas, camping areas, shelters, paths and trails, landscaping and utilities. Figures 4, 5, 6, and 7 show the locations of the lakes, as well as the basic facilities. Facilities for each recreation site are shown in the following tabulation:

BASIC RECREATIONAL FACILITIES
Site 35 (Iron Ore Lake)

Item	Design	Unit	Quantity	Unit Cost (dollars)	Total Cost Estimated (dollars)
1. Land Clearing		Acre	20	100	2,000
2. Circulation					
A. Access Roads					
(1) Entrance	Hard Surface	Mile	0.4	35,000	14,000
(2) Interior	Hard Surface	Mile	1.6	35,000	56,000
(3) Service	Gravel	Mile	0.6	7,000	4,200
B. Walks	Hard Surface	Sq. Ft.	30,000	0.15	4,500
C. Trails		Mile	4.5	200	900
3. Parking Areas	Hard Surface				
A. Picnicking Areas	125-car	Sq. Ft.	36,000	0.15	5,400
B. Boat Areas	60-car	Sq. Ft.	24,000	0.15	3,600
C. Overlook Area	25-car	Sq. Ft.	6,000	0.15	900
D. Swimming Area	150-car	Sq. Ft.	42,000	0.15	6,300
4. Picnicking					
A. Tables	Concrete	No.	125	150	18,750
B. Base and Post for Refuse Can		No.	65	15	975
C. Drinking Fountains		No.	4	50	200
D. Fireplaces or Grills		No.	65	50	3,250
E. Shelters w/Rest Rooms		No.	2	10,000	20,000
5. Camping - Tent and Trailer					
A. Family Units		No.	40	350	14,000
B. Water Outlets		No.	8	50	400
C. Electric Outlets		No.	20	50	1,000
D. Wash House		No.	1	12,000	12,000
6. Swimming					
A. Beach	Sand	Cu. Yd.	1,000	2	2,000
B. Retaining Wall	Concrete	Lin. Ft.	500	6	3,000
C. Grading					1,000
D. Bath House		No.	1	15,000	15,000
E. Drinking Fountains		No.	2	50	100
7. Boating and Fishing					
A. Launching Ramps (includes grading to 12-15% slope)	Concrete (200' x 25')	No.	2	3,500	7,000
B. Docks	200' x 8'	No.	2	3,000	6,000
8. Utilities					
A. Water	1" line	Lin. Ft.	4,000	2.50	10,000
B. Sewage					
(1) Septic Tank and Field		No.	4	2,500	10,000
C. Power		Lin. Ft.	6,000	1	6,000
D. Refuse					1,000

BASIC RECREATIONAL FACILITIES - Continued
Site 35 (Iron Ore Lake)

Item	Design	Unit	Quantity	Unit Cost (dollars)	Total Cost Estimated (dollars)
9. Signs and Markers					1,325
10. Fencing and Gates					
A. Fencing		Lin. Ft.	8,000	0.40	3,200
B. Cattle Guards		No.	2	250	500
C. Gates		No.	5	100	500
11. Planting					
A. Landscaping and Vegetation		Acre	150	40	6,000
B. Afforestation		Acre	150	100	15,000
Total Facilities Cost					256,000
Contingencies					25,600
TOTAL ESTIMATED FACILITIES COST					281,600

BASIC RECREATIONAL FACILITIES
Site 38 (Waterloo Lake)

Item	Design	Unit	Quantity	Unit Cost (dollars)	Total Cost Estimated (dollars)
1. Land Clearing		Acre	10	100	1,000
2. Circulation					
A. Access Roads					
(1) Entrance	Hard Surface	Mile	.34	35,000	11,900
(2) Interior	Hard Surface	Mile	1.60	35,000	42,000
B. Walks	Hard Surface	Sq. Ft.	8,000	0.15	1,200
C. Trails		Mile	2.5	200	500
3. Parking Areas	Hard Surface				
A. Picnicking Area	100-car	Sq. Ft.	30,000	0.15	4,500
B. Boat Area	20-car	Sq. Ft.	8,000	0.15	1,200
4. Picnicking					
A. Tables	Concrete	No.	95	150	14,250
B. Fireplaces or Grills		No.	47	50	2,350
C. Base and Post for Refuse Can		No.	47	15	705
D. Drinking Fountains		No.	10	50	500
E. Shelter-Rest Room Buildings		No.	3	10,000	30,000
5. Boating and Fishing					
A. Launching Ramps	20' x 100'	No.	1	2,000	2,000
B. Dock	10' x 100'	No.	1	1,500	1,500
6. Utilities					
A. Water					5,000
B. Sewage					7,000
C. Power					3,000
D. Refuse					500
7. Landscaping and Vegetation					1,000
8. Signs and Markers					995
Total Facilities					131,100
Contingencies					13,110
TOTAL ESTIMATED FACILITIES COST					144,210

The total estimated cost of all structural measures is $8,717,397. This includes $3,436,674 for floodwater retarding structures, $640,909 for stream channel improvement, $22,326 for grade stabilization structures, $4,602,699 for multiple-purpose structures including basic recreational facilities, and $14,789 for drainage main and laterals.

Figures 1, 2, 2A, and 3 show structures which are typical of those planned for this watershed. Tables 1, 2, 3, 3A, and 3B show details on quantities, costs, and design features.

All applicable State water laws will be complied with in design and construction of the planned structural measures.

EXPLANATION OF INSTALLATION COSTS

Land Treatment

Land treatment measures to be applied by local interests during the installation period are estimated to cost $2,258,955. This includes Public Law 46 technical assistance by the Soil Conservation Service and Agricultural Conservation Program cost sharing as administered by the Agricultural Stabilization and Conservation Service. To speed up the application of land treatment measures, $25,267 of Public Law 566 funds will be used for accelerated technical assistance during the 7-year period. This amount includes $9,614 for the completion of standard soil surveys during the first two years of the installation period. Costs are based on 1965 prices that were paid by local farmers to establish land treatment measures.

Floodwater Retarding Structures

The construction cost of the 34 single-purpose floodwater retarding structures, amounting to $2,081,200, and associated installation services cost of $524,633 will be borne by Public Law 566 funds. The total Public Law 566 cost for the installation of these structures is $2,605,833.

Land, easements, and rights-of-way, including relocations, for these structures will be furnished by the local organizations. The estimated value of land easements, legal fees, changes in utilities, and roads and bridges is $813,841, which includes the values of those easements that will be donated. The cost of administration of contracts, $17,000, will be borne by local sponsors.

Stream Channel Improvement

The estimated construction cost of $391,600 for stream channel improvement and associated installation services cost of $79,059 will be borne by Public Law 566 funds. Land, easements, rights-of-way, legal fees and

and relocations costs amounting to $168,750 will be borne by the sponsors along with the cost of contract administration, $1,500.

Grade Stabilization Structures

The estimated construction cost of the 7 grade stabilization structures, $15,950, and associated installation costs, $4,651, will be borne by Public Law 566 funds. The cost of land, easements, legal fees, and rights-of-way, $725, and contract administration, $1,000, will be borne by the sponsors.

Multiple-Purpose Structures

The Use of Facilities Method was used to allocate joint construction and installation services costs to purpose to be served for each multiple-purpose reservoir. The costs of the diversion works are specific costs and are allocated to municipal water supply. The following tabulation shows the allocation of storage to purpose for these structures:

ALLOCATION BY PURPOSE

Choctaw Creek Watershed, Texas

Structure	Flood Prevention		Municipal		Recreation		Irrigation		Total	
	Ac. Ft.	Percent	Ac. Ft.	Percent	Ac. Ft.	Percent	Ac. Ft.	Percent	Ac. Ft.	Percent
1	6,142	46.80	6,981	53.20	-	-	-	-	13,123	100
4	3,938	36.00	7,002	64.00	-	-	-	-	10,940	100
13	1,698	36.67	2,932	63.33	-	-	-	-	4,630	100
30	1,139	56.98	860	43.02	-	-	-	-	1,999	100
34	383	79.13	-	-	-	-	101	20.87	484	100
35	4,060	32.36	6,352	50.62	2,136	17.02	-	-	12,548	100
38	1,279	70.31	-	-	540	29.69	-	-	1,819	100

In connection with the multiple-purpose Site 35, which incorporates capacity for flood detention, municipal water and recreation, all costs of fee title land rights, including relocation and modification of existing improvements, were allocated between municipal water supply and recreation. The percentage allocated to recreation was determined on the basis of the total land area required for the dam and reservoir minus the reservoir area for municipal water and divided by the total area for the dam and reservoir. The remainder was allocated to municipal water supply.

Refer to the following tabulation for specific details:

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ALLOCATION OF COST OF LAND RIGHTS, RELOCATIONS, ETC., TO PURPOSE AND COST SHARING 1/

Choctaw Creek Watershed, Texas - Site 35
(Sherman)

Item	Total Acres	Incremental Area Acres	Incremental Area Percent	Allocation	Cost Sharing: Sponsor Acres	Sponsor Percent	Sponsor Cost	PL 566 Acres	PL 566 Percent	PL 566 Cost
Pee Title	900	344	38.22	Recreation	172	-	99,945	172	-	99,945
Top of M & I Pool	536	306	34.00	M & I	306	-	177,820	-	-	-
Top of Recreation Pool	250	250	27.78	Recreation	125	-	72,645	125	-	72,645
Total Reservoir	xxx	900	100.00	xxx	603	67.00	350,410	297	33.00	172,590
Recreation Area	170	170	xxx	Recreation	85	50.00	42,500	85	50.00	42,500
SUMMARY	xxx	1,070	xxx	xxx	688	2/64.62	392,910	382	2/35.38	215,090

1/ Does not include area for which flowage easements will be obtained.

2/ Percent cost sharing to be used in Watershed Work Plan Agreement.

Benefits which will accrue from installation of multiple-purpose drainage main and laterals were deemed inseparable and were allocated 50 percent to drainage and 50 percent to flood prevention; therefore, the second alternative, Section 1132.2 of the Watershed Protection Handbook, was used to allocate costs to flood prevention and drainage. The allocation of costs is shown in table 2A.

Public Law 566 funds will bear all construction and installation services costs allocated to flood prevention, one-half of the construction costs and all of the installation services costs allocated to agricultural water management (drainage) and recreation development. In addition, Public Law 566 funds will bear one-half of construction, installation services, land, easements, and rights-of-way costs allocated to recreation facilities. Other funds will bear the entire cost of all land, easements, rights-of-way and administration of contracts allocated to flood prevention. In addition, local interests will bear the entire cost of construction, installation services, land, easements, rights-of-way, administration of contracts, and water rights allocated to municipal and agricultural water management (irrigation) development. Local interests will pay one-half of the cost of construction, land, easements, rights-of-way, the entire cost of administering contracts and obtaining water rights, and one-half the cost of installation services associated with the construction of basic recreation facilities.

The cost sharing summary for each multiple-purpose site and the multiple-purpose drainage main and laterals is shown on the following tabulations:

Multiple-Purpose Site 1
(Sherman)

Item	Total Cost Dollars	Estimated Sponsors' Cost Percent	Estimated Sponsors' Cost Dollars	Estimated PL 566 Cost Percent	Estimated PL 566 Cost Dollars
nstruction					
Multiple-Purpose Structure	718,300	53.20	382,136	46.80	336,164
stallation Services					
Multiple-Purpose Structure	132,077	53.20	70,265	46.80	61,812
id, Easements, and Rights-of-Way	251,500	100.00	251,000	-	-
:er Rights	1,500	100.00	1,500	-	-
ministration of Contract	5,000	100.00	5,000	-	-
CAL	1,108,377		710,401		397,976

Multiple-Purpose Site 4
(Sherman)

Item	Total Cost Dollars	Estimated Sponsors' Cost Percent	Estimated Sponsors' Cost Dollars	Estimated PL 566 Cost Percent	Estimated PL 566 Cost Dollars
istruction					
Multiple-Purpose Structure	462,000	64.00	295,680	36.00	166,320
tallation Services					
ultiple-Purpose Structure	84,950	64.00	54,368	36.00	30,582
d, Easements, and Rights-of-Way	181,500	100.00	181,500	-	-
er Rights	1,500	100.00	1,500	-	-
inistration of Contracts	5,000	100.00	5,000	-	-
AL	734,950		538,048		196,902

Multiple-Purpose Site 13
(Howe)

Item	Total Cost Dollars	Estimated Sponsors' Cost Percent	Estimated Sponsors' Cost Dollars	Estimated PL 566 Cost Percent	Estimated PL 566 Cost Dollars
Construction					
Multiple-Purpose Structure	210,100	63.33	133,056	36.67	77,044
Diversion Works	75,000	100.00	75,000	-	-
Installation Services					
Multiple-Purpose Structure	38,632	63.33	24,466	36.67	14,166
Diversion Works	9,000	100.00	9,000	-	-
Land, Easements, and Rights-of-Way	87,125	100.00	87,125	-	-
Water Rights	1,500	100.00	1,500	-	-
Administration of Contract	1,000	100.00	1,000	-	-
TOTAL	422,357		331,147		91,210

Multiple-Purpose Site 30
(Bells)

Item	Total Cost Dollars	Estimated Sponsors' Cost Percent	Estimated Sponsors' Cost Dollars	Estimated PL 566 Cost Percent	Estimated PL 566 Cost Dollars
Construction					
Multiple-Purpose Structure	129,800	43.02	55,840	56.98	73,960
Diversion Works	75,000	100.00	75,000	-	-
Installation Services					
Multiple-Purpose Structure	28,072	43.02	12,077	56.98	15,995
Diversion Works	9,000	100.00	9,000	-	-
Land, Easements, and Rights-of-Way	34,000	100.00	34,000	-	-
Water Rights	1,000	100.00	1,000	-	-
Administration of Contract	1,000	100.00	1,000	-	-
TOTAL	277,872		187,917		89,955

Multiple-Purpose Site 34
(Irrigation)

Item	Total Cost Dollars	Estimated Sponsors' Cost Percent	Estimated Sponsors' Cost Dollars	Estimated PL 566 Cost Percent	Estimated PL 566 Cost Dollars
Construction					
Multiple-Purpose Structure	42,900	20.87	8,953	79.13	33,947
Installation Services					
Multiple-Purpose Structure	11,582	20.87	2,418	79.13	9,164
Land, Easements, and Rights-of-Way	5,600	100.00	5,600	-	-
Water Rights	100	100.00	100	-	-
Administration of Contracts	500	100.00	500	-	-
TOTAL	60,682		17,571		43,111

Multiple-Purpose Site 35
(Sherman)

Item	Total Cost Dollars	Estimated Sponsors' Cost Percent	Estimated Sponsors' Cost Dollars	Estimated PL 566 Cost Percent	Estimated PL 566 Cost Dollars
Construction					
Multiple-Purpose Structure	597,300	59.13	353,184	40.87	244,116
Installation Service					
Multiple-Purpose Structure	109,829	50.62	55,596	49.38	54,233
Land Rights					
Land (900 acres) Including Relocations	523,000	-	350,410	-	172,590
Flowage Easements (15 acres)	3,750	100.00	3,750	-	-
Administration of Contract	5,000	100.00	5,000	-	-
Water Rights	1,500	100.00	1,500	-	-
Legal Fees and Lsnd Surveys	13,000	100.00	13,000	-	-
Subtotal - Reservoir	1,253,379		782,440		470,939
Recreation Development					
Land (170 acres)	85,000	-	42,500	-	42,500
Facilities	281,600	50.00	140,800	50.00	140,800
Installation Services	51,778	50.00	25,889	50.00	25,889
Administration of Contract	1,000	100.00	1,000	-	-
Legal Fees	2,000	100.00	2,000	-	-
Subtotal - Recreation	421,378		212,189		209,189
TOTAL PROJECT	1,674,757		994,629		680,128

Multiple-Purpose Site 38
(Denison)

Item	Total Cost Dollars	Estimated Sponsors' Cost Percent	Estimated Sponsors' Cost Dollars	Estimated PL 566 Cost Percent	Estimated PL 566 Cost Dollars
onstruction	103,400	14.845	15,350	85.155	88,050
nstallation Services	24,576	-	-	100.00	24,576
and Rights					
Land (21 acres) Including Relocations	16,800	-	8,400	-	8,400
Flowage Easements (25 acres)	5,000	100.00	5,000	-	-
Administration of Contract	500	100.00	500	-	-
Water Rights	100	100.00	100	-	-
Legal Fees and Land Surveys	1,000	100.00	1,000	-	-
Subtotal - Reservoir	151,376		30,350		121,026
ecreation Development					
Land (1 acre)	1,000	-	500	-	500
Facilities	144,210	50.00	72,105	50.00	72,105
Installation Services	26,518	50.00	13,259	50.00	13,259
Administration of Contract	500	100.00	500	-	-
Legal Fees	100	100.00	100	-	-
Subtotal - Recreation	172,328		86,464		85,864
OTAL PROJECT	323,704		116,814		206,890

Multiple-Purpose Drainage Main I and Laterals IA, IB, and IC

Item	Total Cost Dollars	Estimated Sponsors' Cost Percent	Estimated Sponsors' Cost Dollars	Estimated PL 566 Cost Percent	Estimated PL 566 Cost Dollars
onstruction	7,700	25.00	1,925	75.00	5,775
nstallation Services	3,239	-	-	100.00	3,239
and Rights					
Easements, etc.	3,350	100.00	3,350	-	-
Administration of Contract	500	100.00	500	-	-
OTAL PROJECT	14,789		5,775		9,014

Summary of All Costs

The total installation cost of the structural measures (including recreation facilities) is estimated to be $8,717,397. Of this total, $5,336,060 is for construction; $1,137,596 is for installation services; $2,197,041 is for land, easements, rights-of-way, etc.; $39,500 is for administration of contracts; and $7,200 is for water rights (table 1). The Public Law 566 share is $4,812,279, which includes $3,727,031 for construction; $861,258 for installation services; and $223,990 for easements and rights-of-way. The local share of the cost is $3,905,118, which includes $1,609,029 for construction; $276,338 for installation services; $1,973,051 for value of land, easements, and legal fees; $39,500 for contract administration; and $7,200 for water rights (table 2).

Construction costs include the engineer's estimate and contingencies. The engineer's estimate was based on the unit cost of structures in similar areas modified by special conditions inherent to each individual site location. Ten percent of the engineer's estimate was added as a contingency to provide funds for unpredictable construction costs.

Installation services consist of engineering and administrative costs and are based on analysis of previous work in similar areas. The engineering portion of this cost consists of, but is not limited to, detailed surveys, geological investigations, laboratory reports, designs, cartographic services, and inspection services.

Cost of land, easements, and rights-of-way was estimated by representatives of the local sponsors and concurred in by the Service. The estimated cost for altering or re-routing roads, utility and pipe lines was furnished by the County Commissioners Court and the utility and pipeline companies.

The estimated schedule of obligations for the 7-year installation period, covering installation of land treatment and structural measures, is as follows:

Schedule of Obligations

Fiscal Year	Measure	Public Law 566 Funds (dollars)	Other Funds (dollars)	Total (dollars)
1st	Sites 35, 37, 38, 11, and Land Treatment	802,990	1,471,104	2,274,094
2nd	Sites 2, 3, 8, 9, 10, 36, 39, 40, Post Oak Creek Stream Channel Improvement, Recreational Facilities Site 35, and Land Treatment	902,260	754,112	1,656,372
3rd	Recreational Facilitiea Site 38, Sites 4, 5, 6, 7, 12, 14, 15, 16, 101, 102, and Land Treatment	760,421	1,025,560	1,785,981
4th	Sites 17, 18, 19, 20, 21, 22, 23, 24, 25, and Land Treatment	699,984	454,798	1,154,782
5th	Sites 26, 27, 28, 29, 31, 32, Mill Creek Stream Channel Improvement, and Land Treatment	506,986	405,448	912,434
6th	Sites 13, 33, 34, 41, Choctaw Creek Stream Channel Improvement, and Land Treatment	655,402	803,966	1,459,368
7th	Sites 1, 30, 103, 104, 105, 106, 107, Drainage Main I and Laterals IA, IB, IC, and Land Treatment	509,503	1,223,818	1,733,321
TOTAL		4,837,546	6,138,806	10,976,352

EFFECTS OF WORKS OF IMPROVEMENT

This comprehensive plan for watershed protection, flood prevention, water resource development and recreation, and drainage will benefit approximately 100,000 residents of the watershed. At the expected rate of growth in this area, it is anticipated that well in excess of 200,000 people will benefit from this project during its life.

The installation of the land treatment and structural measures will directly benefit about 100 owners and operators of the 10,100 acres of flood plain in agricultural production below floodwater retarding structures. The installation of needed land treatment measures throughout the watershed will bring about a slight reduction in flood damages which are occurring on about 256 acres of flood plain land on tributaries not protected by structural measures.

Upland erosion rates in the watershed are expected to be reduced by an average of 22 percent after the application of needed land treatment measures. Treatment of gullies and restoration of vegetative cover within the steeply sloping, high erosion area of the Blackland Prairies (figure 8) is expected to reduce erosion in this area by approximately 50 percent. A reduction of 20 percent through better management of cover and crop residues for soil protection is expected in the intensively cultivated, moderate erosion area of the Blackland Prairies. A general improvement of cover conditions on grassland and cropland in the low erosion areas of the Blackland Prairies, East Cross Timbers, and Red River terrace soils will reduce erosion by an estimated 15 to 18 percent.

Overbank deposition damage will be reduced by 76 percent in Evaluation Reach 1, 66 percent in Reach 4, and 50 percent in Reach 7 after installation of the combined project of land treatment and structural measures (figure 8). Land treatment measures alone will bring about a reduction of 50 percent in Reach 1, 16 percent in Reach 4, and 20 percent in Reach 7. A similar reduction in sediment load and associated loss of channel capacity due to filling by sediment is expected on streams flowing out of these areas.

Had the project been installed during the evaluation period, 1930-1962, 45 of the 51 major floods would have been reduced to minor floods, inundating less than half of the flood plain, and 48 of the minor floods would have been eliminated. The storm of September 7 and 8, 1962 inundated 9,400 acres of agricultural land below proposed floodwater retarding structures. Had the complete project been installed, flooding would have been reduced to 6,800 acres.

The following tabulation shows expected flood for both with and without project conditions for recurrence intervals of 1, 2, 5, and 25 years:

AREA INUNDATED								
	Average Recurrence Interval							
	1-Year		2-Year		5-Year		25-Year	
Evaluation Reach (Figure 8)	Without Project (acres)	With Project (acres)	Without Project (acres)	With Project (acres)	Without Project (acres)	With Project (acres)	Without Project (acres)	With Project (acres)
1	3,600	66	4,520	1,050	5,940	3,710	6,980	5,160
2	695	258	820	500	950	725	1,040	850
3	290	19	535	165	855	458	1,045	775
4	145	11	213	37	256	163	290	202
5				Urban Reach				
6	155	43	202	132	275	164	319	235
7	49	41	61	54	75	67	94	80
TOTAL	4,934	438	6,351	1,938	8,351	5,287	9,768	7,302

Approximately 800 acres of fertile land will be restored to its former state of high productivity as a result of project installation. About half of this acreage will be returned to improved pasture and the balance will be used for alfalfa production. These crops will improve standards of living of farm operators of the watershed, as well as producing additional benefits to suppliers of equipment, fertilizers, and like commodities. It is not expected that this increase in production will result in any increase of farm crops in surplus supply.

Site 34 will provide water for irrigation of 25 acres of improved pasture. The supplemental water supply will make possible more intensive management of improved pasture with a resultant increase in efficiency of beef production.

Figure 9 shows the urban area of Sherman that will be inundated by a 100-year frequency storm under both without and with project conditions. The combination of floodwater retarding structures 8, 9, 10, and 11 and stream channel improvement of Post Oak Creek will provide protection from the 100-year event except for a few residences and commercial establishments which were built in exceptionally low lying areas. The project will also protect approximately 17 acres of land in West Hill Cemetery not utilized under present conditions because of frequent flooding. No monetary evaluation was made of this benefit although it is obvious that substantial benefits will accrue in the form of revenue from sale of additional burial plots and reduction in annual maintenance costs.

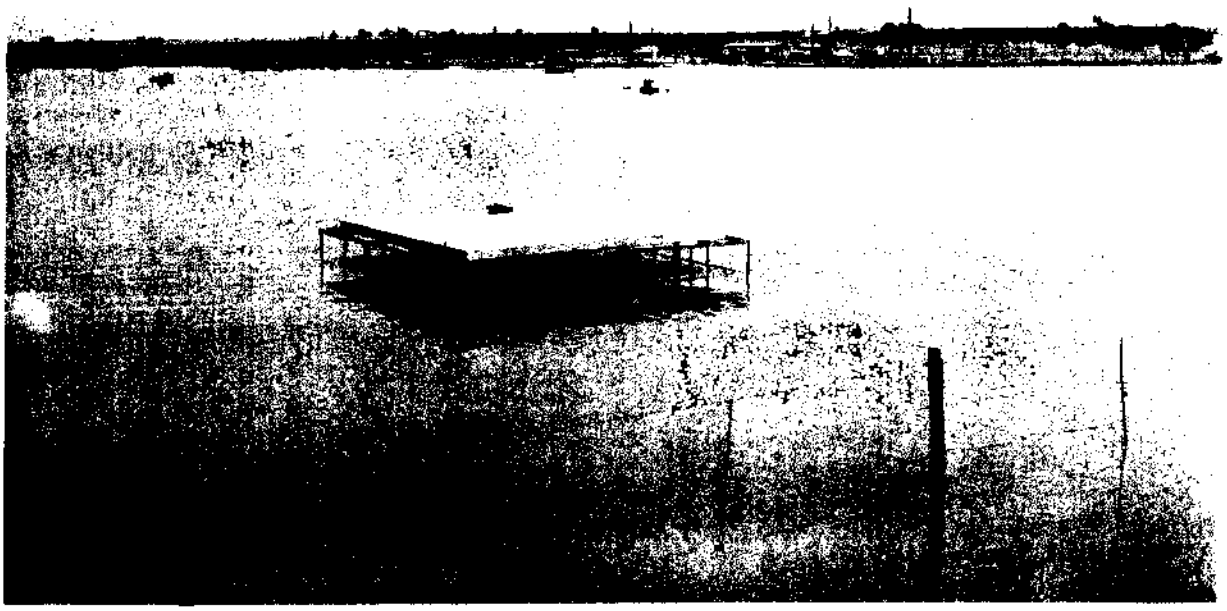
Installation of 4.09 miles of drainage main and lateral ditches will enable 14 operators to install on-farm drainage systems on 260 acres of wet land. This will increase yields and will result in more efficient farming operations on about 1,100 acres adjacent to the wet area. These measures will also reduce the cost of installing irrigation systems on 1,352 acres of

land in this area considered suitable for irrigation as shown in "Reconnaissance Report on Libert Bottoms Project, Oklahoma - Texas," by the Bureau of Reclamation, U. S. Department of Interior, dated February 1958.

Sites 1, 4, 13, 30, and 35 will provide municipal water storage for the cities of Sherman, Howe, and Bells, Texas. This is an excellent opportunity for these cities, faced with a limited economical ground water supply, to supplement their water supply for the future. The city of Sherman has been investigating possible sources of surface water supply for several years. These reservoirs can supply this invaluable resource at a reasonable cost to the municipalities concerned. The use of these sites for single-purpose flood prevention structures only would severely handicap these cities in their quest for this sorely needed resource. The significance of an adequate supply of good water becomes more apparent with each passing year. This additional water will attract industry, increase payrolls, instill a deeper sense of well-being in the present populace, and will provide for future expansion. The following tabulation shows pertinent data about structures which contain storage for municipal water supply purposes:

Structure	Sponsor	Amount of Municipal Storage Acre-Feet	Dependable Yield Million Gallon/Day
1	Sherman	6,981	1.30
4	Sherman	7,002	1.00
13	Howe	2,932	.45
30	Bells	860	.18
35	Sherman	6,352	1.00

Structures 35 and 38 will include recreation storage and will provide basic recreation facilities for public use. These facilities will complement, rather than compete with, Lakes Texoma and Loy. Recreation facilities will enable visitors to enjoy fishing, swimming, water skiing, boating, sightseeing, picnicking, camping, strolling along nature trails, and relaxing. In addition, facilities will be available for such playground activities as softball, horseshoe and washer pitching, and related activities. Facilities will provide for the needs of 2,700 people during peak days expected during special weekends and holidays. Comparatively mild, short winters will permit some form of recreation throughout the year, with the most usage during May through August. It is estimated that 115,000 visitors will benefit from these facilities annually.



The sediment pools of floodwater retarding structures will offer excellent opportunities for the development of income-producing recreation facilities such as these, which are located in a nearby watershed.

In addition to the multiple-purpose structures planned for recreation, the municipal and irrigation water supply pools and the sediment pools of floodwater retarding structures open to the public will be utilized for recreation. These pools, when properly managed, are excellent fishing waters for largemouth bass, channel catfish, and sunfish. Installation of land treatment measures on the watershed will improve the habitat for bobwhite quail, rabbits, and other small animals and birds. Proper use of pasture grasses, installation of grassed waterways, cover cropping, and crop residue use will add to the effectiveness of planned wildlife habitat development, and wildlife habitat preservation. This combined treatment will provide more ground cover and food for furbearers, game birds, and animals. The aforementioned effects of project installation will provide an excellent opportunity for the development of income-producing recreation enterprises in association with normal farming operations.

The farm family will benefit from increased income. Of even greater importance is the fact that each member of the family, young or old, can participate actively in the farming operation and can take pride in the fact that he or she is making an important contribution to the family's well-being. This sense of pride and satisfaction has been the motivating force throughout the entire history of our nation's development, and no opportunity to encourage future development of this attribute should be lost.

Secondary benefits will accrue to the trade area as a result of increased activity and business to those who furnish farm equipment, petroleum products, fertilizers, farm supplies, and the various services associated with a farming and ranching community.

PROJECT BENEFITS

The estimated average annual monetary damages (table 5) within the watershed will be reduced from $254,939 to $49,053, a reduction of 81 percent.

Crop and pasture damages, excluding indirect damages, will be reduced from $96,369 to $24,870 or 74 percent. Other agricultural damages, such as losses of fences, farm equipment, etc., will be reduced from $35,747 to $9,054 or 75 percent. Road and bridge damage will be reduced from $21,340 to $1,508 or 93 percent. Urban damage in the city of Sherman will be reduced from $54,650 to $3,150 or 94 percent. Of the $205,886 damage reduction benefits attributable to the project, $197,039, or 96 percent, is the result of structural measures, with the remaining 4 percent reduction the result of the land treatment.

The average annual floodwater, sediment and erosion damage reduction in the benefited area is presented as follows for each evaluation reach shown in figure 8:

Evaluation Reach (figure 8)	Without Project (dollars)	With Project (dollars)	Reduction (percent)
1	134,961	28,922	79
2	22,579	6,998	69
3	15,213	3,100	80
4	9,672	3,097	68
5	60,115	3,465	94
6	8,991	1,646	82
7	3,408	1,825	46
TOTAL	254,939	49,053	81

Valley trenching occurring at the rate of $1,075 annually will be reduced to $747 annually as a result of the project. Flood plain scour damages occurring throughout the watershed will be reduced from $18,514 to $3,840, a reduction of 79 percent.

Damages from overbank deposition of infertile sediment upon formerly fertile land amount to $2,068 under present conditions. This will be reduced to $745 after project installation, a reduction of 64 percent. Channel deposition will be reduced from $2,000 to $680 under project conditions, a reduction of 66 percent.

Benefits from restoration of flood plain land to its former state of productivity as a result of project installation are expected to accrue at the rate of $26,619 annually. These benefits will result from returning approximately 800 acres of formerly cultivated land now in low grade pasture to improved pasture and alfalfa production. This figure allowed for a lag of 5 years in accrual of expected benefits. The loss from the original production has been included in the crop and pasture damage and its restoration a benefit in table 5.

Incidental recreation benefits will be $4,323 annually.

Benefits of $1,900 annually can reasonably be expected to accrue as a result of installing the drainage system for the 260 acres of wet land. Benefits from irrigation amounting to $2,331 annually will result from providing 100 acre-feet of capacity for this purpose in Site 34.

The 2 multiple-purpose structures with associated recreation facilities will produce approximately $153,598 in annual benefits to residents of the area.

Benefits accruing as a result of developing municipal water storage for the cities of Sherman, Bells, and Howe are expected to be $67,918 annually.

Secondary benefits are not considered pertinent from a national viewpoint, but are expected to average $37,313 annually in the immediate locale. This amount, which excludes indirect benefits in any form, results from $33,110 in secondary benefits stemming from the project and $4,203 induced by the project.

Other substantial benefits will accrue to the project, such as increased sense of security, a more satisfying environment in which to work and rear a family, and a deeper feeling of well-being, secure in the knowledge that one is living in a more wholesome community. These benefits, although extremely important, have not been evaluated in monetary terms, nor have they been used for project justification.

COMPARISON OF BENEFITS AND COSTS

The total average annual cost of structural measures and basic recreational facilities (amortized total installation cost, plus operation, maintenance, and replacement) is $314,164. These measures are expected to produce average annual primary benefits of $427,109. The ratio of primary benefits to cost will be 1.4 to 1.0. The ratio of total average annual project benefits ($464,422) to the average annual cost of structural measures and basic recreational facilities ($314,164) is 1.5 to 1.0 (table 6).

PROJECT INSTALLATION

Farmers will be encouraged to establish the remaining land treatment measures in cooperation with the Upper Elm-Red Soil and Water Conservation District during a 7-year installation period. The governing body of the Soil and Water Conservation District will assume aggressive leadership in accelerating the land treatment program now being applied. Maintenance of all existing conservation measures will also be encouraged.

The Soil Conservation Service will provide any additional technical assistance needed to the Soil and Water Conservation District to accelerate the planning and application of soil, plant, and water conservation measures. The Grayson County ASCS County Committee will cooperate with the governing body of the Upper Elm-Red Soil and Water Conservation District and the Choctaw Watershed Water Improvement District in selecting, for financial assistance, those practices which will accomplish the conservation objectives in the shortest possible time. The Extension Service will assist in the educational phase of the program by holding local farm meetings, preparing press, radio and televison releases, and using other methods of getting information to watershed landowners and operators. Soil and water conservation loans available through the Farmers Home Administration will be given special emphasis. Present FHA clients in the watershed will be

encouraged to cooperate in the program. The goal of the application of 80 percent of the needed land treatment practices by or before the end of the installation period is expected to be accomplished as follows:

Land Use	FISCAL YEAR							
	1st (acres)	2nd (acres)	3rd (acres)	4th (acres)	5th (acres)	6th (acres)	7th (acres)	Total (acres)
Cropland	4,587	4,587	4,587	4,587	4,587	4,587	4,588	32,110
Pastureland	10,617	10,617	10,617	10,617	10,618	10,618	10,618	74,322
TOTAL	15,204	15,204	15,204	15,204	15,205	15,205	15,206	106,432

The Choctaw Watershed Water Improvement District will act as the Contracting Local Organization to administer the contracts for the construction of all planned structural measures. The water district will make arrangements for necessary legal, administrative, and clerical personnel, facilities, supplies and equipment to advertise, award, and administer the contracts. The water district will select and appoint a Contracting Officer. His letter of appointment will include a listing of duties, responsibilities, and authorities. The individual appointed as Contracting Officer will be available at all times to carry out his duties. He should be selected on the basis of his administrative ability. Legal, accounting, and/or engineering background would be helpful assets to the Contracting Officer. He will be provided with clerk-typist assistance, available to him at all times. He will also be provided with office space at a recognized location easily accessible to the public and construction contractors. Arrangements will be made by the Contracting Officer to handle formal construction contract bid openings, publicly conducted and attended by approximately 20 persons. The Contracting Officer will be provided with transportation facilities so that he will be able to make inspection trips to the locations of apparent low bidders' equipment plants and to all construction sites as necessary to perform his duties.

Land, easements, and rights-of-way, including utility, pipe line, road and improvement changes, will be acquired for the planned structural measures by the responsible sponsoring organization as set forth herein:

Choctaw Watershed Water Improvement District and Grayson County Commissioners Court:

1. All single-purpose floodwater retarding structures except Nos. 10 and 11.

2. Multiple-purpose structure No. 34.

3. All grade stabilization structures.

4. Stream channel improvement on Choctaw Creek, 88,700 feet; 7,850 feet of stream channel improvement on Mill Creek, and 21,600 feet of drainage main I and laterals IA, IB, and IC in the Carpenters Bluff area.

City of Sherman:

1. Multiple-purpose structures 1, 4, and 35 (Iron Ore Lake).

2. Single-purpose floodwater retarding structures Nos. 10 and 11.

3. Stream channel improvement on Post Oak Creek, 13,600 feet.

City of Denison:

Multiple-purpose structure No. 38 (Waterloo Lake).

City of Howe:

Multiple-purpose structure No. 13.

City of Bells:

Multiple-purpose structure No. 30.

Each sponsoring local organization is a political subdivision of State government. As such, each has the authority under applicable State law to exercise the right of eminent domain, if necessary, to acquire such land, easements, or rights-of-way, including utility, pipe line, road and improvement changes, as will be needed in connection with the works of improvement to be installed with Federal assistance.

The legal adequacy of easements, permits, etc., for the construction of the planned structural measures will be determined by the sponsoring local organization that has the responsibility for land, easements, and rights-of-way.

The cities of Sherman, Howe, and Bells will engage the services of private engineers to prepare the construction plans and specifications for multiple-purpose structures Nos. 1, 4, 13, 30, and 35. The private engineers engaged must:

1. Prepare construction plans and specifications in accordance with applicable Service standards, including making of field surveys, foundation and embankment stability investigations, and such

other investigations, studies, and designs as are required. This will include plans and specifications for the municipal and industrial water control features associated with these structures.

2. Represent the city with the Texas Water Rights Commission in obtaining water rights.

The cities of Sherman and Denison each will be expected to provide engineering and architectural services, without Federal cost sharing, from their regularly employed staffs to prepare plans and specifications and to supervise construction of the recreation facilities at Sites 35 and 38, respectively. Service personnel will assist, as available, with on-site locations, designs, and supervision of construction. If the cities do not have a regularly employed staff and private consulting engineering and architectural services are required, the Federal cost sharing will not exceed 50 percent of the payments made for such services.

No engineering services involving expenditure of Federal funds, either by the utilization of the sponsoring local organizations forces or by contract with professional engineers or firms, will be engaged prior to the execution of an Architectural and Engineering Project Agreement with the Service. Selection of professional engineers or firms will be in accord with Service policy and with Service approval.

The Soil Conservation Service will:

1. Provide technical assistance in the design, preparation of plans and specifications for the construction of all structural measures except multiple-purpose structures Nos. 1, 4, 13, 30, and 35.

2. Provide to the private engineers such criteria as are necessary to insure that structures meet Service standards.

3. Approve work done under the A & E contracts in accordance with the established policies of the Service.

4. Provide technical assistance in the supervision of construction, preparation of contract payment estimates, final inspection, execution of certificate of completion, and related tasks necessary to establish all of the planned structural measures.

5. For basic recreation facilities, Service personnel will assist, as available, with on-site locations, designs, and supervision of construction.

The structural measures will be installed during a 7-year installation period pursuant to the following conditions:

1. The requirements for land treatment in the drainage area above the floodwater retarding structures and the multiple-purpose structures have been met.

2. All land, easements, rights-of-way, and permits have been obtained for all structural measures or written assurance has been furnished by the Choctaw Watershed Water Improvement District, the Grayson County Commissioners Court, and the cities of Sherman, Denison, Howe, and Bells, giving a schedule for remaining non-cleared sites, by site number, and the exact date by which all land rights therefor will be obtained or their right of eminent domain used to secure any remaining land, easements, or rights-of-way, and that sufficient funds are available for purchasing those easements and rights-of-way and for condemnation proceedings and awards.

3. Water rights for storage of water for all purposes have been obtained.

4. Court orders have been obtained from the Grayson County Commissioners Court that the county roads affected by the floodwater retarding structures and those multiple-purpose structures having municipal water storage only will be relocated or raised 2 feet above emergency spillway crest elevation at no expense to the Federal government or closed or permission granted to temporarily inundate the road, provided equal alternate routes can be provided.

5. Court orders have been obtained from the Grayson County Commissioners Court stating that all county and private road bridges affected by stream channel improvement will be modified or replaced, if needed, concurrently with or prior to the construction of the enlarged channel.

6. Flowage easements outside the project area have been obtained.

7. Funds will be available in amounts sufficient to pay for the local share of the cost of installing the multiple-purpose reservoirs and the recreational facilities as scheduled.

8. The contracting agency is prepared to discharge its responsibilities.

9. Project, land rights, engineering services, facilities, and operation and maintenance agreements have been executed.

10. Public Law 566 funds are available.

FINANCING PROJECT INSTALLATION

Federal assistance for carrying out the works of improvement described in this work plan will be provided under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83rd Congress; 68 Stat. 666), as amended.

The cost of installing the needed land treatment measures during the 7-year installation period will be borne by the landowners and operators of the land on which these measures are installed. The Agricultural Stabilization and Conservation Service will provide financial assistance for the installation of those land treatment measures which are eligible for this assistance. The Farmers Home Administration and local banks and other lending institutions can arrange financing for the landowners and operators' share of the cost. The Soil Conservation Service will provide funds in the estimated amount of $196,191 to finance the cost of technical assistance to plan and apply the land treatment measures. This consists of $25,267 of Public Law 566 funds and $170,924 to be provided from Public Law 46 funds (table 1).

Funds for the local share of the cost of installing the structural measures will be provided by the sponsoring local organization that has been assigned the responsibility for acquiring land, easements, and rights-of-way for the particular structure or group of structures. (See section on Project Installation.)

The Choctaw Watershed Water Improvement District is collecting an annual tax of five cents on each $100 of assessed property valuation. Approximately $2,400 per year is being collected. These funds can be used for any purpose except to pay off a bond issue or a loan from the Federal government. These funds may be used for that purpose only upon approval by a vote of the qualified voters. The Upper Elm-Red Soil and Water Conservation District and the Choctaw Watershed Water Improvement District have entered into an agreement with the Grayson County Commissioners Court whereby the latter will assume prime responsibility for acquisition of such land, easements, or rights-of-way as will be needed, upon specific request, in given cases. This applies to the following works of improvement:

1. All single-purpose floodwater retarding structures except Nos. 10 and 11.

2. Multiple-purpose structure No. 34.

3. All grade stabilization structures.

4. Stream channel improvement on Choctaw Creek, 88,700 feet; 7,850 feet of stream channel improvement on Mill Creek; and 21,600 feet of drainage main I and laterals IA, IB, and IC in the Carpenters Bluff area.

It is anticipated that 80 percent of the easements to be acquired by the water district and/or the county will be donated. Out-of-pocket costs to these 2 sponsors are expected to be $410,000. This consists of the cost of acquiring those land easements and rights-of-way nut donated, the costs of modification or relocation of roads, pipe lines, utilities, and the local share of the cost of installing multiple-purpose structure No. 34 and drainage main and laterals 1, 1A, 1B, and 1C.

The voters of Sherman have approved the sale of revenue bonds which included approximately $1,000,000 for the city's share of the cost of installing multiple-purpose structure No. 35, Iron Ore Lake. Additional bond issues will have to be approved to provide funds for the local share of the cost of multiple-purpose structures 1 and 4. The city is in sound financial condition and it is anticipated that the additional bond issues can be passed if and when they are needed. The costs to be borne by Sherman are shown in table 2.

A bond issue will have to be approved by the city of Denison to provide the local share of the cost of multiple-purpose structure No. 38, Waterloo Lake. Interest is high in developing this structure as a recreation facility. Past acceptance of park and recreation bond issues by the people of Denison indicates that this issue will meet with approval.

The cities of Bells and Howe are investigating the feasibility of obtaining loans from the Farmers Home Administration or the Texas Water Development Board to finance their share of the cost of installing multiple-purpose structures 13 and 30.

The Service will execute separate Land Rights Agreements with the cities of Sherman and Denison. Terms and provisions governing acquisition and cost sharing for all areas dedicated to public recreational use in Iron Ore Lake and Waterloo Lake will be set forth in these agreements. Each city will be responsible for the full cost of appraisals ordered by it for its use, the cost of land surveys, title evidence, recording fees, U. S. revenue stamps, other State and local transfer costs, legal fees, salaries and travel of its employees, and other associated costs incurred in acquiring land rights. Cost sharing for each development will be limited to the land rights purchase price or the value jointly determined by the concerned city and the Service, whichever is the lesser amount; if joint agreement cannot be reached on the value, Service cost sharing will be on the fair market value established by the Service.

Financial and other assistance to be furnished by the Service is contingent on the appropriation of funds for this purpose. In addition, all prerequisite conditions will be met before Federal funds will be made available for the installation of the structural measures.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land treatment measures will be maintained by the landowners and operators of farms on which the measures are installed under agreements with the Upper Elm-Red Soil and Water Conservation District. Representatives of the district will make periodic inspections of the completed land treatment measures to determine maintenance needs. The landowners and operators will be encouraged to perform needed maintenance and management practices. District-owned equipment will be made available for this purpose in accordance with existing working arrangements.

The structural measures will be operated and maintained by the sponsoring local organization having responsibility for acquiring land, easements, and rights-of-way. Operations and maintenance agreements will be executed by the parties hereto prior to the issuance of invitation to bid on construction of the structural measures and/or the acquisition of land rights for the recreational developments. The agreements will set forth specific details on proeedure in line with recognized assignments of responsibility.

Withdrawal of municipal water from structure No. 35 will be from the water supply storage space between elevation 698.0 and elevation 677.3. All multiple-purpose structures with municipal water supply will be operated in accordance with State laws. The flood prevention features will be operated in accordance with Service criteria.

The estimated annual value of operation, maintenance, and replacement cost is $28,582, based on long-term prices. This consists of $4,416 for the single-purpose floodwater retarding structures; $410 for the grade stabilization structures; $4,561 for stream channel improvement; $409 for drainage main and laterals; and $18,786 for multiple-purpose structures. These costs include $2,016 for replacement of appurtenances such as side inlets, grade stabilization structures, and those basic recreation facilities which will require replacement before the end of the 100-year evaluation period. Total estimated costs for making replacements is $234,000, based on 1965 prices. The sponsors who are responsible for operating and maintaining the recreational developments will arrange for protective services, clean-up of grounds and repair of facilities.

The Water District will have maintenance inspection and coordinating responsibility for all of the structural measures, but accomplishment and financing of maintenance will be the responsibility of the local organization for those structures for which it has accepted this responsibility. The following tabulation shows the structural measures and the estimated cost of maintenance to each sponsor:

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OPERATION, MAINTENANCE, AND REPLACEMENT COST DISTRIBUTION

Choccaw Creek Watershed, Texas

Measure	Grayson County		Sherman		Denison		Howe		Bells		Total Annual Cost
	Structure Number or Amount	Annual Cost	Structure Number or Amount	Annual Cost	Structure Number or Amount	Annual Cost	Structure Number or Amount	Annual Cost	Structure Number or Amount	Annual Cost	
		(dollars)		(dollars)		(dollars)		(dollars)		(dollars)	(dollars)
Floodwater Retarding Structures	32	4,073	2	343							4,416
Stream Channel Improvement	96,580 ft.	3,942	13,600 ft.	619							4,561
Drainage Main and Laterals	21,600 ft.	409									409
Grade Stabilization Structures	7	410									410
Multiple-Purpose Structures	No. 34	88	Nos. 1,4,& 35	12,430	No. 38	5,955	No. 13	182	No. 30	131	18,786
TOTAL		8,922		13,392		5,955		182		131	28,582

The Choctaw Watershed Water Improvement District and the Upper Elm-Red Soil and Water Conservation District will be represented on each joint inspection group making scheduled inspections of works of improvement in accordance with procedural details of the Operation and Maintenance Agreements. Representatives of the County Commissioners Court and the cities of Sherman, Denison, Howe, and Bells will participate in scheduled or special inspections of those works of improvement for which each has operation and/or maintenance responsibility.

The Service and the sponsors will make a joint inspection annually, or after unusually severe floods, or in the event of other unusual conditions that may adversely affect the works of improvement, for three years following installation of each structure. Inspection after the third year will be made annually by the sponsors. The Service will participate in annual inspections as often as it elects to do so after the third year. Items of inspection will include, but will not be limited to, the condition of the principal spillways, earth fills or embankments, vegetative cover of the earth fills and emergency spillways; the need for removal of woody vegetation, sediment bars and debris from improved channels; the need for corrective measures to prevent bank cutting in the improved channels; and the condition of fences, gates, and other appurtenances installed as a part of the structural meaaures. Inspections will be made of the recreation facilities and access roads to determine maintenance and replacement needs.

Maintenance needs for all structural measures noted by the representative of the Choctaw Watershed Water Improvement District, or those called to his attention by others and confirmed by him, will be referred to the responsible local organization for maintenance action. The representative of the Water District will prepare a report of all inspections. A copy of the report will be submitted to the Service representative. The Water District representative will be furnished with reports on maintenance done by each sponsoring local organization and he will keep summary control records in support of proper maintenance having been performed on these works of improvement for the entire watershed.

The Soil Conservation Service, through the Upper Elm-Red Soil and Water Conservation District,will participate in operation and maintenance by furnishing technical assistance to aid in inspections and technical guidance and information necessary for the operation and maintenance program.

Provisions will be made to provide for free access of representatives of the Choctaw Watershed Water Improvement District, the Grayson County Commissioners Court, and Federal representatives to inspect and provide maintenance for all structural measures and their appurtenances at any time.

The Choctaw Watershed Water Improvement District, the Grayson County Commissioners Court, and the cities of Sherman, Denison, Howe, and Bells fully understand their obligations for operation and maintenance. Specific operation and maintenance agreements will be executed prior to execution of land rights agreements and the issuance of invitations to bid on construction of the structural measures.

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST
Choctaw Creek Watershed, Texas

Installation Cost Item	Unit	Number to Be Applied	Estimated Cost (Dollars) 1/ Public Law 566 Funds	Other	Total
LAND TREATMENT					
Soil Conservation Service					
Cropland	Acre	40,138	-	362,586	362,586
Grassland	Acre	92,902	-	1,700,178	1,700,178
Technical Assistance			25,267	170,924	196,191
SCS Subtotal			25,267	2,233,688	2,258,955
TOTAL LAND TREATMENT			25,267	2,233,688	2,258,955
STRUCTURAL MEASURES					
Soil Conservation Service					
Floodwater Retarding Structures	No.	34	2,081,200	-	2,081,200
Stream Channel Improvement	Foot	110,180	391,600	-	391,600
Grade Stabilization Structures	No.	7	15,950	-	15,950
Drainage Main and Laterals	Foot	21,600	5,775	1,925	7,700
Multiple-Purpose Structures	No.	7	1,019,601	1,244,199	2,263,800
Basic Recreational Facilities	No.	2	212,905	212,905	425,810
Diversion Works	No.	2	-	150,000	150,000
SCS Subtotal			3,727,031	1,609,029	5,336,060
Subtotal - Construction			3,727,031	1,609,029	5,336,060
Installation Services					
Soil Conservation Service			531,414	153,492	684,906
Engineering Services			329,844	122,846	452,690
Other			861,258	276,338	1,137,596
SCS Subtotal			861,258	276,338	1,137,596
Subtotal - Installation Services					
Other Costs			223,990	1,973,051	2,197,041
Land, Easements, and Rights-of-way			-	39,500	39,500
Administration of Contracts			-	7,200	7,200
Water Rights			223,990	2,019,751	2,243,741
Subtotal - Other Costs			4,812,279	3,905,118	8,717,397
TOTAL STRUCTURAL MEASURES			4,837,546	6,138,806	10,976,352
TOTAL PROJECT					
SUMMARY			4,837,546	6,138,806	10,976,352
Subtotal SCS			4,837,546	6,138,806	10,976,352
TOTAL PROJECT					

1/ Price Base: 1965

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TABLE 1A - STATUS OF WATERSHED WORKS OF IMPROVEMENT

Choctaw Creek Watershed, Texas

Measures	Unit	Applied to Date	Total Cost (Dollars) 1/
LAND TREATMENT			
Cropland			
Conservation Cropping System	Acre	26,070	26,070
Contour Farming	Acre	13,950	13,950
Cover and Green Manure Crop	Acre	3,512	52,504
Grasses and Legumes in Rotation	Acre	3,512	59,704
Crop Residue Use	Acre	27,180	108,720
Diversion	Foot	132,800	14,608
Grassed Waterways	Acre	749	89,880
Terraces, Gradient	Foot	3,924,284	196,214
Terraces, Parallel	Foot	129,237	9,047
Grassland			
Grade Stabilization Structure	No.	26	39,000
Land Clearing	Acre	3,570	160,650
Pasture and Hayland Renovation	Acre	15,754	441,112
Pasture and Hayland Planting	Acre	35,784	1,538,712
Pond Sealing	No.	25	2,200
Wildlife Habitat Preservation	Acre	4,980	498
Wildlife Habitat Development	Acre	1,390	25,020
TOTAL LAND TREATMENT			2,777,889

1/ Price Base: 1965

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TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION

Choctaw Creek Watershed, Texas

(Dollars) 1/

Structure Site Number or Name	Installation Cost - Public Law 566 Funds					Installation Cost - Other Funds							Total Installation Cost
	Construction	Installation Services: Engineering	Installation Services: Other	Easements and Rights-of-Way	Total Public Law 566	Construction	Installation Services: Engineering	Installation Services: Other	Adm. of Contracts	Easements and Rights-of-Way	Water Rights	Total Other	
Floodwater Retarding Structures													
2	60,500	9,075	5,304	-	74,879	-	-	-	500	14,525	-	15,025	89,904
3	70,400	10,560	6,173	-	87,133	-	-	-	500	30,325	-	30,825	117,958
5	57,200	10,296	5,146	-	72,642	-	-	-	500	16,325	-	16,825	89,467
6	53,900	9,702	4,850	-	68,452	-	-	-	500	11,200	-	11,700	80,152
7	51,700	9,306	4,651	-	65,657	-	-	-	500	10,375	-	10,875	76,532
8	53,900	9,702	4,850	-	68,452	-	-	-	500	24,450	-	24,950	93,402
9	84,700	12,705	7,426	-	104,831	-	-	-	500	35,600	-	36,100	140,931
10	72,600	10,890	6,366	-	89,856	-	-	-	500	31,050	-	31,550	121,406
11	104,500	13,585	9,004	-	127,089	-	-	-	500	293,066	-	293,566	420,655
12	56,100	10,098	5,048	-	71,246	-	-	-	500	7,900	-	8,400	79,646
14	41,800	7,524	3,760	-	53,084	-	-	-	500	15,125	-	15,625	68,709
15	58,300	10,494	5,246	-	74,040	-	-	-	500	10,700	-	11,200	85,240
16	45,100	8,118	4,056	-	57,274	-	-	-	500	5,725	-	6,225	63,499
17	67,100	10,065	5,884	-	83,049	-	-	-	500	12,525	-	13,025	96,074
18	89,100	13,365	7,813	-	110,278	-	-	-	500	17,000	-	17,500	127,778
19	70,400	10,560	6,173	-	87,133	-	-	-	500	11,125	-	11,625	98,758
20	52,800	9,504	4,750	-	67,054	-	-	-	500	9,150	-	9,650	76,704
21	38,500	8,470	3,580	-	50,550	-	-	-	500	5,025	-	5,525	56,075
22	74,800	11,220	6,559	-	92,579	-	-	-	500	28,575	-	29,075	121,654
23	45,100	8,118	4,056	-	57,274	-	-	-	500	8,325	-	8,825	66,099
24	74,800	11,220	6,559	-	92,579	-	-	-	500	30,450	-	30,950	123,529
25	44,000	7,920	3,958	-	55,878	-	-	-	500	9,025	-	9,525	65,403
26	100,100	13,013	8,625	-	121,738	-	-	-	500	24,975	-	25,475	147,213
27	48,400	8,712	4,355	-	61,467	-	-	-	500	6,150	-	6,650	68,117
28	56,100	10,098	5,048	-	71,246	-	-	-	500	9,350	-	9,850	81,096
29	61,600	9,240	5,358	-	76,198	-	-	-	500	7,450	-	7,950	84,148
31	85,800	12,870	7,524	-	106,194	-	-	-	500	21,650	-	22,150	128,344
32	35,200	7,744	3,274	-	46,218	-	-	-	500	7,025	-	7,525	53,743
33	55,000	9,900	4,949	-	69,849	-	-	-	500	8,475	-	8,975	78,824
36	66,000	9,900	5,787	-	81,687	-	-	-	500	15,325	-	15,825	97,512
37	64,900	9,735	5,691	-	80,326	-	-	-	500	45,150	-	45,650	125,976
39	39,600	8,712	3,684	-	51,996	-	-	-	500	7,100	-	7,600	59,596
40	35,200	7,744	3,274	-	46,218	-	-	-	500	6,200	-	6,700	52,918
41	66,000	9,900	5,787	-	81,687	-	-	-	500	17,425	-	17,925	99,612
Subtotal	2,081,200	340,065	184,568	-	2,605,833	-	-	-	17,000	813,841	-	830,841	3,436,674
Stream Channel Improvement													
Choctaw Creek	309,100	30,910	25,925	-	365,935	-	-	-	500	108,750	-	109,250	475,185
Post Oak Creek	68,200	10,230	5,979	-	84,409	-	-	-	500	53,750	-	54,250	138,659
Mill Creek	14,300	4,576	1,439	-	20,315	-	-	-	500	6,250	-	6,750	27,065
Subtotal	391,600	45,716	33,343	-	470,659	-	-	-	1,500	168,750	-	170,250	640,909

TABLE 2 - ESTIMATED STRUCTURE COST DISTRIBUTION - Continued
Choctaw Creek Watershed, Texas
(Dollars) 1/

Structure Site Number or Name	Installation Cost - Public Law 566 Funds					Installation Cost - Other Funds							Total Installation Cost
	Construction	Installation Services: Engineering	Installation Services: Other	Easements and Rights-of-Way	Total Public Law 566	Construction	Installation Services: Engineering	Installation Services: Other	Adm. of Contracts	Easements and Rights-of-Way	Water Rights	Total Other	
Grade Stabilization Structures													
101	3,960	792	363	-	5,115	-	-	-	250	325	-	575	5,690
102	5,060	1,012	463	-	6,535	-	-	-	250	275	-	525	7,060
103	1,430	286	131	-	1,847	-	-	-	100	25	-	125	1,972
104	1,210	242	111	-	1,563	-	-	-	100	25	-	125	1,688
105	1,540	308	141	-	1,989	-	-	-	100	25	-	125	2,114
106	1,540	308	141	-	1,989	-	-	-	100	25	-	125	2,114
107	1,210	242	111	-	1,563	-	-	-	100	25	-	125	1,688
Subtotal	15,950	3,190	1,461	-	20,601	-	-	-	1,000	725	-	1,725	22,326
Multiple-Purpose Structures													
1	336,164	33,616	28,196	-	397,976	382,136	38,214	32,051	5,000	251,500	1,500	710,401	1,108,377
4	166,320	16,632	13,950	-	196,902	295,680	29,568	24,800	5,000	181,500	1,500	538,048	734,950
13	77,044	7,704	6,462	-	91,210	133,056	13,306	11,160	1,000	87,125	1,500	247,147	338,357
Diversion Works	-	-	-	-	-	75,000	6,000	3,000	-	-	-	84,000	84,000
30	73,960	9,622	6,373	-	89,955	55,840	7,265	4,812	1,000	34,000	1,000	103,917	193,872
Diversion Works	-	-	-	-	-	75,000	6,000	3,000	-	-	-	84,000	84,000
34	33,947	6,110	3,054	-	43,111	8,953	1,612	806	500	5,600	100	17,571	60,682
Subtotal	687,435	73,684	58,035	-	819,154	1,025,665	101,965	79,629	12,500	559,725	5,600	1,785,084	2,604,238
35	244,116	29,494	24,739	172,590	470,939	353,184	30,236	25,360	5,000	367,160	1,500	782,440	1,253,379
Basic Recreational Facilities	140,800	14,080	11,809	42,500	209,189	140,800	14,080	11,809	1,000	44,500	-	212,189	421,378
Subtotal	384,916	43,574	36,548	215,090	680,128	493,984	44,316	37,169	6,000	2/411,660	1,500	994,629	1,674,757
38	88,050	15,510	9,066	8,400	121,026	15,350	-	-	500	14,400	100	30,350	151,376
Basic Recreational Facilities	72,105	7,211	6,048	500	85,864	72,105	7,211	6,048	500	600	-	86,464	172,328
Subtotal	160,155	22,721	15,114	8,900	206,890	87,455	7,211	6,048	1,000	3/15,000	100	116,814	323,704
Subtotal - Multiple-Purpose Structures	1,232,506	139,979	109,697	223,990	1,706,172	1,607,104	153,492	122,846	19,500	986,385	7,200	2,896,527	4,602,699
Drainage Main I and Laterals IA, IB, IC	5,775	2,464	775	-	9,014	1,925	-	-	500	3,350	-	5,775	14,789
TOTAL PROJECT	3,727,031	531,414	329,844	223,990	4,812,279	1,609,029	153,492	122,846	39,500	1,973,051	7,200	3,905,118	8,717,397

1/ Price Base: 1965

2/ Intludes the cost of flowage easements, legal fees, and land surveys which are not eligible for cost sharing ($18,750).

3/ Includes the cost of flowage easements, legal fees, and land surveys which are not eligible for cost sharing ($6,100).

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TABLE 2A - COST ALLOCATION AND COST SHARING SUMMARY

Choctaw Creek Watershed, Texas

(Dollars) 1/

Item	Purpose					
	Flood Prevention	Municipal Water Supply	Irrigation	Drainage	Recreation	Total
			COST ALLOCATION			
Single-Purpose						
34 Floodwater Retarding Structures 110,180 ft. of Stream Channel Improvement 7 Grade Stabilization Structures	4,099,909	-	-	-	-	4,099,909
Multiple-Purpose						
Structure No. 1	518,018	590,359	-	-	-	1,108,377
Structure No. 4	264,042	470,908	-	-	-	734,950
Structure No. 13	123,525	298,832	-	-	-	422,357
Structure No. 30	109,899	167,973	-	-	-	277,872
Structure No. 34	47,939	-	12,743	-	-	60,682
Structure No. 35	232,920	545,119	-	-	896,718	1,674,757
Structure No. 38	95,331	-	-	-	228,373	323,704
21,600 ft. of Drainage Main and Laterals	7,395	-	-	7,394	-	14,789
TOTAL	5,498,978	2,073,191	12,743	7,394	1,125,091	8,717,397
			COST SHARING			
Public Law 566	4,240,523	-	-	3,544	568,212	4,812,279
Other	1,258,455	2,073,191	12,743	3,850	556,879	3,905,118
TOTAL	5,498,978	2,073,191	12,743	7,394	1,125,091	8,717,397

1/ Price Base: 1965

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TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES

Choctaw Creek Watershed, Texas

Item	Unit	STRUCTURE NUMBER 1	2	3	4	5	6	7	8	9	10	11	12
Drainage Area	Sq. Mi.	10.47	1.35	2.60	7.46	1.50	1.56	1.25	4.60	3.19	1.64	3.97	0.65
Storage Capacity													
Sediment Pool (50-year or 200 acre-feet)	Ac. Ft.	-	94	152	-	104	91	87	196	170	88	169	55
Sediment Reserve (Below riser - 50-year)	Ac. Ft.	-	-	-	-	-	-	-	-	-	-	-	-
Sediment in Water Supply Pool 1/	Ac. Ft.	1,284	-	-	756	-	-	-	-	-	-	-	-
Sediment in Detention Pool 2/	Ac. Ft.	167	72	125	119	88	75	66	172	119	61	127	46
Water Supply Pool	Ac. Ft.	9/ 6,981	-	-	9/ 7,002	-	-	-	-	-	-	-	-
Floodwater Pool	Ac. Ft.	4,691	545	874	3,063	526	454	448	1,631	1,379	964	1,682	246
Total	Ac. Ft.	13,123	711	1,151	10,940	718	620	601	1,999	1,668	1,113	1,978	347
Surface Area													
Sediment Pool (50-year or 200 acre-feet)	Acre	-	17	29	-	17	17	13	33	36	17	35	10
Sediment Reserve (Below riser)	Acre	-	-	-	-	-	-	-	-	-	-	-	-
Water Supply Pool	Acre	434	-	-	406	-	-	-	-	-	-	-	-
Floodwater Pool	Acre	614	64	103	512	64	58	44	145	158	77	190	33
Volume of Fill	Cu. Yd.	910,000	124,400	135,700	708,000	112,100	105,900	102,400	92,400	198,100	136,600	206,300	118,400
Elevation Top of Dam 3/	Foot	759.8	804.1	757.2	734.5	711.8	742.1	695.9	752.7	783.3	751.3	759.2	774.3
Maximum Height of Dam 4/	Foot	73	39	52	72	51	37	44	50	40	53	44	49
Emergency Spillway													
Crest Elevation	Foot	755.0	800.0	754.0	730.0	708.0	739.0	692.5	748.5	778.5	746.0	754.0	772.0
Bottom Width	Foot	300	100	100	300	160	112	50	400	140	170	400	50
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Percent Chance of Use 5/		1.5	2.0	3.4	2.0	3.1	3.8	3.1	2.9	1.9	0.6	1.4	2.7
Average Curve No. - Condition II		81	81	80	81	81	81	81	82	83	82	81	81
Emergency Spillway Hydrograph													
Storm Rainfall (6-hour) 6/	Inch	9.6	9.6	6.8	9.6	9.6	6.8	6.8	9.6	9.6	13.0	13.0	6.8
Storm Runoff	Inch	7.3	7.3	4.5	7.3	7.3	4.6	4.6	7.4	7.5	10.7	10.6	4.6
Velocity of Flow (V_c) 7/	Ft./Sec.	0	0	0	0.6	0.7	0	0	0.5	0	0	1.3	0
Discharge Rate 3/	C.F.S.	0	0	0	85	105	0	0	200	0	0	1,010	0
Maximum Water Surface Elevation 3/	Foot	-	-	-	730.6	708.7	-	-	749.0	-	-	755.3	-
Freeboard Hydrograph													
Storm Rainfall (6-hour) 6/	Inch	20.6	20.7	14.0	20.7	20.7	14.0	14.0	20.7	20.7	30.5	30.5	14.0
Storm Runoff	Inch	18.0	18.1	11.4	18.1	18.1	11.5	11.5	18.3	18.4	28.0	27.9	11.5
Velocity of Flow (V_c) 8/	Ft./Sec.	9.1	8.9	7.5	9.0	8.3	7.3	7.7	8.7	9.2	9.8	9.6	6.4
Discharge Rate 3/	C.F.S.	7,010	2,150	1,340	6,880	2,850	1,360	720	8,480	3,550	5,050	11,360	380
Maximum Water Surface Elevation 3/	Foot	759.8	804.1	757.2	734.5	711.8	742.1	695.9	752.7	783.3	751.3	759.2	774.3
Principal Spillway													
Capacity (Maximum)	C.F.S.	136	23	26	75	18	31	13	69	45	33	99	7
Capacity Equivalents													
Sediment Volume	Inch	-	1.30	1.10	-	1.30	1.10	1.30	0.80	1.00	1.00	0.80	1.60
Sediment Reserve Volume (Below riser)	Inch	-	-	-	-	-	-	-	-	-	-	-	-
Sediment in Water Supply Pool 1/	Inch	2.30	-	-	1.90	-	-	-	-	-	-	-	-
Sediment in Detention Pool 2/	Inch	0.30	1.00	0.90	0.30	1.10	0.90	1.00	0.70	0.70	0.70	0.60	1.30
Water Supply Pool	Inch	12.50	-	-	17.60	-	-	-	-	-	-	-	-
Detention Volume	Inch	6.40	7.57	6.30	7.70	6.57	5.45	6.72	6.65	8.10	11.02	7.94	7.12
Spillway Storage	Inch	5.90	4.18	2.48	6.10	3.61	2.40	2.47	2.75	5.20	5.68	5.66	2.38
Class of Structure		B	B	A	B	B	A	A	B	B	C	C	A

(See footnotes last page table 5)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Choctaw Creek Watershed, Texas

Item	Unit	STRUCTURE NUMBER 13	14	15	16	17	18	19	20	21	22	23	24
Drainage Area	Sq. Mi.	3.11	2.79	2.13	0.71	2.20	4.24	1.79	1.14	0.59	5.11	1.02	7.31
Storage Capacity													
Sediment Pool (50-year or 200 acre-feet)	Ac. Ft.	-	178	159	53	164	181	153	128	85	199	93	199
Sediment Reserve (Below riser - 50-year)	Ac. Ft.	-	-	-	-	-	-	-	-	-	73	-	74
Sediment in Water Supply Pool 1/	Ac. Ft.	415	-	-	-	-	-	-	-	-	-	-	-
Sediment in Detention Pool 2/	Ac. Ft.	49	149	125	42	129	136	114	97	60	191	70	234
Water Supply Pool	Ac. Ft.	9/ 2,932	-	-	-	-	-	-	-	-	-	-	-
Floodwater Pool	Ac. Ft.	1,234	968	755	268	810	1,628	649	388	197	1,594	360	2,631
Total	Ac. Ft.	4,630	1,295	1,039	363	1,103	1,945	916	613	342	2,057	523	3,138
Surface Area													
Sediment Pool (50-year or 200 acre-feet)	Acre	-	23	20	10	25	23	19	16	11	44	13	47
Sediment Reserve (Below riser)	Acre	-	-	-	-	-	-	-	-	-	53	-	58
Water Supply Pool	Acre	187	-	-	-	-	-	-	-	-	-	-	-
Floodwater Pool	Acre	237	112	69	32	83	123	63	50	27	157	43	235
Volume of Fill	Cu. Yd.	359,000	63,600	114,400	88,500	135,700	175,600	141,900	86,900	66,400	150,400	80,000	162,900
Elevation Top of Dam 3/	Foot	747.2	700.3	696.7	673.5	664.7	683.1	648.1	639.1	630.3	614.0	664.2	633.0
Maximum Height of Dam 4/	Foot	74	46	47	37	53	57	49	36	37	35	45	43
Emergency Spillway													
Crest Elevation	Foot	743.0	697.0	693.0	671.0	661.5	678.5	645.0	636.0	628.0	610.0	661.0	628.5
Bottom Width	Foot	100	100	80	50	80	80	80	60	50	160	50	100
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Percent Chance of Use 5/		1.9	3.2	3.2	2.7	2.8	3.0	2.5	3.3	2.3	4.0	2.9	3.0
Average Curve No. - Condition II		81	81	81	81	81	85	80	79	78	82	79	82
Emergency Spillway Hydrograph													
Storm Rainfall (6-hour) 6/	Inch	9.6	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8	6.8
Storm Runoff	Inch	7.3	4.6	4.6	4.6	4.6	5.1	4.5	4.4	4.3	4.7	4.4	4.7
Velocity of Flow (V_c) 7/	Ft./Sec.	0	0	0	0	0	0	0	0	0	0	0	0
Discharge Rate 3/	C.F.S.	0	0	0	0	0	0	0	0	0	0	0	0
Maximum Water Surface Elevation 3/	Foot	-	-	-	-	-	-	-	-	-	-	-	-
Freeboard Hydrograph													
Storm Rainfall (6-hour) 6/	Inch	20.7	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0	14.0
Storm Runoff	Inch	18.1	11.5	11.5	11.5	11.5	12.1	11.4	11.3	11.1	11.7	11.3	11.7
Velocity of Flow (V_c) 8/	Ft./Sec.	8.9	7.7	8.3	6.6	7.7	9.2	7.3	7.5	6.4	8.6	7.5	9.2
Discharge Rate 3/	C.F.S.	2,200	1,430	1,420	430	1,110	2,020	970	800	380	3,210	670	2,460
Maximum Watec Surface Elevation 3/	Foot	747.2	700.3	696.7	673.5	664.7	683.1	648.1	639.1	630.3	614.0	664.2	633.0
Principal Spillway													
Capacity (Maximum)	C.F.S.	62	28	17	7	22	42	18	9	15	61	8	73
Capacity Equivalents													
Sediment Volume	Inch	-	1.20	1.40	1.40	1.40	0.80	1.60	2.10	2.70	0.73	1.70	0.51
Sediment Reserve Volume (Below riser)	Inch	-	-	-	-	-	-	-	-	-	0.27	-	0.19
Sediment in Water Supply Pool 1/	Inch	2.50	-	-	-	-	-	-	-	-	-	-	-
Sediment in Detention Pool 2/	Inch	0.30	1.00	1.10	1.10	1.10	0.60	1.20	1.60	1.90	0.70	1.30	0.60
Water Supply Pool	Inch	17.68	-	-	-	-	-	-	-	-	-	-	-
Detention Volume	Inch	7.44	6.50	6.65	7.10	6.90	7.20	6.80	6.38	6.25	5.85	6.62	6.75
Spillway Storage	Inch	6.33	2.80	2.40	2.28	2.40	2.87	2.18	2.82	2.15	2.50	2.68	2.05
Class of Structure		B	A	A	A	A	A	A	A	A	A	A	A

(See footnotes last page table 3.)

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TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued

Choctaw Creek Watershed, Texas

Item	Unit	STRUCTURE NUMBER 25	26	27	28	29	30	31	32	33	34	35	36
Orainage Area	Sq. Mi.	1.47	2.86	1.15	1.92	1.47	2.11	4.75	0.86	1.60	0.68	8.65	2.15
Storage Capacity													
Sediment Pool (50-year or 200 acre-feet)	Ac. Ft.	55	198	86	123	118	-	198	50	43	-	-	103
Sediment Reserve (Below riser - 50-year)	Ac. Ft.	-	-	-	-	-	-	131	-	-	-	-	-
Sediment in Water Supply Pool 1/	Ac. Ft.	-	-	-	-	-	292	-	-	-	69	646	-
Sediment in Detention Pool 2/	Ac. Ft.	47	168	67	102	94	45	254	42	59	11	46	80
Water Supply Pool	Ac. Ft.	-	-	-	-	-	9/860	-	-	-	10/101	11/8,488	-
Floodwater Pool	Ac. Ft.	492	1,034	419	693	521	802	1,705	337	690	303	3,368	785
Total	Ac. Ft.	594	1,400	572	918	733	1,999	2,288	429	792	484	12,548	968
Surface Area													
Sediment Pool (50-yeac or 200 acre-feet)	Acre	16	29	15	25	20	-	33	10	11	-	-	18
Sediment Reserve (8elow riser)	Acre	-	-	-	-	-	-	48	-	-	-	-	-
Water Supply Pool	Acre	-	-	-	-	-	87	-	-	-	22	556	-
Floodwater Pool	Acre	61	126	53	80	60	128	160	45	85	40	688	67
Volume of Fill	Cu. Yd.	59,300	230,000	86,300	109,900	123,700	243,600	155,600	55,400	94,500	72,000	872,000	142,700
Elevotion Top of Dam 3/	Foot	583.3	756.3	716.9	719.2	704.4	691.7	684.9	597.0	631.7	607.1	708.3	692.5
Maximum Height oi Dam 4/	Foot	34	52	40	40	49	53	50	34	45	32	56	41
Emergency Spillway													
Crest Elevation	Foot	580.0	753.0	714.0	716.0	701.0	688.0	681.0	594.5	627.5	604.0	703.5	689.0
Bottom Width	Poot	50	100	50	80	50	180	100	50	100	86	200	100
Type		Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.	Veg.
Percent Chance of Use 5/		3.4	3.1	3.0	3.0	3.1	2.0	2.9	2.8	1.5	1.4	2.0	3.0
Average Curve No. - Condition II		79	82	81	81	81	80	81	83	77	77	80	82
Emecgency Spillway Hydrograph													
Storm Rainfall (6-hour) 6/	Inch	6.8	6.8	6.8	6.8	6.8	9.6	6.8	6.8	9.6	9.6	9.6	6.8
Storm Runoff	Inch	4.4	4.7	4.6	4.6	4.6	7.1	4.6	4.8	6.8	6.8	7.1	4.7
Velocity of Flow (V_c) 7/	Pt./Sec.	0	0	0	0	0	0	0	0	0	0	0	0
Discharge Rate 3/	C.F.S.	0	0	0	0	0	0	0	0	0	0	0	0
Maximum Water Surface Elevation 3/	Foot	-	-	-	-	-	-	-	-	-	-	-	-
Freeboard Hydrograph													
Storm Rainiall (6-hour) 6/	Inch	14.0	14.0	14.0	14.0	14.0	20.7	14.0	14.0	20.7	20.7	20.7	14.0
Storm Runofi	Inch	11.3	11.7	11.5	11.5	11.5	18.0	11.5	11.8	17.5	17.5	18.0	11.7
Velocity of Flow (V_c) 8/	Ft./Sec.	7.7	7.7	7.3	7.5	7.8	8.2	8.5	6.6	8.7	7.5	9.1	8.0
Discharge Rate 3/	C.F.S.	700	1,370	580	1,040	750	3,020	1,920	430	2,070	1,080	4,710	1,640
Maximum Watec Surface Elevation 3/	Poot	583.3	756.3	716.9	719.2	704.4	691.7	684.9	597.0	631.7	607.1	708.3	692.5
Principal Spillway													
Capacity	C.F.S.	15	29	12	19	15	49	48	9	16	7	130	22
Capacity Equivalents													
Sediment Volume	Inch	0.70	1.30	1.40	1.20	1.50	-	0.78	1.10	0.50	-	-	0.90
Sediment Reserve Volume (Below riser)	Inch	-	-	-	-	-	-	0.52	-	-	-	-	-
Sediment in Water Supply Pool 1/	Inch	-	-	-	-	-	2.60	-	-	-	1.90	1.40	-
Sediment in Detention Pool 2/	Inch	0.60	1.10	1.10	1.00	1.20	0.40	1.00	0.90	0.70	0.30	0.10	0.70
Water Supply Pool	Inch	-	-	-	-	-	7.64	-	-	-	2.80	18.40	-
Oetention Volume	Inch	6.28	6.78	6.82	6.77	6.65	7.13	6.73	7.35	8.08	8.35	7.30	6.85
Spillway Storage	Inch	3.02	3.07	2.68	2.73	2.83	5.03	2.67	2.65	4.12	3.65	7.80	2.13
Class of Struccuce		A	A	A	A	A	B	A	A	B	B	B	A

(See footnores last page table 3.)

TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURES - Continued
Choctaw Creek Watershed, Texas

Item	Unit	STRUCTURE NUMBER 37	38	39	40	41	Total
Drainage Area	Sq. Mi.	2.31	2.32	0.95	0.87	4.07	112.57
Storage Capacity							
Sediment Pool (50-year or 200 acre-feet)	Ac. Ft.	-	-	30	28	102	3,939
Sediment Reserve (Below riser - 50-year)	Ac. Ft.	-	-	-	-	-	278
Sediment in Water Supply Pool 1/	Ac. Ft.	12/86	74	-	-	-	3,622
Sediment in Detention Pool 2/	Ac. Fc.	25	25	26	28	108	3,860
Water Supply Pool	Ac. Ft.	13/314	14/540	-	-	-	27,218
Floodwater Pool	Ac. Ft.	874	1,180	313	300	1,305	43,106
Total	Ac. Ft.	1,299	1,819	369	356	1,522	82,023
Surface Area							
Sediment Pool (50-year or 200 acre-feet)	Acre	-	-	8	7	18	685
Sediment Reserve (Below riser)	Acre	-	-	-	-	-	159
Water Supply Pool	Acre	44	52	-	-	-	1,788
Floodwater Pool	Acre	109	111	38	32	128	5,304
Volume of Fill	Cu. Yd.	103,000	195,300	58,900	44,600	120,700	7,342,900
Elevation Top of Dam 3/	Foot	690.1	699.0	624.9	615.0	615.9	xxx
Maximum Height of Dam 4/	Foot	46	57	36	38	44	xxx
Emergency Spillway							
Crest Elevation	Foot	686.0	694.5	622.0	612.0	612.0	xxx
Bottom Width	Foot	170	100	50	50	100	xxx
Type		Veg.	Veg.	Veg.	Veg.	Veg.	xxx
Percent Chance of Use 5/		2.0	1.3	3.1	2.9	3.1	xxx
Average Curve No. - Condition II		81	86	77	77	77	xxx
Emergency Spillway Hydrograph							
Storm Rainfall (6-hour) 6/	Inch	9.6	9.6	6.8	6.8	6.8	xxx
Storm Runoff	Inch	7.3	7.9	4.2	4.2	4.2	xxx
Velocity of Flow (V_c) 7/	Fc./Sec.	0	0	0	0	0	xxx
Discharge Rate 3/	C.F.S.	0	0	0	0	0	xxx
Maximum Water Surface Elevation 3/	Foot	-	-	-	-	-	xxx
Freeboard Hydrograph							
Storm Rainfall (6-hour) 6/	Inch	20.7	20.7	14.0	14.0	14.0	xxx
Storm Runoff	Inch	18.1	18.9	11.0	11.0	11.0	xxx
Velocity of Flow (V_c) 8/	Ft./Sec.	8.7	9.1	7.1	7.5	8.6	xxx
Discharge Rate 3/	C.F.S.	3,550	2,420	560	630	1,760	xxx
Maximum Water Surface Elevation 3/	Foot	690.1	699.0	624.9	615.0	615.9	xxx
							xxx
Principal Spillway Capacity (Maximum)	C.F.S.	58	46	10	7	41	xxx
Capacity Equivalents							
Sediment Volume	Inch	-	-	0.60	0.60	0.50	xxx
Sediment Reserve Volume (Below riser)	Inch	-	-	-	-	-	xxx
Sediment in Water Supply Pool 1/	Inch	0.70	0.60	-	-	-	xxx
Sediment in Detention Pool 2/	Inch	0.20	0.20	0.50	0.60	0.50	xxx
Water Supply Pool	Inch	2.55	4.36	-	-	-	xxx
Detention Volume	Inch	7.10	9.54	6.19	6.47	6.01	xxx
Spillway Storage	Inch	3.95	4.48	2.44	2.23	2.54	xxx
Class of Structure		B	B	A	A	A	xxx

1/ Includes submerged portion of 100-year sediment accumulation.

2/ See item 11, page 74.

3/ Values obtained from routing.

4/ Difference in elevation between top of the settled dam and the bottom of the stream channel.

5/ Is the average number of times the emergency spillway will be expected to function in 100 years based on a reglonal analysis of gaged runoff.

6/ Based on Engineering-Hydrology Memorandum TX-1, "Design Storm Inflow Hydrograph Development Methods." October 15, 1963.

7/ Velocity was obtained from the formula V = Q/A and was determined from the routed Hp and Q. Critical velocity was not attained.

8/ Obtained from curves drawn from figure 4-R-11472 revised March 1959 and ES 98, dated April 27, 1955, based on flows obtained from graphical routing of the Freeboard Hydrograph.

9/ Municipal water.

10/ Irrigation water.

11/ Includes 6,352 acre-feet municipal water and 2,136 acre-feet recreation water.

12/ Sediment storage in existing recreation pool.

13/ Existing recreation water.

14/ Recreation water.

TABLE 3A - STRUCTURE DATA
CHANNELS
Choctaw Creek Watershed, Texas

Channel Designation	Station Numbering for Reach: Station (100 ft.)	Station (100 ft.)	Watershed Area (sq. mi.)	Required Drainage Curve	Required Drainage Channel Capacity (c.f.s.)	Planned Channel Capacity (c.f.s.)	Average Bottom Width (ft.)	Average Side Slope	Average Depth (ft.)	Average Grade (pct.)	Average Velocity in Channel (ft./sec.)	Volume of Excavation (1,000 cu. yds.)
Choctaw Creek												
	631+70	682+50	36.10	-	-	2,933	32	1.5:1	11.9	0.114	4.95	
	682+50	758+50	48.12	-	-	3,629	32	1.5:1	13.3	0.114	5.25	
	758+50	817+00	48.81	-	-	3,732	32	1.5:1	13.5	0.114	5.29	
	817+00	862+00	51.45	-	-	3,938	32	1.5:1	13.9	0.114	5.38	
	862+00	897+00	52.49	-	-	4,183	32	1.5:1	14.3	0.114	5.47	
	897+00	961+00	53.54	-	-	4,404	32	1.5:1	14.7	0.114	5.54	
	961+00	1010+00	54.95	-	-	4,520	32	1.5:1	14.9	0.114	5.58	
	1010+00	1070+00	55.67	-	-	4,578	32	1.5:1	15.0	0.114	5.60	
	1070+00	1149+00	57.07	-	-	4,639	32	1.5:1	15.1	0.114	5.62	
	1149+00	1222+50	62.14	-	-	4,724	32	1.5:1	15.2	0.114	5.67	
	1222+50	1224+50					Transition Section					
	1224+50	1349+50	66.85	-	-	4,822	28	1.5:1	18.2	0.070	4.79	
	1349+50	1466+80	96.94	-	-	5,834	28	1.5:1	20.0	0.070	5.00	
	1466+80	1519+00	126.99	-	-	6,508	24	1.5:1	22.0	0.070	5.20	1,365.0
Mill Creek												
	78+50	102+50	5.97	-	-	185	10	1.5:1	4.0	0.160	2.90	
	102+50	104+50					Transition Section					
	104+50	140+50	8.39	-	-	426	16	1.5:1	5.9	0.105	2.91	
	140+50	157+00	10.14	-	-	587	12	1.5:1	7.7	0.105	3.23	40.0
Post Oak Creek												
	349+50	360+00	8.18	-	-	4,862	36	1.5:1	12.7	0.200	6.95	
	360+00	364+00					Transition Section					
	364+00	423+50	13.12	-	-	8,326	50	1.5:1	15.9	0.150	7.09	
	423+50	451+00	15.21	-	-	9,126	50	1.5:1	16.7	0.150	7.28	
	451+00	453+00					Transition Section					
	453+00	475+00	15.99	-	-	9,213	34	1.5:1	19.5	0.150	7.47	
	475+00	477+00					Transition Section					
	477+00	485+50		-	-	9,255	24	1.5:1	21.7	0.150	7.54	234.0
Ditch I												
	32+50	56+00	0.47	$40M^{5/6}$	21	26	4	3:1	2.0	0.120	1.28	
	56+00	90+00	0.92	$40M^{5/6}$	37	46	4	3:1	2.2	0.120	1.35	
	90+00	95+00	1.13	$40M^{5/6}$	44	54	4	3:1	2.6	0.120	1.49	
	95+00	100+00	2.08	$40M^{5/6}$	74	84	4	3:1	2.8	0.120	1.56	
	100+00	136+00	2.39	$40M^{5/6}$	82	162	4	3:1	3.4	0.440	3.36	
	136+00	150+00	2.45	$40M^{5/6}$	85	109	4	3:1	3.4	0.200	2.26	17.0

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TABLE 3A - STRUCTURE DATA - Continued

CHANNELS

Choctaw Creek Watershed, Texas

Designation	Station Numbering for Reach: Station (100 ft.)	Station (100 ft.)	Watershed Area (sq. mi.)	Required Drainage Curve	Required Drainage Capacity (c.f.s.)	Planned Channel Capacity (c.f.s.)	Average Bottom Width (ft.)	Average Side Slope	Average Depth (ft.)	Average Grade (pct.)	Average Velocity in Channel (ft./sec.)	Volume of Excavation (1,000 cu. yds.)
Lateral IA												
	13+50	30+00	0.49	$40M^{5/6}$	22	21	4	3:1	2.0	0.080	1.05	
	30+00	40+00	0.78	$40M^{5/6}$	33	35	4	3:1	2.0	0.250	2.62	
	40+00	57+00	0.88	$40M^{5/6}$	36	35	4	3:1	2.2	0.150	1.52	
	57+00	70+00	0.93	$40M^{5/6}$	38	77	4	3:1	2.2	0.700	3.29	7.2
Lateral IB	0+00	24+50	0.21	$40M^{5/6}$	11	33	4	3:1	2.0	0.200	1.67	3.6
Lateral IC	0+00	17+50	0.27	$40M^{5/6}$	13	29	4	3:1	2.0	0.150	1.44	2.2
											Total Excavation	1,669.0

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TABLE 3B - STRUCTURE DATA - GRADE STABILIZATION STRUCTURES

Choctaw Creek Watershed, Texas

Item	Unit	STRUCTURE NUMBER 101	102	103	104	105	106	107
Drainage Area	Acre	96	250	250	344	1,368	380	[illegible]
Elevations	MSL							
Principal Spillway	Feet	748.0	758.0	509.5	508.0	505.0	504.0	507.0
Emergency Spillway	Feet	751.0	762.0	512.5	512.3	510.0	510.5	513.0
Top of Dam	Feet	753.0	764.0	514.5	514.0	514.0	514.0	515.0
Principal Spillway Capacity	C.F.S.	46	226	40	34	128	40	21
Principal Spillway								
Barrel								
Diameter	Inch	24	48	24	24	42	24	18
Gage		14	12	16	16	14	14	16
Riser								
Diameter	Inch	42	78	42	36	-	42	30
Gage		12	10	14	14	-	12	14

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TABLE 4 - ANNUAL COST

Choctaw Creek Watershed, Texas

(Dollars) 1/

Evaluation Unit	Amortization of Installation Cost	Operation and Maintenance Cost 2/	Total
34 Floodwater Retarding Structures; 110,180 feet of Stream Channel Improvement; Multiple-Purpose Structures 1, 4, 13, 30, 34, 35, and 38, including Basic Recreational Facilities; and Grade Stabilization Structures 101, 102, 103, 104, 106, and 107	285,029	28,130	313,159
21,600 feet of Drainage Main and Laterals and Grade Stabilization Structure 105	553	452	1,005
TOTAL	3/285,582	4/28,582	314,164

1/ Price Base: 1965

2/ Long-term prices as projected by ARS, September 1957.

3/ Amortized for 100 years at 3.125 percent.

4/ Includes replacement costs of $2,016 for basic recreational facilities and for any structure or appurtenance requiring replacement before end of 100-year evaluation period.

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TABLE 5 - ESTIMATED AVERAGE ANNUAL FLOOD DAMAGE REDUCTION BENEFITS

Choctaw Creek Watershed, Texas

(Dollars) 1/

Item	Estimated Average Annual Damage: Without Project	Estimated Average Annual Damage: With Project	Damage Reduction Benefit
Floodwater			
Crop and Pasture	96,369	24,870	71,499
Other Agricultural	35,747	9,054	26,693
Non-agricultural			
Road and Bridge	21,340	1,508	19,832
Urban	54,650	3,150	51,500
Subtotal	208,106	38,582	169,524
Sediment			
Overbank Deposition	2,068	745	1,323
Channel Deposition	2,000	680	1,320
Subtotal	4,068	1,425	2,643
Erosion			
Flood Plain Scour	18,514	3,840	14,674
Valley Trenching	1,075	747	328
Subtotal	19,589	4,587	15,002
Indirect	23,176	4,459	18,717
TOTAL	254,939	49,053	205,886

1/ Price Base: Long-term prices as projected by ARS, September 1957.

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TABLE 6 - COMPARISON OF BENEFITS AND COSTS FOR STRUCTURAL MEASURES

Choctaw Creek Watershed, Texas

(Dollars)

Evaluation Unit	AVERAGE ANNUAL BENEFITS 1/									Avcrage Annual Cost 2/	Benefit Cost Ratio
	Flood Prevention			Agricultural Water Management		Non-Agricultural Water Management					
	Damage Reduction	More Intensive Land Use	Incidental Recreation	Irrigation	Drainage	Municipal Water Supply	Recreation	Secondary	Total		
34 Flood Retarding Structures; 110,180 feet of Stream Channel Improvement; Multiple-Purpose Structures 1, 4, 13, 30, 34, 35, and 38, including Basic Recreational Facilities; and Grade Stabilization Structures 101, 102, 103, 104, 106, and 107 3/	197,039		4,323	2,331		67,918	153,598	36,758	461,967	313,159	1.5:1
21,600 feet of Drainage Main and and Laterals and Grade Stabilization Structure 105		950			950			555	2,455	1,005	2.4:1
GRAND TOTAL 4/	197,039	950	4,323	2,331	950	67,918	153,598	37,313	464,422	314,164	1.5:1

1/ Price Base: Long-term prices as projected by ARS, September 1957.

2/ From table 4.

3/ Interrelated measures.

4/ In addition, it is estimated that land treatment measures will provide flood damage reduction benefits of $8,847 annually.

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INVESTIGATIONS AND ANALYSES

Land Use and Treatment

The status of land treatment measures for the watershed was developed by supervisors of the Upper Elm-Red Soil and Water Conservation District, with assistance from personnel of the Soil Conservation Service Work Unit at Sherman, Texas.

A 20 percent sample of current conservation plans was used to develop conservation needs data. These were expanded to represent conservation needs for the entire watershed. Acres to be treated by land use during the 7-year project installation period were based on total conservation needs and the priority of planning and servicing set by the Soil and Water Conservation District. Technical assistance needs were based on the amount of funds now being expended for this purpose plus the additional funds that would be needed to complete all soils mapping and to assure the application of the land treatment practices during the installation period.

Engineering Investigations

The procedures used to determine the most feasible plan of structural measures to meet the objectives of the sponsoring local organizations that could not be accomplished by land treatment measures were as follows:

1. A base map of the watershed was prepared showing watershed boundary, drainage pattern, systems of roads and railroads, utility lines, and other pertinent information.

2. A study of photographs, supplemented by field examination, indicated the limits of flood plain subject to flood damage.

3. Stereoscopic photo and topographic map studies and field examination indicated 58 possible floodwater retarding structure site locations. Subsequent investigation indicated a need for channel improvement for portions of Choctaw, Mill, and Post Oak Creeks. Soil survey information indicated the need for providing improved surface drainage for 260 acres of wet land in the Red River terrace near the mouth of Choctaw Creek.

4. A system of 41 floodwater retarding structures, 20.87 miles of channel improvement, 4.09 miles of drainage mains and laterals, and 7 grade stabilization structures was recommended to the sponsoring local organizations for further consideration and detailed survey. The ownership and property lines for each floodwater retarding structure and for channel improvement were located and drawn on the photographs by the local sponsors prior to the start of engineering surveys.

5. Surveys - Engineering surveys were made after agreement was reached with the sponsoring local organizations on locations of structural measures to be studied.

   a. Horizontal control - Scales of aerial photographs were determined by using the tellurometer and by chaining between identifiable points.

   b. Vertical Control - Existing U. S. Coast and Geodetic Surveys and U. S. Geodetic Survey bench marks were supplemented with temporary bench marks set at strategic locations for use in making structural surveys.

   c. Floodwater Retarding Structures - Field surveys were made in 2 stages. First, topographic maps were made of the reservoir areas. Surveys were made of roads, pipe lines, and utility lines located within the reservoir areas. Second, after preliminary plans were reviewed and accepted by the local sponsors, detailed topographic maps with a contour interval of 2 feet and a scale of 1 inch to 100 feet were made of emergency spillway areas. A profile survey was made of the centerline of each structure. Contour lines of water elevations at the lesser of the 50-year sediment pool or 200 acre-feet level, at the top of the riser, the emergency spillway crest, and 2 feet above the emergency spillway crest were located on the ground and recorded on the photo map. These surveys provided the data necessary to determine if required sediment and floodwater detention storage capacities could be obtained, determine the most economical design for each structure, estimate the installation cost and make land rights maps. Criteria for accuracy of surveys as outlined in Watersheds Memorandum TX-2 were used for both the single and multiple-purpose floodwater retarding structures.

   d. Stream Channel Improvement - Stream channel improvement surveys were made in accordance with procedures outlined in Watersheds Memorandum TX-1. Surveys consisted of 20.87 miles of profiles and cross sections of existing channels.

   e. Grade Stabilization Structures - Detailed investigation indicated the need for 7 grade stabilization structures to stabilize 2 existing waterways and 5 side inlets.

   f. Drainage - 260 acres of wet land were mapped in the Carpenters Bluff area of Choctaw Creek. Detailed surveys were made on 1 main ditch and 3 laterals in accordance with Watersheds Memorandum TX-1.

6. Designs - Designs of structural measures were initiated as survey data for individual or related groups of structures were completed.

   a. Floodwater Retarding Structures - Criteria outlined in Engineering Memorandum-27 (1958) and Texas State Manual Supplement 2441 were used to determine the sediment and floodwater detention storage requirements, structure classification, and principal and emergency spillway design. As the topography was determined for each floodwater retarding structure site, storage tables and curves were developed. Preliminary layouts of pools, centerlines of dams, and emergency spillways were prepared and reviewed on the ground with the sponsors. These preliminary layouts showed the approximate area of the dam, emergency spillway, and the sediment and detention pools affecting each landowner. After any adjustments found desirable and feasible were made, the final pool elevation was determined, release rates for the principal spillways were established, and emergency spillways were designed.

      The elevations of the sediment pools were determined in accordance with Engineering Memorandum-16 and Section 3107, Watershed Protection Handbook. The lower sediment pool elevation was set, using the lesser of the capacity required for 50 years or 200 acre-feet. Storage of permanent water is limited by State law to 200 acre-feet unless a special permit is obtained. Detention volumes exceed the minimum criteria set forth in Engineering Memorandum-27 (1958). Detention volumes meet or exceed the Texas State Manual Supplement 2441 criteria in all sites except 5 and 11.

   b. Stream Channel Improvement - The design of the improved channel was based on the procedures outlined in "Suggested Interim Guide for the Planning and Design of Stable Channels," issued by the Fort Worth Engineering and Watershed Planning Unit, November 1963, and USDA Technical Release No. 25, "Planning and Design of Open Channels," December 15, 1964.

      The allowable velocity for the 10 percent chance discharge slightly exceeds the allowable on Post Oak Creek in order to fit the proposed bottom of the improved channel to the bottom of the existing channel. The velocities for the 1 percent and the 100 percent chance discharges are less than the allowable.

      A sampling procedure was used to determine that an average of 4 grade stabilization structures per mile will be required as inlets to the improved channel to prevent erosion or head cutting in the side inlets. The exact location of each of these will be determined by the construction engineer during the construction stage.

c. Grade Stabilization Structures - The grade stabilization structures were designed in accordance with Texas Engineering Handbook, Section 17.

d. Drainage - The drainage system was designed using the procedure outlined in Watersheds Memorandum TX-1 and Engineering-Drainage Memorandum TX-2.

7. Cost Estimates - Construction costs were based on unit prices being expended at similar sites, Soil Conservation Service experience, and values furnished by local organizations and companies. Economic evaluation of 5 systems of structural measures was made to determine the least costly system in order to reach project objectives. Alternate dam site locations were analyzed to determine the least costly combinations of emergency spillways and embankments. The adjusted long-term average annual cost of maintaining the single and multiple-purpose floodwater retarding structures is based on the following equation:

$$M = .73 (\$40 + \$10V + \$15F)$$

Where .73 = factor to adjust 1965 prices to 1957 long-term prices

M = the cost of maintenance

V = the number of acres to be vegetated on the dam and in the emergency spillway

F = the percent chance of use of the emergency spillway (table 3)

or F = the average number of times the emergency spillway is expected to function in a 100-year period

The cost of maintaining the stream channel improvement and appurtenances was estimated at $200 per mile based on the best available information. The replacement cost of appurtenances is based on replacing them at their original cost at the end of 50 years. The cost of maintaining drainage ditches was estimated at $100 per mile because of the smaller size channels. Operation and maintenance cost of grade stabilization structures and recreation facilities includes replacement of those structures and facilities having an expected life shorter than the 100-year evaluation period.

Hydraulic and Hydrologic Investigations

The following steps were taken as part of the hydraulic and hydrologic investigations:

1. Basic meteorologic and hydrologic data were tabulated from U. S. Weather Bureau Climatological Bulletins for the gage at Sherman, Texas, U. S. Geological Survey Water Supply Papers, Texas Board of Water Engineers Bulletins, and U. S. Study Commission Reports.

2. The without project hydrologic conditions for pasture and cropland were determined from soils and cover condition data developed by field mapping of samples for erosion rate and sediment production studies. Approximately 10 percent of the watershed was sampled. This data was summarized by land resource areas and sub-areas and curve numbers weighted for areal coverage within drainage basins. The with project condition was determined by considering the effect of changes in land use and treatment that could be expected during the installation period.

   Condition II curve numbers for land resource areas, sub-areas, and the watershed are as follows:

Land Resource Area or Sub-Area	Without Project	With Project
Blackland Prairie (Austin fm. bedrock)	82	81
Blackland Prairie (Eagle Ford fm. bedrock)	84	83
East Cross Timbers	78	77
Red River Terrace Soils	78	77
Watershed Average	82	81

3. A tabulation of cumulative departure from normal precipitation for the U. S. Weather Bureau gage at Sherman showed the period 1930 through 1962 to be representative of normal. Storms that occurred during this period were used to evaluate flood damages on the agricultural land. Each storm during this period was analyzed to determine the antecedent moisture condition, using the procedure outlined in National Engineering Handbook, Section 4, Supplement A, Section 3.4. The depth of runoff from individual storms was estimated, using runoff curves, Figure 3.10-1, NEH, Section 4, Supplement A. The runoff from each storm was adjusted to reflect future hydrologic conditions of the watershed. U. S. Department

of Commerce Technical Paper No. 40, "Rainfall Frequency Atlas of the United States," was used to develop a synthetic storm series for evaluating flood damages in the urban area of Sherman.

4. Engineering surveys were made of 153 valley cross sections to represent the stream hydraulics and flood plain area. Of these, 50 were surveyed in the urban reach of Sherman on Post Oak and Sand Creeks.

5. Stage discharge relationships for the valley cross sections through the urban area on Post Oak and Sand Creeks were determined by solving water surface profiles with the IBM 650 Computer. The procedure described on page 3.14-2, NEH, Section 4, Supplement A, was used to establish the stage discharge relationships for the remaining cross sections.

6. The peak discharge runoff relationship was developed at each proposed floodwater retarding structure site and at each valley cross section with the IBM 7090/7094 computer program outlined in USDA Technical Release No. 20, Project Formulation Program - Hydrology, June 8, 1965. Different combinations of floodwater retarding structures were analyzed to determine the system of structures which would accomplish the project objectives most efficiently.

   The peak discharge runoff relationship was modified to reflect the effect of change in time of concentration due to improving the stream channel.

7. Stage-area inundated curves were developed for each portion of the flood plain represented by a single cross section. Acres inundated by 0-1, 1-3, and 3 feet plus depth increments were determined for selected floods. Composite runoff-area inundated curves were developed for without project conditions and to reflect the effect of the planned works of improvement.

8. Determinations were made of the area that would be flooded by each storm in the evaluation series under each of the following conditions:

   a. The present conditions of the watershed remaining static.

   b. The application of land treatment.

   c. The application of land treatment and installation of floodwater retarding structures.

   d. The application of land treatment, and installation of floodwater retarding structures and stream channel improvement.

9. Reservoir operation studies were made for those floodwater retarding structures where additional capacity was provided for recreation development. The procedure for making these studies is contained in Texas Engineering Handbook, Section 4, Hydrology, Chapter 2. The runoff records indicated that the period 1950 through 1957 was the most critical drouth period in recent times. The inflow to the sites was based on analysis of rainfall records for the U. S. Weather Bureau gage at Sherman and/or inflow data to Lavon Reservoir on the West Fork of the Trinity River.

   The inflow data to Lavon Reservoir is contained in the U. S. Study Commission Report, Volume 1, Trinity River Basin Runoff. Reservoir evaporation rates were obtained from the Texas Board of Water Engineers, Bulletin 6006, Monthly Reservoir Evaporation Rates for Texas.

   Private engineers employed by the sponsors made operation studies for those sites which will include municipal water supply.

10. The required channel capacities for stream channel improvement were determined from routings described in item 6. The required capacities consist of the peak discharge produced by the runoff from the design storm with an antecedent moisture condition II.

11. Detention volumes for floodwater retarding structures were determined in accordance with Texas State Manual Supplement 2441 criteria. Volumes used exceed these criteria at most sites to obtain a more economical or desirable emergency spillway or structure design. The percent chance of use of emergency spillways was determined by adding to the actual detention storage the volume which would be released by the principal spillway during a 2-day period.

12. The principal spillway release rates vary from 8 csm to 25 csm. The average release rate for the watershed is 13 cfs per square mile controlled. The capacity of stream channels downstream from the reservoir and structure site conditions influenced the release rate selected for each site.

13. The size of the emergency spillway and freeboard design storms was selected from Engineering-Hydrology Memorandum TX-1. The values used equal or exceed those shown on standard drawing ES-1020. The distribution graph method was used to develop inflow hydrographs for each site in the watershed. Since routing of the emergency spillway hydrographs resulted in either no flow or very shallow flow, the dimensions of the emergency spillway were determined from the freeboard hydrographs. The elevation of the top of the dam was determined by graphically routing the freeboard

hydrographs. The routing method described on page 5.8-12, NEH, Section 5, was used.

Sedimentation Investigations

Sedimentation investigations were made in accordance with procedures outlined in Technical Release No. 12, "Procedures for Computing Sediment Requirements for Retarding Reservoirs," September 1959, USDA, SCS, and Watersheds Memorandum TX-25, "Sedimentation Investigations," August 21, 1959, USDA, SCS.

Sediment Source Studies

The following steps were used to determine the required 100-year sediment storage requirements for the planned floodwater retarding structures:

1. Representative samples covering about 10 percent of the watershed drainage area were selected on aerial photographs.

2. Soils and slope data from unpublished soil survey field sheets were utilized for all samples.

3. Land use, cover conditions, land treatment, and slope lengths in sample areas were mapped in the field.

4. Field investigations of gullies and stream channels above all structures were made to determine lengths, depths, and estimated rates of erosion.

5. Soils by slope in percent, slope length, land use, and cover conditions were tabulated for each land resource area.

6. The Musgrave soil loss equation for computing sheet erosion was used to adjust present erosion rates to reflect the effect of land treatment to be applied.

7. Sheet erosion rates were expanded by land use for each land resource area in the drainage area of each planned structure.

8. Applicable delivery ratios were applied to the gross erosion rates obtained in steps 4 and 7 to determine the sediment delivered to the reservoir.

9. The sediment delivered to the reservoir was adjusted for estimated trap efficiency.

10. Allowances for differences in density between soil in place and sediment were made for the required sediment storage volumes.

These densities were based on the following textural classes:

Texture	Soil in Place (lbs./cu.ft.)	Submerged Sediment (lbs./cu. ft.)
Clay and clay loam	80	44
Loam and sandy loam	90	60

11. Allocation of sediment to the floodwater retarding structure pools was made on textural classes as follows:

Period of Deposition	Structure Pool	Condition of Sediment	Allocation (Percent) Clay and Clay Loam	Allocation (Percent) Loam and Sandy Loam
		Single-Purpose Structures		
First 50 Years	Detention	Aerated	20	30
	Sediment	Submerged	80	70
Last 50 Years	Detention	Aerated	100	100
		Multiple-Purpose Structures		
100 Years	Detention	Aerated	20	30
	Sediment	Submerged	80	70

Flood Plain Sedimentation and Scour Damages

The following sedimentation and scour damage investigations were made to determine the nature and extent of physical damage to flood plain land:

1. Observations were made along each of the valley cross sections, making note of the depth and texture of sediment deposits, soil conditions, sheet and channel scoured areas, stream channel aggradation or degradation, and other factors contributing to flood plain damages.

2. The approximate elevation of the original flood plain before modern deposition or erosion began was determined for each valley section.

3. Information on past physical damages was obtained through interviews with landowners and operators.

4. Damage tables were developed to show percent damage to productive capacity of the flood plain soil, by depths for scour and by texture and depth for deposition. Adjustments for recoverability of productive capacity for each damage category were made on the basis of information obtained from landowners and operators and from field studies.

5. The damage areas were measured and data tabulated for each valley segment, and summarized for each evaluation reach.

6. Using the average annual erosion rates as a basis, the average annual volume of sediment produced above the area damaged was estimated for without project conditions, with land treatment applied, and with structural measures installed. These volumes were used as a basis for estimating the average reduction of overbank deposition in the watershed. Scour damage reductions are based on reductions of depth and area inundated for with project conditions.

7. Land destruction by valley trenching was determined by comparing the positions of overfalls shown on aerial photographs taken in 1941, 1950, and 1957. Acreage computations reflect ultimate total width of the trench after widening due to aging and length of time expected for destruction to occur based on present rate of advancement.

Channel Stability Studies

Channel investigations for stability studies were made on the mainstem and all major tributaries. These included studies of the general geology and soils of the drainage basin, depth and nature of the alluvium, thickness and types of modern alluvial deposits, types of bedload carried, relative stability under present conditions, and the nature of the underlying bedrock.

The alluvium along all streams is dominantly a cohesive, clayey material. Plastic alluvial clays derived from the heavy, clay-textured Blackland Prairies soils predominate on the mainstem of Choctaw Creek, Mill Creek, and Cedar Creek. These clays are classified as CL and CH under the Unified Soil Classification System. Sandy clay (CL) and clayey sand (SC) alluvium occurs on Iron Ore Creek where the clays from the Blacklands have been mixed with sands from the East Cross Timbers soils. Similar alluvial soils occur on Post Oak Creek where sands derived from sandy members in the upper Eagle Ford shale formation have mixed with clays from the Blacklands. Modern alluvial overbank deposits range from 2 to 5 feet deep, usually forming a natural levee along the banks. The texture of these deposits ranges from clays (CL) to silty sands (SM).

Bedrock of the Comanche series is exposed in the degraded reach of lower Choctaw Creek. These beds consist of hard limestones, hard sandstones, and soft shales and clays. The hard beds appear to be resisting further degradation. Accumulations of sandy and gravelly bedload in Iron Ore Creek cover the underlying Woodbine and bedrock. Cohesive clays with gravels cover the Woodbine sand, Eagle Ford shale, and Austin chalk bedrock of most of the other channels on Choctaw Creek and its tributaries. Deep alluvial clay deposits occur in upper Mill and Cedar Creeks.

Improved channels on the mainstem of Choctaw Creek and upper Mill Creek will be located in cohesive clays (CL and CH) having plasticity indexes ranging from 20 to more than 30. The Post Oak Creek channel is located on sandy cohesive materials having slightly lower plasticity indexes ranging from 10 to 30.

Geologic Investigations

Preliminary geologic investigations were made at each structure site. These investigations included studies of exposed geologic formations and structure, valley slopes, alluvium, and channel banks. Core drill equipment was used at multiple-purpose structure Site 38. Manual equipment was used at other sites for making necessary borings to obtain preliminary information on water tables, nature of foundation materials, stability, and extent of borrow materials, and type of material in the emergency spillways.

Description of Problems

All of the planned structures are located on rocks of Cretaceous age. Formations belonging to both the Comanche and Gulf series are represented. However, only Site 41 is located on rocks of the Comanche series. Quaternary terrace deposits are found in the abutments of many sites. Site locations by formations are tabulated as follows:

Series and Formation		Structure Numbers
Gulf Series	Austin Chalk Formation	2, 3, 4, 5*, 6, 7, 12, 13, 14, 15, 16, 17, 18*, 19, 20, 21, 26, 27, 28, 29
		1*, 9, 10, 31
	Eagle Ford Shale Formation	8, 11*, 22, 23. 24, 30, 32, 35, 36
		25*, 33, 34
	Woodbine Sand Formation	37, 38, 39, 40
Comanche Series	Grayson marl, Mainstreet ls., Pawpaw, and Weno Formations	41*

*Structures with Quaternary terrace deposits in abutment(s).

Degree and direction of dip vary locally with amounts of dip ranging from almost none up to 150 feet per mile. The steeper dips occur on the northeastern limb of the Sherman syncline. The regional dip is toward the southeast at 30 to 40 feet per mile.

The geologic structure is influenced by the Preston anticline in the extreme northeastern part of the watershed and the Sherman syncline extending from northwest to southeast across the central part.

Comanche Series - Site 41 is located on the Weno clay, Pawpaw sand, Mainstreet limestone and Grayson marl formations. Seepage is expected in the sandy beds of the abutments. Removal of hard sandstone boulders from the channel area of the foundation will be necessary. Borrow materials will be obtained from a low terrace deposit consisting of sandy clays and clayey sands over basal clayey gravels and sands, gravels, and cobbles classified as CL, SC, GC, GP, and GM.

The Woodbine sand - Crossbedded and massive fine-grained sandstones predominate in the Woodbine formation. Thin beds of sandy shales, lignite, and gypsiferous shales resembling the Eagle Ford also occur in the formation. Springs and seepage out of bedding planes were observed at many sites. Seepage problems requiring drainage measures are expected at all sites located in this formation. Soils from the borrow areas are classified as CL, SC, SM, and SP.

The Eagle Ford shale - The Eagle Ford formation is dominated by soft, dark-colored shales containing disseminated minute crystals of gypsum. The upper part contains some sandy shales, thin beds of sand and sandstone and a prominent bed of cemented fossils (Ostrea lugubris). Soil development on these materials consists of plastic and sandy to silty clays classified as CH and CL. Seepage from the sandy beds was observed at Site 1 and may also be a problem at Sites 10 and 31.

The Austin chalk - The Austin formation consists of medium to thick-bedded, moderately soft chalk near the base. Soft marls and shales occur above the chalk beds and make up the largest areal outcrop of the Austin in the watershed. Thick-bedded, massive chalk beds lie above the marl and crop out near and along the southern watershed divide.

Rock excavation is not expected to be a problem at any site in the Austin formation. Most of the chalk should be rippable under average moisture conditions. Steep escarpments at sites with chalk beds in the abutments, underlain by the soft shales of the Eagle Ford formation, may require additional foundation preparation to reduce danger of differential settlement. Excess seepage through the bedding planes of the chalk beds may require drainage measures at Sites 1, 2, 3, 4, and 18. Adequate borrow material, classified as CL and CH under the Unified Soil Classification System, is available at all sites.

Quaternary Terrace - All terrace deposits at the planned sites consist of materials derived mainly from limestone and chalk bedrock. Seepage is a problem in the basal sand and gravel materials and will require drainage measures or cutoffs through these beds.

Economic Investigations

Basic methods used in the economic investigations and analyses are outlined in the "Economics Guide for Watershed Protection and Flood Prevention," U. S. Department of Agriculture, Soil Conservation Service, March 1964.

Selection of Evaluation Reaches

Because of the diversity of damageable values and flood plain characteristics, the flood plain was divided into 7 evaluation reaches (figure 8). Six of these are agricultural reaches and 1 consists of the urban area of Sherman.

Determination of Non-Agricultural Damages

The frequency method of analysis was used in evaluation of the urban reach. An inventory was made of all buildings, both residental and commercial, occupying the area subject to damage from a flood which could be expected on an average of once in 100 years. Any inventory of this rapidly expanding population center is hopelessly outdated within a few months, however.

Evaluationsof damages for without project conditions and with project conditions were made on the basis of present buildings plus future development, which has already begun, assumed to be in place by or before the end of the installation period. Little development can be expected beyond these limits since available space will be almost completely utilized by that time. No attempt has been made to evaluate monetary benefits on 17 acres of flood plain in West Hill Cemetery, although obviously monetary benefits will accrue as a result of the project.

Damageable values used for urban evaluation are based upon values on the current market in Sherman. It is recognized that damageable values will continue to increase as the result of the general improvement of the standard of living of residents of the area. Indirect damages such as dislocation of residents and rehabilitation of business is estimated at 10 percent of the direct damages.

Damage estimates to roads and bridges in the flood plain were obtained from county commissioners, state highway officials, and landowners.

Determination of Agricultural Damages

Agricultural damage estimates were based upon information obtained by interviewing landowners and operators of approximately 30 percent of the acreage of the flood plain. This sample was considered adequate and representative for the economic evaluation. Schedules covered past, present, and intended future use, crop distribution under normal conditions, yields, historical data on flooding and flood damages to crop and pasture, as well as other agricultural damage such as loss of fences, farming equipment, and livestock. Supplemental information pertaining to crop yields and trends in crop production and farming operations were obtained from agricultural workers in the area. The present land use of all the land in the flood plain was obtained by field mapping.

Analyses of this information formed the basis for determing the damageable value and damage rates for various depths and seasons of flooding, in the historical series 1930-1962, inclusive. An adjustment was made to take into account the effect of recurrent flooding when several floods occurred within one year.

The monetary value of the physical damage from erosion and from deposition of infertile sediment upon formerly fertile bottomland was based upon the value of production lost, taking into account the time lag in recovery.

Indirect damages, involving such items as additional travel time for farmers; re-routing of general traffic, school buses, and mail deliveries; and additional feeding costs for livestock, were estimated to approximate 10 percent of the direct damage.

Average annual damages within the watershed were calculated for conditions without a project, with planned land treatment applied, and after installation of the complete project.

The difference between the damage after the installation of a phase of a project and that before its installation constituted the benefit from reduction of damage creditable to that phase.

Owners and operators, when interviewed, were asked if they would make any changes in their operations if protection from flooding were provided. They indicated that they would restore to its former productivity approximately 800 acres which has reverted to pasture and woody pasture. The shift will be to improved pasture and alfalfa. Consequently, it is not expected that acreages of crops subject to acreage allotments will be increased as a result of the project.

Fourteen farm operators having drainage problems indicated that they would install on-farm drainage systems. Damages from poor drainage and flooding are considered inseparable; therefore 50 percent of both project costs and damage reduction benefits are assigned to each purpose. Benefits will accrue as a result of more efficient operation of farm equipment, better scheduling of farming operations, and a higher level of management.

One landowner intends to install a supplemental irrigation system. Benefits will result from higher level of management as a result of a more assured water supply.

Two sites have storage for recreation and basic recreation facilities. Estimates of population within the 50 and 100-mile radius were based on the 1960 census. In accordance with Watersheds Memorandum-57, October 3, 1962, a value of $1.50 per visitor-day was used for evaluation purposes for Iron Ore Lake, and a value of $1.25 was used for Waterloo Lake since it does not offer facilities for overnight camping.

Incidental recreation benefits were evaluated for sediment pools of floodwater retarding structures. A value of $.50 per visitor-day was used for purposes of evaluation in view of the expected lack of basic recreation facilities at these pools. Replacement costs, based upon 1965 prices, were calculated for all facilities and appurtenances requiring replacement before the end of the 100-year evaluation period. Annual cost for this purpose is that amount of money which, if deposited annually in a sinking fund, would accumulate a lump sum sufficient to pay replacement costs.

All project benefits, other than those which occur immediately following project installation, such as reduced damages from flooding, were discounted for lag in accrual.

Benefits from storage of municipal water for municipalities concerned are considered to be equal to cost of facilities necessary to provide this

valuable resource for the future, inasmuch as this is one resource upon which ever greater demands are made with each passing year. Actually it is questionable whether it is possible to place a monetary value upon it under any circumstances.

Values of local secondary benefits were calculated in accordance with interim procedures outlined in Watersheds Memorandum-57, October 3, 1962. Secondary benefits of a local nature were considered as either (1) stemming from the project, or (2) induced by the project. Benefits stemming from the project were estimated to be at least 10 percent of the direct primary benefits accruing to the structural measures included in this plan. Secondary benefits induced by the project were estimated to be 10 percent of the additional cost of increased production as a result of the project.

The value of easements was determined by local appraisal, giving full consideration to current real estate market values. An estimate was made of the value of production lost in the pool areas after project installation. It was considered that sediment pools would yield no agricultural production. Land needed for detention pools would be used for intermittent grazing after program installation. The average annual loss in production within the floodwater retarding structure sites, plus secondary losses therefrom, was compared with the amortized value of easements. The easement value was found to be greater and therefore was used in economic evaluation in the interest of a conservative analysis.

Fish and Wildlife Investigations

The Bureau of Sport Fisheries and Wildlife, in cooperation with the Texas Parks and Wildlife Department, made a detailed study of Choctaw Creek watershed, Grayson County, Texas.

This report, reflecting a 100-year period of analysis, was prepared in accordance with Section 12 of the Watershed Protection and Flood Prevention Act (68 Stat. 666, as amended; 16 U.S.C. 1008).

Pages 6 through 11 of this report have been reproduced on the following pages and are made a part of this work plan.

Basic recreational facilities would be provided at Sites 35 and 38. These facilities would include access roads, parking areas, boat docks and launching ramps, beach areas, sanitary facilities, picnic areas, camping areas, shelters, paths and tracts, landscaping, and utilities.

Principal species of fish in the watershed include largemouth bass, white crappie, white bass, bluegill, channel catfish, carp, gar, smallmouth buffalo, and gizzard shad.

Fish habitat in Choctaw Creek Watershed occurs in Loy and Waterloo Lakes and in some farm ponds in the watershed. Public fishing is permitted in the two lakes, but the privately owned farm ponds are closed to public use. Fish habitat in the watershed streams, all of which are intermittent and are reduced to small pools or dry out during most of the year, is insignificant. The watershed streams, particularly those draining the highly erodible uplands south of Choctaw Creek, carry large loads of sediment. Sewage effluents are discharged into Choctaw and Iron Ore Creeks, respectively, by the Cities of Sherman and Denison. If the area continues to grow and attract new industry at the rate expected, stream pollution may become a serious problem.

Fish habitat is not expected to improve significantly in the future. There would be about 8,000 man-days of fishing annually without the project, most of which would be done in Loy and Waterloo Lakes. There is no commercial fishing in the watershed and none is expected in the future.

The construction of 34 floodwater retarding reservoirs and 7 multiple-purpose reservoirs and the installation of land treatment measures would increase fish habitat and fishing in the watershed. Measures that would result in the reduction of erosion and curtailment of silt pollution would improve the quality of fish habitat in existing and proposed impoundments. Public access to six multiple-purpose structures and recreational developments on three of them would result in a large increase in fishing in the watershed. There also would be some fishing on the 34 floodwater retarding reservoirs which would be located on private lands. Access to these 34 reservoirs would be by landowner's permission, by payment of a user fee, or by leasing.

There would be no public access to Site 34 which would contain water for irrigation. The water levels in Site 34 probably would fluctuate drastically, even to the extent that the reservoir could dry up.

With the project, sport fishing would amount to 52,000 man-days annually. A summary of sport fishing in man-days annually without and with the project is presented in Table 2. There would be no commercial fishing with the project.

Table 2. Summary of Sport Fishing in Man-days Annually

Reservoir	Without Project	With Project	Gain or Loss
Site 1	0	5,000	5,000
Site 4	0	5,000	5,000
Site 13	0	5,000	5,000
Site 30	0	2,000	2,000
Site 34	0	0	0
Site 35	0	20,000	20,000
Site 37	5,000	5,000	0
Site 38	3,000	8,000	5,000
Others 1/	0	2,000	2,000
Total	8,000	52,000	44,000

1/ 33 floodwater retarding reservoirs

Most of the watershed lies in the Blackland Prairies Land Resource Area with a small segment of the northwestern portion in the Cross Timbers Land Resource Area. Both areas contain considerable croplands. There is a scarcity of timber and brush in the watershed and generally there is little wildlife habitat, particularly cover, in the watershed.

Wildlife species in the watershed include white-tailed deer, mourning dove, bobwhite, fox squirrel, gray squirrel, cottontail, swamp rabbit, jackrabbit, armadillo, opossum, skunk, mink, beaver, and waterfowl.

White-tailed deer are scarce and are not expected to attain significant numbers because of poor cover in the watershed. There is no hunting for deer and none is expected without the project.

Mourning doves are abundant and moderate numbers of bobwhites occur in the project area. Squirrels are abundant in the bottomland timber but are scarce in the uplands. Rabbit populations are moderate. Most of the hunting done in the watershed is for doves, bobwhites, and squirrels. The hunting occurs on private lands and is done with permission of the landowners, by payment of daily user fees, or under lease of hunting rights. Bobwhite and mourning dove populations would diminish as more land is converted to grassland and the conversion of woodland to other uses would result in fewer squirrels and less hunting in the future.

Waterfowl use of the watershed is moderate and occurs primarily on flooded bottomlands and grain fields during the winter months. Waterfowl are attracted to and held in the general watershed area during the winter by the Hagerman National Wildlife Refuge and Texoma Reservoir. Waterfowl hunting, however, is difficult because the least disturbance causes the birds to leave the area. Hunting for waterfowl in the watershed is of minor importance and would not be expected to change significantly in the future.

Armadillos and most species of fur animals are abundant in the watershed. Beavers invade the watershed from adjacent areas but are usually removed by the Texas Parks and Wildlife Department since they become nuisances in densely settled and intensively farmed areas. There is a considerable amount of sport hunting for fur animals; however, trapping of fur animals for their pelts is insignificant because of low raw pelt prices. It is anticipated that these conditions would prevail in the future.

Upland-game and fur-animal habitat would be destroyed by the construction of the floodwater retarding and multiple-purpose reservoirs. About 260 acres of wetlands would be drained by the installation of 4.09 miles of mains and laterals. This drainage would affect adversely waterfowl populations and some species of fur animals in the watershed.

The establishment of vegetation on critically eroded areas would offset partially the loss of upland-game and fur-animal habitat and populations. Upland-game habitat on the bottomlands downstream from the floodwater retarding and multiple-purpose reservoirs would improve as a result of increased flood protection. The reservoirs would provide resting areas for waterfowl and watering areas for many species of wildlife.

The Texas Parks and Wildlife Department can provide valuable assistance to the sponsors of the project and landowners in the development of

fish and wildlife in the watershed. To obtain such assistance, the Texas Department must know far enough in advance the status of the various phases of the project development so that they may schedule their work program to lend assistance at the proper time. Pre-impoundment investigations are sometimes advisable to determine the presence of undesirable fish populations in the watershed. Should eradication of undesirable fish populations be needed, it is easier, more effective, and more economical to do it when there is only a small amount of water. The Texas Department would stock the project impoundments with the proper species and numbers of fish.

Heavy use is expected on Sites 35, 37, and 38 which are to be developed for recreation. Waterskiing and speedboating could create serious problems and even endanger life and property, especially if there is no control over such activities. The proposed reservoirs would not be large in area and a few skiers and speedboaters might well dominate the use of the entire reservoir to the exclusion of other types of water-based recreation.

To promote maximum use of these three reservoirs, it would be advisable to control speedboating and waterskiing by prohibiting such activities or zoning the reservoirs. Since there would be other multiple-purpose reservoirs in the watershed, it would be advisable to permit selected activities such as boating, waterskiing, swimming, and fishing on certain of the reservoirs and prohibit them on others. The Texas Parks and Wildlife Department would be happy to assist in the formulation of a zoning plan or in the determination of the best fishing reservoirs in the project plan.

Prior to impoundment of the reservoir, all barren areas within the reservoir basins should be planted to cover crops to reduce erosion, add fertility to the water, help clarify the water, decrease turbidity, and improve the quality of fish habitat. The areas above the water line should be planted to grass to prevent sediment from entering the reservoir basins.

The multiple-purpose reservoirs, and when practicable the detention-type reservoirs, should be fenced to prevent fouling of the water, trampling of the dams and vegetation, muddying of the water, and to permit the growth of vegetation around the water's edge. Water requirements for livestock should be met by piping water to tanks below the dams and outside of the enclosures or by providing lanes to the detention pools.

Wildlife cover is scarce in the watershed and may become even more so in the future. Construction of floodwater retarding reservoirs and multiple-purpose reservoirs and improvement of stream channels would damage or eliminate more brush and timber.

To minimize such losses, channel improvements should be aligned within the stream courses as much as practicable. Clearing of floodwater retarding and multiple-purpose reservoirs should be restricted to the areas below the permanent or sediment pool elevations.

When timber or brush must be removed for establishment of project features, such losses should be compensated for by planting wildlife food and cover plants appropriate to the area at eroded areas, marginal areas, and along stream banks and fencerows.

It is recommended:

1. That the sponsors keep the Texas Parks and Wildlife Department informed of the progress of the project, particularly when reservoir construction begins, to permit that agency to investigate the need for eradication of undesirable fish species.

2. That landowners seek the advice of the Texas Parks and Wildlife Department for the development and management of the fish and wildlife on their lands.

3. That the impoundments be stocked with the species of fish and in a manner recommended by the Texas Parks and Wildlife Department.

4. That the sponsors develop a zoning plan for project reservoirs in the interest of safety and to obtain maximum recreational use. The Texas Parks and Wildlife Department would be pleased to assist in the development of a zoning plan for these reservoirs.

5. That barren areas in the reservoir basins be planted to a cover crop and the areas above the water line be sowed in grass to prevent erosion and turbidity and to improve the quality of fish habitat.

6. That the multiple-purpose reservoirs, and when practicable the detention-type reservoirs, be fenced to prevent fouling of the water, trampling of the dams and vegetation, and muddying of the water.

7. That water requirements for livestock be met by piping water to tanks below the dams and outside of the enclosures, or by providing fenced lanes to the detention pools.

8. That channel improvements be confined to stream courses as much as practicable to minimize losses of important wildlife cover along the streams.

9. That timber and brush clearing be kept to a minimum consistent with project objectives.

10. That wildlife food and cover plants be sowed at eroded areas, marginal areas, and along stream banks and fencerows to compensate for losses of brush and timber by project construction.

The above recommendations are in conformance with U.S.D.A. Soil Conservation Service Biology Memorandum-7 (Rev. 1), National Standards for Biology Practices. If adopted as part of the project plan of development, losses of wildlife habitat would be mitigated and, additionally, fish and wildlife benefits would accrue to the project.

The installation and operation of the project features would result in benefits to freshwater sport fishing in the amount of 44,000 man-days annually, valued at $44,000. The project would not significantly affect freshwater commercial fishing.

There would be no wildlife benefits from the project. Instead, habitat losses to upland game, fur animals, and waterfowl would occur from the proposed developments.

Adoption of recommendations 1, 2, 3, 5, 6, 7 would provide high quality fish habitat and better success in sport fishing. Recommendation 4 is proposed to obtain the maximum recreation use of the project reservoirs without conflict with various types of water-oriented activities. Adoption of recommendations 8, 9, and 10 would keep losses of wildlife habitat and populations to a minimum and also would compensate partially for wildlife habitat losses by providing food and cover plants.

This report is based on information received prior to February 24, 1966. Any modifications of the project plans should be brought to the attention of the Bureau of Sport Fisheries and Wildlife and the Texas Parks and Wildlife Department.

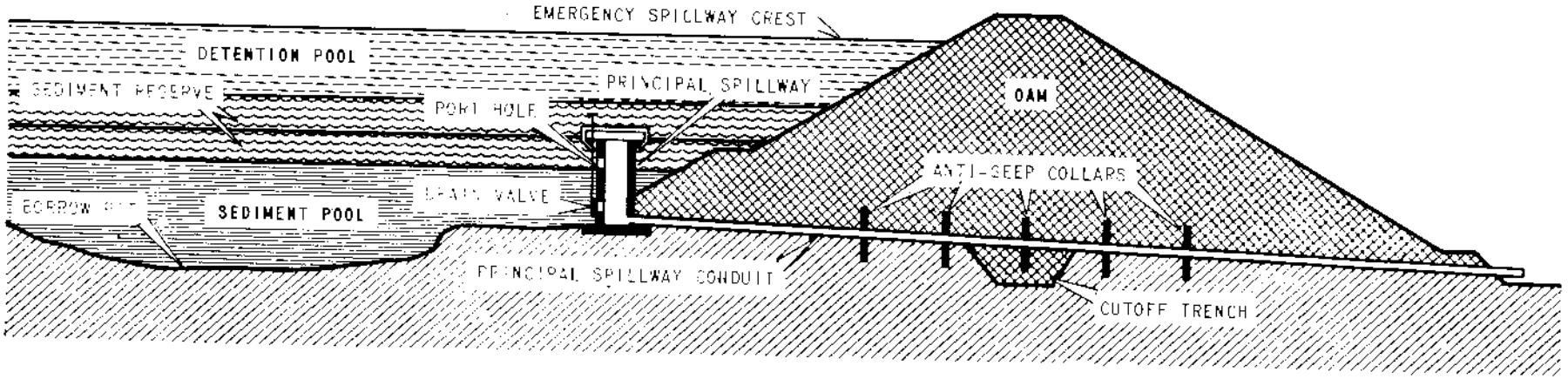


Figure 1

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

Dozer cuts excavated during the soil and foundation investigations, and not obliterated by normal construction operations, shall be filled, leveled, and graded by the contractor.

A minimum of 6" topsoil shall be placed in Emergency Spillway and on all Earth Fill areas. (See Construction Specification 20, I

Stream channel within the embankment area shall be cleared of objectionable material. (See Sheet No. 11 and Construction Specification 4)

FENCE LEGEND

——C——C—— New fence to be constructed under this contract.

——R/S——R/S—— Fence in construction area to be removed and salvaged by the contractor.

Emergency Spillway Diversion: 10' effective height, 3:1 side slopes and 13ft. minimum base, shall be constructed at the approximate location shown on the plan.

Emergency Spillway Diversion.

16' Berm El 674.0

Downstream Toe.

14' Wire Cap in 30' nf fence.

12' Berm El. 686.8

Upstream Toe

Sta. 3+25 on right Side Emergency Spillway = Sta. 3+40 on ℄ Dam

Sta 2+00 on ℄ Principal Spillway = Sta. 8+36 on ℄ Dam

Farm Pond (To be left undisturbed)

14' Wire Cap

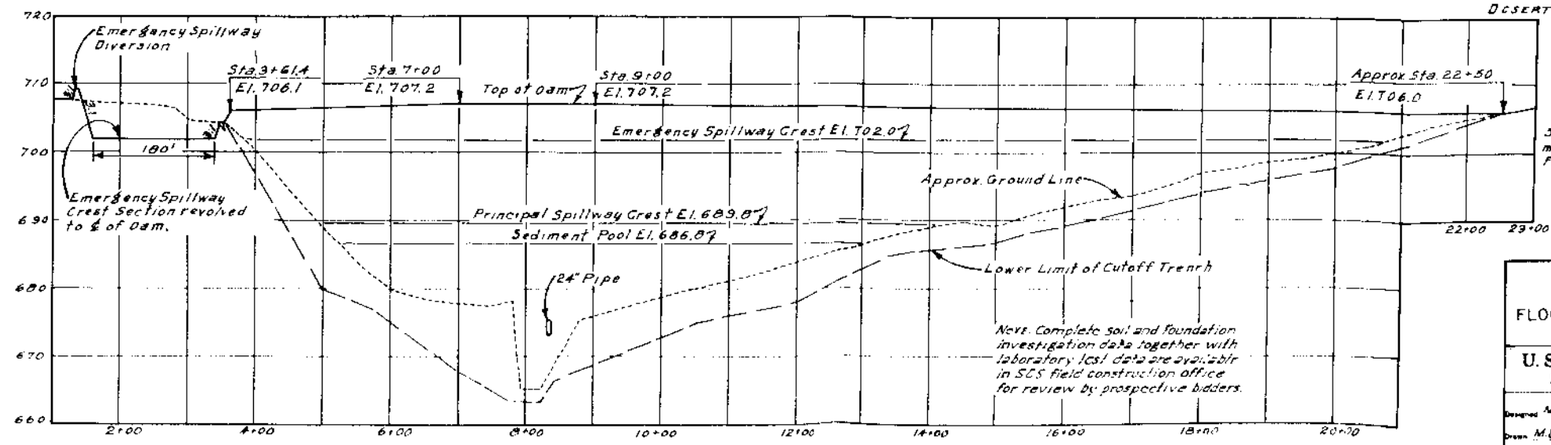
EMERGENCY SPILLWAY CURVE DATA

Δ = 92°00'
D = 40°00'
R = 143.24'
L = 230'
P.C. = Sta. 0+50
P.T. = Sta. 2+80

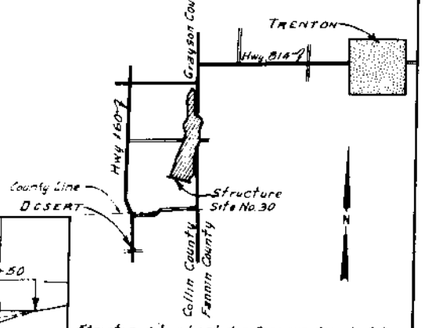
PLAN OF EMBANKMENT AND SPILLWAYS

0 100 200 300 400 500

SCALE IN FEET



PROFILE ON ℄ OF DAM



Structure site is located in Grayson County, 2.0 miles south and 3.0 miles west of Trenton, Fannin County, Texas.

VICINITY MAP

0 1 2 3 4

SCALE IN MILES

Figure 2

TYPICAL

FLOODWATER RETARDING STRUCTURE

GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	Approved by
Designed	M.D.K.	9-65	
Drawn	M.D.K. & D.L.F.	9-65	
Traced	T.F.R.	10-65	
Checked	M.D.K. & G.W.T.	11-65	

Series 1955 — Sheet No. 2 of 2 — Drawing No. 4-E-20,690

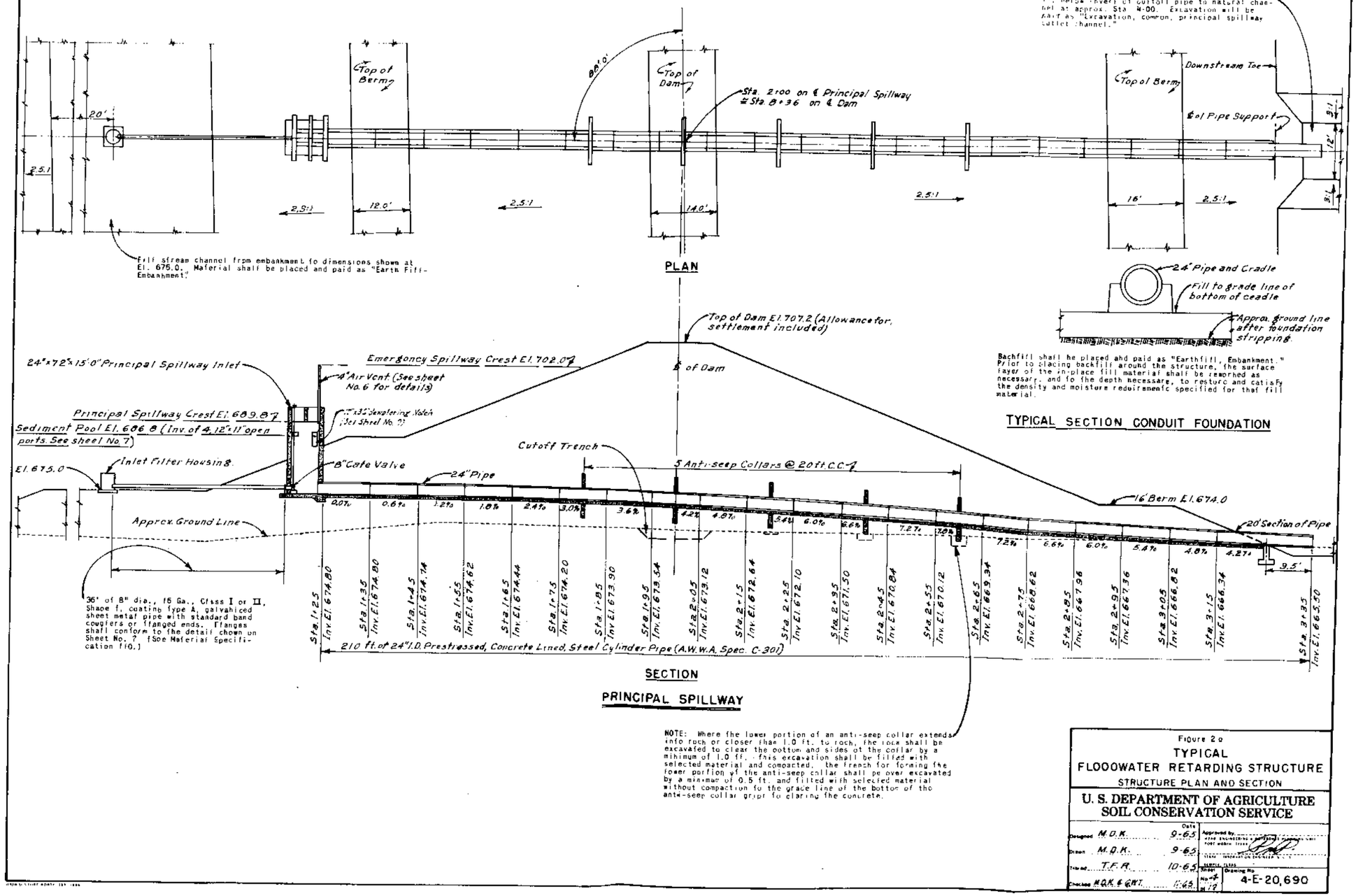


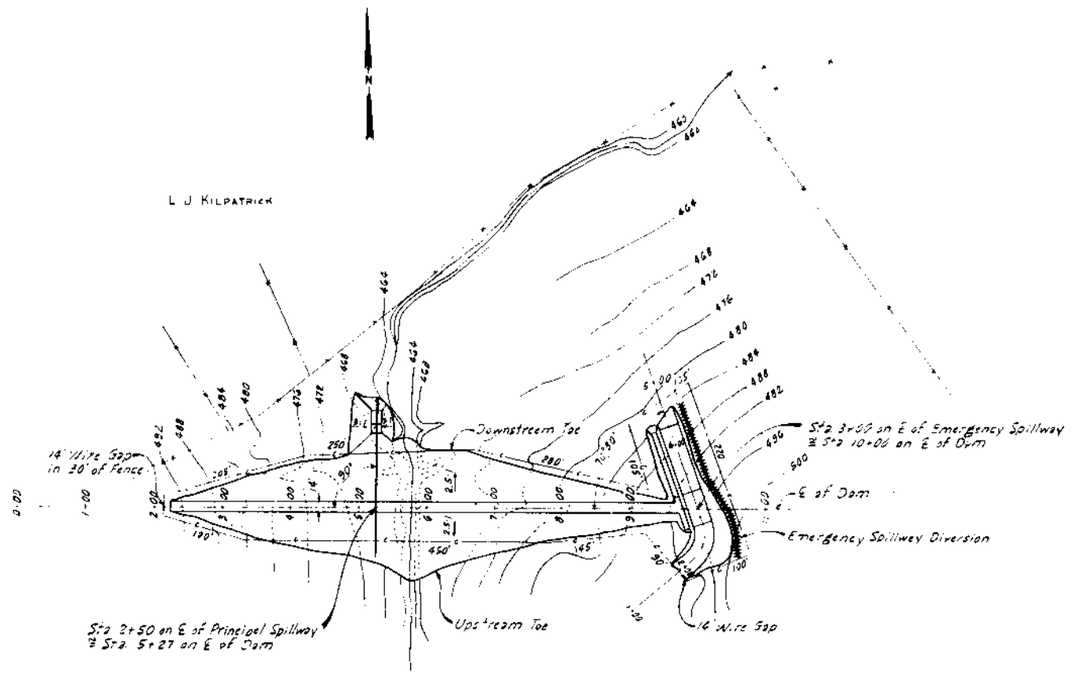
Figure 2 a

TYPICAL
FLOODWATER RETARDING STRUCTURE
STRUCTURE PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	M.D.K.	9-65	Approved by: ... State Engineer
Drawn	M.D.K.	9-65	
Traced	T.F.R.	10-65	Scale: 1/4"=1'-0"
Checked	M.D.K. & G.W.T.	11-65	Sheet No. 4 of 12

Drawing No. 4-E-20,690

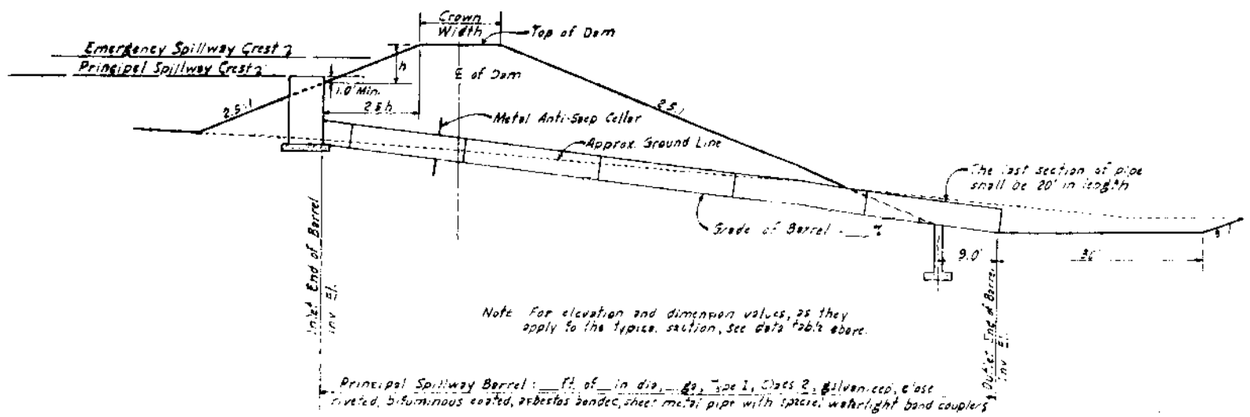


SITE 1

PLAN OF EMBANKMENTS AND SPILLWAYS

0 50 100 200 300 400 500

SCALE IN FEET



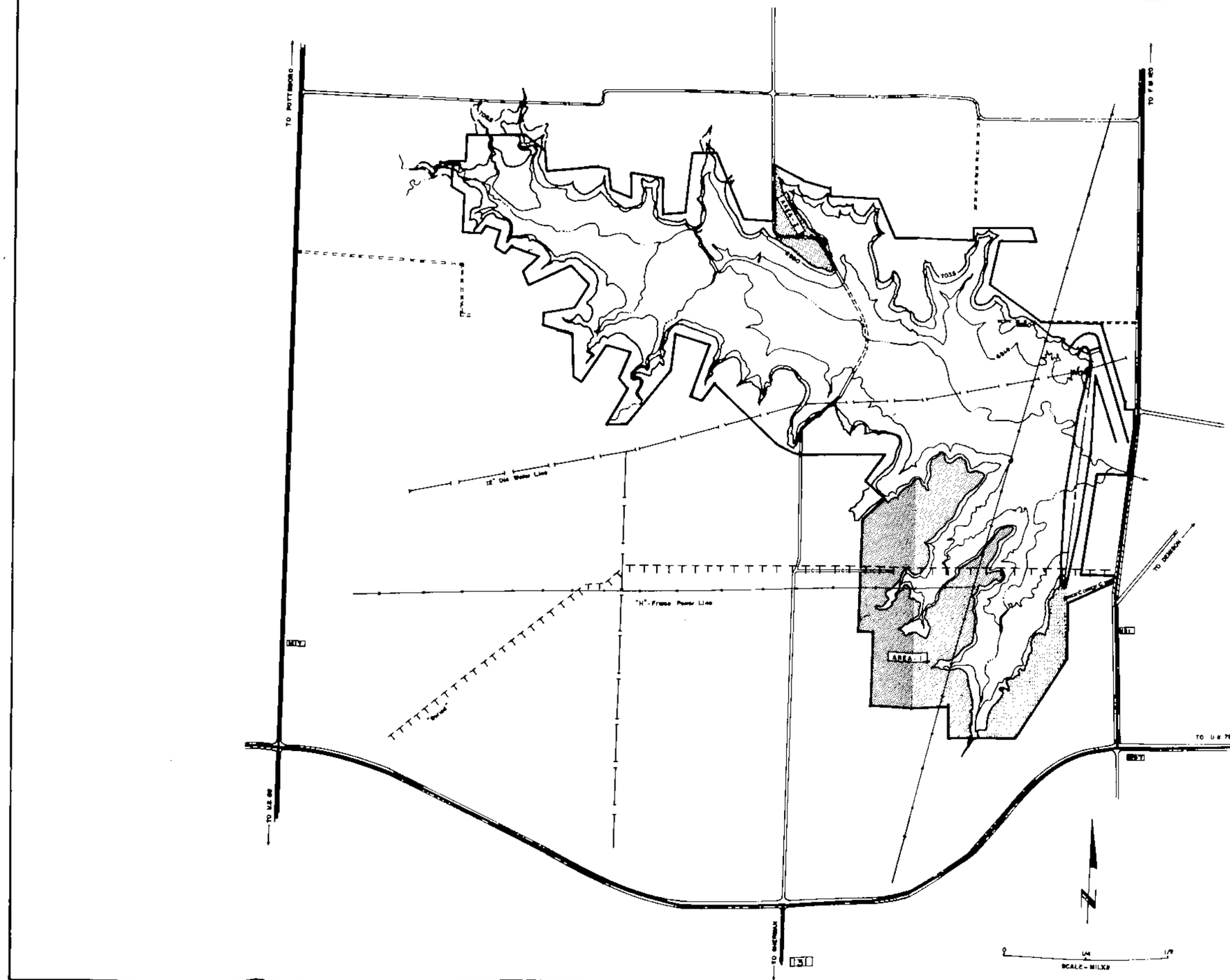
TYPICAL SECTION - PRINCIPAL SPILLWAY

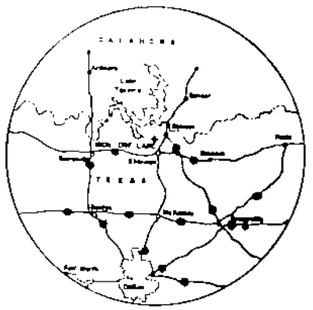
Figure 3
TYPICAL
GRADE STABILIZATION STRUCTURE
STRUCTURE - PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	Approved by
Designed	J.A.B.	4-65	
Drawn	J.A.B.	4-65	
Traced	C.W.C.	5-65	
Checked	J.A.B. & G.M.T.	5-65	

Sheet No. 5 of 14 — Drawing No. 4-E-21,303





LEGEND

- Existing Highways
- Access Road To Be Hard Surfaced
- 681.0 Recreation Pool MSL Elevation
- 698.0 Municipal Pool MSL Elevation
- 703.5 Emergency Spillway MSL Elevation
- 705.5 Limit Of Flowage Easement
- Limit Of Public Access Area
- Recreation Area
  - Area 1 - Picnic, Sanitary, Parking, Beach Development, Boat Dock and Launching Ramp.
  - Area 2 - Boat Dock and Launching Ramp.

Figure 4

RECREATION AREA
SITE 35 IRON ORE LAKE
CHOCTAW CREEK WATERSHED
GRAYSON COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed
Drawn M.W.R. 5-6-60
Traced
Checked
Scale
Approved by
Title
Date
SCS
AC

4-R-20, 874

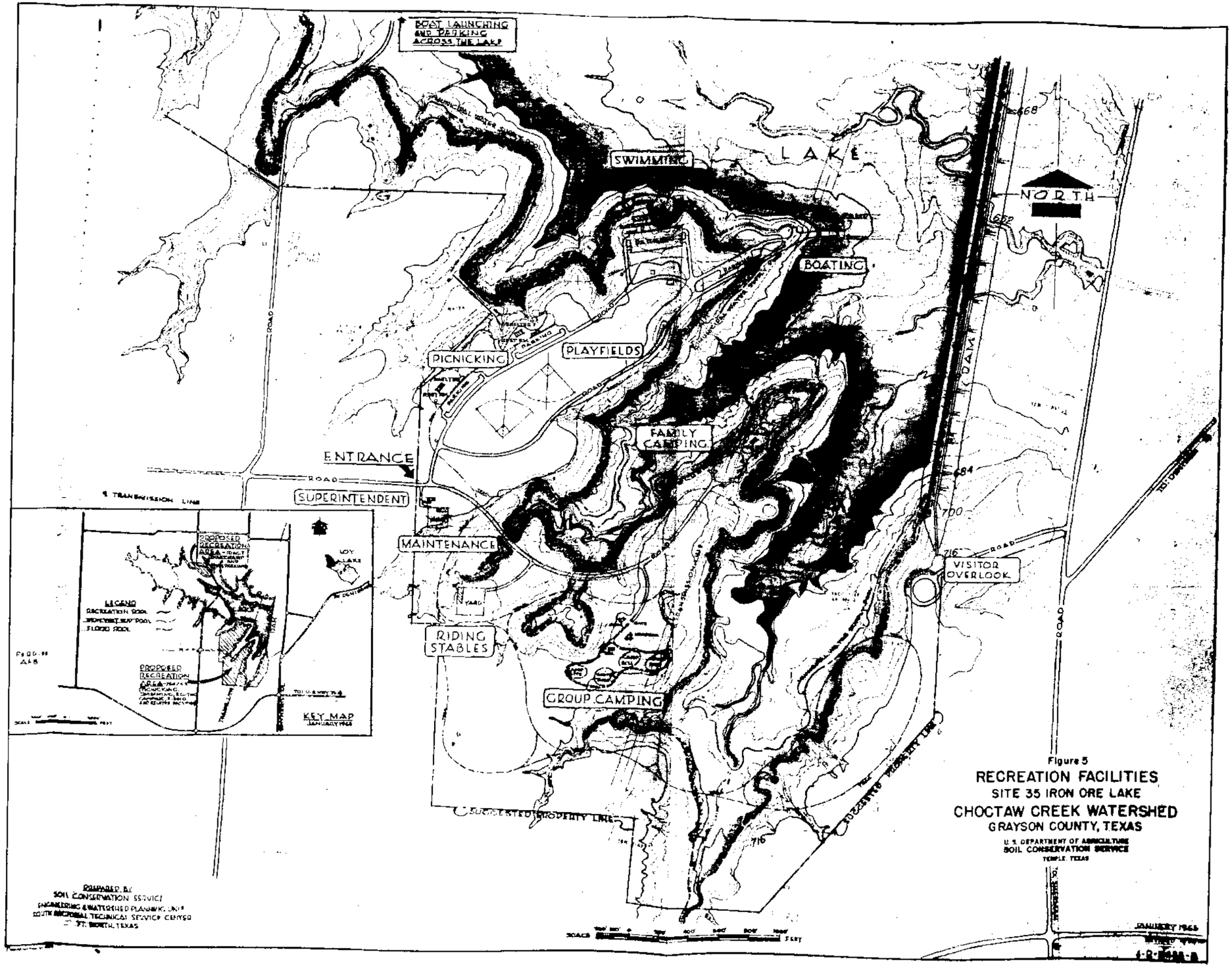


Figure 5

RECREATION FACILITIES

SITE 35 IRON ORE LAKE

CHOCTAW CREEK WATERSHED

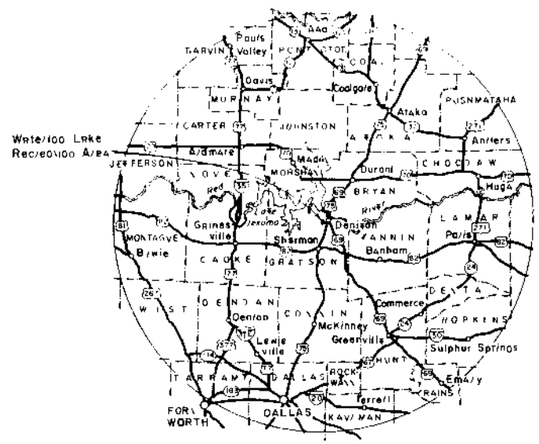
GRAYSON COUNTY, TEXAS

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

JANUARY 1965

LEGEND

- Access Road
- Existing Road
- Limit Of Public Access Area
- Centerline Of Dam
- Railroad
- Drainage
- Bridge
- Recreation Area
- 679.0 Recreation Pool MSL Elevation
- 694.5 Emergency Spillway MSL Elevation
- 696.5 Limit Of Flowage Easement



VICINITY MAP
0 10 20 30
Scale In Miles

Figure 6

RECREATION AREA
WATERLOO LAKE - SITE 38
CHOCTAW CREEK WATERSHED
IN
GRAYSON COUNTY, TEXAS
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

D-65 4-R-20591

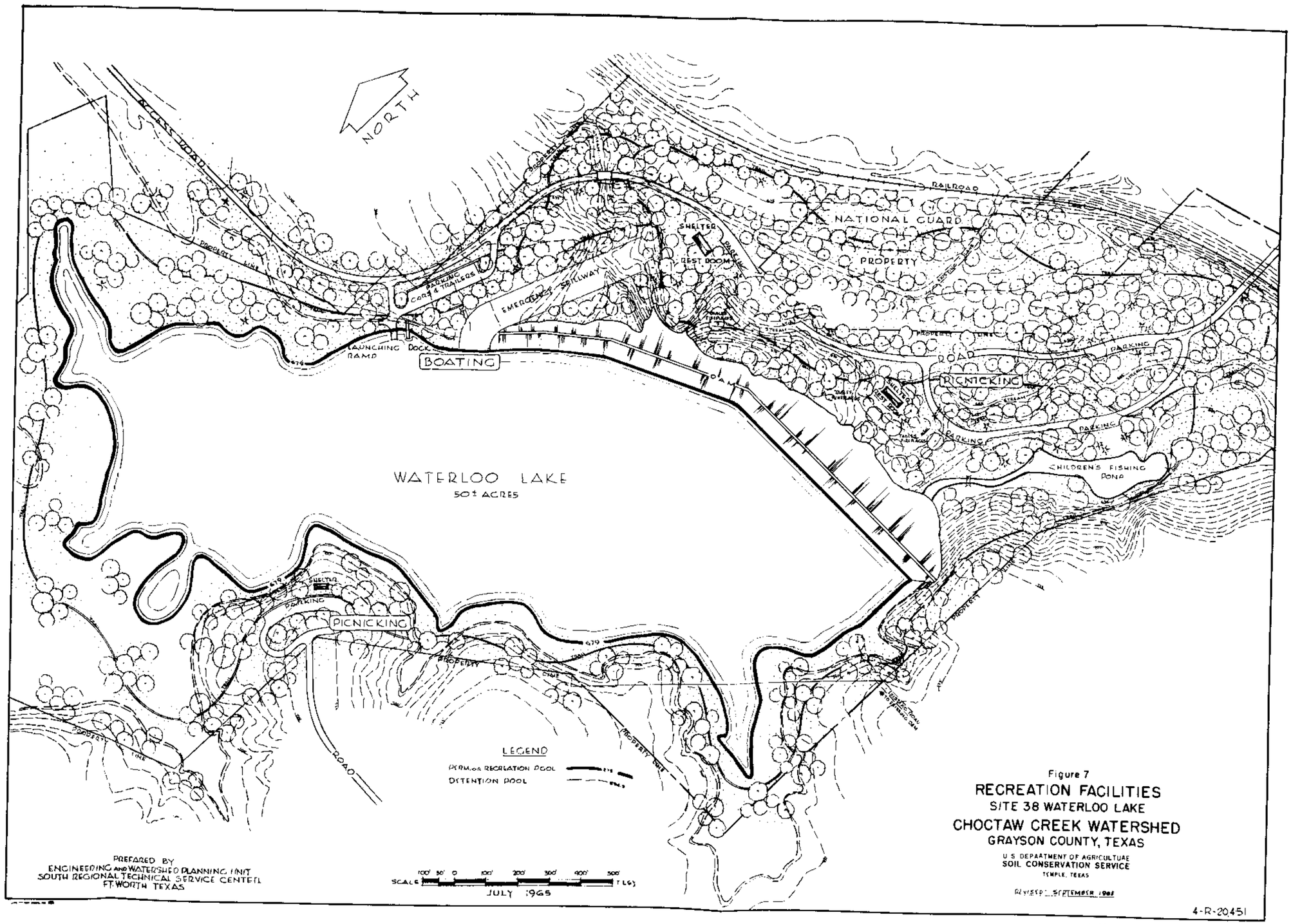


Figure 7

RECREATION FACILITIES
SITE 38 WATERLOO LAKE
CHOCTAW CREEK WATERSHED
GRAYSON COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

REVISED SEPTEMBER 1965

4-R-20,451

6-65 Boss 4-R-20,294

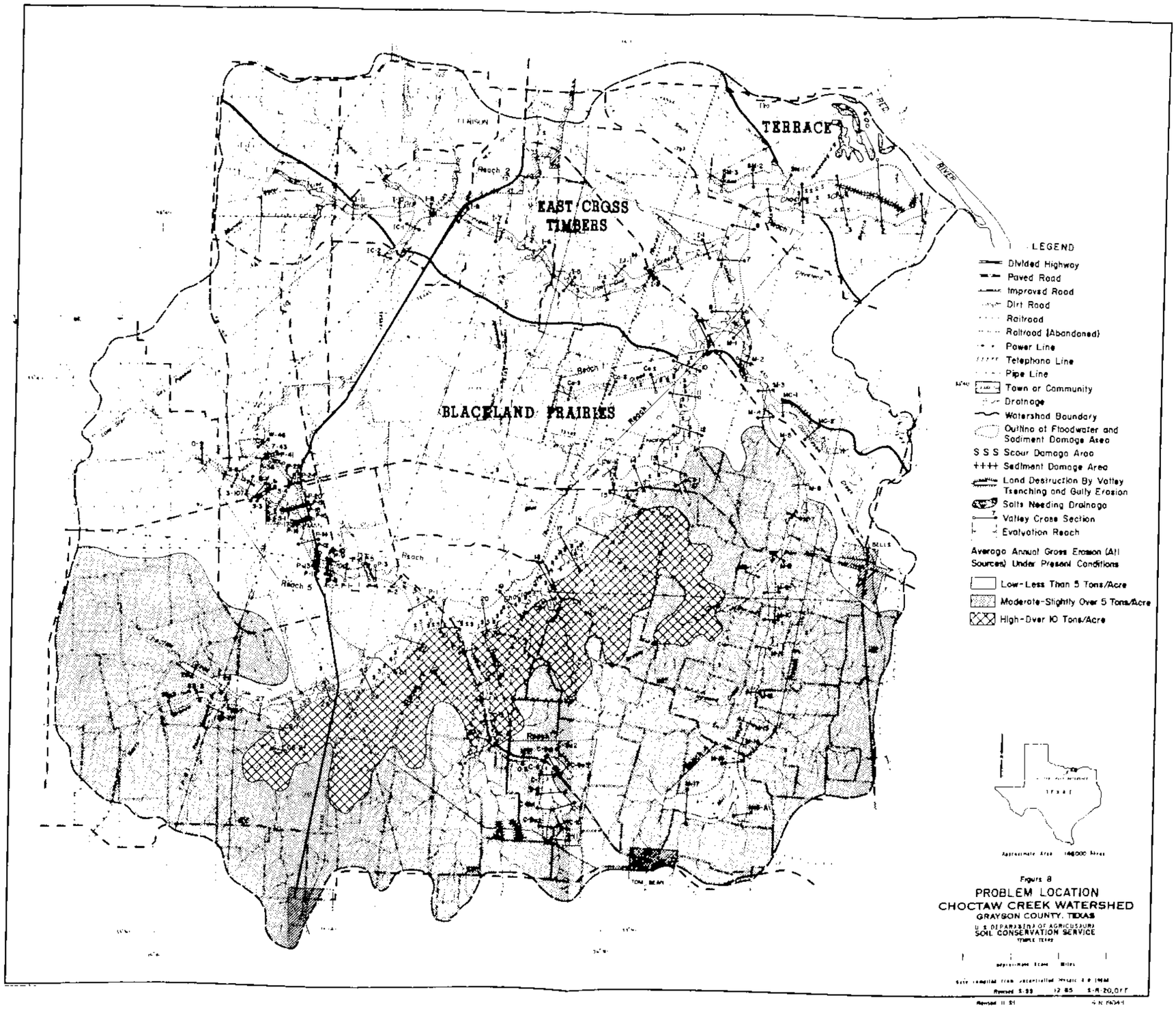
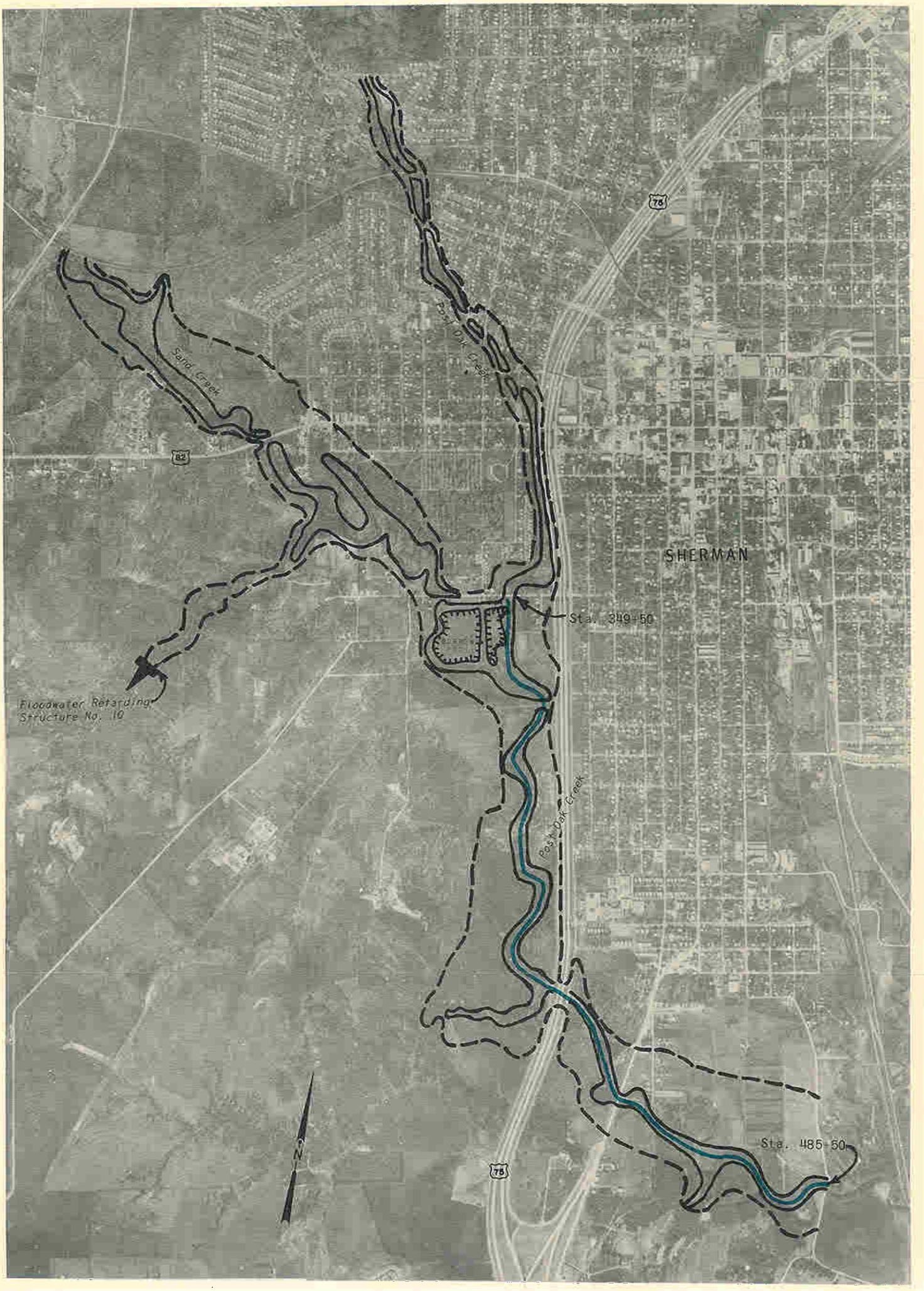


Figure 8

PROBLEM LOCATION
CHOCTAW CREEK WATERSHED
GRAYSON COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS



LEGEND

100-Year Frequency Flood Without Project

100-Year Frequency Flood With Project

Stream Channel Improvement

0 2640 5280

SCALE IN FEET

USDA-SCS-FORT WORTH, TEX. 1965

Figure 9

URBAN BENEFIT AREA
SHERMAN, TEXAS
100-YEAR FREQUENCY FLOOD
CHOCTAW CREEK WATERSHED
GRAYSON COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TEMPLE, TEXAS

11-65 4-R-20861

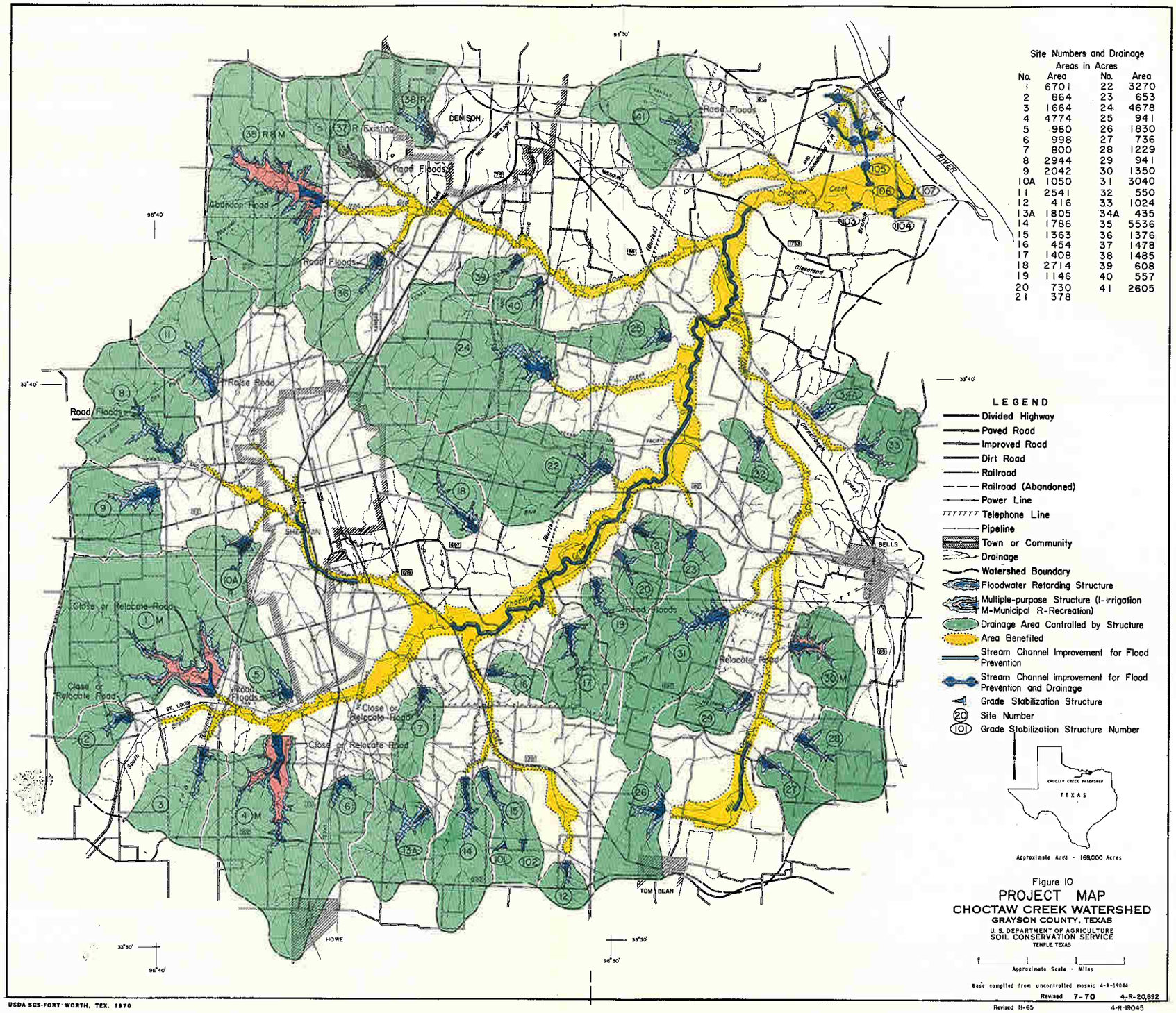


Figure 10

PROJECT MAP

CHOCTAW CREEK WATERSHED

GRAYSON COUNTY, TEXAS

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

Approximate Scale - Miles

Base compiled from uncontrolled mosaic 4-R-19044.

Revised 7-70 4-R-20,692

USDA SCS-FORT WORTH, TEX. 1970

Revised 11-65 4-R-19045