Official Copy

WORK PLAN

BIG SANDY CREEK WATERSHED

Of the Trinity River Watershed

Montague, Wise, Clay and Jack Counties,

Texas

Prepared By

SOIL CONSERVATION SERVICE

U. S. DEPARTMENT OF AGRICULTURE

Temple, Texas

August 1955

UNITED STATES
DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Denton, Texas
January 23, 1956

Chairman, County PMA Committee,
County Agricultural Agent,
County Judge

In accordance with the specific request of the farmers and others living in the Big Sandy Creek Watershed, 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 October 10, 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 from the Chairman, Denton-Sandy Watershed Association, in which the Association and each of the Soil Conservation District Governing Bodies concur 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 Conaervation 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.

R. H. Goodnight

R. H. Goodnight, Area Conservationist

Geo. A. Wood

George Wood, Area Conservationist

Attachment

Denton-Wise Soil Conservation District

Denton, Texas
January 18, 1956

Mr. J. L. Coppedge
Work Unit Conservationist
Soil Conservation Service
Denton, Texas

Dear Mr. Coppedge:

The supervisors of our district have reviewed carefully the Work Plan primarily for flood prevention for Big Sandy Creek watershed.

We believe that the development of this watershed 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,

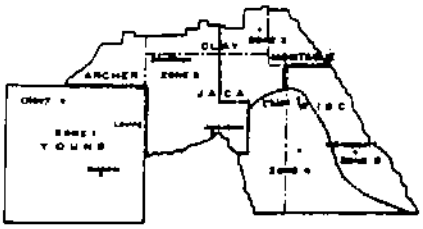
John D. Faught

John D. Faught, Chairman Board,
Denton-Wise Soil Conservation
District Supervisors.

cc: Clifford Powell
Decatur, Texas

Upper West Fork Soil Conservation District

Courthouse Jacksboro, Texas



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JACKSBORO, TEXAS

Jacksboro, Texas

January 18, 1956

Mr. Albert T. Jordan
Work Unit Conservationist
Soil Conservation Service
Jacksboro, Texas

Dear Mr. Jordan:

The supervisors of our district have reviewed carefully the Work Plan primarily for flood prevention for Big Sandy Creek watershed.

We believe that the development of this watershed 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,

Rollan Hill
Chairman, Upper West Fork
Soil Conservation District

cc: W. E. Farrell
Work Unit Conservationist
Soil Conservation Service
Bowie, Texas

O. L. Fenner
Work Unit Conservationist
Soil Conservation Service
Bridgeport, Texas

Denton, Texas
January 18, 1956

Mr. R. H. Goodnight
Area Conservationist
Soil Conservation Service
Gainesville, Texas

Mr. George A. Wood
Area Conservationist
Soil Conservation Service
Denton, Texas

Gentlemen:

The Denton-Sandy Watershed Association and the governing bodies and cooperators of the Upper West Fork, Denton-Wise, and Upper Elm-Red Soil Conservation Districts have sctively participated in the preparation of the attached work plan primarily for flood prevention for the Big Sandy Creek Watershed.

This plan represents a common understanding and agreement on the kinds and amounts of measures needed to be applied in the Big Sandy Creek Watershed to achieve soil and water conservation on all of 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 Big Sandy Creek Watershed has been incorporated with and made a part of the district work plans of the Upper West Fork, Denton-Wise, and Upper Elm-Red 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,

J. A. Wynn — 1-17-56
Chairman, Denton-Sandy Watershed Association (Date)

L. Rollans Hill — 1-16-56
Chairman, Upper West Fork Soil Conservation District Board of Supervisors (Date)

J. W. Hess — 1-16-56
Chairman, Upper Elm-Red Soil Conservation District Board of Supervisors (Date)

John D. Faught — 1-16-56
Chairman, Denton-Wise Soil Conservation District Board of Supervisors (Date)

Upper Elm-Red
Soil Conservation District Number 524

Gainesville, Texas

January 18, 1956

Mr. Jack McFerren
Work Unit Conservetionist
Soil Conservation Service
Gainesville, Texas

Dear Mr. McFerran:

The supervisors of our district have reviewed carefully the Work Plan primarily for flood prevention for Big Sandy Creek watershed.

We believe that the development of this watershed 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,

J. W. Hess

Chairman, Upper Elm-Red
Soil Conservation District

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Of the Trinity River Watershed
Montague, Wise, Clay and Jack Counties, Texas

Participating Agencies

Upper West Fork Soil Conservation District
Upper Elm-Red Soil Conservation District
Denton-Wise Soil Conservation District
Agricultural Conservation Program Service
Extention Service
Soil Conservation Service

Prepared By

Soil Conservation Service
United States Department of Agriculture
August, 1955

WORK PLAN
BIG SANDY CREEK WATERSHED
Of the Trinity River Watershed
Montague, Wise, Clay and Jack Counties, Texas
August, 1955

INTRODUCTION

Authority

The Big Sandy 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 Upper West Fork, Upper Elm-Red, and Denton-Wise 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 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.

Application of this mutually developed plan will provide the protection to and improvement of land and water resources which can be justified economically and undertaken at this time with the combined facilities of local interests 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, Montague, Wise, Clay and Jack, and contains 317,000 acres (495 square miles).

SUMMARY OF PLAN

Thia plan is a combination of land treatment practices and flood prevention measures which contribute directly to soil and water conservation and flood prevention. The works of improvement as listed in Tables 1 and 2A are planned to be installed at an estimated total cost of $5,093,348 of which $3,818,944 is to be borne by State and local interests and $1,274,404 by the Federal Government. These estimates are inclusive of the current costs of local interests and State agencies 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 $30,366 for planning and application assistance through the Soil Conservation Districts, and $289,239 for reimbursement to private interests from ACPS funds.

The Upper West Fork, Under Elm-Red, and Denton-Wise 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 at an estimated annual cost of $2,191. The landownera and operators will maintain the land treatment measures at an estimated annual cost of $118,273 in accordance with provisions of the farmer-district cooperative agreements.

Comparisons of Benefit and Cost

When the works of improvement are applied and operating at full effectiveness the ratio of the estimated average annual benefit ($1,446,270) to the estimated average annual equivalent cost ($344,145) is 4.20 to 1 based on 1954 price levels for costs and long-term prices for benefits.

DESCRIPTION OF THE WATERSHED

Big Sandy Creek rises in the southeastern part of Clay County, Texas, and flows in a southeasterly direction through the southwestern part of Montague County and the north central part of Wise County for approximately 36 miles, entering the West Fork of the Trinity River about 4 miles southeast of the town of Bridgeport. In addition to the area drained by Big Sandy Creek, this watershed includes the drainage areas of several smaller creeks which drain directly into the West Fork of the Trinity River, both west and southeast of Big Sandy Creek (Figure 2).

The watershed has an area of 317,000 acres (495.3 square miles), of which 308,244 acres are in farms and ranches and 8,756 acres are in roads and miscellaneous uses. There are 92,855 acres of the delineated watershed which drain directly into the West Fork of the Trinity River. Of this area 11,294 acres are bottom land common to Big Sandy Creek, the adjacent

laterals and the West Fork of the Trinity River and 6,435 acres are bottom lands of the laterals including 5,090 acres of actual flood plain. The remaining 224,145 acres (350.2 square miles) represent the drainage area of Big Sandy Creek above the common flood plain with the West Fork of the Trinity River. There are 15,542 acres of bottom land in the watershed of Big Sandy Creek and its tributaries, of which 14,750 scres are flood plain and 774 acres are in stream channels. Under present conditions the entire flood plain would be inundated by an 8.40-inch storm occurring over a 2-day period and producing 3.80 inches of runoff.

The Big Sandy Creek watershed lies within three problem areas in Soil Conservation. About 27 percent of the area is in the Reddish Prsiries, 68 percent in the Cross Timbers and 5 percent in the Grand Prairie.

The Reddish Prairies consist of deep to shallow soils of reddish brown color and fine to medium texture. In this watershed the Reddish Prairies is actually a transition area from Cross Timbers to true Reddish Prairies with the Cross Timbers influence predominating. The soils are developed from interbedded sandstone and shale formations.

The Cross Timbers consists of deep, light-colored soils of medium to coarse textures developed from poorly consolidated sand formations. These soils have uncommonly high inherent erodibility because of the well-rounded shape and poor consolidation of the particles. Approximately 30 to 50 percent of this area is severely denuded and is characterized by deep, dendritic gully systems.

The Grand Prairie consists of dark fine textured well aggregated soils which are developed chiefly from limestones.

The soils of the watershed, in general, are in fair to poor physical condition. Where the established cover has been maintained on grazing lands the condition is good. Cultivated lands have lost from 4 to 8 inches of topsoil. In addition, most of the land in the east-central one-half of the watershed has been so damaged by accelerated gully erosion that it is unsuitable for cultivation. In the more erosion resistant prairie lands which lie in the northwestern part of the watershed, small grain agriculture predominates and production is stabilized. These soils are in moderately good condition.

The topography of the watershed ranges from gently rolling to very strongly rolling. Surface geologic exposures of the Cisco group in the northwestern one-fourth of the watershed vary from clays and shales at the northern rim, giving rise to smooth prairie expanses, to massive sandstones which produce a very rugged, hilly topography. The central portion of the watershed is underlain by Trinity sands and has gently rolling slopes on the west and moderately steep slopes on the east. Intensive use of this area has upset the original, mature drainage pattern, and caused the development of deep valley trenches and overfalls that migrate to the heads of upland gully systems. Tributary channels frequently reach depths

of 20 to 30 feet. Relief along the southeastern divide for about 20 miles is rather abrupt as sandy strata make contact with resistant limestone outcrops to form escarpments which rise to gently sloping ridges on the east. Elevations range from 649 feet above mean sea level where the West Fork of the Trinity enters Eagle Mountain Lake to 1,250 feet in the upper reaches above Bowie. The main alluvial valley of Big Sandy Creek ranges from about 4,500 feet wide at its junction with the West Fork to less than 800 feet wide near the headwaters.

Approximately 52 percent of the watershed either is in cultivation or has been cultivated at one time. About 19,900 acres of land unsuitable for cultivation are still being cultivated. An additional 73,086 acres have been abandoned from cultivation and need to be seeded to adapted grasses.

Present land use in the watershed is estimated as follows:

Land Use	Acres	Percent
Cultivation	79,619	25.1
Open Pasture	72,434	22.8
Wooded Pasture	80,174	25.3
Formerly Cultivated	73,086	23.1
Stream Channels	2,931	0.9
Miscellaneous 1/	8,756	2.8
Total	317,000	100.0

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

The Big Sandy Creek flood plain is utilized as follows: approximately 26 percent is cultivated; 44 percent is in open pasture; 28 percent is wooded pasture; and 2 percent is in miscellaneous uses.

The Big Sandy Creek watershed is underlain by formations of the Pennsylvanian and Lower Cretaceous ages. The formations of the Pennsylvanian age are in the Cisco and Canyon groups. The Lower Cretaceous formations are primarily of the Trinity group; however, there are some outcrops of the Fredericksburg and Washita groups.

Outcrops of the Pennsylvanian system comprise almost one-third of the watershed area. These consist of the areas of highest elevation which lie in the northwest part of the watershed. The strata of this system generally strike northeast-southwest and dip somewhat west of north from 70 to 120 feet to the mile.

These outcrops are predominantly of the Cisco group. In this group the Pueblo formation is uppermost, consisting of clays and red shales, and give rise to a gently rolling prairie. The underlying Harpersville

formation consists of basal beds of coarse, thick sandstone, middle beds of heterogeneous sandstone and shale with thin beds of coal, and upper beds of thick massive sandstone. The basal formation of the Cisco group is the Graham. It, together with the Thrifty formation, produces variable outcrops of massive sandstone, persistent limestone, and lenticular shale, sandstone and conglomerate.

Outcrops of the Canyon group occur to a lesser extent and include the Caddo Creek and Brad formations. These formations are characterized by massive limestones and interbedded shales and thin sandstones.

The remainder of the watershed includes formations of Lower Cretaceous age which make contact in a severe unconformity with highly eroded exposures of Pennsylvanian strata. These formations dip about 40 feet to the mile to the southeast.

The Lower Cretaceous outcrops are primarily of the Trinity group. Formations include the Basement sands and conflomerates, the Glen Rose limestones and the Paluxy sands. The Glen Rose strata pinch out near the center of the watershed and cause the upper and lower sand members to become indistinguishable north of that point. These outcropping sands are largely unconsolidated and cover about two-thirds of the watershed, spreading in thin surface mantles over much of the underlying Pennsylvanian beds. They are composed almost entirely of well-rounded quartz particles and as such will constitute porous foundations and abutments and easily eroded spillways.

Other Cretaceous rocks are of the Fredericksburg and Washita groups which outcrop in a long, narrow band along the southeastern divide. Formations include resistant shell agglomerate, soft nodular limestone and marly limestone. No detention structures are proposed in these formations.

The cultivated lands of that part of the watershed developed from material of Pennsylvanian age are utilized primarily for small grain production. The proper utilization of crop residues will provide good vegetative cover for these soils. The cultivated lands of the remainder of the watershed are utilized principally for production of orchard crops, watermelons and peanuts. These crops together with current cropping practices provide very poor cover for these soils.

Rangeland is of two general types; namely, true prairie land and the post oak-savannah. The present condition of the grass cover is poor to fair as a result of excessive use. There are seven range sites in the watershed. These are described as follows:

The Mixed Land Site lies within the Reddish Prairies problem area. It has the highest forage production potential of any of the sites in the watershed. The topography is almost level to gently rolling. The soils are medium textured and are slowly to moderately permeable. Little bluestem, switchgrass, Indiangrass, big bluestem, sideoats grama, tall dropseed and some buffalograss and blue grama made up the original grass

cover. The principal invading plants are post oak and mesquite trees, perennial threeawn, hairy grama, silver bluestem, western ragweed and the lessor annual bromes and annual threeawns. A large percentage of this site is in poor condition.

The Rough Land Site is also in the Reddish Prairies and is characterized by sloping to hilly topography and by the presence of rock both on the surface and embedded throughout the soil profile. The presence of stones and the generally permeable soils along with a degree of inaccessibility to grazing have tended to keep this site in near climax condition. The climax plants are about the same as the mid- and tall grasses of the Mixed Land Site; however, a greater percentage of little bluestem, sideoats grama and tall dropseed is evident.

The Shallow Mixed Land Site comprises the remainder of the rangeland in the Reddish Prairies. The topography of this site ranges from almost level to low rolling hills. Shallow medium textured, permeable soils predominate in this site. Climax vegetation includes bluestems, Indiangrass, gramas, dropseeds, lovegrasses and Texas wintergrass. The site is in fair to poor condition due to loss of climax grasses and invasion of woody plants.

The Medium Deep Soil Site lies in the Grand Prairie problem area. The topography is gently sloping to hilly. The predominate soils are shallow to very shallow in depth and are slowly permeable. The climax grasses include little bluestem, big bluestem, Indiangrass, sideoats grama, tall grama and tall dropseed. Invaders are threeawn, hairy grama, hairy tridens, buffalograss, western ragweed and annuals. This site generally is in fair condition.

The Sandy Upland Site lies in the Cross Timbers problem area. The topography is gently sloping to rolling and the soils are deep and moderately permeable. The predominate vegetation is mid- and tall grasses such as little bluestem, Indiangrass, purpletop and sand lovegrass. About two-thirds of the area of this site has been cultivated at one time. The site generally is in poor condition and post oak and blackjack oak have been heavy invaders where the land was not cultivated.

The Course Sandy Site is also in the Cross Timbers. The topography is nearly level to sloping and the surface soil is coarse with a sandy clay to clay subsoil. These soils are moderately permeable to permeable. Originally this site was a savannah but under present conditions woody plants, post oak and an under-story of smaller oak and green briar, almost dominate the site. The principal adapted climax grasses are little bluestem, Indiangrass, purpletop, switchgrass, sand lovegrass and the dropseeds.

The Shallow Sandy Upland Site constitutes the remainder of the Cross Timbers. The topography is gently sloping to rolling and the soils are shallow with stones on the surface and in the productive profile. Climax grasses include little bluestem, Indiangrass, sideoats grama, tall grama and tall dropseed. Post oak and blackjack oak are the primary invaders.

Mean temperatures range from 83 degrees Fahrenheit for July to 41 degrees for January. The extreme recorded temperatures are 4 degrees below zero and 113 degrees above. The average date of the first killing frost is November 6 and of the last killing frost is March 19, giving a normal frost-free period of 220 days.

The mean annual precipitation of 30.33 inches is fairly well distributed over the growing season. The larger average monthly rainfalls occur in April, May, June and October. Occasionally there is insufficient rainfall during the summer months to assure good crop yields. Individual rains of excessive amounts, which may occur at any season, cause erosion and serious flood damage. The minimum recorded annual rainfall was 16.55 inches, and the maximum was 46.42 inches.

Water for livestock and domestic uses in the rural area is supplied largely by shallow wells and small farm ponds.

There are a number of dairies within the watershed that sell milk in neighboring towns which are within the Dallas-Fort Worth milkshed. About 40 percent of the cattle in the watershed are dairy animals.

Although the Big Sandy Creek watershed is primarily a rural area, an unusually high percentage (approximately 40 percent) of the farms are classified as non-commercial. Almost 53 percent of the farms reported total sales of farm products amounting to less than $1,000 per farm in 1949. The average size of farm in 1950 was approximately 300 acres with a value of land and buildings of about $34 per acre. Although only about 25 percent of the farmland is operated wholly by tenants, the proportion operated by full owners (about 36 percent) is rather low.

Many opportunities for off-the-farm work exist in nearby cities and towns. The chief of these is Fort Worth (1950 population 278,778) where airplane factories and other industries employ a considerable number of the inhabitants of the watershed. Other nearby towns with their 1950 populations in parentheses are: Bowie (4,544), Bridgeport (2,049), Chico (850), Decatur (2,922) and Jacksboro (2,951).

The Big Sandy Creek watershed is served by four Soil Conservation Service work units which are assisting the Upper West Fork, Upper Elm-Red and Denton-Wise Soil Conservation Districts. These work units have assisted farmers and ranchers in preparing 750 conservation plans on 151,643 acres within the watershed.

A network of 707 miles of roads within the watershed include many that are frequently damaged by flooding to such an extent that they cannot be properly maintained and have been virtually abandoned. Of the 42 bridges in the flood plain, 24 span the larger streams. However, floods occasionally make some of the roads impassable and the detours thus occasioned cause delay and extra travel distance to and from schools, markets and places of employment. Two railroads, the Rock Island and the Fort Worth

and Denver, traverse the watershed and provide ample loading facilities for carload lot shipments.

FLOOD AND EROSION PROBLEMS AND DAMAGES

Flood Damages

Big Sandy Creek has flooded frequently and caused high annual damage. During the 20-year period, 1923 and 1942 inclusive, there were 25 floods which covered more than 50 percent of the flood plain and 52 smaller damage-producing floods. These floods have caused considerable damage to growing and mature crops. In addition, operators of flood plain lands state that the flood hazard and the risk of damage from flood plain scour have forced them to shift considerable flood plain land from its former use to lower value "catch" crops and pasture. For the floods experienced during the 20-year period studied, the total direct floodwater and sediment damages were estimated to average $227,458 annually under present conditions, of which $87,545 is crop, pasture and flood plain scour damage. Excluding the area of flood plain which would be inundated by the proposed floodwater retarding structures, these damages would be $226,194 and $87,085, 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 is estimated to be $22,619. The average annual monetary flood damages are summarized in Table 4.

Erosion

Erosion rates in Big Sandy Creek watershed are high, although natural revegetation of large areas of abandoned cropland is reducing the rates. The highest sediment yields are derived from Cross Timbers sources. Forty-two percent of the total gross erosion in the watershed results from sheet erosion. Gully and streambank erosion are about equal and account for 49 percent. Flood plain scour produces the remaining 9 percent. The principal land damage to the Big Sandy Creek flood plain is from infertile overwash.

Reservoir and Pond Sedimentation

Excluding the drainage area of Lake Bridgeport, the Big Sandy Creek watershed comprise 61 percent of the watershed of Eagle Mountain Lake. This reservoir has suffered moderate sedimentation damages. The present annual damage to Eagle Mountain Lake attributable to the Big Sandy Creek watershed is estimated to be $19,274 based on long-term prices.

Farm ponds, in general, have suffered moderate to high losses in storage capacity from sedimentation. The average annual damage to the existing 812 ponds is estimated to be $8,873, computed at long-term prices. Benefits from this source are included in the Conservation Benefit figure, Table 5.

Channel Enlargement

The channels on the lower segment of Big Sandy Creek bear slight evidence of lateral erosion. A substantial volume of sediment is derived from valley trenching of small lateral drains. Upper segments of the main stem are eroding laterally at rates of 0.2 to 1.0 feet per year. The average annual land loss from this process is estimated to be 28 acres. It is estimated that bank erosion contributes approximately 30 percent of the total sediment yield at the mouth of the watershed.

Infertile Overwash

Practically all of the modern infertile overwash is located below the 25 proposed floodwater retarding structures. These deposits range in depth from a few inches to over 10 feet and cover an area of approximately 8,400 acres. A high percentage of the modern sediment consists of relatively infertile silt and silty sand. The rates of damage range from 10 to 90 percent.

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

Flood Plain Scour

Flood plain scour is of minor consequence on the lower reaches of Big Sandy Creek because of the large volume of associated overwash sediments. Frequent flooding on the upper reaches and tributaries has caused appreciable scour damage. An estimated 586 acres have been damaged to the following extent: 109 acres damaged 10 percent, 268 acres damaged 25 percent, 114 acres damaged 50 percent, 53 acres damaged 70 percent, and 42 acres damaged 90 percent.

Swamping

Swamping has affected 338 acres in the Big Sandy Creek watershed. Damages occur to the following extent: 27 acres damaged 25 percent, 104 acres damaged 50 percent, 15 acres damaged 70 percent, and 192 acres damaged 90 percent. It is anticipated that floodwater retarding structures, which will reduce flooding and sedimentation considerably, will do much to eliminate swamping damages.

EXISTING OR PROPOSED WATER MANAGEMENT PROJECTS

Efforts to prevent or to control floods in the Big Sandy Creek watershed have been minor. During the past nine years, several small neighborhood groups of farmers, cooperating with the Upper West Fork, Upper Elm-Red and Denton-Wise Soil Conservation Districts have prepared soil and water conservation plans on a community watershed basis. Progress has been made on application of the needed practices.

The City of Bowie is constructing a city water supply reservoir on Big Sandy Creek just below the confluence of Briar Creek (Montague County). The reservoir, which has a drainage area is 113 square miles, provides for 20,000 acre-feet of storage for water supply and 1.8 inches, or approximately 10,000 acre-feet, of flood storage. The flood storage was included in lieu of a concrete spillway. The floodwater detention and sedimentation benefits for the Bowie reservoir were evaluated and are discussed under the topic "Effect of These Measures on Damages and Benefits."

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 urban improvements are listed with their costs in Tables 1 and 2A.

A system of 25 floodwater retarding structures (Figure 1) is to be installed to protect the flood plain lands along Big Sandy Creek and its major tributaries. The locations of the structures are shown on the Structure Location Map, Figure 2. Data concerning these floodwater retarding structures are summarized in Table 6. This system of floodwater retarding structures will detain runoff from 24 percent of the Big Sandy Creek watershed. Sufficient detention storage can be developed at all structure sites to make possible the use of vegetated spillways, thereby effecting a substantial reduction in cost over concrete or similar type spillways.

Sites for the floodwater retarding structures will be provided by local interests. The value of these sites is estimated to be $73,698, based on market values furnished by real estate dealers and other local people. Site costs were determined by adding the full value of the land in the sediment pool and one-half the value of the land in the flood pool, since the latter will remain in productive use as pasture. The average annual loss of production within the sites was calculated to be $2,310 on the basis of long-term prices. The amortized cost of the structure sites is $3,431. Therefore, in accordance with sound procedures, the larger of the two figures was used in determining the economic evaluation of the program.

The total estimated cost of installing these structures is $1,094,193. The annual cost, including installation and maintenance is $41,692.

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 Upper West Fork, Upper Elm-Red and Denton-Wise 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

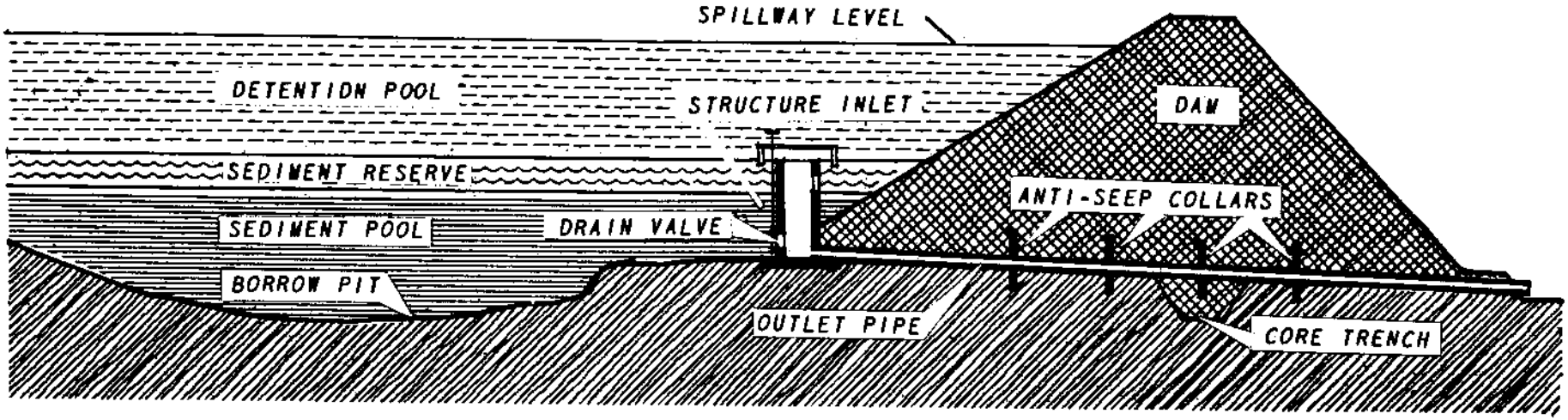


Figure 1

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

U.S.D.A. SOIL CONSERTATION SERVICE

9-20-55 M-L-10071

maintenance of all applicable soil and water conservation and plant management practices. Emphasis will be placed on accelerating the establishment of the following land treatment practices which have a measurable effect on the reduction of floodwater and sediment damages.

An important phase of work which will be done is the seeding or improvement of 73,086 acres of idle land and pastureland which has been so overgrazed that reseeding is necessary to establish adequate cover to reduce erosion and sediment yield. In addition to this, there are 20,167 acres of cultivated land which will be retired and seeded to grasses.

Two hundred and forty-six miles of terraces will be built on cultivated land, and 78 miles of diversion terraces will be built to protect lower lying fields. Two hundred and ninety acres of protected outlets will be established to carry the runoff from these terraces and diversions.

Other needed land treatment measures which have a direct effect on flood prevention include stock ponds, cover crops and proper use of both pasture and rangelands. One thousand and seventy additional stock ponds are to be built to assure adequate distribution of grazing on the grasslands. This density provides approximately one farm pond per average size unit. Cover crops will be planted on a total of 26,102 acres to improve soil condition and reduce erosion. There are 38,444 acres of pasture and 102,989 acres of rangeland which will be used properly to improve and maintain an effective vegetative cover.

Under the guidance and with the assistance of the Soil Conservation Districts, landowners will apply other needed land treatment measures, such as contour farming and crop residue management, and will improve adapted odd areas to provide cover for wildlife. Selected ponds may be stocked and managed for fish production. These practices are needed in a complete soil and water conservation and plant management program.

The estimated total cost of planning and installing these measures is $3,999,155 as shown in Table 1. The annual cost, including installation and maintenance, is $302,453.

Effect of These Measures on Damages and Benefits

The combined program of land treatment and flood prevention measures described above would prevent damage on the flood plain of Big Sandy Creek and its tributaries from 11 of the 52 minor floods such as occurred in the 20-year period 1923 to 1942, inclusive, except on the lower end of the main stem where the channel has very low capacity. Of the twenty-five major floods that occurred during this period sixteen would be reduced to minor floods.

Average annual flooding throughout the watershed will be reduced from 24,656 acres to approximately 14,044 acres. The estimated average annual flood damage, based on the floods experienced in the 20-year period of

study, will be reduced from $248,813 to $112,885. Of this reduction $27,513 will result from the flood prevention effects of the Bowie reservoir. The estimated reduction in flood damages, $108,415, resulting from this program represents 44 percent of the estimated damages under present conditions.

Approximately 44 percent of the expected reduction in average annual flood damages from this program, based on the investigation of damages caused over the 20-year period studied, would result from the system of 25 floodwater retarding structures. Of the total reduction from all measures shown in Table 4, the annual benefits resulting from floodwater retarding structures is $47,626, and the average annual reduction from the Bowie City Reservoir is $27,513.

Owners and operators of flood plain lands say that if adequate flood protection is provided they will be able to increase their income by growing higher value crops, principally alfalfa and cotton on some areas now in relatively unprofitable use because of the flood hazard. It is estimated that this more intensive use would increase the net income, after all associated expenses are deducted, by $29,930 annually.

The total flood prevention benefits, including both the reductions in floodwater and sediment damages and the benefits from more intensive use of flood plain lands, are estimated to be $138,345 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 $1,307,925 annually. The total expected benefit from the combined program would amount to $1,446,270 annually.

The expected benefits due to land treatment were determined by estimating the change in 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 steep and severely eroded areas to pasture, along with idle cropland, it was assumed that the proportionate distribution of kinds of crops would not change.

Likewise, it was assumed that there would be no change in the percentage of cattle used for dairying or beef production, although the total number of cattle would be increased materially because of the increased acreage of pasture and the greater hay production and pasture-carrying capacity to be expected from the application of land treatment measures.

Unless land treatment measures are installed, erosion and deterioration of soil resources can be expected to continue with resulting decreases in average yields. It is estimated that this yield decline will cost the farmers an average of $672,479 annually in net income. Installation and maintenance of the proposed land treatment measures will prevent this loss and, in addition, will increase the annual net income to farmers in the watershed by an estimated $635,446 over present income. Of this estimated total conservation benefit, $1,307,925, crops are expected to produce

$994,089 and pasture $313,836.

Comparison of Cost and Benefit

The ratio of the average annual benefit from structural measures for flood prevention, $77,556, to the average annual cost of the measures, $41,692, is about 1.86 to 1. The ratio of the average annual benefit $1,368,714, from the land treatment measures and practices to their average annual cost, $302,453, is about 4.53 to 1. The estimated ratio of total average annual benefits, $1,446,270, to total average annual value of the costs $344,145, is 4.20 to 1. See Table 5.

ACCOMPLISHING THE PLAN

The Cooperative 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 reach the landowners and operators in the Big Sandy 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 structural measures for flood prevention.

The Soil Conservation Service will assign additional technicians and aids as needed to the Upper West Fork, Upper Elm-Red and Denton-Wise Soil Conservation Districts to assist landowners and operators cooperating with the districts in the preparation and application of soil and water conservation plans. Agricultural Stabilization and Conservation payments will assist the farmers in carrying out the land treatment practices and measures needed in the watershed during the installation period.

The governing bodies of the Upper West Fork, Upper Elm-Red and Denton-Wise Soil Conservation Districts will arrange for meetings according to a definite schedule, and by individual contacts encourage the landowners and operators within the 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 the existing arrangements for equipment usage in the districts. The districts' governing bodies will make periodic inspections of the completed conservation measures within their districts and follow through to see that needed maintenance is performed.

Technical 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 personnel 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.

Subwatershed Construction Units	No. of Sites	Annual Benefits (dollars)	Annual Cost (dollars)	Benefit-Cost Ratio
1. Upper Sandy, Prairie Branch, Briar Creek (Sites 1 through 7)	7	23,378	11,240	2.08:1
2. Jones Creek, Middle Creek, Silk Creek (Sites 10 through 14)	5	17,257	6,842	2.52:1
3. Brushy Creek (Sites 18 through 24)	7	14,943	11,530	1.30:1
4. Keel Creek, Cowskin Creek, Cottonwood Creek, Pringle Creek, Chicken Creek (Sites 8, 9, 15, 16, 17, and 25)	6	21,978	12,082	1.82:1

Construction can be started on any one of the first three units as soon as all easements have been cleared in that unit. Due to the fact that the sites in Unit 4 have very little tributary benefits and receive practically all their benefits from the reduction of main stem damages, construction will not be started on this unit until all easements in the entire watershed have been cleared.

Table 1 indicates the planned schedule of operations for each phase of the program. The cooperating parties have agreed that this schedule 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 current appropriations and accomplishments. The varioua 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 structures have been installed are shown in Table 3.

The floodwater retarding structures will be maintained by the Upper West Fork, Upper Elm-Red and Denton-Wise Soil Conservation Districts, assisted by a maintenance association, membership of which is made up primarily by benefited landowners. The land treatment measures will be maintained by the landowners or operators of the farms on which the measures are installed.

Table 1
Estimated Installation Cost by Years - Total Needed Program
BIG SANDY CREEK WATERSHED
(Trinity River Watershed) August, 1955

(Based on 1954 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	Ea.	5	164,627	-	-	164,627
Easements (Land Values)			-	-	8,765	8,765
Easements (Local Assistance)			-	1,250	-	1,250
Relocation County Roads			-	-	290	290
Relocation Pipeline			-	-	-	-
Relocation Power and Telephone Lines			-	-	225	225
Work Plan Development			31,011	-	-	31,011
Total A-Measures			195,638	1,250	9,280	206,168
B-Measures for Conservation of Watershed Lands Which Contribute Directly to Flood Prevention (SCS)						
Cover Cropping	Acre	1,540	-	-	15,400	15,400
Rotation Hay and Pasture	Acre	156	-	-	2,340	2,340
Terraces	Mile	15	-	-	2,700	2,700
Diversion Terraces	Mile	5	-	-	2,000	2,000
Waterway Development (Upland)	Acre	17	-	-	1,275	1,275
Farm Ponds	No.	63	-	-	21,420	21,420
Pasture Planting	Acre	2,310	-	-	69,300	69,300
Range Seeding	Acre	3,191	-	-	63,820	63,820
Proper Use - Pasture	Acre	2,268	-	-	11,340	11,340
Proper Use - Range	Acre	6,076	-	-	30,380	30,380
Farm & Ranch Planning (Accl.)	Acre	16,474	6,590	-	-	6,590
Farm & Ranch Appl. (Accl.)	Acre	10,873	11,960	-	-	11,960
Work Plan Development		-	10,337	-	-	10,337
Total B-Measures			28,887	-	219,975	248,862
Total A and B Measures			224,525	1,250	229,255	455,030
Facilitating Measures						
Work Plan Development			41,348	-	-	41,348
Summary						
Total Flood Prevention Funds (SCS)			224,525	-	-	-
Grand Total Flood Prevention Program			224,525	1,250	229,255	455,030
Going Program (SCS)	Acre	-	2,168	-	-	2,168

Table 1 - Continued
Estimated Installation Cost by Years - Total Needed Program
BIG SANDY CREEK WATERSHED
(Trinity River Watershed) August, 1955
(Based on 1954 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	Each	6	217,819	-	-	217,819
Easements (Land Values)			-	-	7,883	7,883
Easements (Local Assistance)			-	1,600	-	1,600
Relocation County Roads			-	-	688	688
Relocation Pipeline			-	-	-	-
Relocation Power & Telephone Lines			-	-	-	-
Work Plan Development			-	-	-	-
Total A-Measures			217,819	1,600	8,571	227,990
B-Measures for Conservation of Watershed Lands Which Contribute Directly to Flood Prevention (SCS)						
Cover Cropping	Acre	1,644	-	-	16,440	16,440
Rotation Hay and Pasture	Acre	166	-	-	2,490	2,490
Terraces	Mile	15	-	-	2,700	2,700
Diversion Terraces	Mile	5	-	-	2,000	2,000
Waterway Development (Upland)	Acre	18	-	-	1,350	1,350
Farm Ponds	No.	67	-	-	22,780	22,780
Pasture Planting	Acre	2,467	-	-	74,010	74,010
Range Seeding	Acre	3,408	-	-	68,160	68,160
Proper Use - Pasture	Acre	2,422	-	-	12,110	12,110
Proper Use - Range	Acre	6,488	-	-	32,440	32,440
Farm & Ranch Planning (Accl.)	Acre	14,128	5,651	-	-	5,651
Farm & Ranch Appl. (Accl.)	Acre	11,726	12,899	-	-	12,899
Work Plan Development			-	-	-	-
Total B-Measures			18,550	-	234,480	253,030
Total A and B Measures			236,369	1,600	243,051	481,020
Facilitating Measures						
Work Plan Development (SCS)			-	-	-	-
Summary						
Total Flood Prevention Funds (SCS)			236,369	-	-	-
Grand Total Flood Prevention Program			236,369	1,600	243,051	481,020
Going Program (SCS)	Acre	-	2,168	-	-	2,168

Table 1 - Continued
Estimated Installation Cost by Years - Total Needed Program
BIG SANDY CREEK WATERSHED
(Trinity River Watershed)
(Based on 1954 Price Levels)

August, 1955

Measures	Unit	FY 1958 No. to be Applied	Estimated Cost Fiscal Year 1958			
			Federal	Non-Federal Public	Private	Total
			(dollars)	(dollars)	(dollars)	(dollars)
A-Measures Primarily for Flood Prevention (SCS)						
Floodwater Retarding Structures	Each	6	209,181	-	-	209,181
Easements (Land Values)			-	-	26,945	26,945
Easements (Local Assistance)			-	2,225	-	2,225
Relocation County Roads			-	-	1,828	1,828
Relocation Pipeline			-	-	2,500	2,500
Relocation Power & Telephone Lines			-	-	500	500
Work Plan Development			-	-	-	-
Total A-Measures			209,181	2,225	31,773	243,179
B-Measures for Conservation of Watershed Lands Which Contribute Directly to Flood Prevention (SCS)						
Cover Cropping	Acre	1,749	-	-	17,490	17,490
Rotation Hay and Pasture	Acre	177	-	-	2,655	2,655
Terraces	Mile	16	-	-	2,880	2,880
Diversion Terraces	Mile	5	-	-	2,000	2,000
Waterway Development (Upland)	Acre	20	-	-	1,500	1,500
Farm Ponds	No.	72	-	-	24,480	24,480
Pasture Planting	Acre	2,624	-	-	78,720	78,720
Range Seeding	Acre	3,624	-	-	72,480	72,480
Proper Use - Pasture	Acre	2,576	-	-	12,880	12,880
Proper Use - Range	Acre	6,900	-	-	34,500	34,500
Farm & Ranch Planning (Accl.)	Acre	12,367	4,947	-	-	4,947
Farm & Ranch Appl. (Accl.)	Acre	12,367	13,603	-	-	13,603
Work Plan Development			-	-	-	-
Total B-Measurea			18,550	-	249,585	268,135
Total A and B Measures			227,731	2,225	281,358	511,314
Facilitating Measures						
Work Plan Development (SCS)			-	-	-	-
Summary						
Total Flood Prevention Funds (SCS)			227,731	-	-	-
Grand Total Flood Prevention Program			227,731	2,225	281,358	511,314
Going Program (SCS)	Acre	-	2,168	-	-	2,168

Table 1 - Continued
Estimated Installation Cost by Years - Total Needed Program
BIG SANDY CREEK WATERSHED
(Trinity River Watershed) August, 1955
(Based on 1954 Price Levels)

Measures	Unit	Balance to Complete	Estimated Cost Balance to Complete: Federal	Non-Federal: Public	Private	Total
			(dollars)	(dollars)	(dollars)	(dollars)
A-Measures Primarily for Flood Prevention (SCS)						
Floodwater Retarding Structures	Each	8	381,606	-	-	381,606
Easements (Land Values)			-	-	30,105	30,105
Easements (Local Assistance)			-	3,200	-	3,200
Relocation County Roads			-	-	1,945	1,945
Relocation Pipelines			-	-	-	-
Relocation Power & Telephone Lines			-	-	-	-
Work Plan Development			-	-	-	-
Total A-Measures			381,606	3,200	32,050	416,856
B-Measures for Conservation of Watershed Lands Which Contribute Directly to Flood Prevention (SCS)						
Cover Cropping	Acre	21,169	-	-	211,690	211,690
Rotation Hay and Pasture	Acre	2,137	-	-	32,055	32,055
Terraces	Mile	200	-	-	36,000	36,000
Diversion Terraces	Mile	63	-	-	25,200	25,200
Waterway Development (Upland)	Acre	235	-	-	17,625	17,625
Farm Ponds	No.	868	-	-	295,120	295,120
Pasture Planting	Acre	31,759	-	-	952,770	952,770
Range Seeding	Acre	43,870	-	-	877,400	877,400
Proper Use - Pasture	Acre	31,894	-	-	159,470	159,470
Proper Use - Range	Acre	83,525	-	-	417,625	417,625
Farm and Ranch Planning (Accl.)	Acre	96,560	38,624	-	-	38,624
Farm & Ranch Appl. (Accl.)	Acre	150,498	165,549	-	-	165,549
Work Plan Development			-	-	-	-
Total B-Measures			204,173	-	3,024,955	3,229,128
Total A & B Measures			585,779	3,200	3,057,005	3,645,984
Facilitating Measures						
Work Plan Development (SCS)			-	-	-	-
Summary						
Total Flood Prevention Funds (SCS)			585,779	-	-	-
Grand Total Flood Prevention Program			585,779	3,200	3,057,005	3,645,984
Going Program (SCS)			23,862	-	-	23,862

Table 1 - Continued
Estimated Installation Cost by Years - Total Needed Program
BIG SANDY CREEK WATERSHED
(Trinity River Watershed) August, 1955
(Based on 1954 Price Levels)

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	25	973,233	-	-	973,233
Easements (Land Values)			-	-	73,698	73,698
Easements (Local Assistance)			-	8,275	-	8,275
Relocation County Roads			-	-	4,751	4,751
Relocation Pipeline			-	-	2,500	2,500
Relocation Power & Telephone Lines			-	-	725	725
Work Plan Development			31,011	-	-	31,011
Total A-Measures			1,004,244	8,275	81,674	1,094,193
B-Measures for Conservation of Watershed Lands Which Contribute Directly to Flood Prevention (SCS)						
Cover Cropping	Acre	26,102	-	-	261,020	261,020
Rotation Hay and Pasture	Acre	2,636	-	-	39,540	39,540
Terraces	Mile	246	-	-	44,280	44,280
Diversion Terraces	Mile	78	-	-	31,200	31,200
Waterway Development (Upland)	Acre	290	-	-	21,750	21,750
Farm Ponds	No.	1,070	-	-	363,800	363,800
Pasture Planting	Acre	39,160	-	-	1,174,800	1,174,800
Range Seeding	Acre	54,093	-	-	1,081,860	1,081,860
Proper Use - Pasture	Acre	39,160	-	-	195,800	195,800
Proper Use - Range	Acre	102,989	-	-	514,945	514,945
Farm & Ranch Planning (Accl.)	Acre	139,529	55,812	-	-	55,812
Farm & Ranch Appl. (Accl.)	Acre	185,464	204,011	-	-	204,011
Work Plan Development		-	10,337	-	-	10,337
Total B-Measures			270,160	-	3,728,995	3,999,155
Total A and B Measures			1,274,404	8,275	3,810,669	5,093,348
Facilitating Measures						
Work Plan Development (SCS)			41,348	-	-	41,348
Summary						
Total Flood Prevention Funds (SCS)			1,274,404	-	-	-
Grand Total Flood Prevention Program			1,274,404	8,275	3,810,669	5,093,348
Going Program (SCS)	Acre		30,366	-	-	30,366

1/ Includes $289,239 that may be available from other Federal funds (ACPS) to reimburse private interests.

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

State Texas Date August, 1955

Watershed Big Sandy 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	-	-	-	-
Subtotal		-	-	-	-
B-Measures					
Cover Cropping	Acre	5,985			
Rotation Hay & Pasture	Acre	1,708			
Terraces	Mile	22			
Diversion Terraces	Mile	8			
Waterway Development	Acre	25			
Farm Ponds	Acre	58			
Pasture Seeding	Acre	370			
Range Seeding	Acre	660			
Proper Use - Pasture	Acre	2,014			
Proper Use - Range	Acre	8,288			
Farm & Ranch Planning (Accl.)	Acre	45,722			
Farm & Ranch Application (Accl.)	Acre	34,290			
Subtotal			61,160	245,143	306,303
Total A and B Measures			61,160	245,143	306,303

1/ Flood Prevention Funds including acceleration funds.
2/ Includes an estimated $20,405 of other Federal Funds (ACPS) by which private interests were reimbursed.

Table 2A
Status of Conservation Job in the Watershed
BIG SANDY CREEK WATERSHED
(Trinity River Watershed)

August, 1955

(Based on 1954 Price Levels)

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	25	1,094,193	0	-	-	-	25
Subtotal A-Measures			1,094,193					
B-Measures								
Cover Cropping	Acre	45,754	457,540	19,652	35,373	-	161,147	26,102
Rotation Hay and Pasture	Acre	11,438	171,570	8,802	-	-	132,030	2,636
Terraces	Mile	473	85,140	227	17,282	-	23,578	246
Diversion Terraces	Mile	128	51,200	50	5,927	-	14,073	78
Waterway Development (Upland)	Acre	454	34,050	164	1,279	-	11,021	290
Farm Ponds	No.	1,882	639,880	812	73,868	-	202,212	1,070
Pasture Planting	Acre	41,924	1,257,720	2,764	6,482	-	76,438	39,160
Range Seeding	Acre	60,786	1,215,720	6,693	14,837	-	119,023	54,093
Proper Use - Pasture	Acre	94,910	474,550	55,750	-	-	278,750	39,160
Proper Use - Range	Acre	150,811	754,055	47,822	-	-	239,110	102,989
Farm & Ranch Planning Asst.	Acre	308,244	123,298	152,408	60,963	-	-	155,836
Farm & Ranch Application Asst.	Acre	308,244	339,068	101,104	111,214	-	-	207,140
Work Plan Development (SCS)		-	10,337	-	-	-	-	-
Subtotal B-Measures			5,614,128		327,225		1,257,382	
Total A and B Measures			6,708,321		327,225		1,257,382	

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

Table 3
Annual Costs
BIG SANDY CREEK WATERSHED
(Trinity River Watershed)

August, 1955

Measures	Amortization of Installation Costs 3/				Operation & Maintenance 5/			Grand Total
	Federal 1/	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	35,407	292	3,802	39,501	-	2,191 4/	-	41,692
B-Measures	10,596 7/	-	173,584	184,180	-	-	118,273 6/	302,453
Total A and B Measures	46,003	292	177,386	223,681	-	2,191	118,273	344,145

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/ 1954 prices, the last complete year for which information is available.
4/ Based on estimated average annual maintenance cost of $77 (long-term prices) per structure during 50-year period following installation, except Structures 9, 13, 16, 17, 22, 23, 24 which is $115 per Structure.
5/ Long-term prices (B.A.E.)
6/ Based on estimated average annual maintenance costs of individual land treatment measures during the 50-year period following application.
7/ Includes $1,071 for Going Program (SCS)

Table 4
Summary of Average Annual Monetary Floodwater and Sediment Damage
and Flood Prevention Benefit from the Plan
BIG SANDY CREEK WATERSHED
(Trinity River Watershed)
(Long-Term Prices)

August, 1955

Damages	Average Annual Damage				Average Annual Benefits		
	Under Present Conditions (dollars)	B-Measures Only (dollars)	B-Measures With Bowie Reservoir (dollars)	With A & B Measures With Bowie Reservoir (dollars)	From B Measures (dollars)	From A Measures Only (dollars)	From A & B Measures (dollars)
Floodwater Damage							
Crop and Pasture	82,360	71,546	65,357	47,596	10,814	17,761	28,575
Other Agricultural	52,982	38,733	29,681	17,528	14,249	12,153	26,402
Road and Bridge	6,971	5,112	2,344	984	1,859	1,360	3,219
Flood Plain Scour	4,725	3,997	3,836	2,350	728	1,486	2,214
Flood Plain Swamping	1,766	1,480	1,480	979	286	501	787
Nonagricultural	1,388	1,140	1,012	279	248	733	981
Subtotal	150,192	122,008	103,710	69,716	28,184	33,994	62,178
Sediment Damage							
Infertile Overwash	56,728	34,774	29,207	21,166	21,954	8,041	29,995
Reservoir	19,274	14,149	13,002	11,741	5,125	1,261	6,386
Subtotal	76,002	48,923	42,209	32,907	27,079	9,302	36,381
Indirect Damage	22,619	17,093	14,592	10,262	5,526	4,330	9,856
Total Damage	248,813	188,024	160,511	112,885	xxx	xxx	xxx
Benefit from Reduction of Damage	xxx	xxx	xxx	xxx	60,789	47,626	108,415
Benefit from More Intensive Use of Flood Plain	xxx	xxx	xxx	xxx	xxx	29,930	29,930
Total Flood Prevention Benefit	xxx	xxx	xxx	xxx	60,789	77,556	138,345

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

August, 1955

Item	Total Cost	Average Annual Cost	Average Annual Benefit				Benefit Cost Ratio
			Floodwater & Sediment Benefit	More Intensive Use of Land	Conservation Benefit	Total	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
A-Measures							
Floodwater Retarding Structures	1,094,193	41,692	47,626	29,930	-	77,556	1.86:1
B-Measures	4,029,521	302,453	60,789	0	1,307,925[1/]	1,368,714	4.53:1
Total All Measures	5,123,714	344,145	108,415	29,930	1,307,925	1,446,270	4.20:1

1/ $672,479 due to reduction in land damage.

Table 6
Floodwater Retarding Structure Data
BIG SANDY CREEK WATERSHED
(Trinity River Watershed)

August, 1955

Site No.	Drainage Area	STORAGE CAPACITY: Sediment Pool	Sediment Reserve: Below Riser	Sediment Reserve: Above Riser	Det. Pool	Total	Total Sed. Stor.	Total Det. Stor.	Total	SURFACE AREA: Top of Riser	Top Det. Pool	Max. Ht. of Dam	FLOOD PLAIN AREA INUNDATED: Below Top of Riser	Under Det. Pool	Total	Volume of Fill	Drawdown Rate	Estimated Total Cost
	sq. mi.	acre-feet					inches			acres		feet	acres			cu.yd.	cfs	dollars
1	4.25	136	-	34	1,030	1,200	0.8	4.5	5.3	45	170	28	-	-	-	60,078	21	36,089
2	4.29	160	-	40	1,035	1,235	0.9	4.5	5.4	45	160	29	-	-	-	70,982	21	42,297
3	4.56	176	-	44	1,120	1,340	0.9	4.6	5.5	45	155	33	12	10	22	58,248	44 1/	34,183
4	2.90	116	-	29	712	857	0.9	4.6	5.5	26	80	35	8	4	12	59,708	15	32,546
5	5.29	112	-	28	1,280	1,420	0.5	4.5	5.0	31	150	32	9	6	15	87,920	26	48,570
6	5.73	80	-	20	1,380	1,480	0.3	4.5	4.8	32	153	31	8	5	13	67,338	29	37,012
7	6.38	109	-	27	1,564	1,700	0.4	4.6	5.0	32	166	35	14	6	20	78,392	32	48,571
8	4.77	159	-	40	1,146	1,345	0.8	4.5	5.3	35	120	34	-	-	-	92,578	24	48,501
9	6.69	200	88	72	1,665	2,025	1.0	4.7	5.7	47	174	36	-	-	-	126,006	33	66,663
10	3.59	120	-	30	870	1,020	0.8	4.5	5.3	24	108	37	-	-	-	64,248	18	35,448
11	1.12	35	-	9	269	313	0.7	4.5	5.2	10	31	32	-	-	-	49,122	6	25,380
12	1.23	50	-	13	297	360	1.0	4.5	5.5	14	36	29	-	-	-	64,696	6	33,195
13	3.79	152	-	38	940	1,130	0.9	4.7	5.6	31	103	38	-	-	-	103,110	19	54,929
14	1.17	74	-	18	280	372	1.4	4.5	5.9	15	31	35	-	-	-	51,406	6	26,206
15	3.10	120	-	30	740	890	0.9	4.5	5.4	27	84	38	-	-	-	87,620	16	46,862
16	4.61	158	-	40	1,094	1,292	0.8	4.5	5.3	36	135	37	-	-	-	94,500	23	50,333
17	4.75	151	-	38	1,116	1,305	0.7	4.5	5.2	36	118	41	-	-	-	105,794	24	56,504
18	0.97	40	-	10	240	290	1.0	4.6	5.6	9	30	31	-	-	-	50,146	5	25,842
19	1.49	52	-	22	355	429	0.9	4.5	5.4	14	48	34	-	-	-	66,316	7	33,786
20	1.65	47	-	20	393	460	0.7	4.5	5.2	13	49	34	-	-	-	62,464	8	32,800
21	1.25	30	-	13	297	340	0.6	4.5	5.1	9	38	33	-	-	-	57,910	6	30,443
22	2.61	70	-	30	639	739	0.7	4.6	5.3	19	61	38	-	-	-	106,570	13	55,210
23	3.15	117	-	50	758	925	1.0	4.5	5.5	28	78	39	-	-	-	96,632	16	49,908
24	3.86	200	20	95	925	1,240	1.5	4.5	6.0	35	125	36	-	-	-	127,902	19	70,331
25	2.77	94	-	24	676	794	0.8	4.6	5.4	23	54	34	-	-	-	76,442	14	41,573
Total	85.97	2,758	108	814	20,821	24,501				681	2,457		51	31	82	1,966,128		1,063,182 2/

1/ Site No. 3 is below Site No. 2 in series.

2/

Construction Cost	$707,806
Technical Services	106,171
Contingencies	70,781
Land easements, rights-of-way, road relocation, power and telephone line relocations	89,949
Foundation Investigations, Design, Cartographic, Administration, etc.	88,475
Total	$1,063,182

Note: Vegetative emergency spillways provided on all structures.

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

August, 1955

Item	Unit	Quantity
Years to Complete Program	Year	10
Total Remaining Installation Cost		
Federal	Dollar	1,274,404
Non-Federal	Dollar	3,818,944 1/
Annual O & M Cost		
Federal	Dollar	None
Non-Federal	Dollar	118,273
Annual Benefits (A-Measures)	Dollar	77,556
Floodwater Retarding Structures	Each	25
Maximum Area Subject to Temporary Inundation by Structures 2/		
Flood Plain	Acre	31
Upland	Acre	1,745
Watershed Area Above Structures	Acre	55,021
Reduction of Floodwater Damage		
A-Measures	Percent	23
B-Measures	Percent	19
Reduction of Sediment Damage		
A-Measures	Percent	12
B-Measures	Percent	36
Reduction of Upland Erosion Damage		
A-Measures	Percent	None
B-Measures	Percent	72
Other Benefits		
A-Measures	Dollar	29,930
B-Measures	Dollar	1,307,925

1/ Includes $289,239 that may be available from other Federal funds (ACPS) to reimburse private interests.

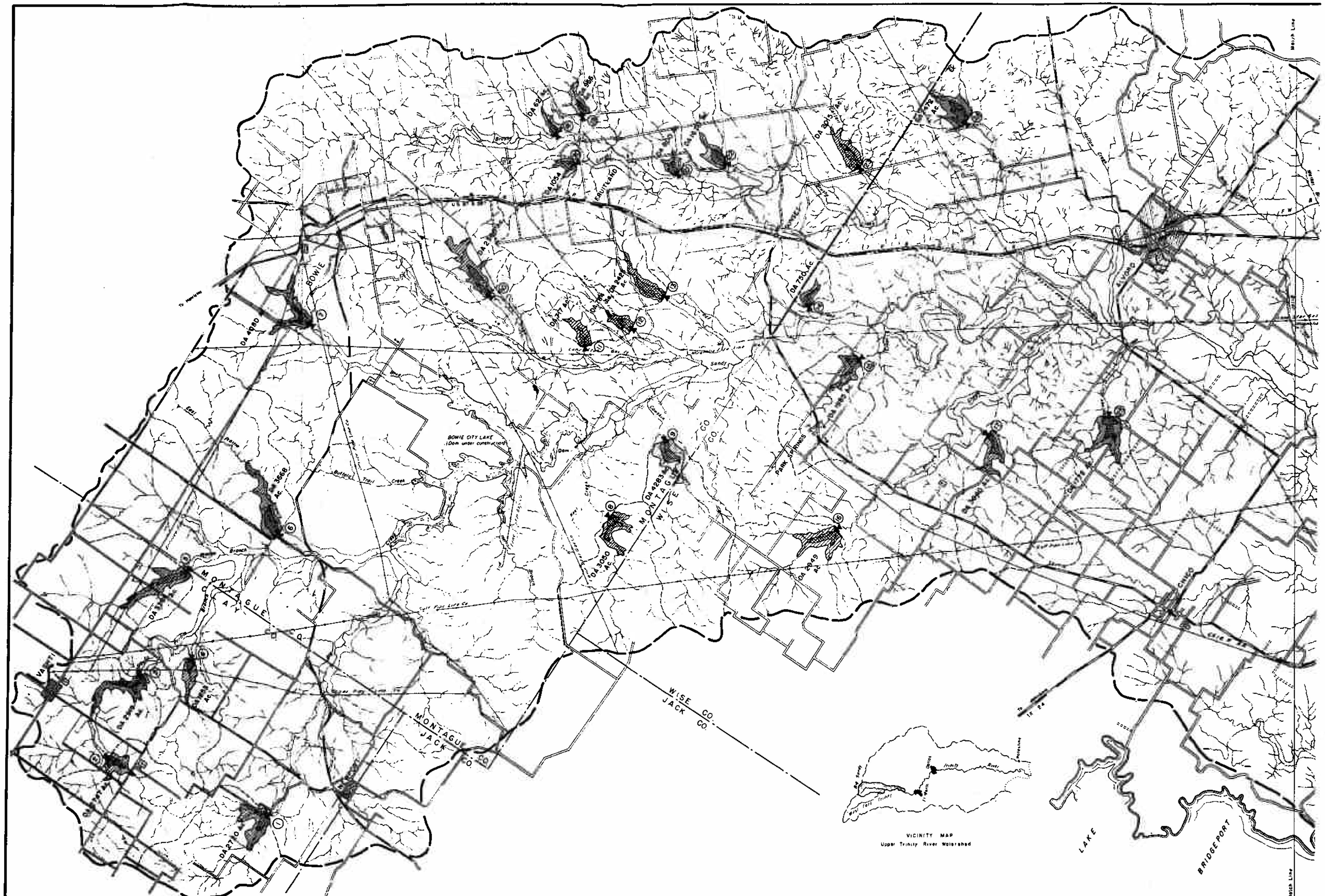
2/ Includes proposed SCS floodwater retarding structures only.

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

August, 1955

Item	Unit	Quantity Without Program	Quantity With Program
Watershed Area	Sq. Mi.	495.31	495.31
Watershed Area	Ac.	317,000	317,000
Area of Cropland	Ac.	79,619	57,448
Area of Grassland	Ac.	145,520	166,893
Area of Woodland	Ac.	80,174	78,828
Flood Plain Area Subject to Damage by Reservoir Design Storm	Ac.	19,840	16,321
Annual Rate of Erosion			
Sheet	Tons/Yr	927,912	498,900
Gully	Tons/Yr.	562,577	315,646
Streambank	Tons/Yr.	509,728	391,529
Scour	Tons/Yr.	203,665	135,706
Area Damaged Annually by			
Sediment	Ac.	8,345	4,401
Flood Plain Scour	Ac.	586	381
Swamping	Ac.	338	192
Streambank Erosion	Ac.	28	24
Sheet Erosion	Ac.	199,189	56,579
Sediment Production 1/	Tons/Ac./Yr.	2.48	1.57
Sediment Accumulation in Existing Reservoirs	Ac.Ft./Yr.	558	355
Frequency of Flooding	Events/Yr.	3.9	3.3 2/
Average Annual Rainfall	Inches	30.33	30.33
Average Annual Surface Runoff	Inches	2.7	2.2 3/

1/ Net leaving the watershed.
2/ This excludes flooding on the lower end of the main stem where excessive channel filling has severely decreased capacity.
3/ 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.


BOWIE
BOWIE CITY LAKE
(Dam under construction)
Dam
MONTAGUE
MONTAGUE CO.
JACK CO.
WISE CO.
JACK CO.
MONTAGUE CO.
WISE CO.
PARK SPRINGS
ALVORD
LAKE
BRIDGEPORT
VICINITY MAP
Upper Trinity River Watershed
Trinity River
Dallas
Ft. Worth
Palestine
Match Line

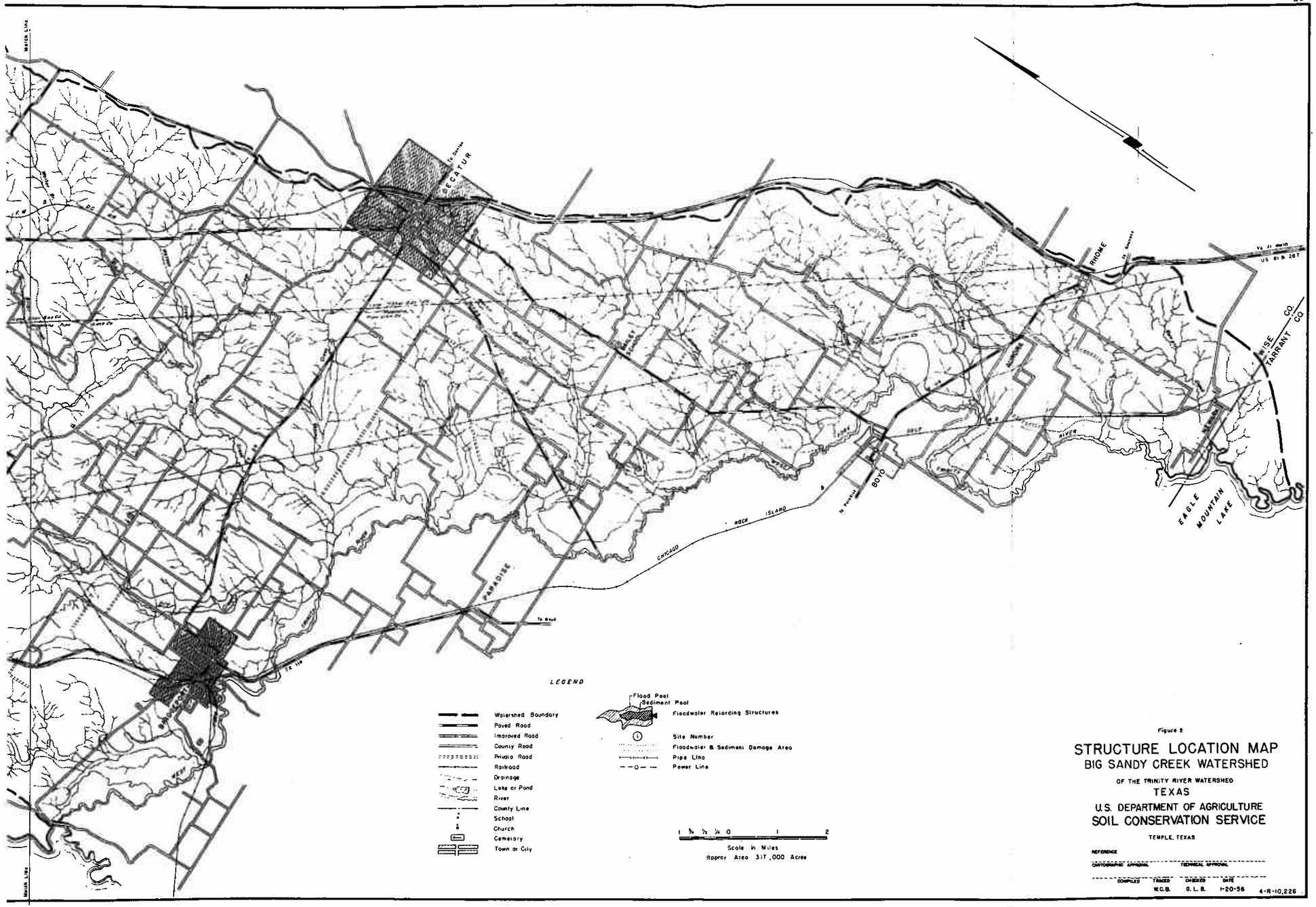


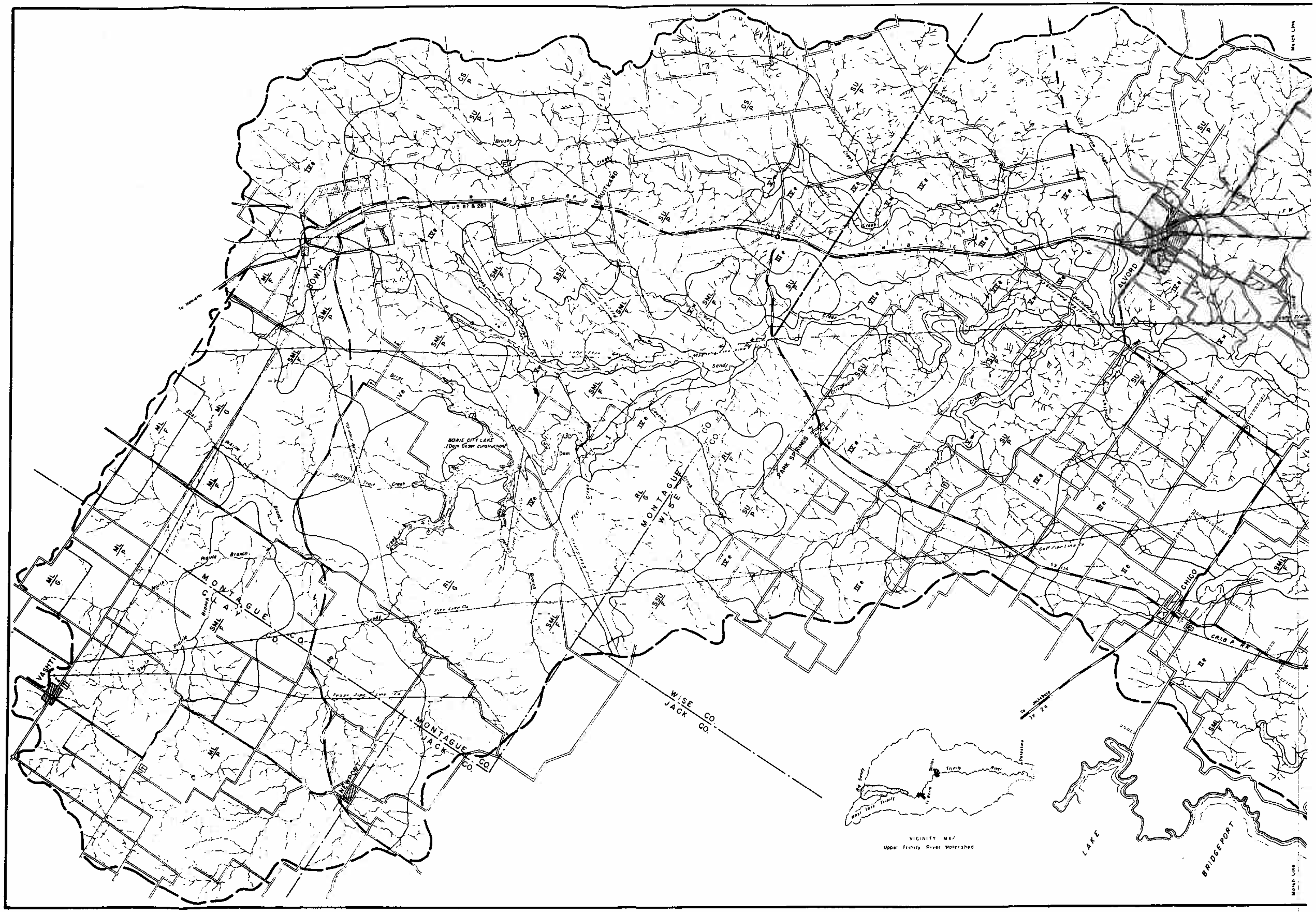
Figure 2

STRUCTURE LOCATION MAP
BIG SANDY CREEK WATERSHED
OF THE TRINITY RIVER WATERSHED
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

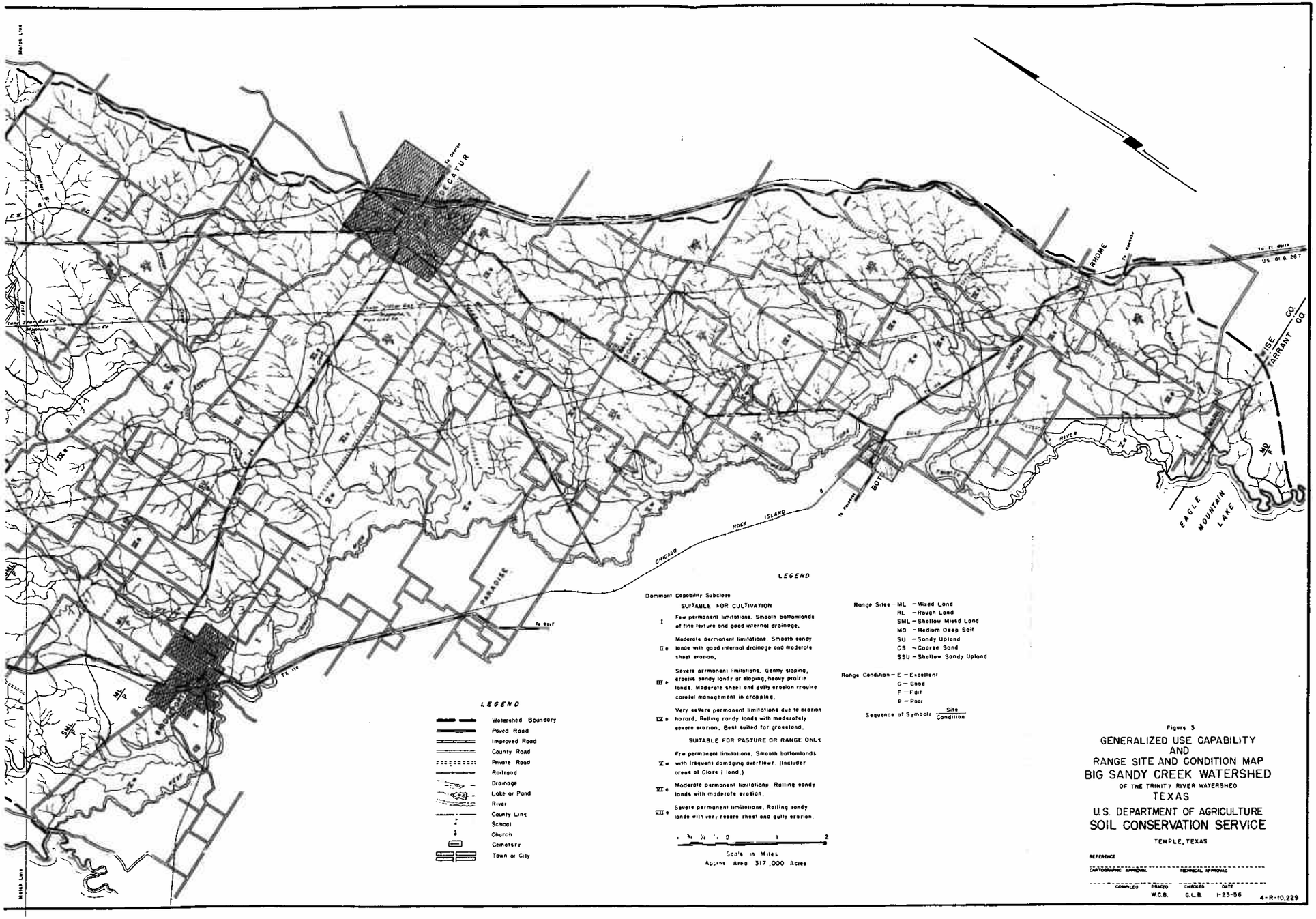
REFERENCE

CARTOGRAPHIC APPROVAL		TECHNICAL APPROVAL	
COMPILED	TRACED	CHECKED	DATE
	W.C.B.	G. L. B.	1-20-56

4-R-10,226



BOWIE
SUNSET
ALVORD
PARK SPRINGS
CHICO
NEWPORT
BOWIE CITY LAKE
(Dam under construction)
MONTAGUE CO.
CLAY CO.
MONTAGUE CO.
WISE CO.
MONTAGUE CO.
JACK CO.
WISE CO.
JACK CO.
LAKE
BRIDGEPORT
VICINITY MAP
Upper Trinity River Watershed
Match Line



LEGEND

- Watershed Boundary
- Paved Road
- Improved Road
- County Road
- Private Road
- Railroad
- Drainage
- Lake or Pond
- River
- County Line
- School
- Church
- Cemetery
- Town or City

LEGEND

Dominant Capability Subclass

SUITABLE FOR CULTIVATION

I — Few permanent limitations. Smooth bottomlands of fine texture and good internal drainage.

IIe — Moderate permanent limitations. Smooth sandy lands with good internal drainage and moderate sheet erosion.

IIIe — Severe permanent limitations. Gently sloping, eroding sandy lands or sloping, heavy prairie lands. Moderate sheet and gully erosion require careful management in cropping.

IVe — Very severe permanent limitations due to erosion hazard. Rolling sandy lands with moderately severe erosion. Best suited for grassland.

SUITABLE FOR PASTURE OR RANGE ONLY

Vw — Few permanent limitations. Smooth bottomlands with frequent damaging overflows. (Include areas of Clore I land.)

VIe — Moderate permanent limitations. Rolling sandy lands with moderate erosion.

VIIe — Severe permanent limitations. Rolling sandy lands with very severe sheet and gully erosion.

Range Sites — ML — Mixed Land
RL — Rough Land
SML — Shallow Mixed Land
MD — Medium Deep Soil
SU — Sandy Upland
CS — Coarse Sand
SSU — Shallow Sandy Upland

Range Condition — E — Excellent
G — Good
F — Fair
P — Poor

Sequence of Symbols: Site / Condition

¼ ½ 1 0 1 2
Scale in Miles

Approx. Area 317,000 Acres

Figure 3

GENERALIZED USE CAPABILITY AND RANGE SITE AND CONDITION MAP BIG SANDY CREEK WATERSHED

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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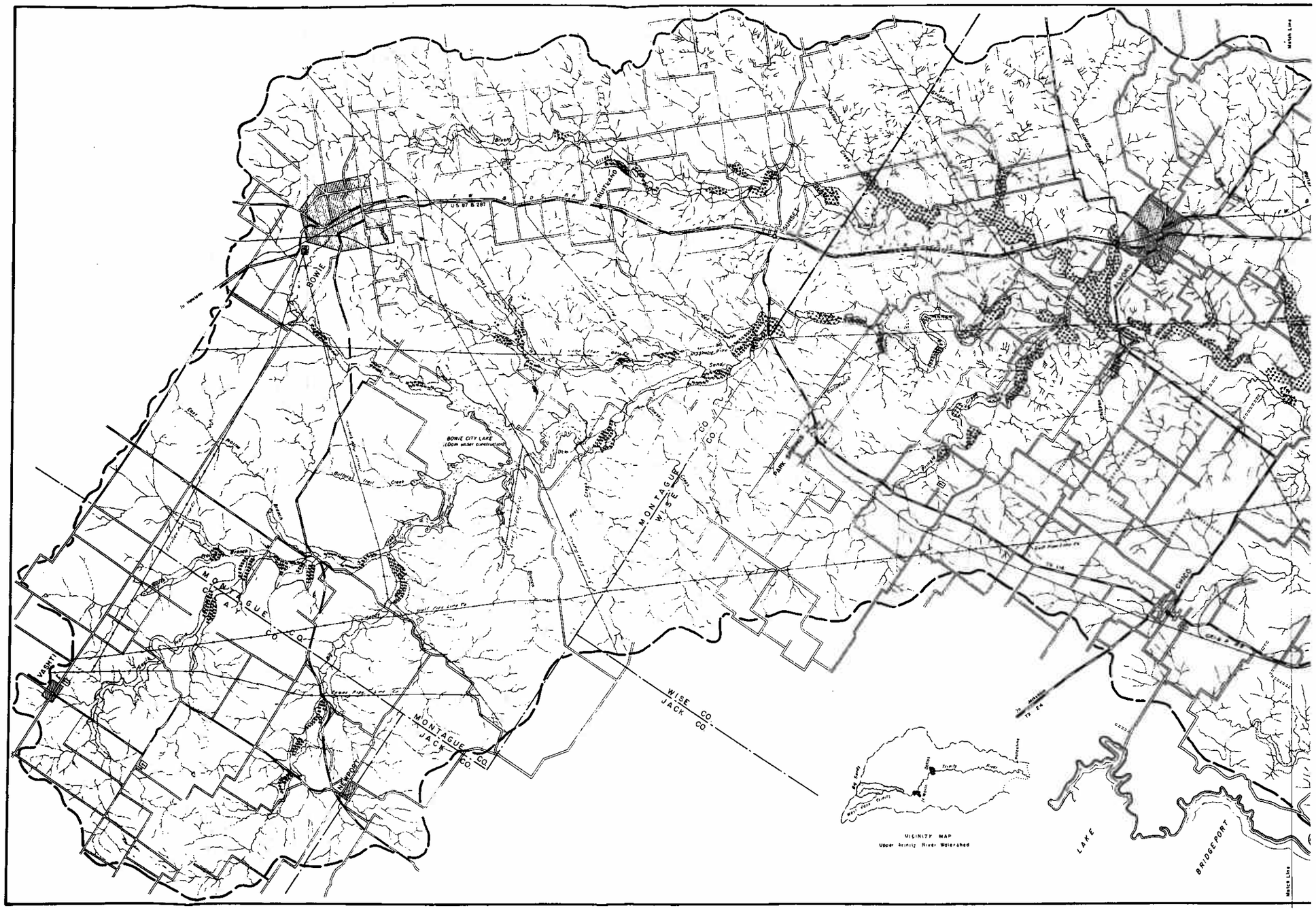
4-R-10,229


BOWIE
BOWIE CITY LAKE
(Dam under construction)
MONTAGUE CO.
WISE CO.
JACK CO.
VASHTI
NEWPORT
LAKE BRIDGEPORT
VICINITY MAP
Upper Trinity River Watershed

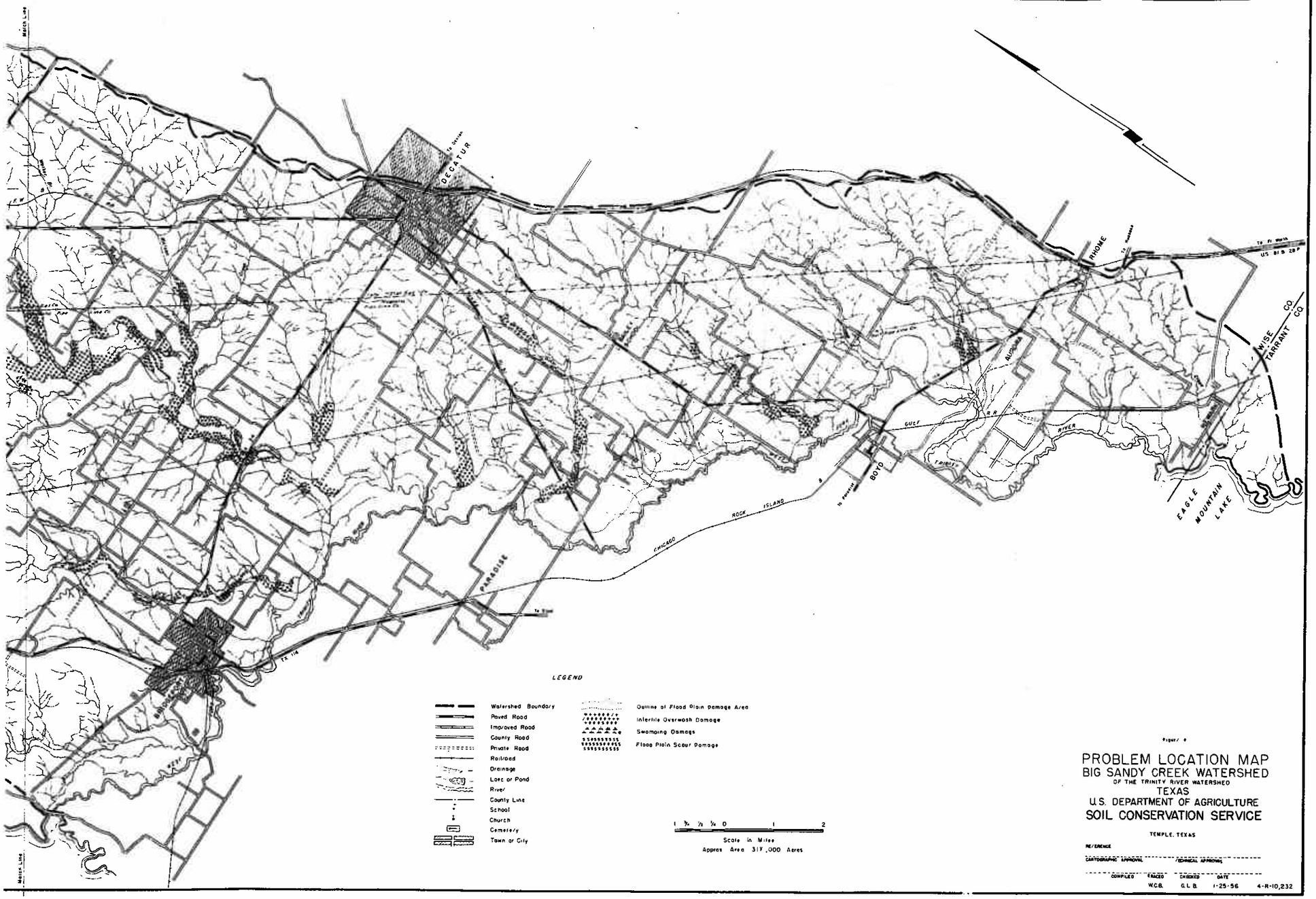


Figure 4

PROBLEM LOCATION MAP
BIG SANDY CREEK WATERSHED
OF THE TRINITY RIVER WATERSHED
TEXAS
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

TEMPLE, TEXAS

REFERENCE

CARTOGRAPHIC APPROVAL _____ /TECHNICAL APPROVAL _____

COMPILED	ERASED	CHECKED	DATE	
	W.C.B.	G.L.B.	1-25-56	4-R-10,232

APPENDIX

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flooded by the runoff from this storm. If such a rain were to occur after all needed land treatment practices and measures had been applied, it is estimated that the area inundated would be reduced to 14,405 acres. With land treatment measures applied and the measures primarily for flood prevention in operation, only 11,321 acres would be flooded. Approximately 51 acres of flood plain would lie within the total sediment pools of the proposed structures and 31 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. For the Big Sandy Creek watershed, this 25-year maximum runoff was 4.5 inches.

From a study of the rainfall-runoff relations for this watershed, it was found that a rain of 1.45 inches, which would produce 0.09 inch of runoff in the summer season, was the minimum that would cause flooding to a depth of six inches at the minimum cross section. No rains of less than this amount were considered for flood routing purposes. A runoff of 0.09 inch would produce a discharge of 670 cubic feet per second at the reference cross section which is also the minimum cross section.

The reference cross section, No. 1, is located approximately 600 feet upstream from the highway bridge across the main channel of Big Sandy Creek on Texas Highway 24 between Decatur and Bridgeport. This section is approximately 4.0 miles from the confluence of Big Sandy Creek with the West Fork of the Trinity River. Channel capacity at this section is 620 cubic feet per second. The peak discharge at this point for a 8.40-inch rain under present conditions would be 28,232 cubic feet per second. After installation and with full functioning of the measures set forth in this work plan the discharge at the same point would be 18,934 cubic feet per second.

SEDIMENTATION INVESTIGATIONS

Methodology

The field surveys of the sedimentation problems in the Big Sandy Creek watershed were made according to methods described in the revised "Sedimentation Section of Procedures for Developing Flood Prevention Work Plans," Water Conservation - 6, SCS, Region 4, February 24, 1954. Field studies included reconnaissance surveys of geology and physiography, studies of infertile overwash, 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. During the investigstion, tabular summaries of all the above problems with explanatory text were prepared. These form the basis for calculation of damages by the economist.

Investigations of sediment sources in the drainage areas above all proposed

floodwater retarding structures were made according to standard procedures, and predictions were made of future sedimentation rates above each structure.

Sediment Source Studies

The sediment derived from sheet erosion was based on planimetric data taken from watershed reconnaissance surveys and conservation surveys made for farm and ranch planning. Sheet erosion was determined by basic erosion rates calculated separately for each soil unit and adjusted according to degree and length of slope, land use and cover effectiveness, and rainfall intensity factors. Sediment derived from gully and streambank erosion was estimated by correlating field studies with comparative measurements on old and recent aerial photographs.

From a study of the drainage areas above the proposed floodwater retarding structures, average annual sediment yields under present conditions, calculated per square mile, include: 0.75 acre-foot from sheet erosion, 0.53 acre-foot from gully erosion, and 0.47 acre-foot from channel enlargement. Scour erosion on flood plain lands contributes another 0.22 acre-foot per square mile. Thus, total annual sediment yield to the flood plain is 1.97 acre-feet per square mile. Total sediment yield at the mouth of Big Sandy Creek is 0.86 acre-foot per square mile, leaving a balance of 1.11 acre-feet per square mile which produces damages in the form of infertile overwash on the flood plain and channel filling.

Of the sediment reaching the mouth of the watershed, it is estimated that 28 percent is produced by sheet erosion, 28 percent by active gully erosion, 30 percent by channel enlargement on the main stem and tributaries, and 14 percent by flood plain scour.

Effect of Watershed Treatment on Sediment Yields

The area damaged annually by sediment under estimated future condition of the watershed will be greatly reduced. Areas of past damage should be rendered productive again after they have been protected from flooding and adapted soil-improving crop rotations are put into use.

Deep-rooted legumes (alfalfa and sweet clover), hairy vetch, or Austrian winter peas grown in the crop rotations will break the plow pan, improve percolation rates and reduce runoff. Soil tests indicate that economical response may be expected from commercial fertilizers.

Present records indicate that adequate conservation treatment to improve and maintain fertility is being applied to 18 percent of the upland suitable for cultivation. Row cropping has been reduced in accordance with capabilities on most lands. However, cover cropping needs to be emphasized in all rotations. Terraces on steeper slopes will reduce erosion and control runoff. These practices, together with the retirement of 20,167 acres of land not suitable for cultivation, will reduce the annual sediment

yield from sheet erosion by an estimated 25 percent.

The volume of sediment produced from grassland amounts to approximately 55 percent of the total for sheet erosion. Proper pasture and range management, together with the reseeding of large areas of formerly cultivated land, will reduce sediment yields by approximately 52 percent.

Severe gully erosion occurs over two-thirds of the watershed. In many areas extensive gully systems are entrenching and severe overfalls are migrating up the slope in a network of deep, narrow gullies. The application of needed land treatment is expected to reduce sediment yields from gully erosion and channel enlargement by approximately 34 percent.

Reservoir Sedimentation

The principal existing reservoir to which Big Sandy Creek watershed contributes sediment is Eagle Mountain Lake. This reservoir serves the City of Fort Worth as one source of its municipal water supply. It also provides water for industrial purposes and serves as a recreation area.

No detailed sedimentation survey of the reservoir has been made by the Soil Conservation Service; however, a detailed study of upland erosion conditions on 37 percent of the Big Sandy Creek watershed was made to facilitate this plan. The results show an estimated average annual sediment yield of 505.4 acre-feet subject to deposition in the reservoir. Using the straight-line method of evaluation, the average annual damage to Eagle Mountain Lake is estimated to be $19,274. These annual damages are based on adjustments of original construction costs to long-term prices.

The application of land treatment measures and the installation of 25 floodwater retarding structures and the Bowie reservoir are estimated to reduce the sediment yield and consequent damages to Eagle Mountain Lake 39 percent. It is estimated that 27 percent of the benefits will accrue from the application of land treatment measures, 6 percent from floodwater retarding structures and 6 percent from the Bowie reservoir.

Farm Pond Sedimentation

There are approximately 812 farm ponds in the watershed having an average surface area of 0.8 acre, an average capacity of 2.2 acre-feet and drainage areas averaging approximately 33 acres. At long-term projected prices these ponds would cost an estimated $230 each to replace.

The average land use in the drainage area of these ponds is 15 percent cropland, 61 percent pasture and 24 percent wooded range. The annual rate of sediment yield is estimated to be 1.50 acre-feet per square mile of drainage. These ponds trap practically all the sediment which reaches them. Their average annual loss of storage capacity to sediment deposits

is estimated to be 3.7 percent. These ponds were grouped by size categories and, using the straight-line depreciation method of evaluation for each group, the annual direct sediment damage to these farm ponds was estimated to be $8,873 at projected long-term prices. After conservation treatment the annual damage is estimated to be $5,404. Thus the average annual benefits as a result of the application of land treatment measures would be $3,469.

FOUNDATION AND BORROW INVESTIGATIONS

Methodology:

Reconnaissance geological inspections were made at all of the 25 floodwater retarding structure sites. These included brief lithologic, stratigraphic and structural studies of the valley slopes, alluvium, channel banks and exposed rock outcrops. No drilling was done at the sites. A study of the problems to be encountered in construction was made from exposed sections in roads and stream channels and from a review of drilling data prepared in detailed investigations on similar adjacent watersheds.

Foundation, Abutment and Borrow Area Conditions:

In general, foundation conditions for proposed floodwater retarding structures are stable. They consist mostly of massive or well-bedded strata that outcrop or can be reached through overlying coarse sand deposits. Proposed structures were grouped into six categories according to construction problems and are described as follows:

1. Sites 4, 6, 7, 8 and 9 occur on formations of the Cisco group in which thick massive brownish sandstone and interbedded dark shale form very steep abutments. The upper slopes on some centerlines are overlain with thin basal Trinity sand remnants and contain gravel and conglomerate fragments. Alluvium is fine sand or silty sand with adequate amounts of clay for use as borrow material. Spillway cuts are in general deep, and excavation in resistant sandstone will be difficult.

2. Sites 10 and 11 consist of very steep slopes of thickly bedded sandstone conglomerates, overlying massive sandstone or shale layers. Alluvium varies from fine sand to sandy clay, with adequate clay available in adjacent slopes for mixing embankment materials. Deep spillway cuts in resistant massive conglomeratic strata will present an excavation problem.

3. Sites 1, 2, 3, 5, 12, 13, 14, 15 and 18 are on steep slopes of moderately hard or weakly bedded sandstones of the Cisco group. Shale and sandy shale may also outcrop. Alluvium is 5 to 10 feet deep and generally suitable for borrow material. Moderate difficulty may be encountered in core trench and spillway excavation.

4. Sites 16, 17 and 25 are located in conglomeratic sandstone and limestone formations of the Canyon group. Centerline sections are highly variable because of unconformable surface deposits of the Trinity group. These include 5 to 10 feet of basal conglomerate or unconsolidated sand or clayey sand. Alluvium is 6 to 10 feet deep, consisting mostly of coarse sand with variable pockets of clay and gravel. Careful selection and placement of material in the embankment will be needed. Consolidated strata in abutments include boulder fragments, but moderate ease in excavation may be expected. Relief wells or foundation drains may be required in permeable materials.

5. Sites 19, 20, 21 and 22 occur on basal Trinity sand beds of coarse, unconsolidated sand, gravel or conglomerate that grade into Pennsylvanian limestone. Alluvium is well-graded with the exception of Sites 21 and 22 in which coarse sands are poorly sorted. Deep excavation in core trenches may be needed to adequately key the fill into stable or impervious material. Relief wells or foundation drains may also be required.

6. Sites 23 and 24 are located in unconsolidated, poorly graded Trinity sand formations in which only small amounts of clay have developed in the soil mantles. Core trench extension in abutments and alluvium to cut off porous strata is generally impractical, and the need for relief wells or foundation drains is probable. Deep, poorly graded sand alluvium may require considerable mixing with finer-grained materials to provide suitable fill material. Site 24 has seasonally high water tables that may cause difficulty in construction.

Spillway excavation in sandstone and conglomerate and the necessity for relief wells and foundation drains in many structures are items which will cause construction costs to be relatively high in this watershed. These factors have been considered in developing the estimated cost of the structural measures.

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

ECONOMIC INVESTIGATIONS

Methodology

The procedures outlined in the Economic Section of Water Conservation-6, Revised, were followed in the economic investigation.

Determination of Damage

Flood plain information for approximately 86 percent of the flood plain area of Big Sandy Creek and its major tributaries was obtained from landowners or operators. Most of the specific information as to the amount and extent of damage related to the June, 1941 flood. Other information obtained included flood plain land use, yields of major crops, property damage which would result from a major flood, and general flood problems. The monetary value of the percentage of damage to flood plain lands by scour and sediment deposition was determined on the basis of 1952 pricea and costs and adjusted to long-term values. Damage rates were determined for both season 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 damage rates were based on acres inundated by a given flood. The amount of damage to flood plain lands by sedimentation and scour was determined on the basis of increased cost of production and reduced productivity.

Twenty-three evaluation reaches were used in the evaluation of damages since damageable values in different parts of the watershed varied considerably. Benefits resulting from the reduction of damages in specific reaches were allocated to the individual structurea responsible for that reduction.

The common flood plain of Big Sandy Creek and the West Fork of the Trinity River was excluded from all damage calculations.

Determination of Benefits

1. Floodwater Reduction Benefits.

Floodwater and sediment damages were calculated under present conditions and under those which will prevail after the installation of each class of measures included in the planned program. The difference between average annual damages at the time of initiation of each class of measures and those expected after their installation constitutes the benefit brought about by that group through reduction of damage.

Benefits from reduction of crop and pasture damages, flood plain scour, and other agricultural and nonagricultural damages were estimated from the combined effects of reduction in area inundated and depth of inundation. No benefits were estimated within pool areas of the floodwater retarding structures.

Benefits from the reduction of valley sediment damages derived from each class of measures were determined on the basis of the reduction in area inundated, lower sediment yield from upland areas and sediment storage in floodwater retarding structures.

No benefits were claimed on the flood plain of the West Fork of the Trinity River. Only land treatment benefits were claimed on the flood plain of the Laterals.

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

More intensive agricultural use of flood plain lands will be made possible by the reductions 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, the degree of flood protection provided, and the capabilities of the flood plain area.

PROGRAM DETERMINATION

Determination was made first of the kinds of conservation measures adapted to this watershed which contribute directly to flood prevention. This determination was based on land capability classes determined from soil surveys. The amounts remaining to be done in the watershed were then determined. The hydraulic, hydrologic, sedimentation, and economic investigations provided data on the effects of these land treatment measures 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:

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

2. Using 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.

3. 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.

4. 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 improved highways or highly developed areas were dropped from further consideration. The remaining sites constituted a system of structures for further consideration and more detailed survey.

5. A topographic map was made of each proposed reservoir site 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 flood pools. The height of the dams and size of the pools were determined by the storage volume needed to detain runoff from the design storm plus additional storage needed for sediment.

6. The limits of the flood pools and sediment pools of all satisfactory sites and the flood plain of the streams 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 separately for detention and for sediment in acre-feet and inches of runoff from the drainage areas, release rate of the outlet tubes, the acres of flood plain inundated by the sediment and detention pools, volume of fill in the dams and estimated cost of the structure.

7. Several flood routings were made using various combinations of structures to determine the most beneficial and economically aound plan. These routings were made both with and without the Bowie municipal reservoir. After the specifications for the Bowie reservoir were made firm, it was determined that even though considerable reduction in flood damages will be attributable to this reservoir, the flood storage provided will not be sufficient to permit the economical installation of a floodway or channel improvement through the lower reaches of the main stem where channel capacity has been greatly reduced due to aggradation.

When the land treatment measures and structural measures for flood prevention had been determined (giving consideration to alternate systems), 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 land treatment and structural 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
BIG SANDY CREEK WATERSHED
(Trinity River Watershed)

Total Annual Benefits from Floodwater Retarding Structures - $77,556
Drainage Area Controlled (Table 6) - 85.97 Square Miles
Average Annual Benefit per Square Mile Controlled - $902.13

Site No.	Drainage Area Sq.Mi.	Total Installation Cost (dollars)	Federal Installation Cost 1/ (dollars)	Non-Federal Installation Cost 2/ (dollars)	Easements (Land Value) 3/ (dollars)	Annual Installation Cost (dollars)	Annual Maintenance Cost (dollars)	Total Annual Cost (dollars)	Annual Benefit (dollars)	Benefit-Cost Ratio
1	4.25	37,622	31,272	6,350	6,100	1,395	77	1,472	3,545	2.41:1
2	4.29	43,845	36,684	7,161	5,540	1,623	77	1,700	3,980	2.34:1
3	4.56	35,828	30,478	5,350	4,900	1,319	77	1,396	3,691	2.64:1
4	2.90	33,592	30,602	2,990	2,640	1,214	77	1,291	2,186	1.69:1
5	5.29	50,478	45,428	5,050	4,650	1,833	77	1,910	3,122	1.63:1
6	5.73	39,079	35,399	3,680	3,255	1,415	77	1,492	2,865	1.92:1
7	6.38	50,872	41,105	9,767	5,960	1,900	77	1,977	3,989	2.02:1
8	4.77	50,222	47,547	2,675	2,375	1,798	77	1,875	4,335	2.31:1
9	6.69	69,076	64,786	4,290	3,990	2,481	115	2,596	6,426	2.48:1
10	3.59	36,743	33,098	3,645	3,120	1,334	77	1,411	9,823	6.96:1
11	1.12	25,784	24,719	1,065	815	918	77	995	1,462	1.47:1
12	1.23	33,639	32,469	1,170	920	1,197	77	1,274	1,317	1.03:1
13	3.79	56,296	52,406	3,890	3,300	2,025	115	2,140	3,478	1.63:1
14	1.17	26,628	25,868	760	610	945	77	1,022	1,177	1.15:1
15	3.10	47,980	44,490	3,490	2,415	1,726	77	1,803	1,964	1.09:1
16	4.61	51,996	48,441	3,555	3,105	1,868	115	1,983	4,574	2.31:1
17	4.75	58,217	54,081	4,136	3,030	2,095	115	2,210	2,997	1.36:1
18	0.97	26,192	25,172	1,020	720	932	77	1,009	1,256	1.24:1
19	1.49	34,324	33,364	960	760	1,218	77	1,295	1,865	1.44:1

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

Site No.	Drainage Area Sq.Mi.	Total Installation Cost	Federal Installation Cost 1/	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)	
20	1.65	33,395	31,515	1,880	1,630	1,196	77	1,273	2,027	1.59:1
21	1.25	30,894	29,116	1,778	840	1,106	77	1,183	1,249	1.06:1
22	2.61	56,152	53,694	2,458	2,258	2.005	115	2,120	2,413	1.14:1
23	3.15	51,044	48,969	2,075	1,675	1,819	115	1,934	3,271	1.69:1
24	3.86	71,723	64,703	7,020	6,420	2,601	115	2,716	2,862	1.05:1
25	2.77	42,572	38,838	3,734	2,670	1,538	77	1,615	1,682	1.04:1
Total	85.97	1,094,193	1,004,244	89,949	73,698	39,501	2,191	41,692	77,556	1.86:1

1/ Includes $31,011 Work Plan Development Cost.
2/ Includes $16,251 for relocation of roads, pipelines, power and telephone lines and easements (Local Assistance).
3/ Included in Non-Federal Installation Cost Figures.