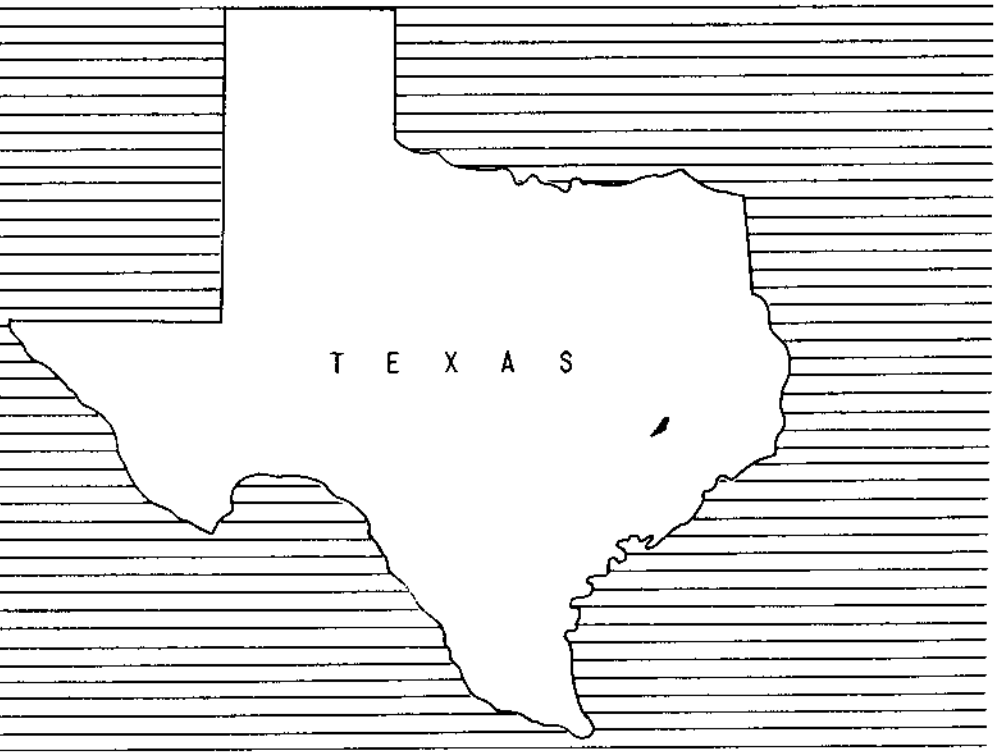
WORK PLAN

- For Watershed Protection,
- Flood Prevention, and
- Fish and Wildlife Development

TOWN BRANCH WATERSHED

Madison County, Texas



October 1961

4-15-065 7-62

WATERSHED WORK PLAN AGREEMENT

between the

Bedias Creek Soil Conservation District

Local Organization

City of Madisonville

Local Organization

Commissioners Court of Madison County

Local Organization

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

and the

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

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsoring Local Organization for assistance in preparing a plan for works of improvement for the Town Branch Watershed, State of Texas under the authority of the Watershed Protection and Flood Prevention Act (Public Law 566, 83d Congress; 68 Stat. 666), as amended by the Act of August 7, 1956 (Public Law 1018, 84th Congress; 70 Stat. 1088); and

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

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

Now, therefore, in view of the foregoing considerations, the Sponsoring Local Organization and the Secretary of Agriculture, through the Service, hereby agree on the watershed work plan, and further agree that the works of improvement as set forth in said plan will be installed, within 2 years, and operated and maintained substantially in accordance with the terms, conditions, and stipulations provided for therein.

It is mutually agreed that in installing and operating and maintaining the works of improvement described in the watershed work plan:

1. The Sponsoring Local Organization will acquire without cost to the Federal Government such land, easements, or rights-of-way as will be needed in connection with the works of improvement. (Estimated cost $ 36,120 .)

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

3 The percentages of construction costs of structural measures and land treatment measures for flood prevention to be paid by the Sponsoring Local Organization and by the Service are as follows:

	Works of Improvement	Sponsoring Local Organization (percent)	Service (percent)	Estimated Construction Cost (dollars)
1	Multiple-Purpose Structure	9.41	90.59	$ 82,720
1	Floodwater Retarding Structure	0	100	$ 33,000

The Sponsoring Local Organization will pay all of the costs allocated to purposes other than flood prevention, and irrigation, drainage, and other agricultural water management.

4. The Service will bear the cost of all installation services applicable to works of improvement for flood prevention and fish and wildlife development. (Estimated cost $ 31,592 .)

The Service will bear - percent of the cost of installation services applicable to works of improvement for agricultural water management and the Sponsoring Local Organization will bear - percent of the cost of such services. (Estimated cost $ None .)

The Sponsoring Local Organization will bear the cost of all installation services applicable to works of improvement for nonagricultural water management. (Estimated cost $ None .)

5. The Sponsoring Local Organization will bear the costs of administering contracts. (Estimated cost $ 1,000 .)

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

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

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

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

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

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

Where there is a Federal contribution to the construction cost of works of improvement, a separate agreement in connection with each construction contract will be entered into between the Service and the Sponsoring Local Organization prior to the issuance of the invitation to bid Such agreement will set forth in detail the financial and working arrangements and other conditions that are applicable to the specific works of improvement.

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

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

Bedias Creek Soil Conservation District
Local Organization

By T. C. Smith

Title Supervisor Ch.

Date 3-5-62

The signing of this agreement was authorized by a resolution of the governing body of the **Bedias Creek Soil Conservation District**
Local Organization

adopted at a meeting held on 3-5-1962

R. E. Samuel, Jr.
(Secretary, Local Organization)

Date 3-5-1962

4-16205 1-62

City of Madisonville
Local Organization

By Jo. N. Heath

Title Mayor

Date 3-5-62

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

adopted at a meeting held on 3-5-62

Rose Madole
(Secretary, Local Organization)

Date 3-5-62

Commissioners Court of Madison County
Local Organization

By J. E. Wells

Title C. Judge, Madison Co. Texas

Date 3/5/62

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

adopted at a meeting held on 3/5/62

Charley R. Fyle County Clerk
(Secretary, Local Organization)

Date 3/5/62

Soil Conservation Service
United States Department of Agriculture

By _____
State Conservationist

Date _____

4-18705 1-62

WORK PLAN

FOR

WATERSHED PROTECTION, FLOOD PREVENTION AND FISH AND WILDLIFE DEVELOPMENT

TOWN BRANCH WATERSHED
Madison County, Texas

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

Prepared By: Bedias Creek Soil Conservation District
(Cosponsor)

City of Madisonville
(Cosponsor)

Commissioners Court of Madison County
(Cosponsor)

With Assistance By:

U. S. Department of Agriculture
Soil Conservation Service
U. S. Department of Interior
Bureau of Sport Fisheries and Wildlife
Texas Game and Fish Commission
October 1961

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SECTION I

WATERSHED WORK PLAN

TOWN BRANCH WATERSHED
Madison County, Texas
October 1961

SUMMARY OF PLAN

General Summary

The work plan for watershed protection, flood prevention, and fish and wildlife development for the Town Branch watershed was prepared by the Bedias Creek Soil Conservation District, the city of Madisonville, and the Commissioners Court of Madison County as cosponsoring local organizations. Technical assistance was provided by the United States Department of Agriculture, the United States Department of Interior, and the Texas Game and Fish Commission.

Town Branch is located in Madison County, Texas below the portion of the Trinity River Basin authorized for installation of flood prevention works of improvement under the Flood Control Act of December 22, 1944. The watershed comprises an area of 3.4 square miles, or 2,176 acres. Approximately 53 percent of the watershed is pasture, 2 percent is cropland, 42 percent is in the city of Madisonville, and 3 percent is in miscellaneous uses, such as roads, highways, and stream channels.

There are no Federal lands in the watershed

The problems in the watershed are flood damage to commercial and residential property, streets, and utilities in the city of Madisonville and to agricultural land in the Town Branch flood plain. The sponsors desire that measures for fish and wildlife development be included in the plan.

The land treatment and structural measures included in the project will virtually eliminate flooding in the main part of the urban area from a 100-year frequency storm, reduce average annual agricultural damages 79 percent, and provide 400 acre-feet of water storage capacity for fish and wildlife development.

The work plan proposes installing in a 2-year period, a project for protection and development of the watershed at a total estimated installation cost of $199,972. The share of this cost to be borne by Public Law 566 funds is $139,531. The share to be borne by other than Public Law 566 funds is $60,441. In addition, local interests will bear the entire cost of operation and maintenance.

Land Treatment Measures

The cost of land treatment measures is estimated to be $14,940, all of which will be borne by other than Public Law 566 funds including expected reimbursements from ACPS and $860 to be spent by the Soil Conservation Service for technical assistance under its going program during the project installation period. Land treatment measures included in the work plan are those which will be installed during the 2-year period (table 1).

Structural Measures

Structural measures included in the plan consist of 1 floodwater retarding and 1 multiple-purpose structure having 440 acre-feet for sediment and fish and wildlife storage and 830 acre-feet of floodwater detention capacity. The total cost of structural measures is $185,032 of which the local share is $45,501. The local share of the cost of structural measures includes land, easements, and rights-of-way, 79.4 percent; construction cost of fish and wildlife development, 17.1 percent; cost of obtaining water rights 1.3 percent; and administering contracts, 2.2 percent. The structures will be installed during a 1-year period.

Damages and Benefits

The reduction in floodwater, sediment and indirect damages will directly benefit 8 landowners of agricultural land in the flood plain in addition to the owners and occupants of 24 residential units and 45 business establishments in Madisonville.

The estimated average annual floodwater, sediment and indirect damage without the project totals $9,403 at long-term price levels. The estimated average annual floodwater, sediment and indirect damage with the project installed, including land treatment and structural measures, amount to $275, a reduction of about 97 percent.

The average annual primary benefits accruing to structural measures are $8,255 and are distributed as follows:

Floodwater damage reduction	$7,239
Sediment damage reduction	67
Indirect damage reduction	949

The ratio of the average annual benefits ($8,255) to the average annual cost of structural measures ($5,446) is 1.5:1.

Provisions for Financing Construction

The city of Madisonville and the Commissioners Court of Madison County have the right of eminent domain and taxing authority under applicable State laws. The city and county will bear all of the local share of the cost of the structural measures and will contract for their construction. The sponsors plan to borrow money from private sources to finance their share of the

installation cost. Farmers Home Administration funds will not be needed.

Operation and Maintenance

Land treatment measures for watershed protection will be operated and maintained by landowners and operators of the agricultural land on which the measures will be installed under agreements with the Bedias Creek Soil Conservation District. Structural measures will be operated and maintained by the city of Madisonville and the Madison County Commissioners Court. The average annual cost of operating and maintaining the structural measures is estimated to be $310 at long-term price levels.

DESCRIPTION OF WATERSHED

Physical Data

Town Branch heads approximately 1.5 miles north of the town of Madisonville in Madison County and flows south and southwest through Madisonville to enter Caney Creek about 2 miles south of town. Caney Creek outlets into Bedias Creek, a tributary of the Trinity River. The watershed is in the portion of the Trinity River watershed below that area authorized for the installation of works of improvement for flood prevention under the Flood Control Act of 1944. Several small unnamed tributaries flow into Town Branch. One of these flowing from the east has its point of junction within the city limits of Madisonville. The drainage area of the total watershed is 3.4 square miles (2,176 acres).

The topography of the watershed is gently to moderately rolling. Elevations range from 350 feet above mean sea level in the headwaters to 225 feet on the flood plain near Caney Creek.

The watershed lies primarily in the Blackland Prairies Land Resource Area with small areas of the East Texas Timberlands occurring throughout the watershed. The soils were developed from the sands, sandy clays, and shales of the Yegua formation of Eocene age and consist of clay loam to fine sandy loam surface soils over dense very slowly permeable clay and sandy clay subsoils. The dominant upland soil series are Wilson, Edge and Lufkin. Soils of the Gowen series predominate on the flood plain.

The dominant land use in the watershed is improved pasture on formerly cultivated land. Bermudagrass, usually overplanted with legumes and fertilized, provides a fair to good hydrologic cover over most of the watershed. The physical condition of these formerly cultivated soils is generally poor to fair.

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

Land Use	Acres	Percent
Pasture	1160	53
Cropland	40	2
Urban	911	42
Miscellaneous 1/	65	3
Total	2176	100

1/ Includes roads, highways and stream channels.

The flood plain comprises 261 acres excluding stream channels. This is the area inundated by the runoff from the 100-year frequency storm.

Land use in the flood plain is 75 percent in pasture; 24 percent urban; and 1 percent in miscellaneous uses.

The average annual rainfall is 43.2 inches, as recorded at the U. S. Weather Bureau gage in Madisonville. The monthly averages range from 4.83 inches in May to 2.35 inches in August. Average temperatures range from 83 degrees Fahrenheit in the summer to 50 degrees in the winter. The normal frost-free period is 239 days.

Water for livestock and rural domestic use is obtained from surface ponds and wells. Municipal water for Madisonville is obtained from two 1200-foot wells, which are adequate for present needs.

Economic Data

Madison County has experienced a marked transition from diversified agriculture to one primarily composed of commercial beef cattle production. The transition began in the middle 1930's and has continued until the present. About 78 percent of the agricultural producing area is now in rangeland. This compares to 66 percent in 1940. The cow-calf enterprise is the most prevalent. The average size farm unit in the county was 256 acres in 1954, an increase from 117 in 1940. However, 59 percent of the agricultural area is comprised of units averaging more than 500 acres and 43 percent of the units average more than 1,000 acres. The average value per farm was $1,864 in 1940, $9,054 in 1950, and $14,453 in 1954. The county's population has decreased from 12,029 in 1940 to 6,749 in 1954. Ninety percent of all the agricultural units, including those in the watershed, are owner-operated. Approximately 50 percent of the beef cattle produced in the county are marketed at local auctions, while the remaining 50 percent are consigned to commission firms at Houston, Fort Worth, or Dallas.

Aside from the beef cattle production there are about 35 dairies operating in the county. The average size herd of about 50 cows is considered to be an economical unit. All of the dairy products are transported to Houston except for a small share consumed locally. The dairy industry is of little importance to the watershed, however, except as a source of employment for some of its inhabitants.

The agriculture in the watershed is primarily in the hands of part-time operators. The average size farm unit is about 50 acres with the operators using outside employment or operating businesses to supplement agricultural income. Beef cattle production is the only agricultural enterprise of significance. Grazing rates in the upland portion of the watershed above Madisonville indicate that about eight acres are necessary for each animal unit while only four acres are required in the flood plain below Madisonville.

Madisonville, the county seat of Madison County, and the only town within the watershed, has a population of 2,324 (1960 census). This is a slight decrease from the 2,393 shown in 1950. It provides the necessary educational and medical facilities required for its inhabitants as well as adequate churches for the different religious groups and some recreational opportunities. The watershed is served by U. S. Highway 75, State Highways 21 and 90, county roads, and city streets which provide access to

all operating units. U. S. Highway 75 which connects the Houston and Dallas-Fort Worth metropolitan areas, contributes materially to the business opportunities in Madisonville. A large portion of the businesses along Highway 75 is of the "service type". Other sources of income for Madisonville include businesses normally associated with county seat towns of this size. A garment factory employs approximately 75 persons. No railroad facilities are available in Madisonville.

WATERSHED PROBLEMS

Floodwater Damage

Frequent flooding has caused moderate to severe damage to the urban area of Madisonville. Principal types of improvements that have suffered flood damages for many years are residential property, business and industrial property, streets, and utilities. The current value of urban property subject to damage is estimated to be $1,903,000.

Small overflows causing damage in the urban area occur on an average of once every one to two years. Damage from these smaller floods is relatively minor and consists primarily of damage to streets and the cost of necessary removal of debris. Major floods which inundate half or more of the 32 city blocks located in the flood plain occur on an average of once every 10 years. Floods of this or greater magnitude cause severe damage to streets, real and personal property, inventories and utilities. There has been no known loss of life due to flooding and the threat to human life is not great; however, there is always the possibility that panic or poor judgment could result in loss of life.

The most damaging flood in recent years occurred in April 1957. This flood of about a 25-year frequency inundated about 30 city blocks and 175 acres of agricultural land causing an estimated $52,400 direct floodwater damage (1957 price levels). Of this amount, approximately $49,700 was to property in Madisonville. The area inundated by the April 1957 flood is shown on figure 1. Other recent floods that caused moderate to severe damage occurred in 1953, 1955, and 1960.

For the floods considered during the evaluation period, including floods up to 100-year frequency, the total direct floodwater damages are estimated to average $8,220 annually, at long-term price levels. Of this, $41 is crop and pasture, $42 is other agricultural damage and $8,137 is urban and other non-agricultural damage.

Indirect damages such as interruption of travel, losses due to interruption of normal business activity, temporary dislocation of persons from homes and work, and similar losses are unusually heavy in this watershed because of the concentration of damageable values in the flood plain. The total annual value of such damage is estimated to be $1,082. The average annual necessary flood damages are summarized in table 7.

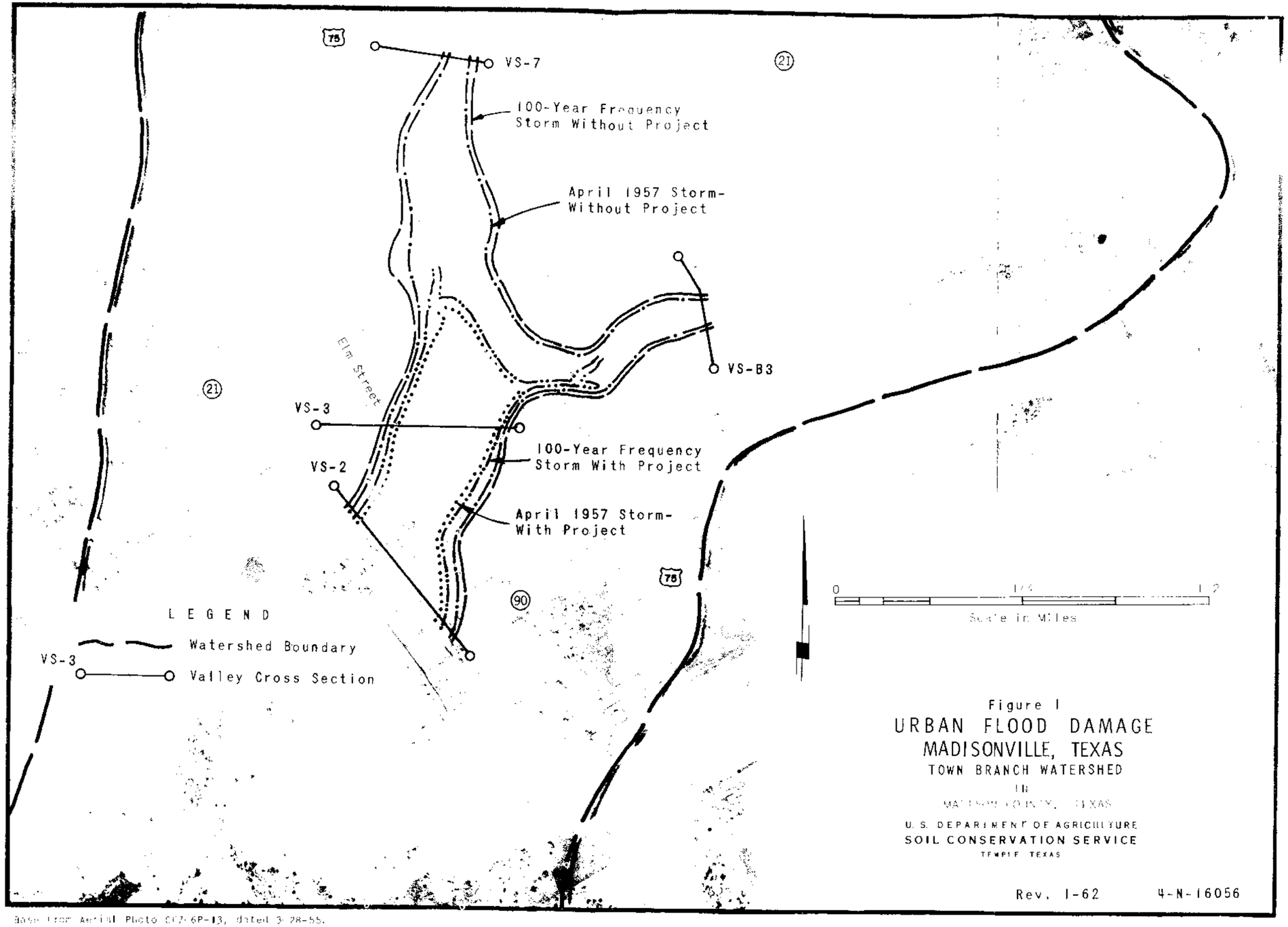


Figure 1

URBAN FLOOD DAMAGE

MADISONVILLE, TEXAS

TOWN BRANCH WATERSHED

IN

MADISON COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE

TEMPLE, TEXAS

Rev. 1-62 4-N-16056

Base from Aerial Photo CF2-6P-13, dated 3-28-55.

Sediment Damage

Damage by overbank deposition is moderately low in the watershed. Deposits of sand, loamy sand and fine sandy loams which are low in organic matter and fertility have damaged the productive capacity of 58 acres from 20 to 60 percent. It is estimated that the productive capacity of 29 acres has been reduced 20 percent; 25 acres, 40 percent; and 4 acres, 60 percent by sediment deposition. The estimated average annual monetary damage by overbank deposition is $101, at long-term price levels (table 7).

Erosion Damage

Erosion rates in the upland areas are low. The average annual rate of upland gross erosion is 0.73 acre-foot per square mile. Sheet erosion is the major process, accounting for 83 percent of the average annual gross erosion. Gully erosion accounts for 5 percent and streambank erosion 12 percent. Flood plain erosion is not significant in this watershed due to effectiveness of good bermudagrass cover on flood plain soils.

Problems Relating to Water Management

There is no need for drainage in the watershed. No individual or group of farmers has indicated a desire to include works of improvement for irrigation in the proposed project.

Municipal water is obtained from wells which are adequate for present needs. The city of Madisonville did not express a desire for municipal water storage to be included as a project purpose.

The sponsors have recognized the opportunity and need for full development of the potential of each structure site. They requested that storage capacity be included for fish and wildlife development.

EXISTING OR PROPOSED WORKS OF IMPROVEMENT

The watershed is served by the Soil Conservation Service Work Unit at Madisonville assisting the Bedias Creek Soil Conservation District. The work unit has assisted farmers and ranchers in preparing 16 soil and water conservation plans on 738 acres, 61 percent of the agricultural land, within the watershed and has given technical assistance in establishing and maintaining planned measures. Approximately 60 percent of the planned practices have been applied.

There are no existing or proposed works of improvement of other agencies in the watershed. However, the Corps of Engineers previously investigated the flood problem in Madisonville to a limited extent. A joint reconnaissance investigation was made by the Soil Conservation Service, Corps of Engineers and the sponsoring local organizations. It was determined that the Soil Conservation Service was the Federal agency which should provide the assistance desired by the local interests.

WORKS OF IMPROVEMENT TO BE INSTALLED

Land Treatment Measures for Watershed Protection

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 Bodias Creek Soil Conservation District, is necessary for a sound watershed protection and flood prevention program on the watershed. Basic to reaching this objective is the establishment and maintenance of all applicable soil and water conservation and plant management practices essential to proper land use. Emphasis will be placed on the establishment of land treatment practices which have a measurable effect on the reduction of floodwater, sediment, and erosion damages.

There are 845 acres of watershed area located above the planned floodwater retarding structures. Land treatment is especially important for protection of these watershed lands to support and supplement the structural measures. The only planned measures for the remaining upland area are land treatment. A conservation program on the 196 acres of agricultural flood plain is also important in reducing floodwater, sediment and erosion damage.

The amounts and estimated costs of the major measures that will be installed by the landowners and operators are shown in table 1. The estimated total cost of planning and installing these measures is $14,940. This cost is to be borne by other than Public Law 566 funds and includes expected reimbursements from ACPS, based on current program criteria, and $860 to be spent by the Soil Conservation Service in providing technical assistance under its going program to the district during the project installation period.

Land treatment measures will decrease erosion damage and sediment production by providing improved soil cover conditions. These measures include pasture planting to establish good cover on grassland and formerly cultivated lands; pasture renovation, proper pasture use, and rotation grazing of grassland to provide improvement, protection, and maintenance of grass stands; farm ponds to provide adequate watering places to prevent cover-destroying seasonal concentration of livestock; brush control to allow grass to improve and replace poor brush cover; and grassed waterways for reduction of erosion damage and sediment production. These measures also effectively improve soil conditions which allow rainfall to soak into the soil at a more rapid rate.

There are no critical sediment source areas in the watershed.

Structural Measures

One floodwater retarding structure and one multiple-purpose structure will be installed to provide needed protection for urban and agricultural flood

TABLE 1 - ESTIMATED PROJECT INSTALLATION COST 1/

Town Branch Watershed, Texas
Price Base: 1961

Installation Cost Item	Unit	Number to be Applied Non-Federal Land	Estimated Cost Public Law 566 Funds (dollars)	Estimated Cost Other Funds (dollars)	Total (dollars)
LAND TREATMENT FOR					
Watershed Protection					
Soil Conservation Service					
Pasture Planting	Acre	93	-	2,790	2,790
Grassland Renovation	Acre	211	-	6,330	6,330
Proper Pasture Use	Acre	400	-	1,180	1,180
Farm Ponds	No.	4	-	1,600	1,600
Grassed Waterways	Acre	2	-	300	300
Brush Control	Acre	47	-	1,880	1,880
Technical Assistance			-	860	860
SCS Subtotal				14,940	14,940
TOTAL LAND TREATMENT			-	14,940	14,940
STRUCTURAL MEASURES					
Soil Conservation Service					
Multiple-Purpose Structure	No.	1	74,939	7,781	82,720
Floodwater Retarding Structure	No.	1	33,000	0	33,000
SCS Subtotal			107,939	7,781	115,720
Subtotal - Construction			107,939	7,781	115,720
Installation Services					
Soil Conservation Service					
Engineering Service			21,155	0	21,155
Other			10,437	0	10,437
SCS Subtotal			31,592	0	31,592
Subtotal - Installation Services			31,592	0	31,592
Other Costs					
Land, Easements, and Rights-of-Way			0	36,120	36,120
Administration of Contracts			0	1,600	1,600
Water Rights			0	600	600
Subtotal - Other			0	37,720	37,720
TOTAL STRUCTURAL MEASURES			139,531	45,501	185,032
TOTAL PROJECT			139,531	60,441	199,972
SUMMARY					
Subtotal SCS			139,531	60,441	199,972
TOTAL PROJECT			139,531	60,441	199,972

1/ No Federal lands involved.

October 1961

plain land that cannot be attained by the land treatment measures described above. Additional storage of 400 acre-feet will be included in the multiple-purpose Site 1 for fish and wildlife development.

This system of structures will temporarily detain runoff from 38.8 percent of the entire watershed. The floodwater retarding and multiple-purpose structure will have floodwater detention capacity to detain an average of 11.79 inches of runoff from the watershed area above them. This is the equivalent of 4.58 inches of runoff from the entire 2,176-acre watershed.

Figure 2 shows a section of a typical floodwater retarding structure. The location of the structural measures is shown on the Project Map, figure 3.

The total estimated cost of installing the structural works of improvement is $185,032. The estimated annual equivalent cost of installation, $5,136, with an estimated annual operation and maintenance cost of $310 makes a total annual cost of $5,446. This does not include $1,550, the annual equivalent of the incremental cost of fish and wildlife development.

Sufficient detention storage can be developed at each structure site to make possible the use of vegetative spillways, thereby effecting a substantial reduction in cost over concrete or similar type of spillway. All applicable state water laws will be complied with in the design and construction of the planned structural measures.

BENEFITS FROM WORKS OF IMPROVEMENT

With the installation of the land treatment and structural measures described above, the estimated average annual monetary floodwater, sediment, erosion and indirect damages within the watershed will be reduced from $9,403 to $275, a 97.1 percent reduction. About 91 percent of the reduction will result from the system of structural measures.

Average annual floodwater damage to nonagricultural property, excluding indirect damage, will be reduced from $8,137 to $205, a reduction of 97.5 percent.

All business houses in Madisonville except for one lumber yard and three gasoline bulk stations will be flood-free from all storms up to the 100-year frequency event after project installation. Several residences along Elm Street and State Highway 90 will continue to receive minor flood damage from storms exceeding 20-year frequency.

The areas subject to inundation by the runoff from a 100-year frequency flood and a flood of the magnitude of that caused by the April 1957 storm, with and without the project, are shown in figure 1. The city of Madisonville understands that the undeveloped flood plain area within the city limits below U. S. Highway 75 still will be subject to flood damage after project installation.

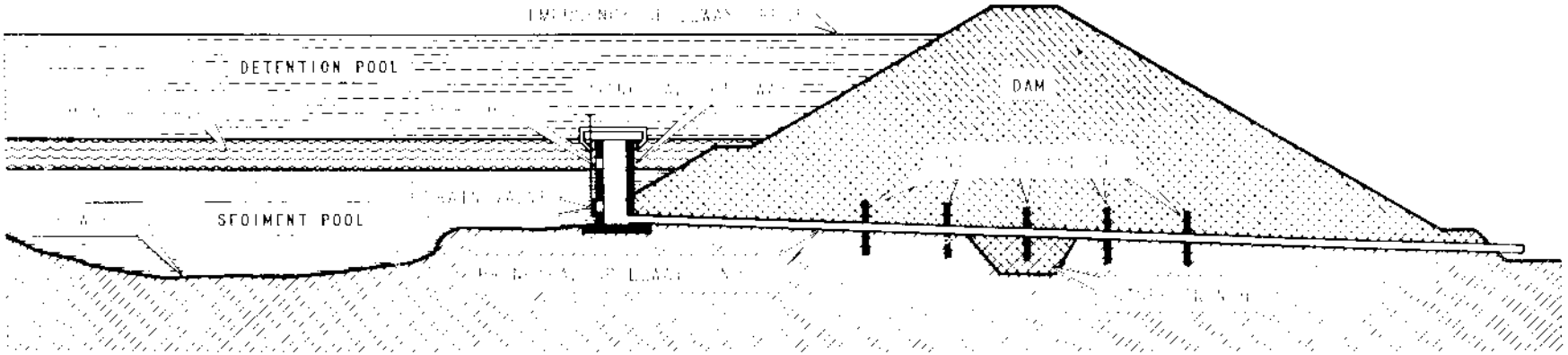


Figure 2

SECTION OF A TYPICAL FLOODWATER RETARDING STRUCTURE

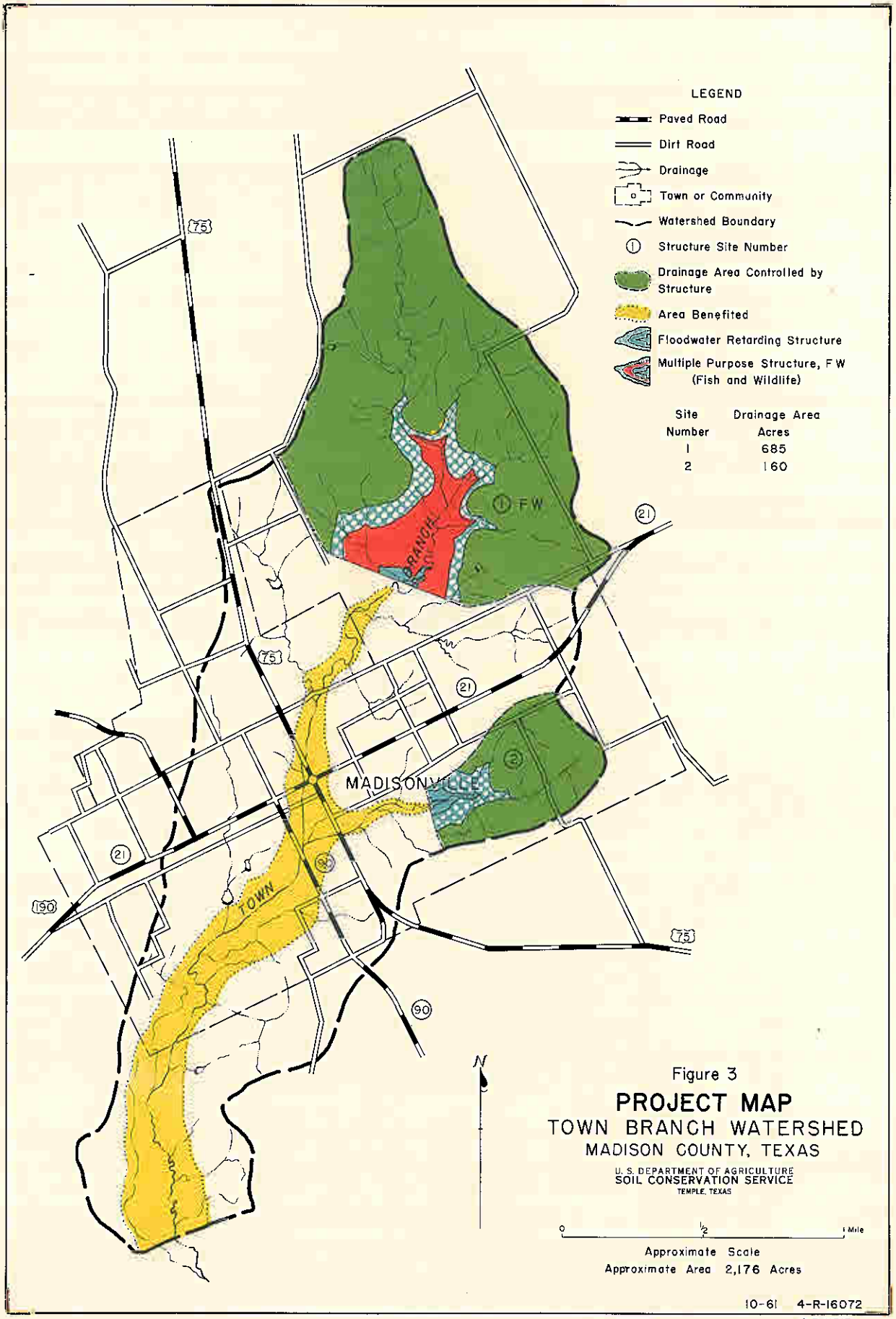


Figure 3

PROJECT MAP

TOWN BRANCH WATERSHED

MADISON COUNTY, TEXAS

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

Approximate Scale

Approximate Area 2,176 Acres

10-61 4-R-16072

Revised 10-24-61 4-R-11513

The city will, within its powers, direct the future development of this area to uses commensurate with the flood protection provided.

The following table shows the effect of the project in reducing urban damages:

Urban Damage in Madisonville

Flood Frequency (year)	Flood Damage Without Project (dollars)	Flood Damage With Project (dollars)
100	66,700	9,500
50	60,400	5,500
25	49,700	2,200
10	31,400	0

Damage to agricultural production and other agricultural property will be reduced from $83 annually to $18, a 78 percent reduction. Average annual area of agricultural land flooded will be reduced from 109 to 54 acres after project installation. These 54 acres are located at the lower end of the watershed near the confluence of Town Branch and Caney Creek. The land use is predominantly pasture and has low damageable value. Therefore, additional works of improvement to protect this area were not economically feasible.

The area subject to sediment damage from overbank deposition will be reduced from 58 acres to 27 acres, a reduction of 54 percent. About 17 percent of the expected reduction will result from land treatment and 83 percent from the structural measures.

With the planned land treatment measures installed, it is estimated that the annual gross erosion in the watershed will be reduced from 2.48 to 2.23 acre-feet per year. The sediment production from the watershed will be reduced approximately 10 percent.

The total flood prevention benefits as a result of structural measures are estimated to average $8,255 annually. In addition to the primary monetary benefits, there are other substantial benefits which will accrue from the project. These include increased sense of security, better living conditions, and improved recreational and fish and wildlife conditions for Madisonville and the surrounding area. None of these benefits were evaluated in monetary terms nor have they been used for project justification.

COMPARISON OF BENEFITS AND COSTS

The ratio of average annual benefits from planned structural measures for flood prevention ($8,255) to the average annual equivalent cost ($5,446) is 1.5 to 1 (Table 8). It was assumed that the benefit from fish and wildlife development would equal the average annual equivalent cost of this purpose ($1,550).

ACCOMPLISHING THE PLAN

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

Land Treatment Measures

The land treatment measures itemized in table 1 will be established by farmers and ranchers over a 2-year period in co-operation with the Bedias Creek Soil Conservation District, which is giving technical assistance in the planning and application of these measures under its going program.

The Bedias Creek Soil Conservation District with the assistance of the city of Madisonville and the Commissioners Court of Madison County will assume aggressive leadership in advancing the land treatment program. The landowners within the watershed will be encouraged to apply and maintain soil and water conservation measures on their farms and ranches. The Soil Conservation Service will assist landowners and operators co-operating with the district in the preparation of soil and water conservation plans and in the application of conservation practices.

The soil and water conservation loan program of the Farmers Home Administration will be made available to all eligible individual farmers and ranchers in the area. Educational meetings will be held in co-operation with other agencies to outline the services available and eligibility requirements. Any present FHA clients will be encouraged to co-operate in the project.

The county ASC committee will co-operate with the governing body of the soil conservation district by selecting and recommending for financial assistance those ACPS practices which will accomplish the conservation objectives in the shortest possible time.

The Extension Service will assist with the educational phase of the program by conducting general information and local farm meetings, preparing radio, television and press releases, and using other methods of getting information to landowners and operators. This activity will help to get the land treatment practices and the structural measures for flood prevention carried out.

Structural Measures for Flood Prevention and Fish and Wildlife Development

The Madison County Commissioners Court and the city of Madisonville have the right of eminent domain under applicable state law and will obtain the necessary land, easements, and rights-of-way including utility, road, and improvement changes; provide necessary legal, administrative, and clerical personnel, facilities, supplies, and equipment to advertise, award, and administer contracts; and will determine the legal adequacy of easements,

Permits, etc., for the construction of the floodwater retarding structure and the multiple-purpose structure included in the plan. Funds for the local share of the project costs including land, easements, rights-of-way, administration of contracts, and the local share of the construction cost allocated to fish and wildlife development are available in the general funds of the county and city and are supported by tax revenue. It is anticipated that practically all of the local cost of structural measures, $45,501, will be out-of-pocket. The cosponsors plan to borrow money from private sources to finance their share of the installation cost.

The structural measures will be scheduled for construction during a 1-year period pursuant to the following conditions:

1. The required land treatment in the drainage area above structures has been installed or is in the process of being installed.

2. All land, easements, and rights-of-way have been secured.

3. Water rights for fish and wildlife storage in multiple-purpose Site 1 have been obtained.

4. Local requirements, including funds and assured public access, for the fish and wildlife development have been met.

5. The contracting agencies are prepared to discharge their responsibilities.

6. Project and operation and maintenance agreements have been executed.

7. Public Law 566 funds are available.

Technical assistance will be provided by the Soil Conservation Service to assist in the design, preparation of plans and specifications, supervision of construction, preparation of contract payment estimates, final inspection, execution of certificate of completion, and related tasks necessary to establish the planned structural measures for flood prevention and fish and wildlife development.

The various features of co-operation between the co-operating parties have been covered in appropriate memoranda of understanding and working agreements.

PROVISIONS FOR OPERATION AND MAINTENANCE

Land Treatment Measures

Land treatment measures will be operated and maintained by the owners and operators of the farms and ranches on which the measures are installed under

agreements with Bedias Creek Soil Conservation District. Representatives of the soil conservation district will make periodic inspections of the land treatment measures to determine maintenance needs and to encourage landowners and operators to perform maintenance.

Structural Measures for Flood Prevention and Fish and Wildlife Development

The estimated annual operation and maintenance cost is $310, based on long-term price levels (table 6). The Madison County Commissioners Court and the city of Madisonville will be responsible for operation and maintenance of the 2 structures. The necessary maintenance work will be accomplished through the use of contributed labor and equipment, by contract, by force account, or a combination of these methods. Funds for this purpose will come from existing city and county tax revenue which is available and adequate.

The floodwater retarding structure and the multiple-purpose structure will be inspected by representatives of the Madison County Commissioners Court, and the city of Madisonville after each heavy streamflow or at least annually. A Soil Conservation Service representative will participate in these inspections at least annually. For the floodwater retarding and multiple-purpose structures items of inspection will include but will not be limited to, the condition of the principal spillway and its appurtenances, the earth fill, the emergency spillway, the vegetative cover of the earth fill and the emergency spillway, and fences and gates installed as a part of the structure.

The city of Madisonville will maintain the existing channel of Town Branch within the city limits by removing brush, debris, and woody vegetation from within the stream channel.

The Soil Conservation Service, through the Bedias Creek Soil Conservation District, will participate in operation and maintenance only to the extent of furnishing technical assistance to aid in inspections and furnish technical guidance and information necessary for the operation and maintenance program.

Provisions will be made for free access of representatives of the cosponsoring organizations and Federal representatives to inspect and provide maintenance for all structural measures and their appurtenances at any time.

Follow-up technical assistance for the operation and maintenance of the fish and wildlife facilities included in Site 1 will be provided by the Texas Game and Fish Commission.

The Bedias Creek Soil Conservation District, the Madison County Commissioners Court, and the city of Madisonville fully understand their obligations for operation and maintenance and will execute specific operation and maintenance agreements prior to the issuance of invitation to bid on construction of the structural measures.

COST-SHARING

Local interests will install the land treatment measures listed in table 1 during a 2-year installation period at an estimated cost of $14,080. This amount includes ACPS payments based on present program criteria. The cost of technical assistance in the amount of $860 will be provided under the provisions of Public Law 46.

The installation cost of the floodwater retarding structure, $49,540, will be shared $44,040 (construction, $33,000 and installation services, $11,040) by Public Law 566 funds and $5,500 (easements, $4,600, legal fees, $400, and administration of contracts, $500) by other than Public Law 566 funds.

The cost of the multiple-purpose structure, $135,492, is allocated $92,590 to flood prevention and $42,902 to fish and wildlife development. The cost allocated to fish and wildlife development represents the cost of adding this purpose to a single-purpose floodwater retarding structure at the same site. It includes an additional land, easement and rights-of-way cost of $13,670 all borne by local interests, and an added construction and installation services cost of $29,232, of which $7,781 will be from other than Public Law 566 funds. The cost of adding the fish and wildlife development this will be shared equally by Public Law 566 and other funds. Details of the cost allocation and cost-sharing may be found in tables A and 9.

Access roads, parking areas, and boating facilities for the harvesting or enjoyment of fish and wildlife resources will be provided by the city of Madisonville and the Madison County Commissioners Court. This will be in addition to the project costs described herein.

The total cost of structural measures, $185,032, will be shared 75.4 percent, $139,531, by Public Law 566 funds and 24.6 percent, $45,501, by other than Public Law 566 funds.

The total project cost of $199,972 will be shared 69.8 percent, $139,531 by Public Law 566 funds and 30.2 percent, $60,441 by other than Public Law 566 funds. In addition, the cost of operation and maintenance ($310 annually) will be borne by local interests.

CONFORMANCE OF PLAN TO FEDERAL LAWS AND REGULATIONS

This project plan conforms to all Federal laws and regulations and will have no known detrimental effect on any downstream projects which are now in existence or that might be constructed in the future. This project is a harmonious element of the over-all plan of development for the Bedias Creek watershed and the Trinity River Basin.

SECTION 2

INVESTIGATIONS, ANALYSES, AND SUPPORTING TABLES

PROJECT FORMULATION

Project Objectives

Watershed problems were discussed with the cosponsoring local organizations and the following project objectives reached:

1. Determine the needed land treatment measures, based on current needs, which remain to be applied in the watershed and which contribute directly to watershed protection, flood prevention and sediment control.

2. Eliminate flooding in the main urban area from the 100-year frequency storm. If waterflow control measures are required, as much of the control as possible will be obtained by use of floodwater retarding structures. Channel improvement will be planned only if necessary to attain the desired degree of control.

3. Inform the city of Madisonville and the Commissioners Court of Madison County of structure sites in which additional storage can be provided for fish and wildlife development.

Land Treatment Measures

The status of land treatment measures for the watershed was developed by supervisors of the Bedias Creek Soil Conservation District with assistance from personnel of the Soil Conservation Service Work Unit at Madisonville. The measures needed and those already applied were tabulated for each farm or group of farms on which conservation plans were available. This information was expanded to represent the watershed. Amounts of land treatment practices already applied, soil conditions, trends in farming operations, grassland cover conditions, and other pertinent data were used in estimating future land treatment needs. Estimates were made of the practices that will be applied during the 2-year installation period for the entire watershed (table 1). The cost of applying the land treatment measures was based on current costs and going program criteria.

Structural Measures

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

2. Using a copy of the base map, a current ownership map of all farms in the watershed was prepared by the Bedias Creek Soil

Conservation District.

3. Photographic study supplemented by field examination indicated the limits of flood plain subject to flood damage.

4. Map and photo studies and field investigations indicated the watershed should be one evaluation unit, since all structural measures will be interrelated.

5. Map and photo studies and a field reconnaissance indicated only 2 possible floodwater retarding structure sites existed in the watershed.

6. After agreement was reached with the local sponsoring organization on location of the 2 floodwater retarding structure sites to be surveyed and studied in detail, topographic maps with a 4-foot contour interval and a scale of 8 inches equal 1 mile were prepared for each site. Topographic maps with a 2-foot contour interval and a scale of 1 inch equals 100 feet were prepared for each emergency spillway. These surveys provided the necessary information to determine if the required sediment and floodwater detention storage could be obtained, an estimate of all installation costs, and the most economical design of each structure. Criteria outlined in Soil Conservation Service, Washington Engineering Memorandum 27, and Texas State Manual Supplement 244l were used to determine the sediment and floodwater detention storage requirements, structure classification, principal and emergency spillway design.

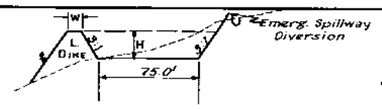
7. Data obtained in land treatment needs studies for the watershed, as well as hydrologic, geologic, sedimentation, and economic investigations provided the necessary data to determine that the 2 floodwater retarding structures would be the most economical system to install which would provide the degree of protection desired by the cosponsoring organizations. Plans of a typical floodwater retarding structure are illustrated by figures 4 and 4A.

8. Tentative capacity-cost, capacity-yield, and yield-cost curves were developed to determine the volume of storage for fish and wildlife development to be included in Site 1. The local sponsors selected this site for a multiple-purpose structure.

9. Cost distribution (table 2) and structure data (table 3) were prepared to show for each structure, the estimated cost, drainage area, capacity needed for detention and for sediment storage in acre-feet and in inches of runoff from the drainage area, release rate of the principal spillway, acres inundated by the sediment and detention pools, volume of fill in the dam, and other pertinent data.

Elevation	Surface Acres	Storage Acre Feet	Storage Inches
406	0.5	1	0.02
410	9.5	21	0.40
412	13.5	44	0.83
412.3	15.0	48	0.91
414	23.0	81	1.53
418	33.0	193	3.65
422	43.0	345	6.53
426	55.0	541	10.24

Top of Dam (Effective) Elev.	426.0
Emergency Spillway Crest Elev.	422.0
Principal Spillway Crest Elev.	412.3
Sediment Pool Elev.	412.3
Drainage Area, Acres	634
Sediment Storage, Acre Feet	52
Floodwater Storage, Acre Feet	293
Max. Emergency Spillway Cap., c.f.s.	1490

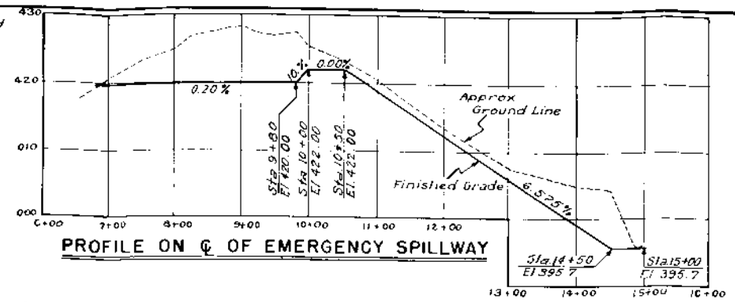


LEFT DIKE

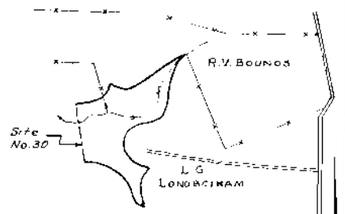
Begin at Sta 9+80 to Downstream Crown of Dam El. 426.0, Z = 2.5:1, W=12.0'. From Downstream Crown of Dam to Sta. 11+00 is Transition Section Sta. 11+00 to Sta 13+50, H=3.0, W=10', Z= 3:1

TYPICAL SECTION EMERGENCY SPILLWAY

Material forming dikes to be placed and paid as "Compacted Fill."



PROFILE ON ℄ OF EMERGENCY SPILLWAY

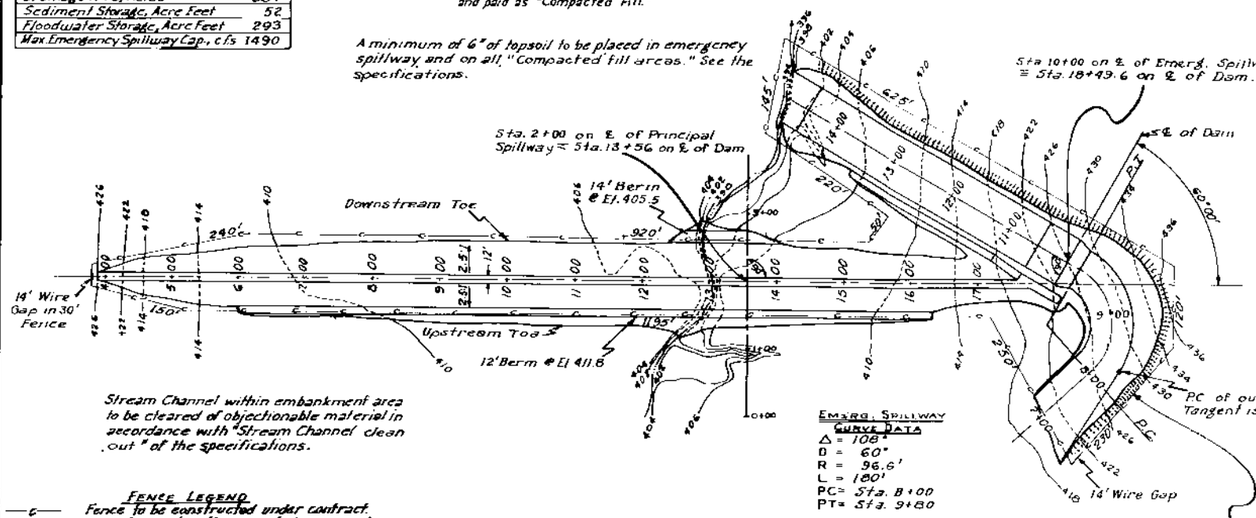


Structure Located 6 miles Southwest of Richland, Navarro County, Texas.

VICINITY MAP

SCALE IN MILES

A minimum of 6" of topsoil to be placed in emergency spillway and on all "Compacted fill areas." See the specifications.



Stream Channel within embankment area to be cleared of objectionable material in accordance with "Stream Channel clean out" of the specifications.

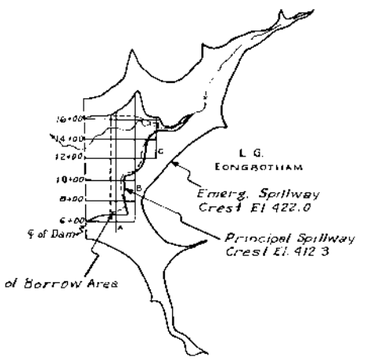
EMERG. SPILLWAY CURVE DATA
Δ = 108°
D = 60°
R = 96.6'
L = 180'
PC = Sta. 8+00
PT = Sta. 9+80

Emergency Spillway Diversion: 18" effective height, 3:1 side slopes, minimum base 13ft., Cost of diversion to be subsidiary to other items of work.

FENCE LEGEND
—c— Fence to be constructed under contract.
—s— Fence in construction area to be removed and salvaged by contractor.

PLAN OF EMBANKMENT AND SPILLWAYS

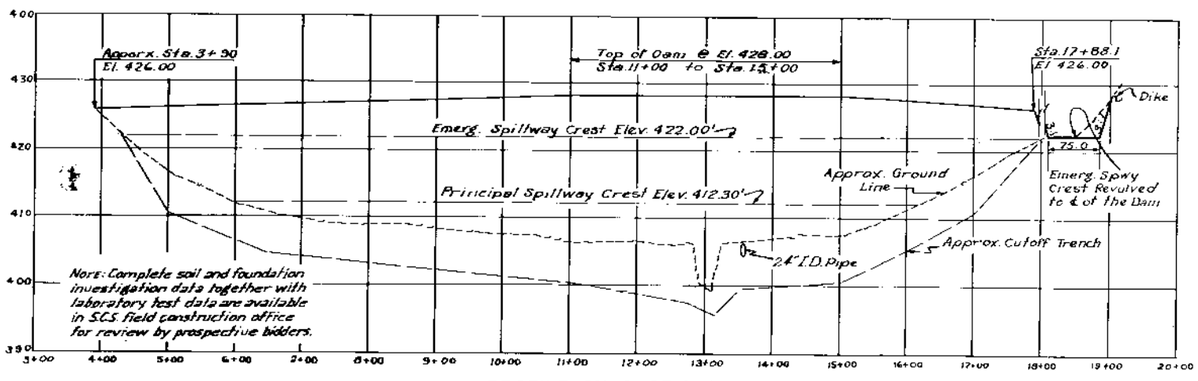
0 100 200 300 400 500



GENERAL PLAN OF RESERVOIR

0 660 1320 1980 2640

SCALE IN FEET



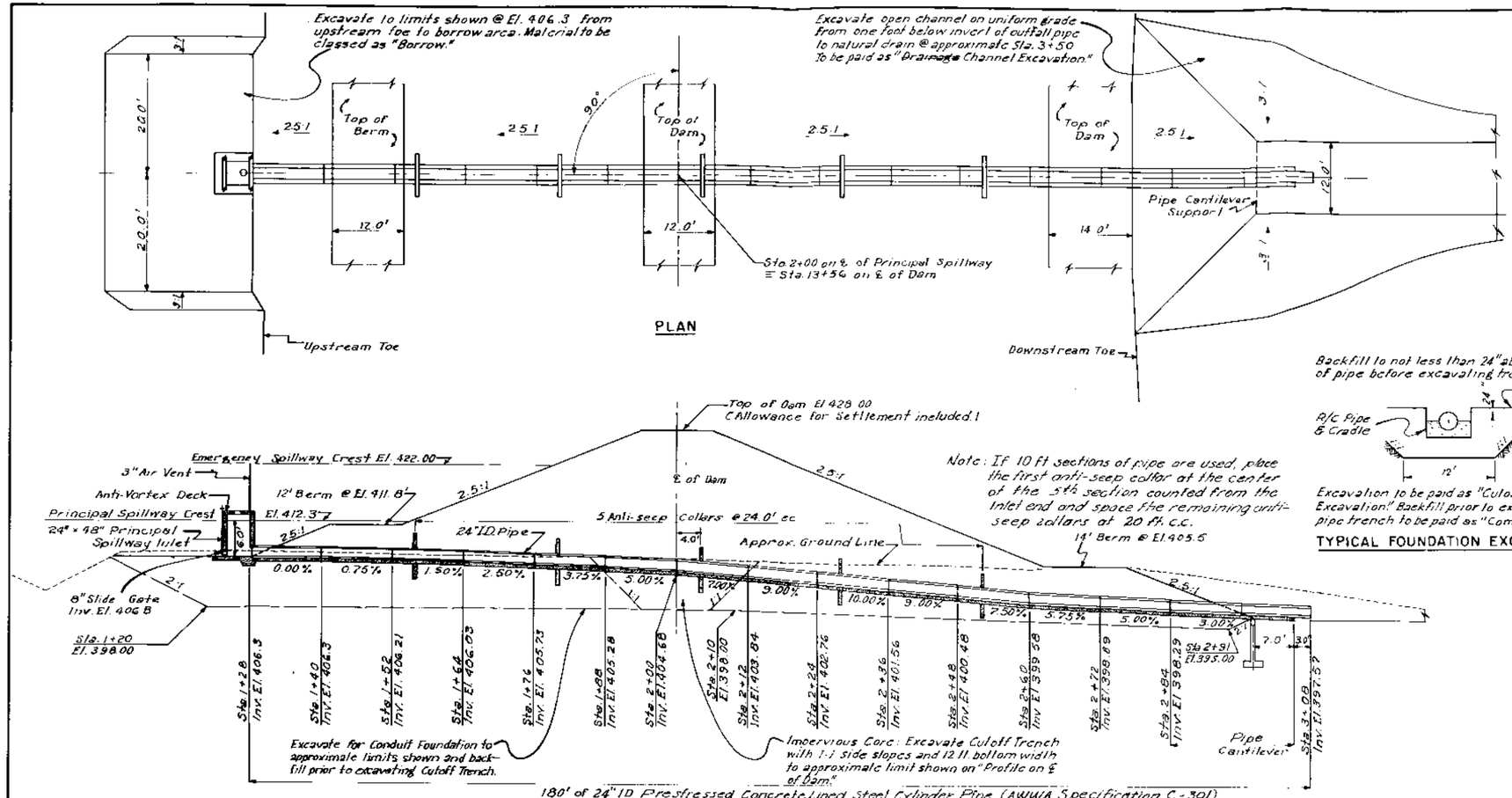
PROFILE ON ℄ OF DAM

Figure 6

TYPICAL FLOODWATER RETARDING STRUCTURE
GENERAL PLAN AND PROFILE

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

	Date	
Designed A.E.G.	12-60	Approved by [signature] Area Engineering Supervisory Training Unit Fort Worth, Texas
Drawn A.E.G. & O.L.S.	1-61	[signature] Area Engineering & Watershed Planning Unit Fort Worth, Texas
Traced O.L.S.	1-61	Sheet No. 2 of 7
Checked G.W.T. & E.G.	1-61	Drawing No. 4-E-15,162



SECTION
PRINCIPAL SPILLWAY

Note: The detail above is planned for 12 ft. sections of pipe. Section lengths of 10 ft may be used with invert of joints set on grade line as established above, utilizing 180 ft of pipe, ending at Sta 3+08. Section lengths in excess of 12 ft. will not be permitted.

PLACEMENT OF EXCAVATED MATERIALS									
EMBANKMENT SECTION		SOURCE OF FILL MATERIAL		LAB TEST		COMPACTION REQUIREMENTS			Lab. Curve
Sec No	Description	Location	Ave. Depth Feet	Modified		Minimum Density	Moisture Range		
				Max. Den	Opt'm Moist	Lbs Per Cu. Ft.	Percent		
			From	To			From	To	No.
	Cutter Section	Emergency Spillway	0	6+	113.0	15.5	101.7	15.0	Up	4
	Any	Borrow - Zone A	4	13	118.5	15.0	106.7	15.0	Up	3
	Outlet Sections	" - Zone B	0	13	117.5	14.0	106.0	14.0	Up	1
		" - Zone A	0	4	118.0	14.5	106.0	14.0	Up	2

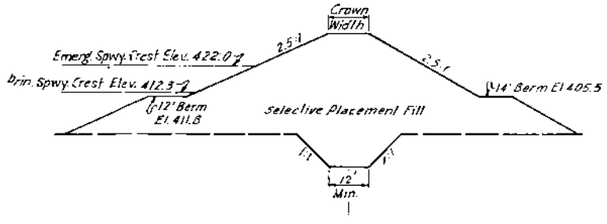
Note: No formal zoning of the embankment is required; however, the Engineer will exercise selective placement of materials based upon the recommendations and data of the laboratory report.

Minimum dry density, optimum moisture, minimum acceptable dry density and moisture range shown in the table above are for material particles passing the No. 4 sieve. If the material being placed contains 3/4" or larger rock particles the minimum acceptable dry density and moisture range will be corrected for the presence of rock.

No upward placement moisture limits are established.

Upward limits of placement moisture to be determined during construction by Engineer, from workability aspects and densities reached.

EMBANKMENT DATA



TYPICAL SECTION

Figure 4A
TYPICAL FLOODWATER RETARDING STRUCTURE
PLAN AND SECTION

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

		Date	
Designed	A.E.G.	12-60	Approved by: Area Conservationist, Fort Worth, Texas
Drawn	A.E.G & O.L.S.	1-61	State Conservation Engineer, Temple, Texas
Traced	O.L.S.	1-61	Sheet No. 5 of 7
Checked	G.W.T., A.E.G.	1-61	Drawing No. 4-E-15,162

Hydraulic and Hydrologic Investigations

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

1. Basic meteorologic and hydrologic data were tabulated from Climatological Bulletins, U. S. Weather Bureau and Water Supply Papers, U. S. Geological Survey and analyzed to determine average precipitation depth-duration relationships, seasonal distribution of precipitation, the probable flood series to be used in the evaluation of the project, and the relationship of geology, soils, and climate to runoff depth for single storm events.

2. Engineering surveys were made of channel and valley cross sections selected to represent adequately the stream hydraulics and flood plain area. Preliminary locations for cross sections were made by stereoscopic examination of aerial photographs of the flood plain. The final locations were selected on the ground, giving due consideration to the needs of the economist and the geologist. The evaluation reaches were delineated in conference with the economist and geologist.

3. The present hydrologic condition of the watershed for evaluation computations was determined by the hydrologist, geologist, work unit conservationist and soil scientist working in the area considering such factors as climate, geology, topography, soils, land use and cover. From this, soil-cover complex data were assembled and rainfall-runoff relationships were computed for use in determining the runoff from various frequency storms.

4. Cross section rating curves were computed from field survey data listed in item 2, above, by solving water surface profiles for various discharges, using Doubt's Method as described on pages 3.14-7 to 3.14-13 of the National Engineering Handbook, Section 4, Supplement A.

5. Technical Paper No. 29 U. S. Weather Bureau plus studies of hourly precipitation records at Levelady and Wheelock, Texas, were used to obtain the rainfall intensity duration frequency curves for use in the analysis.

6. A unit hydrograph was developed for the area above valley section 3. This unit hydrograph was adjusted and used to develop a hydrograph of the storm produced by the 1957 storm that when routed checked favorably with the high water marks of the 1957 flood.

7. Reference valley section 3 was used to determine the frequency at which urban damage from Town Branch would begin in

Madisonville. It was determined that urban damage would begin with a 59 percent chance storm and that this storm would produce 1,300 cubic feet per second at the reference section VS-3.

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

   a. The present conditions of the watershed remaining static.

   b. The installation of land treatment measures for watershed protection.

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

9. The minimum floodwater detention volume in the structures as determined in accordance with Washington Engineering Memorandum 27 using Yarnell's 6-hour 100-year frequency rainfall amounts, revised to conform to Technical Paper No. 25, is 5.95 inches. In accordance with Texas State Manual Supplement 2441 the recommended detention storage volume for the two Class C structures in this watershed is 11.5 inches. Detention volumes in excess of those recommended in accordance with Texas State Manual Supplement 2441 were used to obtain a more economical or desirable emergency spillway or structure design. Percent chance of use of emergency spillways based on regional analysis of gaged runoff from similar watersheds was determined by adding to the actual detention storage the volume which would be released by the principal spillways during a 2-day period.

10. The appropriate emergency spillway and freeboard design storms were selected from figures 3.21-1 and 3.21-4 of National Engineering Handbook Section 4, Supplement A, in accordance with criteria contained in Washington Engineering Memorandum 27, and Texas State Manual Supplement 2441. Emergency spillway and freeboard hydrographs were computed using moisture condition II with 1.0 and 2.5 respectively, of the adjusted point rainfall for the 6-hour storm. Since use of the emergency spillway hydrographs resulted in either no flow or very shallow flow through emergency spillways, the dimensions of the emergency spillways were determined from routing the freeboard hydrographs. Hydrographs were developed for each of the structures by the distribution graph method. The combination of emergency spillway width and depth, and the elevation of top of dam for the most economical structure

was estimated by an empirical equation. The final design was made by the flood routing method described on page 5.8-12 of the National Engineering Handbook Section 5.

Sedimentation Investigations

Sedimentation investigations for the work plan were made in accordance with procedures as outlined in Technical Release No. 17 (Tentative). "Geologic Investigations for Watershed Planning", March 1981, USDA, Soil Conservation Service.

Sediment Source Studies

Detailed sediment source studies to determine the 50-year sediment storage requirements were made in the drainage areas of the 2 planned structures according to the following procedures:

1. The field surveys included:

   a. Mapping soil units by slope in percent, slope length, present land use, present cover condition classes, and land capability classes.

   b. Determining the lengths, depths, and estimating the annual lateral erosion of all gullies and stream channels affected by erosion.

2. Office computations included summarizing erosion by sources (sheet, gully, and streambank) in order to fit these data into formulas for computation of the annual gross erosion in tons.

3. The sediment rates were adjusted to reflect the effect of expected land treatment on the drainage areas of the planned floodwater retarding structures. The computed sediment storage requirement for each site is based on a gradual improvement of watershed conditions as a result of the needed land treatment measures expected to be installed during the 2-year installation period. It is assumed that these measures will be fully effective at the end of five years and maintained at 75 percent effectiveness thereafter. Sediment rates also were adjusted for expected delivery rates of annual gross erosion and trap efficiency of the floodwater retarding structures.

4. The volume of sediment storage allocated to the different pools in the planned structures is based on a volume weight of 60 pounds per cubic foot for submerged sediment and 85-90 pounds per cubic foot for aerated sediment.

5. The allocation of sediment to the structure pools was based on 15 percent deposition in the detention pool and 85 percent

in the sediment pool of Site 2. Since Site 1 includes fish and wildlife storage the allocation of sediment to the structure pools was based on 15 percent deposition in detention pool, 60 percent in the fish and wildlife pool and 25 percent in the sediment pool.

Flood Plain Sedimentation and Scour

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

1. Borings with a hand auger were made along valley cross sections to determine soil conditions and the depth and texture of the deposits. Other pertinent factors contributing to flood plain damage, such as channel degradation or aggradation, scouring, and swamping, were studied.

2. The original condition of the flood plain before modern deposition began was estimated for each valley section.

3. Estimates of past physical flood plain damage were obtained through interviews with landowners.

4. A damage table was developed to show percent damage by texture and depth increment for deposition. Due consideration was given to agronomic and other land treatment practices, soils, crop yields, and land capabilities in assigning damage categories based on percent loss of productivity.

5. The depth and width of modern alluvial deposits were measured and tabulated.

6. The damage areas were grouped by segments. Within each segment, the area for each depth increment of deposition was computed.

7. The sedimentation damages were adjusted for recoverability of productive capacity. Estimates of time required for recovery of productive capacity were developed from data obtained by field studies and interviews with landowners.

8. Using average annual erosion rates as a basis, the average annual sediment yields at selected valley sections along the flood plain were estimated for present conditions and with land treatment and structural measures installed. The results were compared to determine the average reduction of sediment load contributing to overbank deposition. The reduction of damage from overbank deposition is based on this reduction of sediment load and reduction of area inundated by floodwater.

Geologic Investigations

Preliminary geologic investigations were made at each floodwater retarding structure site. These investigations included lithologic and stratigraphic studies of the valley slopes, alluvium, channel banks, and exposed geologic formations. Hand auger borings were made to determine the nature and extent of embankment material, emergency spillway excavation, and possible problems that might be encountered in construction.

Description of Problems

The entire watershed area of Town Branch is located within the Yegua formation, Claiborne group of the Eocene series. The Yegua formation consists of heterogenous layers of sand, clay, sandy clay, and carbonaceous clay lentiles. The soils are light colored sandy and clayey silts, sandy clays, clayey sands, and sands which are classified as SM, CL, MH, and SP. Laboratory analysis of three soil samples from Site 1 indicate that these soils are slightly dispersed. Materials for construction of embankment are ample at both planned site locations. Selection and placement of material may be necessary to utilize properly the less permeable soils for maximum control of seepage at Site 1 which includes storage for fish and wildlife. It also may be necessary to limit depth of borrowing and to keep the borrow area some distance from the embankment as a safety precaution. Some foundation and embankment drainage measures will be needed at both sites because of the sandy nature of the soils and foundation. However, soil and foundation conditions are satisfactory for multiple purpose use at Site 1.

The emergency spillways at both sites are very susceptible to erosion when stripped of vegetative cover. Embankments and emergency spillways will be vegetated as soon as possible after construction. Detailed investigations, including exploration with core drilling equipment, will be made at both sites prior to their construction. Laboratory tests will be made to determine the suitability and treatment of embankment and foundation material.

Economic Investigations

Determination of Annual Benefits from Reduction in Damages

Urban damage estimates were based on schedules taken in the field covering 100 percent of the business establishments and residential units in the urban area subject to flooding. Schedules revealing damages to public utilities and sewage facilities, as well as to streets and roads, were obtained also. These schedules revealed the amount and types of damages sustained, the area inundated and the frequency of flooding. Most of the flood damage information obtained was for floods which occurred in 1957 and 1960. Areas inundated by these two storms and the 100-year frequency storm were delineated on a city map of Madisonville and their estimated damages used as a basis for economic analysis of urban damages.

Agricultural damage estimates were based on information obtained from landowners and operators and covered approximately 50 percent of the agricultural

flood plain. Farm operators were asked to state what changes in land use had been made as a result of past flooding. Indications were that virtually all of the flood plain area had been converted from cropland to permanent pasture. Complete investigations disclosed that the change in land use had occurred as a result of comparative advantage and not as a result of frequent flooding. Therefore, no benefits from restoration of agricultural land to former use were determined.

In determination of the method to be used in the economic evaluation consideration was given to the following: (1) investigations revealed that a major portion of the floodwater damage was to residential, business and other nonagricultural property; (2) seasonal occurrence of flooding has little influence on the amount of damages sustained; and (3) the necessity for determining damages if a 100-year frequency storm were to occur. Based on these considerations, the decision was made to use the frequency method of analysis in the economic evaluation.

In analyzing the damage schedules it was noted that significant variations existed among the types of damages. However, due to the exceedingly close relationship of nonagricultural to agricultural damage, and the small area of total flood plain, the entire flood plain was considered as one reach for evaluation purposes.

A careful study and analysis of the history of Madisonville, the property values in the flood plain and the economy of the watershed disclosed that the increase in urban damageable values would persist even in the absence of a project. However since these would be relatively minor, no benefits were claimed from future urban development without a project or urban enhancement resulting from the project.

Information was very sparse relevant to the amount of indirect damages sustained by owners and operators of flood plain property and nearby business establishments. Indications were that a major portion of the indirect damages included loss of business, cost of directing traffic along alternate routes and the cost of repairing damages incurred to these routes. A conservative estimate of the indirect damages was obtained by weighing the midpoints of the percent indirect damage factors suggested in the Economics Guide in the proportion that each type of damage was to the total damage. Determination of the percent indirect damage factor by this method resulted in these damages being estimated at 13 percent of direct damages.

Cost-sharing Summary

Site 1 is planned as a multiple-purpose structure for flood prevention and fish and wildlife development. The cost allocation was made by use of the Separable Cost-Remaining Benefit method. The benefit to fish and wildlife was considered to equal the separable cost of this purpose. Public Law 566 funds will pay 50 percent of the installation cost allocated to fish and wildlife.

TABLE A

Cost Allocation and Cost-Sharing

Cost Allocation

1. Multiple-purpose structure costs	$135,492
2. Less alternate flood prevention cost	-92,590
3. Cost allocated to fish and wildlife development	$ 42,902

Cost-Sharing

1. Public Law 566 share of fish and wildlife (50 percent)	$ 21,451
2. Other than Public Law 566 share (50 percent)	21,451
3. Incremental other costs 1/	-13,670
4. Local share of construction cost	7,781

Item	Public Law 566 Funds	Other Funds	Total
1. Construction	$74,939	$ 7,781	$ 82,720
2. Installation Services	20,552	-	20,552
3. Other costs	-	32,220	32,220
Total	$95,491	$40,001	$135,492
Percent	70.5	29.5	100

1/ 90.2 acres additional land required for fish and wildlife purposes at $200 per acre $18,040
33.2 acres decrease in flood pool at $150 per acre -4,980
19.9 acres decrease in flood pool at $100 per acre -1,990
Legal fees 100
Water rights 600
Land surveys 300
Fencing 1,600
Total $13,670

Details of Methodology

Details of the procedure used in the investigation are described in the Soil Conservation Service Economics Guide for Watershed Protection and Flood Prevention, December 1958, as used in the synthetic frequency method.

Fish and Wildlife Investigations

The Bureau of Sport Fisheries and Wildlife, USDI, made a detailed study of the fish and wildlife aspects of Site 1 in Town Branch watershed. The following is a summary of that agency's report and concurred in by the Texas Game and Fish Commission:

The inclusion of conservation storage in Site 1 will produce a high-quality fishery. The size of the reservoir will facilitate fishery management, making it possible to maintain optimum fish populations. The reservoir will contain adequate spawning and foraging areas and will be suitable for such game fishes as largemouth bass, bluegills, white crappies, and channel catfish.

Site 1 reservoir will be located within a 50-mile radius of approximately 160,000 people. By the year 2010, the population is expected to be about 222,000 people. Throughout most of the area, demands for public fishing will be inadequately met. Residents of Madisonville, in particular, will find the reservoir an attractive and convenient place to fish. The average annual fisherman use of the reservoir will be approximately 10,000 man-days.

White-tailed deer, mourning doves, bobwhites, fox squirrels, grey squirrels, cottontails, jackrabbits, raccoons, opossums, grey foxes, skunks, minks, and snipe are present in the watershed. Waterfowl migrate through the watershed but do not remain long because of the lack of habitat. Hunting is by landowner's permission. The principal hunting is for mourning doves, bobwhites, and squirrels. There is no significant amount of trapping of fur animals.

The Site 1 project area provides little wildlife habitat. Land use in all but the flood plain is expected to change from agricultural to urban and suburban.

The proposed reservoir area will attract some mourning doves and waterfowl for short periods, but will not support wildlife species in significant numbers. Proximity to urban and suburban areas will hamper hunting.

Opportunities to develop and maintain high-quality fishery habitat are possible in the multiple-purpose structure. The Texas Game and Fish Commission has indicated that they would be willing to provide technical advice and do the following work to provide a high-quality fishing lake:

1. Eradicate the fish populations in ponds to be inundated by Site 1 reservoir.

2. Eradicate the fish populations in ponds in the immediate drainage area of the reservoir, if permission can be obtained from the landowners. The Texas Game and Fish Commission will provide technical advice for such work or will do the work, if the necessary chemicals are provided.

3. Stock species of fish in the multiple-purpose reservoir and in farm ponds which have been chemically treated.

4. At the request of the sponsors, make fishery surveys of the multiple-purpose reservoir to determine management needs.

Additional developments, not a part of the project, should be made by local sponsors as funds and time permit. These developments should include the installation or refinement of public-use facilities such as additional roads, sanitary buildings, water, power, boat-launching ramps, and camping, picnicking, and parking areas.

In addition to the above proposals, to achieve maximum fish and wildlife benefits from the project, all lands to elevation 287.4 or to fish-and-wildlife-pool elevation 284.4 and 300 feet horizontally should be purchased

in fee title, or perpetual easement should be provided to permit public access to the entire reservoir.

The dam should be sodded, and borrow and barren areas in the reservoir basin should be planted to a suitable grain in advance of impoundment to prevent erosion, reduce the amount of silt entering the reservoir, and to enrich and clarify the impounded water.

Where consistent with the objectives of the project, vegetation in the reservoir basin should not be cleared. Retention of vegetation will provide shelter for fish and more attractive fishing areas.

In addition to the benefits provided by fishing and hunting on Site 1, fish and wildlife management practices adopted on the project site may, in many instances, be applicable to the floodwater retarding structure and farm ponds in the watershed. Site 1 reservoir of the Town Branch watershed project can be a means of developing community interest in a fish and wildlife conservation program. Civic groups, youth groups, sportsmen's clubs, and other interested organizations and individuals will find opportunities to assist the local sponsors with the future development and maintenance of the reservoir.

It is recommended:

1. That land in Site 1 reservoir to elevation 287.4, or 284.4 and 300 feet horizontally, be purchased in fee title or be taken in perpetual easement.

2. That public access roads be provided to each side of the reservoir.

3. That all fee-title or perpetual-easement lands be open to public use for fishing and hunting, except for sections reserved for safety, efficient operation, or protection of public property.

4. That wildlife food and cover plants be established around the floodwater detention reservoir, the multiple-purpose reservoir, and farm ponds to increase their value as wildlife habitat.

5. That clearing specifications for reservoir sites and stream channels provide for the retention of as much woody vegetation as is consistent with project objectives.

6. That, where feasible, floodwater detention and multiple-purpose reservoirs be fenced to control grazing. If water is required for livestock, the structures can be designed to provide a tank outside the enclosure to which water can be piped.

TABLE 7 - ESTIMATED STRUCTURE COST DISTRIBUTION

Town Branch Watershed, Texas
Price Base: 1961

Structure Site Number or Name	Installation Cost - Public Law 566 Funds					Installation Cost - Other Funds						
	Construction		Installation Services		Total	Construction		Land	Relocations			
	Engineer's Estimate	Contingencies	Engineering	Other	Public Law 566	Engineer's Estimate	Contingencies	Rights of Way	Facilities and Utilities	Water Supply	Total	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
Multiple-Purpose Structure												
1	68,120	6,813	13,235	7,517	95,685	2,074	207	500	31,120	500	34,401	130,086
Floodwater Retarding Structure												
2	30,000	3,000	7,920	7,120	48,040	-	-	500	3,000	-	3,500	51,540
Total	98,120	9,813	21,155	14,637	143,725	2,074	207	1,000	34,120	500	37,901	181,626

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TABLE 3 - STRUCTURE DATA - FLOODWATER RETARDING STRUCTURE AND MULTIPLE-PURPOSE STRUCTURE

Town Branch Watershed, Texas

Item	Unit	STRUCTURE NUMBER 1	STRUCTURE NUMBER 2	Total
Drainage Area	Sq.Mi	1.07	0.25	1.32
Storage Capacity				
Sediment Pool	Ac.Ft.	7	11	18
Sediment in Fish and Wildlife Pool	Ac.Ft.	18	xx	18
Sediment in Detention Pool	Ac.Ft.	3	1	4
Floodwater	Ac.Ft.	673	157	830
Fish and Wildlife	Ac.Ft.	400	xx	400
Total	Ac.Ft.	1,100	169	1,270
Surface Area				
Sediment Pool 1/	Acre	4	4	8
Floodwater Pool	Acre	130	23	153
Fish and Wildlife	Acre	75	xx	75
Volume of Fill	Cu.Yd.	143,000	57,000	200,000
Elevation Top of Dam	Feet	296.3	294.5	xxx
Maximum Height of Dam 2/	Feet	35	31	xxx
Emergency Spillway				
Crest Elevation	Feet	291.7	290.9	xxx
Bottom Width	Feet	80	70	xxx
Type	-	Veg.	Veg.	xxx
Percent Change of Use 3/	-	1	1	xxx
Average Curve No. Condition II	-	82	82	xxx
Emergency Spillway Hydrograph				
Storm Rainfall (6-hour) 4/	Inch	14.50	14.96	xxx
Storm Runoff	Inch	12.01	12.47	xxx
Velocity of Flow (Ve) 5/	Ft./Sec.	1.33	1.35	xxx
Discharge Rate 6/	c.f.s.	85	140	xxx
Maximum Water Surface Elevation 6/	Feet	292.4	291.2	xxx
Freeboard Hydrograph				
Storm Rainfall (6-hour) 7/	Inch	36.30	37.40	xxx
Storm Runoff	Inch	33.63	34.73	xxx
Velocity of Flow (Ve) 8/	Ft./Sec.	9.4	9.0	xxx
Discharge Rate 6/	c.f.s.	2,065	1,635	xxx
Maximum Water Surface Elevation 6/	Feet	296.3	294.5	xxx
Principal Spillway Capacity (Maximum)	c.f.s.	15	5	xxx
Capacity Equivalents				
Sediment Volume	Inch	0.13	0.80	xxx
Sediment in Fish and Wildlife Pool	Inch	0.32	xx	xxx
Sediment in Detention Pool	Inch	0.05	0.10	xxx
Detention Volume	Inch	11.80	11.75	xxx
Fish and Wildlife Volume	Inch	7.00	xx	xxx
Spillway Storage 9/	Inch	13.10	9.75	xxx
Class of Structure	-	C	C	xxx

1/ Surface area to the top of the riser.

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

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

4/ For Class C structures, 1.0 x P of the 6-hour rainfall shown by Figure 3.21-1, NEH-4, Supplement A.

5/ Where velocity is shown it was obtained from the formula $V = \frac{Q}{A}$ and was determined from the routed Hp and Q. Critical velocity was not attained by any of the routings of the emergency spillway hydrograph due to little or no flow.

6/ Values obtained from routing.

7/ For Class C structures 2.50 x P for 6-hour rainfall shown on figure 3.21-1, NEH, Sec. 4, Supplement A.

8/ Obtained from curves drawn from Figure 4-0-11472 revised 3-59 and ES 98 dated 4-27-55, based on flows obtained from graphical routing of the Freeboard Hydrograph.

9/ Watershed inches stored between the emergency spillway crest and the top of the settled dam.

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TABLE 4 - SUMMARY OF PHYSICAL DATA

Town Branch Watershed, Texas

Item	Unit	Quantity Without Project	Quantity With Project
Watershed Area	Sq.Mi.	3.4	xxx
Watershed Area	Acre	2,176	xxx
Area of Cropland	Acre	40	40
Area of Pastureland	Acre	1,160	1,081
Urban Area	Acre	911	911
Miscellaneous Area	Acre	65	1/ 144
Overflow Area Subject to Damage	Acre	2/ 261	2/ 173
Area Damaged by Overbank Deposition	Acre	3/ 58	4/ 27
Annual Rate of Erosion			
Sheet	Ac.Ft	2.06	1.84
Gully	Ac.Ft	0.13	0.10
Streambank	Ac Ft.	0.29	0.29
Average Annual Rainfall	Inch	43.20	xxx

1/ Includes area inundated by sediment and fish and wildlife pools of the planned structures

2/ Area inundated by the 100-year frequency storm, based on gaged runoff.

3/ Acreage on which some production loss occurs each year.

4/ The acreage on which production loss will occur each year after all recovery has taken place and equilibrium has been reached.

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TABLE 5 - SUMMARY OF PLAN DATA

Town Branch Watershed, Texas

Item	Unit	Quantity
Years to Complete Project	Year	2
Total Installation Cost		
Public Law 566 Funds	Dollar	139,531
Other	Dollar	60,441
Annual O and M Cost		
Public Law 566 Funds	Dollar	-
Other	Dollar	310
Average Annual Monetary Benefits 1/	Dollar	8,255
Agricultural	Percent	13
Nonagricultural	Percent	87
Structural Measures		
Floodwater Retarding Structures	Each	1
Multiple-Purpose Structure	Each	1
Area Inundated by Structures		
Upland		
Sediment Pool	Acre	8
Fish and Wildlife Pool	Acre	71
Detention Pool	Acre	74
Watershed Area Above Structures	Acre	845
Reduction of Floodwater Damage	Dollar	7,997
By Land Treatment Measures		
Watershed Protection	Percent	9.2
By Structural Measures	Percent	88.1
Reduction of Sediment Damage	Dollar	81
By Land Treatment Measures		
Watershed Protection	Percent	13.9
By Structural Measures	Percent	66.3

1/ From structural measures.

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TABLE 6 - ANNUAL COST 1/

Town Branch Watershed, Texas

Measures	Amortization of Installation Costs 2/	Operation and Maintenance Cost 3/			Total
		Public Law 566	Other	Total	
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)
Multiple-Purpose Structure No. 1 and Floodwater Retarding Structure No. 2	5,136	-	310	310	5,446
Total	5,136	-	310	310	5,446

1/ Does not include $1,550, the annual equivalent of costs for fish and wildlife development.

2/ Price Base: 1960 prices amortized for 50 years at 2 5/8 percent.

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

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TABLE 7 - MONETARY BENEFITS FROM STRUCTURAL MEASURES

Town Branch Watershed, Texas
Price Base: Long-Term 1/

Item	Estimated Average Annual Damage: Without Project (dollars)	After Land Treatment for W/S Protection (dollars)	With Project (dollars)	Average Annual Monetary Benefits (dollars)
Floodwater Damage				
Crop and Pasture	41	39	18	21
Other Agricultural	42	38	0	38
Nonagricultural				
Urban Residential and Business	7,800	7,077	202	6,875
Street and Utility	289	264	2	262
Highway and Bridge	48	44	1	43
Subtotal	8,220	7,462	223	7,239
Sediment Damage				
Overbank Deposition	101	87	20	67
Indirect Damage	1,082	981	32	949
Total, All Damages	9,403	8,530	275	8,255
Total Flood Prevention Benefits	xxx	xxx	xxx	8,255
TOTAL PRIMARY BENEFITS	xxx	xxx	xxx	8,255
TOTAL MONETARY BENEFITS	xxx	xxx	xxx	8,255

1/ As projected by ARS, September 1957.

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TABLE 8 - BENEFIT COST ANALYSIS

Town Branch Watershed, Texas

Measures	AVERAGE ANNUAL BENEFITS 1/ Flood Prevention				Average Annual Cost 2/	Benefit Cost Ratio
	Floodwater	Sediment	Indirect	Total		
	(dollars)	(dollars)	(dollars)	(dollars)	(dollars)	
Multiple-Purpose Structure No. 1 and Floodwater Retarding Structure No. 2	7,239	67	949	8,255	5,446	1.5:1
GRAND TOTAL	7,239	67	949	8,255	5,446	1.5:1

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

2/ Derived from installation costs based on 1960 price level and operation and maintenance cost based on long-term levels, as projected by ARS, September 1957. Does not include $1,550. the annual equivalent cost of fish and wildlife development.

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TABLE 9 - ALLOCATION OF INSTALLATION COSTS OF STRUCTURAL MEASURES

Town Branch Watershed, Texas

Price Base: 1960

Item	Purpose		Total
	Flood Prevention	Fish and Wildlife	
	(dollars)	(dollars)	(dollars)
Step A			
Single Purpose Site 2	49,540	xxx	49,540
Multiple Purpose Site 1	92,590	42,902	135,492
Total	142,130	42,902	185,032
Step B			
Public Law 566	118,080	21,451	139,531
Other	24,050	21,451	45,501
Total	142,130	42,902	185,032

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