Official Copy

WORK PLAN

CHAMBERS CREEK WATERSHED

Of the Trinity River Watershed

Navarro, Ellis, Hill and Johnson Counties,

Texas

Prepared By

SOIL CONSERVATION SERVICE

U. S. DEPARTMENT OF AGRICULTURE

Temple, Texas

July 1955

UNITED STATES
DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Fort Worth, Texas
December 9, 1955

Chairman, County PMA Committee
County Agricultural Extension Agent
County Judge

In accordance with the specific request of the farmers and others living in the Chambers Creek Subwatershed, a Work Plan has been prepared primarily for flood prevention, and a copy is being provided you herewith.

As a result of the discussions held during the development of the plan, and as reviewed finally with the group on December 5, 1955, it is our understanding that the unit costs and schedules shown are in harmony with those currently used by the agencies and organizations which will participate in the carrying out of the plan.

We believe you will be interested in the attached copy of letter dated December 9, 1955, in which each of the Soil Conservation District Governing Bodies concurs in the Work Plan and indicate that they have incorporated the pertinent aspects in their respective District work plans.

It is our observation, and we believe also that of all who have helped in the development of this plan, that parties who are to participate are "ready to go."

We have, therefore, submitted for inclusion in the Soil Conservation Service budget request for fiscal year 1957 the estimate for initiating our part of the work as set forth in the schedule of the work plan.

If any significant changes should be needed during the application of this plan, it is expected that the revision will be brought to your attention.

Earle H. Varnell, Area Conservationist

Don C. Larner, Area Conservationist

Attachment

Navarro-Hill Soil Conservation District
DISTRICT 514
BOX 23
CORSICANA, TEXAS

December 16, 1955

Mr. Jack D. Everhart;
Work Unit Conservationist,
Corsicana,Texas.

Dear Mr. Everhart;

The Supervisors of Navarro-Hill Soil Conservation District have reviewed carefully the work plan for the prevention of floods on Chambers Creek in Navarro, Hill, Ellis, Johnson Counties of the upper Trinity Watershed.

We believe that the development of the watershed work plan by the joint effort of the landlords, the Distric Supervisors of the Navarro-Hill , Nolan-Aquilla, Dalworth, and Ellis-Prairie Soil Conservation Districts and the Soil Conservation Service Technicians has resulted in a plan which we thoroughly subscribe to and wish to push through to completion according to the terms of cooperation and the schedule in the plan.

We are officially incorporating into our District Work Plan the portion of Chambers Creek flood prevention plan that directly concerns this District.

We wish to commend Mr. R.L.Thigpin and his party and your own staff for the splendid performance and cooperation that you have shown through the development of this program.

Very truly yours,

H.R. Lively

H.R.Lively, Chairman Board,
Navarro-Hill Soil Conservation
Distric Supervisors.

cc: R.L.Thigpin,
Corsicana, Texas.

DEC 23 1955

Cleburne, Texas
December 9, 1955

Mr. William H. Bennett
Work Unit Conservationist
Soil Conservation Service
Cleburne, Texas

Dear Mr. Bennett:

The supervisors of our district have reviewed carefully the Work Plan primarily for flood prevention for Chambers Creek Subwatershed.

We believe that the development of this subwatershed work plan by joint effort of the landowners, the District Supervisors and Soil Conservation Service technicians and others has resulted in a plan which we all thoroughly subscribe to and are willing to push through to completion according to the terms of cooperation and the schedule shown. We have officially incorporated into our district work plan, the portion that directly concerns our district.

Very truly yours,

Winston Forrest

Winston Forrest
Chairman, Nolan-Aquilla Soil
Conservation District

Waxahachie, Texas
December 9, 1955

Mr. Robert H. Sweatman
Work Unit Conservationist
Soil Conservation Service
Waxahachie, Texas

Dear Mr. Sweatman:

The supervisors of our district have reviewed carefully the Work Plan primarily for flood prevention for Chambers Creek Subwatershed.

We believe that the development of this subwatershed work plan by joint effort of the landowners, the District Supervisors and Soil Conservation Service technicians and others has resulted in a plan which we all thoroughly subscribe to and are willing to push through to completion according to the terms of cooperation and the schedule shown. We have officially incorporated into our district work plan, the portion that directly concerns our district.

Very truly yours,

W. J. Ham
Chairman, Ellis-Prairie Soil
Conservation District

cc: Murray B. Coffey
Work Unit Conservationist
Soil Conservation Service
Itasca, Texas

Billy J. Morris
Work Unit Conservationist
Soil Conservation Service
Italy, Texas

Pat A. Carpenter, Jr.
Work Unit Conservationist
Soil Conservation Service
Ennis, Texas

Arlington, Texas
December 9, 1955

Mr. Arthur H. Courtade
Work Unit Conservationist
Soil Conservation Service
106 U. S. Courthouse
Fort Worth, Texas

Dear Mr. Courtade:

The supervisors of our district have reviewed carefully the Work Plan primarily for flood prevention for Chambers Creek Subwatershed.

We believe that the development of this subwatershed work plan by joint effort of the landowners, tha District Supervisors and Soil Conservation Service technicians and others has resulted in a plan which we all thoroughly subscribe to and are willing to push through to completion according to the terms of cooperation and the schedule shown. We have officially incorporated into our district work plan, the portion that directly concerns our district.

Very truly yours,

A. V. Morrison
Chairman, Dalworth Soil Conservation District

cc: George B. Romans
Work Unit Conservationist
Soil Conservation Service
Burleson, Texas

Corsicana, Texas
December 9, 1955

Mr. Earle H. Varnell
Area Conservationist
Soil Conservation Service
Fort Worth, Texas

Mr. Don C. Larner
Area Conservationist
Soil Conservation Service
Terrell, Texas

Gentlemen:

The governing bodies and cooperators of the Dalworth, Ellis-Prairie, Nolan-Aquilla, and the Navarro-Hill Soil Conservation Districts have actively participated in the preparation of the attached work plan primarily for flood prevention for the Chambers Creek Subwatershed.

This plan represents a common understanding and agreement on the kinds and amounts of measures needed to be applied in the Chambers Creek Subwatershed to achieve soil and water conservation on all the lands in the watershed and to bring about the greatest reduction in flood damages feasible at this time. Our common objective is to place the land in condition and so protected that it may be used for the optimum sustained agricultural production of which it is capable. We believe the carrying out of the works of improvement outlined in the attached plan will accomplish this objective.

The work plan for Chambers Creek Subwatershed has been incorporated with and made a part of the district work plans of the Dalworth, Ellis-Prairie, Nolan-Aquilla, and Navarro-Hill Soil Conservation Districts. A Supplemental Memorandum of Understanding has been entered into between the Soil Conservation Service and each District covering the general terms of cooperation and assumption of responsibilities in the execution of this kind of work.

Very truly yours,

C. V. Thompson — 12-13-55
Chairman, Dalworth Soil Conservation District Board of Supervisors (Date)

W. D. Hamm — 12/20/1955
Chairman, Ellis-Prairie Soil Conservation District Board of Supervisors (Date)

Winston Forrest — 12-21-1955
Chairman, Nolan-Aquilla Soil Conservation District Board of Supervisors (Date)

H. R. Linsley — 12-16-55
Chairman, Navarro-Hill Soil Conservation District Board of Supervisors (Data)

WORK PLAN
CHAMBERS CREEK WATERSHED
Of the Trinity River Watershed
Navarro, Ellis, Hill and Johnson Counties, Texas

Participating Agencies

Navarro-Hill Soil Conservation District
Ellis-Prairie Soil Conservation District
Nolan-Aquilla Soil Conservation District
Dalworth Soil Conservation District
Corps of Engineers
Agricultural Conservation Program Service
Extension Service
Soil Conservation Service

Prepared by

Soil Conservation Service
United States Department of Agriculture
July, 1955

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CHAMBERS CREEK WATERSHED
Of the Trinity River Watershed
Navarro, Ellis, Hill, and Johnson Counties, Texas
July, 1955

INTRODUCTION

Authority

The Chambers Creek Watershed Flood Prevention Project will be carried out under the authority of the Soil Conservation Act of 1935 (Public Law No. 46, 74th Congress), the Flood Control Act of June 22, 1936 (Public Law No. 738, 74th Congress), and the Flood Control Act of December 22, 1944 (Public Law No. 534, 78th Congress, 2nd Session).

Purpose and Scope of Plan

The Navarro-Hill, Ellis-Prairie, Nolan-Aquilla, and Dalworth Soil Conservation Districts provide, through their programs and work plans, for the application of a complete program of soil and water conservation and improved plant management within this watershed. Their objectives are to use each acre of agricultural land in accordance with its capabilities for sustained agricultural production and to treat each acre in accordance with its needs for protection and improvement. Such a program, when applied and maintained on all the land within the watershed, will be effective in reducing runoff from small rains and will effect some reduction in peak flows from excessive rains. An effective land treatment program will have a major effect in the reduction of upland erosion rates which in turn will reduce sediment damages. Additional structural measures for flood prevention are needed to complete the soil and water conservation and plant management program in the watershed and provide effective reductions in flood damage.

The purpose of this plan is (1) to state specifically the land treatment and structural practices and measures to be applied which are designed primarily for, or contribute directly to flood prevention, and (2) to specify how, when, and by whom they will be carried out to achieve the maximum practicable reduction of erosion, floodwater and sediment damages. Measures and practices planned herein constitute an integral part of the complete soil and water conservation and plant management program in this watershed and have been incorporated in the work plan of each of the soil conservation districts concerned.

The Richland-Chambers Creek Watershed Association is promoting a complete watershed protection and flood prevention program on Chambers Creak. The proposal includes, in addition to a system of floodwater retarding structures and channel improvement works, a major flood control and municipal water supply structure on Waxahachie Creek near Bardwell. The preliminary

plan for this structure and its evaluation have been developed by the Corps of Engineers. While the Corps and the Soil Conservation Service have separately developed the structural needs of the watershed, the engineering, design, hydrologic and economic phases of the two projects have been coordinated fully at the Corps' District and the Soil Conservation Service's State levels. For example, the release rate for floodwater retarding structures proposed above the Bardwell site will conform to the planned release rate from the Hardwell Reservoir (2 cubic feet per second per square mile). This arrangement permitted a reduction in the designed storage of the flood pool of the Bardwell Reservoir in the amount of the volume of floodweter stored in the detention pools of the floodwater retarding structures above it.

Such coordinating actions have been taken to assure proper functioning of the combined projects and to eliminate duplication of claimed benefits. In the event a review of the Corps' Bardwell project by higher authorities indicates a need for changes in design of this structure, it may be found necessary to make adjustments in the number of floodwater retarding structurea planned on Waxahachie Creek by the Soil Conservation Service. No other portion of the Chambers Creek plan would be affected. All cost and benefit figures quoted on this plan are exclusive of those for the Corps' Bardwell site, unless otherwise specified.

Application of this mutually developed plan will provide protection to and improvement of land and water resources to the degree which can be undertaken at this time with the combined facilities of local interest and State and Federal agencies. Upon completion and continued maintenance of the measures set forth in this plan, a material contribution will be made toward increasing agricultural production to a level consistent with the capability of the land, thereby promoting the welfare of the landowners and operators, the community, the State, and the Nation. The area in the watershed includes parts of four counties (Navarro, Hill, Ellis, and Johnson), and contains 686,720 acres (1,073 square miles).

SUMMARY OF PLAN

This plan includes a combination of land treatment measures which contribute directly to soil and water conservation and flood prevention and structural measures primarily for flood prevention. The works of improvement listed in Tables 1 and 2A are planned to be installed at an estimated total cost of $20,638,417, of which $10,102,442 is to be borne by State and local interests and $10,535,975 by the Federal Government. These estimates are inclusive of the current costs of local and State interests under the going National programs pertaining to the objectives of this plan. It is estimated that the Federal contribution under going agricultural programs will be $147,798.

The Navarro-Hill, Ellis-Prairie, Nolan-Aquilla, and Dalworth Soil Conservation Districts, under provisions of State-enabling legislation, have agreed to assume responsibility for overall periodic inspection

and maintenance of the floodwater retarding structures and stream channel improvement at an estimated annual cost of $25,527.

The landowners and operators will maintain the land treatment measures at an estimated annual cost of $668,628, in accordance with provisions of the farmer-district cooperative agreements.

Comparison of Benefit and Cost

When the works of improvement are applied and operating at full effectiveness, the ratio of the estimated average annual benefit, $2,642,570, to the estimated average annual equivalent cost, $1,541,019, is 1.71 to 1, based on 1953 price levels for costs and long-term prices for benefits. Benefits were claimed on the Chambers Creek flood plain to its confluence with Richland Creek, on Richland Creek below this confluence, and along the Trinity River below the entrance of Richland Creek, due to the reduction of damages expected as a result of the installation of the planned measures.

DESCRIPTION OF THE WATERSHED

Chambers Creek rises in the central part of Johnson County, Texas, near the town of Keene and flows in a southeasterly direction approximately 77 miles, entering Richland Creek 17 miles southeast of Corsicana in Navarro County. Cedar, Post Oak, Briar, Cummins, Waxahachie, Onion, Mill, South Chambers, Cottonwood and Turkey Creeks are the major tributaries. The towns of Corsicana, Powell, Rice, and Frost in Navarro County are located near the lower end of the watershed. Waxahachie, Ennis, Bardwell, Italy, Milford, Foreston, and Maypearl in Ellis County are located in the central part of the watershed. Itasca in Hill County and Grandview, Alvarado, and Keene in Johnson County are located in the upper part of the watershed.

The watershed has an area of 686,720 acres (1,073 square miles), of which 668,604 acres are in farmlands and 18,116 acres are in urban areas, roads, and other miscellaneous uses. There are 77,530 acres of bottom land in the watershed, of which 70,050 acres are flood plain and 6,928 acres are in stream channels.

The Chambers Creek watershed lies within two Problem Areas in Soil Conservation. About 92.5 percent of the area is in Blackland Prairies and 7.5 percent in the Forested Coastal Plain.

The Blackland Prairies may be broken down into four different soil areas. These are: (1) bottom land or alluvial soils; (2) grayland, or mixed land area; (3) black, waxy soils; and (4) shallow soils developed from Austin chalk. The alluvial soils make up 11.3 percent of the total watershed. They are mostly fine-textured, dark-colored soils, and very productive. The upper reaches of the alluvium consist mostly of light-colored, medium-textured soils which are not as productive as the other

alluvial soils.

The grayland or mixed-land soils (19.1 percent) occupy most of the lower part of the watershed up to a line between Barry and Ennis. These soils are fine and medium textured, light colored, and have a very dense clay subsoil. About 57 percent of this area is in cultivation. A large part of the area in pasture was cultivated at one time. These soils, which are part of the Taylor formation, are very erodible.

The black, waxy soils occupy about 46.2 percent of the watershed and occur in two large general areas. One area is located between a line through Barry and Ennis and a line through Milford and Waxahachie. The other area is bounded by Files, Maypearl, and Mountain Peak on the east and by Parker, Grandview, and Alvarado in the upper part of the watershed. These soils were developed from calcareous shales and clays of the Taylor and Eagle Ford formations. The soils are all fine textured, dark colored and productive where erosion has not been too severe. About 83.4 percent of these soils are in cultivation. The topography ranges from nearly level to rolling.

Between these two areas of black, waxy soils is an area of very shallow soils developed from Austin chalk, and some deep soils of the same parent material. This area makes up 15.9 percent of the watershed, with about 34.0 percent of it in cultivation. These soils are fine textured and very shallow to moderately deep. Colors range from dark to light gray.

The Forested Coastal Plain Area is in the upper part of the watershed down to the towns of Parker, Grandview, and Alvaredo. These soils are light colored and sandy with medium to coarse surface texture. About 18 percent of this area is in cultivation. These soils are of the Woodbine sand formation.

The cultivated soils of the watershed (47 percent) generally are in rather poor physical condition as a result of long, intensive cultivation. The soils have lost considerable organic matter, and erosion is rather severe on much of the sloping land. Most of the formerly cultivated land has a poor cover of grass. The areas in open and wooded pasture are protected by fair cover.

The topography may be classed as nearly level to gently rolling. The surface elevation of the prairie ranges from about 300 feet above mean sea level where Chambers Creek enters Richland Creek to around 780 feet at Alvarado. Chambers Creek has an average gradient of 3.7 feet per mile.

The stream channels of Chambers Creek are very irregular in size, with wide and deep sections alternating with sections of shallow, sediment-filled channels. The main channel ranges from 40 to 260 feet wide and from 7 to 23 feet deep, with no relationship between size and position in the watershed. The main alluvial valley of Chambers Creek ranges

from approximately 14,500 feet wide just above the point where U. S. Highway 75 crosses Chambers Creek to less than 200 feet wide near the headwaters.

At the present time approximately 47 percent of the watershed is in cultivation. The principal crop is cotton, although a considerable acreage is planted to other row crops, such as corn and grain sorghums. Some small grains, chiefly wheat and oats, are grown in the watershed. Total land use in the watershed is estimated as follows:

Land Use	Acree	Percent
Cultivation	322,602	47.0
Open Pasture	121,248	17.7
Wooded Pasture	84,635	12.3
Formerly Cultivated	140,119	20.4
Miscellaneous 1/	18,116	2.6
Total	686,720	100.0

1/ Includes roads, highways, railroad rights-of-way, towns, etc.

Portions of the Chambers Creek flood plain are intensively utilized. At least 90 percent of some areas are in cultivation, while others have been retired from cultivation due to the frequency of flooding. Of the total flood plain of Chambers Creek and its tributaries, 53 percent is in cultivation, 32 percent in pasture, 13.7 percent in wooded pasture, and 1.3 percent in miscellaneous uses.

The Chambers Creek watershed is underlain by formations of Upper Cretaceous (Gulf) and Eocene ages. The formations of the Upper Cretaceous age are Woodbine sand, Austin chalk, Eagle Ford shale, Taylor marl, Neylandville marl, Nacatoch sand, Corsicana marl and Kemp clay. The only formation of the Eocene age is the Wills Point clay which outcrops in the lower part of the watershed.

The Woodbine formation is composed largely of ferruginous, argillaceous sands which are frequently crossbedded and unconsolidated. In places it consists of sandy and sometimes bituminous clays, which occur either as extensive beds or as laminae and thin strata interbedded with the sands.

The Eagle Ford shale is composed chiefly of light-colored, compressed and laminated shales with a few thin ledges of sandstone and sandy clay. In much of the area the outcrop is only a thin mantle covering the Woodbine sands.

The Austin formation consists of alternating beds of chalk, shaly limestones and marls. It is characterized by much small-scale faulting and jointing. The faulting may be barely perceptible, or up to 2 or 3 feet in displacement.

The Taylor marl is similar to the upper marly portion of the Austin formation. It consists of interbedded gray marls, and blue and yellow shales and clays.

The Neylandville marl consists of sandy marl and dark gray, calcareous, sandy clays. The Nacatoch formation, which overlies the Neylandville, is a medium- to fine-grained sand which in places is cemented by lime to form hard, dense, calcareous sandstones.

Overlying the Nacatoch are the Corsicana marl and Kemp clay which outcrop in narrow bands in a northeasterly direction in the vicinity of Corsicana.

The portion of the watershed below Corsicana is covered by Tertiary formations. The Wills Point formation consists dominantly of blue and gray clays interbedded with thin partings of silt. Some faulting is present in this formation. The Wilcox formation is not of significance in the watershed since it occupies only a few square miles in the extreme lower portion.

Mean temperatures range from 84.3 degrees Fahrenheit in the summer to 45.8 degrees in winter. The extreme recorded temperatures are 9 degrees below zero and 115 degrees above zero. The average date of the last killing frost is March 25 and that of the first killing frost is November 12, a normal frost-free period of 232 days.

The average annual precipitation ranges from 34.32 inches in Johnson County to 36.91 inches in Navarro County. Rainfall is fairly well distributed throughout the year, with the larger average monthly rainfalls occur in April, May and June. Individual rains of excessive amounts, which may occur during any season, cause erosion and serious flood damage. The minimum recorded annual rainfall of 19.36 inches occurred in 1917 and the maximum annual rainfall of 53.89 inches fell in 1877.

Water for domestic and livestock uses in the rural areas is supplied largely by small farm ponds and shallow wells. Water for Corsicana and part of Ennis is supplied by reservoir storage, while the remainder of municipal water supplies is obtained from wells.

The Chambers Creek watershed is served by nine Soil Conservation Service Work Units which are assiating the Navarro-Hill, Ellis-Prairie, Nolan-Aquilla, and Dalworth Districts. These work units have assisted farmers and ranchers in preparing 2,505 conservation plans on 435,865 acres within the watershed. Where land treatment measures have been applied and maintained for as long as 10 years, crop yields have increased 25 to 35 percent.

Livestock operations within the Chambers Creek watershed are limited by both water and forage resources. Of the cropland, an estimated 70 percent has been used for production of cotton. The remaining cropland is used for production of corn, grain sorghums and small grains.

The watershed is served by the St. Louis and Southwestern, the Texas and New Orleans, the Fort Worth and Denver City (Burlington), the Illinois and Great Northern, the Missouri, Kansas and Texas, and the Gulf Colorado and Santa Fe Railroads which provide ample loading facilities for carload lot shipments. There are 2,718 miles of roads, of which 382 miles are paved. These roads provide adequate access to the watershed. Of the 590 bridges, 82 span the larger streams. However, floods frequently make some of the roads impassable. Detours thus occasioned cause delay and extra travel to places of employment and markets.

FLOOD, EROSION AND SEDIMENTATION PROBLEMS AND DAMAGES

Flood Damages

Chambers Creek has flooded frequently and caused high annual damage. Devastating floods have occurred at frequent intervals, the more recent ones occurring in May 1944, March 1945, June 1945, June 1947, and May 1953. A major flood also occurred in May 1922, at which time considerable damage was inflicted on business establishments as well as bridges within the city of Waxahachie. This flood occurred prior to the 20-year evaluation period used, and damage resulting from it was not included. Several human lives have been lost as a result of floods occurring on Chambers Creek or its tributaries. The most recent of these included a family of four in June 1935. Two persons drowned in 1918 and a young man lost his life about the turn of the century. Several other instances are known where people have barely escaped the floodwaters with their lives. During the 20-year period 1923 to 1942, inclusive, there were 89 floods in the watershed, 68 occurring during the growing season. Since 1942 most of the large floods have occurred during the growing season. For the floods experienced during the 20-year period studied, the total direct floodwater and sedimentation damages, excluding benefits attributed to the proposed Bardwell Reservoir, were estimated to average $689,372 annually under present conditions, of which $486,922 is crop and pasture damage. Excluding the area of flood plain which would be inundated by the proposed floodwater retarding structures, these damages would be $639,464 and $446,646 respectively. In addition, there are numerous indirect damages such as interruption of travel, initial losses sustained by dealers and industries in the area and similar items. The total annual value of these indirect damages are estimated to be $63,946. The average annual monetary flood damages are summarized in Table 4.

Erosion

Erosion rates in the Chambers Creek watershed range from low to high and average about medium. They vary greatly with the different soil areas, being rather low in the Foreeted Coastal Plain area in the upper reaches of the watershed, and also on the area of "Whiterock" or Austin chalk. In both of these areas about 30 percent of the land is cultivated. In the latter area most of the cultivated land is used to grow small grains. Rates are high on part of the remainder of the blackland area. The high

rates are mainly due to soil type and the percentage (83 percent) of land in cultivation.

Cultivated lands have suffered the major erosion damages, and much of the pastureland has suffered moderate erosion. These pasturelands have been overgrazed to the extent that most of the area supports only a low density cover of grasses and is very susceptible to sheet erosion. Much of the formerly cultivated land is presently in poor cover condition and is subject to moderately severe sheet and gully erosion.

The major sources of sediment in the Chambers Creek watershed are estimated as follows: sheet erosion, 87 percent; flood plain scour, 10 percent; and streambank and gully erosion, 3 percent. These estimates are based on detailed studies of sample watershed and reconnaissance investigations in the remainder of Chambers Creek watershed.

Reservoir and Pond Sedimentation

Lake Halbert, the municipal water supply for Corsicana, and Lake Clark, the municipal water supply for Ennis, are located in the watershed. These reservoirs have suffered moderately high sedimentation damages. The average annual damage to Lake Halbert is estimated to be $6,147, and the damage to Lake Clark is $1,628.

Assuming that the proposed Waxahachie City Reservoir and Bardwell Reservoir will be built, it is estimated that the average annual damage to Waxahachie City Reservoir will be $3,675 and that to the Bardwell Reservoir will be $17,980.

Benefits from the reduction in sedimentation rates due to land treatment measures are included in the figure for Conservation Benefit, Table 5. Benefits due to floodwater retarding structures are allocated to them in Table 4.

Farm ponds, in general, have suffered moderate losses in storage capacity from sedimentation. The average annual damage to the existing ponds is estimated to be $14,593.

Channel Enlargement

Streambank erosion and channel entrenchment are of minor importance in the Chambers Creek watershed. Bank erosion occurs throughout the flood plain area for short sections (50 to 200 feet) with only slight shifting in the sharp meanders of the stream channels. The average annual land loss from bank erosion is estimated to be 1.7 acres. The most severe bank erosion occurs along the main channel from the road north of Emhouse to the road between Lone Cedar and Avalon. Annual lateral erosion of as much as 0.3 foot is occurring in some of the winding reaches of the stream.

It is estimated that bank erosion contributes only 2 percent of the total sediment yield at the mouth of the watershed.

Overbank Deposition

Most of the flood plain on Chambers Creek and its tributaries has received substantial amounts of sediment deposition. Approximately 36,446 acres have been damaged 5 to 10 percent in 50 years. The estimated annual damages are as follows: 418.0 acres damaged 5 percent, and 308.4 acres damaged 10 percent.

Most of the overbank deposits have the same texture and color as the original material and were deposited at the rate of a few inches during each major flood. Much of the area damaged by harmful sediment is affected by impaired internal drainage caused by the deposition of fine silt and clay. The thickness of the deposits ranges from less than 1 foot to 8 feet.

Channel Filling

Channel filling by fine-textured sediments has caused greater frequency of flooding and increased flood heights in numerous valley sections, but no account has been taken of this effect in estimating future damages.

Flood Plain Scour

Frequent flooding has caused considerable scour damage. About 3.1 percent (2,170 acres) of the total flood plain has been scoured by floodwater, with resulting damage ranging from 10 to 90 percent. The most severe damages are caused by scour channels 2.0 to 4.0 feet deep, but larger areas are affected by sheet scour. Sheet scour occurring on freshly plowed fields has eroded the soil down to plow depth during major storms. The flood plain scour damages are estimated as follows: 526 acres damaged 10 percent, 563 acres damaged 30 percent, 313 acres damaged 50 percent, 344 acres damaged 60 percent, 171 acres damaged 75 percent, and 253 acres damaged 90 percent.

Flood plain scour is producing an estimated 10 percent of the sediment yield at the mouth of the watershed.

Estimated benefits based on reduction in sedimentation damage to be brought about by the floodwater retarding structures were limited to that flood plain area below the structures that would be inundated by the largest storm considered in the 20-year rainfall series investigated.

EXISTING OR PROPOSED WATER MANAGEMENT PROJECTS

During the past 40 years attempts have been made by organized groups to control floods on Chambers Creek between the mouth of the stream and a point approximately 2 miles below Highway 77. These attempts have met with varying degrees of success. Numerous unorganized attempts by

individual landowners have been made to control flooding in portions of the watershed. Fifteen levee improvement districts, nine in Navarro County and six in Ellis County, have been organized and have installed works of improvement. Some of these works are inoperative at present. Some, however, are adequate in size and are satisfactorily maintained. These levees generally are open on the downstream end and permit backwater flooding over part of the leveed area. Large cracks in the levees occur during extended periods of dry weather. Excessive rains following these dry periods frequently cause breaks in the levees and result in considerable damage to the levees and growing crops. During the past 10 years, 121 small community groups of farmers have cooperated with the local soil conservation districts in the preparation and application of soil and water conservation plans for their farms. The Richland-Chambers Creek Watershed Association has been formed within the past 2 years for the purpose of promoting and coordinating flood prevention activities within the watershed.

FLOOD PREVENTION WORKS OF IMPROVEMENT TO BE INSTALLED

Measures Primarily for Flood Prevention

The floodwater retarding structures and other measures needed to provide flood protection for flood plain lands, highways, and railroads are listed with their costs in Table 2A.

A system of 131 floodwater retarding structures (Figure 1) and 78.51 miles of stream channel improvement are to be installed to protect the flood plain lands along Chambers Creek and its major tributaries. The locations of the floodwater retarding structures and stream channel improvements are shown on the Structure Location Map, Figure 2. Data concerning the floodwater retarding structures and the stream channel improvement are summarized in Table 6. The system of 131 floodwater retarding structures will detain runoff from 46 percent of the Chambers Creek watershed. With the Bardwell flood control structure included, runoff from 62 percent of the watershed will be detained. Sufficient detention storage can be developed at each of the 131 sitea to make possible the use of vegetated spillways, thereby effecting a substantial reduction in cost over concrete or similar structural type spillways.

Sites for the floodwater retarding structures will be provided by local interests. The value of these sites is estimated to be $919,830. Site costs were determined by adding the full value of the land in the sediment pool and one-half the value in the flood pool, since the latter will remain in productive use as pasture. The amortized current value of land in the structure sites, $42,819 annually, exceeds the average annual value of the loss of production within the sites at long-term price levels. Therefore, in accordance with sound procedures, this figure was used in determining the economic evaluation of the program. The total estimated cost of installing these structures and the stream channel improvement is $11,054,043. The annual equivalent cost, including installation and maintenance is $425,889.

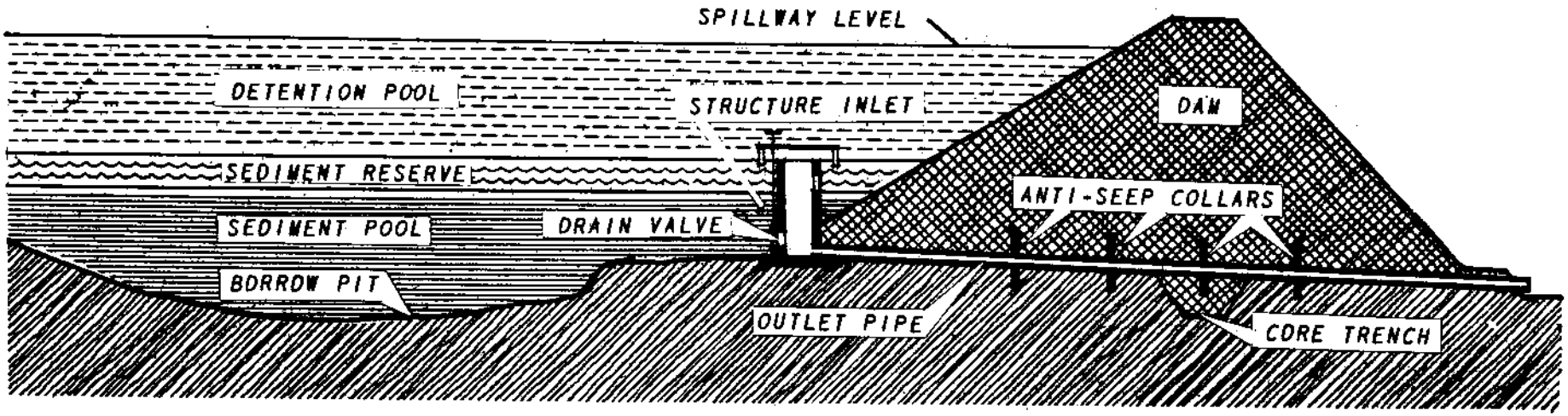

Figure 1

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U.S.D.A. SOIL CONSERVATION SERVICE

9-20-55 4-L-10071

There were four sites, locations of which are shown on the Structure Location Map (Figure 2) by the symbols A, B, D, and E, the inclusion of which would have improved the effectiveness of the project materially. These sites, however, were deleted from the plan since the total storage of each exceeded 5,000 acre-feet. Partial control was obtained above site D by sites 106, 107, and 108, and partial control above site E by sites 125, 126, and 127. It is recommended that the local people request the Corps of Engineers to construct flood control dams at sites A, B, D, and E. If arrangements can be made to have these four structures built, sites 106, 107, 108, 125, 126 and 127 can be deleted from the Plan. Table 9 gives an economic evaluation of the plan both with and without sites A, B, D, and E.

Measures for Conservation of Water and Watershed Lands

An effective conservation program based upon the use of each acre of agricultural land within its capabilities and its treatment in accordance with its needs, such as is now being carried out by the Navarro-Hill, Ellis-Prairie, Nolan-Aquilla and Dalworth Soil Conservation Districts, is essential in a sound and continuing flood prevention program on the watershed. Basic to the attainment of this objective is the establishment and maintenance of all applicable soil, water and plant management practices. Emphasis will be placed on accelerating the establishment of those land treatment practices which have a measurable effect on the reduction of floodwater and sediment damages.

A major phase of work is the seeding of 140,030 acres of idle land and pastureland which has been so overgrazed that reseeding is necessary to establish adequate cover to reduce erosion and resulting sediment yield.

Twelve thousand five hundred forty-one miles of terraces will be built on 250,820 acres of cultivated land and 202.4 miles of diversion terraces will be constructed to protect lower-lying fields. Four thousand six hundred nineteen acres of farm waterways will be established to carry the runoff water from these terraces and diversions.

Other land treatment measures which have a direct effect on flood prevention include farm ponds, cover crops, proper use of pasture and range, brush eradication, and rotation hay and pasture. One thousand nine hundred twenty-eight additional farm ponds will be constructed to assure adequate distribution of grazing and proper use of grasslands in the watershed. This density provides approximately one farm pond per operating unit. Ground water is either nonexistent or not dependable in most of this watershed. Areas of existing pasture or land which should be returned to pasture for proper land use are frequently so located that the farmstead water supply cannot be used conveniently by stock when grazing these areas. Additional stock water points (farm ponds) are necessary if these areas are to be used in such a way as to provide the most effective hydrologic cover and hold sediment yields to a minimum.

The use of cover crops in a conservation crop rotation on an additional 253,678 acres will improve the water-intake rates of cultivated land and reduce sediment yields to a minimum expected for cultivated land. Brush, which provides a very poor hydrologic cover and little or no protection to the land, is a problem on 6,679 acres. Eradication of this brush will permit establishment of pasture grasses which will provide good cover and control erosion on these lands. Rotation hay and pasture will be used on 73,342 acres of cultivated land. Such a cropping system on these acres will provide an erosion-resistant cover on lande which are high in sediment production when kept in clean-tilled crops.

The proper use of pasturelands to maintain effective cover will be practiced on 255,814 acres. This can be obtained through use of good managerial practices.

These and other applicable land treatment practices, such ae proper management of crop residues, contour farming, stripcropping, establishment and improvement of wildlife areas, and establishment and management of fish ponds will be carried out by landowners and operators.

The estimated cost of planning and installing these measures, including the going program, is $9,732,172 (Table 5). The annual cost, including installation and maintenance, is $1,115,130.

Effect of These Measures on Damages and Benefits

The combined program of land treatment and flood prevention measures described above would eliminate damage on the Chambers Creek flood plain from 22 of 66 minor flooda such as occurred in the 20-year period 1923 to 1942, inclusive. Of the 23 major floods, 16 would be reduced to minor floods.

Average annual flooding throughout the Chambers Creek watershed, excluding the protection provided by the Bardwell site, will be reduced from 65,154 acres to approximately 7,996 acres. The estimated average annual floodwater and sediment damage, based on the floods experienced in the 20-year period of study, will be reduced from $703,410 to $120,573, a reduction of 83 percent by the planned maasures.

In tha area described above, approximately 67 percent of the expected reduction in average annual flood damages caused by the etorms in the 20-year period studied would result from the system of floodwater retarding structures and from channel improvement. The annual value of this reduction is estimated to be $388,660 out of the total of $582,837 from all measures, as shown in Table 4. Of this reduction in damages, $295,076 is from floodwater retarding structuras and $93,584 is from stream channel improvement. Owners and operators of flood plain lands say that if adequate flood protection is provided they will intensify their use of these lands by growing more high-value crops, such as cotton and alfalfa,

and shifting some land now in pasture and woods to cultivation. It is estimated that this more intensive use would increase the net income, after all associated expenses are deducted, by $162,976 (long-term prices) annually.

In the coordination of this plan with the Corps of Engineers' plan for a flood control structure at Bardwell, the Corps was able to reduce its initial design sufficiently to provide an annual benefit of $23,700 to be allocated to the floodwater retarding structures on Waxahachie Creek above Bardwell site. A further annual benefit of $10,141 from the reduction of sediment yield to the Bardwell Reservoir was allocated to these structures.

The benefits along the main stem of Chambers Creek below the confluence of Waxahachie Creek with Chambers Creek, lower Richland Creek and the Trinity River below its confluence with Richland Creek resulting from the detention of floodwaters in the Bardwell Reservoir and the floodwater retarding structures in the Chambers Creek watershed above the confluence of Waxahachie Creek were allocated on the basis of flood routings by the Corps. This allocation was 44.1 percent to Bardwell Reservoir and 55.9 percent to the floodwater retarding structures. These floodwater retarding structures were allocated benefits of $257,569 annually from this source. Additional control was obtained below the confluence of Waxahachie Creek by floodwater retarding structures on lower tributaries. The additional benefits from these structures amounted to $39,703 annually.

The total flood prevention benefits, including both the reductions in flood damages and the benefits from more intensive use of flood plain lands, are estimated to be $1,192,654 annually. In addition, it is estimated that the conservation benefits to landowners and operators in upland areas of the watershed from application of land treatment measures would be $1,449,916 annually. The total expected benefit from the combined program would amount to $2,642,570 annually.

The proposed flood prevention program on Chambers Creek will have no known detrimental effect on any downstream projects that might be constructed in the future.

The expected conservation benefits due to land treatment were determined by estimating the increased net income which would result from the application of the needed practices and measures. Although the total area used for cropland would be decreased by the retirement of idle cropland and steep and severely eroded areas to pasture, it was assumed that the percentage of cropland used for each crop would not change. The total number of cattle would be increased materially because of the increased acreage of pasture and the greater pasture-carrying capacity to be expected from the application of land treatment measures.

The estimated increase in annual net income to the farmers from the application of land treatment measures is $1,164,903 from crops and

$285,013 from pastureland, or a total of $1,449,916 annually.

Comparison of Costs and Benefit

The ratio of the average annual benefit from measures primarily for flood prevention, $985,651, to the average annual value of the cost of the measures, $425,889, is about 2.31 to 1.

The ratio of the average annual benefit, $1,656,919, from land treatment measures and practices to their average annual cost, $1,115,130, is about 1.49 to 1. The estimated ratio of total average annual benefits, $2,642,570, to the total average annual value of the costs, $1,541,019, is 1.71 to 1. See Table 5. In addition to the monetary benefits, there are other substantial values which will accrue from the program, such as increased opportunity for recreation, better living conditions and sense of security, which have not been evaluated.

ACCOMPLISHING THE PLAN

The Agricultural Extension Service will conduct general information meetings and local farm meetings, make radio and television broadcasts, prepare radio and press releases, and use other forms of disseminating information to the landowners and operators in the Chambers Creek watershed to help achieve understanding and stimulate participation in the entire plan to be carried out, including the land treatment practices and measures and the measures primarily for flood prevention.

The Soil Conservation Service has accelerated the planning and application of land treatment measures by assigning additional technicians and aids to the Soil Conservation Districts concerned. Agricultural Conservation Program Service payments will assist the farmers in carrying out the land treatment practices and measures needed in the watershed.

The governing body of the Soil Conservation Districts concerned will arrange for meetings according to a definite schedule, and by individual contacts encourage the landowners and operators within the Chambers Creek watershed to adopt and carry out soil and water conservation plans on their farms. District-owned equipment will be made available to the landowners in accordance with existing arrangements for equipment usage in the district. The district governing bodies will make periodic inspections of the completed conservation measures within their districts and follow through to see that needed maintenance is performed.

Professional specialists will be provided by the Soil Conservation Service to assist in the planning, design, supervision of construction, certification of payments and related duties for the structural measures for flood prevention. Since most of this work on private lands will be done by contract, the Soil Conservation Service will be responsible for preparing specifications and discharging the various steps involved in the letting of contracts in accordance with customary Federal procedures.

The following is a grouping of structures that have favorable benefit-cost ratios based on those benefits that will accrue to each group exclusive of their portion of the over-all benefits to the main stem of Chambers Creek. Construction will be started on any group as soon as the local people have obtained all necessary easements and rights-of-way for all structures in the group and Federal funds are available.

Subwatershed Construction Units	No. Sites	Annual Benefits (dollars)	Annual Cost (dollars)	Benefit-Cost Ratio (dollars)
1. Waxahachie Creek - 1 thru 5, 7 thru 18, 23 and 24	19	59,636	34,287	1.74:1
2. Mustang - 19 and 20	2	3,598	2,378	1.51:1
3. Chambers above Cottonwood 30 thru 45	16	38,654	38,590	1.00:1
4. Cottonwood - 46 thru 52	7	24,781	23,306	1.06:1
5. Mesquite Creek - 55	1	2,815	2,061	1.36:1
6. South Fork Chambers - 57 thru 79	23	82,627	57,696	1.43:1
6A. Island Creek - 65 thru 74	10	32,592	26,226	1.24:1
6B. Sites 53, 54 and 56	3	(Can be built when Units 3, 4 and 5 are completed)		
6C. Sites 80 thru 88, 90 and 91	11	(Can be built when Units 3, 4, 5, 6 and 6B are completed)		
7. Eastham Levee Area - 89, 92, 93, 94 and 95	5	16,559	6,360	2.60:1
8. Onion Creek - 106 thru 118	13	44,987	15,393	2.92:1
9. Mill Creek - 96 thru 105	10	79,668	30,018	2.65:1
10. Cummins Creek - 125, 126, and 127	3	10,030	6,103	1.64:1
11. Fortson Levee Area - 122, 123 and 124	3	8,231	5,881	1.40:1
12. Rice Branch - 128 and 129	2	10,436	4,128	2.52:1
13. Dry Creek - 130 and 131	2	5,638	3,965	1.42:1
14. Briar Creek - 132 thru 136	5	23,071	10,412	2.26:1
15. Cedar Creek - 137	1	9,520	5,259	1.81:1
16. Little Cedar - 138	1	3,258	2,558	1.27:1

Sites 119, 120 and 121 will be considered for construction after enough structures have been constructed to give an appreciable degree of control.

Table 1 indicates the schedule of operations for each phase of the program which the cooperating parties have agreed should be followed to achieve the most efficient prosecution of the work. This schedule will be adjusted year by year on the basis of any significant changes in the plan found to be mutually desired and in light of appropriations and accomplishments actually made. The various features of cooperation between the cooperating

parties have been covered in appropriate memoranda of understanding and working agreements.

PROVISIONS FOR MAINTENANCE

Estimated annual maintenance costs after the land treatment measures and flood prevention measures have been installed are shown in Table 3.

The floodwater retarding structures will be maintained by the Soil Conservation District in which the structures are located, assisted by individuals and associations of benefited landowners. The land treatment measures will be maintained by landowners or operators of the farms on which the measures are installed.

Table 1
Estimated Installation Cost by Years - Total Needed Program
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

July, 1955

(Based on 1953 Price Levels)

Measures	Unit	FY 1956: No. to be Applied	Estimated Cost Fiscal Year 1956: Federal (dollars)	Non-Federal: Public (dollars)	Private (dollars)	Total (dollars)
A-Measures Primarily for Flood Prevention (SCS)						
Floodwater Retarding Structures	Nos.	-	-	-	-	-
Stream Channel Improvement	Mile	-	-	-	-	-
Easements					108,110	108,110
Work Plan Development			44,569	-	-	44,569
Total A-Measures			44,569	-	108,110	152,679
B-Measures for Conservation of Watershed Lands Which Contribute Directly to Flood Prevention (SCS)						
Cover Cropping	Acre	38,052	-	-	304,416	304,416
Paature Seeding	Acrs	21,004	-	-	315,060	315,060
Terraces	Mile	1,881	-	-	338,580	338,580
Diversion Terraces	Mile	30.4	-	-	8,664	8,664
Farm Ponds	Each	289	-	-	86,700	86,700
Waterway Development	Acre	693	-	-	36,036	36,036
Proper Use, Pasture	Acre	38,372	-	-	153,488	153,488
Brush Eradication	Acre	1,002	-	-	20,040	20,040
Rotation Hay and Pasture	Acre	11,001	-	-	110,010	110,010
Farm & Ranch Planning & Application Asst. (Accl.)	Acre	34,911	59,155	-	-	59,155
Work Plan Development		-	16,507	-	-	16,507
Total B-Measures			75,662	-	1,372,994	1,448,656
Total A and B Measures (SCS)			120,231	-	1,481,104	1,601,335
Facilitating Measures						
Work Plan Development (SCS)			61,076	-	-	61,076
Summary						
Total Flood Prevention Funds (SCS)			120,231	-	-	-
Grand Total Flood Prevention Prevention Program			120,231	-	1,481,104	1,601,335
Going Program (SCS)			21,114	-	-	21,114

Table 1 - Continued
Estimated Installation Cost by Years - Total Needed Program
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)
July, 1955
(Based on 1953 Price Levels)

Measures	Unit	FY 1957: No. to be Applied	Estimated Cost Fiscal Year 1957: Federal (dollars)	Non-Federal: Public (dollars)	Private (dollars)	Total (dollars)
A-Measures Primarily for Flood Prevention (SCS)						
Floodwater Retarding Structures No. 1,2,3,4,5,7,8,9,10,11,12,13,14, 15,16,92,93,94,95,122,123,124, 128, and 129	Each	24	1,003,664	-	-	1,003,664
Stream Channel Improvement	Mile	-	-	-	-	-
Easements			-	-	236,600	236,600
Relocation of County Roads			-	2,130	-	2,130
Relocation Power Lines			-	-	1,875	1,875
Work Plan Development			-	-	-	-
Total A-Measures			1,003,664	2,130	238,475	1,244,269
B-Measures for Conservation of Watershed Lands Which Contribute Directly to Flood Prevention (SCS)						
Cover Cropping	Acre	50,736	-	-	405,888	405,888
Pasture Seeding	Acre	28,006	-	-	420,090	420,090
Terraces	Mile	2,508	-	-	451,440	451,440
Diversion Terraces	Mile	40.5	-	-	11,542	11,542
Farm Ponds	Each	386	-	-	115,800	115,800
Waterway Development	Acre	924	-	-	48,048	48,048
Proper Use, Pasture	Acre	51,163	-	-	204,652	204,652
Brush Eradication	Acre	1,336	-	-	26,720	26,720
Rotation Hay and Pasture	Acre	14,668	-	-	146,680	146,680
Farm & Ranch Planning & Application Asst. (Accl.)	Acre	46,548	59,155	-	-	59,155
Work Plan Development		-	-	-	-	-
Total B-Measures			59,155	-	1,830,860	1,890,015
Total A and B Measures			1,062,819	2,130	2,069,335	3,134,284
Facilitating Measures						
Work Plan Development (SCS)			-	-	-	-
Summary						
Total Flood Prevention Funds (SCS)			1,062,819	-	-	-
Grand Total Flood Prevention Program			1,062,819	2,130	2,069,335	3,134,284
Going Program (SCS)			21,114	-	-	21,114

Table 1 - Continued
Estimated Installation Cost by Years - Total Needed Program
CHAMBERS CREEK WATERSHED
(Trinity River Watershed) July, 1955
(Based on 1953 Price Levels)

Measures	Unit	FY 1958 No. to be Applied	Estimated Cost Fiacal Year 1958 Federal (dollars)	Non-Federal Public (dollars)	Private (dollars)	Total (dollars)
A-Measures Primarily for Flood Prevention (SCS)						
Floodwater Retarding Structures No. 17,18,19,20,23,24,96,97,98,99,100,101, 102,103,104,105,106,107,108,109,110, 111,112,113,114,115,116,117, and 118	Each	29	1,504,492	-	-	1,504,492
Stream Channel Improvement	Mile	-	-	-	-	-
Easements			-	-	229,660	229,660
Relocation of County Roads			-	1,373	-	1,373
Relocation Power Lines			-	-	614	614
Work Plan Development			-	-	-	-
Total A-Measures			1,504,492	1,373	230,274	1,736,139
B-Measures for Conservation of Watershed Lands Which Contribute Directly to Flood Prevention (SCS)						
Cover Cropping	Acre	50,736	-	-	405,888	405,888
Pasture Seeding	Acre	28,006	-	-	420,090	420,090
Terraces	Mile	2,508	-	-	451,440	451,440
Diversion Terraces	Mile	40.5	-	-	11,543	11,543
Farm Ponds	Each	386	-	-	115,800	115,800
Waterway Development	Acre	924	-	-	48,048	48,048
Proper Use, Pasture	Acre	51,163	-	-	204,652	204,652
Brush Eradication	Acre	1,336	-	-	26,720	26,720
Rotation Hay and Pasture	Acre	14,668	-	-	146,680	146,680
Farm & Ranch Planning & Application Asst. (Accl.)	Acre	46,548	59,155	-	-	59,155
Work Plan Development		-	-	-	-	-
Total B-Measures			59,155	-	1,830,861	1,890,016
Total A and B Measuree			1,563,647	1,373	2,061,135	3,626,155
Facilitating Measuras						
Work Plan Development			-	-	-	-
Summary						
Total Flood Prevention Funds (SCS)			1,563,647	-	-	-
Grand Total Flood Prevention Program			1,563,647	1,373	2,061,135	3,626,155
Going Program (SCS)			21,114	-	-	21,114

Table 1 - Continued
Estimated Installation Cost by Years - Total Needed Program
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)
(Based on 1953 Price Levels)

July, 1955

Measures	Unit	Balance to be Applied	Estimated Cost Balance to Complete: Federal (dollars)	Non-Federal Public (dollars)	Private (dollars)	Total (dollars)
A-Measures Primarily for Flood Prevention (SCS)						
Floodwater Retarding Structures	Each	78	4,718,580	-	-	4,718,580
Stream Channel Improvement	Miles	78.51	2,834,078	-	-	2,834,078
Easements			-	-	359,100	359,100
Relocation County Roads				4,971	-	4,971
Relocation Power Lines			-	-	4,227	4,227
Work Plan Development			-	-	-	-
Total A-Measuree			7,552,658	4,971	363,327	7,920,956
B-Meaeures for Conservation of Watershed Lands Which Contribute Directly to Flood Prevention (SCS)						
Cover Cropping	Acre	114,154	-	-	913,232	913,232
Pasture Seeding	Acre	63,014	-	-	945,210	945,210
Terraces	Mile	5,644	-	-	1,015,920	1,015,920
Diversion Terraces	Mile	91	-	-	25,935	25,935
Farm Ponds	Each	867	-	-	260,100	260,100
Waterway Development	Acre	2,078	-	-	108,056	108,056
Proper Use, Pasture	Acre	115,116	-	-	460,464	460,464
Brush Eradication	Acre	3,005	-	-	60,100	60,100
Rotation Hay and Pasture	Acre	33,005	-	-	330,050	330,050
Farm & Ranch Planning & Application Asst. (Accl.)	Acre	104,432	236,620	-	-	236,620
Work Plan Development			-	-	-	-
Total B-Measures			236,620	-	4,119,067	4,355,687
Total A and B Measures			7,789,278	4,971	4,482,394	12,276,643
Facilitating Measuree						
Work Plan Development			-	-	-	-
Summary						
Total Flood Prevention Funds (SCS)			7,789,278	-	-	-
Grand Total Flood Prevention Program			7,789,278	4,971	4,482,394	12,276,643
Going Program			84,456	-	-	84,456

Table 1 - Continued
Estimated Installation Cost by Years - Total Needed Program
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)
(Based on 1953 Price Levels) July, 1955

Measures	Unit	No. of Units to be Applied	Estimated Total Cost			
			Federal	Non-Federal: Public	Private	Total
			(dollars)	(dollars)	(dollars)	(dollars)
A-Measures Primarily for Flood Prevention (SCS)						
Floodwater Retarding Structures	Each	131	7,226,736	-	-	7,226,736
Stream Channel Improvement	Mile	78.51	2,834,078	-	-	2,834,078
Easements			-	-	933,470	933,470
Relocation County Roads			-	8,474	-	8,474
Relocation Power Lines			-	-	5,398	5,398
Relocation Telephone Lines			-	-	1,318	1,318
Work Plan Development			44,569	-	-	44,569
Total A-Measures			10,105,383	8,474	940,186	11,054,043
B-Measures for Conservation of Watershed Lands Which Contribute Directly to Flood Prevention (SCS)						
Cover Cropping	Acre	253,678	-	-	2,029,424	2,029,424
Pasture Seeding	Acre	140,030	-	-	2,100,450	2,100,450
Terraces	Mile	12,541	-	-	2,257,380	2,257,380
Diversion Terraces	Mile	202.4	-	-	57,684	57,684
Farm Ponds	Each	1,928	-	-	578,400	578,400
Waterway Development	Acre	4,619	-	-	240,188	240,188
Proper Use,Pasture	Acre	255,814	-	-	1,023,256	1,023,256
Brush Eradication	Acre	6,679	-	-	133,580	133,580
Rotation Hay and Pasture	Acre	73,342	-	-	733,420	733,420
Farm & Ranch Planning & Application Asst. (Accl.)	Acre	232,739	414,085	-	-	414,085
Work Plan Development			16,507	-	-	16,507
Total B-Measures			430,592	-	9,153,782 1/	9,584,374
Total A and B Measures			10,535,975	8,474	10,093,968	20,638,417
Facilitating Measures						
Work Plan Development			61,076	-	-	-
Summary						
Total Flood Prevention Funds (SCS)			10,535,975	-	-	-
Grand Total Flood Prevention Program			10,535,975	8,474	10,093,968	20,638,417
Going Program (SCS)			147,798	-	-	147,798

1/ Includes $2,482,967 that may be available from other Federal Funds (A.C.P.S.) to reimburse Private Interests.

Table 2
Status of Flood Prevention Job Prior to First Year of the Work Plan
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

State Texas Date July, 1955

Watershed Chambers Creek

Authorized Flood Prevention Watershed - Trinity River Watershed

Measures	Unit	Number	Federal Cost 1/	Non-Federal: Construction 2/	Total Cost
			(dollars)	(dollars)	(dollars)
"A" Measures					
Floodwater Retarding Structures	Each	-	-	-	-
Stream Channel Improvement	Miles	-	-	-	-
Subtotal		-	-	-	-
"B" Measures					
Cover Cropping	Acre	114,850			
Pasture Seeding	Acre	31,775			
Terraces	Mile	1,926			
Diversion Terraces	Mile	78.1			
Farm Ponds	Each	1,135			
Waterway Development	Acre	1,423			
Brush Eradication	Acre	1,023			
Proper Use, Pasture	Acre	41,818			
Rotation Hay & Pasture	Acre	19,644			
Subtotal			567,600	2,500,700	3,068,300
Total A and B Measures			567,600	2,500,700	3,068,300

1/ Flood Prevention Funds including acceleration funds.

2/ Includes an estimated $908,000 of other Federal funds (ACPS) by which private interests were reimbursed.

Table 2A
Status of Conservation Job in the Watershed
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)
(Based on 1953 Price Levels)

July, 1955

Measures	Unit	Total Conservation Job: Number	Total Conservation Job: Total Cost	Applied To Date	Estimated Cost to Date: Federal 1/	Estimated Cost to Date: Non-Federal Public	Estimated Cost to Date: Private 2/	Remaining to be Applied (See Table 1)
			(dollars)		(dollars)	(dollars)	(dollars)	
A-Measures								
Floodwater Retarding Structures	Each	131	8,210,161	-	-	-	-	131
Stream Channel Improvement	Mile	78.51	2,843,882	-	-	-	-	78.51
Subtotal A-Measures			11,054,043					
B-Measures								
Cover Cropping	Acre	397,241	3,177,928	143,563	349,241	-	799,262	253,678
Pasture Seeding	Acre	179,749	2,696,235	39,719	209,921	-	385,864	140,030
Terraces	Mile	14,949	2,690,820	2,408	263,988	-	169,452	12,541
Diversion Terraces	Mile	300.1	85,528	97.7	18,844	-	9,000	202.4
Farm Ponds	Each	3,347	1,004,100	1,419	215,615	-	210,085	1,928
Waterway Development	Acre	6,398	332,696	1,779	34,356	-	58,152	4,619
Proper Use, Pasture	Acre	308,087	1,153,938	52,273	-	-	130,682	255,814
Brush Eradication	Acre	7,976	159,520	1,297	5,625	-	20,315	6,679
Rotation Hay and Pasture	Acre	97,897	978,970	24,555	37,538	-	208,012	73,342
Farm & Ranch Planning & Application Asst.	Acre	668,604	1,215,680	435,865	653,798	-	-	232,739
Work Plan Development (SCS)			16,507	-	-	-	-	-
Subtotal B-Measures			13,511,922		1,788,926		1,990,824	
Total A and B Measures			24,565,965		1,788,926		1,990,824	

1/ ACPS payments are included.
2/ ACPS payments have been deducted.

Table 3
Annual Costs
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

July, 1955

Measures	Amortization of Installation Costs 3/				Operation and Maintenance 4/			Grand Total
	Federal	Non-Federal Public 1/	Private 2/	Total	Federal	Non-Federal Public	Private	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
A-Measures								
Floodwater Retarding Structures	256,136	299	43,622	300,057	-	-	9,825 5/	309,882
Stream Channel Improvement	100,159	-	146	100,305	-	-	15,702	116,007
Subtotal A-Measures	356,295	299	43,768	400,362	-	-	25,527	425,889
B-Measures	20,393 7/	-	426,109	446,502	-	-	668,628 6/	1,115,130
Total A and B Measures	376,688	299	469,877	846,864	-	-	694,155	1,541,019

1/ 3.5258 percent of Federal and Non-Federal Public Installation Costs for A and B Measures (50-year period) including interest at 2.5 percent on investment.
2/ 4.6550 percent of Private Installation Costs for A and B Measures, including interest at 4 percent on investment.
3/ 1953 prices, the last complete year for which information is available.
4/ Long-term prices (B.A.E.).
5/ Based on estimated average annual maintenance cost of $75 per structure during the 50-year period following installation.
6/ Based on estimated average annual maintenance costs of individual land treatment measures during the 50-year period following application.
7/ Includes $5,211 for Going Program.

Table 4

Summary of Avarage Annual Monetary Floodwater and Sediment Damage and Flood Prevention Benafit from the Plan 1/

CHAMBERS CREEK WATERSHED

(Trinity River Watershed)

July, 1955

(Based on Long-Term Prices)

Damages	Average Annual Damage				Average Annual Benefits			
	Under Present Conditions (dollars)	With Land Treatment Measures (dollars)	With Land Treatment and Detention Storage (dollars)	With Land Treatment Detention Storage and Channel Improvement (dollars)	From Land Treatment Measures Only (dollars)	From Detention Storage Only (dollars)	From Channel Improvement Only (dollars)	Total Flood Prevention Benefit (dollars)
Floodwater Damage								
Crop and Pasture	446,646	343,375	152,983	79,260	103,271	190,392	73,723	367,386
Other Agricultural	48,146	33,571	8,823	4,948	14,575	24,748	3,875	43,198
Roads, Bridges and Railroads	20,734	13,170	1,813	1,332	7,564	11,357	481	19,402
Flood Plain Scour	28,893	20,242	6,434	3,019	8,651	13,808	3,415	25,874
Subtotal	544,419	410,358	170,053	88,559	134,061	240,305	81,494	455,860
Sediment Damage								
Valley Sediment Deposition	72,677	38,004	10,058	6,476	34,673	27,946	3,582	66,201
Farm Ponds	14,593	9,510	9,510	9,510	5,083	-	-	5,083
Lake Halbert	6,147	4,006	4,006	4,006	2,141	-	-	2,141
Lake Clark	1,628	1,061	1,061	1,061	567	-	-	567
Subtotal	95,045	52,581	24,635	21,053	42,464	27,946	3,582	73,992
Indirect Damage	63,946	46,294	19,469	10,961	17,652	26,825	8,508	52,985
Total Damage	703,410	509,233	214,157	120,573	-	-	-	-
Benefit from Reduction of Damage except Chambers Creek below confluence with Waxahachie Creek	-	-	-	-	194,177	295,076	93,584	582,837
Benefit from Reduction of Damage on Chambers Creek below confluence with Waxahachie Creek	-	-	-	-	12,826	166,019	102,902	281,747
Benefit from More Intensive Use of Flood Plain Lands	-	-	-	-	-	134,963	28,013	162,976
Benefits on lower Richland Creek and Trinity River	-	-	-	-	-	131,253	0	131,253
Reduction in Cost of Bardwell Reservoir	-	-	-	-	-	23,700	0	23,700
Reduction of Sediment Rate in Bardwell Reservoir	-	-	-	-	-	10,141	0	10,141
Total Flood Prevention Benefit	-	-	-	-	207,003	761,152	224,499	1,192,654

1/ Exclusive of flood plain acres inundated by the proposed floodwater retarding structures.

Table 5
Distribution of Costs and Benefits by Measures and Groups of Measures
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

July, 1955

Item	Total Cost (dollars)	Average Annual Cost (dollars)	Average Annual Benefit: Floodwater & Sediment Benefit (dollars)	Average Annual Benefit: More Intensive Use of Land (dollars)	Average Annual Benefit: Conservation Benefit (dollars)	Total (dollars)	Benefit-Cost Ratio (dollars)
A-Measures							
Floodwater Retarding Structurea	8,210,161	309,882	626,189	134,963	-	761,152	2.46:1
Stream Channel Improvement	2,843,882	116,007	196,486	28,013	-	224,499	1.94:1
Subtotal	11,054,043	425,889	822,675	162,976	-	985,651	2.31:1
B-Measures	9,732,172	1,115,130	207,003	-	1,449,916	1,656,919	1.49:1
Total All Measures	20,786,215	1,541,019	1,029,678	162,976	1,449,916	2,642,570	1.71:1

Table 6
Floodwater Retarding Structure and Stream Channel Improvement Data
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

July, 1955

Site No.	Drainage Area Sq. Mi.	Storage Capacity Acre-Feet 2/ Sed. Pool	2/ Reserve Pool	Det. Pool	Total	Inches Runoff Total Sed. Pool	Det. Pool	Total	Surface Area Acres 2/ Top Sed Pool	2/ Top Sed. Reserve	Top Det. Pool	Max. Ht. of Dam Feet	Flood Plain Area Inundated - Acres 2/ Under: Sed. Pool	Under: Det. Pool	Total	Volume of Fill Cu. Yds.	Drawdown Rate cfs	Estimated Total Cost (dollars)
1	5.40	200	105	1,527	1,832	1.06	5.30	6.36	45	62	162	37	0	0	0	116,043	27	64,341
2	7.51 1/	200	261	2,403	2,864	1.15	6.00	7.15	50	78	247	56	0	0	0	152,642	38	85,508
3	1.40	89	-	394	483	1.19	5.30	6.49	14	14	52	34	0	0	0	46,514	7	25,084
4	0.91	64	-	258	322	1.27	5.30	6.57	13	13	38	28	0	0	0	37,418	5	20,112
5	3.66	200	15	1,036	1,251	1.08	5.30	6.38	30	32	115	50	0	0	0	113,232	18	60,559
7	2.40	143	-	678	821	1.12	5.30	6.42	22	22	66	48	0	0	0	94,915	12	49,683
8	2.45	142	-	693	835	1.09	5.30	6.39	22	22	72	48	0	0	0	94,671	12	51,023
9	2.68	122	-	758	880	0.85	5.30	6.15	18	18	74	55	0	0	0	98,805	13	51,748
10	4.28	200	110	1,209	1,519	1.36	5.30	6.66	28	43	126	48	0	0	0	125,150	21	67,080
11	1.32 1/	194	-	375	569	2.75	5.30	8.05	34	34	66	36	0	0	0	49,106	7	27,348
12	1.55	117	-	437	554	1.42	5.30	6.72	17	18	56	49	0	0	0	65,933	8	35,511
13	2.02	180	-	571	751	1.67	5.30	6.97	23	25	65	45	0	0	0	85,122	10	44,936
14	1.12	73	-	318	391	1.22	5.30	6.52	14	16	42	32	0	0	0	50,771	6	26,932
15	2.02	153	-	571	724	1.42	5.30	6.72	23	23	62	49	0	0	0	88,899	10	46,615
16	3.14	200	18	888	1,106	1.30	5.30	6.60	38	38	100	49	0	0	0	118,975	16	63,172
17	7.25 1/	200	303	2,258	2,761	1.30	5.84	7.14	41	70	251	56	0	0	0	131,719	36	75,665
18	8.25 1/	200	161	2,852	3,213	0.82	6.48	7.30	49	73	263	58	0	0	0	204,900	41	111,605
19	0.98	99	-	278	377	1.89	5.30	7.19	22	22	50	29	0	0	0	60,627	5	32,230
20	1.67	190	-	471	661	2.14	5.30	7.44	36	36	85	30	9	4	13	48,108	8	28,877
23	1.20	157	-	338	495	2.46	5.30	7.76	25	25	51	29	0	0	0	39,299	6	21,793
24	1.10	118	-	312	430	2.00	5.30	7.30	22	22	52	24	0	0	0	44,091	6	24,125
29	2.32	174	-	657	831	1.40	5.30	6.70	30	30	82	29	16	8	24	67,659	12	38,051
30	1.07	108	-	268	376	1.90	4.70	6.60	23	23	54	31	0	0	0	127,383	5	66,194
31	1.97	168	-	494	662	1.60	4.70	6.30	46	46	107	34	0	0	0	204,174	10	107,246
32	0.99	111	-	248	359	2.10	4.70	6.80	20	20	52	27	0	0	0	65,277	5	35,273
33	7.21	200	69	3,038	3,307	0.70	7.90	8.60	41	54	286	40	0	0	0	212,417	36	119,949
34	1.26	40	-	478	518	0.60	7.10	7.70	11	11	52	38	0	0	0	110,224	6	57,141
35	0.78	29	-	329	358	0.70	7.90	8.60	10	10	62	28	0	0	0	64,272	4	34,774
36	1.10	35	-	341	376	0.60	5.80	6.40	10	10	43	33	0	0	0	68,734	6	36,203
37	2.05	88	-	864	952	0.80	7.90	8.70	16	16	86	38	0	0	0	59,988	10	33,895
38	3.35	197	-	1,411	1,608	1.10	7.90	9.00	39	41	136	33	0	0	0	174,239	17	93,469
39	1.60 1/	86	-	693	779	1.00	8.10	9.10	18	18	105	37	0	0	0	106,465	8	57,680
40	1.37	58	-	387	445	0.80	5.30	6.10	13	13	49	30	0	0	0	57,830	7	31,185
41	2.28	133	-	959	1,092	1.10	7.90	9.00	26	26	99	37	0	0	0	133,700	11	71,262
42	11.15 1/	200	335	4,458	4,993	0.90	7.50	8.40	50	104	368	38	50	162	212	136,700	56	88,164
43	2.56	200	32	738	970	1.70	5.40	7.10	35	42	122	30	15	7	22	92,113	15	52,196
44	2.37	200	2	593	795	1.60	4.70	6.30	27	29	67	41	0	0	0	114,480	12	60,568

Table 6 - Continued
Floodwater Retarding Structure and Stream Channel Improvement Data
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

July, 1955

Site No.	Drainage Area Sq. Mi.	Storage Capacity Acre-Feet 2/ Sed. Pool	Reserve Pool	Det. Pool	Total	Inches Runoff Total Sed. Pool	Det. Pool	Total	Surface Area Acres 2/ Top Sed. Pool	2/ Top Sed. Reserve Pool	Top Det. Pool	Max. Ht. of Dam Feet	Flood Plain Area Inundated - Acres 2/ Under Sed. Pool	Under Det. Pool	Total	Volume of Fill Cu. Yds.	Drawdown Rate cfs	Estimated Total Cost (dollars)
45	6.49	200	250	1,903	2,353	1.30	5.50	6.80	34	56	179	47	32	16	48	142,740	32	80,116
46	2.12	200	49	792	1,041	2.20	7.00	9.20	33	38	100	37	0	0	0	98,942	11	54,556
47	5.27	200	334	1,827	2,361	1.90	6.50	8.40	40	73	211	40	0	0	0	147,590	26	84,457
48	8.86 1/	200	981	3,306	4,487	2.50	7.00	9.50	50	198	520	39	60	30	90	198,459	44	127,038
49	5.71	200	257	1,644	2,101	1.50	5.40	6.90	39	67	186	40	63	31	94	247,709	29	132,796
50	1.25	94	-	361	455	1.40	5.40	6.80	25	25	84	32	13	6	19	69,594	6	38,829
51	4.12	200	41	1,185	1,426	1.10	5.40	6.50	33	42	128	35	13	7	20	83,702	21	48,272
52	9.96	200	172	4,038	4,410	0.70	7.60	8.30	32	52	359	50	21	10	31	230,214	50	130,476
53	5.14	200	101	1,480	1,781	1.10	5.40	6.50	45	54	176	33	43	21	64	118,303	26	68,313
54	4.50 1/	200	160	1,295	1,655	1.50	5.40	6.90	41	57	176	34	51	41	92	74,751	23	46,382
55	2.73	189	0	786	975	1.30	5.40	6.70	43	43	123	29	32	16	48	95,468	14	53,957
56	6.71	200	51	2,004	2,255	0.70	5.60	6.30	29	33	147	55	17	8	25	214,041	34	113,190
57	3.94	200	73	1,135	1,408	1.30	5.40	6.70	28	34	124	45	0	0	0	74,140	20	43,079
58	2.27	169	0	653	822	1.40	5.40	6.80	32	32	81	37	11	5	16	73,335	11	40,901
59	2.89	200	1	833	1,034	1.30	5.40	6.70	29	32	109	48	0	0	0	91,394	14	50,920
60	2.19 1/	117	0	630	747	1.00	5.40	6.40	28	28	73	33	27	14	41	86,621	11	46,977
61	3.08	148	0	888	1,036	0.90	5.40	6.30	25	25	105	39	0	0	0	134,259	15	71,759
62	6.40	200	209	1,842	2,251	1.20	5.40	6.60	37	60	215	42	25	13	38	133,710	32	77,227
63	2.50	200	14	721	935	1.60	5.40	7.00	29	30	95	47	0	0	0	94,991	13	52,080
~~64~~	~~2.57~~	~~200~~	~~15~~	~~681~~	~~896~~	~~1.70~~	~~5.40~~	~~7.10~~	~~34~~	~~39~~	~~187~~	~~33~~	~~0~~	~~0~~	~~0~~	~~81,525~~	~~12~~	~~47,289~~
65	2.43	169	0	701	870	1.30	5.40	6.70	33	33	102	39	0	0	0	77,230	12	43,669
66	4.93	200	273	1,420	1,893	1.80	5.40	7.20	66	66	177	50	0	0	0	194,349	25	107,284
67	4.39	200	268	1,264	1,732	2.00	5.40	7.40	78	78	189	33	18	9	27	134,411	22	77,313
68	1.13	127	0	326	453	2.10	5.40	7.50	23	23	50	33	5	3	8	84,544	6	44,810
69	3.02	200	58	870	1,128	1.60	5.40	7.00	36	36	103	42	10	5	15	134,722	15	72,287
70	4.65	200	197	1,339	1,736	1.60	5.40	7.00	41	63	191	37	11	6	17	88,456	23	54,105
71	3.63 1/	200	129	1,044	1,373	1.70	5.40	7.10	45	57	157	36	51	25	76	98,303	18	57,300
72	6.25	200	300	1,801	2,301	1.50	5.40	6.90	45	52	249	43	0	0	0	178,055	31	100,317
73	4.45 1/	200	251	1,731	2,182	1.90	5.40	7.30	46	67	152	34	57	59	116	83,328	22	50,128
74	4.91	200	193	1,414	1,807	1.50	5.40	6.90	35	56	130	42	16	8	24	157,407	25	85,516
75	10.34	200	682	4,112	4,994	1.60	7.56	9.16	50	119	344	46	63	32	95	292,110	52	163,214
76	2.20	200	11	633	844	1.80	5.40	7.20	38	39	93	33	0	0	0	95,225	11	52,456
77	3.32	159	0	956	1,115	0.90	5.40	6.30	25	25	95	42	0	0	0	93,355	17	51,051
78	2.21	130	0	636	766	1.10	5.40	6.50	19	19	54	47	7	4	11	158,194	11	81,246
79	3.79	200	63	1,092	1,355	1.30	5.40	6.70	38	47	157	35	7	3	10	94,209	19	54,873
80	6.68	200	121	1,960	2,281	0.90	5.50	6.40	31	44	162	57	0	0	0	221,794	33	118,088

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Trinity River
23-60

Table 6 - Continued
Floodwater Retarding Structure and Stream Channel Improvement Data
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

July, 1955

Site No.	Drainage Area Sq. Mi.	Storage Capacity Acre-Feet 2/ Sed. Pool	2/ Reserve Pool	Det. Pool	Total	Inches Runoff Total Sed. Pool	Det. Pool	Total	Surface Area Acres 2/ Top Sed. Pool	2/ Top Sed. Reserve	Top Det. Pool	Max. Ht. of Dam Feet	Flood Plain Area Inundated - Acres 2/ Under Sed. Pool	Under Det. Pool	Total	Volume of Fill Cu. Yds.	Drawdown Rate cfs	Estimated Total Cost (dollars)
81	5.31	200	55	1,415	1,670	0.90	5.00	5.90	28	35	94	57	1	1	2	170,951	17	89,881
82	5.49	200	93	1,581	1,874	1.00	5.40	6.40	25	37	125	43	0	0	0	152,844	27	82,178
83	1.92	92	0	553	645	0.90	5.40	6.30	13	13	41	40	0	0	0	76,481	10	40,059
84	6.63	200	295	1,733	2,228	1.40	4.90	6.30	32	61	142	55	0	0	0	149,685	33	82,254
85	6.04	200	90	1,739	2,029	0.90	5.40	6.30	32	41	118	47	9	4	13	116,259	30	63,929
86	2.61	200	106	751	1,057	1.20	5.40	6.60	19	19	61	49	9	4	13	121,712	13	63,467
87	3.30	200	29	846	1,075	1.30	4.80	6.10	24	28	90	46	0	0	0	122,074	17	65,206
88	4.13	200	20	1,188	1,408	1.00	5.40	6.40	25	28	124	50	5	3	8	128,109	21	69,574
89	1.90	91	0	548	639	0.90	5.40	6.30	21	21	77	32	1	1	2	46,329	10	26,893
90	7.01	200	174	2,132	2,506	1.00	5.70	6.70	34	51	164	50	17	8	25	155,696	35	89,839
91	4.42	200	177	1,273	1,650	1.60	5.40	7.00	39	58	143	38	20	10	30	106,350	22	60,785
92	1.48	118	0	425	545	1.50	5.40	6.90	17	17	53	38	3	1	4	91,795	7	48,299
93	1.58	118	0	455	573	1.40	5.40	6.80	13	13	54	37	3	1	4	57,050	8	30,979
94	0.97	67	0	280	347	1.30	5.40	6.70	12	12	35	36	4	2	6	60,851	5	32,041
95	1.10	59	0	317	376	1.00	5.40	6.40	13	13	48	34	0	0	0	48,459	6	26,448
96	1.47	79	0	652	731	1.00	8.30	9.30	21	21	83	32	0	0	0	90,986	7	49,238
97	10.84 1/	200	436	4,338	4,974	1.10	7.50	8.60	45	79	380	53	0	0	0	272,529	54	153,442
98	7.55 1/	200	203	2,465	2,868	1.00	6.10	7.10	36	65	221	53	0	0	0	141,308	38	81,428
99	4.22	180	0	1,215	1,395	0.80	5.40	6.20	36	37	136	40	18	9	27	87,632	21	50,357
100	9.08	200	333	3,486	4,019	1.10	7.20	8.30	39	84	260	50	6	3	9	165,813	45	95,978
101	8.89	200	559	3,319	4,078	1.60	7.00	8.60	60	160	456	33	27	14	41	108,916	44	78,693
102	6.05	200	446	1,744	2,390	2.00	5.40	7.40	57	112	264	33	29	14	43	170,480	30	99,448
103	5.17	200	269	1,489	1,958	1.70	5.40	7.10	48	84	209	36	19	10	29	138,378	26	80,297
104	1.21	103	0	348	451	1.60	5.40	7.00	20	20	45	28	9	5	14	53,137	6	28,963
105	3.54	200	65	1,021	1,286	1.40	5.40	6.80	40	47	123	34	38	19	57	128,844	18	70,658
106	2.86	200	44	809	1,053	1.60	5.30	6.90	35	40	112	37	13	6	19	94,060	14	52,740
107	1.88	120	0	532	652	1.20	5.30	6.50	20	20	66	32	6	4	10	62,744	9	34,578
108	1.64	200	27	463	690	2.60	5.30	7.90	35	39	74	28	10	4	14	75,567	8	42,025
109	0.88	122	0	248	370	2.60	5.30	7.90	22	22	39	29	3	1	4	52,774	4	28,623
110	0.91	122	0	285	407	2.50	5.30	7.80	17	17	41	33	2	1	3	44,767	5	24,540
111	7.48 3/	200	279	0	0	1.20	0	0	33	56	-	-	13	7	20	-	37	-
112	5.74 3/	200	167	3,949	4,795	1.20	5.60	6.80	40	55	421	40	27	13	40	305,607	29	172,675
113	5.33 1/	200	273	1,536	2,009	1.50	5.40	6.90	61	95	230	27	83	42	125	81,189	27	53,329
114	6.25	200	266	1,799	2,265	1.40	5.40	6.80	48	80	271	34	23	11	34	138,491	31	82,733
115	1.50	120	0	431	551	1.50	5.40	6.90	24	24	67	30	5	3	8	56,144	8	31,471

Table 6 - Continued
Floodwater Retarding Structure and Stream Channel Improvement Data
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

July, 1955

Site No.	Drainage Area Sq. Mi.	Storage Capacity Acre-Feet 2/ Sed. Pool	Reserve Pool	Det. Pool	Total	Inches Runoff Total Sed. Pool	Det. Pool	Total	Surface Area Acres 2/ Top Sed. Pool	2/ Top Sed. Reserve	Top Det. Pool	Max. Ht. of Dam Feet	Flood Plain Area Inundated - Acres 2/ Under Sed. Pool	Under Det. Pool	Total	Volume of Fill Cu. Yds	Drawdown Rate cfs	Estimated Total Cost (dollars)
116	3.51	150	0	1,012	1,162	0.80	5.40	6.20	28	28	114	36	14	7	21	103,341	18	56,973
117	3.55	200	65	1,021	1,286	1.40	5.40	6.80	43	57	151	32	0	0	0	85,279	18	50,634
118	1.29	103	0	371	474	1.50	5.40	6.90	23	23	72	29	0	0	0	52,648	8	29,961
119	6.25	200	400	1,799	2,399	1.80	5.40	7.20	33	75	173	50	0	0	0	229,331	31	123,499
120	4.85	200	59	1,398	1,657	1.00	5.40	6.40	47	54	168	35	27	14	41	111,639	24	64,220
121	1.67	160	0	481	641	1.80	5.40	7.20	33	33	77	31	0	0	0	82,944	8	45,497
122	2.69	200	87	774	1,061	2.00	5.40	7.40	42	52	130	29	15	7	22	83,312	13	49,526
123	2.30	159	0	661	820	1.30	5.40	6.70	41	42	99	30	8	4	12	63,722	12	37,223
124	3.42	200	183	985	1,368	2.10	5.40	7.50	48	74	166	32	25	12	37	113,334	17	65,800
125	1.48	95	0	426	521	1.20	5.40	6.60	22	22	79	28	6	3	9	66,032	7	36,805
126	6.51	200	350	1,875	2,425	1.50	5.40	6.90	53	41	231	39	21	11	32	121,737	53	71,220
127	2.79	200	8	803	1,011	1.40	5.40	6.80	46	46	111	35	10	4	14	89,990	14	50,926
128	4.26	200	231	1,226	1,657	1.90	5.40	7.30	46	29	195	31	11	6	17	90,888	21	57,233
129	3.22	200	109	928	1,237	1.80	5.40	7.20	47	72	150	30	24	12	36	79,997	16	48,578
130	5.42	200	118	1,560	1,878	1.10	5.40	6.50	41	58	185	38	20	10	30	110,981	27	64,856
131	1.74	121	0	502	623	1.30	5.40	6.70	22	22	70	32	9	5	14	69,993	8	38,407
132	1.77	151	0	510	661	1.60	5.40	7.00	44	44	107	25	4	2	6	59,246	8	35,467
133	6.66	200	262	1,955	2,417	1.30	5.50	6.80	55	99	337	31	19	9	28	154,611	33	94,053
134	1.02	92	0	292	384	1.70	5.40	7.10	25	25	57	25	6	3	9	53,154	5	29,631
135	1.98	148	0	569	717	1.40	5.40	6.80	40	40	104	22	15	8	23	135,525	10	72,905
136	2.93	200	19	843	1,062	1.40	5.40	6.80	47	57	152	26	3	1	4	60,297	15	38,267
137	9.99	200	280	4,211	4,691	0.90	7.90	8.80	62	119	333	44	29	14	43	246,853	50	140,432
138	3.84	185	0	1,128	1,313	0.90	5.50	6.40	46	53	140	33	19	10	29	120,827	19	67,629
Total	492.09	21,725	13,242	154,579	189,546				4,354	5,810	17,836		1,431	896	2,327	14,599,467		8,172,256
Stream Channel Improvement																14,170,389 4/		2,837,218
Total																		11,009,474 5/

1/ Excluding the area from which runoff is controlled by floodwater retarding structures in series.
2/ May be adjusted in final design.
3/ These two structures are joined together and considered as one unit for construction.
4/ Volume of excavation.
5/ Construction Cost

Construction Cost	$ 7,384,084
Technical Services	1,107,613
Contingencies	738,408
Land Easements and Rights-of-way	933,470
Relocation of Roads and Utilities	15,190
Foundation Investigations, Design, Cartographic, Administration, etc.	830,709
TOTAL	$11,009,474

NOTE; Vegetative emergency spillways provided on all structures.

Table 7
Summary of Program Data
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

Item	Unit	Quantity
Years to Complete Program	Year	7
Total Remaining Installation Cost		
Federal	Dollar	10,535,975
Non-Federal	Dollar	10,102,442 1/
Annual O & M Cost		
Federal	Dollar	0
Non-Federal	Dollar	694,155
Annual Benefits	Dollar	2,642,570
Floodwater Retarding Structures	Each	131
Stream Channel Improvement	Mile	78.51
Maximum Area Subject to Inundation by Structures		
Flood Plain	Acre	2,327
Upland	Acre	15,509
Watershed Area Above Structures	Acre	314,938
Reduction of Floodwater Damage		
A-Measures	Percent	59
B-Measures	Percent	25
Reduction of Sediment Damage		
A-Measures	Percent	33
B-Measures	Percent	45
Reduction of Upland Erosion Damage		
A-Measures	Percent	0
B-Measures	Percent	85
Other Benefits		
A-Measures	Dollar	596,991
B-Measures	Dollar	1,449,916

1/ Estimated ACPS participation to reimburse private interests $2,482,967 included.

Table 8
Summary of Physical Data
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

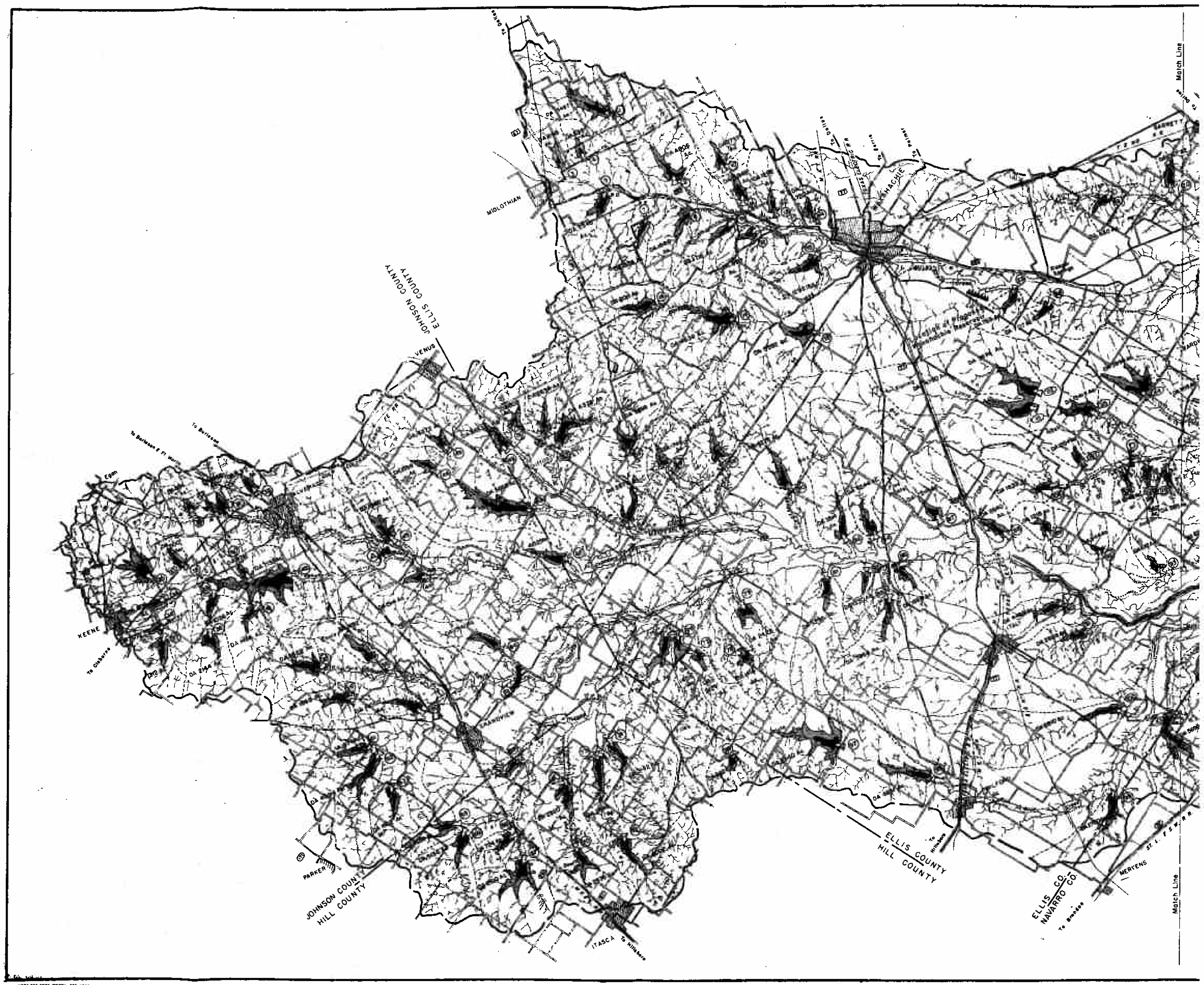
Item	Unit	Quantity Without Program	Quantity With Program
Watershed Area	Sq. Mi.	1,073	1,073
Watershed Area	Ac.	686,720	686,720
Area of Cropland	Ac.	322,602	284,295
Area of Grassland	Ac.	261,367	308,087
Area of Woodland	Ac.	84,635	76,222
Flood Plain Area Subject to Damage by Reservoir Design Storm	Ac.	70,050	41,995
Annual Rate of Erosion			
Sheet	Tons/Yr.	6,687,468	5,051,173
Gully	Tons/Yr.	44,455	29,785
Streambank	Tons/Yr.	183,277	183,277
Scour	Tons/Yr.	801,303	477,577
Area Damaged Annually by			
Sediment	Ac.	34,746	3,096
Flood Plain Scour	Ac.	2,190	227
Swamping	Ac.	-	-
Streambank Erosion	Ac.	1.74	1.74
Sheet Erosion	Ac.	342,181	52,480
Sediment Production 1/	Tons/Ac.	1.3	0.8
Sediment Accumulation in Reservoirs	Ac.Ft./Yr.	233.5	119.8
Frequency of Flooding	Events/Yr.	4.45	2.75
Average Annual Rainfall	Inches	34.88	34.88
Average Annual Surface Runoff	Inches	6.05	4.20 2/

1/ Net leaving watershed.
2/ There is no factual information available to indicate that the reduction in surface runoff would cause a corresponding reduction in annual water yield from this watershed.

Table 9
Effects of Sites Exceeding 5,000 Acre-Feet on Plan
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

Item	With A-B-D-E Without 106, 107, 108, 125, 126, 127	Without A-B-D-E With 106, 107, 108, 125, 126, and 127
Area Controlled (Sq. Mi.) 1/	679.42	601.07
Area Controlled (Percent)	63.32	56.02
Federal Cost - Structures	7,696,781	7,264,641
Channel Improvement	2,301,900	2,840,742
Total	9,998,681	10,105,383
Non-Federal Cost - Structures	1,093,721	945,520
Channel Improvement	2,908	3,140
Total	1,096,629	948,660
Total Cost - Structures	8,790,502	8,210,161
Channel Improvement	2,304,808	2,843,882
Total	11,095,310	11,054,043
Annual Cost - Structures	331,867	309,882
Channel Improvement	95,046	116,007
Total	426,913	425,889
Annual Benefit - Structures	845,245	761,152
Channel Improvement	178,669	224,500
Total	1,023,914	985,652
Benefit-Cost Ratio - Structures	2.55:1	2.46:1
Channel Improvement	1.88:1	1.94:1
Total	2.40:1	2.31:1

1/ Includes 171 square miles above the Bardwell Site but excludes 62.02 square miles controlled by floodwater retarding structures on Waxahachie Creek above Bardwell.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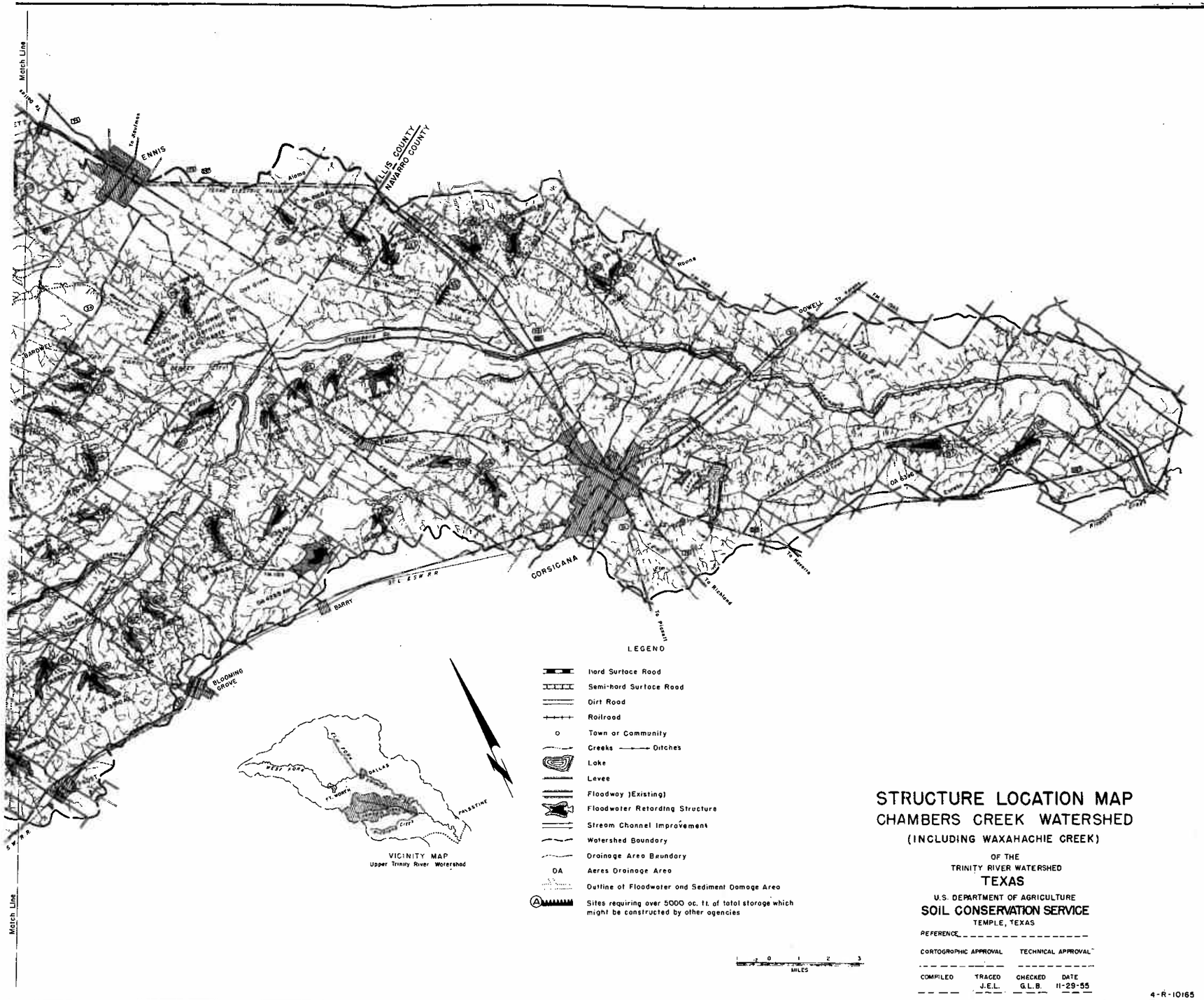
ELLIS COUNTY
JOHNSON COUNTY
Egan
To Burleson
KEENE
PARKER
JOHNSON COUNTY
HILL COUNTY
ITASCA
To Hillsboro
ELLIS COUNTY
HILL COUNTY
ELLIS CO.
NAVARRO CO.
MERTENS
Match Line
Match Line



STRUCTURE LOCATION MAP
CHAMBERS CREEK WATERSHED
(INCLUDING WAXAHACHIE CREEK)

OF THE
TRINITY RIVER WATERSHED
TEXAS

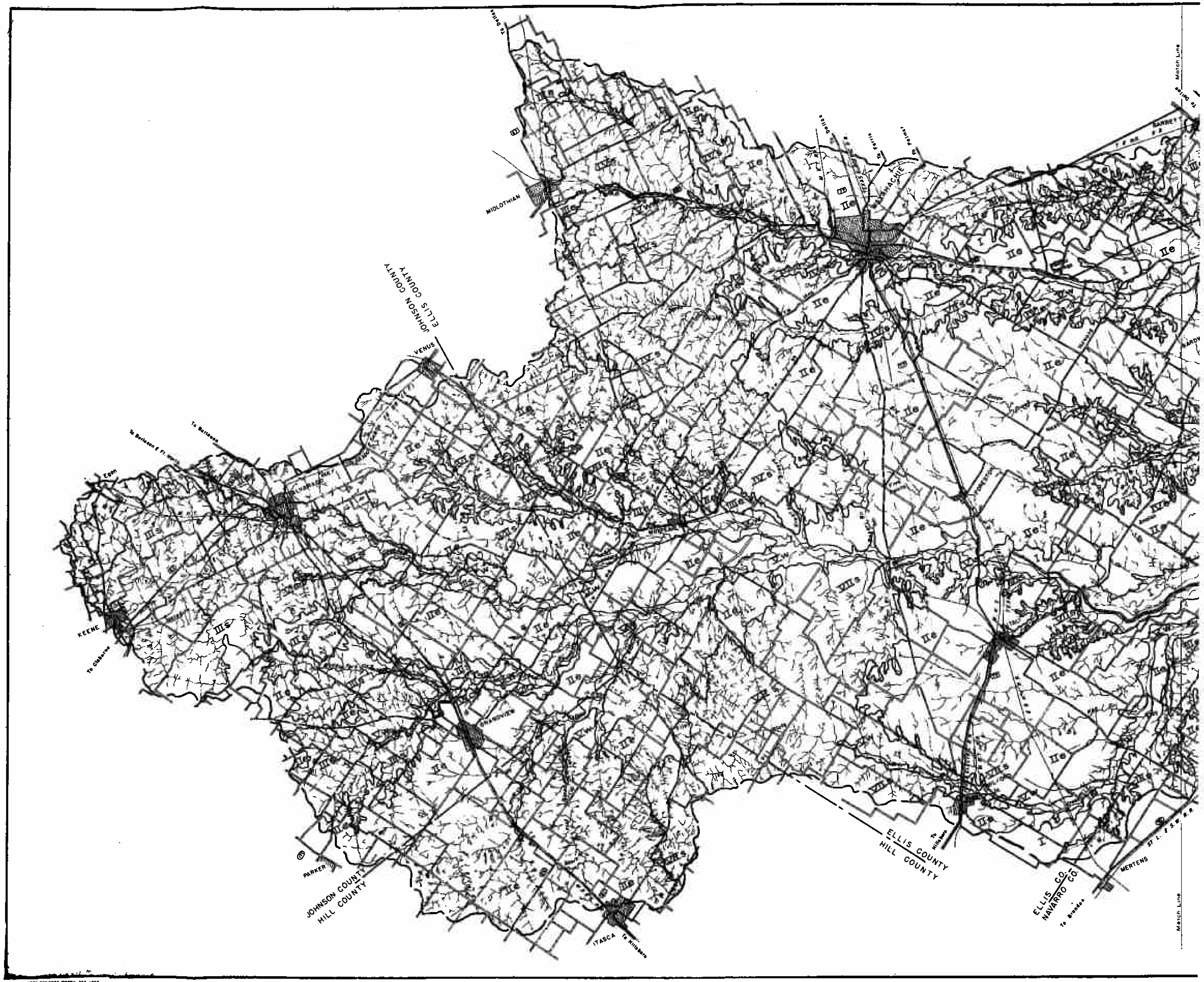
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

REFERENCE

CARTOGRAPHIC APPROVAL	TECHNICAL APPROVAL

COMPILED	TRACED	CHECKED	DATE
	J.E.L.	G.L.B.	11-29-55

4-R-10165



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WAXAHACHIE
ELLIS COUNTY
JOHNSON COUNTY
VENUS
To Burleson
Egan
KEENE
To Cleburne
PARKER
JOHNSON COUNTY
HILL COUNTY
ITASCA
To Hillsboro
ELLIS COUNTY
HILL COUNTY
ELLIS CO.
NAVARRO CO.
To Brandon
MERTENS
Match Line
Match Line

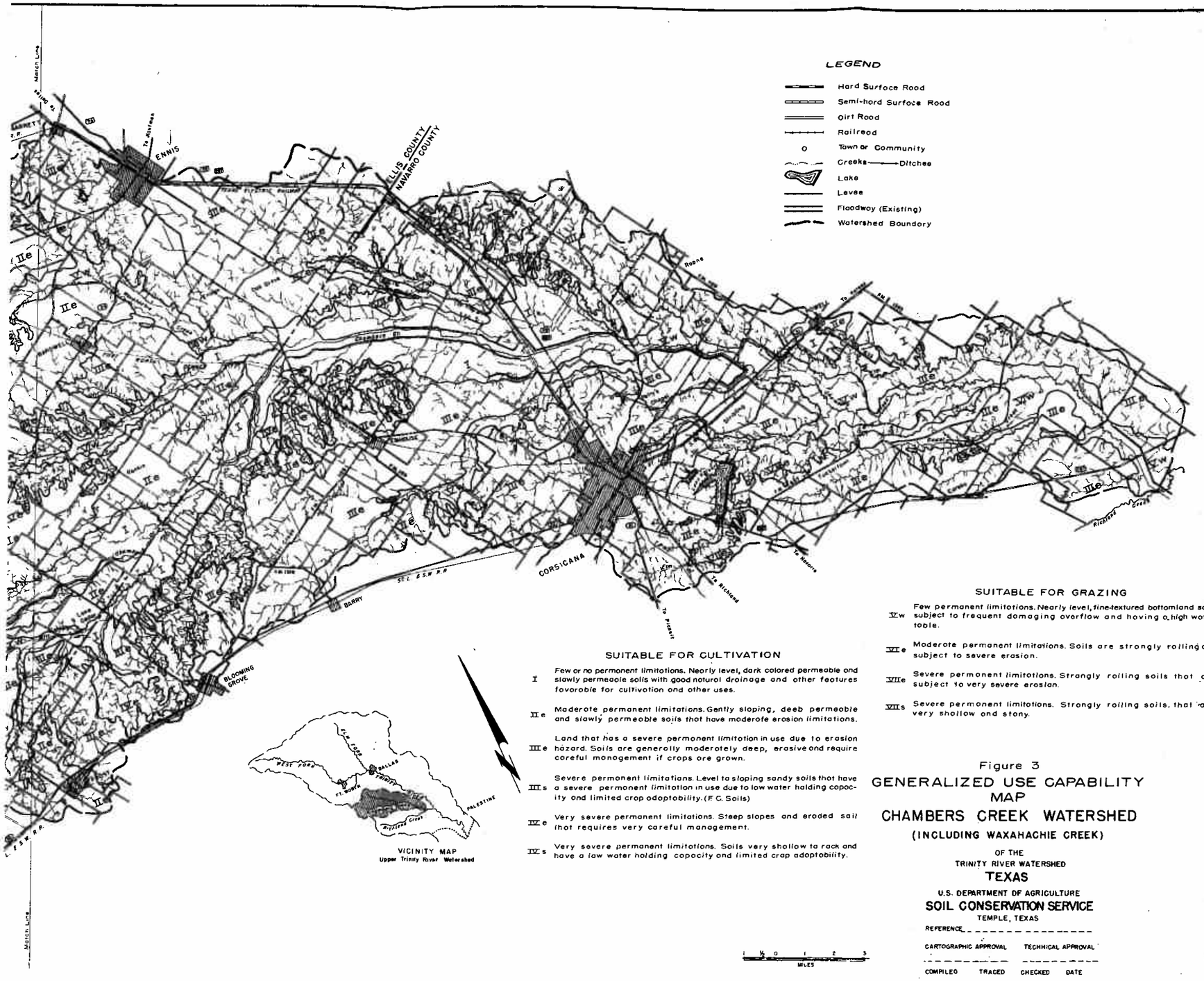


Figure 3

GENERALIZED USE CAPABILITY MAP
CHAMBERS CREEK WATERSHED
(INCLUDING WAXAHACHIE CREEK)

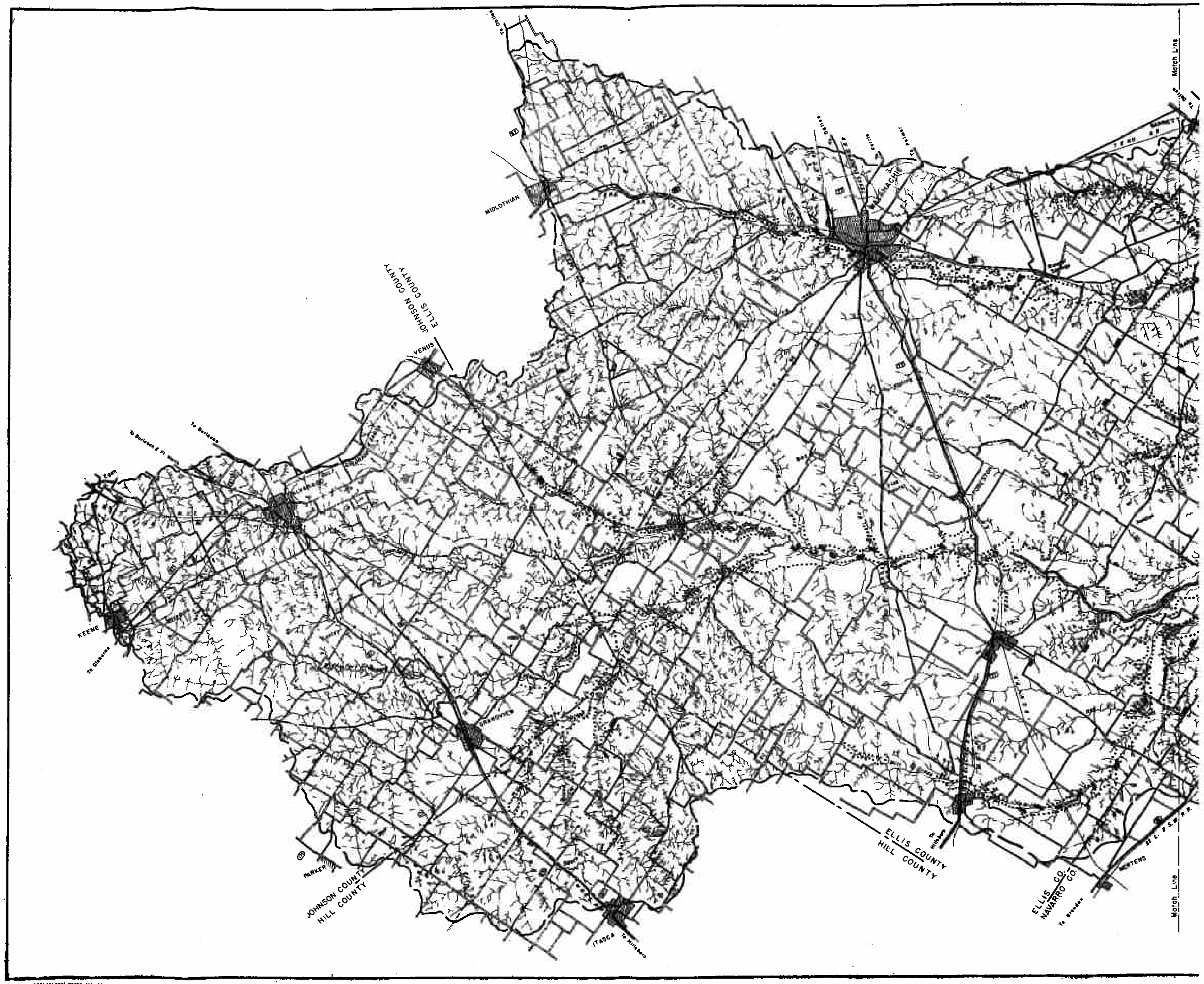
OF THE
TRINITY RIVER WATERSHED
TEXAS

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

REFERENCE _____

CARTOGRAPHIC APPROVAL _____ TECHNICAL APPROVAL _____

COMPILED	TRACED	CHECKED	DATE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VENUS
JOHNSON COUNTY
ELLIS COUNTY
KEENE
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HILL COUNTY
ITASCA
ELLIS COUNTY
HILL COUNTY
ELLIS CO.
NAVARRO CO.
Match Line
Match Line

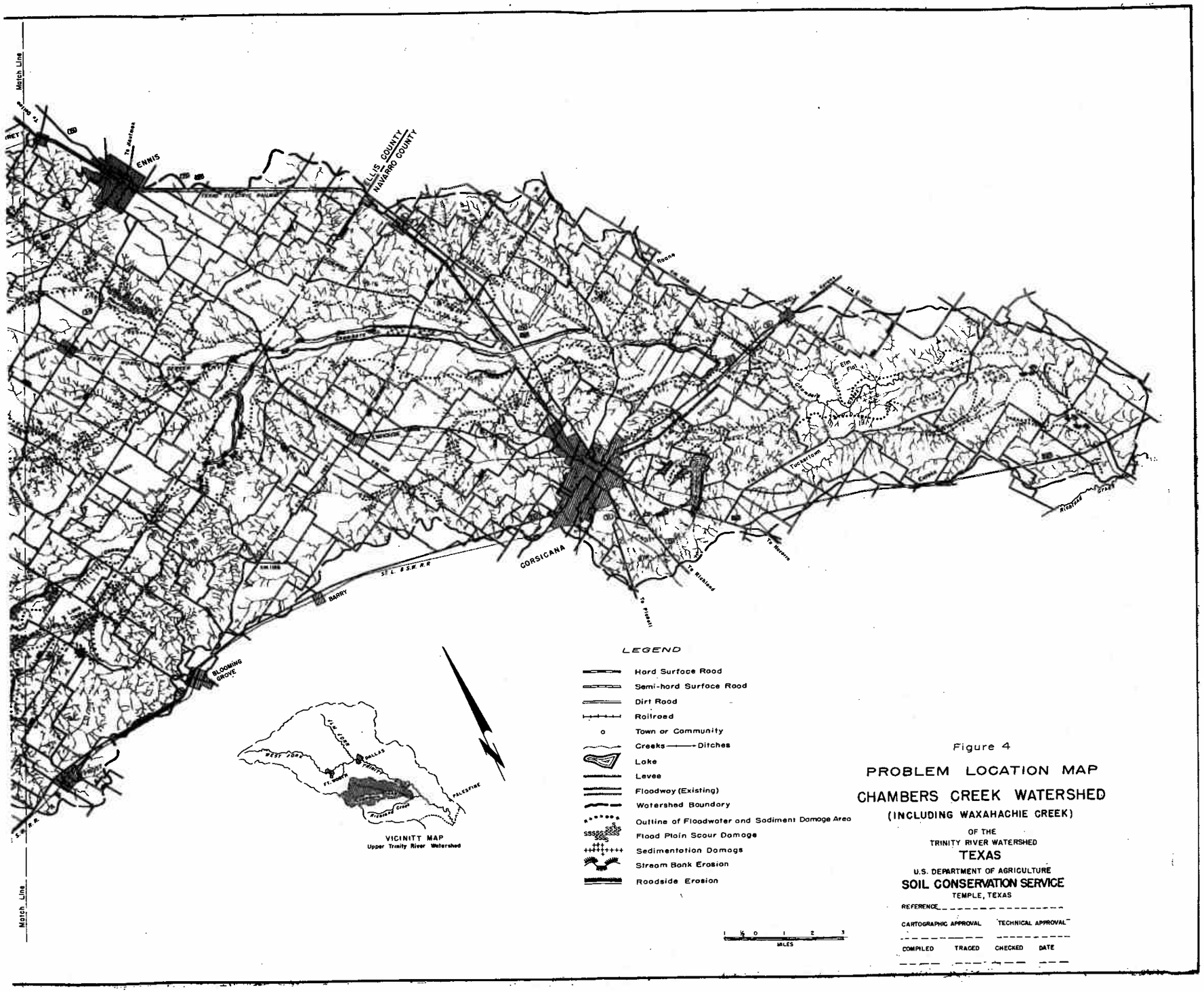

Figure 4

PROBLEM LOCATION MAP

CHAMBERS CREEK WATERSHED

(INCLUDING WAXAHACHIE CREEK)

OF THE

TRINITY RIVER WATERSHED

TEXAS

U.S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

TEMPLE, TEXAS

REFERENCE _____

CARTOGRAPHIC APPROVAL _____ TECHNICAL APPROVAL _____

COMPILED _____ TRACED _____ CHECKED _____ DATE _____

APPENDIX

TABLE OF CONTENTS

A P P E N D I X

HYDRAULIC AND HYDROLOGIC INVESTIGATIONS

Methodology

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

1. Tabulation and analysis of basic meteorologic and hydrologic data.

2. Engineering surveys to collect information on stream reaches including valley cross sections, channel capacities, and other hydraulic characteristics; structure locations and other data for design purposes.

3. Determination of the hydrologic conditions of the watershed, taking into consideration soils, land use, topography, cover, climate, etc.

4. Determination of rainfall-runoff relationships; frequency of occurrence of meterologic events; and relationship of runoff to flood stage and area inundated.

5. Determination of peak discharges under present watershed conditions, as related to area inundated and damages.

6. Determination of peak discharges and area inundated under conditions which will exist due to:

   a. Effect of land treatment measures.

   b. Effect of land treatment measures and floodwater retarding structures.

   c. Effect of land treatment measures, floodwater retarding structures, and stream channel improvement.

Determinations

From a graph showing cumulative departure from normal precipitation, the rainfall for the period 1923 to 1942, inclusive, was selected as most representative of a normal rainfall period for the Chambers Creek watershed.

The largest runoff-producing rain which occurred during the 20-year period investigated was a storm of 9.34 inches on September 25 to 28, 1936. Under present conditions this rain would produce 4.13 inches of runoff and inundate 67,175 acres of flood plain. If such a rain were to occur after land treatment practices and measures had been applied, it is estimated that the area

inundated would be reduced to 66,032 acres. With land treatment applied and the measures primarily for flood prevention, including the proposed Bardwell Reservoir in operation, 30,100 acres would be flooded. Approximately 1,431 acres of flood plain would lie within the sediment and sediment reserve pools of the 131 proposed floodwater retarding structures and 896 additional acres within the detention pools.

The runoff from the 25-year frequency storm was used to establish the minimum detention storage requirements. The 25-year frequency storm which would produce the maximum runoff was found by plotting intensity-frequency and infiltration curves and selecting the maximum ordinate between them. Infiltration rates of 0.10 to 0.15 were assumed on Chambers Creek, which caused the maximum runoff from the design storm to range from 4.7 to 5.5 inches in the different physical and geographic locations.

From a study of the relationship between runoff and flood stage for this watershed, it was found that a runoff of 0.10 inch was the minimum that would cause flooding to a depth of 6 inches at the smallest cross section. Due to changes in runoff-producing characteristics at different seasons of the year, rains of 0.80 inch to 1.40 inches on an average would be required to cause 0.10 inch of runoff and produce a discharge of 1,060 cubic feet per second at the Corsicana stream gage.

The peak discharge at the Corsicana stream gage for rains that produce 4.13 inches of runoff under present conditions is 43,778 cubic feet per second. After installation and full functioning of the measures in the watershed plan, the discharge at the same point would be reduced to 14,458 cubic feet per second. After channel improvement the capacity of the channel will be 9,183 cubic feet per second.

SEDIMENTATION INVESTIGATIONS

Methodology

The field surveys of the sedimentation problems in the Chambers Creek watershed were made according to methods described in the revised "Sedimentation Section of Procedures for Developing Flood Prevention Work Plans," Water Conservation-6, February 24, 1954. Field studies included reconnaissance surveys of geology and physiography, studies of overbank sediment deposits, flood plain scour, streambank erosion, and the nature of channels and valleys on and near all hydrologic cross sections. Borings were made where required to measure and study the modern sediment deposits. In preparation of the report tabular summaries of all the above problems with explanatory text were included. These form the basis for calculation of damages by the economist.

Investigations of sediment sources in the watershed above 109 proposed floodwater retarding structures were made according to standard procedures and predictions were made for future sedimentation rates in each basin.

Sediment Source Studies

The sediment derived from sheet erosion was estimated by the method presented in "Suggested Criteria for Estimating Gross Sheet Erosion and Sediment Delivery Rates for the Blackland Prairies Problem Area in Soil Conservation," February 1953. The formula is based on watershed surveys including the following data:

1. Soil unit in acres by slope in percent, slope length in feet and land use (cultivated, pasture or woods).

2. Average farming practices (percent row crop and/or percent small grain, etc.).

3. Cover condition classes on pasture and woods.

4. Past history of land use.

5. Maximum 30-minute rainfall intensity to be expected once in 2 years. The history of the gully development as given by early settlers indicates that the gullies in the area have developed during the past 60 years. Similar historic information was used to determine the rate of channel enlargement.

From these studies total annual sediment yields above the proposed floodwater retarding structures were calculated to be as follows: 1,051 acre-feet from sheet erosion, 98 acre-feet from modern gullies, and 55 acre-feet from channel enlargement. The average yield of sediment per square mile is 2.16 acra-feet annually.

The principal source of sediment above the proposed structures is sheet erosion. It is estimated that 87 percent of the sediment is produced by sheet erosion, 8 percent by modern gully erosion, end 5 percent by channel enlargement.

Effect of Watershed Treatment on Sediment Yields

Areas damaged by overbank deposition and flood plain scour should be rendered productive egain after they have been protected from flooding and adapted soil-improving crop rotations have been put into effect. In addition, the future rate of damage by theee causes will be reduced by 60.4 percent.

Deep-rooted legumes (sweetclover and alfalfa) grown, where adapted, in the crop rotations will break up the plowpan, improve percolation retes and reduce runoff. On other areas where the above crops are not adapted, winter legumes need to be grown widely. Field observations indicated that such crops would need the application of commercial fertilizers, which should be applied according to soil tests.

[redacted]

Of the 131 proposed structures, 23 are located in the outcrop area of the Woodbine sand, 40 in the Austin chalk, 60 in the Eagle Ford shale, Taylor and Neylandville marls and Nacatoch sand, all of Upper Cretaceous (Gulf) age, and 8 in the area locally known as "Grayland" which is a transitional area between Upper Cretaceous and Tertiary formations, principally the Wills Point clay of Eocene age. At least two structure sites were inspected in each of the geologic formations.

Description of Problems

Some of the sites located in the Woodbine formation may involve serious construction problems for the following reasons: (1) Seepage may occur under the unconsolidated alluvial sediments, requiring the installation of relief wells; (2) a high water table may be present at some sites; (3) the sandy alluvium may not be ideal as fill material; the valley slopes, however, are underlain by sandy clays which when mixed with the sandy alluvium should prove satisfactory for use in the embankment.

No serious construction problems are foreseen for sites located in the Eagle Ford shale area. The available fill materials consist chiefly of clays which should be watertight. Excavation for foundations and abutments should be sufficiently deep to reach unweathered material. The sides of spillway cuts will need to be sloped back sufficiently that slides will not occur. There is a possibility that some sites may be unfavorably located due to downstream dipping strata. This situation may result in sliding or slumping in the dominantly shale bedrock.

Many of the sites located within the Austin chalk area may have unfavorable foundation conditions due to the extensive faulted nature of this formation. All sites should be carefully inspected with the core drilling equipment at the time of detailed investigation to determine the possible existence and nature of faults. Solution cavities in the chalk may also be present and grouting may be necessary in such cases. In places, the Austin chalk consists largely of soft marls and marly clays which probably are satisfactory for use as embankment material in the event there is insufficient alluvium available at the site.

Sites located in the Taylor and Neylandville marl formations should have no particular construction problems from a geological standpoint. Borrow materials will consist chiefly of silty clays or friable clays. Foundations will usually consit of marly clays or shales. The Wolfe City sand, a member of the Taylor formation, is not excessively sandy in this area and site conditions are similar to those within the Taylor. The Nacatoch sand also contains clay and, in places, marl and should furnish adequate and suitable material for embankments.

The borrow material available at sites located within the outcrop of the Wills Point clay, or the area locally referred to as "Graylands," consists of sandy surface soils underlain by sandy clays and clayey silts. Channels observed at some of these sites had dominantly sandy banks. No determination was made as to the nature of the foundation materials below these sites.

Detailed investigations, including exploration with core drilling equipment, will be made at all sites prior to their conxtruction. Laboratory tests will be made to determine the stability of foundation strata and the suitability of the available embsnkment and core-wall materials.

ECONOMIC INVESTIGATIONS

Methodology

The procedures outlined in the Economic Section of Water Conservation-6, Revised, were followed in the economic investigations. The following data are on file to substantiate the findings in this work plan:

1. Map of flood plain showing current land use.
2. Tablee showing damageable value per acre of flood plain.
3. Tables showing crop damage rates by months and depthe.
4. Tables showing damage by floods in the evaluation series to crops, other agricultural property, and to roads, bridges and railroads.
5. Table summarizing damage at long-term prices.
6. Tables showing intensification of flood plain land use.
7. Tables ehowing conservation benefit.
8. Tables showing loss of production in reservoir areas.
9. Table showing individual structure justification.

Determination of Damage

Flood damage information for 70 percent of the flood plain area of Chambers Creek and its major tributaries was obtained from landowners or operators. A large part of the specific information as to the amount and extent of damage related to the September 1936 flood. Other information obtained included flood plain land use, yields of major crops, property damage which would result from a major flood and ganeral flood problems. The monatary value of the percentage of damage to flood plain lands by sediment deposition and scour was determined on the basis of preeent values and costs. Crop and pasture damage rates were determined for both month and depth of flooding. After determining the amount of crop damage which would have resulted from single floods during the 20-year rainfall period, an adjustment was made for recurrence of flooding. Other agricultural and road, bridge and railroad damage rates were based on acres inundated by a given flood. The percentage of damage to flood plain lands by sedimentation and scour was determined on the basis of reduced productivity and increased cost of production.

Determination of Benefits

1. Floodwater Reduction Benefits

Floodwater and sediment damages were calculated under present conditions and those which will prevail after the installation of each class of measures included in the recommended program. The difference between average annual damages at the time of initiation of each class of measures and those expected after their installation constitute the benefit brought about by that group through reduction of damage. Benefits from reduction of crop and paxture damages were estimated from the combined effects of reduction in area inundated and depth of inundation. No benefits were estimated for pool areas of the floodwater retarding structures.

Benefits from the reduction of other agricultural and road, bridge, and railroad damages derived from each class of measures were determined on the basis of the reduction in area inundated.

Benefits from the reduction of flood plain scour by each class of measures were determined on the basis of the reduction in area and depth of inundation, and those of valley sediment damages were determined on the basis of effectiveness of the land treatment program and floodwater retarding structures.

2. Determination of Annual Benefit from Itensified Use of the Flood Plain

More intensive agricultural use of flood plain soils will be made possible by the reduction in extent and frequency of flooding resulting from the floodwater retarding structures. Determination of the benefit from this source was based on the stated intentions of the flood plain landowners or operators and the degree of flood protection provided. The major part of this benefit, according to operators of flood plain lands, will stem from the restoration of previously cultivated lands to their former use before frequent, severe floods caused their abandonment.

Current prices were used for determination of direct floodwater and sediment damages and benefits from more intensive use of flood plain lands but long-term price adjustments were made for the purpose of evaluating the various phases of the program.

PROGRAM DETERMINATION

Determination was made first of the conservation measures which contributs directly to flood prevention remaining to be done in the watershed, based on land capability classes developed from soil surveys.

The hydraulic, hydrologic, sedimentation and economic investigations provided data on the effects of land treatment in terms of conservation benefits and the reduction of flood damages resulting from such treatment.

Although significant benefits would result from installation of land treatment measures, it was apparent that additional measures would be required to attain the degree of watershed protection and flood damage reduction desired.

Determination was made secondly of structural measures for flood prevention which would be feasible to install. The study made and the procedures used in that determination were as follows:

A base map of the watershed was prepared showing the watershed boundary, drainage pattern, system of roads and railroads, and other pertinent items.

Uaing consecutive 4" aerial photographs and a stereoscope, all probable floodwater retarding structure sites were located, the limits and the area of the flood plain delineated, and points marked where valley cross sections should be taken for the determination of hydraulic characteristics and for flood routing purposes. This information was placed on the watershed base map for use in field surveys. Cross sections of the flood plain were made at representative places in the valley. Data developed from these cross sections permitted the computation of stage-area inundated relationships for various flood flows. Separate evaluation reaches were used to reflect significant differences in flooding or damageable values.

A field examination was made of all probable floodwater retarding structure sites previously located on the watershed base map. Sites which did not show good storage possibilities or which would inundate railraods, improved highways or highly developed areas were dropped from further consideration. From the remaining sites a system of reservoirs was selected for further consideration and detailed survey.

A topographic map was made of each proposed reservoir sites in order to determine the storage capacity of the site, the estimated cost of the dam, and the areas of flood plain and upland that would be inundated by the sediment and detention pools. The height of the dams and size of the pools were determined by the storage volume needed to detain the runoff from the design storm and additional storage needed for sediment. The limits of the flood pools and sediment pools of all satisfactory sites and the flood plain of the atream were drawn to scale on a copy of the base map. A structure data table was developed to show for each structure the drainage area, storage capacity needed for detention and for sediment storage in acre-feet and inches of runoff from the drainage areas, release rate of the outlet tube, the acres of flood plain inundated by the sediment and detention pools, volume of fill in the dams and estimated cost of the structuras.

Becauss the watershed is large and the channel capacity relatively small, the releese from floodwater retarding structures alone will produce flooding from the Southern Pacific Railroad, north of Corsicana, to the mouth of Chembers Creek. Due to small channels in this and othar scattered reaches, it was determined that stream channel improvement would be necessary to reduce further the flood hazard.

To conform with policies limiting the size of structures to 5,000 acre-feet storage, several structures were added in series, which increased the cost of the floodwater retarding structure program. There were four other structures which were desirable for effective control which exceeded 5,000 acre-feet in storage and were omitted from the plan.

Close collaboration was maintained with the Fort Worth District Office of the Corps of Engineers in the consideration of possible alternative elements in a watershed plan. As a result of this coordination, Bardwell Site has been substituted for several floodwater retarding structures originally considered. Likewise, the planned storage capacity of the proposed Bardwell Reservoir has been reduced in consideration of the storage capacity of the floodwater retarding structures above it.

When the land treatment measures and those structural measures for flood prevention had been determined (giving consideration to alternate proposals), a table was developed which gave the total cost of each type of measure and the portion of the cost to be borne by the participants. The summation of the total costs for all the needed measures represented the estimated cost of the flood prevention program for the watershed.

A second cost table was developed to show separately the annual installation cost, annual maintenance cost and total annual cost of the A and B measures. This information was used for comparison with annual expected benefits to determine the benefit-cost ratio of the plan of improvements.

APPENDIX
Table 1
Individual Justification - Floodwater Retarding Structures
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

Site No.	Drainage Area Sq.Mi.	Total Installation Cost 1/	Federal Installation Cost	Non-Federal Installation Cost 2/	Easements (Land Value) 3/	Annual Installation Cost	Annual Maintenance Cost	Total Annual Cost	Annual Benefit	Benefit-Cost Ratio
		(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
1	5.40	64,757	57,857	6,900	6,900	2,360	75	2,435	5,398	2.22:1
2 4/	7.51	86,086	76,136	9,950	9,950	3,148	75	3,223	7,507	2.33:1
3	1.40	25,192	23,132	2,060	2,060	912	75	987	1,399	1.42:1
4	0.91	20,182	18,592	1,590	1,590	729	75	804	910	1.13:1
5	3.66	60,840	56,330	4,510	4,510	2,197	75	2,272	3,658	1.61:1
7	2.40	49,868	47,168	2,700	2,700	1,790	75	1,865	2,399	1.29:1
8	2.45	51,212	47,051	4,161	2,900	1,853	75	1,928	2,449	1.27:1
9	2.68	51,955	49,115	2,840	2,840	1,865	75	1,940	2,679	1.38:1
10	4.28	67,410	62,280	5,130	5,130	2,436	75	2,511	4,278	1.70:1
11 4/	1.32	27,449	24,409	3,040	3,040	1,002	75	1,077	1,319	1.22:1
12	1.55	35,630	32,756	2,874	2,260	1,289	75	1,364	1,549	1.14:1
13	2.02	45,091	42,291	2,800	2,800	1,620	75	1,695	2,019	1.19:1
14	1.12	27,018	25,218	1,800	1,800	972	75	1,047	1,120	1.07:1
15	2.02	46,770	44,160	2,610	2,610	1,679	75	1,754	2,019	1.15:1
16	3.14	63,414	59,134	4,280	4,280	2,284	75	2,359	3,139	1.33:1
17 4/	7.25	76,223	65,759	10,464	9,850	2,804	75	2,879	7,247	2.52:1
18 4/	8.25	112,241	102,061	10,180	10,180	4,072	75	4,147	8,247	1.99:1
19	0.98	32,306	30,086	2,220	2,220	1,164	75	1,239	1,331	1.07:1
20	1.67	29,006	23,943	5,063	3,690	1,064	75	1,139	2,267	2.00:1
23	1.20	21,885	19,545	2,340	2,340	797	75	872	1,200	1.38:1
24	1.10	24,210	21,910	2,300	2,300	880	75	955	1,100	1.15:1
29	2.32	38,229	33,669	4,560	4,560	1,400	75	1,475	1,475	1.00:1
30	1.07	66,277	63,137	3,140	3,140	2,372	75	2,447	2,486	1.02:1
31	1.97	107,398	101,218	6,180	6,180	3,857	75	3,932	3,981	1.01:1
32	0.99	35,349	32,389	2,960	2,960	1,280	75	1,355	1,699	1.25:1
33	7.21	120,504	105,702	14,802	13,760	4,404	75	4,479	12,371	2.76:1
34	1.26	57,238	54,658	2,580	2,580	2,047	75	2,122	2,163	1.02:1
35	0.78	34,834	31,874	2,960	2,960	1,262	75	1,337	1,338	1.00:1

APPENDIX
Table 1 - Continued
Individual Justification - Floodwater Retarding Structures
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

Site No.	Drainage Area Sq.Mi.	Total Installation Cost 1/	Federal Installation Cost	Non-Federal Installation Cost 2/	Easements (Land Value) 3/	Annual Installation Cost	Annual Maintenance Cost	Total Annual Cost	Annual Benefit	Benefit-Cost Ratio
		(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
36	1.10	36,288	34,108	2,180	2,180	1,304	75	1,379	1,888	1.37:1
37	2.05	34,053	29,853	4,200	4,200	1,248	75	1,323	3,518	2.66:1
38	3.35	93,726	86,506	7,220	7,220	3,387	75	3,462	5,749	1.66:1
39 4/	1.60	57,803	52,823	4,980	4,980	2,095	75	2,170	2,745	1.26:1
40	1.37	31,291	28,731	2,560	2,560	1,132	75	1,207	2,350	1.95:1
41	2.28	71,438	66,358	5,080	5,080	2,576	75	2,651	3,912	1.48:1
42 4/	11.15	89,022	68,524	20,498	19,180	3,369	75	3,444	19,132	5.56:1
43	2.56	52,393	45,793	6,600	6,600	1,921	75	1,996	4,393	2.20:1
44	2.37	60,750	56,850	3,900	3,900	2,186	75	2,261	4,066	1.80:1
45	6.49	80,615	71,155	9,460	9,460	2,950	75	3,025	9,885	3.27:1
46	2.12	54,719	49,139	5,580	5,580	1,993	75	2,068	3,326	1.61:1
47	5.27	84,863	73,463	11,400	11,400	3,121	75	3,196	8,265	2.59:1
48 4/	8.86	127,720	98,920	28,800	28,800	4,829	75	4,904	13,896	2.83:1
49	5.71	133,236	123,056	10,180	10,180	4,813	75	4,888	8,954	1.83:1
50	1.25	38,926	34,546	4,380	4,380	1,421	75	1,496	1,960	1.31:1
51	4.12	48,589	41,749	6,840	6,840	1,791	75	1,866	6,463	3.46:1
52	9.96	131,243	114,723	16,520	16,520	4,813	75	4,888	15,621	3.19:1
53	5.14	68,709	58,956	9,753	9,280	2,527	75	2,602	6,214	2.39:1
54 4/	4.50	46,729	37,349	9,380	9,380	1,754	75	1,829	5,441	2.97:1
55	2.73	54,167	47,467	6,700	6,700	1,986	75	2,061	5,282	2.56:1
56	6.71	113,707	106,467	7,240	7,240	4,091	75	4,166	10,085	2.42:1
57	3.94	43,383	37,003	6,380	6,380	1,602	75	1,677	7,000	4.17:1
58	2.27	41,076	36,476	4,600	4,600	1,500	75	1,575	4,030	2.56:1
59	2.89	51,142	45,462	5,680	5,680	1,868	75	1,943	5,134	2.64:1
60 4/	2.19	47,145	43,045	4,100	4,100	1,708	75	1,783	3,891	2.18:1
61	3.08	71,997	66,697	5,300	5,300	2,598	75	2,673	5,472	2.05:1
62	6.40	77,720	66,680	11,040	11,040	2,865	75	2,940	11,368	3.87:1
63	2.50	52,272	47,212	5,060	5,060	1,901	75	1,976	4,442	2.25:1
64	2.37	47,471	40,537	6,934	5,940	1,740	75	1,815	3,706	2.04:1

APPENDIX
Table 1 - Continued
Individual Justification - Floodwater Retarding Structures
CHAMBERS CREEK WATERSHED
(Trinity River Watershed)

Site No.	Drainage Area Sq. Mi.	Total Installation Cost 1/	Federal Installation Cost	Non-Federal Installation Cost 2/	Easements (Land Value) 3/	Annual Installation Cost	Annual Maintenance Cost	Total Annual Cost	Annual Benefit	Benefit-Cost Ratio
		(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
65	2.43	43,856	38,416	5,440	5,440	1,608	75	1,683	5,035	2.99:1
66	4.93	107,664	96,583	11,081	9,740	3,921	75	3,996	10,212	2.56:1
67	4.39	77,651	66,871	10,780	10,780	2,860	75	2,935	9,094	3.10:1
68	1.13	44,897	41,937	2,960	2,960	1,616	75	1,691	2,341	1.38:1
69	3.02	72,533	66,933	5,600	5,600	2,621	75	2,696	6,257	2.32:1
70	4.65	54,463	44,143	10,320	10,320	2,037	75	2,112	9,632	4.56:1
71 4/	3.63	57,579	48,939	8,640	8,640	2,128	75	2,203	7,518	3.41:1
72	6.25	100,799	88,619	12,180	12,180	3,692	75	3,767	12,948	3.44:1
73 4/	4.45	50,471	41,591	8,880	8,880	1,879	75	1,954	9,218	4.72:1
74	4.91	85,894	78,294	7,600	7,600	3,114	75	3,189	10,171	3.19:1
75	10.34	164,011	145,391	18,620	18,620	5,993	75	6,068	16,106	2.65:1
76	2.20	52,625	47,305	5,320	5,320	1,916	75	1,991	3,427	1.72:1
77	3.32	51,306	46,466	4,840	4,840	1,863	75	1,938	5,171	2.67:1
78	2.21	81,417	78,477	2,940	2,940	2,904	75	2,979	3,445	1.16:1
79	3.79	55,165	46,925	8,240	8,240	2,037	75	2,112	5,903	2.79:1
80	6.68	118,603	110,303	8,300	8,300	4,275	75	4,350	8,076	1.86:1
81	5.31	90,290	85,030	5,200	5,200	3,243	75	3,318	6,420	1.93:1
82	5.49	82,600	76,080	6,520	6,520	2,987	75	3,062	6,637	2.17:1
83	1.92	40,207	38,007	2,200	2,200	1,442	75	1,517	2,321	1.53:1
84	6.63	82,764	74,604	8,160	8,160	3,011	75	3,086	8,016	2.60:1
85	6.04	64,394	58,014	6,380	6,380	2,343	75	2,418	7,302	3.02:1
86	2.61	63,668	60,448	3,220	3,220	2,281	75	2,356	3,156	1.34:1
87	3.30	65,460	60,680	4,780	4,780	2,362	75	2,437	3,988	1.64:1
88	4.13	69,892	63,732	6,160	6,160	2,533	75	2,608	4,015	1.54:1
89	1.90	27,039	23,079	3,960	3,960	999	75	1,074	5,743	5.35:1
90	7.01	90,379	77,609	12,770	8,740	3,303	75	3,378	6,814	2.03:1
91	4.42	61,122	52,982	8,140	8,140	2,247	75	2,322	4,297	1.85:1
92	1.48	48,413	45,553	2,860	2,860	1,740	75	1,815	4,400	2.42:1

APPENDIX

Table 1 - Continued

Individual Justification - Floodwater Retarding Structures

CHAMBERS CREEK WATERSHED

(Trinity River Watershed)

Site No.	Drainage Area Sq. Mi.	Total Installation Cost 1/	Federal Installation Cost	Non-Federal Installation Cost 2/	Easements (Land Value) 3/	Annual Installation Cost	Annual Maintenance Cost	Total Annual Cost	Annual Benefit	Benefit-Cost Ratio
		(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
93	1.58	31,101	28,361	2,740	2,740	1,128	75	1,203	4,697	3.90:1
94	0.97	32,116	30,196	1,920	1,920	1,154	75	1,229	2,885	2.35:1
95	1.10	26,533	24,073	2,460	2,460	964	75	1,039	3,269	3.15:1
96	1.47	49,351	45,151	4,200	4,200	1,787	75	1,862	2,757	1.48:1
97 4/	10.84	154,277	135,737	18,540	18,540	5,648	75	5,723	20,333	3.55:1
98 4/	7.55	82,008	70,528	11,480	11,480	3,021	75	3,096	14,162	4.57:1
99	4.22	50,682	43,702	6,980	6,980	1,865	75	1,940	7,916	4.08:1
100	9.08	96,678	82,778	13,900	13,900	3,565	75	3,640	17,033	4.68:1
101	8.89	79,377	54,597	24,780	24,780	3,079	75	3,154	23,324	7,40:1
102	6.05	99,914	84,854	15,060	15,060	3,693	75	3,768	11,349	3.01:1
103	5.17	80,695	68,895	11,800	11,800	2,978	75	3,053	9,699	3.18:1
104	1.21	29,056	26,396	2,660	2,660	1,054	75	1,129	2,269	2.01:1
105	3.54	70,931	64,051	6,880	6,880	2,578	75	2,653	6,640	2.50:1
106	2.86	52,960	46,780	6,180	6,180	1,936	75	2,011	5,481	2.73:1
107	1.88	34,722	31,202	3,520	3,520	1,264	75	1,339	3,602	2.69:1
108	1.64	42,152	37,532	4,620	4,620	1,538	75	1,613	3,142	1.95:1
109	0.88	28,691	26,191	2,500	2,500	1,040	75	1,115	1,272	1.14:1
110	0.91	24,610	22,230	2,380	2,380	894	75	969	1,315	1.36:1
111 5/	7.48	-	-	-	-	-	-	-	-	-
112 5/	5.74	173,693	152,293	21,400	21,400	6,367	150	6,517	19,103	2.93:1
113 4/	5.33	53,739	40,599	13,140	13,140	2,043	75	2,118	7,701	3.64:1
114	6.25	83,215	69,035	14,180	14,180	3,094	75	3,169	14,290	4.51:1
115	1.50	31,586	27,906	3,680	3,680	1,155	75	1,230	2,167	1.76:1
116	3.51	57,244	51,424	5,820	5,820	2,085	75	2,160	5,071	2.35:1
117	3.55	50,908	42,488	8,420	8,420	1,890	75	1,965	5,130	2.61:1
118	1.29	30,060	26,160	3,900	3,900	1,102	75	1,177	1,863	1.58:1
119	6.25	123,981	114,001	9,980	9,980	4,485	75	4,560	5,195	1.14:1
120	4.85	64,593	55,633	8,960	8,960	2,378	75	2,453	3,988	1.63:1

APPENDIX

Table 1 - Continued

Individual Justification - Floodwater Retarding Structures

CHAMBERS CREEK WATERSHED

(Trinity River Watershed)

July, 1955

Site No.	Drainage Area Sq. Mi.	Total Installation Cost 1/	Federal Installation Cost	Non-Federal Installation Cost 2/	Easements (Land Value) 3/	Annual Installation Cost	Annual Maintenance Cost	Total Annual Cost	Annual Benefit	Benefit-Cost Ratio
		(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
121	1.67	45,626	41,186	4,440	4,440	1,658	75	1,738	1,874	1.08:1
122	2.69	49,733	41,446	8,287	7,340	1,836	75	1,911	3,472	1.82:1
123	2.30	37,400	31,720	5,680	5,680	1,382	75	1,457	2,969	2.04:1
124	3.42	66,063	56,363	9,700	9,700	2,438	75	2,513	4,413	1.76:1
125	1.48	36,919	32,799	4,120	4,120	1,349	75	1,424	1,840	1.29:1
126	6.51	71,722	60,762	10,960	10,960	2,653	75	2,728	8,087	2.96:1
127	2.79	51,141	44,761	6,380	6,380	1,876	75	1,951	3,466	1.78:1
128	4.26	57,561	45,318	12,243	11,060	2,155	75	2,230	7,271	3.26:1
129	3.22	48,825	39,845	8,980	8,980	1,823	75	1,898	5,497	2.90:1
130	5.42	65,274	55,354	9,920	9,920	2,413	75	2,488	5,958	2.40:1
131	1.74	38,541	34,781	3,760	3,760	1,402	75	1,477	1,913	1.30:1
132	1.77	35,603	29,463	6,140	6,140	1,325	75	1,400	3,396	2.43:1
133	6.66	94,566	77,046	17,520	17,520	3,531	75	3,606	12,778	3.54:1
134	1.02	29,709	26,389	3,320	3,320	1,086	75	1,161	1,956	1.68:1
135	1.98	73,058	67,238	5,820	5,820	2,642	75	2,717	3,799	1.40:1
136	2.93	38,492	30,072	8,420	8,420	1,453	75	1,528	5,621	3.68:1
137	9.99	141,201	122,961	18,240	18,240	5,184	75	5,259	12,135	2.31:1
138	3.84	67,925	60,105	7,820	7,820	2,483	75	2,558	4,456	1.74:1
Total	492.09	8,210,161	7,264,641	945,520	930,330 6/	300,057	9,825	309,882	761,152	2.46:1

1/ Includes $37,905 Work Plan development cost.

2/ Includes $15,190 for cost of removing obatacles.

3/ Included in Non-Federal installation cost figure.

4/ Directly contributing area to lower structures in a series.

5/ These structures considered as one unit for construction

6/ Includes $10,500 for cost of legal fees.